DIVERSITY AND DISTRIBUTION OF NEW WORLD BAMBOOS, WITH SPECIAL EMPHASIS ON THE BAMBUSEAE

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FOREWORD

The richness of bamboo flora of the New World has been virtually unknown until very recently, in spite of large number of bamboo species. It is estimated that in the Americas, there are 46 genera and approximately 515 species of bamboo, both woody and herbaceous, extending from the United States to Chile. Most of the genera (96%) are endemic to the New World and only two genera Arundinaria(woody) and Streptogyna(herbaceous) have a bihemispheric distribution pattern.

This paper was presented at the joint Vth International Bamboo Workshop/IVth International Bamboo Congress at Bali in 1995 and discusses the diversity of the New World bamboo genera. It includes informative distribution maps and also highlights the need for further research on the ecology, natural history and population structure of New World bamboos.

INBAR has invited Dr. Ximena Londono to publish this paper as part of its working paper series. It is hoped that this publication will help in raising awareness about the New World bamboos and also create interest in addressing the bamboo research needs of the region.

Cherla B. Sastry Director, INBAR IV. Ramanuja Rao Principal Scientist, INBAR

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INTRODUCTION

The bamboos, which belong to the family Poaceae and specifically to the subfamily Bambusoideae, can be distinguished from other grasses by the following characteristics: a) an embryo formula of F+PP or F-PP, b) a linear hilum, c) an embryo that is small in comparison to the endosperm, d) three lodicules, e) a seedling in which the first blade is broad and horizontal and preceded by one or more bladeless sheaths, f) rodlike bicellular microhairs, g) a nonradiate mesophyll with both fusoid and arm cells present, h) vascular bundles usually more than one and superposed in the midrib, and i) silica bodies vertically oriented in relation to the long cells (Soderstrom & Ellis 1987). Also they are the only major group of grasses adapted to forests rather than open habitats.

Bamboos are either woody or herbaceous. Woody bamboos represent a monophyletic group and they are recognized as a single tribe, Bambuseae, based on a) its complex vegetative branching, b) dimorphic shoots and culm leaves, c) external ligules and d) gregarious and monocarpic flowering. The herbaceous bamboos do not represent a monophyletic group and they are allocated to a number of separate tribes, Olyreae, Streptogyneae, Buergersiochloeae, Guaduelleae and Puelieae (Soderstrom 1981 a; Soderstrom & Ellis 1987; Clark et al. 1995).

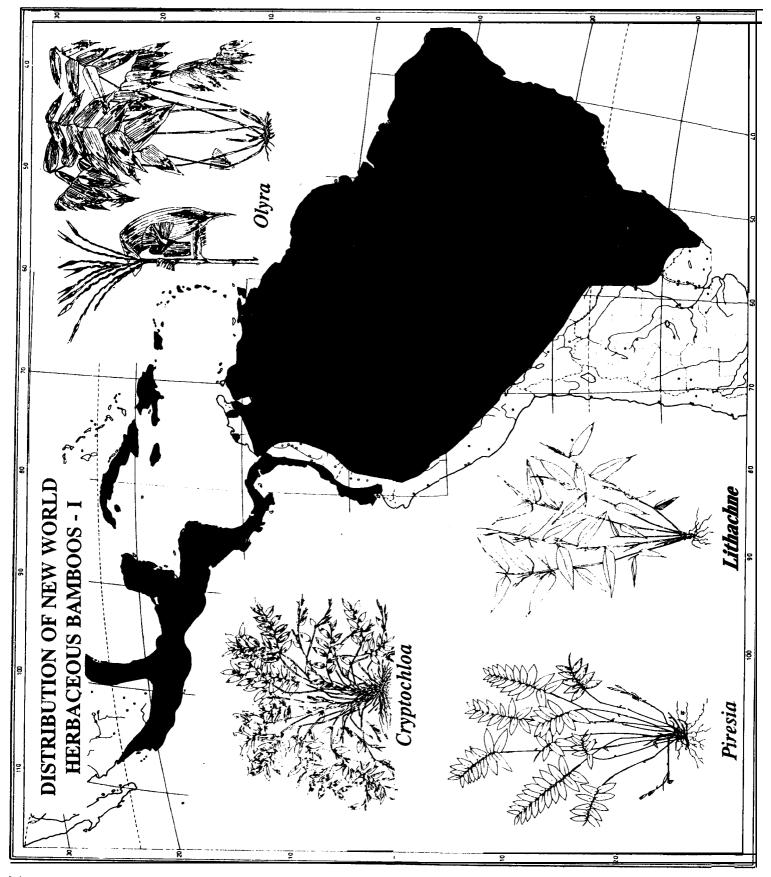
There are approximately 90 genera and 1100 species of bamboos in the world (McClure 1966; Soderstrom et al. 1988; Clark, 1990a). From this total, 42 genera and 547 species occur in Americas, representing more or less 50 % of the worldwide species diversity. They are distributed from the United States of America, through Central and South America, including the Caribbean region, to southern Chile; they range from 40^o N latitude in the USA to approximately 47^o S latitude in Chile, and from the sea level to above 4000 m in the Andean highlands.

The herbaceous bamboos in the Americas are rarely found above 1000 m elevation and prefer lowland wet forest like the Amazon basin and the Choco region in Colombia and Panama. They occur especially in lowlands from Mexico to Uruguay, including the Caribbean Islands (see Map 1). A total of 21 genera and 127 species occur in the New World, representing 87% of the world generic diversity and 85% of the world species diversity of the herbaceous bam-Pharus and Streptochaeta boos. The genera Anomochloa, are excluded from the true bamboos according to DNA sequences produced by Clark and co- workers (unpublished data) using parsimony and distance-base phylogenetic reconstruction methods. However, these phylogenetic relationships have to be explored more thoroughly. From the remaining genera, 20 belong to the tribe Olyreae and are endemic to the New World; and one genus, Streptogyna, belongs to the tribe Streptogyneae and occurs in both the Old and New Worlds. In the Americas, the highest endemism is found in the coastal forest of southern Bahia, representing 53% of all New World herbaceous bamboo genera, out of which 27 species are endemic. Cuba has three endemic genera (Ekmanockloa, Mniochloa and Piresiella) and five endemic species (Zuloaga et al. 1993), and the Choco region of Colombia and Panama have one endemic genus (MaclurolyraJ and approximately 11 endemic species (see Map 2) (Soderstrom et al. 1988). The most common and widespread herbaceous genera in America are Olyru, Cryptochloa, Puriuna,

and Piresia; the majority of their species are known from the Amazon basin (Calderon & Soderstrom 1973, 1980).

The woody bamboos are broadly distributed. They occur nearly continuously throughout Central and South America and the West Indies, except for desert areas, to Chile, They range from approximately 40° N lat. in USA with Arundindria to approximately 47° S lat. in Chile, Chusquea being the most austral genus. Altitudinally they range form sea level to 4000 m in the Andean highlands. (Calderon & Soderstrom 1980; Soderstrom et al. 1988; Clark 1995). In both the Old World and New World, approximately 61 genera of woody bamboos and 951 species are recognized. A total of 21 genera and 420 species occur in the Americas (Clark 1995), representing 34.4% of the worlds woody bamboo generic diversity and 44% of the worlds woody bamboo species. Of these 21 genera, only *Arudinaria* occurs in both the eastern and western hemispheres, with the remaining 20 genera endemic to the New World.

The areas of highest woody bamboo generic diversity and endemism are Brazil with 18 genera, 6 of them endemic (ALvimia, Apoclada, Athroostachys, Criciuma, Eremocaulon, and Gluziophyton); Mexico and Central America with 11 genera, two of them endemic *(Olmecu* and an undescribed one related to Chusquea); Guyana highlands with one endemic genus *(Myriocladus);* Colombia and Venezuela each with nine genera and no endemism; Peru with eight genera; and Ecuador and Bolivia each with six genera (Soderstrom et al. 1988; Burman & Filgueiras 1993; Clark 1990a, 1995). At the species level, the greatest diversity is present in Brazil followed by the Andes from Venezuela to Bolivia (Clark 1995).



Map 1. Distribution of New World herbaceous bamboos

WOODY BAMBOO SUBTRIBES & GENERA OF THE NEW WORLD

A summary is provided on the distribution, habitat and habit of each genus of New World woody bamboo. The summaries are organized in alphabetical order of subtribes and genera. The Soderstrom and Ellis (1987) classification with modification (Dransfield and Widjaja, 1995) has been followed.

1. ARTHROSTYLIDIINAE

Includes 12 genera, representing 57% of the New World generic diversity, and ca, 150 species. They are distributed from Mexico to Argentina, at elevations of 0 - 3700 m, and inhabit different habitats from lower to upper montane forest and dry regions like "cerrado" in Brazil. These bamboos can be distinguished by the anatomy of the leaf blade with sclerenchyma cells in the intercostal zone and refractive papillae (Soderstrom & Ellis 1987) (see Map 3).

1.1. Actinocladum McClure ex Soderstrom.

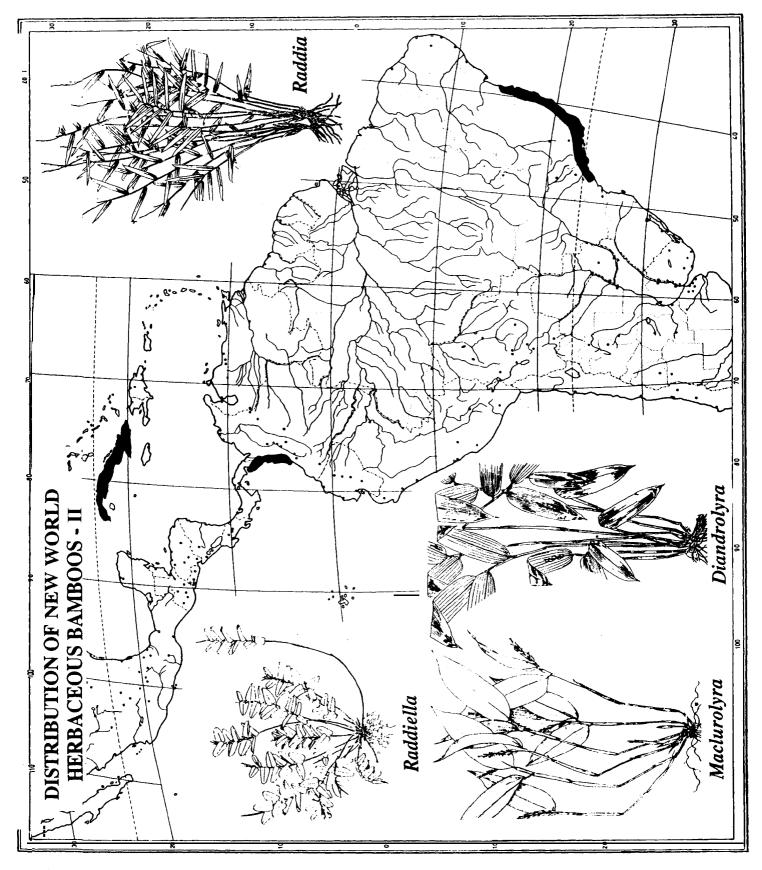
A monotypic genus from the "cerrado" of central Brazil and Bolivia (Map 4). Actinocladum uerti*cillatum* (Nees) McClure is a fire-resistant bamboo, inhabiting open savannas. It is adapted to survive a prolonged dry season and fire due to its thick-walled, pith-filled culms, thick coriaceous leaves, and indurate scales which protect the specialized buds (Soderstrom 1981b; Filgueiras & Pereira 1988). It occurs between O-500 m (-700) el evation and is characterized by culms erect below and arching above, paniculate inflorescences, apsidate-like branch complements, and nucoid caryopses.

1.2. Alvimid Soderstrom & Londono.

This is a slender and vining bamboo which inhabits the "restinga" or white sand coastal forest in the state of Bahia in Brazil between 40-100 m elevation (Soderstrom & Londono 1988) (Map 4). It includes three species characterized by fleshy fruits, a condition found in several Old World genera such as Melocanna, Ochlandra and *Dinochloa* but infrequent in the New World; only Olmeca a genus from Mexico and *Guadua*, surcocarpa from Peru and Brazil share this morphological character (Soderstrom et al. 1988; Soderstrom & Londono 1988; Londono & Peterson 1991).

1.3. Arthrostylidium Ruprecht.

This is a relatively widespread genus, with 30 species distributed from southern Mexico through Central America and the West Indies into northern South America including the Amazon basin (Map 3) and from sea level to 3700 m elevation (Judziewicz & Clark 1993). The principal centre of the diversity is the West Indies with 15 species, representing 50% of the diversity of this genus. In Cuba and the Caribbean region, the majority of species inhabit dry sandy and serpentine soils, while in South America, they are known from riverside or montane forests. Species of *Arthrostylidium are* characterized by scandent, slender culms and erect culm leaf blades. According to Clark (1995) a thorough study of Arthrostylidium is needed, and its phylogenetic relationships to other genera (such as *Rhipidocladum* and Atractantha) should be investigated, because *Arthrostylidium* may not be monophyletic:



Map 2. The highest endemism places for herbaceous bamboos in the New World

1.4. Athroostdchys Bentham,

This is a manotypic and endemic genus with vining culms, occurring at low elevations in the coastal forest of Brazil, from Bahia to Rio de Janeiro (Soderstrom *et* al. 1988) (Map 4). Athroostachys can be distinguished by crowded and condensed capitate inflorescence, and the prominent radiate oral setae on its leaf sheaths (McClure 1973). It seems to have suffered badly from environmental destruction (Burman & Filgueiras 1993).

1.5. Atractantha McClure.

It is a genus of five species with vining and scandent culms. Four species inhabit the "restinga" and Atlantic forest from Bahia to Espirito Santo, at elevations from 0 to 650 m, and one, Atractantha *amazonica*, occurs in the Amazon region of Brazil and Venezueia, at elevations from 80 to 100 m in wet, lowland, seasonally flooded forest known as "igapo" or "varzea" (Judziewicz et al, 1991; Judziewicz, 1992 (Map *4). Atractantha* can be distinguished form the other bamboos by its pungent, spindle like florets, often arrayed in elegant, fan- shaped clusters or capitate heads, and by its solid calms sometimes with small but well-developed peripheral air canals (Judziewicz, 1992). According to Judziewicz (1992), possible related genera are *Alvimia, Arthostylidium* and *Elytrostachys*.

1.6. Aulonemia Goudot.

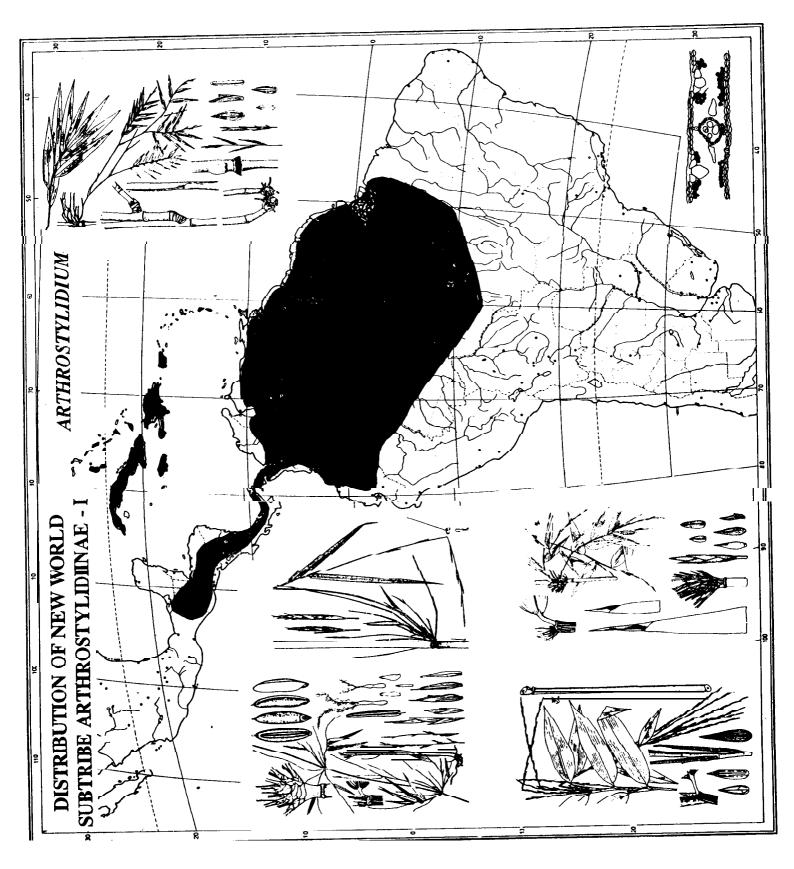
This is a widespread genus with ca, 36 species. It is distributed nearly continuously along the Andes from Venezuela to Bolivia, and in southeastern Brazil, with disjunct species in the Guyana Highland, Central America, and southern and Central Mexico (Map 4). The aggregate altitudinal range from the genus is from (0-) 600-3600 m, The Andean species are found in lower and upper montane forests, subparamos and paramos from (1500-) 2000 -3600 m but the Brazilian species commonly grow below 2000 m (Clark 1995). *Aulonemia* can be distinguished by its reflexed culm leaf blades, well-developed fimbriae on the culm lead margins and foliage leaf sheaths, paniculiform inflorescences, and multi-flowered spikelets (McClure 1973; Clark & Londono 1990). *Aulonemiu queko* Goudot is the most widely distributed Andean species, from Colombia to Bolivia, and is known for its long internodes that may reach 2 m in length. This has allowed indigenous Andean populations to use it for musical instruments (flutes, trumpets), hunting (blow-pipes) and for other handicrafts. This species may be considered threat-ened due to habitat destruction and overharvesting (Londono 1990).

1.7. Colunthelia McClure & Smith.

This genus includes seven species distributed in Brazil, from Minas Gerais and Rio de Janeiro to Rio Grande do Sul, and northern Argentina in Misiones (Clark 1995 Map 4). The species are delicate, climbing and hanging bamboos that occur at higher elevations (ca.1300 m) than other endemic genera of Brazil, except Glaziphyton (McClure 1973; Smith et ul, 1981). The majority of species are found along roadsides or in moist forest in the Atlantic forests and "restinga" of southeastern Brazil.

1.8, *Elytrostuchys* McClure.

It includes two species, E. *clawigera* McClure and E. *typica* McClure, distributed from Honduras to Colombia and Venezuela, and one disjunct and undescribed species in the tropical rain forest of southeastern Peru and adjacent Brazil and Bolivia (McClure 1942;



Map 3. Distribution of New World genusArthrostykiium

London0 1995 Map 5). The culms are thin-walled, erect below and clambering and vining above (McClure 1973). The prophyllate inflorescence of this genus links it to Atractantha, but its affinities within the arthrostylidioid alliance are not well established (Clark 1995).

1.9. Glaziophyton Franchet.

A monotypic genus, endemic to the Serra dos Orgaos in the State of Rio de Janeiro in Brazil (Map 4). Glaziophyton mirabile Franchet is a bizarre species, forming dense clumps approximately 2 m tall in difficult to access places mountain tops. The culms are junciform and septate, with thin walls, At some stage in its life, the plant produces tiny leaves on some culms of the entire clump (McClure 1973; Burman & Soderstrom 1990; Burman & Filgueiras 1993). The phylogenetic relationships of Glazioghyton to other genera remained unknown but according to DNA sequences produced by Zhang *et* al, (unpublished data) Glaziphyton has been shown to have arthrostylidioid affinities.

1.10 Merostachys Sprengel.

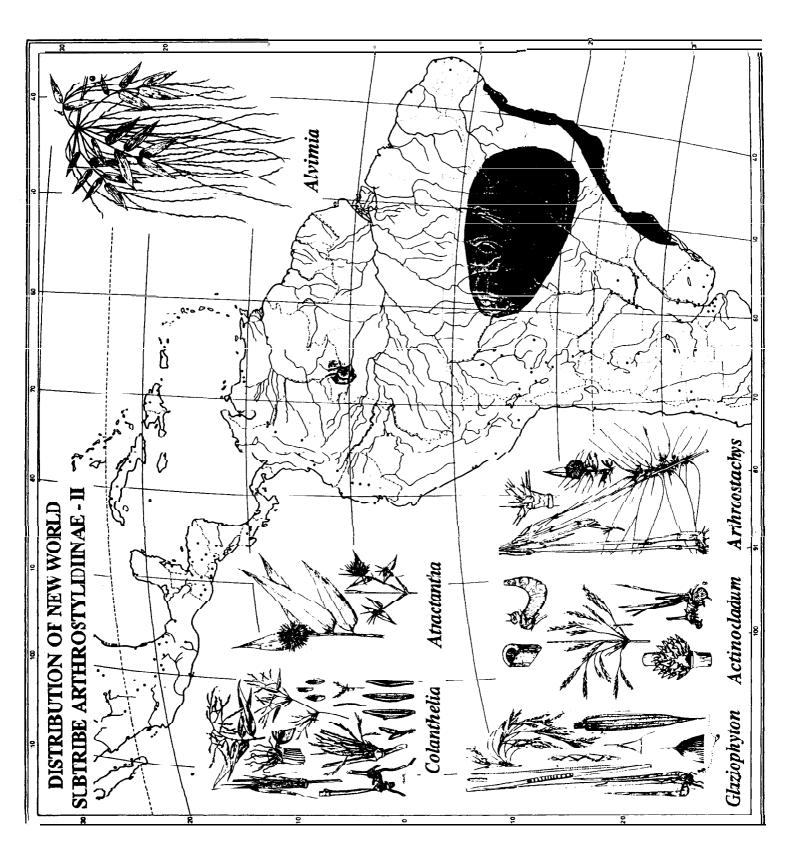
This is a relatively widespread genus with approximately 48 species. 87% of species diversity is found in the montane forests of eastern and southeastern Brazil where Merostachys plays an important ecological role (Sendulsky 1995). Some disjunct species occur in Mexico, Central America and northwestern South America (Colombia, Venezuela and the Guianas) McClure 1973; Davidse & Pohl 1992; Clark 1995 Map 5). The altitudinal range for the genus is from sea level to 1500 m elevation. The majority of species are erect, arching apically, and all share reflexed culm leaf blades, fan-shaped branch complements, and racemiform inflorescences. It appears to be closely related to *Rhipidocladum*.

1.11. Myriocladus Swallen,

This is an endemic genus of sandstone mountains called "tepuis" of Venezuela and neighboring Brazil (see Map 5). It includes 20 species characterized by erect habit and thick leaves. The members of this genus are found at elevations of 1200-2500 m (McClure 1973; Judziewicz 1990; Judziewicz et al. 199 1).

1.12. Rhipidockdum McClure.

This is a widespread genus of ca. *20* species, distributed primarily from southern Mexico to Panama and the West Indies, and in the Andes from Venezuela to northwestern Argentina, with disjunct species in central Mexico, northeastern South America (eastern Venezuela, Guyana and Surinam), Trinidad and western Amazonian and central Brazil (Clark & Londono 1991 a, Map 5). Species occur in humid forests at elevations of 100-2900 m. 5'0% of the diversity occurs in Andean mountain forests at elevations of 350 to 2900 m (Clark 1995). The species are erect, arching apically or clambering and hanging, and are characterized by fanshaped branch complements, racemiform inflorescences and thin-walled culms (McClure 1973). *Rhipidocladum harmonicurn* Parodi is the most widely distributed Andean species, from Colombia to Bolivia, and is used by native communities for musical instruments such as flutes ("quenas") and panpipes ("zamponas"). This species may be considered threatened by habitat destruction (Londono 1990; Londono 1992).



Map 4. Distribution of New World genera Altknia, Colunthelia, At-uctuntha, Glaziophyton, Actinoclulum and Anhmroostachys

2. ARUNDINARIINAE

This is essentially an Old World subtribe with the extension of one genus, Arundinaria to the southeastern USA. The genera of Arundinariinae are mostly temperate and occur on mountains in the tropics and at lower elevations with increasing latitude. It is very similar to the Bambusinae (Soderstrom & Ellis 1988).

2.1. Arundinaria Michaux.

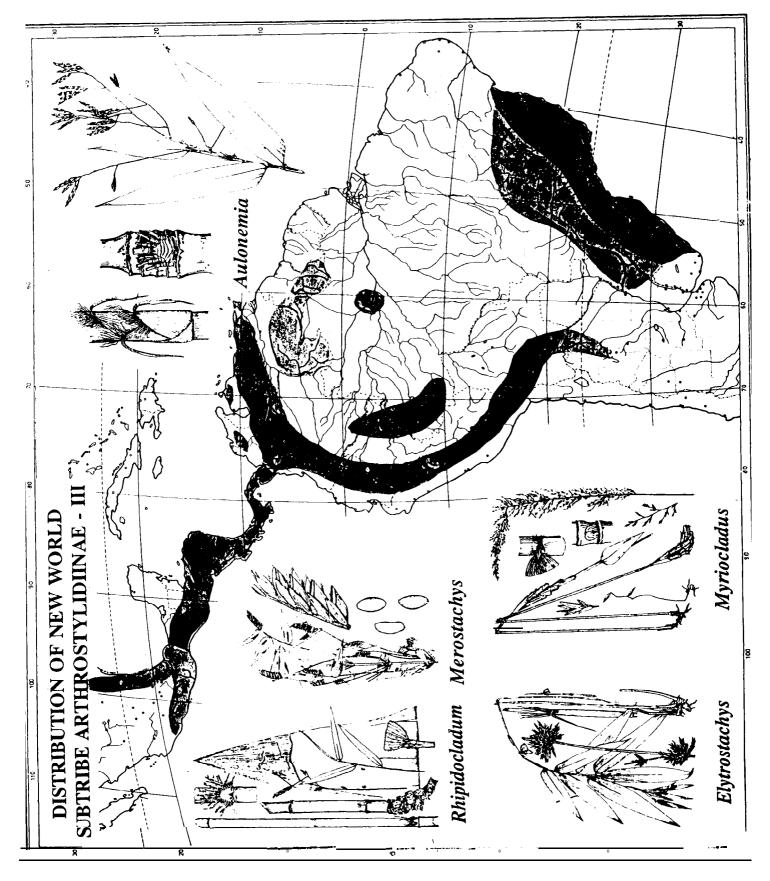
This is the only genus of woody bamboos to occur in both the Old and New Worlds. In *Amndinaria,* one species and three subspecies are limited to southeastern USA (Map 6). *Amndinaria* can be -distinguished by leptomorph rhizomes with or without air canals, hollow rarely solid culms, determinate inflorescences with racemes or open to closed panicles, and multiflowered spikelets (McClure 1973).

3. CHUSQUEINAE

This natural subtribe is found only in the New World tropics, mostly occurring at high elevations, and contains Chusquea and *Neurolepis* (Dransfield & Widjaja 1995; Clark pers. comm.). *Chusquea* occurs from Mexico to Chile and *Neurolepis* from Costa Rica to Bolivia Species can be characterized by development of one or more than one bud. at the node, solid or hollow culms, papillate subsidiary cells of the stomata1 apparatus, and spikelets with 2 empty glumes, 2 sterile lemmas, and a perfect terminal floret, with 3 stamens, free filaments, and a glabrous ovary with 2 plumose stigmas (McClure 1973; Soderstrom & Ellis 1987; Clark 1990b & 1995).

3.1. *Chusquea* Kunth.

This is the most speciose bamboo genus in the world with the widest latitudinal range, from 24⁰ N lat. to 47⁰ S lat. in Chile with *Chusquea culeou* Desv., and from sea level to 4000 m with *C. angustifolia*, C. *tessellata* and several others in ecosystems known as "paramos" in the Andes. It includes an estimated 180 species which are distributed from Mexico to Argentina and Chile, with a large group of species in Brazil, with one disjunct species in the Juan Fernandez Islands and another in the West Indies (Clark 1989; 1995 Map 7). It is primarily and Andean montane genus with 42% of the species diversity found in the Andes between 2500-3500 m, and 96% of these Andean species being endemic; the next most diverse area is southeastern Brazil and parts of Uruguay, Argentina and Paraguay with 31% of species diversity (Clark 1992, 1995). Chusquea can be distinguished from other bamboos by its multiple, independent and dimorphic buds on each node. Clark (1995) established the Andes as a primary centre of diver sity, and also recognized six sections and one subgenus with the genus (Clark 1989, 1990b): Sect. Chusquea, Sect. Longifoliae, Sect. Longiprophyalle, Sect. Serpentes, Sect. Swallenochloa, Sect. Verticilltae, and Subg. Rettbergia. Chusquea is usually associated with montane forests "subparamo ', "paramo" and high altitude grasslands, and is found more rarelly in lowland rain forests. It is ecologically important in the Andean montane forests where it forms extensive pop ulations called "carrizales", a great ecological habitat for butterflies, beetles, rodents and birds (Londono 1990). Also, culms are used by Andean inhabitants for house construction, basket manufacturing, and ritual ceremonies (Cleef 1981; Londono 1992). Some species are extremely successful colonizers of disturbed habitats in Andean montane forests and may be indicator species for site instability (Young 1991; Stern 1992).



Map 5. Distribution of New World genera Aulonemia, Rhipidocladum, Merostachys, Elytrostachys and Myriocladus

3.2. Neurolepis Meisner .

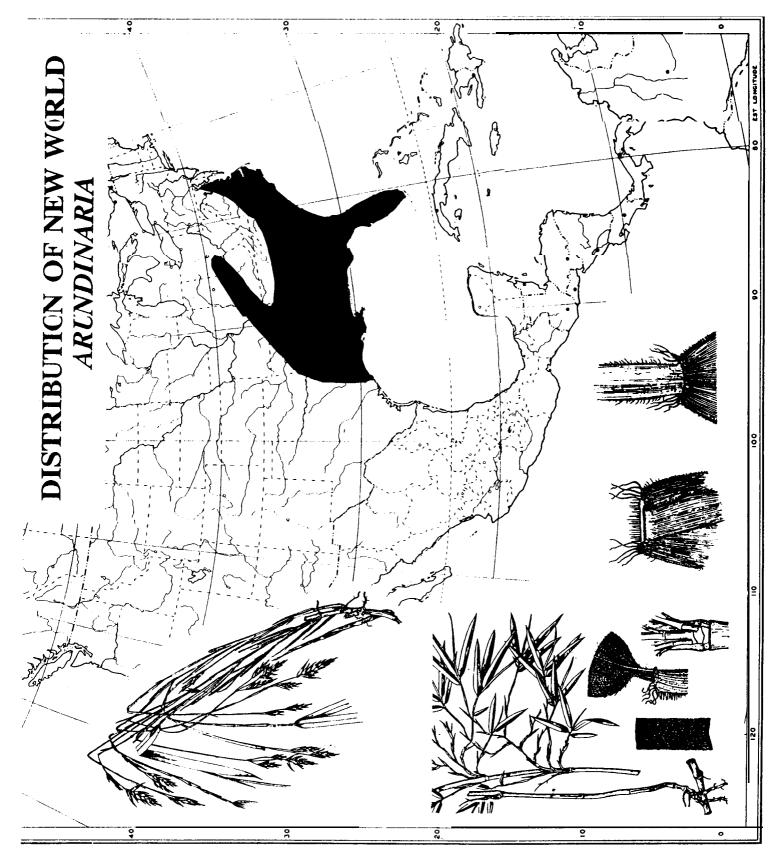
This genus includes approximately 20 species, distributed from Mount Tocuche on Trinidad through Venezuela and along the Andes into Bolivia, with some disjunct species in Panama, Costa Rica and the Guyana Highlands (Soderstrom et al. 1988; Judziewicz 1990; Clark 1995 Map 8). It occurs in habitats like "tepuis", "paramos", and upper montane forests, at elevation from 1500-4100 (-4300) m. It is primarily an Andean montane genus with approximately 75% of its species diversity occuring between 2500 and 3500 m; northern South America is considered to be the centre of this genus (Clark pers. comm.). The one flowered spikelets with four glumes, papillate subsidiary cells of the stomatal apparatus, and seedling morphology of some species indicate its affinity with *Chusquea* (Clark 1995). However, it requires additional study before its taxonomy and phylogeny can be resolved. *Neurolepis* can be distinguished from other Bambusoideae by lack of aerial branching and its long, thick, tough, and leathery leaves up to 4 m long and 20 cm wide which appear to represent adaptations to relatively rigorous environmental conditions (Soderstrom 1969). *Neurolepis* leaves are used by Andean inhabitants for that thing (Londono 1992).

4. GUADUINAE

This subtribe occurs in the New World tropics from Mexico to Argentina with species found mostly at lower elevations (Soderstom & Ellis 1987). It includes Six genera: Apoclada, Criciuma, Eremocaulon, Guadua, Olmeca, and Olatea, with an estimated total of 35 species. The first three genera are endemic to Brazil; Guadua occurs from Mexico to Argentina and Uruguay; Olmeca is endemic to Mexico; and Otatea occurs from Mexico and Central America and was recently found in northeastern Colombia. Guaduinae has a wide distribution range from approximately 27' N latitude in northwestern Mexico (Otatea acuminata (Munro) Calderon & Soderstom) to approximately 33' S latitude in Argentina and Uruguay (Guadua lrinii (Nees) Nees ex Ruprecht) and from 0 to 2200 (-2800) m elevation. This subtribe includes the largest bamboos of the New World, and it can be distinguished anatomically by the increased frequency of stomata on the adaxial surface, and the fact that these stomata usually have papillae associate with them. The most striking morphological features are the presence of sympodial rhizomes with short to long necks, hollow or solid culms, unarmed or armed branches, erect to scandent habit, one solitary bud at the midculm node, multiflowered spikelets with 6 or 3 stamens, and ovary glabrous or pubescent with 2 or 3 plumose stigmas (Soderstrom & Ellis 1987; Soderstrom & Londono 1987).

41 Apoclada McClure.

This genus is endemic to Brazil and occurs between 44-55' W long. and 15-28' S lat. at elevations of 55.0-1130 m (Map 9). It includes three species. Two of them, A. *arenicola* McClure and A. *Cannavieira* (Silverira) McClure,are from Central Brazil and adapted to survive fire and long dry periods in the "cerrado". The third species, A. *simplex* McClure grows in the Araucaria forests of southern Brazil (Guala 1995). It can be distinguished from the other bamboos by the presence of two to many separate and equal primary branch buds in a single line above the node, and by a lack of fusoid cells in the foliage leaf blade (Guala 1995). According to Guala (1995), the phylogenetic position of the genus is still in doubt but the presence of intercostal sclerenchyma fibers and refractive papillae in the group point to an affinity with Arthrostylidiinae. However, recent study of the Bambusoideae based on DNA sequences



Map 6. Distribution of genus Arundinaria in the New World

by Zhang et al. (unpublished data) indicates that Apoclada appears to be more closely related to subtribe Guaduinae than to subtribe Arthrostylidiinae. *Apoclada* simplex is of great utility in southern Brazil for building construction, drying racks, plants supports and structures such as fences. *Apoclada* arenicola and *A. cannavieira are* important to both livestock and native fauna (Guala 1995).

4.2. Criciuma Soderstrom & Londono.

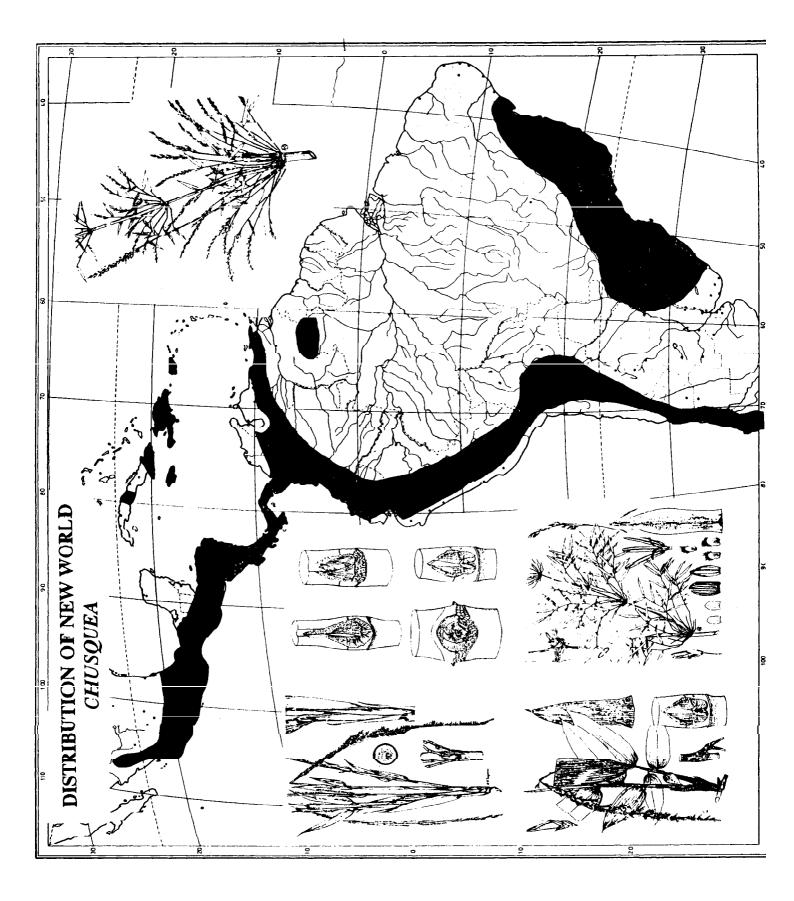
This is a monotypic genus of climbing bamboos found only in the sandy coastal forest of a restricted area of southern Bahia at 20-100 m elevation between the towns of Una and Olivenca (Soderstrom & Londono 1987; Soderstrom et al, 1988; Map 9). The most distinguishing morpological character in this genus is the asymmetrical central midnerve of the foliage leaf, vinelike culms with reflexed blade of the culm leaves and very long pseudospikelets (Soderstrom 6r Londono 1987).

4.3. Eremocaulon Soderstrom & Londono.

This endemic genus from Brazil occurs in the states of Bahia, Goias, Minas Gerais and Mato Grosso at elevation of 140-400 (-900) m (Map 9). It can be distinguished by its isolated culms with rhizome necks as long as 2 m, reflexed blade of the culm leaf and presence of oral setae in the inner ligule of the culm leaves (Soderstorm & Londono 1987). It appears to be closely related to Olmeca from Mexico.

4.4. Guadua Kunth.

This represents the biggest and the most economically important genus of the New World, with species reaching heights 30 m and culms reaching 21 cm in diameter. It also constitutes the most extensive bamboo forest in America, covering more than 120000 km 2 in the western Amazon basin. The genus includes ca, 25 species distributed almost continually from San Luis de Potosi, Mexico at 22' 55' N lat. (G. velutina Londono & Clark), through all the countries of Central and South America to Argentina and Uruguay approximately at 33' S latitude (G. trinii), except for the West Indies and Chile (Soderstrom & Londono 1987; Clark & Londono 1991b; Londono 1990, 1992; Young 1992 Map 10). It is primarily an Amazonian genus with 45% of the species diversity in the Amazon and Orinoco basins (Londono & Judziewicz 1991). The next most diverse area is central Brazil and eastern Bolivia with 30% of the species diversity in the "cerrado" or savanna, Species have been found from sea level to 2200(-2800) m, being more abundant and diverse at lower elevation between O-1500 m, being more abundant and diverse at lower elevation between O-1500 m. It occurs in different types of habitats such as lowland tropical forests, savannas, cerrados, gallery forests and the lower montane forests, Guadua can be distinguished from the other Bambusoideae by its thorny and large culms, triangular culm leaves, white bands of hairs below and above the nodal line, and the palea of the spikelet with the keels winged. The majority of the species have erect culms arch, ing apically, however, a few species such as G. glomerata Munro and G. ciliata Londono & Davidse have slender and scandent culms hanging apically (Londono & Davidse 1991; London 1992). Uses have been reported for many of them but due to its exceptional timber quality and natural durability, G. angustifoliaKunth is the most useful. Abundant in the Andes from Venezuela to Ecuador, it plays a significant role in the daily lives of the local inhab-



Map 7. Distribution of New World genus Chusquea

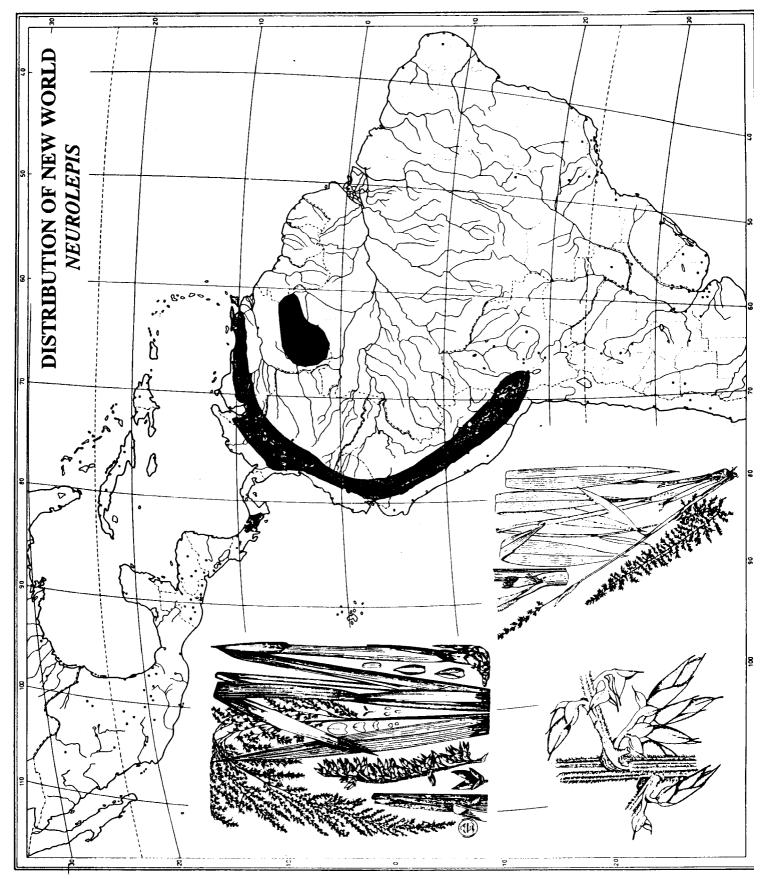
itants; its culms are utilized mainly for construction, handicrafts and agricultural and musical instruments; also, it is important for erosion control and protection of river banks (Mcclure 1966; Londono 1992; Young 1992). The most widespread species of the genus is G. *paniculata* Munro, extending from Mexico to Brazil, the most widespread Amazonian species is G. *weberbaueri* Pilger, characterized by long internodes up to 1 m long, and elongated rhizome necks reaching 8 m (Londono 1995); G tugoara (Nees) Kunth is the most common one in the montane and coastal forests of southern Brazil and, G. surcocarpa Londono and Peterson is the only species in the genus with a fleshy caryopsis and the first report of an edible bamboo fruit in the New World (Londono & Peterson 1991; Londono 1992).

4.5 Olmeca Soderstrom.

This is an endemic genus from Mexico, It includes two species, o. *recta.* from the Tuxtlas region in Veracruz, and 0. reflexa from the states of Chiapas, Oaxaca and Veracruz (Map 9). It can be distinguished by its long rhizome necks (up to 8 m), and by its fleshy fruits, a feature uncommon in New World bamboos, but shared with Alvimia and *Guadua sarcocarpa*, (Soderstrom 1981c; Soderstrom & Londono 1988; Londono & Peterson 1991).

4.6.0tatea (McClure & Smith) Calderon and Soderstrom.

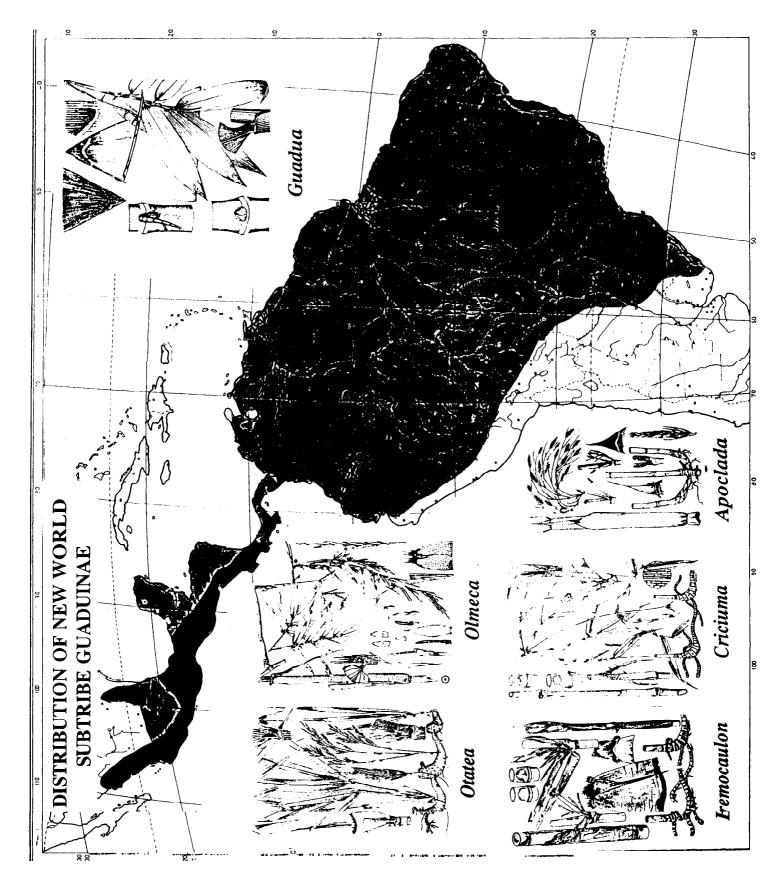
This genus includes two species occurring in Mexico, Central America and northeastern Colombia, growing in tropical deciduous or subdeciduous forests at elevations of 200-2700 m (Map 9). Otatea acuminata (Munro) Calderon and Soderstrom, is found in dry areas of caduciform and xeromorphic vegetation in Mexico. The other, *O. fimbriuta* Soderstrom, occurs on slopes and in humid canyons and extends from Mexico into Central America and to Colombia. It can be distinguished by thick-walled to almost solid culms, thornlike roots on the lower nodes of the culm, branch complement with 3 branches/node and a characteristic culm leaf, with the base of the blade narrower than the sheath apex. Otatea is commonly called 'Otate" in Mexico and "cana brava" in Colombia, and its major use is for house rafters (Guzman *et* al. 1984; Soderstrom et al. 1988).



Map 8. Distribution of New World genus Neurolepis

RESEARCH NEEDS

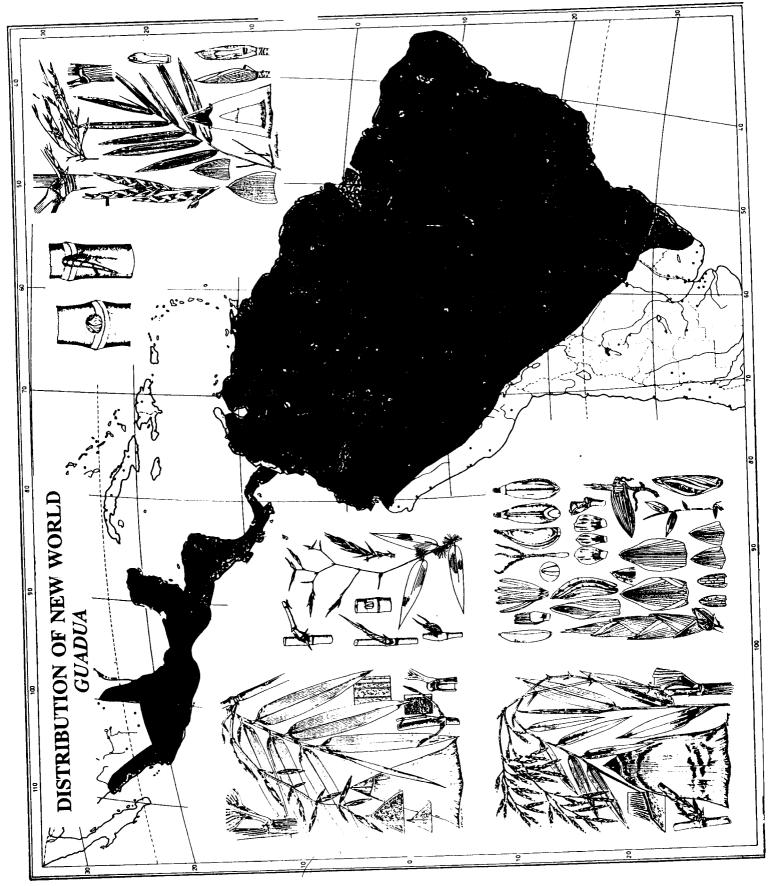
T he diversity of the New World bamboos needs further study in order to answer biogeographic, phylogenetic and taxonomic questions. However, much more has to be done on ecology, natural history and population structure. As in Asia, bamboo remains an ideal study case for establishing a solid linkage between economic development and environmental conservation strategies. It is my strong conviction that some social problems in the tropics can partially be solved by making bamboo a source of economic growth, with strong emphasis on sustainable management.



Map 9. Distribution of New World subtribe GuLuluinac

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A4ap 10. Distribution of New World genusGuadua

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