

Chusquea sect. Swallenochloa (Poaceae: Bambusoideae) and allies in Brazil

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Clark, Lynn G. (Department of Botany, Iowa State University, Ames, IA 50011, U.S.A.). *Chusquea* sect. *Swallenochloa* (Poaceae: Bambusoideae) and allies in Brazil. *Brittonia* 44: 387–422. 1992.—The 13 high altitude/latitude, dwarf species of *Chusquea* in Brazil are described, illustrated, and mapped, and their morphology, habitats, distributions, and taxonomic affinities are discussed. Two keys to species are provided, one based solely on vegetative characters, and the other on vegetative and flowering characters. *Chusquea erecta*, *C. nutans*, *C. riosaltensis*, *C. windischii*, *C. caparaensis*, and *C. nudiramea* are described as new, and *C. microphylla* is elevated to specific status. Two subspecies are recognized within the variable *C. mimosa*: *C. mimosa* subsp. *australis* and subsp. *mimosa*. Seven species are formally classified within *Chusquea* sect. *Swallenochloa*; the remaining six species are classified into two informal categories, the *Nudiramea* and *Heterophylla* groups. A list of all the species currently included within *Chusquea* sect. *Swallenochloa* is provided.

Key words: *Chusquea*, bamboo, taxonomy, Brazil, grasslands.

Species of *Chusquea* sect. *Swallenochloa* (McClure) L. G. Clark are common, sometimes dominant elements of the *páramos* of the northern Andes and Central America. These dwarf bamboos also occur in similar habitats, known as *campos de altitude*, in the mountains of eastern Brazil. Clark (1989) recognized two species of sect. *Swallenochloa* in Brazil, but subsequent fieldwork and herbarium study have revealed the existence of five additional species of this section. Six other species with morphological and ecological similarities to *Chusquea* sect. *Swallenochloa* also were found in Brazil. The most recent taxonomic treatment for *Chusquea* Kunth in Brazil is that of the Flora Ilustrada Catarinense (McClure & Smith, 1967), but only two of the species in this paper were included there, and changes are proposed for both of those species. The last comprehensive treatment of *Chusquea* in Brazil is that of Doell (1880), in which the known high altitude species, except for *C. sclerophylla* Doell, were all lumped under *C. pinifolia* (Nees) Nees. Although this paper is predicated partly on similarity of hab-

itat among the 13 species, the formal and informal groups used are inclusive for Brazil. My intent is to describe the new species of dwarf bamboos of *Chusquea* and to clarify the taxonomic confusion surrounding all of the high altitude/latitude chusqueoid bamboos in Brazil.

In this paper, the 13 high altitude/latitude, Brazilian species of *Chusquea* are described, illustrated, and mapped, and their morphology, habitats, distributions, and taxonomic affinities are discussed. Seven species are formally classified within *Chusquea* sect. *Swallenochloa*; the remaining six species are classified into two informal categories, the *Nudiramea* and *Heterophylla* groups. Six of the 13 are described as new, and two subspecies within *C. mimosa* McClure & Smith are described. A current list of all the species included within *Chusquea* sect. *Swallenochloa* is provided.

Morphology

Habit.—With the exception of *C. sclerophylla*, for which no data are available, the

remaining six species of sect. *Swallenochloa* and the *Heterophylla* group have erect, fastigiate culms. Species of the *Nudiramea* group are more or less erect but usually also somewhat arching and not fastigiate.

Internodes. — The culm internodes of species of sect. *Swallenochloa* are usually short and covered with a thin, waxy exudate (Clark, 1989). The Brazilian species of this section conform to this pattern; they exhibit waxy internodes 3 to 14 cm long. The *Heterophylla* group also has waxy internodes that range from 1.5 to 13.5 cm in length. The internodes of the *Nudiramea* group are also waxy, but tend to be longer, ranging in length from 9 to 26 cm. Young culms of *C. juergensii* Hackel and *C. nudiramea* L. G. Clark usually have a glaucous bloom on the internodes that wears off with age.

Buds. — As is characteristic of sect. *Swallenochloa* (Clark, 1989), the bud complement in the Brazilian members of the section comprises one triangular central bud flanked by one to several smaller subsidiary buds in a more or less linear array (Figs. 1A, H, 3C, 9E). The sheath scar is more or less horizontal, and the supranodal ridge is visible, but only in *C. windischii* L. G. Clark is it prominent (Fig. 9E).

The bud complements of the *Nudiramea* and *Heterophylla* groups are markedly different from those typical of sect. *Swallenochloa*. In the *Nudiramea* group, the central bud is triangular, but may be nearly indistinguishable from the larger subsidiary buds as in *C. juergensii* (Fig. 10A) or much larger than even the larger subsidiary buds as in *C. caparaoensis* L. G. Clark, *C. mimosa*, and *C. nudiramea* (Figs. 14B, 15A). The subsidiary buds of this group are dimorphic (*C. caparaoensis*, *C. mimosa*, *C. nudiramea*, Figs. 14B, 15A) or trimorphic (*C. juergensii*, Fig. 10A), in contrast to the usually monomorphic subsidiary buds of sect. *Swallenochloa*. The largest subsidiary buds in *C. juergensii* flank the central bud, and the remaining medium and small subsidiary buds are more or less linearly arranged in four or five tiers below the tier containing the central bud (Fig. 10A). This arrangement is very different from that of the other three species in this group, in which the subsidiary buds

are arranged in one or two strictly constellate rows (Figs. 14B, 15A). The sheath scar in all four species is more or less horizontal, but the supranodal ridge is prominent in only *C. caparaoensis*, *C. mimosa*, and *C. nudiramea*.

In the *Heterophylla* group, the triangular central bud is distinctly larger than any of the subsidiaries (Fig. 16B, G), but the two species differ in the arrangement of the subsidiary buds. In *C. heterophylla*, the subsidiary buds are monomorphic and arranged in one or two strictly constellate rows (Fig. 16B). The subsidiary buds of *C. microphylla* (Doell) L. G. Clark are dimorphic with the two larger subsidiaries flanking the central bud and with the other smaller subsidiaries arranged in five or six tiers subtending the central bud tier (Fig. 16G). In both species, the sheath scar dips below the bud complement, but the supranodal ridge is prominent in *C. heterophylla*, and obscure in *C. microphylla*.

Branching. — The Brazilian species of *Chusquea* sect. *Swallenochloa* exhibit the intravaginal branching characteristic of the section (Clark, 1989; Figs. 1F, 3B, H, 6C, E, 9A). The central branch develops simultaneously or nearly so with the subsidiary branches, and all branches are erect at least initially (Figs. 1G, 3B, H, 5, 9A) and often rebranch. The shorter branches of *C. nutans* L. G. Clark remain erect, but the longer ones, which may reach up to 1 m in length, are lax and nodding (Fig. 4). The branches of *C. windischii*, in particular the central branches, usually curve away from the main culm and then curve upward again (Fig. 9A). The other species of the section have erect or ascending branches.

Branching in the *Nudiramea* group is considered to be modified extravaginal, in which the branches are more or less horizontally exerted, but the culm leaves fall as the branches develop, although the base of the culm leaf sheath is often split by the branches. This type of branching is known elsewhere in the genus only in *Chusquea* sect. *Verticillatae* L. G. Clark (Clark, 1989). The central branch often develops in *C. caparaoensis*, *C. mimosa*, and *C. nudiramea*, and less commonly in *C. juergensii*. In all four

species, the more robust subsidiary branches are well developed and can reach 1 m in length whereas the leafy subsidiary branches are usually much shorter, often reaching no more than 20 cm in length.

Branching in the *Heterophylla* group is strictly extravaginal, and the numerous subsidiary branches break through the base of the culm leaf sheath (Fig. 16C). In both species, the leafy subsidiary branches reach no more than 15 cm in length. The central branch is robust and develops at most mid-culm nodes in *C. heterophylla* Nees (Fig. 16C) whereas the central bud apparently never develops in *C. microphylla* (Fig. 16H).

Foliage leaves. — Foliage leaf blades in sect. *Swallenochloa* are usually stiff, yellowish, and erect to ascending (Clark, 1989). The Brazilian species of sect. *Swallenochloa* exhibit this leaf morphology. Among the Brazilian species, the leaf blades of *C. sclerophylla* and *C. windischii* are more than 0.5 cm wide, whereas those of the remaining five species are usually less than 0.5 cm wide and are very narrow and needle-like in *C. pinifolia* and *C. nutans*. The leaf blades persist for some time, but eventually fall, leaving the persistent leaf sheaths clothing the branch bases. The leaf blades in the *Heterophylla* group are similar to those of sect. *Swallenochloa*; the blades are also narrow (0.1–0.4 cm wide), and the leaf sheaths persist.

The foliage leaf blades in the *Nudiramea* group are usually ascending but not erect, and lax to somewhat stiff, but not rigid. They can be slightly yellowish and narrow or wide. However, the four species of this group possess a leaf feature that appears to be unique within *Chusquea*. The leaf blades eventually fall, as is typical for bamboos, but, in addition, the leaf sheaths are also deciduous, such that the branch bases are naked (Figs. 9H, 10F, 14A, H, 15D). This feature is also reflected in the caducous culm leaves. It may be that only one year's production of foliage leaves remains on a branch at any given time, but this needs to be verified by additional field observations. In both the foliage and culm leaf sheaths, the margins are usually scarious, also an unusual feature within *Chusquea*.

Inflorescences. — Three species in this study, *C. erecta* L. G. Clark, *C. riosaltensis* L. G. Clark, and *C. caparaoensis*, are known only vegetatively. The remaining ten species usually have narrow, paniculate inflorescences 0.5 to 5 cm long. The inflorescence axes are not bracteate. In *C. nutans* of sect. *Swallenochloa*, the inflorescence is 0.5 to 1 cm long, and in some cases the branching is so limited that the inflorescence is actually racemose. The branches and pedicels may be appressed or reflexed to strongly divergent in *C. mimosa*, but this feature is not consistent even between the two subspecies.

Spikelets. — The spikelets of the Brazilian species of sect. *Swallenochloa* are typically chusqueoid (Clark, 1989) and are laterally compressed to terete. Spikelets are known for only five of the seven Brazilian species, so generalization is difficult. However, the glumes are usually small, and the sterile lemmas are well developed and usually subequal. The spikelets of the *Heterophylla* group are very similar, but are more or less terete.

Spikelets are known for three of the four species of the *Nudiramea* group. In *C. jurgensii*, *C. mimosa*, and *C. nudiramea*, the spikelets are usually dorsally compressed, and the glumes are minute and scalelike. The palea is often longer than the fertile lemma. Within *Chusquea*, dorsally compressed spikelets with small glumes are also known in sect. *Verticillatae* (Clark, 1989).

Habitats and Distributions

Vegetation formations known in Brazil as *campos de altitude* or *campos altimontanos* (perhaps best translated as "high altitude grasslands") occur at higher elevations in the mountains of eastern Brazil (Maack, 1972; Martinelli et al., 1989; Fernandes & Bezerra, 1990). These high altitude grasslands often occur in conjunction with granitic outcrops, where high endemism often is found (Mori, 1989; Martinelli et al., 1989). This type of vegetation is dominated by bunchgrasses and sedges, and species of melastomes, orchids, ericads, Eriocaulaceae, Droseraceae, Berberidaceae, and com-

positives are common (Brade, 1956; Maack, 1972; Fernandes & Bezerra, 1990). Dwarf bamboos are a characteristic element (Brade, 1956; Wettstein, 1970; Maack, 1972; Fernandes & Bezerra, 1990). The high altitude grasslands of Brazil are physiognomically and taxonomically similar to the *páramos* of the Andes (Brade, 1956; Smith, 1962; Vuilleumier, 1971), but the climatic conditions, latitude, and topography of eastern Brazil allow grasslands to occur at elevations much lower (1500–2800 m) than those at which *páramos* normally occur in the Andes (Brade, 1956; Fernandes & Bezerra, 1990).

Although other species of *Chusquea* and other genera also occur (van der Hammen & Cleef, 1986; Clark, 1989), the dwarf bamboos of the Brazilian *campos de altitude* and the Andean *páramos* are generally species of *Chusquea* sect. *Swallenochloa*. Cleef (1981) classified the Andean bamboo associations as “bamboo *páramos*.” In Brazil, high altitude grasslands occur on a few, more humid peaks in the Serra do Espinhaço in Minas Gerais, but are primarily distributed as “islands” along the topologically complex Serra do Mar from Espírito Santo south to Santa Catarina (Maack, 1972; Fernandes & Bezerra, 1990; pers. obs.).

One of the most northern of the high altitude grasslands occurs in the Serra do Caparaó (Parque Nacional do Caparaó) on the border of Minas Gerais and Espírito Santo. The highest part of the range reaches 2884 m (Brade, 1942). Two dwarf bamboos, *C. baculifera* Silveira and *C. pinifolia* of sect. *Swallenochloa*, are common and in places dominant in the high altitude grassland, whereas *C. caparaoensis* of the *Nudiramea* group is a relatively uncommon species that occurs in the transition zone between the upper montane forest and the grassland. To the southwest lies the Serra dos Órgãos, where *Chusquea pinifolia* and *C. heterophylla* are commonly found above 2000 m. The original collection locality of *C. sclerophylla* is clearly indicated on one of only two specimens as “haut des Orgues” (*Glaziou 4311*), but this species has not been recollected since the late 1800s.

Somewhat further west, in the Serra da

Mantiqueira, lies the Parque Nacional de Itatiaia, which includes within its boundaries the Pico das Agulhas Negras, at 2787 m the highest part of this range (Brade, 1956). At approximately 2000 m, the grassland formation begins to appear, and clumps of *Chusquea* are common (Brade, 1956). Brade (1956) listed *C. pinifolia* as the only dwarf bamboo, but two additional species also occur on the planalto of Itatiaia. Both species of the *Heterophylla* group, *C. heterophylla* and *C. microphylla*, are common there, and all three species grow in close proximity, but *C. heterophylla* grows at slightly lower elevations and can form large associations in more protected sites, whereas *C. pinifolia* often occupies boggy areas, and *C. microphylla* is more common among rocky outcrops on slightly higher slopes.

An anomalous high altitude grassland formation occurs in a low coastal range of the Serra do Mar in the state of São Paulo. This area is known as the “Campos da Boraceia”; it occupies an altitudinal range of approximately 800 to 1100 m and is dominated by *C. erecta* (sect. *Swallenochloa*). It is not clear whether this grassland formation is natural or due to human disturbance, but because of its occurrence at such a low altitude, it deserves further study. *Chusquea pinifolia* extends into Paraná, where it reaches its southernmost distribution on several high peaks in the coastal range (Maack, 1972); Pico Caratuba (Caratuba) is named for this dwarf bamboo. The southernmost distribution of sect. *Swallenochloa* is marked by the occurrence of *C. windischii* in a high altitude grassland at the top of Morro da Igreja (1750–1800 m) in southern Santa Catarina. At this site, *C. windischii* is common on better drained slopes, while the boggy depressions are occupied by another dwarf bamboo, *Aulonemia ulei* (Hackel) McClure & Smith.

Campo rupestre is a savanna-like vegetation that occurs at higher elevations on shallow, rocky soils primarily in the states of Minas Gerais, Bahia, and Goiás (Joly, 1970; Mori, 1989; Fernandes & Bezerra, 1990), but it is especially associated with the Serra do Espinhaço in Minas Gerais and Bahia (Giulietti & Pirani, 1988). The Vel-

loziaceae, Poaceae, Cyperaceae, Eriocaulaceae, Melastomataceae, Asteraceae, and Euphorbiaceae are well represented in *campo rupestre* vegetation, which exhibits high endemism (Giulietti & Pirani, 1988; Mori, 1989). Gallery forests along rivers and streams frequently penetrate the *campo rupestre* (Giulietti & Pirani, 1988; Fernandes & Bezerra, 1990); two bamboos of sect. *Swallenochloa* are endemic to these forests. On the eastern border of Minas Gerais, isolated *campo rupestre* vegetation in the Serra do Ibitipoca is found (Giulietti & Pirani, 1988); *C. riosaltensis* occurs in gallery and elfin forests in this mountain range, where it is apparently endemic. *Chusquea nutans* also occurs in gallery forests, but is more widespread (Fig. 2); it appears to be endemic to the Espinhaço range.

A large expanse of southern Brazil in the states of Paraná, Santa Catarina, and Rio Grande do Sul is covered by forests of *Araucaria* Juss. interspersed with grasslands (Brade, 1956; Joly, 1970; Mori, 1989; Fernandes & Bezerra, 1990); patches of these *Araucaria* forests extend discontinuously up into the state of São Paulo and the eastern edge of Minas Gerais. Due to the more temperate conditions under which these forests thrive, a particular flora is associated with the *Araucaria* forests (Joly, 1970; Mori, 1989; Fernandes & Bezerra, 1990). At least two species of *Chusquea*, *C. juergensii* and *C. mimosa*, form part of this associated flora. *Chusquea juergensii* occurs almost exclusively along streams and rivers within the *Araucaria* forest zone. To the north, in São Paulo and Minas Gerais, *Araucaria* forest patches occur only at higher elevations (ca. 1500 m), but with increasing latitude (i.e., toward the south), these forests occur at lower elevations. The altitudinal distribution of *C. juergensii* reflects this pattern. Further south, in Rio Grande do Sul and Uruguay, this species is no longer associated with *Araucaria* forests but occurs in isolated populations in gallery forests within the extensive grassland or pampas region (Joly, 1970).

Chusquea mimosa subsp. *mimosa* occurs in moist sites or along rivers and streams at higher elevations in the Atlantic or *Arau-*

caria forests. *Chusquea mimosa* subsp. *australis* L. G. Clark has a more southern distribution but grows in habitats similar to those of subsp. *mimosa*, although subsp. *australis* seems to withstand somewhat drier conditions. *Chusquea nudiramea* occurs in Atlantic forest at a low altitude, which makes it the exception among the species treated here.

Of the 13 species of dwarf bamboos, four (*C. nutans*, *C. pinifolia*, *C. juergensii*, and *C. mimosa*) can reasonably be considered widespread (Figs. 2, 11, 12, 13). The apparently disjunct populations of *C. juergensii* in São Paulo and *C. pinifolia* in Paraná are possibly due to artifacts of collection. *Chusquea heterophylla* is known from three populations with a restricted distribution in the Serra dos Órgãos and the Serra da Mantiqueira (Agulhas Negras) (Fig. 7). The remaining eight species, *C. baculifera*, *C. erecta*, *C. riosaltensis*, *C. sclerophylla*, *C. windischii*, *C. caparaoensis*, *C. nudiramea*, and *C. microphylla*, are currently known from only one population each (Figs. 2, 7, 8) and thus can be considered narrow endemics.

Discussion

Chusquea sect. *Swallenochloa* is characterized by the following combination of features: usually erect culms, relatively short, waxy internodes, usually linearly arranged bud complements, intravaginal branching, and usually stiff, erect or ascending foliage leaf blades (Clark, 1989). Seven Brazilian species, *C. baculifera*, *C. erecta*, *C. nutans*, *C. pinifolia*, *C. riosaltensis*, *C. sclerophylla*, and *C. windischii*, possess this combination of features and thus are classified within sect. *Swallenochloa*. Clark (1989) noted that, with the exception of two species of the montane forest, the members of sect. *Swallenochloa* occur in high montane grassland habitats such as *subpáramo/páramo* vegetation in the Andes and Central America. Two of the Brazilian members of sect. *Swallenochloa* inhabit gallery forests in *campo rupestre* vegetation, but the other five are typical elements of high altitude grasslands, a habitat similar to the Andean *páramos* (see Habi-

tats and Distributions). In the Brazilian highlands, as in the high Andean formations, these bamboos often form thickets and may be the dominant species.

Among the described species of *Chusquea* sect. *Swallenochloa*, there are seven species in Brazil, seven in the Andes, and 10 in Central America. No species are held in common between any of these geographic areas. The Central American species are all wide-leaved, whereas both wide-leaved and narrow-leaved species are present in both the Andes and Brazil (Clark, 1989). *Chusquea baculifera*, *C. riosaltensis*, and *C. erecta* are very similar vegetatively (Table I), and appear to form a closely related species complex within sect. *Swallenochloa* in Brazil. It should be noted that in the vegetative condition, however, it would be difficult to separate the Andean *C. angustifolia* (Söderstrom & C. Calderón) L. G. Clark and *C. depauperata* Pilger from the Brazilian *C. baculifera*. Likewise, although *C. pinifolia* and *C. nutans* are probably sister species based on their needlelike leaves, *C. neurophylla* of Ecuador and Peru also exhibits this feature. As a third example of possible sister taxa between the Andes and the Brazilian highlands, the two wide-leaved species of Brazil, *C. sclerophylla* and *C. windischii*, may be more closely related to the widespread Andean *C. tessellata* Munro, which has wide leaves, than to the other Brazilian species of the section. A rigorous morphological cladistic analysis is desirable, but must await more complete data; three species of sect. *Swallenochloa* are known only vegetatively, and the two available collections of *C. sclerophylla* are vegetatively incomplete.

The *Heterophylla* group has in common with sect. *Swallenochloa* the erect habit, short, waxy internodes, and stiff foliage leaf blades, but is excluded from sect. *Swallenochloa* based on the presence of extravaginal branching and non-linear bud complements. The two species of this group occupy the same high altitude grassland habitat as most members of sect. *Swallenochloa*. The question of whether the similarities between

sect. *Swallenochloa* and the *Heterophylla* group are due to convergence or phylogenetic relationship remains unresolved. However, the *Heterophylla* group should be included in any cladistic analysis of sect. *Swallenochloa*, as it may be more parsimonious to postulate a reversal of the branching pattern than convergence among the other features.

The four species that comprise the *Nudiramea* group approach sect. *Swallenochloa* in their more or less erect habit and relatively short, waxy internodes, but differ in several important respects. The modified extravaginal branching pattern is distinct, as are the consistently dimorphic or trimorphic subsidiary buds in the *Nudiramea* group. In addition, these four species are united by the synapomorphy of deciduous culm and foliage leaf sheaths. Within this group, *C. mimosa*, *C. nudiramea*, and *C. caparaoensis* share very similar bud complements, and a tendency toward narrow foliage leaf blades. It should be noted that *C. culeou* Desv. of Chile and Argentina shows some similarity to sect. *Swallenochloa*, but has a bud complement that is virtually identical to that of *C. juergensii* (A. Pearson, pers. comm.; L. Clark, unpubl.); however, it does not appear to have deciduous culm and foliage leaf sheaths. Until more data is available, the *Nudiramea* group is considered to be allied with *Chusquea* sect. *Swallenochloa*, but its exact status remains unresolved.

Taxonomic Treatment

The morphological and ecological convergence of the 13 species of dwarf bamboos included in this treatment may make their identification problematical, even though these species may not all be closely related to each other (see Discussion). Therefore, I have included these species together in the identification keys, but I have arranged species descriptions according to their formal or informal groupings.

Key to species of *Chusquea* sect. *Swallenochloa* and allies in Brazil
(based on vegetative specimens)

- 1 Foliage leaf sheaths deciduous from the lower nodes of the subsidiary branches.
- 2 Foliage leaf blades 0.18–0.2 cm wide, 3.8–5.3 cm long; 2000–2100 m (Serra do Caparaó) 8. *C. caparaoensis*
- 2 Foliage leaf blades (0.2) 0.4–1.2 cm wide, 3.4–16 cm long; 50–1800 m (São Paulo, Brazil to Uruguay).
- 3 Foliage leaves with the inner ligule 0.2–0.5 (1) mm long, truncate, the sheaths lightly mottled with green; subsidiary buds/branches in several more or less linear rows, subequal 9. *C. juergensii*
- 3 Foliage leaves with the inner ligule (0.5) 1–4 mm long, rounded, the sheaths usually uniform in color, rarely lightly mottled with green; subsidiary buds/branches in 1–2 rows curving around the central bud, constellate, 2–3 more robust subsidiary buds/branches present.
- 4 Smaller subsidiary branches 4–10 per node; culm leaf blades narrow triangular, erect becoming reflexed, caducous, adaxially pubescent at the base, the sheaths 2–3.3 (6.5) times as long as the blades 11. *C. nudiramea*
- 4 Smaller subsidiary branches 15–80 per node; culm leaf blades triangular, erect, usually persistent, adaxially glabrous or retrorsely scabrous at base, the sheaths 1–22.5 times as long as the blades.
- 5 Foliage leaf blades (0.3) 0.5–0.9 (1.2) cm wide, L:W = (4) 7.7–15; smaller subsidiary branches 15–40 per node; culm leaf sheaths 1–5 times as long as the blades 10A. *C. mimosa* subsp. *mimosa*
- 5 Foliage leaf blades (0.2) 0.4–0.7 cm wide, L:W = 10.6–24; smaller subsidiary branches 45–80 per node; culm leaf sheaths (3.5) 12–27.5 times as long as the blades 10B. *C. mimosa* subsp. *australis*
- 1 Foliage leaf sheaths persistent.
- 6 Foliage leaf blades (0.5) 0.8–1.1 cm wide.
- 7 Foliage leaf blades 7.3–10.8 cm long, the sheaths pubescent between the 2–3 marginal nerves, inner ligule about 1 mm long, truncate, pubescent (Serra dos Órgãos, Rio de Janeiro) 6. *C. sclerophylla*
- 7 Foliage leaf blades 3.6–5.9 cm long, the sheaths glabrous, inner ligule 1.5–2 mm long, rounded, glabrous (Morro da Igreja, Santa Catarina) 7. *C. windschii*
- 6 Foliage leaf blades 0.06–0.5 (0.7) cm wide.
- 8 Branching extravaginal; subsidiary branches (12) 20–60 per node, more or less horizontally exserted, in 3–6 rows, constellate.
- 9 Foliage leaf blades 1.3–3.7 cm long, 0.2–0.4 cm wide; subsidiary branches 3–15 cm long, (12) 20–45 per node, the central branch usually developing, robust; nodes with the supranodal ridge prominent; subsidiary buds in 2 rows in a crescent-shaped arrangement; culms 1–2 (3.5) m tall 12. *C. heterophylla*
- 9 Foliage leaf blades 0.8–2 cm long, 0.1–0.2 cm wide; subsidiary branches 1.5–4 cm long, 30–60 per node, the central branch usually not developing; nodes with the supranodal ridge obscure; subsidiary buds in 5 or 6 rows in a triangular arrangement; culms 0.5–1 m tall 13. *C. microphylla*
- 8 Branching intravaginal; subsidiary branches 3–20 (30) per node, erect, in 1 row, linear.
- 10 Foliage leaf blades 0.06–0.25 (0.4) cm wide, L:W = 17–60, the base attenuate.
- 11 Foliage leaf blades 0.06–0.15 cm wide, L:W = (25) 33–60; subsidiary branches (8) 18.5–65 cm long, usually nodding, the shorter branches ascending to slightly arched; culm leaf sheaths fused at the base for 0.3–1.5 cm, the blade usually not distinguishable from the sheath; culms (2) 4–5 m tall (1000–1720 m alt.) 3. *C. nutans*
- 11 Foliage leaf blades 0.07–0.25 (0.4) cm wide, L:W = 17–31 (47); subsidiary branches (4) 8–21 cm long, usually erect, sometimes arching slightly; culm leaf sheaths not fused at the base, the blade distinguishable from the sheath; culms (0.5) 2–3 m tall [(1600) 2100–2500 m alt.] 4. *C. pinifolia*
- 10 Foliage leaf blades 0.3–0.5 (0.7) cm wide, L:W = 6.5–14, the base more or less rounded.
- 12 Foliage leaf sheaths glabrous to softly pubescent toward the apex, the blades 0.35–0.5 (0.7) cm wide, L:W = 6.5–11; culm leaves abaxially glabrous (2000–2800 m alt.) 1. *C. baculifera*
- 12 Foliage leaf sheaths pubescent between the nerves, the blades 0.3–0.45 cm wide, L:W = 10–14; culm leaves abaxially scabrid or pubescent (800–1300 m alt.).
- 13 Subsidiary branches 9–13 per node, 16–23 cm long; foliage leaves 19–24 per complement; culm leaves abaxially pubescent, the blades narrowly triangular (800–900 m alt.) 2. *C. erecta*
- 13 Subsidiary branches 4–6 per node, 10–13 cm long; foliage leaves 8–13 per complement; culm leaves abaxially scabrid, the blades triangular (1300 m alt.) 5. *C. riosaltensis*

Key to species of *Chusquea* sect. *Swallenochloa* and allies in Brazil
(based on flowering specimens)

- 1 Foliage leaf sheaths deciduous from the lower nodes of the subsidiary branches.
- 2 Spikelets 6.9–9.1 mm long.
- 3 Spikelets 1.5–2.3 mm wide, the palea overtopping the fertile lemma; foliage leaf sheaths lightly mottled with green; subsidiary buds/branches in several more or less linear rows, subequal 9. *C. juergensii*
- 3 Spikelets 1.3–1.5 mm wide, the palea and fertile lemma subequal; foliage leaf sheaths uniform in color; subsidiary buds/branches in one row curving around the central bud, constellate, 2 more robust subsidiary buds/branches present 11. *C. nudiramea*
- 2 Spikelets 4.3–7.5 mm long.
- 4 Spikelets 4.3–6.3 (7.5) mm long, 0.9–1.4 mm wide, the palea and fertile lemma subequal; panicles (1.5) 2–4 cm long, narrow to open; foliage leaf blades (0.3) 0.5–0.9 (1.2) cm wide, L:W = (4) 7.7–15; smaller subsidiary branches 15–40 per node 10A. *C. mimosa* subsp. *mimosa*
- 4 Spikelets (5.5) 6–7.5 mm long, 1.1–1.6 mm wide, the palea and fertile lemma subequal or more often the palea overtopping the fertile lemma; panicles 1–3 cm long, narrow or only the lower branches and pedicels reflexed; foliage leaf blades (0.2) 0.4–0.7 cm wide, L:W = 10.6–23.7; smaller subsidiary branches 45–80 per node 10B. *C. mimosa* subsp. *australis*
- 1 Foliage leaf sheaths persistent.
- 5 Panicles 0.5–1.5 cm long.
- 6 Spikelets 5.6–6.6 mm long, sterile and fertile lemmas abaxially pubescent, sterile lemma II ca. $\frac{1}{2}$ the length of the spikelet; branching intravaginal; foliage leaf blades 0.06–0.15 mm wide (1000–1720 m alt.; Serra do Espinhaço, Bahia/Minas Gerais) 3. *C. nutans*
- 6 Spikelets 4.7–5.5 mm long, sterile and fertile lemmas abaxially pubescent only toward the apices, sterile lemma II $\frac{2}{3}$ – $\frac{3}{4}$ the length of the spikelet; branching extravaginal; foliage leaf blades 0.1–0.2 (0.3) cm wide (2300–2600 m alt.; Agulhas Negras, Itatiaia, Minas Gerais/Rio de Janeiro) 13. *C. microphylla*
- 5 Panicles (1) 1.5–5 cm long.
- 7 Spikelets 4.3–4.9 mm long; central branch usually curving horizontally away from the main culm, then curving upwards 7. *C. windischii*
- 7 Spikelets 5–8.7 mm long; central branch erect or ascending, not curved.
- 8 Foliage leaf blades 0.8–1.1 cm wide 6. *C. sclerophylla*
- 8 Foliage leaf blades 0.07–0.5 (0.7) cm wide.
- 9 Spikelets 6.2–8.7 mm long, glabrous; glumes both scalelike, subequal; foliage leaf blades 0.3–0.5 (0.7) cm wide 1. *C. baculifera*
- 9 Spikelets 5–7.1 (8.1) mm long, pubescent for the upper $\frac{1}{2}$ – $\frac{2}{3}$ of all bracts except the glumes; glume I scalelike, glume II usually twice as long as glume I; foliage leaf blades 0.07–0.4 cm wide.
- 10 Branching intravaginal; subsidiary branches (5) 9–30 per node, erect, in one row, linear; foliage leaf blades with L:W = (8.6) 17–31 (47) 4. *C. pinifolia*
- 10 Branching extravaginal; subsidiary branches (12) 20–45 per node, more or less horizontally exserted, in 2 rows, constellate; foliage leaf blades with L:W = 6.5–15 12. *C. heterophylla*

CHUSQUEA Kunth sect. SWALLENCHLOA
(McClure) L. G. Clark

Swallenochloa McClure, Smithsonian Contr. Bot. 9: 106. 1973. *Chusquea* sect. *Swallenochloa* (McClure) L. G. Clark, Syst. Bot. Monographs 27: 29. 1989. TYPE: *Chusquea subtessellata* A. Hitchc.

Culms usually erect, fastigiate, sometimes arching at tips. Internodes usually 3–16 cm long, sometimes as much as 17–30 cm long, glabrous or occasionally pubescent below the nodes, usually thinly covered with a waxy exudate. Culm leaves usually persistent, eventually shredding and disintegrating, deciduous in a few species. Nodes

at mid-culm with one triangular central bud flanked by 1–several (rarely numerous) smaller subsidiary buds, all buds arranged more or less linearly. Branching intravaginal; central bud usually developing simultaneously with the subsidiary buds but usually retaining its dominance in size; branches erect and rebranching. Foliage leaf blades 1.3–40 cm long, 0.06–5 cm wide, L:W = 5.5–40 (60), erect or ascending, usually stiff, often abaxially tessellate. Inflorescence usually a narrow panicle (sometimes racemose in *C. nutans*), 0.5–45 cm long. Spikelets 3.9–10.4 mm long, laterally compressed to terete. Glumes usually present and less than

$\frac{1}{2}$ the spikelet length, rarely absent. Sterile lemmas subequal, or sterile lemma II longer than sterile lemma I, apiculate or subulate. Fertile lemma and palea subequal or palea shorter than the fertile lemma.

This description of *Chusquea* sect. *Swal-lenochloa* was modified from Clark (1989) to include the species described in this paper. See Clark (1989) for a more detailed description and comments about the section.

Since Clark (1989) treated this section, two new species (Clark et al., 1989; Widmer & Clark, 1991) were described. The following is a list of the 24 described species currently classified within *Chusquea* sect. *Swal-lenochloa*, including the species treated in this paper: *C. amistadensis* L. G. Clark, Davidse & Ellis; *C. angustifolia* (Söderstrom & C. Calderón) L. G. Clark; *C. baculifera* Silveira; *C. bilimekii* Fourn.; *C. deflexa* L. G. Clark; *C. depauperata* Pilger; *C. erecta* L. G. Clark; *C. lanceolata* A. Hitchc. in Morton; *C. longiligulata* (Söderstrom & Calderón) L. G. Clark; *C. macchurei* L. G. Clark; *C. neurophylla* L. G. Clark; *C. nutans* L. G. Clark; *C. paludicola* L. G. Clark; *C. pinifolia* (Nees) Nees; *C. riosaltensis* L. G. Clark; *C. sclerophylla* Doell in C. Martius; *C. smithii* L. G. Clark; *C. spencei* Ernst; *C. subtessellata* Hitchc.; *C. talamancensis* Widmer & L. G. Clark; *C. tessellata* Munro; *C. tonduzii* Hackel; *C. windischii* L. G. Clark; and *C. vulcanalis* (Söderstrom & C. Calderón) L. G. Clark. An additional three or four undescribed species belonging to this section are known from the Andes and Central America.

1. CHUSQUEA BACULIFERA Silveira (Fig. 1)

Chusquea baculifera Silveira, Arq. Mus. Nac. Rio de Janeiro 22: 99. 1919. TYPE: BRAZIL. Minas Gerais: Serra do Caparaó, 2800 m, Sep 1911 (fl), Silveira 600 (HOLOTYPE: R!; ISOTYPES: US-2 sheets!).

Culms to 1 cm in diam., to 2–3 m tall, more or less erect with mature culms slightly inclined. *Internodes* 4–11.6 cm long, terete, glabrous, waxy. *Culm leaves* 7.8–17 cm long, abaxially glabrous, juncture of sheath and blade a more or less horizontal to curved, indistinct line; sheaths 5–12.4 cm long, 1.4–2.7 times as long as the blade,

more or less triangular; blades 2.8–5.7 cm long, triangular, erect, persistent, apex subulate; girdle poorly developed, glabrous; inner ligule 1–2 mm long, irregular, ciliate. *Nodes* at mid-culm with the central bud linearly subtended by 7–18 subsidiary buds; sheath scar more or less horizontal; supranodal ridge prominent; root primordia absent. *Branching* intravaginal; central branch 41–49 cm long, erect to divergent, rebranching; leafy subsidiary branches 7–18 per node, 6–16 cm long, erect to ascending, occasionally rebranching from the base. *Foliage leaves* 10–13 per complement; sheaths persistent, glabrous to softly pubescent toward the apex; blades 2.6–5.6 cm long, 0.35–0.5 (0.7) cm wide, L:W = 6.5–11, stiff, adaxially and abaxially glabrous, not tessellate, apex subulate, base truncate-rounded; pseudopetiole 0.3 mm long, distinct; outer ligule a short, usually ciliate rim, 0.2–0.3 mm long; inner ligule 0.2–0.5 mm long, truncate, abaxially pubescent. *Panicles* 2–5 cm long, spike-like, the base retained within the subtending sheath; rachis more or less triquetrous, scabrous-pubescent; branches to 1 cm long, appressed, angular, scabrid to pubescent; pedicels 1–3 mm long, angular, scabrid. *Spikelets* 6.2–8.7 mm long, the antherium 1.1–1.3 mm wide, more or less terete to slightly dorsally compressed. *Glumes* 2, 0.2–0.4 mm long, less than $\frac{1}{20}$ the spikelet length, subequal, scale-like, glabrous. *Sterile lemmas* 2, $\frac{1}{2}$ – $\frac{2}{3}$ the spikelet length, abaxially finely pubescent; sterile lemma I 2.8–5.1 mm long, subulate, 1- or 3-nerved; sterile lemma II 3.1–5.5 mm long, subulate to awn-tipped, 1-, 3-, or 5-nerved. *Fertile lemma* 6–8.3 mm long, subulate to awn-tipped, glabrous to scabrous-pubescent, 7-nerved. *Palea* 5.8–8 mm long, subequal to the fertile lemma, sulcate only toward the apex, bimucronulate, glabrous, 4- or 6-nerved. *Stamens* and *fruit* unknown.

Distribution: Serra do Caparaó on the border of Minas Gerais and Espírito Santo, Brazil (Fig. 2); above timberline on rocky, open slopes in high altitude grassland; 2000 to 2800 m.

Specimens examined: BRAZIL. *Espírito Santo*: Serra do Caparaó, 25 Nov 1929 (fl), Chase 10088 (GH, US); *Mexia* 4018 (CAS, GH, MO, US). *Minas Gerais*:

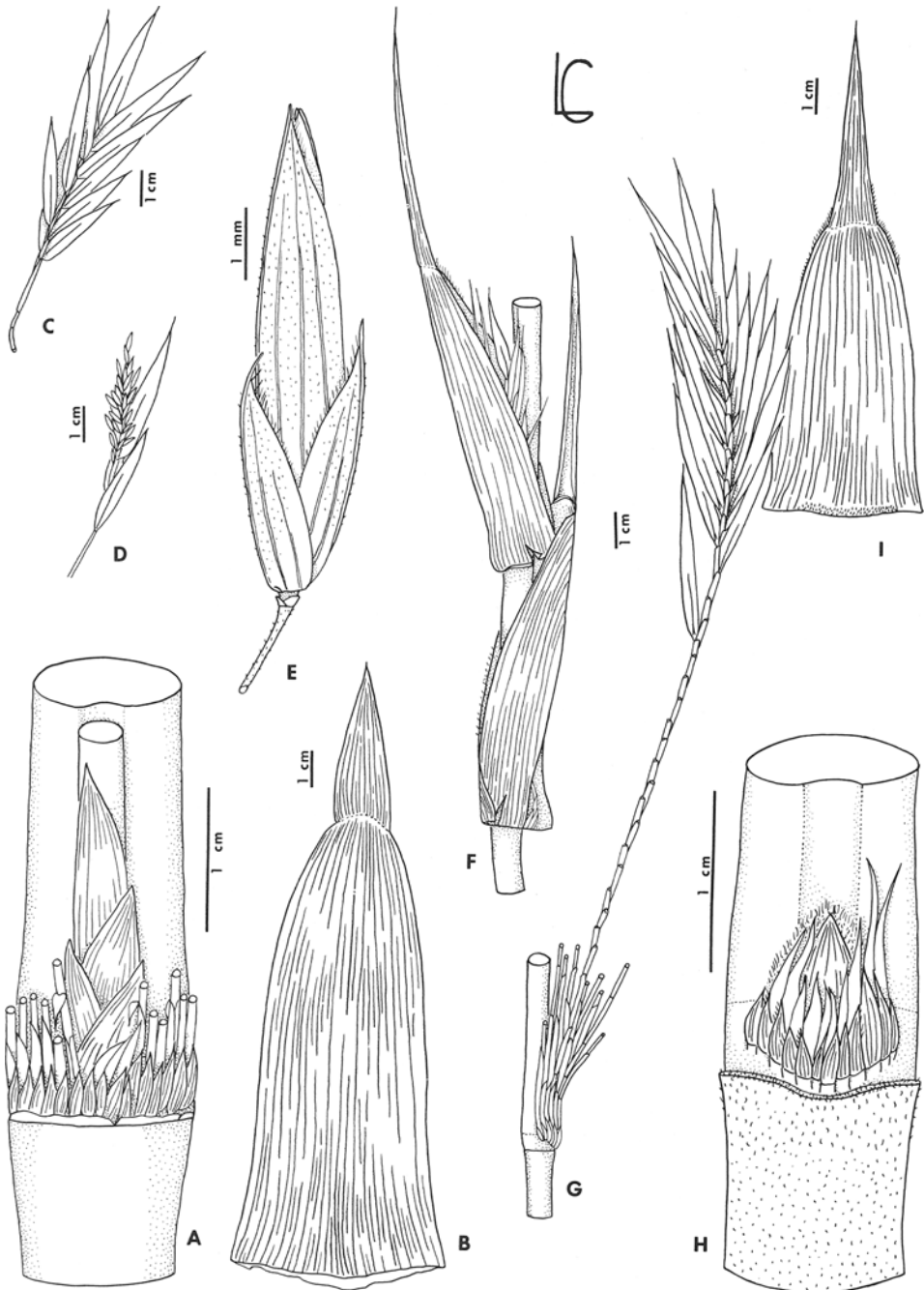


FIG. 1. *Chusquea baculifera* and *C. erecta*. A-E. *C. baculifera* (Clark & Morel 702). A. Bud complement. B. Culm leaf, abaxial view. C. Leaf complement. D. Panicle. E. Spikelet. F-I. *C. erecta* (Clark & Morel 826). F. Young culm showing culm leaves and intravaginal branching. G. Branch complement showing one leafy subsidiary branch. H. Bud complement. I. Culm leaf, abaxial view.

Serra do Caparaó, Pico do Cristal, 24 Sep 1941 (fl), *Brade 17009* (RB); Serra do Caparaó, trail to Pico de Bandeira, 30 Apr–4 May 1925 (fl), *Chase 9695* (GH, MO, US); *Chase 9722* (US); 26 Nov 1929 (fl), *Chase 10095* (US); Mun. Caparaó, Parque Nacional do Caparaó, trail to Pico de Bandeira, 23 Feb 1990 (fl), *Clark & Morel 702* (BHC, ISC, K, MO, NY, RB, SJRP, SP, US); Parque Nacional do Caparaó, caminho para o Pico da Bandeira, 7 Feb 1985 (fl), *de Lima et al. 2567* (RB); Serra do Caparaó, 9 Feb 1890 (fl), *Schwacke 6800* (RB).

Although at times confused with *C. pinifolia*, *C. baculifera* is a distinct species characterized by abaxially glabrous culm leaves with a glabrous, poorly developed girdle, foliage leaf blades 0.35 to 0.5 (0.7) cm wide with L:W = 6.5 to 11, and spikelets 6.2 to 8.7 mm long with both glumes scalelike (Clark, 1989). These two species are sympatric in the Serra do Caparaó, and they grow adjacent to and even intermingled with each other, but to date no evidence of hybridization has been observed.

Two newly described species, *C. erecta* and *C. riosaltensis*, are morphologically very similar to *C. baculifera*, but are recognized as distinct species based on the morphological differences presented in Table I. Although the three species are likely closely related to each other, they exhibit ecological and altitudinal differentiation, and the populations are isolated (Figs. 2, 8).

2. *Chusquea erecta* L. G. Clark, sp. nov. (Fig. 1)

TYPE: BRAZIL. São Paulo: Mun. Salesópolis, Reserva Hidrológica do Rio Claro-SABESP/Estação Biológica Boraceia, Campos da Boraceia, 870 m, 25 Feb 1991, *Clark & Morel 826* (HOLOTYPE: SP; ISOTYPES: ISC, MBM, MO, RB, SJRP, US).

Culmi circa 1 cm diam., 1.5–2.5 m alti, erecti. Folia culmorum 11.5–15.5 cm longa, decidua, abaxialiter pubescentia; vaginae 5.9–9.6 cm longae, 1.1–1.6-plo longiores quam laminam; laminae 5.5–7 cm longae, anguste triangulares, ad basim angustiores quam vaginorum apicem. Ramificatio intravaginalis; ramus centralis 22–38 cm longus, ascendens; rami subsidiarii cujusque nodi 10–14, 16–23 cm longi, erecti. Folia cujusque complementi 19–24; vaginae persistentes, pubescentes inter nervos; laminae 4.5–5.6 cm longae, 0.4–0.45 cm latae, ratio long./lat. = 11–14, glabrae, basi rotundato-attenuatae. Inflorescentia ignota.

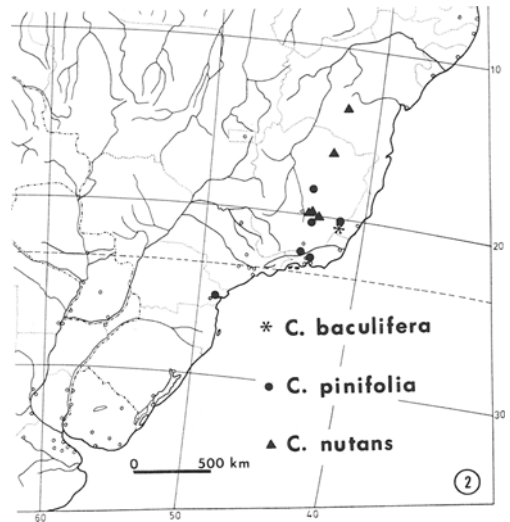


FIG. 2. Distributions of *Chusquea baculifera*, *C. pinifolia*, and *C. nutans*.

Culms ca. 1 cm in diam., 1.5–2.5 m tall, erect. Internodes 6–7 cm long, slightly flattened above the branch complement, minutely pubescent for the upper 1/2, becoming nearly glabrous with age, waxy. Culm leaves 11.5–15.5 cm long, deciduous as the branches develop, the base often splitting, more or less loosely wrapped around the culm, abaxially pubescent, juncture of the sheath and blade abaxially a more or less horizontal, indistinct line; sheaths 5.9–9.6 cm long, 1.1–1.6 times as long as the blade, more or less rectangular; blades 5.5–7 cm long, narrowly triangular, persistent, adaxially scabrid, apex subulate, base narrower than the sheath apex; girdle 1 mm wide, pubescent; inner ligule 0.5–1 mm long, glabrous. Nodes not swollen, the central bud linearly subtended by 9–13 subsidiary buds; sheath scar more or less horizontal; supra-nodal ridge obscure; root primordia absent. Branching intravaginal; central branch 22–38 cm long, ascending, rebranching; leafy subsidiary branches 10–14 per node, 16–23 cm long, erect, usually not rebranching. Foliage leaves 19–24 per complement; sheaths persistent, pubescent between the nerves; blades 4.5–5.6 cm long, 0.4–0.45 cm wide, L:W = 11–14, glabrous and not tessellate, apex subulate, base rounded-attenuate;

TABLE I
MORPHOLOGICAL COMPARISON OF *Chusquea baculifera*, *C. riosaltensis*, AND *C. erecta*

	<i>C. baculifera</i>	<i>C. riosaltensis</i>	<i>C. erecta</i>
Internode pubescence	glabrous	glabrous	minutely pubescent on upper half
Culm leaf pubescence	glabrous	scabrid	pubescent
Foliage leaf sheath pubescence	glabrous to softly pubescent toward apex	pubescent between nerves	pubescent-hispid between nerves
Foliage leaf blade L:W ratio	6.5–11	10–13	11–14
Number of leaves per complement	10–13	8–13	19–24
Number of branches per node	7–18	4–6	9–13
Subsidiary branch length (cm)	6–16	10–13	16–23
Central branch length (cm)	41–49	24–52	22–38
Culm height (m)	2–3	1–1.5	1.5–2.5
Altitude (m)	2000–2800	1300	800–900
Habitat	high altitude grassland	montane forest	high altitude grassland

pseudopetiole 0.5 mm long, distinct; outer ligule a minute, glabrous rim; inner ligule 0.5–0.8 mm long, truncate, minutely pubescent. *Inflorescence* unknown.

Distribution: Low coastal range near São Paulo, São Paulo, Brazil (Fig. 8); high altitude grassland formation; 800 to 900 m.

Chusquea erecta is distinguished by internodes minutely pubescent on the upper half, abaxially finely pubescent culm leaves with narrow blades and pubescent girdles, and 19 to 24 foliage leaves per complement. In addition to these features, this species has more strictly erect culms than *C. baculifera*, which it resembles (Table I). Both of these species occur in high altitude grasslands, but *C. baculifera* grows at 2000 to 2800 m whereas *C. erecta* grows at 800 to 900 m. This species is known only from the type collection and appears to be a narrow endemic.

3. *Chusquea nutans* L. G. Clark, sp. nov. (Figs. 3A–F, 4 & 5)

TYPE: BRAZIL. Bahia: Serra das Almas, lower NE slopes of the Pico das Almas, ca. 25 km WNW of the Vila do Rio de Contas, 17 Feb 1977 (fl), *Harley et al.* 19596 (HOLOTYPE: CEPEC; ISOTYPES: IPA, K!, MO!, NY, P, RB, U!, US).

Culmi 1–1.5 cm diam., (1–2) 4–5 (6) m alti, erecti ad basim, interdum leviter arcuati ad apicem. Folia culmorum 6.6–17 cm longa, decidua, plerumque fissa ad basim, vagina et lamina plerumque confluentes,

margines connati ad basim per 0.3–1.5 cm; vaginae si manifestae 5.6–12.6 cm longae, 3–6.5 (10)-plo longiores quam laminam; laminae si manifestae 0.8–2.3 cm longae, triangulares. Ramificatio intravaginalis; ramus centralis 32.5–100 cm longus, nutans; rami subsidiarii cujusque nodi 5–10, (8) 18.5–65 cm longi, nutantes. Folia cujusque complementi 4–8 (14); vaginae persistentes, plerumque pubescentes inter nervos; laminae 2–5.3 cm longae, 0.06–0.15 cm latae, ratio long./lat. = (25) 33–60, adaxialiter scabridae, abaxialiter glabrae, basi attenuatae. Panicula vel racemus 0.5–1 cm longus, spicatus. Spiculae 5.6–6.6 mm longae, pubescentes. Glumae 2, squamiformes. Lemmata sterilia 2, subulata, mediam spiculam attingentia. Lemma fertile 5.2–5.9 mm longum, subulatum. Palea 4.7–5.6 mm longa.

Culms 1–1.5 cm in diam., (1–2) 4–5 (6) m tall, erect at base, sometimes slightly arching at the apex. *Internodes* 7.7–14 cm long, slightly flattened above the branch complement, glabrous, waxy. *Culm leaves* 6.6–17 cm long, deciduous as the branches develop, the base usually splitting, usually no clear distinction between the sheath and blade present, abaxially retrorsely scabrous on the upper half, glabrous below, the apex subulate, the margins fused at the base for 0.3–1.5 cm; sheaths when manifest 5.6–12.6 cm long, 3–6.5 (10) times as long as the blade; blade when manifest 0.8–2.3 cm long, triangular, erect, persistent, adaxially retrorsely scabrous-pubescent; girdle 0.5 mm wide, glabrous; inner ligule usually absent, when present ca. 0.5 mm long, ciliolate. *Nodes* with the central bud flanked by 2–5 subsidiary buds on each side; sheath scar more or less horizontal; supranodal ridge

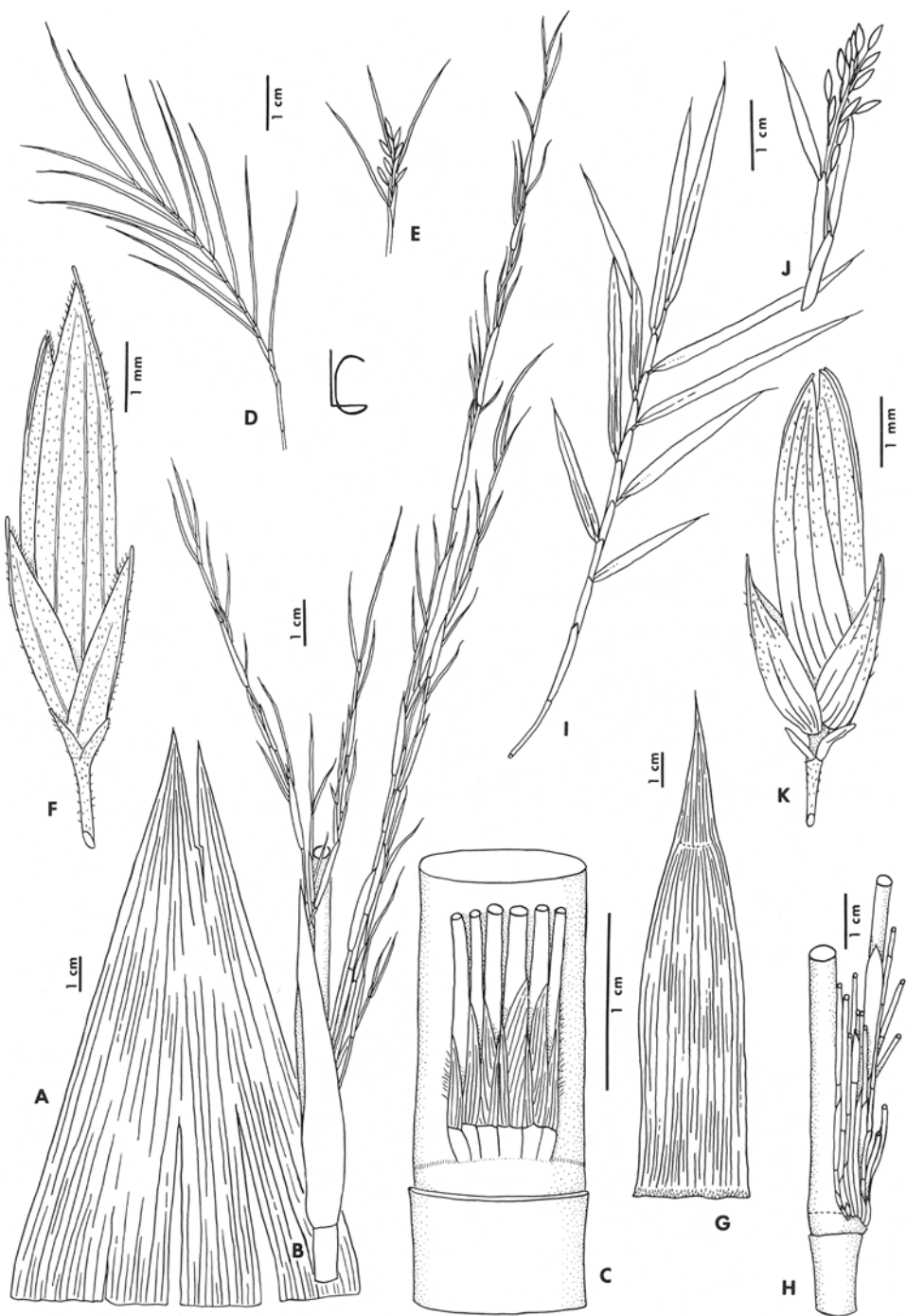


FIG. 3. *Chusquea nutans* and *C. pinifolia*. A-F. *C. nutans* (A, D. Clark & Morel 715; B, C, F. Calderón 2459; E. Harley et al. 19596). A. Culm leaf, abaxial view. B. Young culm showing culm leaf and intravaginal branching. C. Bud complement. D. Leaf complement. E. Panicle. F. Spikelet. G-K. *C. pinifolia* (G. Clark & Morel 703; H-K. Sello s.n.). G. Culm leaf, abaxial view. H. Branch complement. I. Leaf complement. J. Panicle. K. Spikelet.



FIGS. 4 & 5. *Chusquea nutans*. 4. Habit, showing nodding branches (Clark & Morel 715). 5. Branch complement (Clark et al. 768).

obscure; root primordia absent. *Branching* intravaginal; central branch 32.5–100 cm long, nodding, rebranching; leafy subsidiary branches 5–10 per node, (8) 18.5–65 cm long, nodding, rebranching. *Foliage leaves* 4–8 (14) per complement; sheaths persistent, usually pubescent between the nerves, less commonly glabrous; blades 2–5.3 cm long, 0.06–0.15 cm wide, L:W = (25) 33–60, adaxially scabrid, abaxially glabrous, not tessellate, apex subulate, base attenuate; pseudopetiole 0.5 mm long; outer ligule a minute, glabrous or ciliate rim 0.1 mm long; inner ligule 0.2–0.5 mm long, truncate. *Inflorescence* a panicle or raceme, 0.5–1 cm long, spikelike, the base retained within the subtending sheath; rachis angular, scabrous-pubescent; branches and pedicels angular, scabrous-pubescent, the pedicels 2.5–

4 mm long. *Spikelets* 5.6–6.6 mm long, pubescent, the antherium 1–1.2 mm wide, more or less terete. *Glumes* 2, 0.6–0.8 mm long, ca. $\frac{1}{10}$ the spikelet length, scalelike, acute to obtuse, nerves absent. *Sterile lemmas* 2, 2.8–3.2 mm long, ca. $\frac{1}{2}$ the spikelet length, subulate; sterile lemma I 1-nerved; sterile lemma II 3-nerved. *Fertile lemma* 5.2–5.9 mm long, subulate, 7-nerved. *Palea* 4.7–5.6 mm long, slightly shorter than the fertile lemma, sulcate only toward the apex, acute, 2-nerved. *Stamens* 3; anthers 2.6–2.8 mm long. *Fruit* a caryopsis.

Distribution: Serra do Espinhaço, south-central Bahia to southern Minas Gerais, Brazil (Fig. 2); gallery forests along rivers and streams in *campo rupestre*, often associated with rocky outcrops; 1000 to 1720 m.

Specimens examined: BRAZIL. **Bahia:** Mun. Rio de Contas, Pico das Almas, 17 km W of Rio de Contas, 11 Apr 1977 (fl), *Calderón 2459* (MO, US). **Minas Gerais:** Parque Natural e Santuário de Caraça, along the creek that flows into the Rio Caraça, near the Piscina, *Clark & Morel 715* (BHCB, ISC, K, MO, NY, RB, SJRP, SP, US); Mun. Caeté, Serra da Piedade, trail descending behind the sanctuary, *Clark & Morel 719, 720B* (BHCB, ISC, MO, NY, RB, SJRP, SP, US); *Clark & Morel 764* (BHCB, ISC, MO, RB, SJRP, SP, US); Mun. Brumadinho, ca. 16 km from Belo Horizonte along BR-040, Condomínio Retiro das Pedras, slopes behind the community, below Rua Quares Meira Roxa, drainage of the Rio Mutuca, periphery of Serra da Moeda, 29 Jan 1991 (fl), *Clark et al. 768, 769* (BHCB, ISC, MBM, MO, RB, SJRP, SP, US); Serra do Caraça, piscina do Imperador, *Grandi et al. s.n.* (BHCB); Serra da Piedade, Caeté, *Grandi et al. 2229* (BHCB); Serra do Garimpo, Cocaes, *Hoehne 4954* (US); ca. 10 km W of Barão de Cocais, base of Serra da Caraça, *Irwin et al. 29086* (MO, US); Grão-Mogol, Vale do Ribirão da Morte, *Mello-Silva & Pirani 10835* (ISC, SPF); Serra da Caraça, *Pabst 4163* (US); Serra da Piedade, Caeté, *Paula & Grandi 7368* (BHCB, ISC); Serra da Piedade, *Reinhardt s.n.* (C); Rio das Velhas, Serra de Itabira do Campo, 12 Sep 1887 (fl), *Schwacke 5925* (RB); Caraça, Caminho p/piscina, *Trindade 28* (BHCB); Serra da Piedade, *Herb. Warming* (C).

This species was previously included within *C. pinifolia*, but recent field observations and collections have shown it to be distinct. *Chusquea nutans* is characterized by culms usually 4 to 5 m tall; somewhat brittle, deciduous culm leaves usually with no differentiation between the sheath and blade and with glabrous girdles; usually long, nodding branches; foliage leaf blades 0.06 to 0.15 cm wide and L:W = (25) 33 to 60; inflorescence a panicle or raceme 0.5 to 1 cm long; and pubescent spikelets 5.6 to 6.6 mm long. This species also differs from *C. pinifolia* in that it grows at lower elevations in gallery forests in *campo rupestre* vegetation and appears to be restricted to the Serra do Espinhaço.

From the flowering collections *Clark et al. 768* and *769*, it is likely that the Brumadinho population underwent a gregarious flowering event two or three years ago. Most of the plants, especially on the upper slopes, were dead, but a number of plants were still green and producing spikelets. Seedlings with attached caryopses were found at the base of both dead and living clumps. The seedlings were typically bambusoid (Soderstrom, 1981) and not more than a few centimeters tall, which indicates

that they were probably not more than one or two years old. The only other flowering specimens are *Calderón 2459* and *Harley et al. 19596* from Pico das Almas, Bahia, collected in 1977. It is not clear from the accompanying field notes whether or not that was a gregarious flowering episode.

4. CHUSQUEA PINIFOLIA (Nees) Nees (Fig. 3)

Chusquea pinifolia (Nees) Nees, *Linnaea* 9: 490. 1835. ?*Arundinaria pinifolia* Nees in C. Martius, *Fl. bras. enum.* 2(1):525. 1829. ?*Ludolfia pinifolia* (Nees) Dietrich, *Sp. pl.* 2: 25. 1832. TYPE: BRAZIL. *Sello 1073* (LECTOTYPE, designated by Clark, 1989: US frag.).

Culms 0.5–1 cm in diam., (0.5) 2–3 m tall, erect. *Internodes* 3–11 cm long, terete, sometimes pubescent below the nodes when young, otherwise glabrous, waxy. *Culm leaves* 5.3–14.2 cm long, persistent, abaxially glabrous or retrorsely scabrid, juncture of sheath and blade a more or less horizontal, indistinct line; sheaths 3.2–11.7 cm long, 1.4–4 (6) times as long as the blade, triangular; blades 1.3–5 cm long, triangular, persistent, adaxially retrorsely scabrid, apex subulate; girdle 0.5–1 mm wide, pubescent; inner ligule 0.2–1 mm long, ciliate. *Nodes* with the central bud more or less linearly subtended by 5–20 subsidiary buds; sheath scar more or less horizontal; supranodal ridge obscure; root primordia absent. *Branching* intravaginal; central branch 10–65 cm long, erect, rebranching; leafy subsidiary branches 5–20 (30) per node, (4) 8–21 cm long, fine, erect, often rebranching from basal and upper nodes. *Foliage leaves* 10–12 (16) per complement; sheaths persistent, finely pubescent between the nerves; blades 1.5–4.7 (6.6) cm long, 0.07–0.25 (0.4) cm wide, L:W = (8.6) 17–31, stiff, glabrous and not tessellate, apex navicular-subulate to setose, base attenuate; pseudopetiole 0.2–1 mm long, not very distinct; outer ligule a minute rim, virtually absent; inner ligule 0.3–0.5 mm long, truncate. *Panicles* 1–2 (4) cm long, narrow spikelike, the base retained with the subtending sheath; rachis angular, scaberulous to pubescent; branches less than 1 cm long, appressed, angular, scabrid to pubescent; pedicels 1–3.5 mm long, angular, scabrid to pubescent. *Spikelets* 5–7.1 (8.1)

mm long, finely pubescent on the upper half of each bract, the antherium (1.1) 1.2–1.7 mm wide, more or less terete. *Glumes* 2, nerves absent; glume I 0.3–0.9 mm long, less than $\frac{1}{10}$ the spikelet length, scalelike; glume II 0.4–1.3 mm long, ca. $\frac{1}{10}$ the spikelet length, scalelike to oblong. *Sterile lemmas* 2, 2.9–4.3 mm long, $\frac{1}{2}$ – $\frac{2}{3}$ the spikelet length, mucronate, 1-, 3-, or 5-nerved. *Fertile lemma* 4.7–7.5 mm long, mucronate to subulate, 5-, 7-, or 9-nerved. *Palea* 4.3–7 mm long, subequal to the fertile lemma, sulcate only toward the apex, bimucronulate, 4-nerved. *Stamens* 3; anthers 2.8–3.5 mm long. *Fruit* unknown.

Distribution: Southern tip of the Serra do Espinhaço in central Minas Gerais to Paraná, Brazil (Fig. 2); above timberline on rocky outcrops in high altitude grasslands, frequently in somewhat marshy or boggy areas; (1600) 2100 to 2500 m.

Specimens examined: BRAZIL. State unknown: *ex herb.* Eug. Warming (US); *Riedel* 436 (GH, P, US, W); *Riedel* s.n. (MO, P, W); *Sello* s.n. (BR, US). **Minas Gerais:** Serra do Espinhaço, summit of the Pico do Itambé, 10 Feb 1972 (fl), *Anderson et al.* 35769 (ISC, MO, R, US); Serra do Caparaó, 18 Sep 1941 (fl), *Brade* 10971 (RB); Serra do Caparaó, *Chase* 9669 (US); Mun. Caparaó, Parque Nacional do Caparaó, trail to Pico da Bandeira, *Clark & Morel* 703 (BHCB, ISC, MO, NY, RB, SJRP, SP, US); 10 Feb 1990 (fl), *Clark & Morel* 704 (BHCB, ISC, MO, NY, RB, SJRP, SP, US); Mun. Caeté, Serra da Piedade, trail descending behind the sanctuary, *Clark & Morel* 720A (BHCB, ISC, MO, NY, SJRP, SP, US); Mun. Itamonte, Parque Nacional de Itatiaia, Pico das Agulhas Negras, near abrigo Rebouças, Rio Campo Belo, *Clark et al.* 660 (BHCB, ISC, MO, NY, RB, SJRP, SP, US); Itacolumi–Ouro Preto, ponto mais alto do Itacolumi, *Grandi* 2363 (BHCB); prope Lagoa Esgotada in campo lapidoso, Dec 1903 (fl), *Moreira* s.n. (R); Serra do Caparaó, Sep 1911 (fl), *Silveira* s.n. (R); a 4 km do Pico da Bandeira, 6 Aug 1969 (fl), *de Souza* 7 (RB); Serra do Itatiaia, prope Agulhas Negras, 30 Dec 1895 (fl), *Ule* 57 (R, W); Serra do Caparaó, 18–22 Feb 1915 (fl), *Zikan* 12 (R). **Paraná:** Mun. Campina do Sul, Pico Caratuva, *Hatschbach* 16445 (MBM); Mun. Campina Grande do Sul, Serra Ibitiraquire, Abrigo 1, 25 Sep 1969 (fl), *Hatschbach* 22210 (C, MBM, S, US); Mun. Quatro Barras, Morro Mãe Catira, *Kummrow et al.* 3173 (MBM). **Rio de Janeiro/Minas Gerais:** Itatiaia unter Binsen an der Basis des Kegels, *Wawra* 413 (W); in rupestribus montis Itatiaia, *Wettstein & Schiffner* s.n. (W). **Rio de Janeiro:** Serra dos Órgãos, Campo das Antas, 5 Sep 1949 (fl), *Barbosa* 312 (HBR); Serra dos Órgãos, Pedra do Sino, 31 Jul 1940 (fl), *Brade* 16521 (RB); 3–6 Sep 1949 (fl), *Brade* 20039 (RB); Itatiaia, *Camerik* 233 (K, U); Serra dos Órgãos, 19 Oct 1958 (fl), *Castellanos* 22302

(R); Itatiaia, *Chase* 8292 (GH, US); Mun. Teresópolis, Parque Nacional Serra dos Órgãos, Campo das Antas, trail to Pedra do Sino, *Clark et al.* 789 (ISC, MBM, MO, RB, SJRP, SP, US); 11 Feb 1991 (fl), *Clark et al.* 790 (ISC, MBM, MO, RB, SJRP, SP, US); Serra do Itatiaia, *Dusén* 2140 (S, US); ecacumine Serra dos Órgãos, *Glaziou* 1868 (BR, US); sommet des Orgues, *Glaziou* 2831 (BR, C, P, US); haut des Orgues, 23 Oct 1872 (fl), *Glaziou* 6445 (BR, C, GH, P, S, US); haut des Orgues, Pedra Açu, 22 Oct 1872 (fl), *Glaziou* 6446 (BR, C, P–1 sheet, US); haut des Orgues, par Petrópolis, 1886 (fl), *Glaziou* 16626 (BR, C, P, US, W); Itatiaia, *Luederwaldt* 10306 (US); Serra dos Órgãos, Teresópolis, *Lutz* s.n. (R); Petrópolis, *Lützelburg* 411 (US); Serra dos Órgãos, Pedra do Sino, *Pinheiro* 3 (RB); Campo das Antas, Serra dos Órgãos, *Segadas-Vianna* 108 (RB); Mun. Petrópolis/Teresópolis, Serra dos Órgãos, Morro Açu, 4 Apr 1972 (fl), *Soderstrom* 1927 (RB, US); Itatiaia-Gebiet, Hochgebirges Camp am Fusse der Agulhas Negras, 22 Oct 1927 (fl), *Zerny* s.n. (W). **São Paulo:** Campos do Jordão, Pico de Itapeva, along a small paved road descending from the main road about 50 m below the main parking area to Fazenda Mirante, *Clark & Windisch* 1056 (ISC, MBM, MO, SJRP, SP, US).

Chusquea pinifolia is characterized by culms (0.5) 2 to 3 m tall; persistent culm leaves with the sheaths 1.4 to 4 (6) times as long as the blades; more or less erect subsidiary branches (4) 8 to 21 cm long; foliage leaf blades 0.07 to 0.25 (0.4) cm wide with L:W = (8.6) 17 to 31; panicles 1 to 2 (4) cm long; and spikelets with all bracts except the glumes finely pubescent on the upper half. Clark (1989) noted some variation among populations of this species; while some variation clearly exists in *C. pinifolia*, the more northern populations from the Serra do Espinhaço are here segregated as *C. nutans*.

Although *C. pinifolia* and *C. nutans* occupy different habitats, there is one locality where they appear to be sympatric. On the moist slopes below the sanctuary at the top of Serra da Piedade, Caeté, Minas Gerais, there is an extensive, although somewhat atypical, population of *C. nutans* (*Clark & Morel* 719, 720B, 764, and *Grandi et al.* 2229). Although some plants with unusually wide leaves were collected along one gully (*Clark & Morel* 720A) and later determined to be more like *C. pinifolia*, their somewhat depauperate condition made an exact identification difficult. No evidence of wide juvenile leaves in *C. nutans* was observed in any other populations, as occurs in the Andean *C. spencei* (Clark, 1989), so

it is presumed that these plants represent *C. pinifolia*. It is possible that hybridization has occurred at this locality, which could possibly explain the rather short stature and unusually short branches of the *C. nutans* population on nearby slopes. Hybridization between other species of sect. *Swallenochloa* (Clark et al., 1989) has been documented and should be investigated at the Serra da Piedade site.

5. *Chusquea riosaltensis* L. G. Clark, sp. nov. (Fig. 6)

TYPE: BRAZIL. Minas Gerais: Mun. Lima Duarte, Serra do Ibitipoca, Parque Estadual (Florestal) do Ibitipoca, Paredão do Rio Salto, fork from trail to Ponte da Pedra, 1300 m, 2 Feb 1991, Clark & Morel 775 (HOLOTYPE: SP; ISOTYPES: BHCB, ISC, MO, RB, SJRP, US).

Culmi ca. 1 (1.5) cm diam., 1–1.5 m alti, erecti. Folia culmorum 6.6–11.4 cm longa, persistentia, abaxialiter retrorsus scabrida; vaginae 3.6–8 cm longae, 1.2–3.6-plo longiores quam laminam; laminae 2–4 cm longae, triangulares. Ramificatio intravaginalis; ramus centralis 24–52 cm longus, ascendens; rami subsidiarii cujusquisque nodi 4–6, 10–13 cm longi, erecti. Folia cujusquisque complementi 8–10 (13); vaginae persistentes, pubescentes inter nervos; laminae 3.5–4.7 cm longae, 0.3–0.4 cm latae, ratio long./lat. = 10–12.8, glabrae, basi rotundatae. Inflorescentia ignota.

Culms ca. 1 (1.5) cm in diam., 1–1.5 m tall, erect. *Internodes* 5–8 cm long, slightly flattened above the branch complement, glabrous, waxy. *Culm leaves* 6.6–11.4 cm long, persistent, abaxially retrorsely scabrid, juncture of sheath and blade abaxially a more or less horizontal line; sheaths 3.6–8 cm long, 1.2–3.6 times as long as the blade, more or less triangular, the shoulders slightly rounded, the margins glabrous, ciliate at apex; blades 2–4 cm long, triangular, erect, persistent, adaxially glabrous, the apex subulate; girdle 0.5–1 mm wide, pubescent; inner ligule 0.5 mm long, ciliate. *Nodes* not swollen, with one triangular central bud flanked by 2 or 3 smaller subsidiary buds on each side; sheath scar horizontal; supranodal ridge present; root primorida absent. *Branching* intravaginal; the central branch 24–52 cm long, erect at base, ascending but gently curving away from the

main culm, rebranching; leafy subsidiary branches 4–6 per node, 10–13 cm long, erect, not rebranching. *Foliage leaves* 8–10 (13) per complement; sheaths persistent, pubescent between the nerves; blades 3.5–4.7 cm long, 0.3–0.4 cm wide, L:W = 10–13, glabrous, not tessellate, the apex subulate, the base rounded; pseudopetiole ca. 0.5 long; outer ligule 0.1–0.2 mm long, ciliate; inner ligule 0.3 mm long, truncate. *Inflorescence* unknown.

Distribution: Serra do Ibitipoca in eastern Minas Gerais, Brazil; gallery and elfin forests above the Rio Salto and tributaries (Fig. 8); 1200 to 1300 m.

Specimen examined: BRAZIL. Minas Gerais: Parque Estadual Ibitipoca, Lima Duarte, borda da mata ciliar de altitude, presente também no paredão do Rio do Salto, Andrade 1082 (BHCB).

This diminutive species is known only from two vegetative collections from the Serra do Ibitipoca in eastern Minas Gerais. Although similar to *C. baculifera* in many respects, *C. riosaltensis* is distinguished by culms 1 to 1.5 m tall; abaxially scabrid culm leaves; 4 to 6 branches per node, with the subsidiary branches 10 to 13 cm long; and foliage leaves with the sheaths pubescent between the nerves and the blades with L:W = 10 to 13 (Table I). Ecologically, this species differs greatly from *C. baculifera* in that it grows in elfin or gallery forests at about 1300 m, whereas the latter species typically occurs in high altitude grasslands at 2000 to 2800 meters.

In 1991, many dead clumps and some young plants that appeared to be about one to three years old were observed. The population evidently underwent a gregarious blooming event approximately three to four years ago, but no collections are available to document that occurrence.

6. *CHUSQUEA SCLEROPHYLLA* Doell in C. Martius (Fig. 6)

Chusquea sclerophylla Doell in C. Martius, Fl. bras. 2(3): 200. 1880. TYPE: BRAZIL. near Rio de Janeiro, Glaziou 6463 (LECTOTYPE, here designated: C!; isolectotype: US—frag!).

Culms ca. 0.4 cm in diam. *Internodes* 3–3.5 cm long, slightly flattened above the

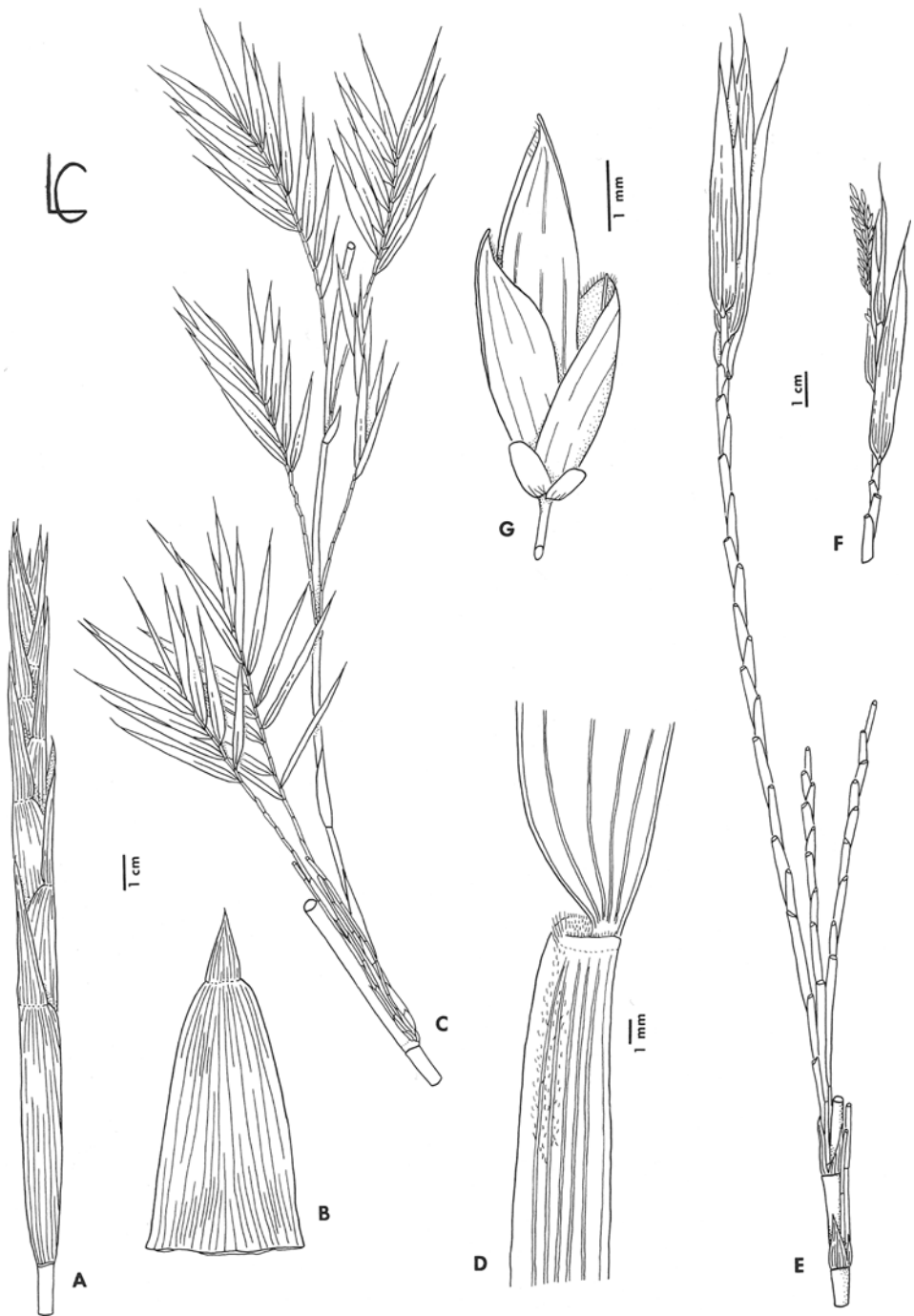


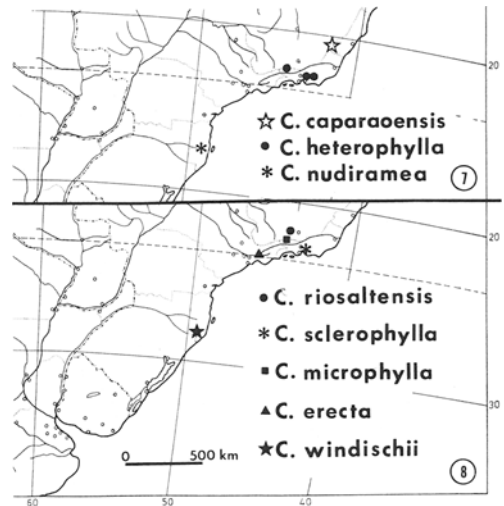
FIG. 6. *Chusquea riosaltensis* and *C. sclerophylla*. A-C. *C. riosaltensis* (Clark & Morel 775). A. Apex of a new shoot. B. Culm leaf, abaxial view. C. Branch complement and leaf complements. D-G. *C. sclerophylla* (D. Glaziou 4311; E-G. Glaziou 6463). D. Ligular area of foliage leaf. E. Branch complement with one leafy subsidiary branch. F. Panicle. G. Spikelet.

branch complement, glabrous, waxy. *Culm leaves* persistent, disintegrating, no complete examples available. *Nodes* not swollen; sheath scar horizontal; supranodal ridge obscure; root primordia absent. *Branching* intravaginal; one or three subequal branches per node, erect, 21–28 cm long, not rebranching. *Foliage leaves* 6 or 7 per complement; sheaths persistent, pubescent between the 2 or 3 marginal nerves, otherwise glabrous; blades 7.3–10.8 cm long, 0.8–1.1 cm wide, L:W = 9–10, glabrous, not tessellate, the apex subulate to short setose, the base rounded; pseudopetiole ca. 1 mm long, distinct; outer ligule ca. 0.3 mm long, ciliolate; inner ligule 1 mm long, truncate, pubescent. *Panicles* 3–4 cm long, narrow, the base retained within the subtending sheath; rachis, branches, and pedicels angular, scabrous, the pedicels 2–3 mm long. *Spikelets* 5.2–5.8 mm long, glabrous, the antherium 1.2–1.3 mm wide, laterally compressed. *Glumes* 2, scalelike; glume I $\frac{1}{10}$ – $\frac{1}{15}$ the spikelet length; glume II ca. $\frac{1}{8}$ the spikelet length. *Sterile lemmas* 2, mucronate; sterile lemma I $\frac{1}{2}$ – $\frac{2}{3}$ the spikelet length; sterile lemma II ca. $\frac{2}{3}$ the spikelet length. *Fertile lemma* mucronate. *Palea* subequal to the fertile lemma or slightly shorter. *Flowers* and *fruits* unknown.

Distribution: Serra dos Órgãos (Fig. 8); no habitat or altitudinal data available.

Specimen examined: BRAZIL. Rio de Janeiro: haut des Orgues, 3 Apr 1870, Glaziou 4311 (C, US).

Although known from only two incomplete collections, this species clearly belongs within sect. *Swallenochloa* based on the presence of short, waxy internodes, intravaginal branching, and stiff, erect foliage leaves. In addition, *C. sclerophylla* is characterized by foliage leaves with the sheaths pubescent between the 2 or 3 marginal nerves and the non-tessellate blades 0.8 to 1.1 cm wide with L:W = 9 to 10, narrow panicles 3 to 4 cm long, and glabrous spikelets 5.2 to 5.8 mm long. Based on the foliage leaves, this species is more similar to *C. tessellata* of the Andes than to any other Brazilian species of this section. Efforts to relocate this species in the Serra dos Órgãos have so far proven unsuccessful.



FIGS. 7 & 8. Distributions of seven species of *Chusquea*. 7. *C. caparaoensis*, *C. heterophylla*, and *C. nudiramea*. 8. *C. riosaltensis*, *C. sclerophylla*, *C. microphylla*, *C. erecta*, and *C. windischii*.

7. *Chusquea windischii* L. G. Clark, sp. nov. (Fig. 9A–G)

TYPE: BRAZIL. Santa Catarina: Mun. Urubici, Morro da Igreja, Serra Geral, 1680 m, 25 Feb 1992 (fl), Clark, Londoño & Oliveira 1046 (HOLOTYPE: SP; ISOTYPES: HBR, ISC, MBM, MO, SJRP, US).

Culmi ca. 1 cm diam., ca. 1 m alti, erecti. Folia culmorum 10.6–13 cm longa, primum persistentia, demum decidua; vaginae 6.4–9.2 cm longae, 1.5–2.8-plo longiores quam laminam, abaxialiter scabridae praeter basim glabram; laminae 3.2–4.2 cm longae, triangulares. Ramificatio intravaginalis; ramus centralis 15–30 cm longus, curvatim adscendens; rami subsidiarii cujusquisque nodi 4–8, 7–15 (21) cm longi, plus minusve erecti. Folia cujusquisque complementi 4–8; vaginae persistentes, glabrae vel pubescentes inter nervos; laminae 3.6–5.9 cm longae, (0.5) 0.8–1 cm latae, ratio long./lat. = 5.5–8.6, glabrae, basi rotundatae vel rotundato-attenuatae. Paniculae 1.5–2 cm longae. Spiculae 4.3–4.9 mm longae, glabrae. Glumae 2, squamiformes. Lemmata sterilia 2, mucronata, $\frac{2}{3}$ spiculam attingentia. Lemma fertile 4.3–4.8 mm longum. Palea 4.1–4.7 mm longa.

Culms to ca. 1 cm in diam., ca. 1 m tall, erect. *Internodes* 6–8 cm long, shallowly sulcate above the branch complement, glabrous, waxy. *Culm leaves* 10.6–13 cm long, persistent until the subsidiary branches rebranch, then deciduous, juncture of the

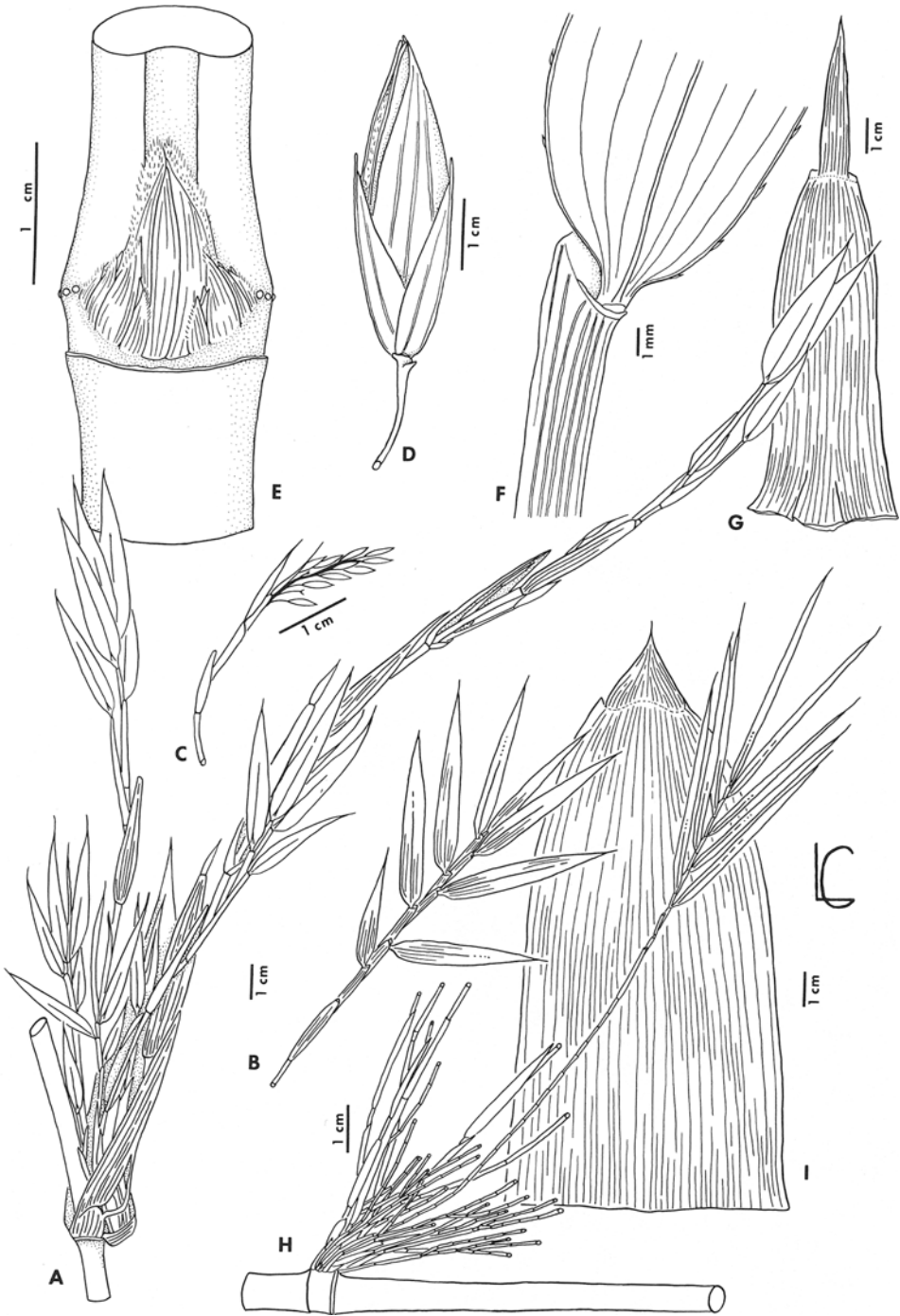


FIG. 9. *Chusquea windischii* and *C. caparaoensis*. A-G. *C. windischii* (A, B, E-G. Clark & Windisch 869A; C & D. Clark et al. 1046). A. Branch complement. B. Leaf complement. C. Panicle. D. Spikelet. E. Bud complement. F. Ligular area of foliage leaf. G. Culm leaf, abaxial view. H, I. *C. caparaoensis* (Clark & Morel 701). H. Branch complement showing one leafy subsidiary branch. I. Culm leaf, abaxial view.

sheath and blade abaxially a more or less horizontal, indistinct line; sheaths 6.4–9.2 cm long, 1.5–2.8 times as long as the blade, more or less triangular, abaxially scabrid for the upper $\frac{2}{3}$, margins glabrous to sparsely apically ciliate on the overlapping margin; blades 3.2–4.2 cm long, triangular, erect, persistent, abaxially glabrous, adaxially retrorsely scabrid, the apex subulate; girdle 1–2 mm wide, glabrous; inner ligule 1–2 mm long, slightly irregular, ciliolate. *Nodes* slightly swollen; the one triangular central bud flanked by 2–4 smaller subsidiary buds on each side; sheath scar more or less horizontal; supranodal ridge prominent; root primordia sometimes replacing the supranodal ridge at the more basal nodes. *Branching* intravaginal; central branch 15–30 cm long, usually curving horizontally away from the main culm, then curving upwards, rebranching; leafy subsidiary branches 4–8 per node, 7–15 (21) cm long, more or less erect, sometimes curving, often one subsidiary branch on each side of the central branch more robust, up to twice the diameter of the other subsidiaries. *Foliage leaves* 4–8 per complement; sheaths persistent, glabrous to pubescent between the nerves; blades 3.6–5.9 cm long, (0.5) 0.8–1 cm wide, L:W = 5.5–8.6, glabrous, not tessellate, the apex subulate, base rounded to rounded-attenuate; pseudopetiole 0.5 (1) mm long, distinct, often conspicuously plicate; outer ligule 0.1–0.3 mm long, glabrous, somewhat irregular; inner ligule 1.5–2 mm long, rounded, glabrous. *Panicles* 1.5–2 cm long, narrow, the base retained within the subtending sheath; rachis, branches, and pedicels angular, pubescent-scabrous, the edges scabrous; branches to 1 cm long, appressed; pedicels 2–3.5 mm long. *Spikelets* 4.3–4.9 mm long, glabrous, the anthercium 1.1–1.2 mm wide, more or less terete. *Glumes* 2, scalelike, less than $\frac{1}{20}$ the spikelet length. *Sterile lemmas* 2, 2.8–3.2 mm long, $\frac{2}{3}$ the spikelet length, mucronate, 3-nerved. *Fertile lemma* 4.3–4.8 mm long, shortly mucronate, 7-nerved. *Palea* 4.1–4.7 mm long, subequal to the fertile lemma, sulcate only toward the apex, bimucronulate, 4-nerved, the sulcus scabrous-pubescent. *Lodicules* unknown. *Stamens* unknown. *Fruit* unknown.

Distribution: Morro da Igreja of the Serra Geral, Santa Catarina, Brazil (Fig. 8); high altitude grassland; 1680 to 1800 m.

Specimens examined: BRAZIL. **Santa Catarina:** Morro da Igreja, about 16.7 km from the main road between Urubici and Tuberão, above Fazenda Caiambora, Serra Geral, Clark & Windisch 869A (HRB, ISC, MO, RB, SJRP, SP, US); Mun. Urubici, Morro da Igreja, Clark et al. 1047 (HBR, ISC, MBM, MO, SJRP, SP, US); Mun. Urubici, Morro da Igreja, G. & M. Hatschbach & Guimarães 55355 (ISC, MBM).

This species is named for Dr. Paulo G. Windisch of the Universidade Estadual Paulista, São José do Rio Preto, whose considerable assistance and cooperation made my fieldwork in Brazil possible. *Chusquea windischii* is characterized by culms 1 m tall; culm leaves with the sheaths 1.5 to 2.8 times as long as the blades with the base of the blade narrower than the sheath apex; nodes with a prominent supranodal ridge that is sometimes replaced by root primordia; a central branch that usually curves horizontally away from the culm and then curves upwards; foliage leaf blades (0.5) 0.8 to 1 cm wide with L:W = 5.5 to 8.6; and spikelets 4.3 to 4.9 mm long. The foliage leaves of this species somewhat resemble those of *C. sclerophylla*, but the blades are more rounded at the base, and the sheaths lack the marginal pubescence. A better estimation of the relationship of these two species will be possible only when both are completely known.

Nudiramea Group

Culms 0.7–3 cm in diam., 1.5–5 m tall, more or less erect to somewhat arching at the apices. Internodes 9–26 cm long, terete to slightly flattened above the branch complement, glabrous, waxy. Culm leaves caducous, sheath and blade manifest, the margins above and below the junction of the sheath and blade usually scarios; blades usually erect and persistent, becoming reflexed and deciduous in one species, variable in size relative to the sheath; girdle only slightly developed, glabrous. Nodes at mid-culm with one triangular central bud subtended/flanked by several to many subsidiary buds usually of two sizes. Branching modified extravaginal, the culm leaves falling as the branches develop, but the branch-

es often splitting the base of the culm leaf; all branches rebranching; leafy subsidiary branches of two or three sizes in the mature complement, basally lacking leaf sheaths, the more robust subsidiary branches reaching 1 m. Foliage leaf sheaths with the margins usually scarios, deciduous; blades 3.4–16 cm long, 0.18–1.2 cm wide, L:W = (4) 6.5–26.5, not tessellate. Panicles 1–5 cm long, narrow or open. Spikelets 4.3–9.1 mm long, usually dorsally compressed. Glumes scalelike, less than $\frac{1}{20}$ the spikelet length.

The four species of this group are linked by their deciduous foliage leaf sheaths, a feature not observed elsewhere in *Chusquea*. In addition, the margins of the culm and foliage leaf sheaths are usually scarios, which is also somewhat unusual within the genus. All four species share the feature of dimorphic (*C. caparaoensis*, *C. mimosa*, and *C. nudiramea*) or trimorphic (*C. juergensii*) subsidiary buds/branches, a feature also present in other species of *Chusquea*, such as *C. spencei* (Clark, 1989) and *C. albilanata* L. Clark & Londoño (Clark & Londoño, 1991). The more or less erect habit, short, waxy internodes, and high altitude/latitude habitats of this group indicate possible affinity with sect. *Swallenochloa*, but the group does not fit well within the section based on features of branching and spikelet morphology. Until more data is available, these four species will be known informally as the *Nudiramea* Group.

A recent vegetative collection from Rio Pardo, Rio Grande do Sul, Brazil (*Clark et al. 1041*) has deciduous culm and foliage leaf sheaths, and resembles *C. juergensii* in some features. Its branch complement, however, is not like that of any of the four described species of this group, and the collection probably represents a new taxon, but more field study is required before it can be described.

8. *Chusquea caparaoensis* L. G. Clark, sp. nov. (Fig. 9H, I)

TYPE: BRAZIL. Minas Gerais: Mun. Caparaó, Parque Nacional do Caparaó, trail to Pico da Bandeira, just above turnoff to Vale Encantado, 2070 m, 23 Feb 1990, *Clark &*

Morel 701 (HOLOTYPE: SP; ISOTYPES: BHC, ISC, K, MO, NY, RB, SJRP, US).

Culmi 2.5 cm usque diam., ca. 4.5 m alti, plus minusve erecti, arcuati ad apicem. Folia culmorum 12.4–16.3 cm longa, caduca, abaxialiter retrorsus scabrida; vaginae 10.8–14 cm longae, 3–7-plo longiores quam laminam; laminae 1.6–3.6 cm longae, late triangulares. Ramificatio extravaginalis mutata; ramus centralis 34–41 cm longus, divergens vel nutans; rami subsidiarii tenues cujusque nodi 20–26, 10–20 cm longi, divergentes vel nutantes, robustiores 6, 26–40 cm longi, plerumque divergentes interdum nutantes. Folia cujusque complementi 8–9; vaginae deciduae, glabrae; laminae 3.8–5.3 cm longae, 0.18–0.2 cm latae, ratio long./lat. = 21–26.5, glabrae, basi attenuatae. Inflorescentia ignota.

Culms to 2.5 cm in diam., ca. 4.5 m tall, more or less erect, arching over at apices. *Internodes* 10–15 cm long, terete, glabrous, waxy. *Culm leaves* 12.4–16.3 cm long, caducous, abaxially retrorsely scabrid, juncture of sheath and blade abaxially an obscure, inverted “V,” the margins glabrous, scarios just above and below the juncture; sheaths 10.8–14 cm long, 3–7 times as long as the blade; blades 1.6–3.6 cm long, broadly triangular, erect, persistent, the apex apiculate-subulate; girdle ca. 0.5 mm wide, glabrous; inner ligule 1.5–2.5 mm long, erose, ciliate. *Nodes* slightly swollen, with the central bud subtended by 1 or 2 rows of 15–17 smaller subsidiary buds in a constellate array; sheath scar more or less horizontal; supranodal ridge prominent; root primordia absent. *Branching* modified extravaginal; central branch 34–41 cm long, divergent to nodding, rebranching; smaller leafy subsidiary branches 20–26 per node, 10–20 cm long, divergent to nodding, rebranching, the more robust subsidiaries usually 6 per node, 26–40 cm long, usually divergent, sometimes nodding. *Foliage leaves* 8 or 9 per complement; sheaths deciduous, glabrous; blades 3.8–5.3 cm long, 0.18–0.2 cm wide, L:W = 21–26.5, glabrous, not tessellate, apex subulate, base attenuate; pseudopetiole ca. 0.5 mm long; outer ligule ca. 0.1 mm long, glabrous; inner ligule 0.5 mm long, slightly rounded, glabrous. *Inflorescence* unknown.

Distribution: Serra do Caparaó, Minas Gerais, Brazil; transitional zone between upper montane forest and high altitude grassland (Fig. 7); 1900 to 2100 m.

Specimen examined: BRAZIL. Minas Gerais: Parque Nacional do Caparaó, próxima a Tronqueiras, Mun. Caparaó, *Hatschbach & Silva 55481* (ISC, MBM).

Chusquea caparaoensis is characterized by abaxially retrorsely scabrid culm leaves with the sheaths 3 to 7 times as long as the blade and the blades broadly triangular; nodes with a prominent supranodal ridge; nodding, divergent branches; and foliage leaf blades 0.18 to 0.2 cm wide with L:W = 21 to 26.5. This species bears a superficial resemblance to *C. pinifolia*, which grows slightly higher on the same peak, but the two species are easily distinguished by the caducous culm leaves, prominent supranodal ridge, nodding, divergent branches, and deciduous foliage leaf sheaths of *C. caparaoensis*.

9. CHUSQUEA JUERGENSII Hackel (Fig. 10)

Chusquea juergensii Hackel, Repert. Spec. Nov. Regni Veg. 7: 325. 1909. TYPE: BRAZIL. Rio Grande do Sul: Mun. Rio Pardo, ad Fazenda Hortícola, 70 m, Sep 1907 (fl), *Jürgens 322* (HOLOTYPE: W—2 sheets!; ISOTYPE: US!).

Chusquea swallenii McClure & Smith in Reitz, Fl. Ilus. Cat. Gramineas-Suplemento: 44 + pl. 48, fig. a-c. 1967. TYPE: BRAZIL. Santa Catarina: Caçador, Rio Caçador, 22 Jan 1946, *Swallen 8284* (HOLOTYPE: US!).

Culms 0.7–1.5 (2.5) cm in diam., 2–4 (5) m tall, erect, often slightly arching at the apex. *Internodes* 11–19 cm long, more or less terete, glabrous, waxy. *Culm leaves* 13.8–24 cm long, caducous, juncture of sheath and blade abaxially an obscure, more or less horizontal line or an inverted "V"; sheaths 9–19.5 cm long, 1.6–5 (9) times as long as the blade, abaxially glabrous, margins glabrous, slightly scarios; blades 1.4–6 cm long, triangular to narrowly triangular, erect, persistent, abaxially and adaxially glabrous or retrorsely scabrous, apex subulate; girdle 0.5–1 mm wide, glabrous; inner ligule 1–3 mm long, ciliolate. *Nodes* slightly swollen, the one triangular central bud only slightly larger than the 4 or 5 more robust subsidiary buds that flank it, this tier of buds subtended by 4 or 5 tiers of medium- and small-sized subsidiary buds; sheath scar dipping slightly below the bud/branch complement; supranodal ridge visible but not prominent; root

primordia absent. *Branching* modified extravaginal, the culm leaves falling as the branches develop, but the branches often split the base of the culm leaf; central branch ca. 85 cm long, ascending or divergent, rebranching; leafy subsidiary branches of two to three sizes, the smaller subsidiaries 25–50 per node, 4–23 cm long, ascending or divergent, rebranching, the more robust medium to large subsidiaries 4–16 per node, 16–60 cm long, ascending or divergent, rebranching. *Foliage leaves* 5–9 per complement; sheaths deciduous, maculate with light green spots, usually glabrous, sometimes pubescent between the nerves, the margins scarios; blades (3.5) 4.9–10.3 cm long, (0.3) 0.5–1.2 cm wide, L:W = 6.5–11.2 (13), adaxially glabrous, abaxially usually glabrous, rarely pilose, not tessellate, apex short subulate, base rounded to rounded-attenuate; pseudopetiole (0.5) 1–2 mm long; outer ligule 0.1–0.5 mm long, glabrous to ciliate; inner ligules 0.2–0.5 mm long, truncate, abaxially glabrous or pubescent, often ciliate. *Panicles* 1–3 cm long, narrow, base retained within the subtending sheath; rachis, branches, and pedicels angular, scabrous-pubescent to just the edges scabrous, bracts often present at the bases of the branches and pedicels; pedicels 2–6 mm long, appressed. *Spikelets* 6.9–8.7 mm long, glabrous, the anthecium 1.5–2.3 mm wide, dorsally compressed. *Glumes* 2, 0.1–0.4 mm long, no more than $\frac{1}{20}$ the spikelet length, scalelike, nerves absent. *Sterile lemmas* 2, mucronate or subulate; sterile lemma I 2.4–3.3 mm long, $\frac{1}{3}$ – $\frac{1}{2}$ the spikelet length, 1- or 3-nerved; sterile lemma II 3.3–3.6 mm long, $\frac{1}{2}$ – $\frac{3}{5}$ the spikelet length, 3-nerved. *Fertile lemma* 6.1–7.2 mm long, mucronate to short subulate, 7-nerved. *Palea* 6.4–7.6 mm long, overtopping the fertile lemma, sulcate only near the apex, bimucronulate, 4-nerved. *Stamens* 3, the anthers 4.3–4.5 mm long. *Lodicules* unknown. *Caryopsis* ca. 3.7 mm long, dark purple, beak 0.2 mm long, hilum linear, 2.8 mm long, the embryo ca. $\frac{1}{3}$ the caryopsis length.

Distribution: Serra da Bocaina, São Paulo, Brazil to Uruguay (Fig. 13); in gallery forests and high altitude grasslands associated with *Araucaria* formations, nearly al-

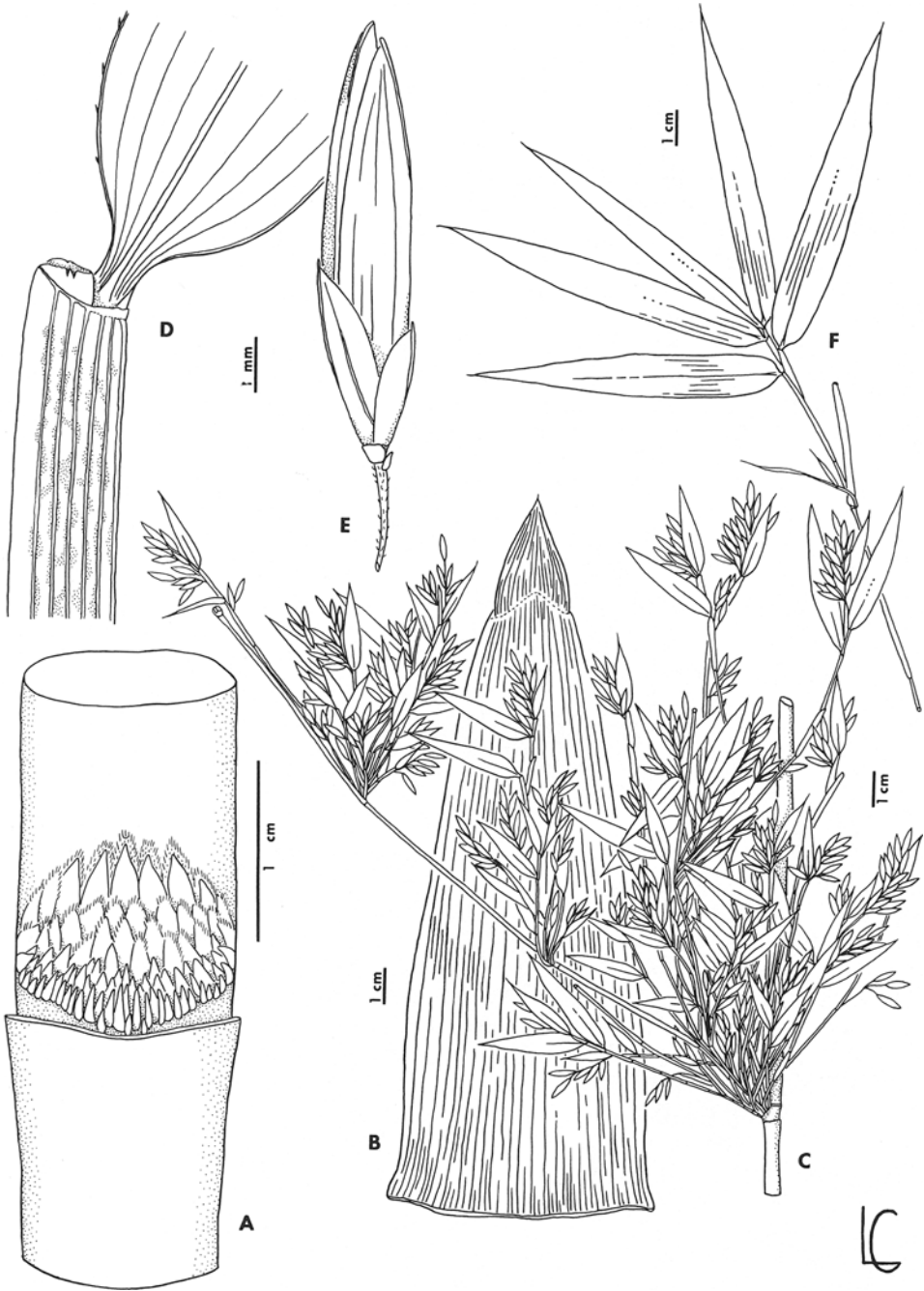
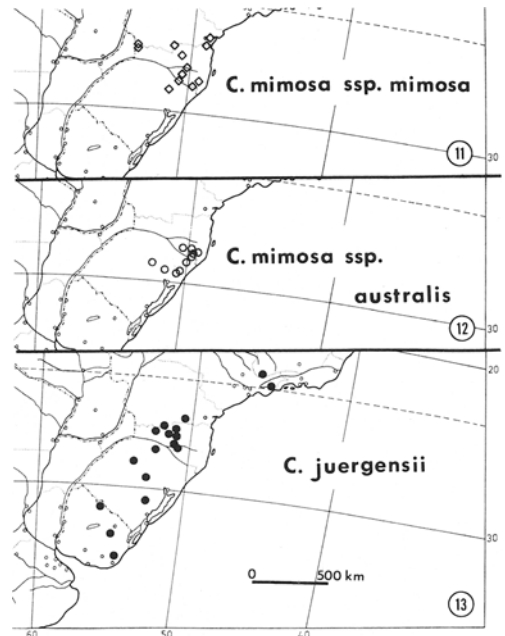


FIG. 10. *Chusquea juergensii* (A. Clark & Oliveira 897; B. Swallen 8284; C & E. Jürgens 322; D. Clark & Oliveira 906; F. Clark & Oliveira 901). A. Bud complement. B. Culm leaf, abaxial view. C. Flowering branch complement. D. Ligular area of foliage leaf. E. Spikelet. F. Leaf complement showing deciduous foliage leaf sheath.

ways along streams and rivers; 200 to 1500 m, with the altitudinal distribution strongly inversely correlated with latitude.

Specimens examined: BRAZIL. **Minas Gerais:** Mun. Camanducaia, road to Monte Verde, about 1.3 km before Monte Verde, Serra da Mantiqueira, *Clark & Windisch 737* (BHCB, ISC, MO, RB, SJRP, SP, US); Vila Monte Verde, just past entrance to the town at turnoff to airport, *Clark & Windisch 1067* (ISC, MBM, MO, SJRP, SP, US). **Paraná:** Mun. Mateus do Sul, Rio Potinga, *Hatschbach 22296* (MBM); Palmas, rod. para Ponte Serrada, *Hatschbach 43452* (MBM, US). **Rio Grande do Sul:** BR-153, between Erechim and Passo Fundo, 9.8 km S of exit to G. Vargas-Sananduva, *Clark & Oliveira 911* (ICN, ISC, MO, RB, SJRP, SP, US); road Encruzilhada do Sul—Passo dos Marinheiros, about 14 km N of Rio Camaquã, *Clark & Oliveira 915* (ICN, ISC, MO, RB, SJRP, SP, US); Cruz Alta, ad torrentes camporum, *Lindman A1573* (US); Encruzilhada do Sul—Estr. entre Pompeu Machado e o Passo dos Marinheiros, 13 km ao Norte do Passo, *Valls et al. 2268* (CEN, ICN); Lagoa Vermelha, O da cidade, na BR-285, Km 86.5, *Valls et al. 2669* (CEN, ICN); Sertão—Estr. nova P. Fundo—Erechim, 17 km ao sul do entroncamento com a estr. G. Vargas-Sananduva, 7 Jan 1974 (fl), *Valls et al. 3081* (CEN, ICN, US). **Santa Catarina:** Mun. Caçador, road Caçador—Calmon, along Rio do Peixe or a tributary, 24.5 km NW of Caçador, *Clark & Oliveira 897* (HRB, ISC, MBM, MO, RB, SJRP, SP, US); BR-470, Rio Inferno Grande, about 6.5 km W of turnoff from Fraiburgo, about 15 km E of Campos Novos, *Clark & Oliveira 900* (HRB, ISC, MO, RB, SJRP, SP, US); same locality, *Clark et al. 1035* (HBR, ISC, MBM, SJRP, SP, US); Mun. Campos Novos, 3 km E of Campos Novos, intersection of BR-282 and road to Tupitinga, *Clark & Oliveira 901* (HRB, ISC, MO, RB, SJRP, SP, US); Abdom Baptista—BR-282 (BR-470) to Campos Novos along a river, probably a tributary of Rio do Inferno, *Clark & Oliveira 906* (HRB, ISC, RB, SJRP, SP, US); Mun. Ponte Serrada, BR-282, Km 444, about 8 km before the intersection with BR-153, near a gas station, *Clark et al. 1038* (HBR, ISC, MBM, MO, SJRP, SP, US); Poço Preto, Irineópolis, *Klein 7776* (HBR, US); *Klein 7777, 7778* (HBR, US); perto do Rio das Antas, Rio das Antas, *Klein 7780* (HBR, US); 10 km a leste de Campos Novos, Campos Novos, *Klein 7818, 7819* (US); Rio da Dúvida, Abelardo Luz, *Klein & Klein 11027* (HBR, US); Mun. Agua Doce, 5 km S of turn to the south in road E of Palmas, *Smith et al. 15684* (HBR, MO, US). **São Paulo:** Campos da Serra da Bocaina, 6 Apr 1929 (fl), *Kuhlmann 200* (US); Barreiro Co., Serra da Bocaina, Pinherinho, *Segadas-Vianna 2983* (US).

URUGUAY. Dept. unknown: Cerro de las Animas, Maldonado, *Berro 804* (K); Corticeiras, Rivera, *Berro 4672* (K). **Treinta y Tres:** Yerbal, *Herter 1089* (GH, MO, US); Isla Patrulla, Quebrada de los Cuervos, *Rosengurt B-4821* (US); ao Carajá del Olimar, a 2 leguas de Sta. Clara, 9 Oct 1945 (fl), *Rosengurt B-4836* (K, US); Quebrada do Los Cuervos, *Rosengurt et al. 10252* (US).



FIGS. 11–13. Distributions of two species of *Chusquea*. 11. *C. mimosa* subsp. *mimosa*. 12. *C. mimosa* subsp. *australis*. 13. *C. juergensii*.

This widespread species is characterized by abaxially glabrous culm leaves with the sheaths 1.6 to 5 (9) times as long as the blade; nodes with the central bud only slightly larger than the largest of the trimorphic subsidiary buds; foliage leaves with the sheaths maculate, the inner ligules 0.2–0.5 mm long and truncate, and the blades (0.3) 0.5 to 1.2 cm wide with L:W = 6.5 to 11 (13); narrow panicles 1 to 3 cm long; and dorsally compressed spikelets 6.9 to 8.7 mm long with the palea overtopping the fertile lemma. *Chusquea juergensii* is readily distinguished from *C. mimosa* by its unusual trimorphic bud/branch complement, maculate foliage leaf sheaths, and larger spikelets with the palea overtopping the fertile lemma.

Until recently, *C. swallenii* was thought to be a rare species known only from the vegetative type collection near Caçador, Santa Catarina (McClure & Smith, 1967). The type perfectly matches various collections of the previously named *C. juergensii*, hence the two are treated here as the same

species. While the Caçador population of *C. juergensii* is probably threatened, the species itself persists along streams and rivers in forest remnants throughout southern Brazil.

10. *CHUSQUEA MIMOSA* McClure & Smith (Fig. 14)

Chusquea mimosa McClure & Smith in Reitz, Fl. Ilus. Cat. Gramineae-Supl. Bambuseae 1: 37. 1967. TYPE: BRAZIL. Santa Catarina: Campo Alegre, Morro do Iquererim, riverside, 1300 m, 10 Jan 1958 (fl), Reitz & Klein 6139 (HOLOTYPE: US!; ISOTYPE: HBR!).

Chusquea elegans Renvoize, Kew Bull. 42(4): 924. 1987. TYPE: BRAZIL. Paraná: Mun. Morretes, Serra Marumbi, Pico Olimpo, 1500 m, 13 Nov 1970 (fl), Hatschbach 25386 (HOLOTYPE: MBM!; ISOTYPES: K!, US!).

Culms 0.7–2.5 (3) cm in diam., 1.5–4 (5) m tall, erect to somewhat arching at the apices. *Internodes* 9–26 cm long, more or less terete to slightly flattened above the branch complement, glabrous, waxy. *Culm leaves* 12.6–29 cm long, caducous, juncture of sheath and blade abaxially a more or less horizontal line or a shallow, inverted “V,” obscure or distinct; sheaths 6.9–27.3 cm long, 1.2–27.5 (50) times as long as the blade, abaxially glabrous or retrorsely scabrous toward the apex or in one population densely tomentose with appressed hairs along one shoulder near the apex, the margins usually glabrous, sometimes ciliate toward the apex, often somewhat scarious; blades 0.3–5.7 (9.2) cm long, triangular, erect, persistent, rarely deciduous, abaxially and adaxially glabrous or retrorsely scabrid or abaxially glabrous and adaxially scabrid, the apex subulate; girdle (0.5) 1–2 mm wide, glabrous; inner ligule 0.5–6 mm long, irregular, ciliate, sometimes absent. *Nodes* slightly swollen, the one triangular central bud subtended and partially encircled by 1 or 2 rows of smaller subsidiary buds in a constellate array, with usually two of the subsidiaries robust and much larger than the others; sheath scar dipping slightly below the bud complement; supranodal ridge prominent; root primordia absent. *Branching* modified extravaginal, the culm leaves often split at the base but falling as the branches develop; central branch 50–75 cm long, divergent,

rebranching; smaller leafy subsidiary branches 15–80 per node, 6–20 cm long, divergent to ascending, occasionally rebranching, the robust subsidiary branches 2 or 3 per node, 26–100 cm long, divergent, rebranching. *Foliage leaves* 5–9 per complement; sheaths deciduous, usually uniform in color, rarely maculate with light green spots, glabrous, the margins glabrous or ciliate, scarious; blades 3.4–11.4 cm long, (0.2) 0.5–0.9 (1.2) cm wide, L:W = (4) 7.5–24, adaxially glabrous, abaxially glabrous or less commonly pilose, not tessellate, apex subulate, base attenuate to rounded-attenuate; pseudopetiole 1–2 (3) mm long; outer ligule 0.1–0.5 (1) mm long, glabrous or ciliate; inner ligule 0.5–4 mm long, rounded, glabrous or abaxially pubescent at the base. *Panicles* 1.5–5 cm long, the mature panicle narrow or the basal branches divergent or all branches and pedicels divergent to recurved and the panicle open, the base usually retained within the subtending sheath, sometimes fully exerted; rachis angular, usually scabrous-pubescent at base, only the edges scabrous toward the apex, or less commonly completely scabrous-pubescent or completely glabrous; branches angular, usually glabrous with only the edges scabrid, sometimes completely glabrous to completely pubescent, the lower ones to 1 cm, these appressed or reflexed; pedicels 1.5 mm long, angular, glabrous, the edges scabrid, or completely pubescent, appressed or reflexed, often slightly sinuous. *Spikelets* 4.3–7.5 mm long, glabrous, sometimes slightly falcate, the antherium 0.9–1.6 mm wide, more or less dorsally compressed. *Glumes* 2, 0.1–0.4 mm long, less than $\frac{1}{20}$ the spikelet length, scalelike, nerves absent. *Sterile lemmas* 2, 1.8–3.8 mm long, ca. $\frac{1}{2}$ the spikelet length, mucronate or subulate, 1- or 3-nerved. *Fertile lemma* 4.2–6.4 mm long, mucronate, 7-nerved. *Palea* 4–6.6 mm long, palea and fertile lemma subequal or the palea overtopping the fertile lemma, sulcate toward the apex, bimucronulate, 4-nerved. *Stamens* 3, the anthers 3–3.7 mm long. *Lodicules* 3, the anterior pair ca. 0.7 mm long, the posterior one ca. 0.5 mm long, all ciliate. *Fruit* unknown.

Distribution: Southeastern Brazil from

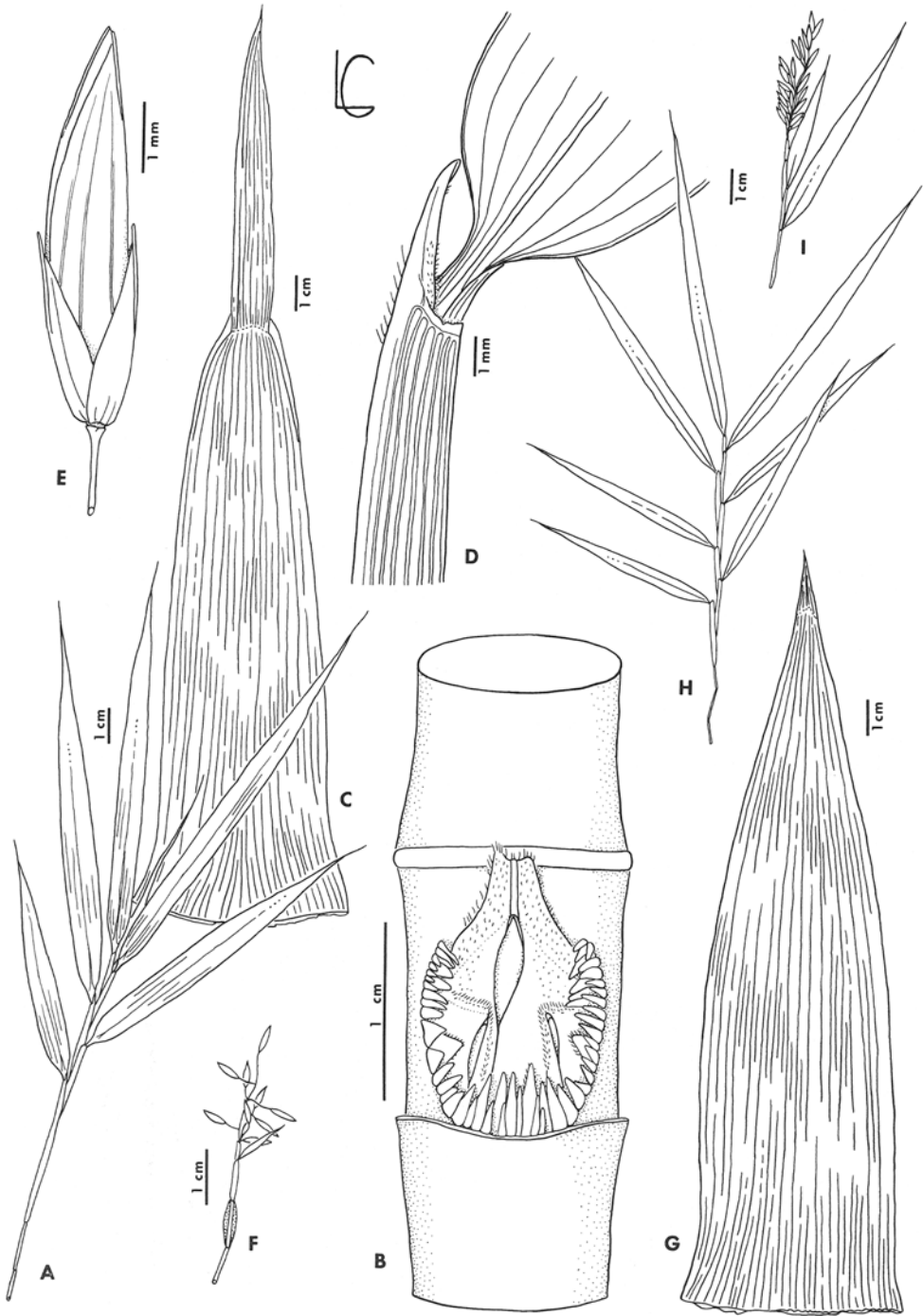


FIG. 14. *Chusquea mimosa*. A-F. subsp. *mimosa* (A-D. Clark & Oliveira 928; E & F. Reitz & Klein 6139). A. Leaf complement. B. Bud complement. C. Culm leaf, abaxial view. D. Ligular area of foliage leaf. E. Spikelet. F. Panicle with spreading branches. G-I. subsp. *australis* (G & H. Clark & Oliveira 875; I. Klein 8528). G. Culm leaf, abaxial view. H. Leaf complement. I. Panicle with appressed branches.

Paraná to Rio Grande do Sul (Figs. 11 & 12); canyons, gallery forests, dwarf or cloud forests, or shrubby grasslands, often associated with *Araucaria* formations, frequently along river or streambanks or in marshy areas; (450) 650 to 1800 m.

Chusquea mimosa is a widespread, variable species of southern Brazil that is characterized by strongly dimorphic subsidiary buds/branches in a constellate arrangement; foliage leaves with the sheaths usually uniform in color and the inner ligules 0.5–4 mm long and rounded; and more or less dorsally compressed spikelets 4.3–7.5 mm long and 0.9–1.6 mm wide with minute, scalelike glumes and sterile lemmas about ½ the spikelet length. Sheath : blade length ratio of the culm leaves, number of subsidiary branches, width of the foliage leaf blades, divergence of the branches/pedicels of the panicles, and spikelet length are features that show great variation within the species. Although the extremes of variation illustrated in Figure 14 appear to be sufficient to justify the recognition of two species, there are many intermediates; thus, formal recognition of two subspecies is deemed more appropriate. Divergence of the panicle branches and pedicels is an unreliable character in distinguishing between the subspecies.

10A. *CHUSQUEA MIMOSA* subsp. *MIMOSA* (Fig. 14A–F)

Culms 0.7–1.5 cm in diam., 1.5–4 m tall. *Culm leaf* sheaths 1–5 times as long as the blade. *Smaller subsidiary branches* 15–40 per node. *Foliage leaf* blades (0.3) 0.5–0.9 (1.2) cm wide, L:W = (4) 7.7–15, base attenuate to rounded-attenuate. *Panicles* (1.5) 2–4 cm long. *Spikelets* 4.3–6.3 (7.5) mm long, the antherium 0.9–1.4 mm wide, palea and fertile lemma subequal.

Specimens examined: BRAZIL. **Paraná:** Paranaguá, pr. Pico do Marumbi, 10 Mar 1983 (fl), *Chagas e Silva* 469 (SP); Mun. Quatro Barras, above Borda do Campo, Morro Anhangava, along trail to the peak, *Clark & Oliveira* 932 (ISC, MBM, MO, RB, SJRP, SP, US); Mun. Piraquara, Morro Anhangava (cume), 8 Apr 1951 (fl), *Hatschbach* 2219 (US); Mun. Piraquara, Serra do Emboque, 14 Oct 1970 (fl), *Hatschbach* 24950 (MBM, US); Mun. Morretes, Serra Marumbi, picada Frontal, 20 Oct 1982 (fl), *Hatschbach* 45696 (MBM, US); Mun. Quatro Barras, Morro Anhangava, 11 Nov 1970 (fl),

Imaguire 637 (K); Mun. Guaratuba, Serra do Araçatuba, 19 Aug 1982 (fl), *Kummrow* 2031 (MBM, US). **Rio Grande do Sul:** BR-116, between Caxias do Sul and Vacaria, about 18 km S of Vacaria, along a stream crossing, *Clark & Oliveira* 921 (ICN, ISC, RB, SJRP, SP, US). **Santa Catarina/Rio Grande do Sul:** Serra Geral, road Timbê do Sul to S. José dos Ausentes, about 22.2 km from Timbê do Sul, Serra da Rocinha (Serra dos Pinheiros), 6 Mar 1991 (fl), *Clark & Windisch* 878 (HRB, ISC, MO, RB, SJRP, SP, US). **Santa Catarina:** Lages, 1935 (fl), *Bruni* 7031 (PACA, US); BR-470, Rio do Sul–Curitibanos, about 33.3 km W of Pouso Redondo, about 41.5 km E of Curitibanos, *Clark & Oliveira* 893 (HRB, ISC, MO, RB, SJRP, SP, US); BR-116, about 40 km S of Lages, Km 292, *Clark & Oliveira* 922 (HRB, ISC, MO, RB, SJRP, SP, US); Mun. Campo Alegre, along the Rio Negro, Serra do Iquererim below the Morro, about 19.5 km from Postema, *Clark & Oliveira* 928 (HRB, ISC, MO, RB, SJRP, SP, US); Serra Geral, along access road to Morro Campo do Padre, turnoff from main road between Urubici and Tuberão, *Clark & Windisch* 871 (HRB, ISC, MO, SJRP, SP, US); Barra do Arroio União, Dionisio Cerqueira, *Klein* 7800 (HBR, US); Tunel 18, Estrada SC-23, Curitibanos, *Klein* 7821 (HBR, US); bank of Rio das Flores, 25 km SE of Barracão at border with Paraná, 11 Dec 1966 (fl), *Lindeman & Haas* 3604 (MBM, U, US); Mun. São Joaquim, camino a Lajes, 10 km de S. Joaquim, 15 Dec 1967 (fl), *Lourteig* 2191 (HBR, US); Porto União, in silva, *Orth* 2508 (HBR, PACA, US); Campo dos Padres, Bom Retiro, *Reitz* 2636 (HBR); Morro do Iquererim, Campo Alegre, 18 Oct 1957 (fl), *Reitz & Klein* 5255 (HBR, MO, US); Serra do Oratório, Bom Jardim, São Joaquim, 12 Jan 1959 (fl), *Reitz & Klein* 8115 (HBR, PACA, US); Rio dos Pinheiros, Anitápolis, 1 Jun 1968 (fl), *Reitz & Klein* 18155 (HBR); Mun. Bom Jardim da Serra, 10 km S of Bom Jardim at Rio Capivari, *Smith & Klein* 15807 (MO, US).

10B. *Chusquea mimosa* subsp. *australis* L. G. Clark, subsp. nov. (Fig. 14G–I)

TYPE: BRAZIL. Rio Grande do Sul: Mun. Cambará do Sul, canyon of Itaimbezinho, 920 m, 3 Feb 1973 (fl), *Soderstrom* 2042 (HOLOTYPE: US!).

Culmi 1–2.5 (3) cm diam., 2–4 (5) m alti. *Vaginae* culmorum (3.5) 12–27.5 (50)-plo longiores quam laminam. *Rami* subsidiarii tenues cujusquisque nodi 45–80. *Laminae* foliorum (0.2) 0.4–0.7 cm latae, ratio long./lat. = 10.6–24, basi attenuatae. *Paniculae* 1–3 cm longae. *Spiculae* (5.5) 6–7.5 mm longae, 1.1–1.6 mm latae, palea plerumque longior quam lemma fertile.

Culms 1–2.5 (3) cm in diam., 2–4 (5) m tall. *Culm leaf* sheaths (3.5) 12–27.5 (50) times as long as the blade. *Smaller subsidiary branches* 45–80 per node. *Foliage leaf* blades (0.2) 0.4–0.7 cm wide, L:W = 10.6–24, base attenuate. *Panicles* 1–3 cm long. *Spikelets* (5.5) 6–7.5 mm long, the anthe-

cium 1.1–1.6 mm wide, palea and fertile lemma subequal or more commonly the palea overtopping the fertile lemma.

Specimens examined: BRAZIL. **Rio Grande do Sul:** 1935 (fl), *Orth* 1950 (US); Mun. Cambará do Sul, Itaimbezinho, May 1971 (fl), *Baptista & Loescheiter s.n.* (ICN); Parque Nacional de Aparados da Serra, Itaimbezinho, along river near entrance, 18.3 km S of Cambará do Sul, *Clark & Windisch* 881 (ICN, ISC, MO, RB, SJRP, SP, US); BR-116, between Caxias do Sul and Vacaria, about 20.5 km S of San Marcos, *Clark & Oliveira* 919 (ISC, MO, PACA, RB, SJRP, SP, US); Mun. Barros Cassal, upper Rio Pardo, 23 Feb 1992 (fl), *Clark et al.* 1040 (ICN, ISC, MBM, MO, SJRP, SP, US); S. Francisco de Paula, Oct 1905 (fl), *Dutra* 415 (ICN, US); Ferrabraz, Dec 1927 (fl), *Dutra* 1542 (ICN); Morro Pelado, ca. 8 km S de Canela, no matto abaixo mirante, *Girardi & Porto s.n.* (CEN, ICN); Taimbezinho para São Francisco de Paula, 3 Jan 1970 (fl), *Klein* 8526 (HBR, US); depois de Caracol, ca. 10 km N de Canela, *Porto et al. s.n.* (CEN, ICN); Serra da Rocinha para Bom Jesus, 18 Jan 1950 (fl), *Rambo* 45388 (PACA); Mun. Cambará do Sul, 100 m N of the cellulose factory ("Celulose Cambará"), NE of Cambará do Sul, *Soderstrom* 2043 (US); Bom Jesus-Encl. das Antas, Pinhal a 1 km a O do Posto Fiscal, 9 Aug 1972 (fl), *Valls et al.* 2126 (CEN, ICN, ISC); São Francisco de Paula-Morro da Pera, prox. a vertente canalizada a beira da Rodovia RS-2, *Valls et al.* 2594 (CEN, ICN); Cambará do Sul-Itaimbezinho, entre a extremidade inicial do perau e o restaurante, *Valls & Soderstrom* 2611 (CEN, ICN); Caxias do Sul-Distrito de Vila Oliva, 2 km a oeste da Vila, *Valls* 2165 (CEN, ICN). **Santa Catarina:** along road to Morro da Igreja, 8.9 km from the main road between Urubici and Tubarão, Serra Geral, 5 Mar 1991 (fl), *Clark & Windisch* 868 (HRB, ISC, MO, RB, SJRP, SP, US); Serra Geral, road from Timbé do Sul to S. José dos Ausentes, about 15.2 km from Timbé do Sul, Serra da Rocinha (Serra do Pinheiro), *Clark & Windisch* 875 (HRB, ISC, MO, RB, SJRP, SP, US); road from Orleans to Bom Jardim da Serra, 24 Feb 1992 (fl), *Clark et al.* 1044 (HBR, ISC, MO, SJRP, SP, US); Serra da Rocinha, Timbé, 3 Jan 1970 (fl), *Klein* 8528 (HBR, US); Campo dos Padres, Bom Retiro, *Reitz* 2663 (HBR, US); Morro do Trombudo, Bom Jardim, S. Joaquim, 12 Dec 1958 (fl), *Reitz & Klein* 7824 (HBR, MBM, SP, US); Urupema, S. Joaquim, 24 Dec 1962 (fl), *Reitz & Klein* 14583 (HBR, US); 15 Jul 1963 (fl), *Reitz & Klein* 15904 (HBR, US); *Reitz & Klein* 15872 (HBR, US); 15 Sep 1963 (fl), *Reitz & Klein* 16349 (HBR, US); 1 Jun 1968 (fl), *Reitz & Klein* 18147 (HBR, US); Mun. Bom Retiro, Fazenda Campo dos Padres, Campo dos Padres, *Smith et al.* 7773 (HBR, R, SP, US); Mun. Timbé do Sul, Serra da Rocinha, local "Curva Fria," 30 Dec 1970 (fl), *Valls & Arzience* 1393 (US).

11. *Chusquea nudiramea* L. G. Clark, sp. nov. (Fig. 15)

TYPE: BRAZIL. Santa Catarina: Santo Amaro da Imperatriz, Cobrinha de Ouro, S. do Rio, 200 m, 9 Aug 1973 (fl), *Bresolin*

1002 (HOLOTYPE: MBM!; ISOTYPES: HBR!, ISC—frag., US!).

Culmi 1–1.2 cm diam., 2–4 m alti, erecti vel inclinati. Folia culmorum 7.5–14 cm longa, decidua; vaginae 7.2–10.2 cm longae, 2–3.3 (6.5)-plo longiores quam laminam, glabrae; laminae 1–4.6 cm longae, loratae, erectae reflexescentes, deciduae. Ramificatio extravaginalis mutata; ramus centralis 0.5–1 m longus, divergens; rami subsidiarii tenues cujusquisque nodi 4–10, 16–23 cm longi, adscendentes, duo robustiores, 20–50 cm longi, adscendentes. Folia cujusquisque complementi 7–8; vaginae deciduae, glabrae; laminae 7–16 cm longae, 0.4–1.1 cm latae, ratio long./lat. = 11–19, glabrae, non tessellatae, basi attenuatae vel rotundato-attenuatae. Panicula 3–3.5 cm longa. Spiculae 8.3–9.1 mm longae, glabrae. Glumae 2, squamiformes. Lemmata sterilia 2, subulata, $\frac{1}{2}$ spiculam attingentia. Lemma fertile 7.9–8.3 mm longum, subulatum. Palea 7.6–7.9 mm longa.

Culms 1–1.2 cm in diam., 2–4 m tall, erect to leaning. *Internodes* 16–22 cm long, terete, glabrous, glaucous when young. *Culm leaves* 7.5–14 cm long, deciduous as the branches develop, the base often splitting, juncture of sheath and blade a more or less horizontal line; sheaths 7.2–10.2 cm long, 2–3.3 (6.5) times as long as the blade, abaxially glabrous, the margins ciliate; blades 1–4.6 cm long, straplike, articulated with the sheath, erect becoming reflexed, deciduous, abaxially glabrous, adaxially pubescent at the base, the apex mucronate, the margins serrulate; girdle 0.5 mm wide, glabrous; inner ligule 0.4 mm long, ciliolate. *Nodes* with the nearly circular central bud subtended by 1 row of smaller subsidiary buds in a constellate array, two of the subsidiaries robust and larger than the others; sheath scar dipping slightly below the bud complement; supranodal ridge prominent; root primordia absent. *Branching* modified extravaginal, the culm leaves often split at the base but falling as the branches develop; central branch 0.5–1 m long, divergent, rebranching; smaller leafy subsidiary branches 4–10 per node, 16–23 cm long, more or less ascending, occasionally rebranching, the robust subsidiary branches usually 2 per node, 20–50 cm long, ascending, rebranching. *Foliage leaves* 7 or 8 per complement; sheaths deciduous, uniform in color, glabrous, the margins sparsely ciliate; blades 7–16 cm long, 0.4–1.1 cm wide, L:W = 11–19, abaxially and adaxially glabrous, not tessellate, the apex short setose, the base attenuate to

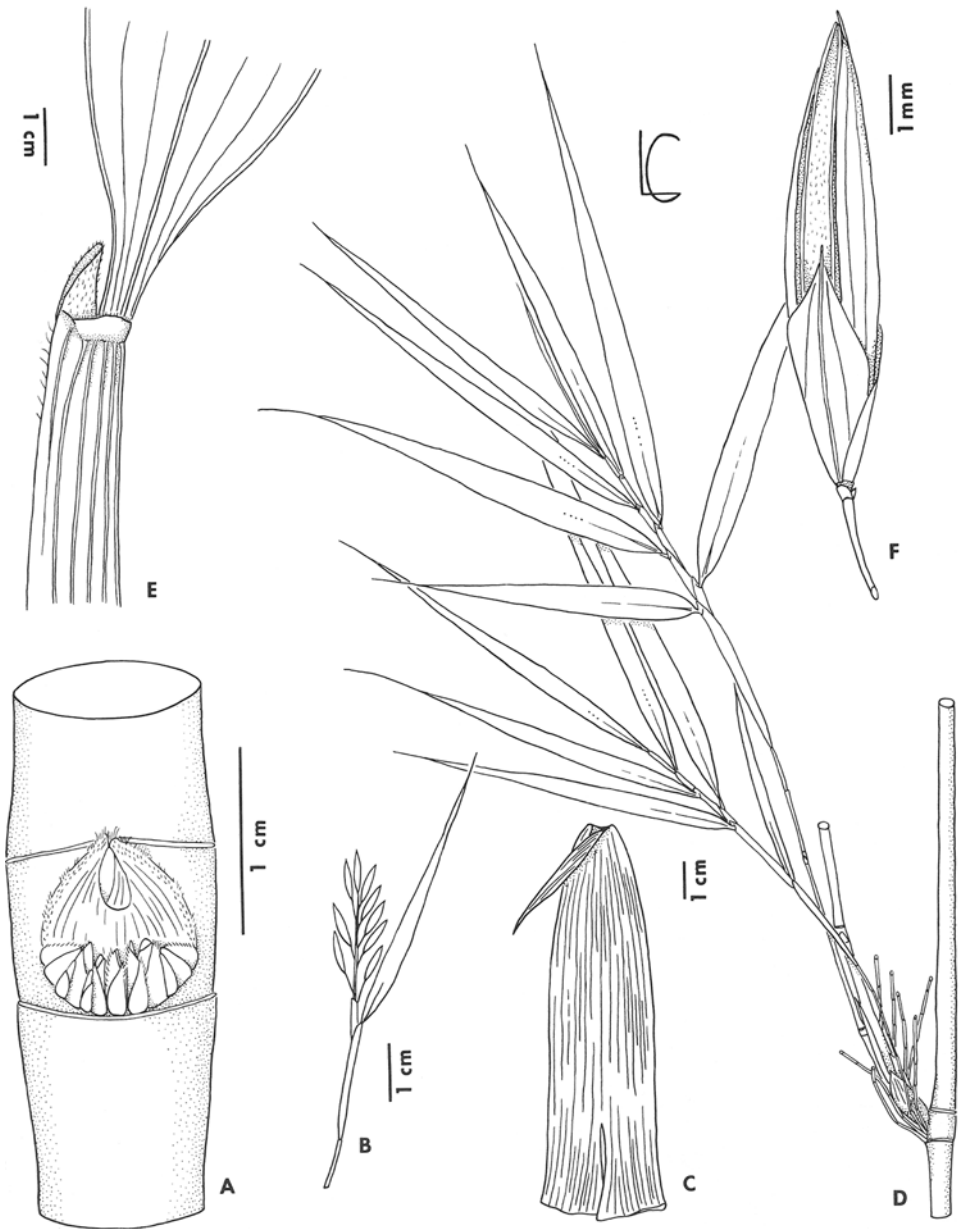


FIG. 15. *Chusquea nudiramea* (A, C-E. Clark & Windisch 1068; B, F. Bresolin 1002). A. Bud complement. B. Panicle. C. Culm leaf, abaxial view. D. Branch complement with leafy subsidiary branches. E. Ligular area of foliage leaf. F. Spikelet.

rounded-attenuate; pseudopetiole 1.5–3 mm long; outer ligule 0.5–2 mm long, glabrous; inner ligule 1–3 mm long, rounded, abaxially pubescent. Panicles 3–3.5 cm long, narrow, the base retained within the subtending

sheath; rachis angular, glabrous, the edges scabrous; branches angular, glabrous, the edges scabrous, the lower ones 0.5–0.8 cm long, appressed; pedicels 1–3 mm long, angular, glabrous, the edges scabrid, ap-

pressed. *Spikelets* 8.3–9.1 mm long, glabrous, sometimes slightly falcate, the antherium 1.3–1.5 mm wide, dorsally compressed. *Glumes* 2, 0.1–0.2 mm long, less than $\frac{1}{30}$ the spikelet length, scalelike, nerves absent. *Sterile lemmas* 2, 3.5–4.5 mm long, ca. $\frac{2}{5}$ the spikelet length, subulate, 1- or 3-nerved. *Fertile lemma* 7.9–8.3 mm long, subulate, 7- or 9-nerved. *Palea* 7.6–7.9 mm long, subequal to the fertile lemma, sulcate toward the apex, the sulcus scabrid, bimucronate, 4-nerved. *Stamens* unknown. *Lodicules* unknown. *Caryopsis* 4.1 mm long, reddish-brown.

Distribution: Santa Catarina, Brazil, along the Rio Cobrinha de Ouro (Fig. 7); rocky river banks; 50 to 200 m.

Specimen examined: BRAZIL. Santa Catarina: Santo Amaro da Imperatriz, Rio Cobrinha de Ouro, 50–75 up the river from the rapids, 7 Mar 1992, Clark & Windisch 1068 (HBR, ISC, MBM, MO, SJRP, SP, US).

This species, named for the naked branches characteristic of this group, is also distinguished by the culm leaves with the blades becoming reflexed and deciduous; nearly circular central bud; subsidiary branches in one constellate row, with 4 to 10 smaller subsidiary branches per node; and glabrous spikelets 8.3 to 9.1 mm long. *Chusquea nudiramea* is only known from one locality, but is probably more widely distributed in the Atlantic forest of Santa Catarina; further study of this species is necessary. Although *C. nudiramea* clearly belongs to the *Nudiramea* group based on its deciduous culm and foliage leaf sheaths and the dimorphic subsidiary buds/branches, it is unusual in that it occurs at such low altitudes.

Heterophylla Group

Culms 0.3–1.5 (2) cm in diam., 0.5–2 (3) m tall, fastigiate, erect to arching slightly at the apices. Internodes 1.5–13.5 cm long, terete to sulcate above the branch complement, pubescent just below the nodes, otherwise glabrous, waxy. Culm leaves persistent, abaxially glabrous to scabrous; sheaths 1–6.2 times as long as the blades, fused at the base; blades erect, persistent. Nodes at mid-culm with one triangular cen-

tral bud subtended by either 1 or 2 rows of subsidiary buds in a constellate array, or 5 or 6 tiers of subsidiary buds in a more or less linear array; sheath scar dipping slightly below the bud/branch complement. Branching extravaginal; central branch developing or not; leafy subsidiary branches 12–60 per node, 1.5–15 cm long. Foliage leaf blades 0.85–3.7 cm long, 0.1–0.4 cm wide, L:W = 5–15, not tessellate. Panicles 1–4 cm long, narrow. Spikelets 4.7–6.9 mm long. Glumes scalelike, $\frac{1}{8}$ or less than the spikelet length. Sterile lemmas subequal or sterile lemma II longer than sterile lemma I, at least $\frac{1}{2}$ the spikelet length, mucronate or subulate.

The two species included in this informal group resemble *Chusquea* sect. *Swallenochloa* in their erect, fastigiate habit, short, waxy internodes, and high-altitude habitat. However, both species exhibit extravaginal branching with usually numerous subsidiary branches, features that exclude them from sect. *Swallenochloa*. Until the affinities of these species can be determined, *C. heterophylla* and *C. microphylla* will be regarded informally as members of the *Heterophylla* group. Clark (1989) noted some similarity between *C. heterophylla* and two other species, *C. linearis* N. E. Brown (Venezuela) and *C. abietifolia* Griseb. (West Indies), which have similar foliage leaves and branch complements but are viny. Their affinity to the *Heterophylla* group remains to be clarified.

12. CHUSQUEA HETEROPHYLLA Nees (Fig. 16A–F)

Chusquea heterophylla Nees, Linnaea 9: 488. 1834 (1835). *Chusquea heterophylla* var. *squamosa* Doell in C. Martius, Fl. bras. 2(3): 207. 1880. *Chusquea pinifolia* Nees var. *heterophylla* (Nees) Hackel in Wettstein, Danks. Kaiserl. Akad. Wiss. 79: 82. 1908. TYPE: BRAZIL. *Sello s.n.* (HOLOTYPE: B—destroyed; LECTOTYPE, here designated: LE, photograph seen; probable isotype: US! no. 1021584). *Chusquea heterophylla* var. *elongata* Doell in C. Martius, Fl. bras. 2(3): 207. 1880. TYPE: BRAZIL. *Sello 853* (HOLOTYPE: B—destroyed; LECTOTYPE, here designated: US! no. 2874627).

Culms 1–1.5 (2) cm in diam., 1–2 (3) m tall, erect at the base, inclined to arching slightly at the apices. Internodes 3.8–8.6 cm

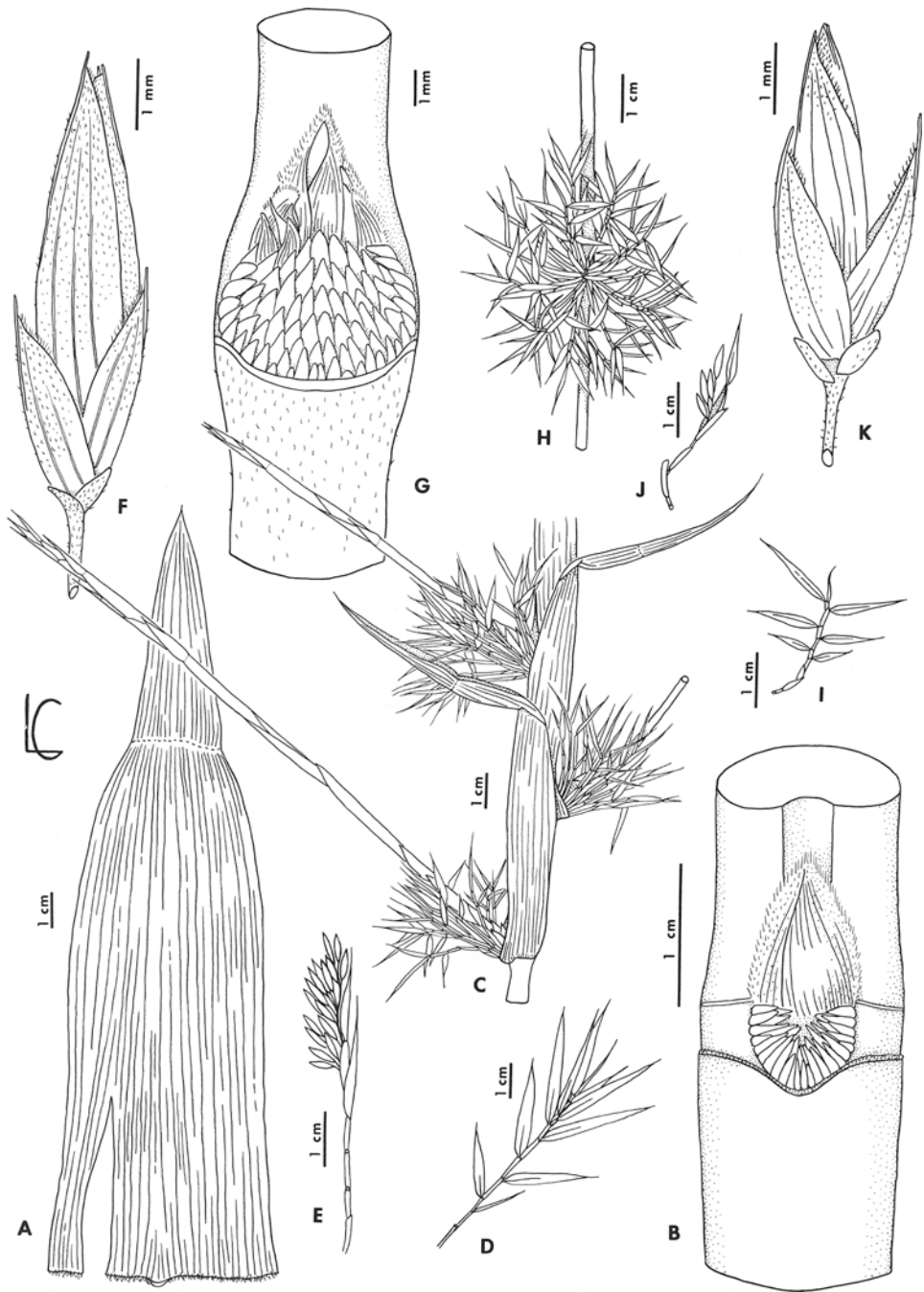


FIG. 16. *Chusquea heterophylla* and *C. microphylla*. A-F. *C. heterophylla* (A, B, D. Clark & Morel 634; C. Soderstrom 1928; E & F. Clark et al. 658). A. Culm leaf, abaxial view. B. Bud complement. C. Young culm showing extravaginal branching and precocious development of the central branch. D. Leaf complement. E. Panicle. F. Spikelet. G-K. *C. microphylla* (G-I. Clark & Morel 633; J. Campos Porto 1117; K. Wettstein & Schiffner s.n.). G. Bud complement. H. Branch complement. I. Leaf complement. J. Panicle. K. Spikelet.

long, slightly flattened to sulcate above the branch complement, pubescent just below the nodes, glabrous on the lower half, waxy. *Culm leaves* (9) 11.6–23.6 cm long, persistent, often surpassing the next node, abaxially scabrid to scabrous, juncture of sheath and blade abaxially an obscure, more or less horizontal line; sheaths (6) 7.5–16 cm long, 1–2.4 (4.2) times as long as the blade, fused for 1–2 cm at the base; blades (3.5) 6–9 cm long, triangular, erect, persistent, adaxially scabrid or pubescent toward base or apex, apex mucronate or subulate, base narrower than the sheath apex; girdle 1–2 mm wide, pubescent; inner ligule 0.5–1 mm long, irregular, ciliolate, sometimes absent. *Nodes* slightly swollen, the one triangular central bud subtended by 1 or 2 rows of smaller subsidiary buds in a constellate array; sheath scar dipping below the branch complement; supranodal ridge prominent; root primordia absent. *Branching* extravaginal; central branch 18–29 cm long, ascending, rebranching; leafy subsidiary branches 12–45 per node, 3–15 cm long, ascending, occasionally rebranching from the base. *Foliage leaves* 9–12 (18) per complement; sheaths persistent, pubescent between the nerves, especially toward the margins, the margins ciliate or glabrous; blades 1.3–3.7 cm long, 0.2–0.4 cm wide, L:W = 6.5–15, glabrous, not tessellate, apex subulate, base rounded to more commonly rounded-attenuate; pseudopetiole ca. 0.5 mm long, more or less distinct; outer ligule 0.1–0.2 mm, ciliolate; inner ligule 0.3–0.5 mm long, truncate. *Panicles* 1–4 cm long, narrow, base retained within the subtending sheath; rachis angular, pubescent; branches angular, pubescent, appressed, the lower ones to 1 cm long; pedicels 1–3.5 mm long, angular, pubescent, appressed. *Spikelets* 5.4–6.9 mm long, the antherium 1.2–1.5 mm wide, more or less terete. *Glumes* 2, ca. $\frac{1}{10}$ the spikelet length, scalelike, acute to obtuse, pubescent; glume I 0.4–1 mm long, 1-nerved or nerves absent; glume II 0.4–2 mm long, 1- or 3-nerved or nerves absent. *Sterile lemmas* 2, $\frac{1}{2}$ – $\frac{2}{3}$ the spikelet length, mucronate or subulate, abaxially pubescent on the upper one-half to two-thirds, 3- or 5-nerved; sterile lemma I 2.9–4.2 mm long; sterile lemma II 3.1–4.7

mm long. *Fertile lemma* 4.9–6.7 mm long, mucronate or subulate, abaxially pubescent on the upper two-thirds, 5-, 7-, or 9-nerved. *Palea* 4–6.1 mm long, slightly shorter than the fertile lemma, bimucronulate, sulcate toward the apex, 4- or 6-nerved. *Stamens* 3, the anthers ca. 3 mm long. *Lodicules* 3, the anterior pair 0.8–1 mm long, the posterior one ca. 0.8 mm long, ciliate. *Caryopsis* ca. 3.7 mm long, the beak 0.3 mm long, reddish-brown with a dark, linear hilum.

Distribution: Serra dos Órgãos, Rio de Janeiro, and Itatiaia, Rio de Janeiro/Minas Gerais, Brazil (Fig. 7); high altitude grasslands; 2100 to 2500 m.

Specimens examined: BRAZIL. State unknown: *Glaziou* 3602 (C, US); *Glaziou* 6777 (BR, C). **Minas Gerais:** Mun. Itamonte, road to Pico das Agulhas Negras, Km 13–14, Fazenda Alsene, *Clark & Morel* 634 (BHC, ISC, MO, NY, RB, SJRP, SP, US); Mun. Itamonte, Parque Nacional de Itatiaia, Pico das Agulhas Negras, near abrigo Rebouças, Rio Campo Belo, 10 Feb 1990 (fl), *Clark et al.* 658 (ISC, K, MO, NY, RB, SJRP, SP, US); Planalto de Itatiaia, *Samperio* 4759 (R). **Rio de Janeiro:** Itatiaia, Rio d'Ouro, Sep 1934 (fl), *Brade* 14061 (RB); Itatiaia, Pedra do Echo, Mar 1937 (fl), *Brade* 15633 (RB); Parque Nacional do Itatiaia, *Camerik* 135 (U); Alto de Itatiaia, *Chase* 8292 (MO, US); Mun. Teresópolis, Parque Nacional Serra dos Órgãos, Campo das Antas, trail to Pedra do Sino, *Clark et al.* 791 (ISC, MBM, MO, RB, SJRP, SP, US); 11 Feb 1991 (fl), *Clark et al.* 792 (ISC, MO, RB, SJRP, SP, US); Mun. Nova Friburgo, Pico de Caledônia, Reserva do Petrobras, Serra dos Órgãos, *Clark et al.* 803 (ISC, MBM, MO, RB, SJRP, SP, US); 15 Feb 1991 (fl), *Clark et al.* 804 (ISC, MBM, MO, RB, SJRP, SP, US); Mun. Teresópolis/Petrópolis, Serra dos Órgãos National Park, ca. 7 km SW of city of Teresópolis, *Eiten & Eiten* 7144 (SP, US); Organ Mts., *Gardner* 5910 (US); Haut des Órgãos, 1872 (fl), *Glaziou* 6444 (BR, C, RB, S, US, W); 22 Aug 1872 (fl), *Glaziou* 6446 (P-1 sheet); Serra do Itatiaia, *Hemmendorff* 622 (S); Alto do Itatiaia, 19 Oct 1922 (fl), *Kuhlmann s.n.* (GH, US); Parque Nacional do Itatiaia, *McChure* 21286 (US); vicinity of Itatiaia, 26–30 Jul 1915 (fl), *Rose & Russell* 20481 (US); Resende Co., Serra do Itatiaia, Aug 1950 (fl), *Segadas-Vianna* 5124 (US); Mun. Petrópolis/Teresópolis, Serra dos Órgãos, Morro Açu, *Soderstrom* 1928 (RB, US); 4 Apr 1972 (fl), *Soderstrom* 1928X (RB, US); Planalto of Itatiaia, 150 km NW of Rio de Janeiro, shelter house to Pedra Atar, *Tryon & Tryon* 6692 (US).

Chusquea heterophylla is distinguished by persistent, abaxially scabrid to scabrous culm leaves with the sheaths fused at the base and 1 to 2.4 (4.2) times as long as the

blades; extravaginal branching; central branches that nearly always develop; constellate leafy subsidiary branches 12 to 45 per node and 3 to 15 cm long; foliage leaf blades 1.3 to 3.7 cm long and 0.2 to 0.4 cm wide with L:W = 6.5 to 15; narrow panicles 1 to 4 cm long; and pubescent spikelets 5.4 to 6.9 mm long. This species was cited as a synonym of *C. pinifolia* by McClure (1973), but Clark (1989) excluded it based on several consistent vegetative differences. Recent study has shown that *C. heterophylla* is indeed a good species, and further, that one of its varieties recognized by Doell (1880) deserves specific status (see *C. microphylla*).

This species is known from three populations in the eastern coastal range of Brazil, where it often forms extensive stands in high altitude grasslands. Variation in height as a function of exposure is often evident; the plants are much shorter when they grow on exposed ridges. The principal variation among the three populations is seen in the culm leaves, such that the Itatiaia population has the best developed blades, the Pedra do Sino population has moderately developed blades, and the Pico da Caledônia population often shows no differentiation at all between the sheath and blade. In all three populations, however, the culm leaves usually surpass the next node, and the apex of most culm leaves is pushed away from the culm by the developing subsidiary branches at the next higher node (Fig. 16C) which gives a very characteristic appearance to the young culms.

12. *Chusquea microphylla* (Doell in C. Martius) L. G. Clark, comb. et stat. nov. (Fig. 16G–K)

Chusquea heterophylla Nees var. *microphylla* Doell in C. Martius, Fl. Bras. 2(3): 207. 1880. TYPE: BRAZIL. Rio de Janeiro/Minas Gerais: Itatiaia, 1871, *Glaziou 5436* (LECTOTYPE, here designated: C!).

Culms 0.3–0.5 cm in diam., 0.5–1 m tall, erect. *Internodes* with the basal ones 4.5–13.5 cm long, the distal ones 1.5–7 cm long, terete, pubescent just below the nodes, otherwise glabrous, more or less waxy. *Culm leaves* 5.5–11 cm long, persistent, abaxially

glabrous, juncture of sheath and blade abaxially an obscure, inverted “V”; sheaths 3.4–9.4 cm long, 1.6–6.2 times as long as the blade, fused for ca. 1 cm at the base, the margins glabrous; blades 0.9–2.5 cm long, triangular, erect, persistent, apex mucronate to subulate; girdle ca. 1 mm wide, glabrous; inner ligule 0.5 mm long. *Nodes* slightly swollen, the one triangular central bud flanked by one robust subsidiary bud on each side, these subtended by 5 or 6 tiers of smaller subsidiary buds totalling 30–60 buds; sheath scar dipping below the branch complement; supranodal ridge obscure; root primordia absent. *Branching* extravaginal; central bud does not develop; leafy subsidiary branches 30–60 per node, 1.5–5 cm long, horizontal to curving upwards, not rebranching. *Foliage leaves* 4–7 (12–15) per complement; sheaths persistent, pubescent between the nerves, glabrescent; blades 0.85–2 cm long, 0.1–0.2 (0.3) cm wide, L:W = 5–12, stiff, glabrous, not tessellate, apex subulate, base rounded-cuneate; pseudopetiole 0.2–0.5 mm long; outer ligule ca. 0.1 mm long, ciliolate; inner ligule 0.2–0.5 mm long, truncate or slightly rounded. *Panicles* 1–1.5 cm long, narrow, the base retained within the subtending sheath; rachis angular, pubescent; branches and pedicels angular, pubescent, appressed, the pedicels 1–3 mm long. *Spikelets* 4.7–5.5 mm long, slightly farinose when young, the antherium 1.2–1.5 mm wide, more or less terete to slightly dorsally compressed. *Glumes* 2, scalelike, obtuse, abaxially scabrid-pubescent, nerves absent; glume I 0.4–0.8 mm long, less than $\frac{1}{10}$ the spikelet length; glume II 0.6–1.2 mm long, ca. $\frac{1}{8}$ the spikelet length. *Sterile lemmas* 2, 2.9–4 mm long, subulate, abaxially scabrid-pubescent on the upper one-half, 1-, 3-, or 5-nerved; sterile lemma I $\frac{1}{2}$ – $\frac{2}{3}$ the spikelet length; sterile lemma II $\frac{3}{4}$ – $\frac{4}{5}$ the spikelet length. *Fertile lemma* 4.5–5.5 mm long, mucronate, abaxially scabrid-pubescent toward the apex, 5- or 7-nerved. *Palea* 4.5–5.3 mm long, subequal to the fertile lemma, sulcate toward the apex, bimucronulate, 4-nerved. *Stamens* 3, the anthers 2.5–2.7 mm long. *Lodicules* unknown. *Fruit* unknown.

Distribution: Agulhas Negras, Parque

Nacional de Itatiaia, Rio de Janeiro/Minas Gerais, Brazil (Fig. 8); rocky outcrops in high altitude grassland; 2300–2600 m.

Specimens examined: BRAZIL. Minas Gerais: Mun. Itamonte, Parque Nacional de Itatiaia, below Agulhas Negras, *Clark & Morel 633* (BHC, ISC, K, MO, NY, RB, SJRP, SP, US); Mun. Itamonte, Parque Nacional de Itatiaia, trail to Pico das Agulhas Negras, 10 Feb 1990 (fl), *Clark et al. 663* (ISC, SJRP); in Mt. Itatiaia, 1901 (fl), *Wettstein & Schiffner* (US, W). Rio de Janeiro: Itatiaia, massiv das Agulhas Negras, Mar 1937 (fl), *Brade 15632* (RB); Parque Nacional do Itatiaia, *Camerik 135* (U); Itatiaia, arredores das Agulhas Negras, 20 Oct 1922 (fl), *Campos Porto 1117* (RB, US); Itatiaia, summit of Agulhas Negras, *Chase 8281* (GH, MO, US); Serra do Itatiaia, Serra da Pedra Sentada, *Dusén s.n.* (S); Itatiaia, base das Agulhas, 22–26 Nov 1938 (fl), *Markgraf & Brade 3728* (RB); Resende Co., Serra do Itatiaia, base das Agulhas, *Segadas-Vianna & Brade 5019* (US); Serra da Itatiaia in montosis, 30 Dec 1895 (fl), *Ule 670* (W); Itatiaia, auf dem Gipfel zwische bemoosten Steinen, *Wawra 398* (W); Itatiaia, Wälder um die obere Fasenda, *Wawra 475* (W); de rupestribus montis Itatiaia, Sep 1901 (fl), *Wettstein & Schiffner s.n.* (W); Itatiaia, May 1980 (fl), *Windisch 2846* (HRCB, US).

This diminutive species is known from only one population growing on the upper slopes of Agulhas Negras in the National Park of Itatiaia. *Chusquea microphylla* has always been included within *C. heterophylla*, but it was recognized as a variety by Doell (1880). Field observation and further study show that it should be elevated to the rank of species, based on the following differences with *C. heterophylla*: basal internodes 4.5 to 13.5 cm long, becoming shorter toward the apex, the distal internodes 1.5 to 7 cm long, all internodes terete; culm leaves abaxially glabrous; nodes slightly swollen with the supranodal ridge obscure; dimorphic subsidiary buds, with the 30 to 60 smaller subsidiary buds arranged in 5 or 6 tiers subtending the central bud, which never develops; leafy subsidiary branches 1.5 to 5 cm long; foliage leaf blades 0.85 to 2 cm long and 0.1 to 0.2 (0.4) cm wide; narrow panicles 1 to 1.5 cm long; and spikelets 4.7 to 5.5 mm long with only the upper half of each bract abaxially scabrid-pubescent.

Chusquea microphylla tends to form rather widely scattered clumps, especially on rocky outcrops. Although it grows in close proximity to both *C. heterophylla* and *C.*

pinifolia, no evidence of hybridization has been observed.

Acknowledgments

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Literature Cited

- Brade, A. C. 1942. Excursão à Serra do Caparaó. *Rodriguesia* 6: 87–92, pl. 1–4 + fig. 1–22.
- . 1956. A flora do Parque Nacional do Itatiaia. Parque Nacional do Itatiaia, Bol. 5: 1–85.
- Clark, L. G. 1989. Systematics of *Chusquea* section *Swallenochloa*, section *Verticillatae*, section *Serpentes*, and section *Longifoliae* (Poaceae-Bambusoideae). *Syst. Bot. Monographs* 27: 1–127.
- , G. Davidse & R. Ellis. 1989. Natural hybridization in bamboos: evidence from *Chusquea* sect. *Swallenochloa* (Poaceae: Bambusoideae). *Natl. Geog. Res.* 5: 459–476.
- & X. Londoño. 1991. Miscellaneous new species of bamboo (Poaceae: Bambusoideae). *Nord. J. Bot.* 11: 323–331.
- Cleef, A. M. 1981. The vegetation of the páramos of the Colombian Cordillera Oriental. *Dissertationes Botanicae*, Band 61. J. Cramer, Vaduz, Germany.
- Doell, J. C. 1880. Gramineae. III., Bambusaceae. Pages 161–219 + pl. 44–56. In: A. W. Eichler, editor. *Flora brasiliensis* 2(3). Friederich Fleischer, Leipzig.
- Fernandes, A. & P. Bezerra. 1990. Estudo fitogeog-

- gráfico do Brasil. Stylus Comunicações, Fortaleza, Brazil.
- Giulietti, A. M. & J. R. Pirani.** 1988. Patterns of geographic distribution of some plant species from the Espinhaço range, Minas Gerais and Bahia, Brazil. Pages 39–69. *In*: W. R. Heyer & P. E. Vanzolini, editors. Proceedings of a workshop on neotropical distribution patterns. Academia Brasileira de Ciências, Rio de Janeiro, Brazil.
- Joly, A. B.** 1970. Conheça a vegetação Brasileira. Ed. Univ. de São Paulo e Polígono, São Paulo, Brazil.
- Maack, R.** 1972. A Serra do Mar no Estado do Paraná. *Bol Geogr. Rio de Janeiro* 31 (229): 79–105. Ministério do Planejamento e Coordenação Geral, Fundação IBGE, Rio de Janeiro.
- Martinelli, G., J. Bandeira & J. de Orleans e Bragança.** 1989. Campos de Altitude. Editora Index, Rio de Janeiro, Brazil.
- McClure, F. A.** 1973. Genera of bamboos native to the New World (Gramineae: Bambusoideae). T. R. Soderstrom, editor. *Smithsonian Contr. Bot.* 9: 1–148.
- & **L. B. Smith.** 1967. Bambuseae. Pages 1–78. *In*: R. Reitz, editor. *Flora Ilustrada Catarinense*, Pt. 1 Gramineae—Suplemento. Herbario “Barbosa Rodrigues,” Itajaí, Santa Catarina, Brazil.
- Mori, S. A.** 1989. Eastern, extra-Amazonian Brazil. Pages 428–454. *In*: D. G. Campbell & H. D. Hammond, editors. Floristic inventory of tropical countries. New York Botanical Garden, Bronx, New York.
- Smith, L. B.** 1962. Origins of the flora of southern Brazil. *Contr. U.S. Natl. Herb.* 35 (3): 215–249.
- Soderstrom, T. R.** 1981. Some evolutionary trends in the Bambusoideae (Poaceae). *Ann. Missouri Bot. Gard.* 68: 15–47.
- van der Hammen, T. & A. Cleef.** 1986. Development of the high Andean páramo flora and vegetation. Pages 153–201. *In*: F. Vuilleumier & M. Monasterio, editors. High altitude tropical biogeography. Oxford University Press, New York.
- Vuilleumier, B. S.** 1971. Pleistocene changes in the fauna and flora of South America. *Science* 173: 771–780.
- Wettstein, R. R. v.** 1970. Aspectos da vegetação do sul do Brasil. Editora Edgard Blücher Ltda., São Paulo, Brazil. [Portuguese translation by B. L. de Morretes and M. G. Ferri.]
- Widmer, Y. & L. G. Clark.** 1991. New species of *Chusquea* (Poaceae: Bambusoideae) from Costa Rica. *Ann. Missouri Bot. Gard.* 78: 164–171.

Correction

It has been brought to my attention by James Reveal that if, in the future, priority is extended to ordinal names, the citation for the Order Cycadales in my recent paper (*Brittonia* 44: 220–223, 1992) should be changed to: *Ordo Cycadales Dumortier, Analyse des Familles des Plantes*. 65. 1829. (“*Cycadarieae*”).—DENNIS WM. STEVENSON, New York Botanical Garden, Bronx, NY 10458, U.S.A.