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## TYPIFICATION AND CHANGE IN STATUS OF *YUCCA SCHOTTII* (AGAVACEAE)

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### ABSTRACT

George Engelmann's concept of *Y. schottii* as a plant with short, stiff, yellow-green leaves has not been accepted by recent authors who apply the name to plants of southern Arizona with broad, flexible blue-green leaves. Interspecific hybrids among three yuccas present in the area, *Y. baccata*, *Y. elata*, and the wide, blue-green leafed plant are common. We believe that Arthur Schott's collections made in 1853 upon which Engelmann based his description are of hybrid origin. We accept Engelmann's designation as the earliest applicable binomial but accord it a change in status as *Y. ×schottii* Engelm. pro. sp. and apply it as a collective epithet to include all hybrids among the three species. We designate Schott's unnumbered gathering in the Torrey Herbarium (NY) as lectotype. We consider that *Y. schottii* of authors is conspecific with *Y. madrensis* Gentry of Chihuahua and Sonora, Mexico.

### INTRODUCTION

During our investigation of the yuccas of southwestern United States we have had occasion to examine the typification of *Yucca schottii* Engelm. As currently circumscribed it is a caulescent plant with long, flexible, blue-green leaves, without marginal fibers, with inflorescences borne on a short stalk or within the leaf head, and with pendant, fleshy fruits, native to limited montane portions of Arizona.

In 1855, Arthur Schott, a member of the second International Boundary Survey, or a soldier detailed to gather plants for him (Schott to Torrey, 31 August 1854, NY), collected specimens of a *Yucca* in the vicinity of the present-day twin cities of Nogales, Arizona, and Sonora, as well as in the Sierra del Pajarito that straddle the Arizona-Sonora border. Specimens were sent to John Torrey, with Schott later making distributions to Engelmann at Saint Louis and to the Smithsonian. Today there are three herbarium sheets of *Yucca* with labels bearing Schott's name as collector: one unnumbered sheet (NY) that McKelvey (1938) mistakenly reported as missing (Fig. 1) one at US (35304) and one at MO (135693) (Fig. 2). A second sheet at MO (135723) consists of fragments, which are attributed on the sheet by Engelmann as coming from "Torrey sheet of Schott's mixture." All

known Schott material has been examined for this study.

The specimen at US (35304) consists of a fragment of an old inflorescence ~10 cm long and two small flowers. Attached to the sheet are two labels; one, a United States Department of Agriculture Herbarium label reading, "Yucca puberula Torrey, not Haworth. | Yucca schottii Engelm. | Arizona | Dr. A Schott, 18[?]5". [Note: a vertical bar within a quote indicates end of line.] Above the label is "Yucca schottii Eng." In an unknown hand, and written on the sheet is, "Mr. Painter thinks this is the type." [Joseph Hannum Painter, US Nat. Mus., clerk, 1903–05]. The second label is McKelvey's annotation label reading "Yucca schottii Engelm. | Locality vague and date uncertain." Although McKelvey (1938) accepted this as *Y. schottii*, and further suggested that it might form part of the original collection; the material is without value.

The Schott collection in the Torrey herbarium (NY) is an unnumbered sheet bearing a portion of a leaf, originally two as shown in Trelease (1902, pl. 57) (Fig. 2), ~22 cm long, rigid, yellow-green, and a portion of a glabrous inflorescence, bearing a nearly mature but nonfleshy fruit ~4.5 cm long, a bract, and four small flowers. There are also two mature, rather coarse, pubescent inflorescence fragments, perhaps from the pre-

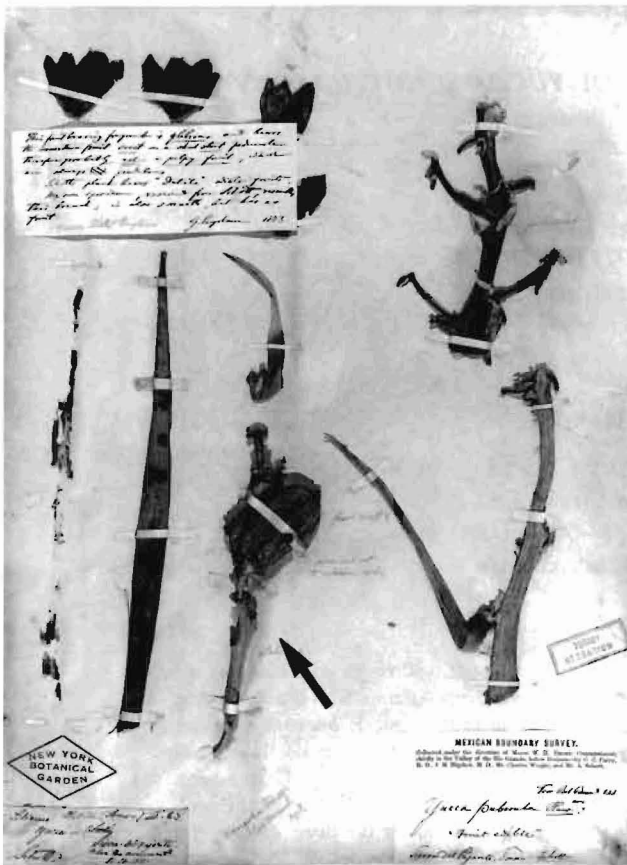


Fig. 1. New York Botanic Garden unnumbered sheet in Torrey Herbarium. Arrow indicates lectotype of *Yucca*  $\times$ schottii Engelm. pro. sp. (elements on left side of sheet). Two elements on the right hand side are excluded.

vious year or from another plant. Mounted at the bottom of the sheet on the left is Schott's blue field label that reads "Liliaceae | Datili (Sonor) | *Yucca*—| Sierra del Pajarito | near the monument | VI. 28.1855 | Schott," and presumably added later "III. 23." At the bottom of the sheet on the right is an official Mexican Boundary Survey label, in Torrey's hand, reading, "Torr. Bot. Bound. 221 | *Yucca puberula*, Haw. | 'Fruit edible' | Sierra del Pajarito, Sonora. Schott." Following Haw. and slightly above is "non?" in what appears to be Torrey's hand, possibly his questioning the identification. Surveying of the US Mexican boundary westward from Emory's monument, at 111°00'W, 31°20'N, began on 26<sup>th</sup> of June, 1855, and with Schott's specimen dated the 28<sup>th</sup> collected two days later "near the monument," it is possible that that monument would have been in, or near, the eastern end of the Sierra del Pajarito. Depending upon how rapidly the survey crew worked, the monument could have been 124, 125 or 126. The first two are located west of Nogales in a gradually rising area that Humphrey (1987) was able to reach without great difficulty, an area with an overstory of two common Arizona oaks, *Quercus oblongifolia* Torr., and *Q. emoryi* Torr.



Fig. 2. Missouri Botanical Garden sheet 135693. Arrow indicates lectotype of *Yucca arizonica* McKelvey (single leaf). Remaining elements are McKelvey's lectotype of *Yucca schottii* Engelm.

and a wide variety of grasses. Number 126 is located in evergreen woodland at about 5300 feet. Considering the nature of Schott's material and our familiarity with the region, we favor either monuments 124 or 125 as probably the type locality.

The material on the sheet in the Torrey herbarium (NY) may represent elements from more than a single plant: The current season's inflorescence is glabrous, the older fragments pubescent. Normally, flowers and nearly mature fruits are not found on the same plant at the same time; however, the flowers may have come from a late-blooming branch although this appears improbable.

Attached on the left side of the unnumbered NY sheet is a note by Engelmann, "This fruit bearing fragment is *glabrous* and bears | the immature fruit *erect* on a short stout peduncle | therefore probably *not* a *pulpy fruit* which | are always pendulous. | Schott's plant bears 'Datili' edible fruits. | My own specimens [MO 135693] received from Schott, resembles | this branch, is also smooth, but has no | fruit. G. Engelmann 1873." In early descriptions much emphasis was often given to whether inflorescences were smooth or pubescent, a character easily determined on dry ma-

terial but without significance inasmuch as both conditions may be encountered in a single population (pers. observation LWL).

One of the fragment folders on MO 135723 has an inflorescence fragment and in Engelmann's hand, "Yucca puberula Torr.! Fragment of the original | *pubescent* specimen in | herb Torrey, with large | white membranous bracts". The second reads, "Flowers of Y. puberula, Torr. | sent by Schott as such". The third one reads, "bud & flower of Y. puberula Torr. | ex Herb. Torrey." McKelvey's annotation label reads, "Yucca Schottii Engelm. Fragments from misplaced Torrey | Herb. sheet (See Rep. Mo. Bot. Gard. | XIII, t, 57,1902)."

The Engelmann sheet, MO 135693, consists of a portion of a single leaf ~23 cm long and ~1.3 cm wide, two glabrous fragments of an inflorescence, three flowers and a portion of a fourth. There are seven attachments on the sheet. Two are Schott's field labels on blue paper. The third is a label in Schott's hand attached at a later date. The fourth is a Missouri Botanical Garden label of no importance. The fifth is an undated note by Trelease, and the sixth is McKelvey's annotation label. The seventh attachment is a carefully executed original sketch by Schott labeled "Yucca brevifolia (mihi)" showing plant habit, a fruit, a cross section of the fruit, a seed, and cross section of a leaf.

(1) One of Schott's labels reads: "Liliaceae | Yucca brevifolia (mihi) [*mihi*, Latin used after a name to indicate the author's responsibility for it." (Stearn 1992)] | Salti Sonor | Valle de Tubac, VI. VII, 1855 | Schott."

(2) The second Schott label reads: "Liliaceae, Yucca Satili (mihi) | Sierra oeste de | Sta. Cruz | VII. 1855 | Schott." Later, ellipses were placed around Satili and written above is "brevifolia" in what appears to be Schott's hand.

(3) The third label, which appears to be in Schott's hand, and was so attributed by McKelvey, reads "Yucca brevifolia, mihi, n. sp. | Yucca puberula, Haw. | see Mex. Bound. Report | Sonora | At the potrero on headwaters of the Sta | Cruz river. 1855 | Ex herb. Schott." Michler (1859) identifies "Potrero" as "in the valley of Nogales." McKelvey's puzzling statement regarding this label is: "Label (a) [our 3] would seem to have been written by Schott after Torrey's determination of his material and to represent his attempt to combine Torrey's opinion with his own findings and is therefore of no great importance."

The two blue Schott field labels are carefully attached to the sheet by their lower left corners under the Schott herbarium label (3).

(4) Missouri Botanical Garden label of no importance. It merely reads "Y. Schottii | Y. brevifolia, Schott."

(5) The undated note by Trelease reads "This yucca

puberula Torrey | in Bot. Bound. p. 221 | may be identical with my macrocarpa | [but above the line the words] Yucca brevifolia Schott | is a mixture of this pubescent | and smooth variety or species | now is ext | See my paper p[ate] 46." [Annual Rep. Missouri Bot. Gard. 3 (1893): Plate 46].

(6) Finally there is McKelvey's annotation label that will be considered later.

Also written on the sheet in an unrecognized hand is "This looks as if it might be the erect—thing related to filifera. No!"

#### DISCUSSION

I. Torrey (1859), in describing Schott's collection, mistakenly referred to it as *Yucca puberula* Haw. although there may have been a question in his mind about the identification (see above). In part, Torrey's protologue reads: "Leaves . . . about a foot long and 5–6 lines wide . . . of a thick, firm texture . . . Scape 2–3 feet long . . ." He then quotes Schott as to its vernacular name and the fact that it bore large fleshy fruits. As a synonym, he listed "Y. brevifolia, A. Schott, MSS." He cited two collections; one from the "Sierra del Pajarito, near the monument, Sonora, June; Schott." That specimen is the one in the Torrey Herbarium (NY). No mention is made of the fact that that sheet bears an upright, nonfleshy fruit (see later). The other cited collection is given as, "Valley of the Santa Cruz River." No Schott specimen bears that locality, however, Schott's sketch gives the locality as "Santa Cruz River valley, Sonora." The Santa Cruz River originates in Arizona, flows around the Patagonia Mountains into Sonora, then turns north and reenters Arizona a few miles east of Nogales where it continues northward, and in the past flowed into the Gila River.

II. Engelmann (1873) designated as a new species, *Yucca Schottii*, and in the protologue wrote "Leaves "yellowish-green" [quote marks in original] 9–10 inches long, 6–8 lines wide . . . panicle pubescent or glabrous. . . [with] pendulous, ovate, short-rostrate berry . . . about 2 inches long . . ." He questioned whether ". . . all parts of the specimens in Schott's, Torrey's and my own herbarium, all collected by Dr. Schott, belong together." As a synonym, Engelmann listed *Y. brevifolia* Schott in Herb. and *Y. puberula* Torrey, in *Bot. Mex. Bound* 221, non Haw. [Two years earlier Engelmann (1871) had named the Joshua tree of the Mohave Desert, *Yucca brevifolia*]. Engelmann cited, "Upper Santa Cruz River in southern Arizona, A. Schott, in June and July, 1855." According to Engelmann, his description of leaves and flowers were based upon herbarium specimens [MO 135693 and fragments on 135723?] whereas he depended upon Schott's notes for stem and fruit. He concluded his description by noting that ". . . the leaves appear so

peculiar that there can scarcely be a doubt about the distinctness of the species to which they belong." Most recent authors have misinterpreted Engelmann's concept of *Y. schottii* and have applied the name to plants with long, wide, flexible, blue-green leaves and pendant, fleshy fruits, native to portions of Arizona, New Mexico and Mexico.

III. Baker (1880) followed Engelmann in applying the name *Yucca schottii* to the plants with short, rigid leaves native to *Arizona australis*.

IV. Engelmann (1881) described *Yucca macrocarpa* from the Santa Rita Mountains [Arizona] and in the protologue described it as having a trunk 1–4 feet tall, leaves spreading, with entire margins, the inflorescences with white, fleshy bracts and with pulpy, yellow fruits 4–6 inches long. He considered it closely related to *Yucca baccata* Torr. On the annotation label on MO 135693 he questions whether his species is not identical with *Yucca puberula* which, citing *Botany of the Boundary*, page 221, he attributes to Torrey.

V. Trelease (1902) published a major work titled, "*The Yuccae*" in which he recognized both *Y. brevifolia* Schott in Torrey, and *Y. schottii* Engelm., separating the two in the key (p. 46) as:

[Leaves] thin, flexible: threads sparing and fine . . . *Y. Schottii*  
[Leaves] thick, rigid, with usually coarse threads.

Leaves narrow, smooth, small tree . . . . . *Y. brevifolia*

"*Yucca Schottii* Engelm. 1873 . . . . Arboresecent, rarely over 3–4 m high, simple or few branched above. Leaves blue-green, smooth, rather rigidly divergent, thin, concave, pungent, 20–40 mm wide, very finely and often sparingly filiferous. Inflorescence densely paniced close to the leaves, very tomentose or rarely nearly glabrous. Flowers subglobose. Fruit oblong, mostly large: seeds 7 × 9 mm . . ."

This is the *first* description of the plant that is generally known today as *Y. schottii* and differs from the circumscription of *Y. schottii*, by Engelmann (see II above).

"*Yucca brevifolia* Schott, in Torrey . . . . Shortly caulescent, scarcely reaching a height of 2 m., mostly cespitose. Leaves green, smooth, rigidly divergent, often falcate, thick, plano-convex, very pungent, .3 to .6 m. long, 6–25 mm. wide, the margins freely filiferous. Inflorescence paniced close to the leaves, glabrous. Flowers apparently rather small, with tapering style. Fruit baccate, large: seeds 9–10 to 12 mm."

Trelease's characterization of *Y. brevifolia* generally covers many of the plants that today are common in the vicinity of Nogales and in the Sierra del Pajarito. The main difference is that many of the plants, rather than having inflorescences close to the leaves, have flowers borne above the leaves on a short to long stalk as shown in Schott's original drawing. In August 1900, and in April 1902, Trelease visited Schott's localities

in Arizona where ". . . the species was found in abundance . . . varying to a surprising extent from the original fragmentary material." He went on to describe plants "with thick, apple green abundantly filiferous leaves, which are frequently falcately curved to one side, [a character often observed in *Y. baccata*] are usually about 0.75 m. in length but vary in this respect, and especially in width, which, commonly about 20 mm, may reach 30 mm, or be reduced to 5–6 mm." (Trelease 1902).

In discussing *Y. brevifolia*, Trelease noted the discrepancies between descriptions and the extant specimens noting in particular the fruit on the Torrey specimen at New York as, "bearing an immature fruit which may have been either erect on an ascending branch, or, as is more likely, pendent from a drooping one." From our observations fleshy, pendent, and non-fleshy upright fruits are both found in the area.

VI. In typifying *Y. schottii*, McKelvey (1938) wrote "The flowers and inflorescence fragments of this sheet (M[O] 135693) are selected as type of *Y. schottii* and with them is associated the Schott field label (d) [our 2] which indicates that 'Yucca Satili (or Y. Datili) was the collector's choice of name, which cites the Sierras west of Santa Cruz [Sonora], and is dated July, 1855.'" On the annotation label she wrote "Yucca schottii Engelm. as to flowers, in part as to sketch, as to label 'Sierras oeste de Sta. Cruz' . . . Type." The choice of associating the flowers and inflorescence fragments with that particular label was capricious. The lower left corner of each of Schott's field labels is attached under his later label and are mounted side by side near the bottom of the sheet and cannot with certainty be associated with any element on the sheet itself.

McKelvey (1938) then typified her previously published (McKelvey 1935), but untypified *Yucca arizonica* by choosing ". . . this leaf-blade [on MO 135693] is selected as type of *Y. arizonica* and with it is associated the Schott field label (c) [our 1]. On the sheet she wrote "Yucca arizonica McKelvey as to leaf, in part as to sketch, as to label 'Valle de Tubac' . . . Type." Again choice of associating a portion of a single leaf with a particular label was capricious. On the annotation label of both *Y. schottii* and *Y. arizonica* she cites Schott's sketch without indicating to what portion of the sketch she was referring. Of the sketch she writes, "Any determination of this sketch must be purely hypothetical. . . it is obviously an aggregate . . . and seems to indicate Schott's attempt to make his findings conform to Torrey's concept. There is also reason to suppose that the sketch was not made in the Santa Cruz river valley for the plant is, almost laughably like two shown in an engraving (no. 42) in the Michler (1859) report [by Schott]. The sketch, for all these reasons, does not seem of any importance." Schott was an accomplished and recognized artist and

McKelvey's criticism of his sketches is without merit. Schott's depiction of his "*Yucca brevifolia*" accurately portrays plants commonly found today in the vicinity of Nogales and the Sierra del Pajarito (pers. observation).

We reject McKelvey's typification of *Yucca schottii* for the following reasons. (1) There is no substantiated evidence that MO 135693 consists of more than a single gathering, nevertheless McKelvey designates the types of two species (*Y. schottii* Engelm. and *Y. arizonica* McKelvey) from elements on the sheet (a portion of a single leaf, three flowers and two fragments of an inflorescence). McKelvey's decision to consider the elements on the sheet as representing two collections might not have arisen had the sheet had only a single Schott field label instead of two. (2) Even if it is a composite collection there is no way to determine that a particular label can be correctly assigned to any element on the sheet. (3) Schott's later label, "*Yucca brevifolia*, mihi, n. sp." would seem to indicate that he considered the elements on the sheet as representing a single collection. (4) The localities cited on the three Schott labels are discordant: "Valle de Tubac [Arizona]", "Sierra oeste Sta. Cruz [Sonora]" and "At the Potrero on the headwaters of the Santa Cruz river", as are the dates, "VI, VII", and "1855." The imprecision as regards dates, and perhaps even localities, suggests that the material may have been gathered by a soldier assigned to collect plants for Schott who failed to keep accurate records (see below).

Although the Schott label which McKelvey associates with *Y. schottii* reads "Sierra oeste St. Cruz" [Sonora], McKelvey, without explanation, places the type locality as an area between boundary markers 128 and 129. Those markers are located near the west end of the Sierra del Pajarito in very steep and rugged terrain. Marker 128 at 5453 feet was the highest point along the boundary in the Pajarito Mountains (Humphrey 1987). This is an area that from the narrative of the survey we know proved difficult for the surveying party (Michler 1859), and would appear not to have been an area conducive for Schott or his soldier assistant, to collect plants. In 1984 in commenting on the vegetation surrounding monument 128 Humphrey noted the presence of banana yucca (*Y. baccata*) and a plant shown in a photograph near the marker could well be that species.

The area in the vicinity of Nogales and the Sierra del Pajarito is part of a wide zone of interspecific hybridization between three species, *Y. elata* Engelm. with dry, upright dehiscent fruits, *Yucca baccata* Torr., and what has been known as *Yucca schottii* Engelm., both with pendant fleshy fruits (Lenz and Hanson in prep.). It is our opinion that all of Schott's limited and fragmentary *Yucca* material represents plants of hybrid origin, and his collections may readily be duplicated

today in the vicinity of Nogales and the Sierra del Pajarito (Lenz and Hanson 9728, 9750, 9850, RSA). For that reason we have accepted Engelmann's 1873 concept of *Yucca schottii* as the earliest applicable name and are applying it as *Yucca* ×*schottii* Engelm., a collective term, which includes all hybrids between *Y. baccata*, *Y. elata*, and the long, wide, flexible, blue-leaved plants generally known as *Yucca schottii*. We are selecting Schott's unnumbered specimen in the Torrey herbarium (NY) as the lectotype of *Y. schottii*. Our selection is supported by the fact that the specimen was cited by Torrey in the *Bot. Mex. Boundary*, p. 221, (1859). It is the only Schott specimen with precise information concerning date of collection and locality, and it is possible that it is the only *Yucca* material collected by Schott.

***Yucca* ×*schottii* Engelm. pro. sp., stat. nov.—TYPE.**

USA. Arizona, [Santa Cruz Co.] near the monument. 28 July 1855. A. Schott. s.n. (LECTOTYPE: here designated by L. W. Lenz. NY.)

*Yucca schottii* Engelm. *Trans. St. Louis Acad. Sci.* 3: 46. 1873.

*Yucca macrocarpa* Engelm. *Bot. Gaz.* 6: 224. 1881. TYPE: Arizona. In the canon at our camp, Santa Rita Mts., 26 Sep 1880, Engelmann s.n., [holotype MO! (135727)].

Not *Y. macrocarpa* (Torr.) Coville, 1893, *Contr. U.S. Nat. Herb.* 4: 202.

*Yucca brevifolia* Schott ex Torrey. In Emory, *Rep. U.S. & Mex. Bound. Surv.* 2, 221, 1859 pro. syn. nom. ambig. *Yucca brevifolia* Schott ex Trel., *Rep. Mo. Bot. Gard.* 13: 100. Pls. 57–59, 1902. Not *Y. brevifolia* Engelm. *Bot. King Exp.* 496. 1871. *Yucca treleasii* Macbr., *Contr. Gray Herb.* n. ser. 56: 15. 1918. A substitute name for *Y. brevifolia* Schott ex Engelm., not *Y. xtreleasii* Sprenger In Cat. 1901, fide G. Molon, *Le Yucche*. 1914: 192. *Y. baccata* var. *brevifolia* (Schott ex Trel.) L. D. Benson and R. A. Darrow, *Amer. J. Bot.* 30: 234.

*Yucca arizonica* McKelvey. *J. Arnold Arbor.* 16: 270. 1935. TYPE: USA. Arizona. Santa Cruz Co., Valle de Tubac, June, July 1855, A. Schott s. n. [lectotype, MO! (135693)—in part], designated by McKelvey, *Yuccas SW United States*, part 1, 54. 1938.

*Yucca thornberi* McKelvey. *J. Arnold Arbor.* 16: 268. 1935. TYPE: USA. Arizona, Pima Co., foothills of Rincon Mts., slightly north of Rincon Creek, 23 Mar 1930, McKelvey 1627, (holotype, A).

This leaves the familiar long, flexible, blue-green leafed, fleshy-fruited yucca common at mid and upper elevations in the mountains of southern Arizona without a name.

Gentry (1972) described a *Yucca* from the southern Chihuahua/Sonora border growing in pine-oak forest at 4500–5000 ft elevation (1372–1524 m) as *Y. madrensis*. He designated as the HOLOTYPE Gentry 21209, 9 Sep 1965 (US 2557499, ISOTYPE MEXU), a specimen consisting of a leaf and a portion of a dried inflorescence. He also cited a second specimen collected at the same locality on 23 July 1936 (Gentry 2304), originally identified as *Y. rigida* (Engelm.) Trel. (Gentry 1942) from which description of the flowers was made. According to Gentry the new species resembled *Y. schottii* [sensu Trel.] in the small flowers and flex-

ible leaves 50–100 cm long and 2–3.5 cm wide, but, lacking fruits, he was unable to determine the section of the genus to which it belonged. However on the basis of serrulate leaf margins he favored placing it in section *Chaenocarpa* Engelm. His garden-grown specimens, however, had leaves that were serrulate only along the upper margins of the leaves and he later concluded (Gentry 1972) that the plants might indicate an infusion of genes from *Y. schottii*. Gentry noted however that in possessing an inflorescence similar to that of *Y. schottii*, and with thin flexible leaves, it appeared to him that plants from the Sierra Charuco formed an alliance with *Y. schottii* to the north and *Y. jaliscensis* to the south. We concur and add a third species, the recently described *Y. capensis* L. W. Lenz (Lenz 1998). McVaugh (1989) identified plants growing in Parque Nacional 'Cascada de Basaseachi', Chihuahua, on the western slopes of the Sierra Madre Occidental as *Y. schottii* Engelm. whereas Laferrière (1990) identified plants growing at Nobogame, Chihuahua (28.30 N, 108.30 W), ~60 km from the type locality, as *Y. madrensis* Gentry. Martin et al. (1998) in considering the tropical deciduous forest of northwestern México recognizes *Y. madrensis* as occurring in the Sierra Charuco in both Sonora and Chihuahua, and at Cascada de Basaseachi, Chihuahua. In the Sierra Charuco in Sonora these same authors recognize a "*Yucca* sp." and at Cascada de Basaseachi they list "*Yucca* cf. *Schottii*." All authors agree that *Y. madrensis* and *Y. schottii* are found in the Madrean pine-oak forest at elevations of 4500–5000 ft (1372–1524 m). After studying plants in the experimental garden grown from seed collected in Arizona and Chihuahua it is our opinion that *Y. schottii*, sensu Trelease (non-Engelm.), and *Y. madrensis* Gentry are conspecific and should be recognized as *Y. madrensis* Gentry.

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