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Blooming history of the Costa Rican bamboos

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Abstract: This paper lists the eight genera and 37 species of known wild ligneous bamboos of Costa Rica and six genera of cultivated foreign bamboos. The account is based upon herbarium specimens and the author's field experiences over 24 years. Localities and dates of herbarium collections are indicated, along with the dates of vegetative and blooming collections. Successive blooming dates are known for colonies of *Rhipidocladum pittieri* along the Río Virilla are 1891, 1973, and 1989. Successive dates of bloom for an individual colony of *R. racemiflorum* at Río Chiquito are 1973 and 1989.

Key words: bamboos, gregarious blooming, Costa Rica, flora.

During the previous 24 years the author has observed numerous native populations of woody Bambusoideae in Costa Rica. During this period, some of these populations have bloomed and in some cases have died out without evident replacement from seed. This paper is an attempt to record the locations and blooming episodes of colonies so that their existence may be followed. Cited specimens are in the Herbarium of Iowa State University (ISC) or in a few cases in the Herbario Nacional de Costa Rica (CR) or the U.S. National Herbarium (US). Replicates of many are in the Herbario Nacional de Costa Rica, the Missouri Botanical Garden, the Field Museum or the U.S. National Herbarium.

The author thanks the curators of the above institutions for the use of their collections and Dr. L.G. Clark, whose determinations of species of *Chusquea* are followed herein, and whose recent publications (1985, 1986, 1987, 1989, 1989a) are the most modern references available on this important American bamboo genus.

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Nomenclature of the species follows the author's treatment of the Gramineae of Costa Rica (1980) and of *Rhipidocladum* species (Pohl 1985). Nomenclature of species of *Chusquea* follows L.G. Clark (1987,1989, 1989a).

Flowering in Costa Rican bamboos: little is known about the intervals between successive flowering episodes of American bamboos. Parodi (1955) recorded two flowering occurrences of *Guadua trinii* Ruprecht from Argentina, based upon cultivated plants taken from seed from a wild population. Seifriz (1923) recorded a second blooming of *Chusquea abietifolia* Grisebach in Jamaica in 1918, 33 years after the previous blooming at that locality. Janzen (1976) has discussed the flowering of numerous bamboos, especially the Asiatic species.

It is possible to determine many flowering dates for the Costa Rican bamboos from herbarium specimens, but it is impossible to know whether some intervening blooming dates have not been recorded. Thus the flowering intervals may appear much longer than is actually the case. In several species recorded in this paper, my observations have been frequent enough to determine the minimum interval between successive flowerings.

Reproductive success in bamboos has been little studied. In gregarious flowering of bamboos, the quantity of spikelets produced is

tremendous, and the ground beneath the plants may be carpeted with fallen spikelets. In one instance, I obtained about a kilogram of fallen spikelets of *Bambusa arundinacea* from a cultivated clump. Analysis of this material by the Iowa State University Seed Laboratory indicated a very small percentage of filled seed. Nevertheless, flower beds near the fruiting clumps were densely filled with seedlings. In some instances of blooming, many seedlings are albino or have white-striped blades. Cultivated variegated-leaf strains of some species may have originated in this fashion. Abnormalities of this type may persist because the bamboos have such long generation times, and are so little dependent on sexual reproduction. The extensively rhizomatous habit of many species may allow a single established seedling to spread eventually to a large area. A striking example of this is the common cultivated tropical bamboo, *Bambusa vulgaris* var. *striata*. This form has a worldwide distribution in the tropics, and is extensively cultivated for paper pulp and construction. It rarely blooms, and then never gregariously. Seed is never produced, and the anthers are shrunken and empty. Apparently this form is a single clone of tremendous dispersion in cultivation.

Some bamboos cease the annual production of new canes a year before gregarious flowering. The absence of new canes may serve as a useful indicator of incipient flowering.

Seedlings: the native Costa Rican bamboos are highly selective as to germination sites. In the species that I have observed, seedlings occur in shade near the parent plants, mostly on moss polsters rather than on mineral soil. Some of our spikelet collections have not germinated in the greenhouse, but we now have seedlings of *Otatea acuminata* from Mexico, and *Chusquea virgata, C. simpliciflora, Rhipidocladum pittieri,* and *R. racemiflorum* from Costa Rica. In the latter three species, seedlings were not observed in the wild from the plants we collected for seed.

One of the principal hazards to the continued existence of native bamboo populations is grazing by cattle. Where populations exist in pastures, the fruiting plants soon decompose, and there is little refuge for the tender seedlings. I fear that in such cases, a bamboo population may be eliminated entirely. In *Guadua paniculata*, a thorny species common in Guanacaste, the thorny dead culms persist and provide good protection for the seedlings in their early stages.

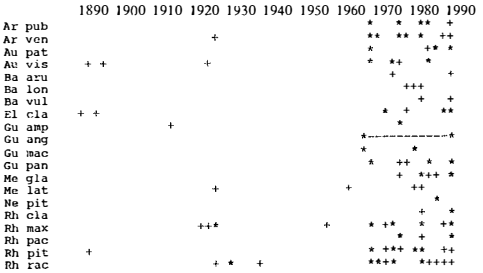
The native species of bamboos found in Costa Rica are listed below, with herbarium records of their vegetative or blooming state (flowering or fruiting). A few of the introduced cultivated species have been included. Month and year of collection are given, since some species have been observed to change from the vegetative state to flowering in a matter of a few months, as in the cases of *Elytrostachys clavigera* and *Aulonemia patriae*.

Arthrostylidium Ruprecht

The species of *Arthrostylidium* are slender or viny bamboos, often leaning on trees for support. They may at times be confused with species of *Chusquea*, because the slender culms

TABLE 1

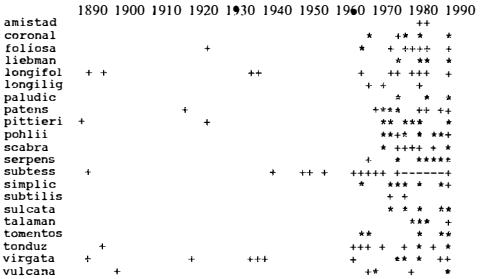
Vegetative and blooming collections of bamboos in Costa Rica



Abbreviated names are from text. * = vegetative + = blooming

TABLE 2

Vegetative and blooming collections of Chusquea *in Costa Rica*



Abbreviated names are from text. * = vegetative + = blooming

may appear to be solid. Usually, however, the upper internodes have a small lumen, and the branching pattern is quite distinct from that of *Chusquea* (McClure 1973).

Arthrostylidium pubescens Ruprecht, Bambuseae Monogr. Exponit. 119, Tab. 4. 1839.

This species was previously known in Central America only by several vegetative specimens from the area of Río Pacuare. The largest colony is along Hy. 232, 7 km E. of the

crossing of the Río Pacuare. Here the bamboos form a dense colony on the hillside south of the road. The canes clamber into the trees and hang. The plants may be identified by their very scabrous internodes and tight, scabrous culm sheaths. Our first collection at this site was in 1976, but subsequent visits have never shown blooming. Flowering was first found in the Grano de Oro locality in Apr. 1990, this being the first North American flowering record. Prov. de Cartago: 7 km by road E. of Río Pacuare, *Pohl & Pinette 13183*, Jun. 1976; same location, *Pohl 14162*, Oct. 1982, vegetative; Moravia de Chirripó, *Pohl & Davidse 10875*, Aug. 1968, vegetative; 2 km by road E. of Grano de Oro, hillside, *Pohl & Clark 14598*, Dec. 1984, vegetative; same site, *Pohl 15747*, Apr. 1990, flowering; 1 km W. of La Fortuna de Moravia, leafless canes only, *Pohl 15748*, Apr. 1990.

Arthrostylidium venezuelae (Steud.) McClure, J. Wash. Acad. Sci. 32:172.

This is a very slender viny bamboo, the culms 1-3 mm in diameter and very weak. The plants clamber into trees and droop. The type of *Arundinaria standleyi* Hitchc., which was included in this species by McClure, was collected from El Muñeco in old fruiting condition in 1926 by Standley and Torres. We have no further flowering records of this species from Costa Rica until our recent collection (*Pohl 15692*) made in Feb. 1989. This collection was gathered from a large population scattered in cloud forest at Alto Patillos (Tausito), on the road from Tapantí to Turrialba. We observed this colony in vegetative condition in the years 1976, 1978, and 1982, but never saw flowering until 1989. In the latter year, the entire population was in gregarious bloom and the plants were dying. Large numbers of seedlings were found at the same site in Apr. 1990, mostly growing on moss polsters (*Pohl 15768*). Another fruiting specimen is *Pohl 15770*, from the road to Río Macho Dam in Apr. 1990. The species occurs in brush or forests at middle altitudes and is widespread but not common. Most populations consist of only a few individuals. Other Costa Rican populations observed in vegetative condition are the following. Prov. de San José: La Palma, *Kuhbier 738*, Mar. 1971, vegetative; Prov. de Cartago: El Muñeco area, *Pohl & Davidse 11787*, Ap. 1969; *Pohl 14089*, 1982; Carretera Interamericana, 2 km N. of San Cristobal Norte intersection, *Pohl & Pinette 13254*, Jun. 1976; ca. 4.5 km S. of bridge on Agua Caliente at Lourdes, *Liesner & Judziewicz 14618*, Apr. 1983; Prov. de Limón: 2 km by road W. of Bribri, *Pohl & Gabel 13575*, Jun. 1978.

Blooming specimens from Nicaragua are *Grijalva 345* from Cerro La Pimienta (1980) and *Pipoly 6058* (1980) from the same locality.

Aulonemia McClure

This genus is primarily South American, with only a few species in Central America and Mexico. The Central American species are subligneous, with somewhat fleshy stems and viscid bands below each node. The branching pattern is nearly dichotomous, with alternate elongated and very short internodes, the solitary branches arising from the short internodes. In vegetative state, the plants could be mistaken for large plants of *Olyra*. Two species occur in Costa Rica.

Aulonemia patriae Pohl, Fieldiana Bot. N.S. 4:68. 1980.

The type locality of this species is at the Río Las Vueltas, just south of the bridge at the terminus of the road, at 10 30' N., 84 29' W. The plants occur in mass on the east side of a small canyon east of the road, with a few on the west side of the canyon. All are in danger of extinction from grazing. The area is extremely wet cloud forest at 2000 m elevation. Our first observation of this colony was in 1968 (*Pohl & Davidse 11781*). Subsequent observations were made almost every year, but no blooming occurred until Jun. 1982, when the type (*Pohl & Gabel 13577*) was collected at the same locality in late fruiting condition. The colony was in gregarious bloom at that time and the plants were dying. No subsequent bloom has been observed, although we have visited the colony almost each year to 1990.

This species has been collected as well in vegetative condition at the following localities, in each place only from a very few individuals. As at the type locality, the plants occur in cloud forests at 2000-2500 m. Prov. de Alajuela: 10 km N. of Zarcero, Carretera de Pueblo Nuevo a las minas de azufre, *L.D. Gómez 22061*, Nov. 1983; Prov. de Cartago: km. 67, Carretera Interamericana, at Madre Selva, *Pohl & Davidse 10751*, Jul. 1968; Panama: Prov. Bocas de Toro: Cerro Echandi, 9° 5' N. 82° 50' 30" W., *Davidse et al. 25208*, Mar. 1984.

No other localities are known for this species.

Aulonemia viscosa (Hitchc.)McClure, Smithsonian Contrib. Bot. 9:61. 1973.

The type of this species is *Tonduz 11793*, collected from the Cerros de Verirla, Copey, Prov. de San José. at 2600-2700 m. The specimen was collected in late fruiting condition in Mar. 1893. Subsequent flowering collections are: Prov. de Cartago: *Ocampo 1472*, Trillo San Gerardo-Chirripó, Nov. 1976; Prov. San José: Entre La División y Lagunilla, *Pittier 10526*, Jan. 1897 (US); Laguna La Escuadra, N.E. of El Copey, *Standley 41944*, Dec. 1925 (US). All other collections known to me are vegetative. They are the following: Prov. San José: Chirripó Massif, 2700-3000 m, *Davidse & Pohl 1648*, Apr. 1969; Carretera Interamericana, 4 km S. of División, 2100 m, *Pohl & Lucas 13113*, Dec. 1974; Carretera Interamericana, *ca.* 16 km S. of El Empalme, elev. 2650 m, *Pohl & Lucas 13008*, Dec. 1974; Prov. de Puntarenas: Between Cerro Frantzius and Cerro Pittier, 1500-1600 m, *Davidse et al. 28436*, Sep. 1984.

Bambusa Schreb.

This genus is now regarded by agrostologists as being entirely Asiatic, and the thorny American bamboos formerly included in *Bambusa* are now placed in *Guadua*. Numerous Asiatic species of *Bambusa* are widely cultivated in the tropics, and a number have been introduced in Costa Rica. The following species have been found in flowering condition in Costa Rica.

Bambusa arundinacea Willd., Sp. Pl. 245. (1799).

This is a tall, thick-stemmed bamboo widely cultivated in the tropics, although its timber quality is poor. During the decade of the 1970's, it bloomed gregariously over much of the American tropics and the plants subsequently died. I have observed blooming at the La Ceiba Botanical Garden in Honduras as well as in Costa Rica. The specimen listed below came from a large clump, at least 10 m in diameter, cultivated in a garden. The production of seeds was extremely prolific, and the seedlings were becoming aggressive weeds in flower beds. At La Ceiba, birds were harvesting seeds from the dying plants. Costa Rica: Prov. Alajuela, Río Segundo, *Pohl & Lucas 13009*, December 1974, fruiting and dying; Prov. de Limón: Carretera Interamericana, Río Hondo, several large clumps persisting after cultivation, *Pohl 15730*, Mar. 1990, fruiting and dying.

Bambusa longispiculata Gamble ex Brandis, Ind. Trees 668. 1906.

This is a tall, stout cultivated bamboo, apparently preferred to the preceding because of its lack of thorns. The canes are somewhat weak and tend to bend horizontally on the upper parts. The plants often have a few spikelets, but also may enter into gregarious blooming. Seed production is abundant, and seedlings may be numerous under the dying plants. Seedlings with white striae on the blades or entirely albino seedlings were common in *Pohl & Gabel 13704*. Costa Rica: Prov. de Guanacaste, La Pacífica, *Pohl & Gabel 13704*, Dec. 1978, flowering; La Pacífica, *Pohl & Clark 13934*, Jun. 1980, flowering; La Pacífica, *Pohl 14182*, Oct. 1982, flowering; Prov.de Alajuela, Fabio Baudrit, *Pohl 14082*, Jul. 1982, flowering; Honduras: Dept. Atlántida, Lancetilla, *Pohl & Gabel 13809*, Dec. 1979; Lancetilla, *Pohl & Clark 13961*, Jun. 1980; Nicaragua: Dept. Zelaya: El Recreo, *Sandino 2642*, May 1982, fruiting.

Bambusa vulgaris Schrad. ex Wendl. Coll. Pl. 2:26. 1810, var. **striata** Gamble, Bambuseae 44. 1896.

This is the common cultivated bamboo with yellow and green striped internodes. This form blooms very rarely. Eleven records of flowering of American plants exist in the U.S. National Herbarium, the earliest from 1814 (Pohl 1982). In our experience, only individual plants bloom and die, and gregarious flowering does not occur. Seed production does not occur, and the anthers are sterile. This taxon is apparently a clone of very wide dispersion in cultivation. Three widely separated plants were collected in flower in Costa Rica. Prov. de Heredia: Corazón de Jesus, *Pohl 14062*, Jun. 1982; Prov. de Alajuela: 3 km N.W. of Esparza, *Pohl 14084*, Jul. 1982; Prov. de Puntarenas: Km 218, Carretera Interamericana, 2 km S. of San Francisco, *Pohl 15774*, collected by Yvonne Widmer, Jan. 1990.

Chusquea Kunth

Chusquea is the commonest genus of bamboos in Central America. Numerous species occur on the Cordillera de Talamanca, and the plants are found in large stands along the Carretera Interamericana as well as elsewhere on the Costa Rican mountains. With the exception of some species of the Section *Swallenochloa*, the plants tend to bloom gregariously and at at

long intervals, like many other bamboos. The genus is easily recognized by the solid or nearly solid stems and the presence of a fascicle of numerous small branches at each node, which subtend a single larger branch. Recent treatments by Clark (1989) have done much to clarify the Costa Rican species.

Chusquea amistadensis L.G. Clark, Davidse, & Ellis, Nat. Geogr. Res. 5:462. 1989.

This species, related to *C. longiligulata*, is known from the Parque Nacional la Amistad and a few other localities in extreme southern Costa Rica and adjacent Panama. Costa Rica/Panama: Cerro Echandi, 3050-3160 m, on pßramo, *Davidse et al. 23867,* Aug.1983, fruiting; same area, *Davidse et al. 25513*, Mar.1984, fruiting; Prov. de Limón: S.W. of Cerro Kamuk, 3200-3350 m, *Davidse et al. 25958*, Mar. 1984, fruiting; N.E. of Kamuk, 3000-3300 m, *Davidse et al. 29269*, Sep. 1984, fruiting.

Chusquea coronalis Soderstrom & Calderón, Brittonia 30:158. 1978.

This very graceful species occurs from Costa Rica to southern Mexico, but has also been cultivated in California. Prov. de San José: 2 km N.W. of Río Conejo, in a small valley below a waterfall, *Pohl & Davidse 11054*, Sept. 1968, vegetative; same site, *Pohl & Pinette 13209* (type), Jun. 1976, flowering but one plant already dead; same site, seedlings of 1976 blooming, *Pohl & Gabel 13580*, Jun. 1978; same site, *Pohl & Clark 14105*, Jul. 1982, vegetative.

I have observed this site almost yearly to February 1990, and always found the plants vegetative. The colony, which occurs in a small canyon below a waterfall, is in danger of destruction by coffee cultivation.

Chusquea foliosa L.G. Clark, Iowa State J. Res. 61:115. 1986.

This species occurs from Volcán Poás to the Panamanian border, and is abundant in some areas along the Carretera Interamericana. Many specimens have been collected but few are in flower. These are listed here. Prov. de Cartago: km. 79-80, Carretera Interamericana, *Pohl & Clark 13915*, May 1980 (type); 3.6 km N.W. of La Georgina, *Pohl & Gabel 13734*, Dec. 1978; Villa Mills, *Pohl & Lucas 13101*, Dec. 1974; same site, *Pohl 14186*, Nov. 1982; Hda. Retes, near Parque Prusia, Volcán Irazú, *Pohl 15751*, Apr. 1990; Río Birrís Canyon, 3 km N.E. of San Gerardo, *Pohl 15721*, Feb. 1990; Prov. de San José: Cerro de las Vueltas, *Standley & Valerio 43904*, Dec. 29, 1925- Jan. 1, 1926; Prov. de Puntarenas: Cerro Buru, *Davidse et al. 23744*, Aug.1983.

A number of specimens formerly assigned to *C. foliosa* have been segregated by Dr. Clark as two new species. They are from the Carretera Interamericana and from Volcán Turrialba.

Chusquea liebmannii Fourn., Mex. Pl. 2:132. 1881.

This species is similar to *C. pittieri* in possessing short root thorns at some nodes, but differs in the circular central bud in the branch complement. It occurs in much dryer sites than *C. pittieri.* Blooming is not known from Costa Rica. Costa Rica: Prov. de Guanacaste: 2.6 km by road W. of Carmona, *Pohl 14129*, Aug.1982; 4 km W. of Colonia Carmona, road to Zapotal, *Pohl & Pinette 13234*, Jun. 1976; Prov. de Puntarenas: 2 km above Guacimal turnoff, road to Monteverde, *Pohl & Clark 14608*, Jan. 1985; same site, *Pohl 15735*, Mar.1990. At the latter time, the plants seemed stressed, with many dead or partially leafless canes. All specimens vegetative.

Chusquea longifolia Swallen, J. Wash. Acad. Sci. 30:210. 1940.

This is an exceedingly common and widespread species in Costa Rica, extending from the volcanoes of the Meseta Central to the Cordillera de Talamanca. Numerous specimens are cited by Clark (1989) and will not be listed here. Flowering dates known for Costa Rica are: 1892, 1896, 1937, 1939, 1968, 1974, 1976, 1981, 1982, 1983, 1984, 1985.

Chusquea longiligulata (Soderstrom & Calderón) L.G.Clark, Ann. Mo. Bot. Gard.74:428. 1987.

This species is characterized by its long ligules,dense cylindrical panicle, and intravaginal branching, which relates it to the section *Swallenochloa*. It is endemic to Costa Rica. Prov. de Alajuela: Alto Paloma, 12 km N. of La Luisa, *Pohl & Davidse 11708*, Feb. 1969, flowering; Prov. de Heredia: Río Las Vueltas, N.E. of Volcán Barba, Lent 2626, Jun. 1972, flowering; Río las Vueltas, *Burger & Gentry 9039*, Apr. 1973, blooming; Alto del Roble, *L.G. Clark et al. 280*, Mar.1982, flowering; Alto del Roble, *Pohl & Selva 12810*, May 1973, flowering (type); Prov. de San José: 5 km

by road S. of El Empalme, Tres de Junio, Pohl 12844, Jun. 1973, flowering; Las Nubes, *Standley 38763*, Mar. 1924, flowering; Prov. de Puntarenas: Cerro Echandi, *Davidse et al. 23937*, Aug. 1983, vegetative.

Chusquea paludicola L.G. Clark, Iowa State J. Res. 61:100. 1986.

This slender, graceful species occurs only in open *Lomaria-Sphagnum* bogs on the Cordillera de Talamanca, around 2700 m. It is recognizable by its thin, yellow culms and abundant subsidiary branches and narrow yellow-green foliage blades. It has never been collected in flower. Prov. de Cartago: 19.6 km S.E. of El Empalme, *Pohl & Pinette 13282*, Jun. 1976, vegetative; along Carretera Interamericana, km 68.5, *Sally Horn, SPH 206*, May 1985, vegetative, burned; km 68, *Pohl & Clark 14604*, Dec. 1984, vegetative; Prov. de San José: km 70, west side of CIA, *Pohl & Clark 14600*, Dec.1984 (holotype), vegetative; same site, *Pohl 15716*, Feb. 1990, vegetative. From visual observation, this species continues vegetative to 1990, and with abundant new canes.

Chusquea patens L.G. Clark, Iowa State J. Res. 61:118. 1986. *C. meyeriana* Rupr. ex Doell, in Pohl, Fl. Costaricensis 132 (1980) only as to Costa Rican plants.

This species is characterized by its very open, few-flowered panicle. It occurs from the volcanoes of the Meseta Central to northern Panama. The plants have bloomed gregariously in recent years. Costa Rica: Prov. de Heredia: Alto del Roble, near Río Las Vueltas, *Pohl & Lucas 12999*, Dec. 1974, vegetative; same site, *Pohl & Clark 14109*, Jul. 1982, flowering (holotype); same area, *Pohl & Selva 12810A*, May 1973, vegetative; same area, *L.G. Clark et al. 282*, Mar. 1982, vegetative; Quebrada El Mochote, Cerro Zurquí, *L.D. Gómez et al. 21029*, Dec. 1984, flowering; Prov. de San José: Cascajal, *Lankester 105*, yr. 1919, flowering; same site, *Pohl & Lucas 13089*, Dec. 1974, vegetative; same site, *Pohl 15678*, gregarious flowering, Jan.1989; same site, *Pohl 15713*, Feb. 1990, fruiting and dying; Canyon of Río Cascajal, *Pohl & Clark 14586*, Dec. 1984 flowering; Autopista to Guápiles, 1 km S. of Zurquí Tunnel, *Pohl & Clark 14591*, Dec. 1984, flowering; Prov. de Puntarenas: Monteverde, *Pohl & Pinette 13248*, Jun. 1976, vegetative; same site, *Wilbur 14254*, May 1971, fruiting; same site, *Pohl 15731*, Mar. 1990; Prov. de Limón: Valle de Silencio, just north of Cerro Hoffman, *Davidse et al. 28658*, Sep. 1984, fruiting, seedlings present.

This species also occurs in northern Panama.

Chusquea pittieri Hack., Oesterr. Bot. Z. 53:153. 1903.

This is a handsome species with tall, arching culms bearing rings of short root thorns at many nodes. It is fairly common at middle altitudes around the Meseta Central. Blooming has been rare. Canes are sometimes harvested for farm uses. Prov. de Alajuela: Río Zarcero, N. of Zarcero, *Pohl & Clark 14124*, Aug.1982, vegetative; 6 km S. of Los Cartagos, *Pohl & Gabel 13546*, Jun. 1978, vegetative; km 23, 5 km S. of Vara Blanca, *L.G. & M.S. Clark 278*, Feb. 1982, vegetative; Prov. de Heredia: Finca San Juan, Volcán Barba, *Pohl & Selva 12928*, Jun. 1973, vegetative; Prov. de San José: Cuesta de los Arrepentidos between San Marcos and Santa María de Dota, *Pittier 2249*, Jun. 1890, blooming, (type); Santa María de Dota, *Standley 41825*, Dec. 1925, flowering (US); Santa María de Dota, Río Pirrís, *Pohl & Clark 14107*, Jul. 1982, vegetative; near Copey, *Pohl & Lucas 13140*, Jan. 1975, vegetative; Rancho Redondo, *Pohl & Clark 14118*, Aug. 1982; Bajos de Las Nubes, *Pohl & Lucas 13088*, Dec. 1974, vegetative; 5 km S.E. of Santa María de Dota, *Pohl & Gabel 13552*, Jun. 1978, vegetative; Prov. de Cartago: 1-2 km below San Juan de Chicoa, *Pohl 12881*, Jun. 1973, vegetative; Río Reventado, between Llano Grande and Tierra Blanca, *Pohl & Lucas 13098*, Dec. 1974, vegetative; same site, *Pohl & Clark 13912*, May 1980, vegetative; Prov. de Puntarenas: Quarry N. of La Tigra, Parque Nacional La Amistad, *Pohl 14098*, Jul. 1982, vegetative.

Chusquea pohlii L.G. Clark, Ann. Mo. Bot. Gard. 72:867. 1985.

This is one of the most distinctive species of Costa Rican bamboos. The plants are coarse and stiff, and the leaf sheaths are very hispid. The plants are common around the volcanoes of the Meseta Central and on the Cordillera de Talamanca. Blooming is very rare and to date only two flowering specimens have been collected. The species occurs from Central Costa Rica to northern Panama. Costa Rica: Prov. de Puntarenas: Monteverde, *Judziewicz 4629*, Apr. 1983, vegetative; same site, *Pohl & Pinette 13246*, Jun. 1976, vegetative; same site

Pohl 15734, Mar. 1990, vegetative; Prov. de Alajuela: km 28-29, Vara Blanca, *Clark & Clark 277*, Feb. 1982, vegetative; km 15-16, N. of San Ramón, *Pohl & Clark 14115*, Jul. 1982; Prov. de Heredia: Røo Sardinal, N. of Volcán Barva, *Grayum 7304*, Apr. 1986, vegetative; Prov. de Heredia: Alto del Roble, *Pohl & Gabel 13676*, Dec. 1978, vegetative; same site, *Pohl & Lucas 12998*, Dec. 1974, vegetative; same site, *L.G. Clark et al.*, Mar. 1982, vegetative; Prov. de San José: N. of Río Cascajal, *Pohl 14101*, Jul. 1982, vegetative; Cascajal, *Pohl 15712*, Feb. 1990, vegetative; Autopista to Guápiles, 2 km S. of tunnel, *Pohl 15691*, Feb. 1989, vegetative; Parque Nacional Braulio Carrillo, 2 km S. of Bajo la Hondura, *Pohl & Clark 14104*, Jul. 1982, vegetative; same site, one plant blooming, *Pohl 15737*, Mar. 1990; Prov. de Cartago: 4.5 km S. of bridge on Agua Caliente at Lourdes, *Liesner & Judziewicz 14607*, Apr. 1983, vegetative; Tapantí Reserve, along Río Dos Amigos, Reserva de Tapantí, *L.D. Gómez 18866*, Nov. 1982, vegetative; Río Grande de Orosi, S. of Tapantí, *Pohl 12886*, Jun. 1973, vegetative; Tapantí Reserve, along Río Dos Amigos, *Croat 36232*, Jun. 1976, (MO, US); Carretera Interamericana, km 44-45, *Clark & Clark 275*, Feb. 1982, vegetative (type). A number of blooming specimens have been collected in northern Panama in 1985-86.

Chusquea scabra Soderstrom & Calderón, Brittonia 30:300. 1978.

The tall plants of this species are recognizable by their scabrous internodes and by the presence of distorted fibrillar branchlets, caused by a fungus infection. One recent period of gregarious bloom is known in this Costa Rican endemic species. Prov. de Puntarenas: Monteverde, *Pohl 15732*, Mar. 1990, vegetative; Prov. de Alajuela: 4.5 km N. of Vara Blanca, Hda. Cayuga, *Pohl & Clark 13928*, Jun. 1980, flowering gregariously; Road to Colonia la Virgen de Socorro, Barranca de Río Sarapiquí, *Stevens 13568*, Aug. 1979, flowering; just below Hda. Cayuga gate, road to waterfall, *L.G. Clark et al. 284*, Mar. 1982 (regenerating after flowering); Prov. de Heredia: Montaña Azul, 2 km N. of Vara Blanca, E. of road, *Pohl 14060*, Jun. 1982, seedlings among dead plants; Prov. de San José: Cascajal, *Pohl & Gabel 13545*, May 1978, flowering; Bajo la Hondura, *De Vries 20*, Jun. 1979, flowering, (CR); Prov. de Cartago: Río Coliblanco, 4 km N.E. of Capellades, *Pohl & Pinette 13305*, Jun. 1976, type number, flowering; same site, *Pohl 12888*, Jun. 1973, vegetative; Río Aquiares, 3 km W. of Santa Cruz, *Pohl & Pinette 13307*, Jun. 1976, flowering; 0.5 km above Santa Cruz, *Pohl 14204*, Nov. 1982, vegetative; Cañón de Río Grande de Orosi, *Chacón et al. 1455*, Oct. 1983, old fruiting; Finca Llanos de Quetzal, *Pohl 14164*, Oct. 1982, vegetative; 2 km S. of El Muñeco, valley of Río Sombrero, *Pohl 12871*, Jun. 1973, vegetative; Parque Arqueológico Guayabo, Turrialba, *Gómez Laurito 3206*, Mar. 1977, flowering gregariously.

Chusquea serpens L.G. Clark, Ann. Mo. Bot. Gard. 72: 870. 1985.

This is one of a small group of viny species characterized by having infravaginal branching and a very restricted number of branches, usually 2 per node. The plants are rare in Costa Rica, occurring on steep cliffs or bluffs. The slender canes are very elongated and scramble high into trees. The only blooming specimens known from Costa Rica are from the type locality . Prov. de Alajuela: Río Cariblanco, near bridge, *Pohl & Davidse 11023*, 26 Aug.1968, flowering (type); same site, *Pohl & Davidse 11267*, Oct. 1968, flowering; same site, *Pohl & Pinette 13224*, Jun. 1976, vegetative; same site, *Pohl 15687*, Feb. 1989, vegetative; same site, *Pohl 15741, Mar.1990*, vegetative; Cataratas de San Ramón, *R. Ocampo S.1326*, Sep. 1976, vegetative; Prov. de Heredia: Río Peje-Río Sardinalito, N. slope of Volcán Barva, *Grayum & Jermy 6777*, Apr. 1986, vegetative; Prov. de San José: Tinamastes, 13 km S.W. of San Isidro del General, road to Dominical, *Pohl 14187*, Nov. 1982, vegetative; same site, *Pohl & Clark 14622*, Jan. 1985, vegetative; same site, *Pohl 15741*, Mar. 1990, vegetative; Prov. de Cartago: 1 km S. of Palo Verde, confluence of Río Estrella and Río Empalme, *Liesner & Judziewicz 14538*, Apr. 1983, vegetative.

Chusquea simpliciflora Munro, Trans. Linn. Soc. London 26:54. 1868.

This species extends from Guatemala to northern South America, but has been best collected in Costa Rica. The culms are slender and often decumbent, forming large masses on trees and shrubs. It occurs at lower altitudes than most species of its genus. We had no records of blooming in Costa Rica until 1990,

when the species was in gregarious bloom in a number of isolated sites. At each site, the plants were dying or with a few canes still vegetative. No seedlings were seen and seed germinated very poorly in the greenhouse. Prov. de Alajuela: Río Zapote bridge, S. of Upala, *Pohl & Gabel 13705*, Dec. 1975, vegetative; Río San Lorenzo, 3 km S.W. of Bajo Rodríguez, km 39, *Pohl & Clark 14114*, Jul. 1982, vegetative; Prov. de San José: Los Cusingos, Alexander Skutch residence, *Pohl & Lucas 13114*, Dec. 1974, vegetative; same site, *Pohl & Pinette 13257*, Jun. 1976, vegetative [Skutch says it bloomed *ca.* 1955]; Alto San Juan, 6 mi. S.W. of San Isidro del General on Hy. 223, *Pohl & Calderón 10061*, Jul. 1966, vegetative; 10 km by road S. W. of Santiago de Puriscal, *Pohl & Pinette 13286*, Jun. 1976, vegetative; same site, *Pohl 14131*, Aug. 1982, vegetative; same site, km. 30.7, *Pohl 15720*, Feb. 1990, fruiting; km 37.3, *Pohl 15718*, Feb. 1990, fruiting; 8 mi S. W. of San Isidro del General, road to Dominical, *J.P. Smith Jr. 3000*, Aug. 1967, vegetative; Prov. de Limón: Alto Cuen, Valle la Estrella, *Ocampo 1729*, Jun. 1977, vegetative; Bribri, *Burger et al. 10441*, Feb. 1977, vegetative; Prov. de Puntarenas, Boruca, *Ocampo 1361*, Jul. 1976, vegetative; Abrojos, Fila Cal, *Ocampo 2574*, Jun. 1979, vegetative, (CR); San Vito de Java, cliff above road W. of town, *Pohl 15743*, Mar. 1990, fruiting and dying; Alto de Garrote, 24 km N. W. of San Vito de Java, *Pohl 14092*, Jul. 1982, vegetative; same site, 1.5 km S.E. of Puesto de Control Jabillo, *Pohl 15675*, Jan. 1989, vegetative; same site, Pohl 15745, Mar. 1990, late fruiting, dying; 2 km by road N.W. of Guácimo, Valle de Coto Brus, *Pohl & Pinette 13272*, Jun. 1976, vegetative; Alto Conte, Burica, *Ocampo 1923*, Apr. 1978, vegetative; Punta Burica, *Ocampo 2551*, Mar. 1979, vegetative (CR).

Chusquea subtessellata Hitchc., Proc. Biol. Soc. Washington 40:81. 1927.

This is the most abundant species on the páramos of the Cordillera de Talamanca, where it forms short, shrubby growths 1-3 m tall. Unlike many other species it always shows some percentage of bloom, although this varies from year to year. For a complete listing of known specimens, see L.G. Clark (1989).

Chusquea subtilis Y.Widmer & L.G. Clark Ann. Mo. Bot. Gard. 1991.

This species is characterized by very narrow leaf blades and by fertile lemmas bearing short awns. Prov. de San José: Villa Mills, S. of La Georgina, *Pohl & Gabel 13725*, Dec. 1978, flowering; 4 km S. of La Georgina, *Pohl & Lucas 13112*, Dec. 1974, flowering.

Chusquea sulcata Swallen, J. Wash. Acad. Sci. 30: 209. 1940.

This species has been collected from only a single locality in Costa Rica, but occurs in Mexico and Guatemala as well. At the following site, the plants have slender canes 5-10 mm in diameter, growing in small clumps and reaching 3-5 m in height. They occur in open forest around the margins of a cafetal. No flowering has been observed. Prov. de San José: Above new road *ca.*1 km S. of Río Tarrazú, S. E. of Frailes, *Pohl & Lucas 13143*, Jan. 1975, vegetative; same site, *Pohl & Gabel 13551*, Jun. 1978, vegetative; same site, *Pohl, sight record*, Feb. 1990.

Chusquea talamancensis Y. Widmer and L.G. Clark Ann. Mo. Bot. Gard. 78: 1991.

This recently described species has bloomed in 1990. Prov. de Cartago: La Georgina, N.E. of restaurant, *Pohl 15676*, Jan. 1990, in gregarious bloom; same site, *Pohl & Clark 13924*, May 1980, vegetative; Prov. de San José: Cerro Jaboncillo, *Horn SPH 130*, Mar. 1985, vegetative; same site, *Horn SPH 129*, Mar. 1985, vegetative; 1 km W. of Cerro Jaboncillo, *Horn 242*, May 1985, vegetative; Prov. San José-Cartago: CIA below páramo, *Clark & Clark 273*, Feb. 1982, vegetative; Prov. de Puntarenas: Cerro Echandi, *Davidse et al. 23885*, Aug. 1983, vegetative; same site, *Davidse et al. 23961*, Aug. 1983, vegetative.

Chusquea tomentosa Y. Widmer & L.G. Clark Ann. Mo. Bot. Gard. 78: 1991.

This newly described species has abaxially minutely pubescent leaves. Prov. de San José: Carretera Interamericana, km 77-78, *L.G. & M.S. Clark 274*, Feb. 1982, vegetative; Carretera Interamericana, km. 107, *Davidse 761*, Jul. 1966, vegetative; Prov. de Cartago: 1-2 km E. of Hda. Central, Volcán Turrialba, *Pohl & Davidse 10867b*, Aug. 1968, vegetative; Villa Mills, road to Piedra Alta, *Clark et al. 500*, May 1989, flowering (type); La Esperanza de Guarco, km 61.8, Carretera Interamericana, 4 km N.E., *Widmer 505*, Jan. 1990, flowering.

Chusquea tonduzii Hack., Oesterr. Bot. Z. 53:155. 1903.

This robust species occurs from Volcán Poás to the Panamanian border, and is most common along the Carretera on the Cordillera de Talamanca. Massive blooming occurred in 1966, with some scattered flowering since. Prov. de Alajuela: Summit of Volcán Poás, *Tonduz 10755*, Oct. 1896, flowering (type number, isotypes in US); same site, *J.P.Smith, Jr. 2837*, Jul. 1967, flowering; same site, *Pohl & Davidse 10810*, Aug. 1968, flowering; same site, *Weston 1580*, Aug. 1964, flowering; same site, *Tessene 1579*, Aug. 1964, flowering (one clone); same site, *Mayra Montiel s.n.*, Jun. 1972, flowering; same site, *Pohl & Gabel 13735*, Dec. 1978, few flowering; same site, *Grayum et al. 6615*, Mar.1986, flowering; same site, *Pohl 15710*, Feb. 1990, vegetative; Prov. de Cartago: Hda. Central de Volcán Turrialba, *Pohl & Calderón 10318*, Aug. 1966, flowering; Volcán Turrialba, 1-2 km E. of Hda. Central, *Pohl & Davidse 10868*, Aug. 1968, gregarious blooming; Quebrada Palma, 2 km W.S.W. of Volcán Turrialba, *Pohl & Davidse 11714*, Feb. 1969, gregarious blooming; seedlings present; km 73, Carretera Interamericana, *Pohl & Calderón 10119*, Jul. 1966, gregarious flowering; km 56, Carretera Interamericana, *Raven 20951*, Mar. 1967, flowering; km 79-80, at electric line crossing, *Pohl 14194*, Nov. 1982, vegetative; Prov. de San José: Carretera Interamericana, 15.7 km S.E. of El Empalme, *Pohl & Davidse 10505*, Jun. 1968, flowering; km 80, Carretera, *Pohl & Davidse 11144*, Sep. 1968, old fruiting.

Chusquea virgata Hack., Oesterr. Bot. Z. 53:156-157. 1903.

This species is very conspicuous in bloom, with long, virgate inflorescences produced in large numbers. We saw no blooming in recent years until 1989-1990, when gregarious bloom occurred near San José de la Montaña and Copey. The plants were dying after fruiting, but no seedlings were seen. However, seeds from these colonies germinated abundantly in the greenhouse. Prov. de Alajuela: La Peña de Zarcero, *Austin Smith NY993*, flowering, Jul. 1938; Tapezco River, 10 km N. of Zarcero, *Williams et al. s.n.*, Feb.1965, blooming (EAP); Tapezco, *A. Smith P2219*, Jan. 1940, flowering (EAP); 2.5-2.8 km N. of San José de la Montaña, *Pohl & Gabel 13670*, Dec. 1978, vegetative; same site, *Pohl & Clark 14111*, Jul. 1982, vegetative; same site, *Pohl 15672*, Jan.1989, blooming; same site, *Pohl 15706*, Feb. 1990, fruiting, no seedlings seen; Prov. de San José: San Marcos, *Tonduz 1888*, Mar. 1893, flowering (Type No., also bears # 7730, *Pittier & Durand Exsiccatae*); Río Pedregoso, 2 km S.E. of Copey, *Pohl 15728*, Mar. 1990, fruiting; Prov. de Cartago: 3 km N.E. of Pacayas, crossing of Río Birrís, *Pohl & Pinette 13304*, Jun. 1976, vegetative; Río Navarro, N. side, N.E. of El Muñeco, *Pohl 14090*, Jul. 1982, vegetative; El Copey (Tarrazú), *Jiménez 1117*, Mar. 1918, late fruiting (US); 1.5 km S. of Frailes, *Lent 737*, Aug. 1965, vegetative (F); Prov. de Puntarenas: N. of Las Alturas, *Davidse 24168*, Aug. 1983, vegetative; Río Bella Vista to Sitio Cotón, *Davidse et al. 24052*, August 1983, vegetative; Parque Nacional La Amistad campground N. of La Tigra, *Pohl 14093*, Jul. 1982, vegetative.

Chusquea vulcanalis (Soderstrom & Calderón) L.G.Clark, Ann. Mo. Bot. Garden 74:428. 1987.

This species is similar to *C. subtessellata* but larger and blooming is much less frequent. Prov. de Alajuela: Volcán Poás, around the meadow, *Pohl & Davidse 11509*, Nov. 1969, flowering; same site, in meadow, *Pohl 13929*, Jun. 1980, flowering; same clump, *Pohl 15709*, Feb. 1990, vegetative; Prov. de Cartago: Volcán Irazú, *Pittier 14126*, Dec. 1900, flowering; same site, *Pohl & Davidse 10805*, Aug. 1968, flowering; same site, *Pohl & Davidse 10621, 10803*, Jul.-Aug. 1968, vegetative; same site, *Pohl & Clark 13914*, May 1980, vegetative; same site, *Kuhbier 676*, March 1971, vegetative; same site, Pohl 1990, sight record only, vegetative; Volcán Turrialba, 2 km E. of Hda. Central, *Pohl & Davidse 10859*, Aug. 1968, one plant flowering.

A putative hybrid of *C. vulcanalis* and *C. subtessellata* (Clark el al.,1989), occurs in the sphagnum bog at km 70 on the Carretera Interamericana. *Pohl 15677*, Jan. 1989, blooming in 1989 and 1990. This was not blooming in previous years; same site, *Horn SPH 88*, Mar. 1985, vegetative.

Elytrostachys McClure

This is a small genus of tall bamboos with very weak canes that are easily crushed and normally finding support by scrambling or leaning in trees. The plants are readily recognized

by the very prominent auricular bristles on the culm leaves and the narrow, reflexed blade. They flower gregariously, some colonies isolated by many kilometers blooming at the same time.

Elytrostachys clavigera McClure, J. Wash. Acad. Sci. 32:176. 1942.

This species occurs mostly in lowland forests, where the plants ascend into trees, the upper parts leaning and drooping. The earliest flowering collections known from Costa Rica are three Tonduz specimens, listed below. Costa Rica: Prov. de Alajuela: Río Zapote bridge, S. of Upala, *Pohl 13566,* Jun. 1978, old fruiting; this colony had disappeared by 1990 (sight record); El Fósforo, *Pohl & Gabel 13706,* Dec. 1978, flowering; Prov. de San José: along Autopista to Guápiles, 13 km N. of tunnel, alt. 2000 m, *Pohl 15690*, Feb.1989, vegetative; same site, *Pohl 15722*, Feb. 1990, vegetative; Prov. de Limón: 2 km S.W. of Bribri, along Río Sixaola, *Pohl & Gabel 13719*, Dec. 1978, flowering; same locality, *Pohl & Gabel 13717,* Dec. 1978, vegetative in previous Jun. but now dead and apparently flowered much earlier; Katsi, *Ocampo 1574,* Feb. 1977, label states that Indians claim it blooms once every seven years; Suirri, Río Uren, *Ocampo, s.n.* May 1979, seedlings (CR); Yorquín, *Ocampo s.n.*, May 1978, seedlings (CR); Valle de la Estrella, *Ocampo s.n.,* Oct. 1978, seedlings (CR); Prov. Puntarenas, Buenos Aires; *Tonduz 377 or 3627*, year 1891, flowering; Tsaki, *Tonduz 9490*, year 1895, flowering; Parque Nacional Corcovado, *Knapp 880* (CR); Nicaragua: Dept. Zelaya: Risco de Oro, *Pipoly 5038*, Mar. 1979, fruiting.

Non-flowering material has been collected from several localities in recent years. The population along the Carretera south of the Buenos Aires intersection continues in vegetative state. The 1978 flowering was gregarious, and our collections from El Fósforo and Bribri were simultaneous, although the colonies were separated by about 300 km, and on opposite sides of the isthmus.

Guadua Kunth

The species of this genus are usually recognizable by the presence of branch thorns. The lower internodes may be solid, resembling species of ***Chusquea***, but the plants may be distinguished vegetatively by the thorns and in flower by having pseudospikelets.

Guadua amplexifolia Presl, Rel. Haenk. 256. 1830.

This species is recognizable vegetatively by its very broad leaf blades, thick-walled or solid stems, and in fruit by the thick, stiff, frequently mottled pseudospikelets. While widespread in Central America, it is rare in Costa Rica. Some of the occurrences may be from planted individuals. Costa Rica: Prov. de Guanacaste: Corralillo, Nicoya, en los Valles del Tempisque, *A. Alfaro 17999*, Apr.1914, fruiting; 6.5 km by road S.E. of Nicoya, *Pohl & Pinette 13236*, Jun. 1976, vegetative.

Guadua angustifolia Kunth, Syst. 1:253. 1822.

This widespread species is much more abundant in South America than in Central America. Some of our records are obviously from plantings. The only Costa Rican herbarium record is from the following enormous clump on the campus of the CATIE at Turrialba. I have observed this plant nearly every year since 1966 and it remains vegetative. Costa Rica: Prov. de Cartago: Near Cacao Grove, *Pohl & Davidse 11749*, vegetative. Propagules (culm segments) from this clump are being rooted and disseminated in cultivation.

Sight records indicate cultivated clumps near La Suiza and Tuis.

Guadua macclurei Pohl & Davidse, Ann. Mo. Bot. Gard. 78: 1991.

This newly described species occurs in wet lowland forests in Nicaragua and Costa Rica. It may be recognized by its broad leaf blades with acicular hirsute auricles and thin-walled stems. Costa Rica: Prov. de Alajuela: El Fósforo, N. of Upala, *Pohl & Clark 13930,* Jun. 1980, vegetative; Prov. de Puntarenas: Piedras Blancas, *Pohl & Calderón 10103,* Jul. 1966, vegetative.

Guadua paniculata Munro, Monogr. Bamb. 85. 1868.

This is the most widespread species of *Guadua* in Costa Rica, and is especially prevalent in Guanacaste. The canes are of moderate size and frequently are solid near the base. The plants are apparently fire-resistant and regenerate rapidly after flowering. Costa Rica: Prov. de Guanacaste: Road to Los Inocentes, 3 km E. of Carretera Interamericana, *Pohl & Pinette 13239*, Jun. 1976, flowering; same site, *Pohl & Pinette 13238*, vegetative; same site, *Pohl & Gabel 13557*, Jun. 1978, seedlings and dead plants; same site, *Pohl & Gabel 13702*, Dec.

1978 flowering; same site, *Pohl & Clark 14615*; Jan.1985, vegetative but some seedlings; Carretera, 10 km S. of La Cruz, *Pohl & Davidse 10599*, Jun. 1968, vegetative; 2 km E. of Liberia, *Pohl & Davidse 10613*, Jun. 1968, vegetative; Road to Cuajiniquil, *Pohl & Pinette 13238*, Jun. 1976, vegetative; Prov. de Puntarenas: 1 km S. of Buenos Aires intersection, along Carretera, *Pohl & Davidse 10756*, Jul. 1968, vegetative; same site, *Pohl & Gabel 13727*, Dec. 1978, vegetative; same site, *Pohl & Clark 13917*, May 1980, vegetative; 1.4 km from Carretera, road to Térraba, *Pohl & Clark 14625*, Jan.1985, flowering.

Merostachys Sprengel

This genus is very closely related to *Rhipidocladum*, from which it differs in the narrow, reflexed blades of the culm sheaths, and in the more pectinate inflorescences. Both genera have fan-shaped arrays of branches arising from an adnate triangular meristem just above the node. The plants are rare and little known in Costa Rica, but recent blooming of the population at Monteverde has given us good material for identification.

Merostachys glabra Pohl, Ann. Mo. Bot. Gard. 78: 1991.

This recently recognized species is currently known from only three localities in Costa Rica. The holotype was collected from the Monteverde Reserve in Jan.1985, although presence of seedlings to 1 m tall indicated earlier flowering, as also the Dryer specimen, collected in flower in 1977 from the same site. Costa Rica: Prov. de Puntarenas: Monteverde Reserve, *Pohl & Clark 14613*, Jan. 1985 (holotype); Monteverde Reserve, Sendero Brillante, *Grayum et al. 5126*, Feb. 1985, fruiting; Cerro Amigos, Monteverde, *Judziewicz 4628*, Apr. 1983, vegetative (CR); Guanacaste: Parque Rincón de la Vieja, Cabeceras de Quebrada Rancho Grande, in sotobosque, *Herrera 1488*, Dec. 1987, early flowering (CR); Prov. de Alajuela: 4-7 km N. of Balsa, *Liesner & Judziewicz 14771*, Apr. 1983, vegetative, apparently a young seedling.

All collections known to me represent small plants, rarely over 1 m tall when flowering. The species appears to be restricted to wet cloud forests.

Merostachys latifolia Pohl, Ann. Mo. Bot. Gard. 78: 1991.

This species has much larger leaves than the previous one, and a narrow, velutinous rachis. The type is from Nicaragua, and the species is known from Costa Rica only by the cited specimens. Costa Rica: Prov. de Puntarenas: Zapotal, Montes de Oro, *O. Jiménez s.n.*, May 1961, specimen is in late flowering condition; Prov. de Alajuela: La Palma de San Ramón, *A.M. Brenes 18110*, Apr. 1927, fruiting (CR); Nicaragua: Dept. de Jinotega: Hy. 3, 1 km N. of La Fundadora entrance, *Stevens & Henrich 20418*, May 1981 (Holotype), specimen in late fruiting condition; Dept. de Matagalpa: Cerro el Picacho, *Stevens 22117*, May 1983, specimen is in late fruiting condition.

Neurolepis Meissner

This is the most unusual genus of the Bambusoideae, with erect unbranched culms, terminal panicles, and very elongated (more than 1 m) leaf blades. The genus is almost entirely South American, but *N. pittieri* McClure has been seen in vegetative condition from extreme southem Costa Rica and is also known from Cerro Hornito, Panama, near the Costa Rican border.

Rhipidocladum McClure

The bamboos of this genus are very slender and graceful. They share with *Merostachys* the triangular platelike meristem which bears a fan-shaped array of branches at each node, but differ from that genus in having culm leaf blades that are broad-based and erect. The plants are widespread and common in Costa Rica.

Rhipidocladum clarkiae Pohl, Ann. Mo. Bot. Gard. 72:272. 1985.

This species is known only from the type locality, at the old entry to the Parque Nacional Braulio Carrillo, above Bajo la Hondura. The plants were collected in bloom in Jul. 1982. The area is a very wet cloud forest. This species is to be expected in similar sites in the area. The plants are very graceful and have ornamental possibilities. They may be distinguished from other Costa Rican species by the very large number of fine lateral branches. Costa Rica: Prov. de San José: Bajo la Hondura, *Pohl & Clark 14103* (holotype), Jul. 1982; same site, *Davidse et al. 23228*, Jan. 1983, flowering; same site, *Pohl 15736*, Mar. 1990, vegetative. Plants at that time were of adult stature.

Rhipidocladum maxonii (Hitchc.) McClure, Smithsonian Contrib. Bot. 9:105. 1973.

This is the most delicate of all Costa Rican bamboos, the culms only 2-3 m long and 2-3

mm in diameter. They lean on brush or scramble in vegetation. The type, from Santa Clara de Cartago, was in flower in 1923. Recent flowering has not been observed until 1989. The plants die after flowering and seedlings seem to be abundant. The species is endemic to central Costa Rica. Prov. de San JosÈ: Yerba Buena, N. of San Isidro, *Standley & Valerio 49781*, Feb. 1926, vegetative; Prov. Cartago: Santa Clara de Cartago, *Maxon & Harvey 8154* (US; type no.), Jul. 1923, flowering; El Muñeco, *Standley 33643*, Feb. 1924, flowering (US); La Estrella, *Standley 39179*, Mar. 1924, flowering; El Muñeco, *Pohl & Davidse 11697*, Feb. 1969, vegetative (US); El Muñeco, *Primack, Utley, & Luteyn 190*, Jun. 1972, late fruiting; Carretera Interamericana, km 41-42, *Pohl & Lucas 13005*, Dec. 1974, vegetative seedlings; same site, *Pohl & Clark 14112*, Jul. 1982, vegetative; same site, *Pohl 15681*, Jan. 1989, dead plants with few spikelets, numerous seedlings; La Estrella, *Pohl 14125*, Aug. 1982, adult but vegetative; Quebrada Cangreja, *Liesner & Judziewicz 14471*, Apr. 1983, adult but vegetative; between La Estrella and Vara de Roble, 2.6 km by road S. of La Estrella church, *Pohl 15766*, Apr. 1990, seedlings only, abundant, no old plants; Carretera Interamericana S. of Cartago, *Schubert et al. 710*, Jun. 1956, fruiting (US).

These plants are so delicate and small that they may be easily missed. Almost all known collection sites are in the Province of Cartago, south of Cartago in very moist areas. They are highly decorative and worthy of cultivation.

Rhipidocladum pacuarense Pohl, Ann. Mo. Bot. Gard. 72:273. 1985. Listed in Pohl (1980) as *R. harmonicum* (Parodi)Mc Clure.

This is among the largest of Costa Rican species of *Rhipidocladum*, with canes 2-3 cm thick. The plants occur scattered in southern and eastern Costa Rica. We originally collected this species in vegetative state at the type locality in 1975 and 1976. The only blooming colony flowered in 1982 and has since nearly disappeared. A few adult canes were seen at this locality in 1990. Costa Rica: Prov. de Cartago: 1.8 km E. of Hy. 232 crossing of Røo Pacuare, *Pohl & Pinette 14161* (type), Oct. 1982, flowering; same site, *Pohl 15750*, Apr. 1990, vegetative; 1 km S.E. of Pavas de Turrialba, *Pohl & Pinette 13207*, Jun. 1976, vegetative; Prov. de Puntarenas: Cañas Gordas, in a sink hole, *Pohl & Pinette 13274*, Jun. 1976, vegetative.

Rhipidocladum pittieri (Hack.) McClure, Smithsonian Contrib. Botany 9:105. 1973.

This species was described from the Río Virilla near San José. The type, represented by fragmentary flowering branches, was collected in 1892. I began to observe the large population at Puente de las Mulas in 1968, and first found blooming in 1973. Observation each year revealed no further blooming until Jan. 1989, when the species was again in massive gregarious bloom along the Río Virilla in the San José area. This establishes a blooming cycle of about 16 years at this site. At Puente de las Mulas, seed set was very poor and few seedlings developed. However, spikelets collected from *Pohl 15707* produced many seedlings in the greenhouse. The plants occur on the canyon walls above the Río Virilla over a considerable area. Flowering plants always die. Costa Rica: Prov. de Alajuela: Tuetal Norte, *Ocampo 1825*, Mar. 1976, flowering; San Miguel Oeste, Naranjo, *Herrera 2338*, Dec. 1988, fruiting (CR); Río Barranca, *Pohl & Clark 14116,* Jul. 1982, vegetative; Prov. de San José: Río Virilla prés San José, *Tonduz 7193*, Nov. 1892 (type number), flowering; Río Conejo, *Pohl & Davidse 11056*, Sep. 1968, vegetative; same site, *Pohl & Clark 13926,* May 1980, vegetative; same site, *Pohl 15680*, Jan.1989, flowering; Puente de las Mulas, *Pohl & Selva 12836*, Jun. 1973, flowering; same site, *Pohl & Lucas 12996*, Dec. 1974, seedlings; same site, *Pohl 15707*, Feb. 1990, fruiting, seeds germinated readily in the greenhouse; same site, *Pohl 15680*, Jan. 1989, flowering; Rodeo de Pacaca, *Pohl 14206*, Nov. 1982, vegetative; Prov. de Cartago: Barrio la Libertad, Río Virilla, *Pohl 15693*, Feb. 1989, flowering; same site, plants dying (sight record), Feb. 1990.

Rhipidocladum racemiflorum (Steud.) McClure, Smithsonian Contrib. Bot. 9:106. 1973.

This is a slender bamboo similar to *R. pittieri* but differing in its very narrow leaf blades and in spikelet characteristics. Both species tend to flower during the same years. This species is widespread from Mexico to Bolivia. Blooming is fairly frequent. Costa Rica: Prov. de Guanacaste: Río Chiquito, crossing of Upala Road and Río Tenorio, *Pohl 12641,* Jul. 1971, vegetative; same site, *Pohl 12963*, Jun. 1973,

flowering; same site, *Pohl & Lucas 13060*, Dec.1974, seedlings among old dead plants; same site, *L.D. Gómez 18612*; same site, *Pohl 14174*, Oct. 1982, vegetative; same site, *Pohl 15685*, Feb. 1989, early flowering; Río Marterio, *Pohl 12962*, Jun. 1973, fruiting; Líbano, *Standley & Valerio 44899*, Jan. 1926, fruiting (US); Liberia, *Pohl & Davidse 10612*, Jun. 1968, vegetative; Colonia Carmona, *Pohl & Davidse 10586*, Jun. 1968, vegetative; Hda. Los Inocentes, *Pohl 12652*, Jul. 1971, vegetative; Prov. de Alajuela: Alto del Monte, *Pohl 15661*, Jan. 1988, vegetative; 1.5 km W. of Sarchí Norte, Río Colorado, *Pohl 14154*, Sep. 1982, vegetative; same site, sight record only, year 1984; same site, *Pohl 15684*, Feb.1989, in gregarious bloom; Prov. de San José: 5 km S.W. of San Isidro del General, *Pohl 14189*, Nov. 1982, vegetative; Puriscal, km 25, *Pohl 14132*, Aug. 1982, vegetative; Rodeo de Pacaca, *Pohl 14205*, Nov. 1982, vegetative; same site, *Pohl 15683*, Jan. 1989, gregarious flowering; same site, *Pohl 15708,* Feb. 1990, dying, seeds germinated abundantly in the greenhouse Prov. de Puntarenas: Boruca, *Pohl & Davidse 11148A*, Sep. 1968, vegetative; Peñas Blancas de Esparza, *G. Herrera Ch. et al. 271*, Nov. 1986, blooming; San Vito de Java-Ciudad Neily, *Hammel & Grayum 14171,* Jy. 1985, blooming (US); .

The plants at Río Chiquito showed a blooming cycle of sixteen years. In 1973, blooming was widespread, and the Río Marterio colony was in bloom simultaneously with the Río Chiquito plants. Similarly, the 1989 bloom occurred both at Río Chiquito and at Rodeo de Pacaca, approximately 140 km apart. The colony at Sarchí Norte was also in bloom at the same time.

Other cultivated bamboos

Various species of the following genera are seen in cultivation, but never become naturalized.

Dendrocalamus Nees.

Several species are grown in experimental gardens.

Phyllostachys Siebold & Zuccarini.

The commonest species, used for hedges and ornament, is *P. aurea* A. & C. Riv.

Bambusa Schreb.

See text above.

Melocanna Trin.

Cultivated only at the CATIE in Turrialba.

Otatea (McClure & Smith) Calderón & Soderstrom.

Cultivated at the CATIE and at Faubio Baudrit. It has bloomed and died at both sites, as well as at the Escuela Agrícola Panamericana at El Zamorano, Honduras.

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RESUMEN

Se presenta una lista anotada de los géneros y especies de bambúes leñosos de Costa Rica, tanto nativos como introducidos. Hay en total ocho géneros y 40 especies nativas, y seis géneros y por lo menos ocho especies introducidas y cultivadas. Esta informacióm se basa en muestras de herbario y en las experiencias del campo del autor durante 24 años. Se indica localidades y fechas de colección y en algunos casos, de floración para cada muestra de herbario. Las fechas sucesivas de floración para las colonias individuales de *Rhipidocladum pittieri* a lo largo del Río Virilla son 1892 (tipo), 1973, y 1989. Las fechas para una colonia individual de *Rhipidocladum racemiflorum* en el Río Chiquito son 1973 y 1989.

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