



Chusquea nedjaquithii (Poaceae: Bambusoideae, Bambuseae, Chusqueinae), a new endemic species from Oaxaca, Mexico

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Abstract

Chusquea is the most diverse among woody bamboo genera, with 174 described species. Not surprisingly, *Chusquea* is the most diverse bamboo genus in Mexico, and with the description of *C. nedjaquithii* the number of species will increase to 20, representing almost 45% of the total Mexican woody bamboo diversity. Based on fieldwork in the Mexican state of Oaxaca and revision of herbarium specimens we describe and illustrate *C. nedjaquithii*, a species endemic to the Sierra Madre del Sur in Oaxaca, Mexico. *Chusquea nedjaquithii* is similar to *C. liebmannii* but differs in having culms with deciduous hairs, an oblate central bud and fewer subsidiary buds, strongly geniculate branches in one row forming an incomplete verticil, oblique foliage leaf blade bases, and longer inner ligules in the foliage leaves. A key to the Mexican *Chusquea* species based on vegetative characters is provided.

Keywords: endemic, Neotropical cloud forest, Sierra Madre del Sur, woody bamboo

Resumen

El género *Chusquea* es el más diverso entre los géneros de bambúes leñosos. En México no es la excepción, con la descripción de *C. nedjaquithii*, se incrementa el número de especies a 20, representando casi el 45% de la diversidad total de bambúes leñosos en México. Basados en trabajo de campo en el estado de Oaxaca y revisión de especímenes de herbarios, describimos e ilustramos *C. nedjaquithii* endémica de la Sierra Madre del Sur en Oaxaca, México. *Chusquea nedjaquithii* es similar a *C. liebmannii*, pero difiere en tener culmos con pelos hirsutos y deciduos, yema central oblada y menos yemas subsidiarias, ramas fuertemente geniculadas formando un verticilo incompleto en una única fila, hojas del follaje con bases oblicuas y lígula interna más larga. Se presenta una clave de las especies Mexicanas de *Chusquea* basada en caracteres morfológicos vegetativos.

Palabras clave: especie endémica, Bosques nublados Neotropicales, Sierra Madre del Sur, bambúes leñosos

Introduction

Chusquea Kunth (1822: 151) is the most diverse woody bamboo genus, with 174 described species (Fisher *et al.* 2009, 2014; Bamboo Phylogeny Group 2012; Costa Mota *et al.* 2014a,b; Guerreiro & Rúgulo de Agrasar 2014). *Chusquea* species are found in a wide range of habitats, from Andean montane forests, páramos, subpáramos, campos de altitude, Atlantic forests, Southern beech forests to Neotropical cloud forests, tropical dry forests, pine-oak and fir-pine forests in South America, Mexico, Central America and the West Indies (Clark 1989; Judziewicz *et al.* 1999; Fisher *et al.* 2009; Ruiz-Sanchez & Clark 2013; Ruiz-Sanchez *et al.* 2014). Species of *Chusquea* range from sea level to 4,300 m in elevation, giving this genus the broadest altitudinal range of any bamboo. *Chusquea* species tend to form a visible and sometimes dominant component of the vegetation (Clark 1989; Judziewicz *et al.* 1999; Fisher *et al.* 2009).

Recent molecular phylogenetic studies indicate that *Chusquea* is a monophyletic lineage, recognized as the

Neotropical woody bamboo subtribe Chusqueinae, which is sister to the clade formed by the subtribes Arthrostylidiinae and Guaduinae (Clark *et al.* 2007; Fisher *et al.* 2009; Ruiz-Sanchez *et al.* 2011a; Kelchner & BPG 2013). Taxonomically *Chusquea* is divided into five subgenera: *Chusquea* subg. *Chusquea*, *Chusquea* subg. *Swallenochloa* (McClure) Clark (1997: 42), *Chusquea* subg. *Rettbergia* (Raddi) Clark (1997: 41), *Chusquea* subg. *Platonina* Nees (1835: 486) and *Chusquea* subg. *Magnifoliae* Clark & Fisher (2014: 841), the latter two representing the two clades of the formerly recognized genus *Neurolepis* (Fisher *et al.* 2009; Fisher *et al.* 2014).

Mexico is home to 46 species of woody bamboos. Two genera (*Chusquea* with 19 species and *Otatea* (McClure & E.W. Sm) Calderón & Soderstrom (1980: 21) with eight species) account for more than 62% of the diversity (Ruiz-Sanchez 2012, 2013; Ruiz-Sanchez *et al.* 2011b, 2014; Ruiz-Sanchez & Clark 2013; Londoño & Ruiz-Sanchez, 2014). Of the 19 Mexican *Chusquea* species, 15 grow in Neotropical cloud forest and 10 are endemic to Mexico. With our description of the new endemic species the number of Mexican *Chusquea* species will increase to 20, with 11 of these endemic to Mexico.

Following fieldwork in the summer of 2013 in the Sierra Madre del Sur in the Mexican state of Oaxaca and a review of herbarium specimens we noted one entity that did not match any known Mexican *Chusquea* species morphologically, although it shared similarities with *C. liebmannii* Fournier (1886: 587). We conducted a morphological analysis comparing our collected specimens with the species cited above and concluded that it represented an undescribed species, which we here describe as *C. nedjaquithii*. *Chusquea nedjaquithii* is classified in *Chusquea* subg. *Chusquea* sect. *Verticillatae* Clark (1989: 74) because it has 13 to 17 subsidiary smaller buds in two patches (one subtending the central bud) arranged in an incomplete verticil. A morphological key to the Mexican *Chusquea* species based on vegetative characters is presented.

Key to the species of *Chusquea* present in Mexico based on vegetative characters

1. Internodes hollow2
1. Internodes solid, sometimes becoming fistulose with age3
2. Internodes thin-walled; subsidiary buds/branches at mid-culm nodes numerous, verticillate, subequal; foliage leaf blades abaxially glabrous *C. perotensis* Clark, Cortés & Cházaro (1997: 225)
2. Internodes thick-walled; subsidiary buds/branches at mid-culm nodes 5–16, constellate, of two sizes; foliage leaf blades abaxially ciliate at the blade base *C. matlatzinca* Ruiz-Sanchez & Clark (2013: 3)
3. Subsidiary buds/branches at mid-culm nodes numerous, verticillate or nearly so4
3. Subsidiary buds/branches at mid-culm nodes few to numerous, constellate or linear but never encircling the node8
4. Central bud circular or oblate; apex of culm leaf sheath short and more or less broad5
4. Central bud triangular; apex of culm leaf sheath narrow and elongate6
5. Central bud circular, subsidiary buds arranged in a complete verticil in two or three rows of buds, more than 100 subsidiary branches per node; foliage leaf inner ligule 0.5–1 mm long *C. liebmannii*
5. Central bud oblate, subsidiary buds not forming a complete verticil, in a single row of buds, with 13 to 17 subsidiary branches per node in two patches; foliage leaf inner ligule 5–10 mm long *C. nedjaquithii*
6. Culms 3–5 cm in basal diameter, 10–20 m tall, erect to scandent at the tips; root thorns encircling the lower and middle nodes of culm and major branches, some root thorns usually present on upper nodes of culms and major branches *C. pittieri* Hackel (1903: 153)
6. Culms to 2.5 cm in basal diameter, to 15 m tall, arching and clambering, not erect; root thorns usually absent, rarely a few present at mid-culm nodes7
7. Subsidiary branches 60–100 or more per node, 0.3–0.5 mm in diameter, exerted more or less horizontally; foliage leaf blades 0.3–1.2 cm wide, L:W = 5.8–10, the base attenuate, the apex apiculate *C. coronalis* Soderstrom & Calderón (1978: 158)
7. Subsidiary branches 20–50 per node, 0.6–0.9(–1) mm in diameter, exerted more or less vertically; foliage leaf blades 0.3–0.7 cm wide, L:W = 8–16.5(–23), the base attenuate to rounded-attenuate, the apex apiculate to subulate *C. circinata* Soderstrom & Calderón (1978: 156)
8. Subsidiary branches 2–6 per node9
8. Subsidiary branches (5–)10–100 per node11
9. Branching infravaginal, never extravaginal or intravaginal; plants scrambling and hanging from vegetation *C. glauca* Clark (1989: 95)
9. Branching extravaginal or both extravaginal and intravaginal, never infravaginal; plants erect to arching and clambering10

10. Foliage leaf blades 10–11.7 cm long, 0.8–1.2 cm wide; culms 0.05–0.15 cm in diameter, 0.2–1 m tall; endemic to Volcan Acatlán, Veracruz, Mexico *C. enigmatica* Ruiz-Sanchez, Mejía-Saulés & Clark (2014: 20)
10. Foliage leaf blades 12.5–24.5 cm long, 2.1–4 cm wide; culms 1–2 cm in diameter, 2–8 m tall; Chiapas, Mexico to Honduras *C. lanceolata* Hitchcock ex Morton (1935: 145)
11. Branching intravaginal; subsidiary buds both flanking and subtending the central bud, forming a line extending up to half the circumference of the node; foliage leaf blades abaxially tessellate *C. bilimekii* Fournier (1886: 132)
11. Branching infravaginal or extravaginal; subsidiary buds strictly constellate, subtending or curving around the central bud; foliage leaf blades abaxially usually not tessellate 12
12. Branching extravaginal, culm leaves often deciduous as branches develop; foliage leaf blades usually with an abaxial tuft of hairs at the base (sometimes lacking in *C. sulcata*) 13
12. Branching infravaginal; culm leaves usually persistent; foliage leaf blades abaxially glabrous, pilose or with scattered hairs but lacking a defined tuft of hairs at the base 16
13. Central bud circular; internodes 27–50 cm long *C. galeottiana* Munro (1868: 59)
13. Central bud triangular; internodes 10–22 cm long 14
14. Foliage leaf blades 0.7–1.5 cm wide, L:W = 5–8.5; culms climbing and hanging; tropical or montane forest *C. simpliciflora* Munro (1868: 54)
14. Foliage leaf blades 0.3–0.9 cm wide, L:W = 8–30; culms erect and arching only at the apices to arching; montane or pine-oak forests 15
15. Culm leaf sheaths narrowed and elongate toward the apex, bottle-shaped; foliage leaf blade L:W = 8–16.5(–23); culms arching; supranodal ridge a line, not prominent; sometimes a patch of subsidiary buds or branches present on the opposite side of the node from the main bud/branch complement *C. circinata*
15. Culm leaf sheaths more or less triangular with rounded shoulders; foliage leaf blade L:W = (15–)17–30; culms erect, arching at the apices; supranodal ridge prominent; buds/branches strictly constellate *C. sulcata* Swallen (1940: 209)
16. Culms erect, sometimes arching toward the apex; foliage leaf blades yellowish-green, abaxially strongly tessellate *C. aperta* Clark (1987: 74)
16. Culms arching and scandent or trailing and clambering; foliage leaf blades green, abaxially not tessellate 17
17. Subsidiary branches 80–100 per node; culms 2–6 cm in basal diameter, erect at the base and then arching to scandent; foliage leaf blades L:W = 16–33 *C. longifolia* Swallen (1940: 30)
17. Subsidiary branches 5–30 per node; culms 0.2–1 cm in basal diameter; arching to scandent or trailing and clambering; foliage leaf blades L:W = 6–20 18
18. Foliage leaf blades abaxially glabrous 19
18. Foliage leaf blades abaxially pilose (completely or only toward the base) 20
19. Central bud circular; subsidiary branches 6–14 per node, usually rebranching; foliage leaf blades narrowly ovate *C. muelleri* Munro (1868: 65)
19. Central bud triangular; subsidiary branches 10–25 per node, usually not rebranching; foliage leaf blades linear lanceolate *C. repens* Clark & Londoño (1991: 327)
20. Subsidiary branches 5–10 per node; foliage leaf blades 1.1–1.8 cm wide *C. cortesii* Ruiz-Sanchez & Clark (2013: 7)
20. Subsidiary branches 10–30 per node; foliage leaf blades 0.3–1.1 cm wide 21
21. Culms 0.2–0.3 cm in basal diameter, trailing and clambering; Chiapas and Oaxaca *C. repens*
21. Culms 0.5–1 cm in basal diameter, arching and scandent; Guerrero, Michoacan, Chiapas *C. nelsonii* Lamson-Scribner & Smith (1897: 16)

***Chusquea nedjaquithii* Ruiz-Sanchez, Mejía-Saulés, & L. G. Clark *sp. nov.*, Figs. 1–2.**

TYPE:—MEXICO. Oaxaca: Candelaria Loxicha, Portillo del Rayo, Finca El Encanto, 15°58'41"N, 96°31'43"W, 1600 m, 1 June 2013, E. Ruiz-Sanchez & L. Cervantes 445 (holotype: XAL!; isotypes: IEB!, ISC, MEXU!).

Chusquea nedjaquithii is similar to *C. liebmanni* but differs in having culms with deciduous hairs, an oblate central bud, fewer subsidiary branches (13–17) but these larger in diameter, strongly geniculate subsidiary buds and branches in one row in an incomplete verticil, oblique foliage leaf blade bases, and longer (5–10 mm) inner ligules of the foliage leaves.

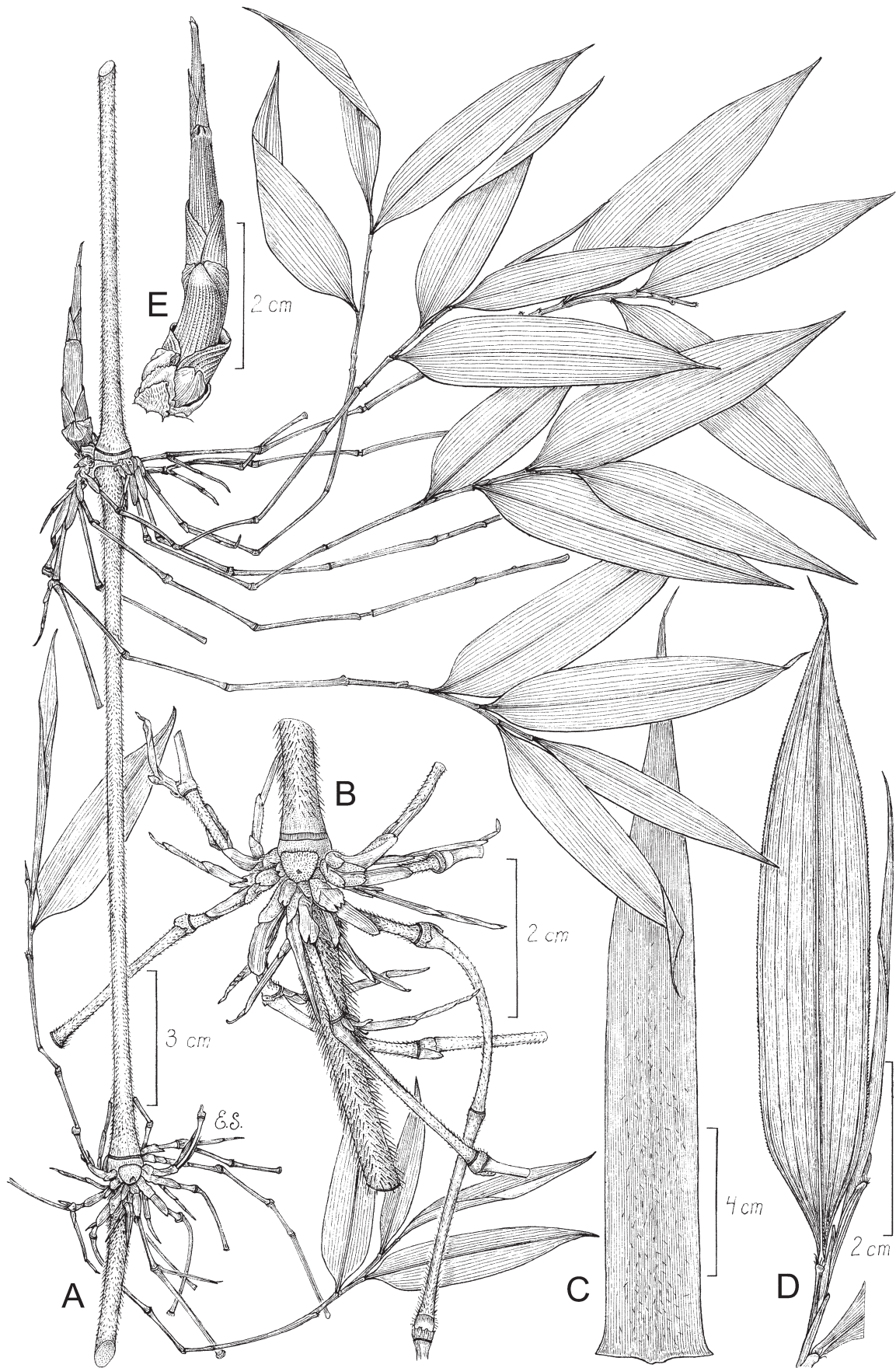


FIGURE 1. *Chusquea nedjaquithii*. A. Mid-culm section, showing branching development, hirsute indument and foliage leaf complements. B. Nodal region, showing oblate central bud, subsidiary branches and hirsute culm. C. Complete culm leaf. D. Foliage leaf blade, showing inner ligule and serrulate margin. E. Detail of central branch development. Based on E. Ruiz-Sanchez & L. Cervantes 445. Drawn by Edmundo Saavedra.

Rhizomes pachymorph. Culms 4–15 m tall, 1.5–4 cm in basal diameter, arching, sometimes clambering. Internodes 14.5–22 cm long, 22–50 per culm, terete, with hirsute deciduous hairs, strigose and red wine in color when young, becoming glabrous and green when old. Culm leaves 21–23.9 cm long, abaxially slightly scabrid, deciduous, triangular, the margins entire and glabrous on both sides, juncture of the sheath and blade obscure, apparently forming a continuous sheath, apex apiculate; girdle not developed. Nodes at mid culm with ca. 8–11 buds, consisting of one larger oblate central bud subtended by 8–10 smaller, closely adjacent circular buds arranged in a single row, and a patch of 5–7 subsidiary buds in a single row on the opposite side of the culm from the central bud, all the buds arising just above the nodal line, nodal line dipping markedly below the central bud, supranodal ridge present and prominent, lower nodes lacking subsidiary buds but encircled by root thorns. Branching intravaginal, the sheaths becoming deciduous when branches develop, 8–10 branches subtending the central bud and a patch of 5–7 branches on the opposite side of the culm per node, all branches strongly geniculate, growing down and later turning upward, 1–1.5 mm in diameter, 8.5–26 cm long, branch internodes hirsute, the larger main branch half of the diameter of the main culm. Foliage leaves (5)8–11(12) per complement; sheaths glabrous, margins ciliate; leaf blades 6.5–9 cm long, 1.3–2.2 cm wide, L:W = 3.6–5, adaxially and abaxially glabrous, not tessellate, the base oblique, the apex acuminate, the margins serrulate; pseudopetioles 2–3 mm long, adaxially and abaxially glabrous, or abaxially with a tuft of hairs that may extend along of the midrib into the base of the blade; inner ligules 5–10 mm long, acute; outer ligules to 0.5 mm long, ciliate. Synflorescences not seen.

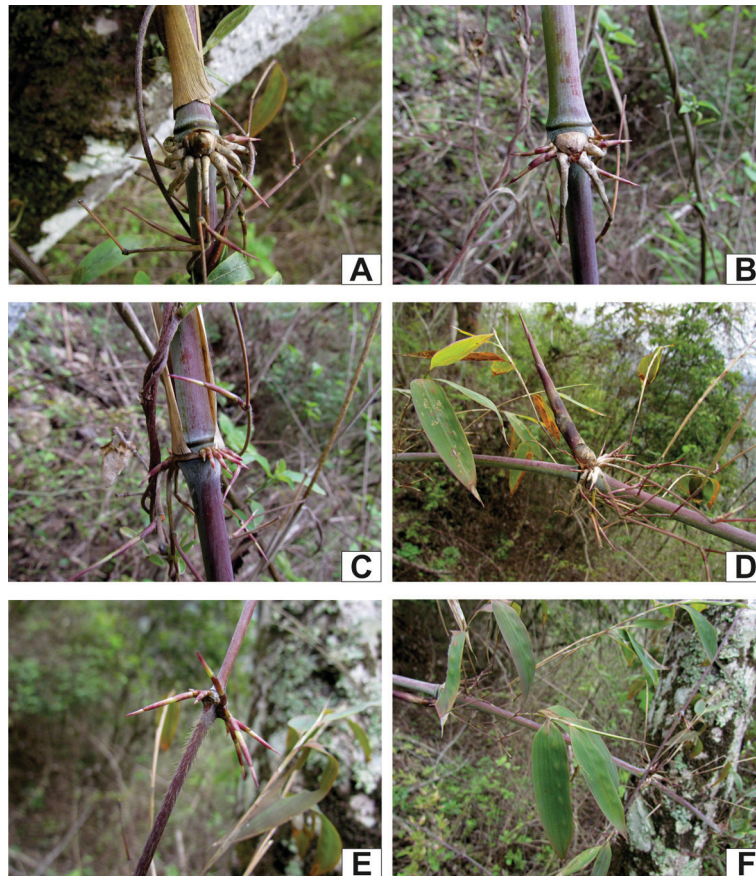


FIGURE 2. *Chusquea nedjaquithii*. A. Nodal region, showing oblate central bud, subsidiary branches and intravaginal branch pattern. B. Nodal region, showing subsidiary branches in development. C. Lateral view of the nodal region, showing incompletely verticillate subsidiary branches in development and part of the culm leaf. D. Central branch in development. E. Apical culm region, showing hirsute indument and branches in development. F. Foliage leaf complements. Photos by E. Ruiz-Sanchez.

Habitat and distribution:—This species is only known from one population in the Sierra Madre del Sur in the state of Oaxaca. *Chusquea nedjaquithii* inhabits Neotropical cloud forest in the ecotone with tropical dry forest. This species grows sympatrically with undescribed *Chusquea* species. In the same locality, Brailovsky (1987) described a new tribe, genus and species of a hemipteran insect, *Barreratalpa* Brailovsky (1987: 157). This insect was discovered feeding on cultivated Asiatic bamboos, but is also known to associate with *Chusquea*, so it likely occurs on *C. nedjaquithii*.

Comparison:—Morphologically *Chusquea nedjaquithii* is most similar to *C. liebmannii*. The differences between *C. nedjaquithii* and *C. liebmannii* are the following: main culms with deciduous hairs, becoming strigose, central bud oblate, subsidiary branches 13–17 arranged in a single row in two patches (forming an incomplete verticil) and strongly geniculate, foliage leaf blades oblique at the base and with an inner ligule 5–10 mm long in *C. nedjaquithii*, vs. culms glabrous, central bud circular, subsidiary branches > 100 in 2 to 3 rows forming a complete verticil and not geniculate, foliage leaf blades attenuate at the base and with an inner ligule 0.5–1 mm long in *C. liebmannii*.

Etymology:—This species honors Mr. Ned Jaquith (1939–2013), a long-time bamboo grower and nurseryman who gave unstintingly of his knowledge and enthusiasm for bamboo species. We recognize Ned’s extensive contributions to the bamboo community by dedicating this species to his memory.

Phenology:—Flowers of this species have never been collected. However, E. Ruiz-Sanchez observed some dead individuals in the population that could have flowered and died one or two years prior to the type collection.

Additional specimen examined:—MEXICO. Oaxaca: Candelaria Loxicha, Portillo del Rayo, Finca El Encanto, 15°58’41”N, 96°31’43”W, 1600 m, 22 Nov. 2012, L. Cervantes 08BA (XAL).

Discussion

With the description of *C. nedjaquithii* the number of native Mexican bamboos will increase to 47 described species representing all three Neotropical woody bamboo subtribes (Arthrostylidinae, Chusqueinae and Guaduinae). Of those 47 Mexican bamboo species, almost half (20) belong to *Chusquea* (Ruiz-Sanchez & Clark 2013; Ruiz-Sanchez *et al.* 2014). Guaduinae are represented by three genera, *Guadua* Kunth (1822: 150), *Olmea* Soderstr. (1982: 161) and *Otatea*, and 20 described species (Ruiz-Sanchez *et al.* 2011a, b; Ruiz-Sanchez 2012, 2013; Londoño and Ruiz-Sanchez 2014) and the rest (seven) species are Arthrostylidinae (Cortés Rodríguez 2000). According to the most recent taxonomic classification of the Bambusoideae (Bamboo Phylogeny Group 2012) the Neotropical woody bamboos comprise 405 described species, of which the Mexican bamboo species account for 12%.

The Mexican *Chusquea* species inhabit mainly tropical dry forests, pine-oak and pine-fir forests and Neotropical cloud forest. The latter represents the main habitat for *Chusquea* in Mexico as 17 of the 20 species inhabit this type of forest (Ruiz-Sanchez *et al.*, 2014).

Sosa *et al.* (2013) published a study using two chloroplast genes (*matK* and *rbcL*) and one spacer (*psbI-psbK*) sequenced from 36 native Mexican bamboo species, to test if those markers could be used to discriminate (barcode) bamboo species. Only *matK* in combination with *psbI-psbK* could distinguish between taxa and only at the generic level. We therefore encourage the use of morphology to identify woody bamboos at the species level.

Chusquea nedjaquithii is known from a single locality in the Sierra Madre del Sur in the state of Oaxaca. We therefore propose the inclusion of this species in the IUCN red list under the “endangered” category of protection.

Acknowledgements

We would like to thank the Academia Mexicana de Ciencias, Programa de Visitas de Profesores Distinguidos, AMC-FUMEC, 2013-2014, for the fellowship to L. G. Clark. We are particularly grateful to Edmundo Saavedra for his excellent illustrations and Damián Piña for his help in scanning the illustrations, and to Luis Cervantes for help with fieldwork. We acknowledge funding from CONABIO (HB004 “Barcode de bambúes nativos de México”). Curators of the following herbaria provided access to their collections: ISC, MEXU, and XAL. The Ned Jaquith Foundation, North Plains, Oregon, U.S.A. and friends of Mr. Jaquith contributed to the American Bamboo Society/Bamboos of the Americas to facilitate the dedication of this species to Mr. Jaquith.

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