A SYNOPSIS OF FUIRENA (CYPERACEAE) FOR THE AMERICAS NORTH OF SOUTH AMERICA

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Fuirena (Cyperaceae) comprises an estimated 30 species, mostly warm-temperate or tropical, in both hemispheres. All are plants of high hydroperiod soils, most are heliophytes. Of the 13 taxa treated here one is a rare ruderal, 6 are found mostly in grass-sedge formations such as found in interdunal swales toward the seacoasts or in "sweet" marshes or seeps inland and the remainder are on highly organic sands or peat mucks of swamps and bogs. Several are wetlands weeds. Only two are annual. No economic value is known for the species.

Some cyperologists consider *Fuirena* to be a part of *Scirpus*. Whether this is true or not is not belabored here; the plants are distinguishable from other sedges through a combination of all or most of the following characteristics: (1.) Culms generally leafy, the leaves with erect, scaly, ciliate ligules and in 3 ranks; spikelets either in terminal clusters or in a compound of sessile or pedunculate, both terminal and axillary, glomerules. (2.) Scales of spikelets numerous, spirally arranged, awned, with the awn of many species spreading or recurved, imparting a "bristly" look to the spikelet. (3.) Perianth usually of 6 bristles, 3 of which are broad-bladed, *or* all 6 lacking blades, *or* of 3 bladed members with 3 reduced to nubs, or vestigial; most of the species in this treatment have some bladed perianth members, but it is interesting to see in the same small group of species a complete range of reduction in perianth. (4.) Style deciduous, but tip of akene produced upward into a definite beak whose apex is frequently tuberculate-papillose or scabrid. (5.) Akene trigonous, usually stipitate.

The most current treatment of North American *Fuirena* is that done by Svenson (1957). This is a very conservative approach based primarily on perianth characteristics. My own work is preliminary to a biosystematic study, and is intended merely to clarify some nomenclature, to present some additional observations on the gross morphology and the ecology, and to provide some additional distributional information not available to Svenson.

Acknowledgments

This preliminary study has been based primarily on field work stretched over a period of more than 10 years and concentrated in the southern United States and Mexico. During this period several hundred duplicate specimens have been collected and these will be distributed at the close of the entire

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study. Also during this period, and thanks to curators and staffs of the following named herbaria, more hundreds of specimens have been provided through loans, namely from: C, CHARL, FSU, GA, GH, KANU, LAF, LSU, MICH, MO, NY, P, PH, POM, RSA, SMU, TENN, TEX, UC, US. Several special collections made by Dr. Sidney McDaniel and Dr. D. Demaree have also been examined.

Grateful acknowledgment is here given to the following people: Dr. L.H. Shinners and Dr. W. Mahler who obligingly made available several valuable references and comments; to Dr. A. Skovsted and to Dr. A. Lourteig of C and P respectively, who either provided basic type materials or took time and trouble to make comparison with these: to all curators, herbarium staffs of institutions mentioned above for their kindness not only in provision of loans but for their patience in extending time periods of loans.

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Morphology

Habit. *Fuirena* is made up of both annual and perennial species, but only two of the taxa considered here are truly annual (*F. pumila*, *F. simplex* var. *aristulata*). Of these the former invariably dies at the end of one growing season, while the latter indicates at the southern portion of its range a tendency to sprout from very contracted overwintering rosettes. Root systems of all species are fibrous and diffuse. Seed of all species tends to germinate freely within two weeks of sowing in the greenhouse. Viability decreases sharply after one year from harvesting.

Rootstock. The two essentially annual taxa are weakly to strongly caespitose, the size of the clump and indeed the individual shoots are strongly dependent on a combination of soil moisture and (probably) on organic content of substratum. These, as would be suspected, have the slenderest roots and the shallowest root systems. The perennial species are all rhizomatous, but the growth patterns of these are of two sorts. In *F. scirpoidea*, *F. longa*, *F. repens* and *F. simplex* var. *simplex* the rhizomes are of relatively consistent width, are sheathed by short, scaly leaves, these at well separated or approximate nodes, in the case of the latter therefore imbricated. In the remaining perennials the rhizomes produce at approximate or distant intervals contracted ovoid, or nearly round cormous offshoots. These are progressively formed as the rhizome elongates and are particularly noticeable and full toward fall and in winter. Actually the whole structure is contracted culm plus an apex with very contracted preformed shoot leaves and all stages of formation and expansion are to be found on a single vigorous plant at any stage of the growing season. In the "bud" or "cormose" stage only the outer leaf is visible with the culm base, distended culm, the sheath and its minute blade enfolding the shoot apex. Through this pushes the rapidly elongating culm as the shoot elongates.

Culm. The culm of *Fuirena* is slenderest toward its base with the internodes contracted and sheathed. Its habit may be erect or quite lax and leaning. It is solid at the nodes, internodes terete or obtusely trigonous, progressively elongating upward, green, strongly and numerously longitudinally ribbed, with the vascular tissue peripheral and the large central area spongy-lacunar. Stomatal areas are confined to the narrow intervals between the ribs.

Leaves. The leaves are in 3 ranks and are comprised of a loose to rather tight cylindrical or 3-angled sheath, this multiribbed as in the culm, and a spreading to ascending linear or lance-linear, acute or narrowly tapering, blade. The sheaths are closed except toward the orifice, where there is produced an erect, usually pale brown, scarious, ciliate scale, the ligule. The upper and lower surfaces of the leaf blades are usually markedly different. The upper surface is as a rule smoother (though in some species it may still be quite trichomiferous and also minutely scabrid or papillose) with numerous longitudinal nerves moderately to slightly impressed, marked usually by a narrow and overlying band. Between the nerves are several rows of short to long-rectangular, longitudinally oriented, epidermal cells, these with side and end walls variously papillose, sometimes with end walls produced upward into dome-shaped processes; cell contents are comparatively translucent or made opaque with mucaceous or farinose material; stomata are not in evidence. If trichomes are present these may be short, unicellular or elongate-tapering, multicellular, glassy like hollow icicles: they may appear over the lumen or toward the endwalls. The lower leaf blade surface appears as an extension of the sheath surface, hence is strongly multicostate, the costal area comprised of shorter, glassy-walled cells, these often drawn out into short or elongated trichomes; cells of the intercostal areas are longer and thinner-walled, are longitudinally oriented in rows, these interrupted at more or less regular intervals by guard cell pairs and subsidiary cells, these likewise vertically oriented and appearing singly or in short transverse rows, slightly sunken or raised depending on the species. The lower surface of the leaf, in trichomiferous species, is usually hairier than the upper with the longer hairs again glassy and mostly found arising from costal cells.

Inflorescence. Spikelets in all species are comprised of very many ascending or erect, rather loosely imbricate, cymbiform scales, all but the lowest 2—3 bearing florets in their axils. The lowermost sterile bracts show transition to uppermost inflorescence bractlets, thus are more leaf-like and longer-tipped. The fertile bracts are rather uniform through the genus, tending to conceal all the floret except the tips of filaments and the anthers at anthesis together with the 3 hispidulous long-linear stigmas; most fertile bracts are of a broadly obovate, oblong to ovate type, broadly scarious margined, the backs rounded, with strongly raised nerves medially which converge to form a stiffish, prominent, erect to spreading or recurved mucro. Bract apices are rounded or slightly retuse, scarious, continuous across the mucro base adaxially (see

plates) and thus in position homologous to ligule. Bract margins and backs are in many species stiff-hairy, the hairs of various lengths but all straight and sharp. Common spikelet shapes are ovoid, lance-ovoid or cylindrical. Sequence of flowering within the spikelet is acropetal. When the fruit is mature the lowermost scales begin to abscise, exposing raised, "V" shaped scars. Old spikelets toward the end of a season therefore show a considerable length of rachis, in that flowering is indeterminate, but (rather interestingly) the spikelet tends to retain the same overall shape and dimensions. While extremes of *F. scirpoidea* may produce but a single spikelet at the culm tip, most produce them either in a terminal cluster or this plus pedunculate clusters from 1 or more of the subtending nodes. Arrangement of spikelets is basically cymose, with central spikelets of a group or unit maturing first. The smallest unit or cluster within the inflorescence is here termed a "glomerule." A single glomerule is subtended by 1 or more variously awned bracts the bodies of which are not much different than those of the spikelet; it is made up of few to many sessile or subsessile spikelets. The glomerule may be solitary or may form a compound with others in a diffuse system, usually with the primary axis or axis branch terminating in a sessile glomerule, this exceeded by pedunculate ones on peduncles of varying lengths. Each peduncle is sheathed at its base by a thin-tubular, oblique-orificed "prophyll" which by position is actually a ligule in that it is located at the inside of the junction between bract sheath and bract blade.

Flowers. The flower of *Fuirena* is perfect, sessile in the axil of a single bract (see plate for *F. breviseta*, fig. 4). A perianth is present and is basically biseriate. The commonest situation in our species is for the outer set of 3 to be simple bristles, these smooth or retrorsely barbellate, while the inner set of 3 bear broadish blades. In *F. incompleta* there are no bladed members, only 6 simple bristles or (in var. *obliterata*) the bristles very reduced or absent. In *F. camptrotricha*, *F. umbellata*, *F. repens* only 3 members develop prominently and these bear blades; the other set of 3 is reduced to short, tubercle-like processes or is absent. The most unusual perianth situation is displayed by the introduced *F. wallichiana*, whose perianth has a combination of short unbranched bristles and longer, flatter sparingly pinnately-branched segments.

The stamens range from 1 in the annual species to 3 in the perennials, the hypogynous, long-linear, flattened filaments at anthesis projecting the linear or oblong, basifixed, 2-locular anthers beyond the bract tips. The pollen is in cryptotetrads. Anthers are smallest in the annuals.

The ovary is tricarpellate, sessile or stipitate, the beaked apex prominent, jointed to an elongate smoothish style, this terminating in 3, exserted, long-linear, hispidulous stigma lobes.

The mode of flowering is similar to that observed for *Fimbristylis, Bulbostylis, Abildgaardia*. In a given flower the stamens are later to shed pollen than are the stigma lobes to receive. In a given spikelet, usually in a given

inflorescence, a series of spirals of florets will either be presenting *or* receiving pollen but not doing both simultaneously. The opportunity for selfing appears to be remote.

Fruit. The fruit is rather uniform through all our species, being a more or less stipitate akene, whose apex is a prominent linear or narrowly triangular beak (this sometimes papillose), whose body is broadly elliptic and trigonous with prominent rounded angles. The surfaces of the akene body between the wirelike angles are usually glassy, sometimes very delicately striated and cross-striated, only in *F. wallichiana* being cancellate.

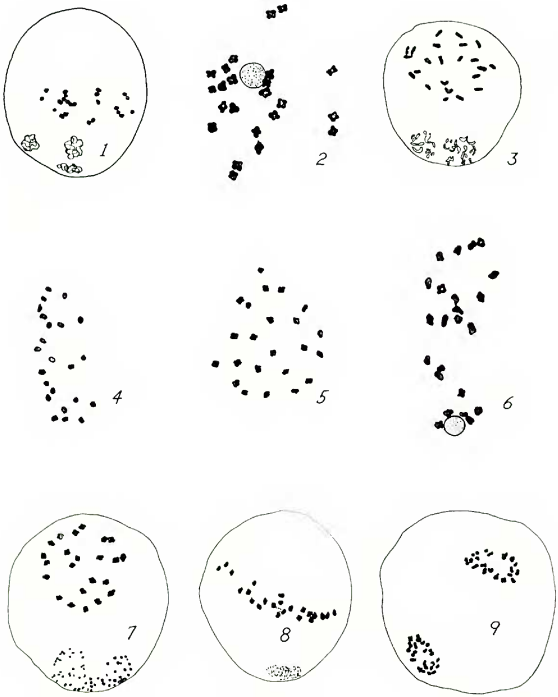
Cytology

Some preliminary studies have been made of microsporogenesis in a few species, sufficient to convince this writer that, at least in North America the mode of spore production is uniformly cryptosporic. Microsporogenesis proceeds as has been observed in *Fimbristylis* and related genera (Tanaka, 1939, 1941; Kral, 1971). The nucleus of the microspore mother cell meiotically divides and a tetrad is formed. Though low sutures appear to develop in the mother cell wall, cytokinesis does not take place. Instead, 3 of the 4 haploid nuclei move to one end of the sporocyte, lose both size and distinctness, while the fourth nucleus divides mitotically. Of these two products, one loses size and joins the other 3 reduced genomes. The remaining, or fifth, nucleus is thus the only functional product. (See illustrations of the various stages.)

My own counts are still rather limited, and more will be published later on the subject as additional chromosomal studies are made. They now reveal a haploid number of 23 for *F. breviseta, F. longa, F. pumila, F. scirpoidea, F. squarrosa,* and *F. camptotricha* (mistakenly reported as *F. umbellata* in a prior, 1971, paper!). This count is so unusual and so unexpected that one wonders at the derivation of this condition; certainly it needs to be examined further. My limited inspection of chromosomes of *F. simplex* var. *simplex* has revealed two conditions for what appear to be phenotypically very similar sorts. In Texan material of the variety I have a haploid count of 15; in material of the same variety from the Gulf Coast of Mexico, the "conventional" count of 23 was made. As stated earlier, this information is so peculiar and conflicting as to warrant a more ample study.

Pollination. The flowers of *Fuirena* appear to be, with their exserted hispidulous stigma lobes and anthers, anemophilous. However, I was able to make one observation of what appeared to be bee pollination in a large population of *Fuirena scirpoidea* near Port St. Joe, Gulf County, Florida in July 1958. The bee was the common honeybee, and there was no question of abundance and persistence of these bees on and around the spikelets. It should probably be assumed that the visits were for pollen.

Hybrids. Some coastal plain habitats have up to 4 species of *Fuirena* growing together or in proximity. Yet the differences between the taxa, however, fine, appear to be consistent over the range. Such variation as occurs is also



MICROSPOROGENESIS IN FUIRENA. 1. *F. pumila* (*Kral 22886*, third division). 2. *F. pumila* (*Kral 22411*, prophase 1). 3. *F. breviseta* (*Kral 22905*, third division). 4. *F. breviseta* (*Kral 22887*, prophase 1). 5. *F. scirpoidea* (*Kral 22961*, prophase 1). 6. *F. scirpoidea* (*Kral 23005*, prophase 1). 7. *F. longa* (*Kral 22962*, third division. 8. *F. longa* (*Kral 23004*, third division). 9. *F. squarrosa* (*Kral 20668*, prophase 2). 10. *F. simplex* (*Kral 24997*, prophase 1). 11. *F. simplex* (*Kral 27810*, third division). 12. *F. longa* (*Kral 22962*, prophase 1). 13. *F. scirpoidea* (*Kral 22961*, metaphase 1).

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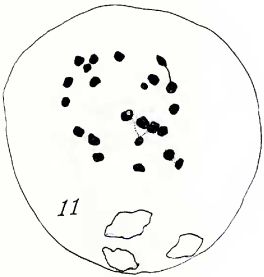

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consistent over the range. Further study is desirable in the case of *F. longa*, which has a morphology strikingly intermediate between that of *F. breviseta* and *F. scirpoidea* and may be of comparatively recent hybrid origin.

Taxonomic Treatment

In the treatment which follows, keys and descriptions are based on material collected from within the area of study, namely America north of South America. Generic limits are drawn only in the sense of the species treated. Keys and descriptions, while based in part on vegetative characteristics, are still centered on the characteristics of fruiting spikelets and healthy plants. Dimensions of spikelets are drawn only from the scale-bearing portion of rachis from which the scales have fallen, and this is not included in the measurement. Species are numbered in a single continuous sequence.

The large number of specimens examined in the course of the project makes it necessary to cite these collections separately. A list of citations is being prepared and, hopefully, will be available upon request to the writer at the time this paper appears.

The illustrations are numbered to correspond with the text treatment. Each plate shows a whole plant reduced together with enlarged views of florets, fertile bracts, nodes showing inner surfaces of lower parts of leaf blades. All illustrations are by the author.

FUIRENA, Rottb., Descr. & Ic. 70. 1773.
Vaginaria Pers., Syn. Pl. 1:70. 1805.

Perennial or annual, usually pubescent, caespitose or rhizomatous herbs, if rhizomatous with rhizomes short and thickened or extensively creeping and forking or producing in addition axillary cormous offshoots from which culms arise. Culms erect or leaning to 1 m tall, simple, stiff or wand-like. Sheaths of leaves loosely or closely investing the culm, strongly costate; blades either reduced to scale-like appendages or of a linear type, stiffly spreading or erect. Spikelets usually 1 cm or more long, ovoid, short-cylindrical, or ellipsoidal, arranged singly at culm apices or in terminal and axillary clusters, these made up of 1-several, sessile or variously pedunculate glomerules, or (less usual) the spikelets more pinnately arranged. Scales of spikelets numerous, spirally arranged, lowest 1—3 barren, the fertile mostly ovate, oblong or obovate, thinnish, the backs rounded, usually hairy, medially strongly to faintly costate, costae merging subapically to form a conspicuous, erect, or spreading stiffish, usually scabrid, awn. Perianth of most species 6-parted, with 3 simple bristles forming an outer whorl and 3 stipitate-bladed members forming an inner whorl; in some species the perianth is reduced to 3 bladed members, or comprised only of bladeless members or (rarely) lacking. Stamens (1-) 2—3 (-6), the filaments elongate, flattish, the anthers basifixed, oblong or linear, 2-locular, the pollen in "cryptotetrads". Style 3-cleft, disarticulating from an elongate gynoecial beak, stigma lobes linear, papillate-scabrid. Akene slightly to prominently stipitate, usually strongly 3-angled, body in outline rhombic or broadly ellipsoidal, the angles prominent, wirelike, the faces flat or slightly convex or concave, smooth or faintly cross-lined or cancellate, the apex a prominent narrowly triangular or linear beak, this sometimes expanded distally and there scabrid or papillose.

Key to *Fuirena* of the New World north of South America

1. Perianth in part or solely of bristles bearing broad blades; akene surface lustrous, smooth or very finely striate.
   2. Perianth comprised both of bladed and bladeless members, the bladeless bristles reaching at least to the middle of the stipe of the akene.
      3. The plants rhizomatous (often producing corm-like structure also); anthers at least 0.8 mm long.
         4. Culms slender, wand-like, smooth, on elongate, creeping, e-cormous rhizomes; mucro of fertile scales erect, mostly less than ½ of the

length of the scale body; sheaths of leaves either essentially bladeless or with longest blades rarely reaching 5 cm; backs of fertile scales usually with at least 5 prominent medial nerves.

5. Blades of upper culm leaves short, mostly mucro-like; apices of perianth scales mostly acute; spikelets mostly ovoid and 1—5, sessile in a terminal glomerule, with subtending bract shorter than the spikelets . . . . . 1. *F. scirpoidea* Michx., p. 318.

5. Blades of upper culm leaves longer, generally plane, to 5 cm long; apices of perianth scales acuminate; spikelets mostly lance-ovoid or lance-cylindric, narrowly acute; spikelets sessile in a terminal glomerule and frequently with pedunculate clusters as well; subtending bract usually longer than the spikelets. . . . . 2. *F. longa* Chapm., p. 319.

4. Culms usually stouter, usually with at least some prominent long hairs on leaf margins and/or sheaths, on elongate to short, cormous rhizomes; mucro of fertile bracts erect or spreading-recurved; leaf blades well developed, the longer ones (at least on healthy plants) rarely as short as 5 cm; backs of fertile scales usually with only 3 prominent medial nerves.

6. Mucro of fertile bracts at least ⅔ as long as the scale body, usually spreading or recurved-tipped; rhizomes cormous or ecormous.

7. Rhizomes producing corm-like shoot buds; perianth scale blades with apex obtusely angled, acute, acuminate or narrowly incurved-conic, not bearing a subapical apiculus or bristle.

8. Perianth bristles (sepals) short, incurved, smooth, their tips not reaching the bases of the perianth blades (petals); lowermost sheaths of leaves hispid, those of mid-culm or above becoming smooth; apex of perianth blades obtuseangled or acute, not conic or acuminate. . . . . 4. *F. breviseta* (Coville) Coville in Harper, p. 324.

8. Perianth bristles longer, more erect or even slightly spreading, smooth or retrorsely barbellate, their tips reaching at to the bases of perianth blades; all sheaths of leaves usually hispid or hispidulous or hirsute; apex of perianth blades either conic and very tumid, or acuminate.

9. Petal blades with an acuminate, thinnish or thickened, incurved apex; perianth bristles retrorsely barbellate; anthers no longer than 1.3 mm; plants of the Gulf and Atlantic Coastal Plain and inland to adjacent provinces east of the Mississippi River, with the cormous rhizome buds usually close-set. . . . . 5. *F. squarrosa* Michx., p. 327.

9. Petal blades tumid at maturity, narrowing distally to be conic and erect, sometimes apiculate as well; perianth bristles smooth; anthers ca. 2 mm long; plants of the Gulf Coastal Plain and Ozarks from La. and Ark. southwestward, with cormous parts of the rhizome often separated by distinct intervals of narrow internode longer than the corm width. . . . . 6. *F. bushii* Kral, p. 331.

7. Rhizomes simple, lacking corm-like shoot buds; perianth scale blades with apex flattish, or tumid, conic, blunt or emarginate, but usually producing a short or elongate, subapical dorsal bristle. . . . . 7. *F. simplex* Vahl, p. 332.

6. Mucro of fertile scales erect, seldom as long as ⅓ the length of the scale body; rhizomes cormous; robust plants from southern Mexico southward; also Cuba.
10. Broader blades of leaves usually at least 1.5 cm wide, these and the sheaths mostly smooth except for stout-based spreading or ascending, stiff, long trichomes along the blade margins proximally; apex of perianth blades usually narrowly acute or acuminate, usually incurved, lacking a short, incurved, subapical dorsal bristle. . . . . 3. *F. robusta* Kunth, p. 322.
10. Broader blades of leaves usually less than 1.5 cm wide, these and the sheaths usually hairy; apex of perianth blades usually tumid, generally blunter, and bearing a short, incurved, subapical dorsal bristle.
. . 10. extremes of *F. camptotricha* C. Wr., p. 342.

3. The plants e-rhizomatous, usually annual; anthers mostly 0.5—0.6 (-0.7) mm long.
11. Apex of perianth scale obtuse to retuse, bearing a dorsal-subapical bristle, this retrorsely barbellate; plants mostly of the prairie provinces.
. . 7a. *F. simplex* Vahl var. *aristulata* (Torr.) Kral, p. 336.
11. Apex of perianth scale acuminate, usually very narrowly so, usually incurved, not bearing a subapical bristle; plants mostly of the Atlantic and Gulf Coastal Plain with outliers in the Lake States.
. . . . . 8. *F. pumila* (Torr.) Spreng., p. 338.

2. The perianth comprised only of bladed members (very reduced, tubercle or papilla-like bristles may sometimes be located in cycles inward or outward from the bladed members!).
12. Claw of petal blades crimped; robust plants with stout cormous rhizomes and culms at least 0.5 cm thick; inflorescence often diffuse, comprised of many glomerules of spikelets.
13. Mature petal blades flattish or thickened only marginally, over the nerves, and apically, the apex generally retuse-notched, from this notch arising a slender, coiled bristle.
. . . . . 9. *F. umbellata* Rottb., p. 340.
13. Mature petal blades with distal half tumid, inflated, the apex broadly conic or obtuse, papillose-scabrid, the bristle, if present, shorter, dorsal, subapical, erect or incurved.
. . . . . 10. *F. camptotricha* C.Wr., p. 342.
12. Claw of petal blades straight; slender lowish plants from slender, diffuse-creeping, e-cormous, elongate rhizomes, the culms never as thick as 2 mm; inflorescence usually a terminal cluster of sessile or subsessile spikelets. . . . . 11. *F. repens* Boeckler, p. 346.

1. Perianth comprising only bristles or with some producing narrow, lineal or lineal-lobed blades, or perianth essentially absent.
14. Akene surface smoothish; perianth bristles simple or lacking.
15. Perianth bristles usually 6, subequal, most of them well exceeding the middle of the akene body.
. . . . . 12a. *F. incompleta* Nees var. *incompleta*, p. 348.
15. Perianth bristles absent or reduced to short, unequal lengths, rarely exceeding the middle of the akene body.
. . . . . 12b. *F. incompleta* Nees var. *obliterata* Kral, p. 350.
14. Akene surface strongly cancellate; some or all of the perianth bristles bearing narrow, frequently pinnate or linear-lobed blades.
. . . . . 13. *F. wallichiana* Kunth, p. 350.

1. FUIRENA SCIRPOIDEA Michx., Fl. Bor. Am. 1:38. 1803.
Vaginaria richardi Pers., Syn. Pl. 1:70. 1805.
Scirpus scirpoideus (Michx.) T.Koyama, Journ. Fac. Sci. Univ. Tokyo III (7):287. 1958.

Essentially glabrous perennial, 2—6 dm tall, from an elongate, often forking system of rhizomes just beneath the substrate surface, these pale, stoutish, with darker brown oblong scales overlapping the lower part of each internode. Culms erect, wand-like, arising like parts of a picket fence, usually very many and rather approximate along the creeping rhizome; internodes rather short at the culm base, elongating toward the inflorescence, subterete, multicostate, nodes swollen. Leaves mostly sheath, particularly those proximal on the culm, the sheaths loosely investing the internode, multicostate, tubular, firm, almost bladeless, producing at the oblique orifice a short (rarely longer than 3—4 mm) incrassate-margined, cusplike blade and an erect, scarious entire or short-ciliate, brownish oblique ligular orifice. Sheaths becoming shorter, internodes progressively longer upward, the ultimate one terminating in a single spike or a tight cluster of 2—5, subtended by a short-bladed bract shorter than the spikelets. Spikelets ovoid to lance ovoid, mostly 7—10 mm long (—1.5 cm), blunt or (rarely) acute. Fertile scales mostly ovate, oblong or obovate, the body 2.5—3.5 mm long, ciliate, thin, mostly tan, greenish-brown or reddish-brown, the backs rounded, puberulent or hirsutulous, with at least 5 strong median nerves, 3 convergent to form a short, stiff, erect mucro mostly less than ½ as long as the scale body and scabrid. Florets mostly 1.5—2.0 mm long, perianth 6-parted, calyx bristles retrorsely barbellate, reaching to the tips of the petal claws or slightly beyond; petal blades mostly ovate, about as long as the claws, thickened distally but somewhat compressed between the 3, raised basal nerves, apex usually compressed-conic, apiculate and also often slightly scabrid. Anthers ca. 2 mm long. Akene slender-stipitate, body trigonous with the angles pale, wirelike and the faces flat to slightly convex, a deep, lustrous reddish-brown or castaneous; stylar apiculus distally papillate or minutely scabrid. Fig. 1.

Sandy or sandy-peaty marshes, swales and seeps, sometimes in slightly brackish situations, along the seacoast from N.C. south to southern peninsular Florida and west in the Gulf Coastal Plain to southern Texas; Cuba. Map 1.

Type: "Florida." *Michaux*. Holotype at P compared with material sent from VDB. Dr. Alicia Lourteig, who made the comparison, found a good match.

2. FUIRENA LONGA Chapm., Fl. S. US. ed. 3:541. 1897.

Similar to *F. scirpoidea* but with rhizomes shorter, more branched and with culms frequently appearing tufted. Sheaths of mid and upper culms producing flat, short-linear blades, these longest at mid-culm or above,

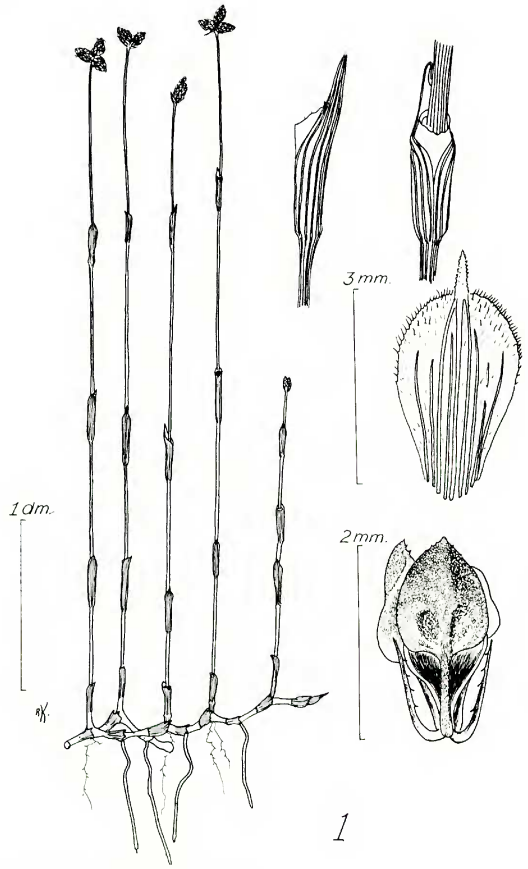
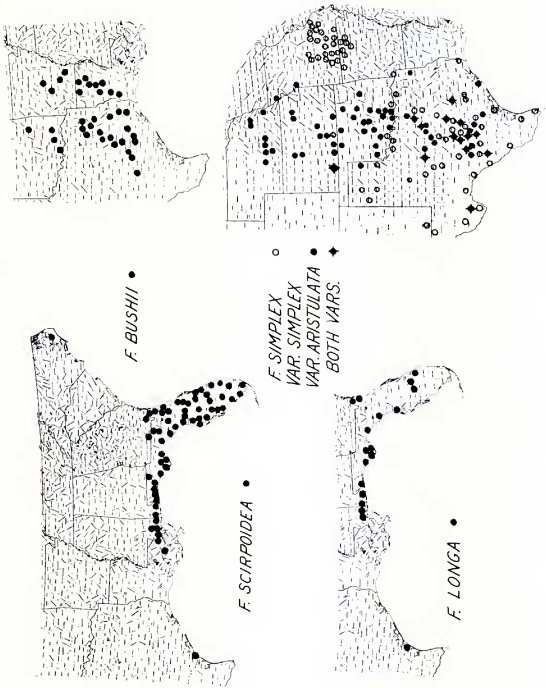


Fig. 1. *F. scirpoidea* (*Kral 32626*).



Map 1.

there 1.5—5.0 cm long, smooth or with the upper surface puberulent. Culms at level of inflorescence frequently hispidulous. Spikelet clusters (glomerules) often 2, subtended by bracts from nearly as long as to longer than the spikelets. Spikelets narrow, mostly cylindric-lanceolate or lance-ovoid, acute, more greenish. Fertile scales with body similar in length, mostly obovate, thin, hirtellous or puberulent, nerved medially as in *F. scirpoidea* but the excurrent mucro longer, sometimes slightly more than ½ the length

of the scale body. Perianth essentially as in *F. scirpoidea* but with petal blades often with a longer, narrower point. Anthers 1.3—1.5 mm long. Fruit as in *F. scirpoidea*. Fig. 2.

In habitats similar to those of *F. scirpoidea* and frequently mixed with it, in Florida and west along the coast to southern Mississippi; southern Texas. Map 1.

Type: Florida. Franklin Co.: "Apalachicola, *A. W. Chapman*"; GH! MO!

This, so often placed in synonymy of *F. scirpoidea*, has a very different look in the field. I have seen much of it in peninsular Florida and in the Gulf Coastal Plain west to southern Alabama. When seen mixed with *F. scirpoidea* it stands out at once because of its more appropriate shoots on shorter, more branching rhizomes, its longer leaf and bract blades, its narrower, more bristly, greener spikelets which appear in larger, more numerous clusters on the culms. I have yet to see it where there was not also some *F. breviseta* nearby and suspect without proof as yet that this entity has probably arisen as a hybrid between *F. scirpoidea* and *F. breviseta* or a similar species such as *F. squarrosa*. Certainly it is a vegetative intermediate. Tending to support this notion is the fact that but one locality for *F. longa* is presently known for Texas (Aransas County), disjunct from the furthest west Mississippi county by several hundred miles. From this same locality have also been collected *F. scirpoidea* and *F. breviseta*, these also representing considerable extensions of known range southwest.

3. FUIRENA ROBUSTA Kunth, Enum. Pl. 2:185. 1837.

F. bahiensis Lindl. & Nees; Nees in Mart. Fl. Bras. 2(1):108. 1842 (Brasil).
F. latifolia Steud. Syn. Cyp. 126. 1855 (Bahia, Brasil).
F. schizophylla C. Wright in Sauv. Anal. Acad. Ci. Habana 8:32. 1871. (Vuelta de Abajo, Cuba).

Perennial, with thick, spongy, erect culms to 16 dm tall, caespitose or set closely together in line on a short, stout, cormiferous rhizome. Lower leaves shortest, sheathing with oblique, ciliate orifices or with short-triangular blades; blades of mid-culm longest, oblong-linear or lance-linear, to 30 cm long and 3 cm wide, usually tapering from a cordate-clasping base to a narrowly acute apex, margins at least proximally with upward appressed, stiff, long trichomes, otherwise tuberculate-scabrid or entire, the surfaces smooth; sheaths smooth or rarely glabrescent. Inflorescence of 3—6 axillary systems of pedunculate, cymose clusters of glomerules from the upper nodes, the system interruptedly cylindrical, primary peduncles hirsutulous, triangular. Spikelets ovoid or lance-ovoid, ca. 5—6 mm long, reddish-brown or greenish-reddish-brown. Fertile scales ovate or obovate, rounded-ciliate, ca. 3 mm long, including a rigid, erect cusp shorter than the scale body, the backs with 3, rarely 5, strong medial nerves, these converging into an erect cusp usually less than ½ as long as the scale

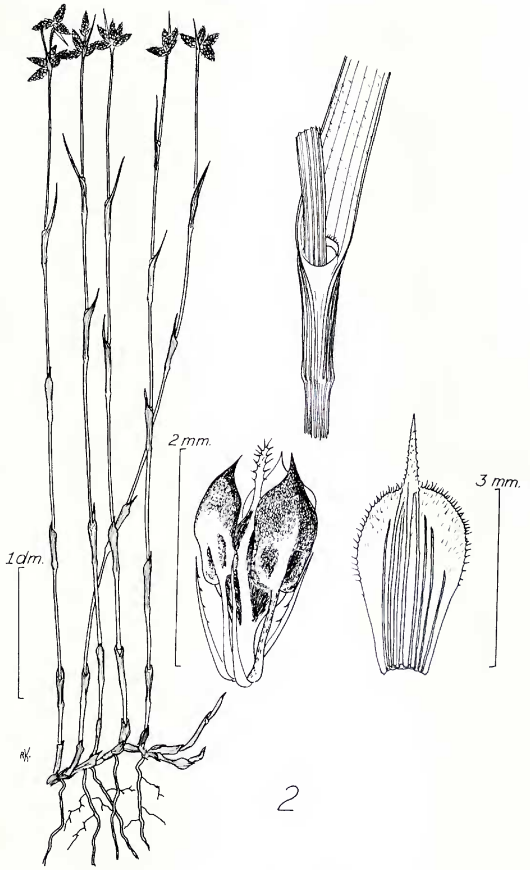


Fig. 2. *F. longa* (*Kral 23139*).

body which is overall glabrous to appressed-puberulent or strigillose. Perianth of 6 members, the outer set of 3 simple bristles, these about as long as the akene body or slightly longer and smoothish, the inner 3 (petals) bladed, clawed, ca. 2 mm long, the blades thickened, oblong or lance-oblong, obscurely 3-nerved, distally tumid, the apices incurved-apiculate or mucronate. Anthers normally 3, ca. 1.5 mm long. Akene ca. 1.5 mm long, stipitate-trigonous, body with angles prominent, wirelike, faces flat or slightly convex, smooth, lustrous, pale brown. Fig. 3.

Swamps and bogs in lowlands in Cuba, Panama; South America. Map 4.

Type: Type locality, southern Brasil. Material not examined by this writer. The description rendered by Nees in Martius (1842) of *F. bahiensis*, which is this species, is very good and matches in all regards. The type description by Kunth, based on material collected by Sellow, is brief but adequate to separate this from *F. umbellata* with which it might be confused.

F. robusta differs from *F. umbellata* mainly as follows: (1.) It is smoother than the latter, the sheath and leaf surfaces (very often even the inflorescence) smooth; in *F. umbellata* the same surfaces are often puberulent, more often hispidulous or hirsute. (2.) The margins of leaves, at least toward the base, have ascending or more often appressed, long, stiff hairs; in *F. umbellata* hairs of this area, if long, are less thick and are spreading. (3.) The spikelets are larger, wider, smoother. (4.) There is but 1 set of perianth segments in *F. umbellata*, these bladed, or crimped stipes, with the truncate or retuse, somewhat flattened blade apex bearing terminally a slender, coiled mucro; in *F. robusta* both sets of perianth are present, with stipes of bladed members mostly straight and with the usually swollen blade tips terminating acuminately in an incurved, not coiled, awn.

4. FUIRENA BREVISETA (Coville) Coville in Harper, Bull. Torrey Bot. Club 28:466. 1901.

   F. squarrosa Michx. var. *breviseta* Coville, Bull. Torrey Bot. Club 17:6. 1890.

Perennial from scaly rhizomes, the shoots arising from axillary, cormous offshoots. Culms to 1 m tall, usually 5 dm or lower, tufted, or approximate along the creeping, superficial rhizome, erect to ascending or leaning, internodes terete or something slightly angulate, multicostate, the lowest shortest, the uppermost longest, usually smooth except toward and in the inflorescence, where hispidulous. Leaf sheaths loosely cylindrical, strongly ribbed, the lowest longest, hispid, becoming shorter and (usually) smooth by mid-culm. Ligular orifice short-cylindric, submembranaceous, oblique, short-ciliate. Largest leaves at mid-culm or above, the blades spreading to reflected or erect, broadly lineal or linear-lanceolate, 5—15 cm long, 3—10 mm broad, flat, usually gradually narrowing from near the cordate-clasping base to the attenuated apex, margin slightly thickened-cartilaginous, usually

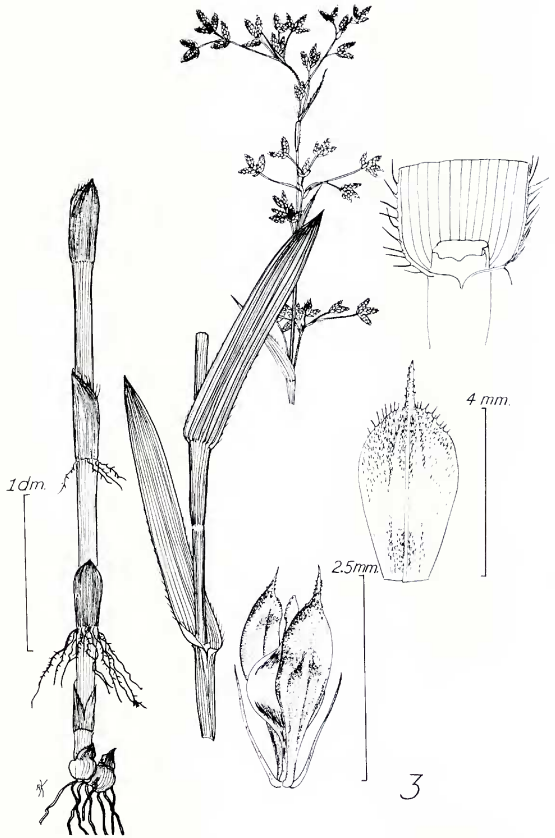
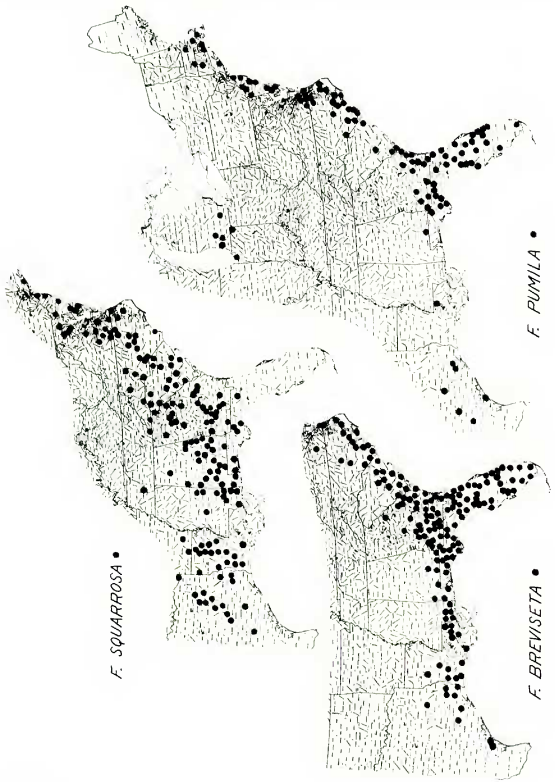


Fig. 3. *F. robusta* (*Bailey 256*).

spreading-hispid-ciliate at least proximally, the upper and lower surfaces smooth to sparsely strigose or strigillose or puberulent (usually nearly smooth), more strongly nerved beneath. Inflorescence a terminal dense to



Map 2.

open system of sessile and pedunculate glomerules of spikelets, primary and secondary peduncles angulate, hispidulous, often subtended by 1—3 additional ascending-pedunculate clusters of glomerules, all glomerules usually from 3—5 or more, digitately spreading spikelets. Spikelets ovoid, lance-ovoid, or cylindrical, mostly 1.0—1.5 (—2.0) cm long. Fertile scale body mostly oblong to obovate, 3.0—3.5 mm long, rounded to slightly emarginate, ciliate, thin, greenish brown or reddish-brown, backs rounded, hirsutulous or minutely scabrid, with usually 3, strongly raised, tan or greenish nerves medially, these converging to a stiffish, slender and spreading-recurved mucro ca. as long as the scale body and scabrid or hispidulous. Perianth of 6 members, the sepal bristles usually smooth, stoutish, incurved, short, rarely as long as the claw of the petal, rarely longer than the stipe of the akene. Petals ca. 2 mm. long, blade long-clawed, ovate or short - oblong, thickened except for the base, where showing 3 raised nerves, apically often incurved, broadly acute to obtuse, sometimes apiculate, usually minutely tuberculate-scabrid. Anthers 1.0—1.3 long. Fruit trigonous-stipitate, body with the three angles pale, wirelike, the faces flattish or slightly convex, a deep, lustrous brown, the stylar apiculus slightly broadened and hispidulous distally. Fig. 4.

Bogs, wet sandy places, seeps, savanna ditches, mostly Coastal Plain from southeastern Virginia south through Florida and west, in the Gulf Coastal Plain to southern Texas; Cuba. Map 2.

Lectotype: Florida. Duval Co.: low grounds, *A. H. Curtiss 3068*. DUKE! F! GH! MIN! NY! PH! TENN! A large set soon to be distributed and which compares well with the type is as follows: Alabama: Baldwin Co.: peaty pockets in sandy slash pine flatwoods just E of Orange Beach by Ala. 180, 22 Oct 1969, *R. Kral 38239*.

This species is placed by many authors in synonymy of *F. squarrosa*, a species admittedly very similar in habit. However, as Coville (1890) long ago recognized, it may be sorted easily from amongst a mass of mixed herbarium material of both, on the basis of its distinctive perianth characters, namely the long-stipitate, bluntish petal blades (in contrast to those of *F. squarrosa* which are narrowly acute to acuminate, born on shorter claws). When one becomes familiar with the species it may also be distinguished in the field by its stiffer, smoother foliage. While in *F. squarrosa* the leaf sheaths are pilose-hispid from base to apex of the culm, those of *F. breviseta* have only the lowermost sheaths hispid, the upper are almost invariably smooth. (In perhaps 1 instance in 100 the upper sheaths may be hispid!) The exceptions may represent chance hybrids, but even these show the perianth character of *F. breviseta*, and are so annotated.

5. FUIRENA SQUARROSA Michx., Fl. Bor. Am. 1:37. 1803.

F. squarrosa var. *hispida* Chapm., Fl. S. US. 514. 1860.

Perennial from scaly rhizomes, shoots arising from axillary, cormous

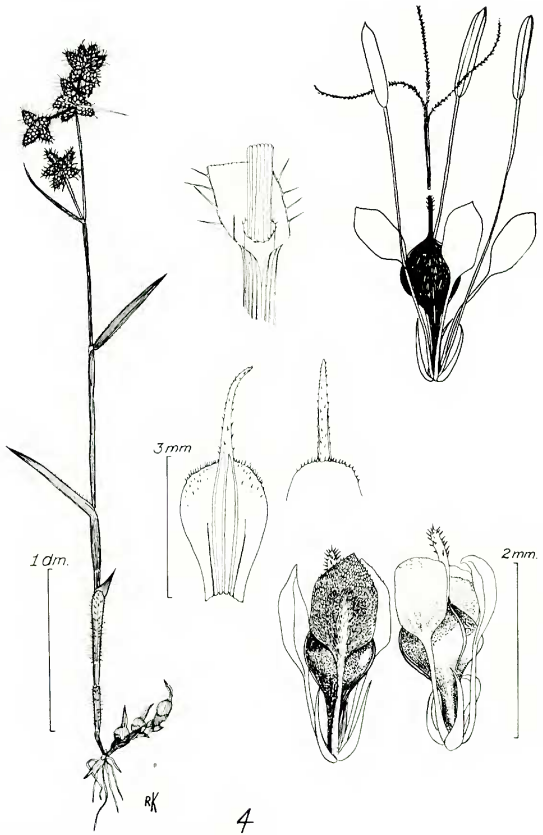


Fig. 4. *F. breviseta* (*Kral 38239*).

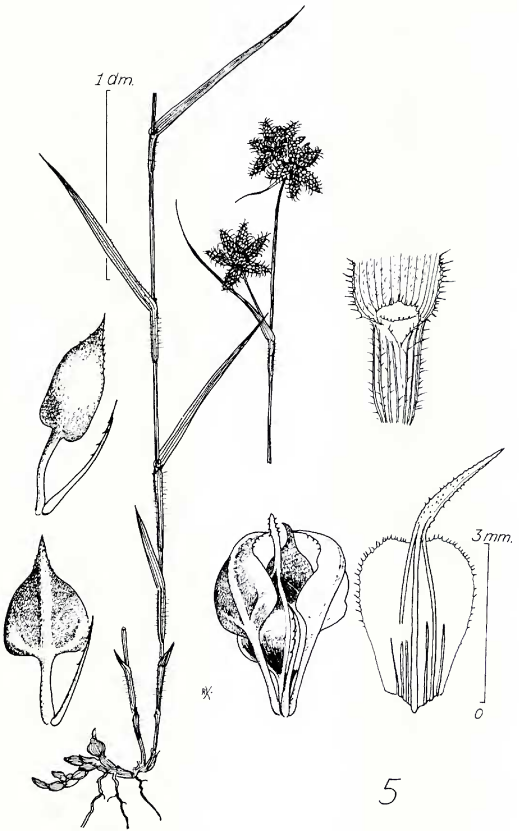


Fig. 5. *F. squarrosa* (*Kral 23225*).

offshoots. Culms to 1 m tall, usually lower, erect to ascending or leaning on other plants, culms strongly multicostate, smooth except in the inflorescence. Lowest leaves scaly, mostly sheath, blades progressively longer as mid-culm is approached, then gradually diminishing in size into the inflorescence; sheaths cylindrical or gradually inflated distally, strongly multicostate, hispid-hirsute, sometimes also hirsutulous (in a few extremes with uppermost sheaths or a culm nearly smooth); leaf blades spreading to erect, linear-attenuate, the larger mostly 8—20 cm long, 4—10 mm broad, mostly tapering from near the clasping base to the apex, strongly margined, upper surface scabro-puberulent and finely nerved, lower surface puberulent and hispid-hirsute, strongly raised-nerved, the margin spreading hispid-hirsute; ligule short-cylindric, ciliate, oblique, scarious. Systems of glomerules in a rather dense terminal cluster, often also from the next lower 1—2 nodes on stiffly erect or ascending, angulate, hirsute or hirsutulous penduncles. Glomerules subcapitate, spikelets crowded, digitately spreading, the clusters subtended by leaf-like bracts, 1 usually longer than the cluster subtended. Spikes ovoid to cylindric-lance-ovoid, to 2 cm long. Fertile scales obovate, 2.5—3.5 mm long, rounded or retuse, ciliate, with reddish or greenish-brown sides and a pale green or tan midzone, longitudinal ribs 3 (—5) medially, the central strongest, all merging into a scabro-hispidulous, spreading-recurved mucro more than ½ as long as the scale body. Florets 2.0—3.5 mm long, perianth 6-parted, calyx bristles reaching at least to the base, often to the middle of the petal blades, antrorsely barbellate. Corolla scales long-stipitate, claws slightly shorter than to nearly as long as the blades, blades narrowly to broadly ovate, usually incurved-acuminate, frequently minutely prickly apically on the inner face, bases cordate, truncate, broadly cuneate or abruptly attenuate, dorsal surface with a strongly raised longitudinal rib continuous with the scale apex and with at least 1 pair of spreading lateral nerves; scale body either of a consistent thickness or distally tumid. Anthers 3, ca. 1.0 mm long. Stipe of akene shorter than the petal claws; akene with 3 edges pale, wirelike, faces lustrous, deep brown or castaneous, faintly cross-lined. Fig. 5.

Open bogs, shores, ditches, seeps and wet peaty clearings, usually on substrates derived from sands, sandy alluvium, siliceous rock or shales, U.S.A. from Long Island southward in the Coastal Plain to peninsular Florida and west into eastern Texas; inland throughout the Piedmont and contiguous portions of the southern Appalachians and into the Mississippi embayment north to southern Arkansas and western Tennessee. Map 2.

Type: "Georgia": Presumably collected by A. Michaux. Holotype: P, material from Florida, Mississippi and Louisiana compared with holotype by Dr. Lourteig matches well.

To the north of its range in the Atlantic Coastal Plain are forms which are quite tumid in the distal 1/2—1/3 of the petal blade. This characteristic shows up less frequently southward in the Coastal Plain and inland, is quite

rare even in southern Alabama populations, and is not found west, where all *F. squarrosa* populations have flatter, frequently more slender petal blades. The elongate, retrorsely barbellate calyx bristles appear to be quite constant in character throughout the range of the species. This same taxon is sometimes parametered so as to include *F. pumila*, which is annual, has anthers but 1/2 as long as those of *F. squarrosa*, and which has tumid, slenderly pointed petal blades as well as much longer calyx bristles. Neither is this to be confused with *F. bushii* (*F. ciliata* B. F. Bush), a southwestern Coastal Plain species which is often taller, has anthers about twice as long as those of *F. squarrosa*, and which has a characteristically longer-ciliate leaf margin together with conspicuously longer awns of the fertile scales. The petal blades of this last are at maturity much more swollen even than the N.J. extremes of *F. squarrosa*.

6. FUIRENA **bushii** Kral, nom. nov.

F. ciliata Bush, Mo. Bot. Gard. Rep. 16:91. 1905.
not Leprieur ex Steud., Syn. Pl. 2:126. 1855.

Rhizome elongate, slender, with rather distant cormous offshoots. Culms 1-several, sometimes appearing tufted, erect to leaning on other vegetation, to 10 dm tall, subterete to angled, multicostate, proximally smoothish, distally hirsute. Lowest leaves scale-like, mostly sheath; medial culm-leaves largest, sheaths mostly overlapping on the culms, strongly hirsute, multicostate, cylindrical, rather loosely investing the culm, ligule scarious, reddish-brown, erect, oblique, ciliate with long hairs; leaf blades linear, spreading to ascending, the largest 6—15 (—20) cm long, 5—10 mm broad, tapering from the rounded-clasping base to the attenuate apex, upper surface sparsely to copiously strigose-pilose, lower surface heavily so, margins incrassate, stiffly spreading-long-ciliate. Upper culm leaves gradually reduced toward the inflorescence, more distant, sheaths not overlapping and culm exposed for longer intervals. Spikelets in tight clusters (in depauperate specimens peduncles may terminate in a single spikelet) on slender, angulate, stiffish, hirsute to hirsutulous primary and secondary peduncles, each cluster from one to several glomerules, some stalked, and arranged either terminally or also with additional clusters from the next lower 1—2 nodes, each cluster of glomerules substended by 1—3 involucral bracts similar to leaf blades but smaller, the longer ones often longer than the spikelet cluster. Fertile scales obovate, 3.0—3.5 mm long, greenish or reddish-brown, marginally subscarious, rounded or retuse, ciliate, backs hirsute and/or hirsutulous, medially strongly 3-nerved, these converging distally to form a spreading-recurved, stiffish, scabrid mucro nearly as long as the scale body. Fruiting florets ca. 2.0—2.5 mm long. Sepals smooth, usually extending to the base of the petal blades. Petal claws often fully 1/2 the total length, blade above the base of the akene body; blades ovate, basally rounded, cordate or short-attenuate, flattish and triple-nerved, distally

becoming very tumid, often subterete and terminating in a short-conic apex, apiculate, smooth or with a slight scabrosity adaxially distally. Anthers 3, ca. 2 mm long. Akene with stipe shorter than the petal claws, surfaces of the sharply trigonous body a lustrous pale to deep brown, angles wirelike, glassy, paler; stylar end sometimes nearly 1 mm long with a papillose-hispidulous apex. Fig. 6.

Acid, usually boggy or seep situations, generally in full sun in arenaceous soil districts, Coastal Plain and Interior Highlands, Louisiana westward into central Texas, northward into the Ozarks of Arkansas and Oklahoma. Map 1.

Type: Texas: Smith Co., swamps, Swan, *J. Reverchon 2911.* 10 Jun 1902, Holotype: MO; Isotypes: GH!, NY!

This species vegetatively and in character of petals is closest to *F. squarrosa.* In Louisiana and in east Texas the two are sometimes found in the same bog. As is true of some other sedge complexes where closely related species may occupy what seems to be the same habitat and not intergrade, these two appear not to hybridize.

7. FUIRENA SIMPLEX Vahl, Eclog. 2:8. 1798.

F. obtusiflora Vahl, Eclog. 2:8. 1798.
F. schiedeana Kunth, Enum. Pl. 2:183. 1837.
F. squarrosa var. *macrostachya* Britt., Bull. Torrey Bot. Club 11:87. 1884.
F. cylindrica Bush, Mo. Bot. Gard. Rep. 16:91. 1905.
F. zacapana Bartlett in Rob. & Bartl. Proc. Am. Acad. 43:50. 1907.
F. primiera M.E. Jones, Contr. W. Bot. 18:25. 1933.

Perennial, to 1 m tall, usually 2—4 dm, from stout and short to long and slender rhizomes, without axillary cormous offshoots. Shoots erect to ascending or leaning on other plants, tufted or lined out along the rhizome, internodes terete to somewhat angled, multicostate, usually smooth except toward the upper culm. Leaf sheaths somewhat inflated, multicostate, those of mid-culm usually smooth, those of upper and lower culm hispid or hirsute; ligule short-cylindric, oblique, membranaceous, pale brown, ciliate; leaf blades linear or lance-linear, larger ones from 5—20 cm long, 3—7 mm broad, spreading or ascending to erect, usually tapering gradually from the clasping base to the attenuated apex, the margin usually hispid ciliate, the upper surface smooth to pilose, the lower surface hispid, pilose, or smooth. Spikelet clusters grading from solitary and terminal to 2—3 (—5), the lower or hirsutulous, slender, slightly spreading or erect, axillary peduncles and all subtended by 1—3, narrowly linear bracts similar to leaf blades, the longest longer than the subtended spikelet cluster. Spikelets ovoid, lance-ovoid or cylindrical, 0.8—1.5 (—2.0) cm long, usually acute. Fertile scales with body mostly obovate or oblong, 2.5—3.5 mm long, thinnish, usually tan with tints or maroon and green, or olivaceous, rounded or slightly emarginate, ciliate, the back scaberulous, puberulent, hispid or

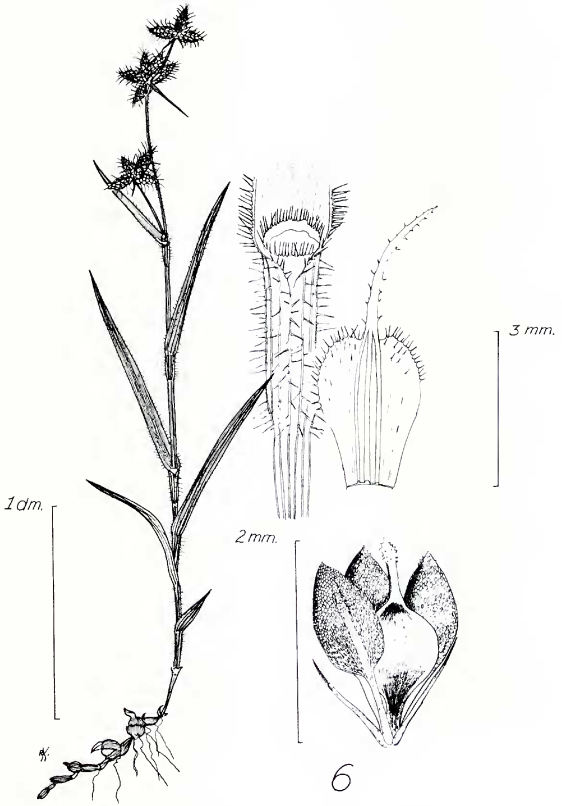


Fig. 6. *F. bushii* (*Kral 24477*).

nearly smooth, usually the lowermost scales of a spikelet with the longest and most abundant hairs; scale back medially with 5—7 strong, raised nerves, 3 strongest convergent to form a stiffish but spreading, usually scabrid, pale green mucro, usually 2/3 or more the length of the scale. Florets mostly 2—3 mm long (exclusive of bristle tips), calyx bristles reaching at least to the bases of the petal scales, retrorsely barbellate, sometimes with narrow blades (i.e. *Marsh 1740*, Monclova, Coahuila, Mexico). Petal blades longer or shorter than their slender claws, mostly ovate with apices acute to rounded or retuse, margins sometimes bristly distally, bases attenuate or truncate, cordate, rounded; bases of petal blades usually flattish except for 3 raised nerves and the thickened margin but distally usually tumid, with the mid-nerve dorsally and subapically excurrent as a short to elongate, erect or incurved mucro. Anthers usually 3, mainly from 0.9—1.2 mm long. Akene prominently stipitate, angles wire-like, glassy, usually pale, faces flat to slightly concave or convex, a deep, glossy brown, reddish-brown or even yellowish; stylar apex narrow, usually papillose-tipped. Fig. 7.

Sunny swamps, swales, bogs, seeps, ditches and wet places, America from southern Kansas and Illinois southward through the Interior Highlands and plains of the U.S. into Texas, New Mexico, thence southward through Mexico (incl. Baja California) into Nicaragua; in the Caribbean in Cuba, Jamaica, Puerto Rico. Venezuela? Map 1, 3.

This is perhaps the most variable in perianth of all American *Fuirena*.

Type: Jamaica: "Bocachica, *V. Rohr 27*". "American meridionali". Holotype: C! The type specimen shows only the leafy culm and the spikelets, but these are ample, the perianth unmistakable.

The common form of the species has 3 calyx bristles and 3 bladed petals but there are individuals throughout the range that produce a third set of very short bristles just inward on the receptacle from the calyx bristles. The calyx bristles are always retrorsely hispidulous or barbellate, their length varying but usually longer than the petal claws. The blade of the petal varies over most the range of the species. In the United States, at least through the Ozark system southwest through Texas, these are usually deltoid or ovoid, triple-nerved and cordate-truncate basally, becoming thickened toward the tumid apex, there somewhat emarginate and with a prominent, subapical-dorsal extension of the mid-nerve, this strongly projecting and retrorsely barbellate. Such plants are consistently perennial, strongly rhizomatous, usually tallish, and agree the most with material from most of Mexico and Central America. To the west in the United States and rarely in northern Mexico is a low, mostly e-rhizomatous, mostly annual

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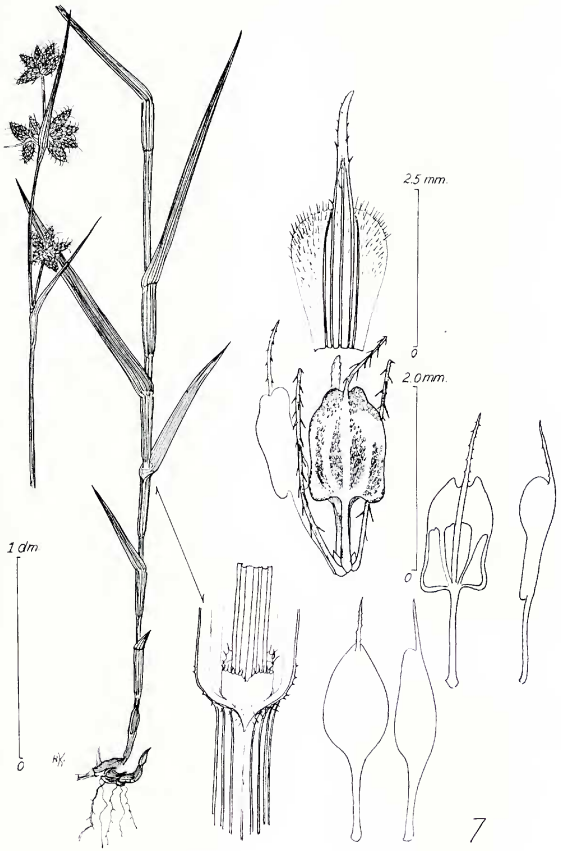
Fig. 7. *F. simplex* (plant habit from *Demaree 61188A*) fertile scale and floret just below from *Demaree 61188A*; perianth scales at mid-right from *York 46180*; perianth scales at lower right from *Kral 25288*).



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plant with anthers 1/2 as long which appears to be a distinct geographical variant, here treated as var. *aristulata* (Torr.). Other variants showing slight perianth anomalies but otherwise blending well into the matrix of forms of this quite variable species, have been described as species, to wit: (1.) *F. zacapana* Bartlett, Guatemala: Swamp, Gualan, *C. C. Deam 423*, 13 Jan 1905 (GH! F!). (2.) *F. primiera* Jones. Mexico: Baja California. Primiera Agua, near Loreto, 19 Oct 1930, *M. E. Jones 27604* (POM! NY! UC!)

Some of the examples of Latin American *F. simplex* that give the most trouble are the ones which have the tumid petal scale apex projecting conically and at the same time have a very reduced subapical bristle. These must often be examined through all stages of their development in order properly to be sure of identification.

Sea-coastal races and those from brackish marshes inland show a tendency to produce the most extensively creeping rhizomes, often develop clones of gigantic size. Such plants are also smoother, shorter and harder-leaved, stiffer in habit.

7a. *FUIRENA SIMPLEX* var. **aristulata** (Torr.) Kral, comb. nov.

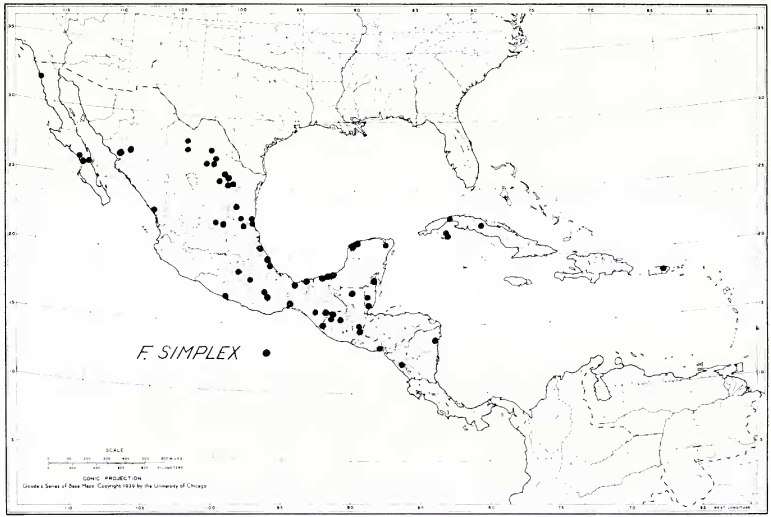
F. squarrosa var. *aristulata* Torr., Ann. Lyc. Nat. Hist. N.Y. 3:291. 1836.

Mostly annual, mostly without rhizomes, the slender culms single or in small tufts, erect or spreading, rarely taller than 3 dm. Lowest leaves mostly sheathing and bladeless or with mucro-like blades, smooth to sparsely hispid or hispidulous. Larger leaf blades ascending or spreading, lance-linear, 10 cm or less, attenuate, the margins hispid-ciliate at least proximally, the surfaces smooth to hispid or hispidulous, particularly along the costae; sheaths multicostate, terete or angled, smooth to sparsely or copiously hispidulous. Both sheaths and blades becoming progressively more pubescent upward on the culm. Upper portion of culm leafless, multicostate, usually hirsutulous. Spikelets in 1—3 clusters per culm, usually the terminal largest, the lower on slender, erect or ascending hispidulous peduncles, at least the uppermost cluster subtended by 1—3 linear-subulate bracts, these spreading or reflexed, 1 usually longer than the cluster. Spikelets mostly lance-ovoid, ca. 1 cm long or less, acute. Fertile scales with body obovate, rounded, 4.0—4.5 mm long, puberulent, brownish-green or olivaceous, midnerves 3, strongly raised, converging to a spreading or squarrose but stiffish, scaberulous or hispidulous mucro fully 2 mm long. Perianth 6-parted, the calyx bristles 1—2 mm long, retrorsely scabrid, the bladed members ca. 1.5 mm long with blades longer than the claws, oblong or ovate, truncate or retuse, flattish or distally tumid, the awn slightly subapical, dorsal, erect, very short to nearly 1 mm long and itself retrorsely barbellate; nerves of scale 3, the laterals arcuate. Stamens 1—3, the anthers mostly 0.5—0.6 mm long. Akene stipitate-trigonous, including the stylar end 1.5—1.7 mm long, the body broadly elliptic in outline, the angles prominent, wire-

Map 3.

CARIBBEAN AMERICA

No. 113



GOODE'S SERIES OF BASE MAPS
HENRY A. LEPPARD, EDITOR

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like, the faces flattish and glassy, usually pale brown or near white, the narrow stylar end smoothish or apically papillate, ca. 0.5 mm long. Fig. 7a.

Sandy or sandy-peaty low places in prairies, river and stream bottoms and seeps, Nebraska (mostly in the Platte and Loup systems) southward through Kansas and northwestern Missouri through Oklahoma and Texas. Rare and local in northern Mexico; New Mexico. Map 1,3.

Type: "Arkansas"? Long's Expedition to the Rocky Mountains, coll. by Dr. James. Holotype: NY, but Coville (1890) cites this, together with material I have on loan, to wit: New Mexico, *A. Fendler 877*; Texas: Comal Co., New Braunfels, *F. Lindheimer 185, 186*; Comanche Springs, *F. Lindheimer 206, 1244.*

One might question the advisability of retaining this as a distinct variety, particularly in context of a species as variable as *F. simplex*. My reasons are that this taxon appears to occupy a definite geographic area and is rather consistently a lower, more slender, and almost always a tufted e-rhizomatus plant. Its anthers at maturity almost always range between 0.5—0.6 mm in length while those of the rest of *F. simplex* are mostly around 1 mm long. There are some anomalies, i.e. material from Oklahoma: Greer Co., *G.W. Stevens 1018.1*, 18 Jun 1913, which has rhizomes. Such plants are occasional in southern Kansas, Oklahoma, and in Texas. But this might be in keeping with a variety of comparatively recent derivation from *F. simplex*. I hope to be able to study the chromosomes of this, essentially prairie plant, in order to see if there are real genomal differences.

8. FUIRENA PUMILA (Torr.) Spreng., Syst. Veg. I: 237. 1825.

F. squarrosa var. *pumila* Torr., Fl. N. & Midl. States I: 68. 1824.
F. torreyana Beck, Bot. U.S. 429. 1833.

Caespitose annual 0.8—6.0 dm tall, mostly 3 dm or lower. Culms erect or spreading, stiffish, but slender, the internodes multicostate, lower ones smoothish, the upper toward and in the inflorescence hispid. Lower leaves mostly sheath, those toward mid-culm with sheaths loosely cylindrical, smoothish to hispid, somewhat dilated distally, there with a pale to reddish-brown, thin, oblique, ciliate, ligule; blades spreading or ascending, linear-lanceolate or linear, mostly 5—12 cm long, 3—5 mm broad, mainly tapering from near the clasping base to the narrowly acute apex, margin somewhat cartilaginous-thickened, usually spreading-hispid or scabrid, surfaces strigose-hispid or smooth, multicostate beneath. Leaf blades thence somewhat reduced into the inflorescence, topping longer internodes, and usually hispid. Inflorescence a terminal cluster of spikelets, leafy-bracted, and often with pedunculate similar clusters from the next-lowest 1—2 nodes (in depauperate specimens the culm may produce but 1 spikelet!). Spikelets ovoid or ovoid-cylindric, mostly 0.7—1.5 cm long, the lowest bracts hairiest, often quite hispid or hispidulous. Fertile scales with bodies mostly obovate, ca. 3 mm long, rounded or slightly emarginate, ciliate, then, mostly greenish-brown,

backs rounded, hirsute, hispidulous or hispid, with usually 3 strongly raised nerves medially, converging to a strong, stiffish but slender and spreading-recurved mucro, nearly as long as the scale body and scabrid. Perianth of 6 members, calyx bristles retrorsely barbellate, extending at least to the base of the petal scales and often to near their tips. Petal blades long-clawed, mostly ovate, slenderly incurved-acuminate into apical bristles, the base rounded cordate or truncate, body thin and 3—5-nerved basally but

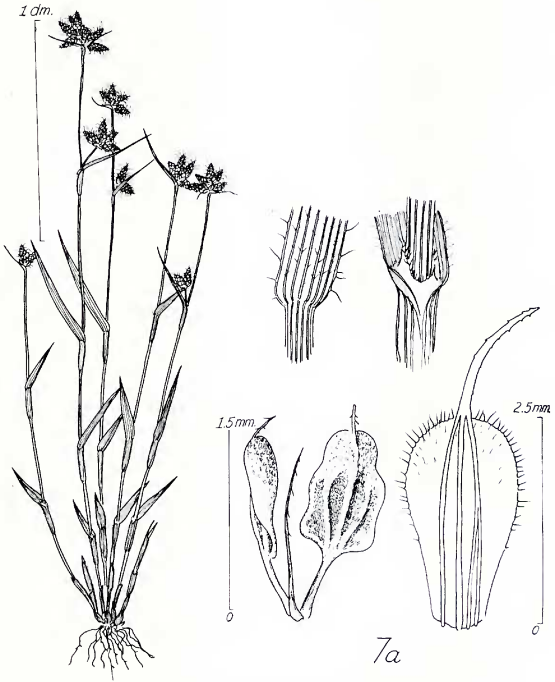


Fig. 7a. *F. simplex* var. *aristulata* (*McGrath 6016*).

medially and distally thickened. Anthers 0.5—0.7 mm long. Fruit stipitate, body trigonous, edges wirelike and pallid, faces a deep, lustrous brown or reddish-brown; apiculus narrow, somewhat papillose and thickened distally. Fig. 8.

Moist to wet, usually sandy or sandy peaty places, sometimes weedy, toward the coast from Massachusetts southward through the Coastal Plain to southern peninsular Florida, west in the Gulf Coastal Plain, but increasingly infrequent, to southern Texas with a disjunction inland in the Great Lakes lowlands of Michigan and Indiana. Map. 2.

Type: New York: Long Island, *J.R. Torrey*. Holotype: NY!; Isotype: GH!

Many have considered this as being but an annual variety of *F. squarrosa*, explaining that that species becomes annual north in its range. However, *F. pumila* has the same annual habit however far south it grows (and is annual in the greenhouse as well!), has a consistently different petal blade character, has consistently smaller, shorter anthers, and never produces the cormous rhizome buds as in *F. squarrosa*.

The nomenclature of the species has been a bit clouded because of the reluctance of some authors to cite the basionym. Thus the species has often been credited to Sprengel, though he himself made it plain that the name originated with Torrey.

9. FUIRENA UMBELLATA Rottb., Descr. & Ic. 70. 1773.

F. paniculata L.f., Suppl. 105. 1781.
F. tereticulmis Presl, Rel. Haenk. 1:180. 1828.
Scirpus umbellatus (Rottb.) O. Ktze., Rev. Gen. 3(2):337. 1898.

Perennial, the thick, scaly, fibrous-internoded rhizomes producing cormous offshoots. Culms stiffly erect or leaning, 5—11 dm tall, internodes multicostate and terete or frequently sharply 3—5-angled, toward the stout base (1.0—1.5 cm thick), smoothish or becoming hirsute or hispid at or toward the inflorescence. Leaf sheaths longest and overlapping at or near culm base, loosely investing the internode, cylindric, multicostate, smooth to hirtellous or hispid, particularly toward or at the inflorescence level; ligular orifice thin, brownish, erect, oblique, short-ciliate; blades short, scale-like at culm base, becoming longest at mid-culm or above, there linear-lanceolate, linear-oblong, 10—30 cm long, 0.8—2.5 cm broad, narrowly acute to attenuate, the margins smooth or scaberulous, the base clasping, upper surface smooth to sparsely or finely hispid, strigose, or scaberulous, finely and evenly nerved, lower surface smooth or variously hairy, strongly multicostate, the nerves often hispid. Leaf blades gradually reduced in size into the inflorescence, this a compound of distant to approximate clusters of sessile and pedunculate glomerules of spikelets, the lowest clusters on slender, elongate, usually hispidulous primary peduncles, the whole structure interruptedly cylindric and each cluster of glomerules subtended by

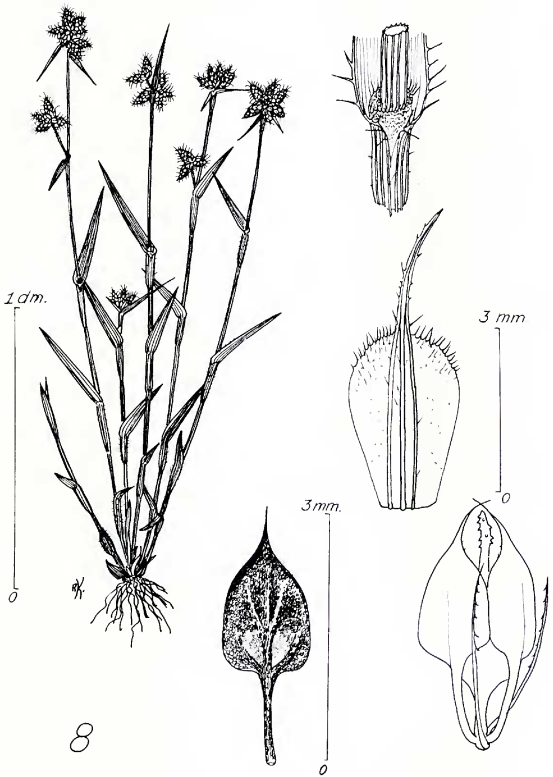


Fig. 8. *F. pumila* (*Kral 44735*).

1—3 leaflike hairy bracts, the longest longer than the cluster. Spikelets lance-ovoid or cylindrical, 5—8 (—10) mm long. Fertile scales oblong to obovate, 2.5—3.0 mm long, rounded or retuse, distally ciliate, thin, the backs greenish-brown, smooth to puberulent or strigillose, medially 3-nerved, these converging to a subapical, stiffish, flattish or subterete, ascending to spreading, scabrid mucro ca. 1/3 as long as the scale body. Florets 2.0—2.5 mm long. Perianth of but 3 scales (petals) the blades on crimped claws, short-oblong or obovate, 1.5—2.0 mm long, obtuse, rounded or emarginate, incurved-aristate, the arista often coiled apically, the blade body 3—5-nerved, thinnish. Stamens 2 or 3, anthers 0.7—1.0 mm long. Akenes 1.0—1.5 mm long, body angles wirelike, paler than the brownish, shining faces; apiculus apically papillose or smooth. Fig. 9.

Swamps, bogs, seeps, marshes and low, wet meadows, throughout the warmer, more humid parts of mainland Latin America and in the Caribbean. Old World tropics. Map 4.

Type: Surinam, *Rolander*. Not examined. The plate (from Rottb., Tab. XVIII. Fig. 3) shows a very good rendition of the slender, long arista on the petal scales, this unmistakably identifying the species.

10. FUIRENA CAMPTOTRICHA C. Wright in Sauv., Anal. Acad. Si. Habana 8:32. 1871.

F. bulbipes Blake, Contribs. U.S. Nat. Herb. 24:2. 1922.
F. umbellata var. *unguiculata* Kukenth., Report. Sp. Nov. 23:200. 1926.

In rhizome, culm, leaf, and generally in habit much like *F. umbellata*. Leaf blades mostly 5—20 cm long, 0.5—1.5 cm broad, usually spreading hispid-ciliate at least toward the bases, the ligular sheath-orifice short-ciliate, sometimes also strigillose. Inflorescence somewhat sparser, often more open. Spikes ovate to lance-ovoid or cylindrical, mostly 0.5—1.0 cm long, reddish or greenish-brown. Fertile scales as in *F. umbellata* with mucro seldom more than 1/3 the scale body length, erect or slightly spreading. Florets as in *F. umbellata*, the perianth scales on crinkled stipes, but the distal ½ of the blade tumid, hispidulous, and with a shorter, subapical mucro or awn (this in a few cases very minute or absent). Fig. 10.

Bogs, swamps, wet sunny places, near the southern coasts of and in the Isthmus of Mexico, southward into Panama and South America; Cuba. Map 4.

Type: Cuba. Havana: en sabanas humedas cerca de Dayaniguas, Jurisdiccion de los Palacios, *C. Wright 3778*; GH!, NY! This material shows the short, slender, subapical awn on the petal scale, together with the tumid scale apex typical of the species.

As Svenson (1957) has commented, this is so close to *F. umbellata* in many respects that it well could have arisen from that more widespread species. It may well be that a world revision of the genus would reduce such as *F. camptotricha* to varietal rank. However, in perianth character

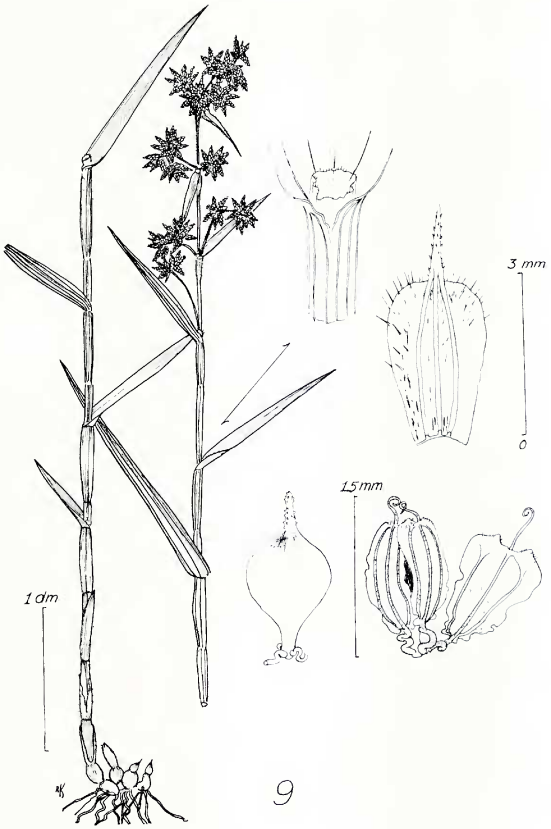


Fig. 9. *F. umbellata* (*Curtiss 299*).

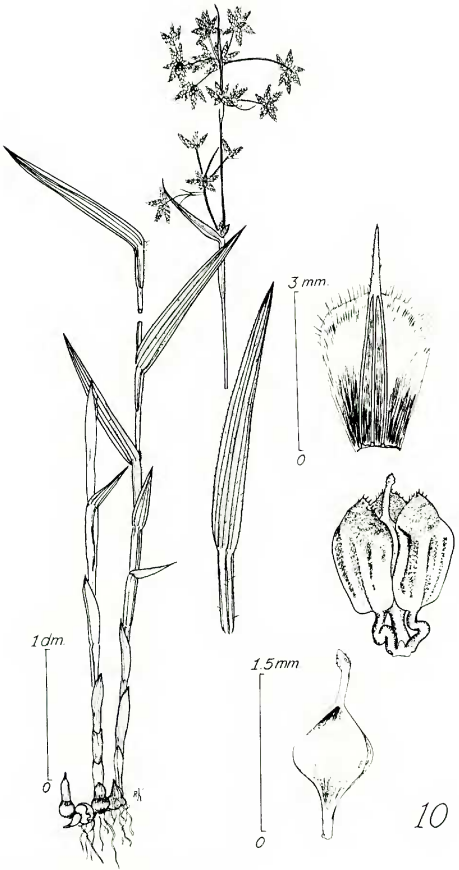
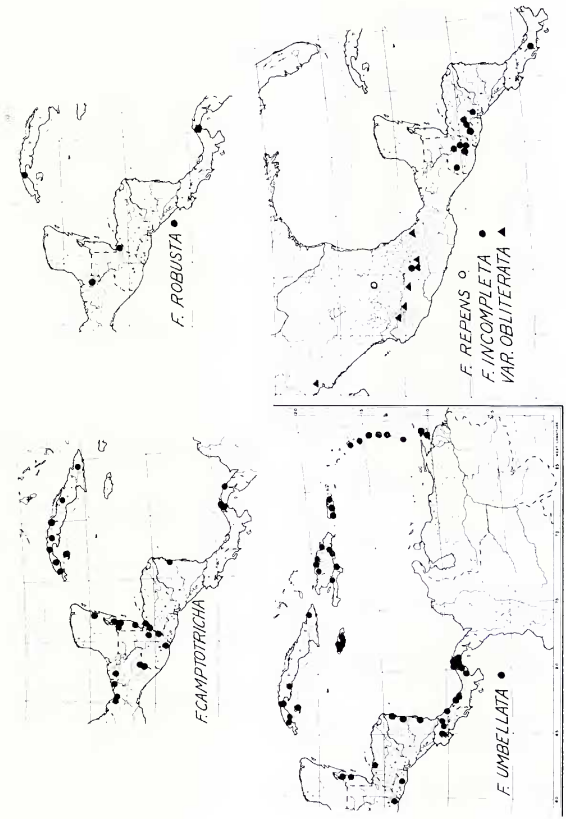


Fig. 10. *F. camptotricha* (*Kral* 25066).


F. ROBUSTA
F. REPENS
F. INCOMPLETA
VAR. OBLITERATA
F. CAMPTOTRICHA
F. UMBELLATA

Map 4.

it does show, with its subapical petal, bristle and tumid petal blade, some overlap with *F. simplex*, another species with which it is sympatric. Type material under the *C. Wright* number *3778* has been interpreted variously in that it also contains some *F. robusta*. But the Wright description on the one hand declares "setis nullis," thus eliminating *F. robusta*, and on the other includes the swollen perianth scale character, which eliminates *F. umbellata*, the species to which Svenson (1957) assigns the Wright specimens. A particularly bad specimen to interpret is *Nee* and *Mori 3636* from Colon, Panama, "0.7 mi NE of bridge over Rio Piedras on road from Portobelo to Pilon." This has petal blades crinkle-stiped, swollen distally and with a short subapical bristle as in *F. camptotricha*; on the other hand there are small bristles also, the base of the leaf blades are prominently and stiffly ciliated and the spikelet has larger dimensions, all characters of *F. robusta*. Such specimens (however rare) are an indication that the next phase of the study has to be an investigation of the cytology and breeding system in these *Fuirena*.

11. FUIRENA REPENS Boeckler, Bot. Jahrb. 7:277. 1886.

Slender low perennial, the rhizomes creeping, slender but swollen at irregular intervals into narrowly fusiform thickened zones, pale reddish-brown, internodes frequently 2 cm long, often forking or 3-branched or producing compact, narrowly fusiform, several-noded rhizomatous offshoots, these developing apically into leafy shoots. Shoots erect, low, rarely reaching 2.5 dm, the lowermost part scaly, smoothest, the leaves of midculm longest; sheaths tubular-cylindric, rather loosely investing the culms and often overlapping, multicostate, hirsute, the ligular orifice scarious, oblique, long-ciliate, pale brown; larger leaf blades narrowly linear, ascending or spreading, to 5 cm long, rarely broader than 5 mm, attenuate from near the base to the slender apex, smooth to sparsely or copiously hirsute, sparingly spreading ciliate proximally. Culm smooth proximally multicostate, with internodes becoming spreading hirsute upward, terminating in a subcapitate cluster of (1-) 3—7 spikelets subtended by 1—3 leaflike bracts, these shorter than to twice the length of the spikelets, spreading, hispid-hirsute proximally, smooth to scabrid distally. Spikelets lance-ovoid, greenish or olivaceous, the longest ca. 1.0 cm long. Fertile scales obovate, thin, ca. 2.5 mm long, the backs hispidulous and sparingly strigose, medially 3-nerved, these converging to form a spreading-ascending mucro to 1.5 mm long. Perianth with calyx bristles reduced to minute sharp-tipped tubercles; petals ca. 2.0—2.5 mm long, the claw ca. 0.4 mm long, the blade ovate, proximally flattish and triple-nerved, the distal ½ inflated and tapering into a slender, erect to incurved awn. Anthers ca. 2 mm long. Akene ca. 1.5 mm long altogether, the stipe shorter than to nearly as long as the sharply trigonous body, the stylar end slender elongate, slightly broadening and scaberulous-papillose distally; akene surface pale, minutely cancellate-punctate, the 3 edges smooth, wirelike, glassy. Fig. 11; map 4.

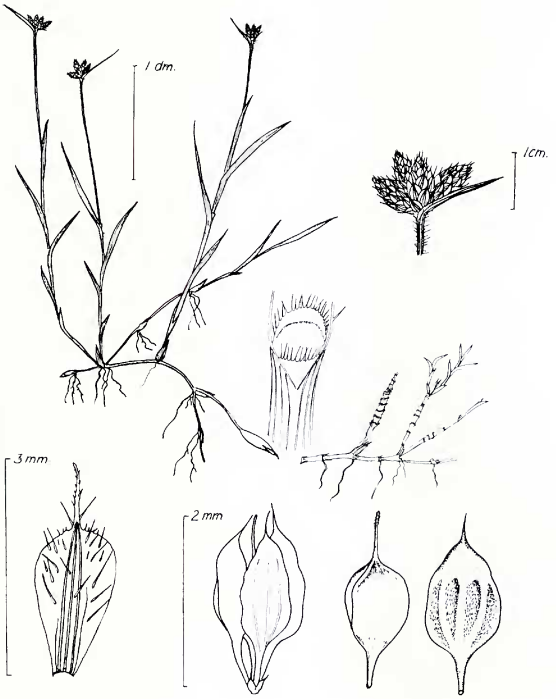


Fig. 11. *F. repens* (*Schaffner 196*).

Type: Mexico: San Luis Potosi: "San Louis Potosi, leg. *J.G. Schaffner 196*, 1879. Herbarium V. A. Vigener." Holotype presumably at Berlin and destroyed. Neotype: NY!; isoneotype: C!

This species, so far as I know, has only been collected from its original locality, and only two numbers, both collections of J.G. Schaffner are extant. I have designated the specimen at NY as the neotype. The label of *J.G. Schaffner 567* (GH! PH!) adds somewhat to the sparse information about the species, namely: "in paludosis, San Rafael, ex convalli San Luis Potosi."

Admittedly, there is little information on which to base retention of this as a species. However, it differs from the others in so many respects as to deserve reconsideration. Hopefully the plant will be refound.

12. FUIRENA INCOMPLETA Nees in Mar., Fl. Braz. 2(1):107. 1842.

F. hexachaeta Schlecht, Linnaea 19:69. 1847.
Scirpus incompletus (Nees in Mart.) T. Koyama, Journ. Fac. Sci. Univ. Tokyo, III, 7:287. 1958.

Perennial 4—14 dm tall, from creeping rhizomes, the culms erect, ascending or leaning on other vegetation, nearly caespitose or set closely together in lines. Internodes usually smooth except in the inflorescence, usually sharply 3-angled. Lowest leaves mostly sheathing and bladeless or with short-triangular blades, usually smooth or puberulent, mid-culm leaves with sheaths loosely enfolding internodes, mostly sharply 3-angled, smooth to puberulent or hispid, the ligular orifice very short-cylindrical, oblique, scarious, reddish-brown, smooth to hispidulous; leaf blades at mid-culm longest, linear, mostly tapering gradually from base to apex, 4—17 cm long, 4—7 mm broad, the edges smooth and cartilaginous thickened, sometimes remotely ciliate proximally, the surfaces smooth or strigillose along the nerves beneath, particularly along the strongly raised median. Inflorescence with central axis usually hispidulous, either a single terminal cymose compound of glomerules of spikelets, or a series of 2—4, well-separate compound of glomerules, the lowest usually on short to elongate, slender, erect to slightly divergent primary peduncles, these densely hispidulous, sharply 3-angled (sometimes the spikelets of clusters tending to be compactly pinnately disposed!). All clusters of glomerules subtended by leaflike bracts, the lowermost longest, usually equal to or longer than the subtended spikelet cluster, then gradually shorter, grading to smaller ones subtending individual glomerules, thence to the lowermost fertile scales. Spikelets narrowly oblong-cylindric to lance-linear, 0.7—1.4 cm long, usually acute. Fertile scale body broadly elliptic, oblong, or obovate, 3.0—3.5 mm long, rounded, short-ciliate or nearly entire, very thin, the backs mostly greenish-brown or olivaceous, rounded, appressed-puberulent or hispidulous, usually with 3 greenish, slightly to strongly raised median nerves convergent to an erect or slightly spreading mucro ½ as long to nearly as long as the scale body and strigillose. Perianth of 4—6 subequal, retrorsely barbellate

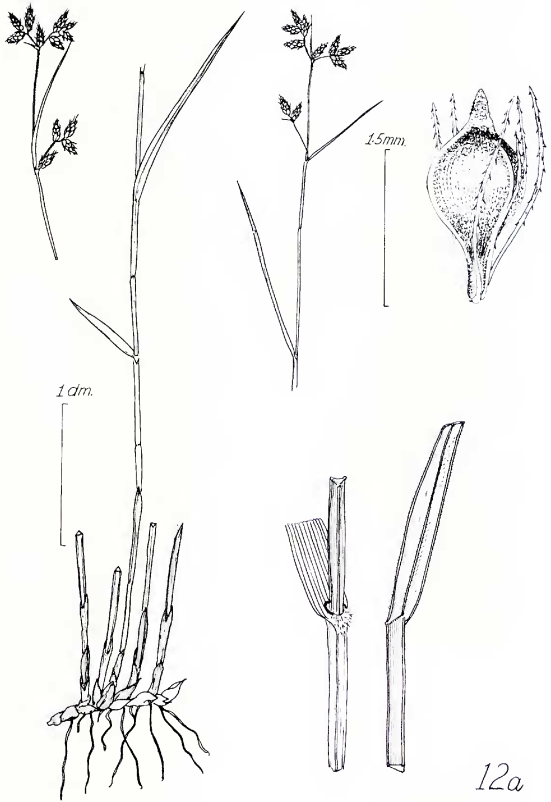


Fig. 12a. *F. incompleta* (*Killip 4573*).

bristles, these extending to or exceeding the style tip of the akene. Anthers mostly 3, 0.8—1.5 mm long. Akene short-stipitate, 1.5—2.0 mm long, the body trigonous, broadly or narrowly rhombic in outline, angles prominent and wirelike, faces concave or flattish, lustrous brown or greenish-brown, stylar apiculus short, distally papillose. Fig. 12.

Marshes, bogs, seeps, usually in full sun and at elevations of 5000 ft. or more in the mountains, Mexico southward into southern South America. Map 4.

Type: Brazil: Sta. Maria. Goyaz, *Pohl.* The type specimen has not been examined by this writer, but the description leaves no doubt. Two varieties are distinguished by Nees, mainly based on pubescence character. The variety "alpha," according to Nees is pubescent, the sheath angles hirsute-ciliate, the leaves puberulent above, hirsute beneath. The variety "beta" is, for the most part, smooth. Material I have seen from north of South America all appears to fit the former variety.

Toward the north of the range of the species, in Mexico from the state of Mexico north and west to Sonora in the Sierra Madre Occidental, a geographical variant appears which merits description, namely:

12a. FUIRENA INCOMPLETA var. **obliterata** Kral, var. nov.

F. incompleta Nees var. *alpha* affinis, a qua imprimis differt perianthii absenti vel vestigiali, setis redactis inaequalibus achenii stipite breviore vel parum longiore.

Similar to the var. "alpha" of *F. incompleta* but from which it differs particularly by the perianth absent or vestigial, with the reduced bristles unequal, shorter than to slightly longer than the stipe of the akene. Fig. 12b.

While this variety overlaps *F. incompleta* proper in the state of Mexico, it is the sole representative of the species northward. It appears from the type description of *F. hexachaeta* Schlecht., that it does not vary significantly in any way from that rendered for the species *F. incompleta* by Nees ab Esenbeck.

Known localities for the new variety are as follows: Type: Mexico: State of Mexico: north end of Tenancingo; large seep near Tenancingo Park by Mex. hwy. 55, *R. Kral 25234*, 30 Jul 1965. Holotype: US!; Isotypes to be distributed. Other records: Mexico: Jalisco State: Sierra del Tigre 3 mi S Mazamitla, *R. McVaugh & W. N. Koelz 410* (MICH); sandy clay of seepage by Mex. hwy. 15, 17.3 mi E Guadalajara, el. 5000', *R. Kral 25622*. Mexico State: Temascaltepec, Penon, 1700 meters, *Hinton 4406*. Nayarit State: rocky sloping oak savanna, el. ca. 4000', 9.5 mi WNW Chapallilla by Mex. hwy. 15, *R. Kral & J. Murrell 27555*; seepage area in red sandy clay soil, oak type with scattered pine, between Chapallilla and Ixtlan beside Mex. hwy. 15, *R. Kral 25648*. Sonora State: Tepopa, Rio Mayo, rooted in mud of springside, *H.S. Gentry 1412* (F, GH, MICH, UC). Map 4.

1. FUIRENA WALLICHIANA Kunth, Enum. Pl. II. 182. 1837.

Below is a description based solely on a collection made by Dr. Clyde F. Reed, seemingly from a chance (temporary?) introduction appearing

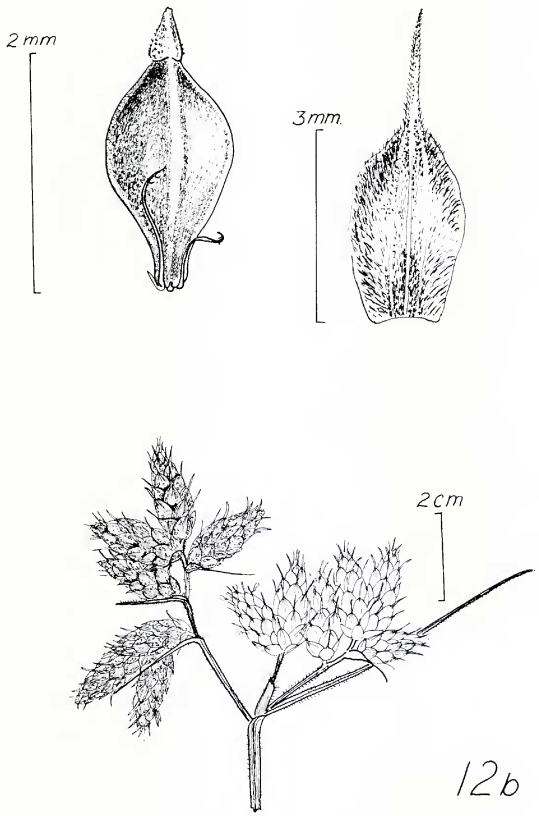


Fig. 12b. *F. incompleta* var. *obliterata* (*Gentry 1312*).

in "wet areas of chrome ore piles" in Newport News, Warwick County, Virginia. The collection, deposited at PH, is described as follows.

Perennial to 5 cm tall, smoothish, culms tufted, close-set along branched, thickish, scaly rhizomes. Internodes smooth, strongly few-costate, slender, longest toward the inflorescence. Sheaths tubular, slightly dilated around the shoot, the lowest lacking blades, oblique, scarious-margined, converging to small cusps. Sheaths at mid and upper culm shorter, their orifices bearing an oblique, scarious, low-ciliate, short-cylindric ligule. Largest blades toward mid-culm or above, these 5—10 mm long, narrowly linear, no wider than 3 mm, gradually attenuated from near the blade base, smooth except for the scabrid, slightly involuted, margin, the lower surface rather strongly costate and with a prominently raised mid-rib. Inflorescence either a single terminal spikelet or an inequilaterally arranged cymose system of spikelets, usually few, digitately spreading or in some cases spreading pinnately along secondary peduncles, the spikelet clusters usually subtended by a linear-filiform-bladed bract, this longer than the cluster; all peduncles angulate, scabrid. Spikelets lance-ovoid or lance-cylindric, acute, ca. 0.7—1.0 cm long, greenish brown. Fertile scales ovate or oblong, ca. 3 mm long, thin, appressed-puberulent, bearing medially 3 rather indistinct nerves converging to a slender, smoothish or papillate-scabrid, pale green, erect to slightly spreading mucro ½ or more as long as the body. Perianth bristles 2—6, of various lengths, often geniculate, sometimes distantly and irregularly pinnately few-branched, even somewhat webbed between the branches on largest bristles, the branches and axis tips marginally long-papillate. Anthers 3, ca. 2 mm long. Fruit trigonous, ca. 1.5 mm long, ellipsoidal in outline, the stipe short, the angles sharp, pale papillate-serrulate, the faces convex, strongly cancellate, the stylar apiculus short-triangular, pale, papillate. Fig. 13.

The webbing between the sparse branches of the petal bristles approaches the description of *F. coerulescens* Steud., but the habit of the plant, the character of its fertile bracts, the tendency for the bristles to be shorter and the strongly cancellate akene faces suggest *F. wallichiana* Kunth, a species of the East Indies. This particular material is interesting in that it shows a transition between a species such as *F. incompleta* whose perianth is entirely of bristles and those which show the conventional *Fuirena* perianth comprised at least in part of bladed members. Certainly one sample alone is not basis enough for identification, particularly in that the specimen comes from a very extreme habitat.

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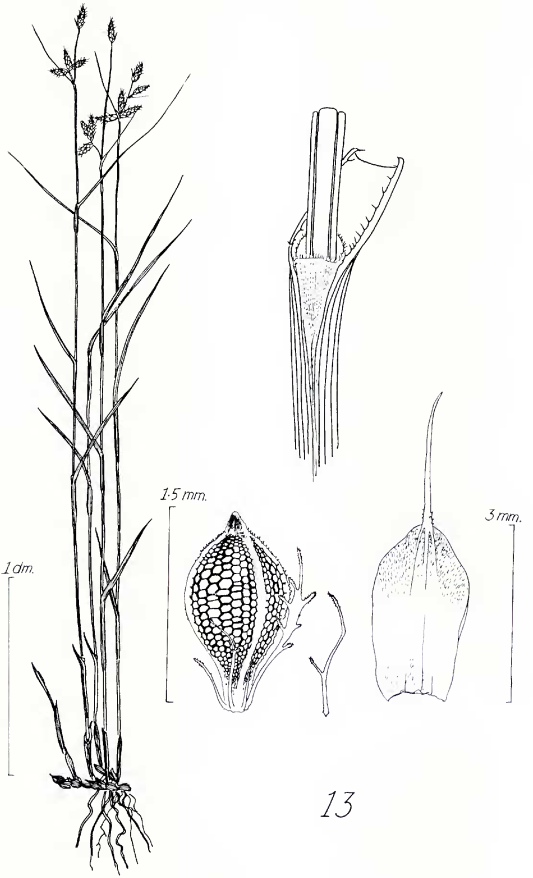

Fig. 13. *F. wallichiana (Reed 44066).*

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