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ORCHIDS OF A REGENERATED TROPICAL DRY FOREST IN THE CALI RIVER WATERSHED, MUNICIPALITY OF CALI, COLOMBIA

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RESUMEN: El bosque seco tropical regenerado en la cuenca media del Río Cali forma un corredor biológico de cerca de 100 hectáreas que conecta la ciudad de Cali con el Parque Natural Farallones de Cali. El Jardín Botánico de Cali, un espacio natural de bosque seco tropical regenerado de 12 hectáreas, forma parte de este corredor y su vegetación muestra una dominancia de especies pioneras de sucesión ecológica secundaria. Las especies que predominan son: "arrayán" (*Myrcia popayanensis*), Laurel Jigua (*Cynammomum triplinerve*), Sangregao (*Crotón gossypifolius*), Guácimo (*Guazuma ulmifolia*), Chiminango (*Pithecellobium dulce*) y Chagualo (*Clusia sp*). Un análisis preliminar de las orquídeas presentes en este corredor incluye especies que crecen bien en terrenos abiertos como *Cyrtopodium paniculatum* y *Catasetum ochraceum* y en afloramientos rocosos como *Epidendrum xanthinum*, *Schomburgkia y Sobralia.* Las especies epífitas del JB incluyen *Dimerandra emarginata*, *Catasetum tabulare*, *Encyclia ceratistes*, *Encyclia sp*), *Bulbophyllum meridense*, *Cladobium, Epidendrum* (3 spp), *Maxillaria* (2 spp), *Lepanthes* y *Oncidium cartaginensis*. Hay dos especies de vainillas que son propiamente especies trepadoras. Las especies típicamente terrestres incluyen los siguientes géneros: (*Oeceoclades, Cleistes, Galeandra, Pelexia y Spiranthes.* En un bosque seco tropical de condiciones similares en la cuenca del Río Claro se encontró una especie de *Coryanthes* posiblemente nueva. La vegetación presente en el corredor biológico y el JBC es una regeneración de los últimos 70 años. El área había sido impactada severamente por procesos de agricultura extensiva, ganadería, proyectos viales y por incendios forestales. Las especies nativas de árboles así como las orquídeas presentes actualmente conforman un banco de germoplasma de gran valor particularmente desde la óptica de la restauración ecológica del bosque seco tropical en laderas andinas. Esta flora de orquídeas es precisamente, la misma que alguna vez existía en los bosques donde hoy la ciudad de Cali se extiende y por tanto representa una ventana del pasado y un enorme potencial educativo para las generaciones presentes.

KEY WORDS: orchids, restoration, conservation, systematics

Introduction

The Tropical dry Forest (Bs-T) is a vegetal formation with continuous forest cover between 0-1,000 m in altitude and temperatures above 24 C and average annual rainfall between 700 and 2,000mm, with one or two dry periods per year (Espinal 1985; Murphy & Lugo 1986, InstitutoAlexander von Humboldt 1998). The Tropical dry Forest represents about 50% of the forested areas of Central America and 22% of South America (Murphy and Lugo, 1986). In Colombia this formation is found in the Caribbean region and in the interandean valleys of the rivers Magdalena and Cauca in an area which presumably covered about 8,146,000 hectares (Espinal and Montenegro, 1977).

The Tropical dry Forest is one of the most threatened ecosystems of the Neotropics (Janzen, 1987). In Colombia it is one of the most degraded and fragmented, with estimates of present total cover of less than 1.5% of the original cover (Etter, 1993). Of this total the greatest proportion is found in the arid peri-caribbean belt with more than 6 million hectares and the NorAndean -Chocó-Magdalena province with about one million hectares (Hernández et al. 1992, Espinal and Montenegro 1977). The dry forest of the upper Cauca river valley, the main tributary of the Magdalena river, originally covered about 300,000

hectares in the Department of Valle del Cauca. Presently, the dry forest of this region has practically disappeared to the advance of sugarcane cultivation, the major economic crop of the State. It is estimated that the cover of this formation in the Cauca Valley is less than 3,000 hectares with documented reductions of 66% between 1957 and 1986 (CVC 1994). Only a few forest relicts remain in the flat portion of the Cauca river valley, all below 12 hectares each. The situation is only slightly less dramatic along the piedmont areas of the Central and Western Andean ranges where a few remnants and regenerated forests exist. The lower and middle portion of the Cali river presents a sizeable sample of the tropical dry forest formation.

The regenerated forest of the middle portion of the Cali River still guards some orchid treasures and is important for conservation purposes (Orejuela 2005, 2006). Without a previous study of the orchids of this watershed, it seemed appropriate to look at the orchids present today after some 70 years of advance of the regeneration process and to attempt to discover the original orchid flora of the local piedmont area in the municipality of Cali. This study presents a composite picture of the orchids of the lower Eastern Andean slopes as the Andes merges with the Cauca river valley. The orchids of this region are typically species of ecological succession. As the forest matures the orchid flora will increase in number of species and possibly also in terms of density of individuals. For now, it is of interest to see a diversified array of species.

General obiective

To determine the composition and growth mode of the orchids present in the regenerated tropical dry forest formation along the middle portion of the Cali river basin with the purpose of conserving the species present, to reintroduce those species which were possibly present in the watershed and to enrich the orchid species collection at the Cali Botanical Garden.

Specific Objectives

To determine the species composition and the growth mode of the orchid species found in the regenerated tropical dry forest formation in the biological corridor of the middle portion of the Cali river basin. To enrich the vegetation and area of the CBG with species of orchids found in the surrounding areas of the garden and in the "sister" watersheds of the Cali river basin.

To determine the potential of the forest remnant of the Cali Botanic Garden to serve as a source of germplasm to undertake restoration processes along the middle sector of the Cali river basin and in the city of Cali.

To design a community conservation education strategy about the orchids (and the associated animal species) of the Cali river watershed and of the Botanical Garden.

Methods

COLLECTION, IDENTIFICATION AND TABULATION OF THE ORCHID SPECIES. The characterization of the vegetation was developed in three stages: The collection of plants, the identification and the tabulation of the species found. The area inventoried covered approximately 45 hectares of forest including the totality of the area of the botanical garden and a forest of 35 hectares under protection by the Utilities Company EPSA. In addition, selected visits were made to similar regenerated and relictual forests of several "sister" watersheds like Rio Claro, Jamundí and Pance. These watersheds originate in the high Andean mountain of the Farallones National Park and descend rapidly to tribute waters into the Cauca river. The orchids collected were assigned to the following growth category: Terrestrial, lithophitic, climber and epiphyte.

COMPARATIVE ANALYSIS OF THE ORCHID FLORA OF THE VARIOUS WATERSHED to establish the breath of species present along the Andean piedmont area adjacent to the Cauca river valley. The "mother" list of potential species which is generated serves as a germplasm bank which could be used for reintroduction purposes in the Cali river basin and in the entire piedmont area of the Municipality.

REINTRODUCTION OF SELECTED SPECIES. A protocol was designed to establish the species most suited for reintroduction in the regenerated forest. A species photographic catalogue was made of the species of the watershed.

A CONSERVATION EDUCATION PROGRAM was developed to use orchids as indicator species of the benefits of

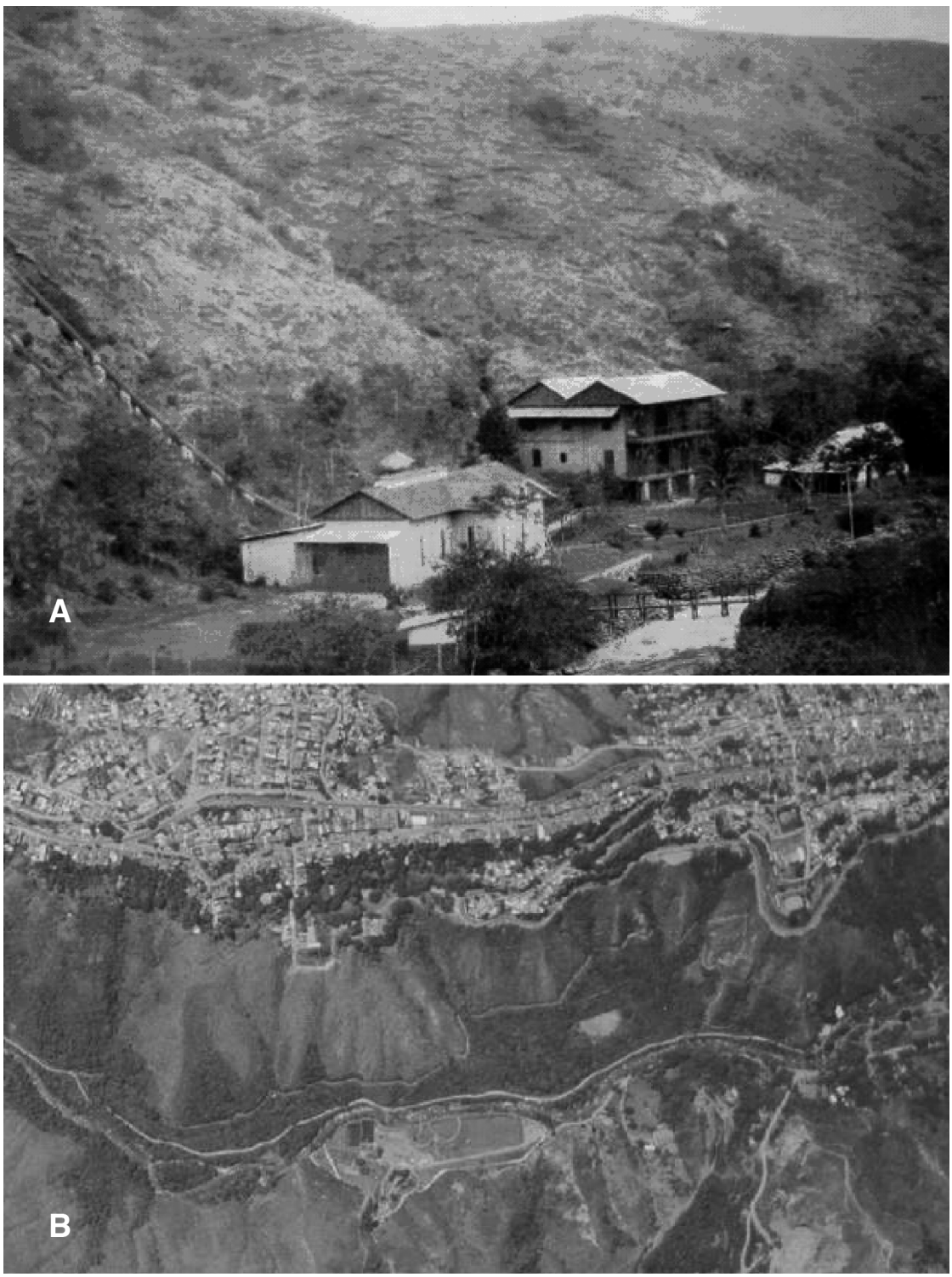


FIGURE 1. A - State of the habitat in the hillsides surrounding the first power plant of Cali, 1910. B - Location of the Cali Botanical garden and the biological corridor of the Cali river.

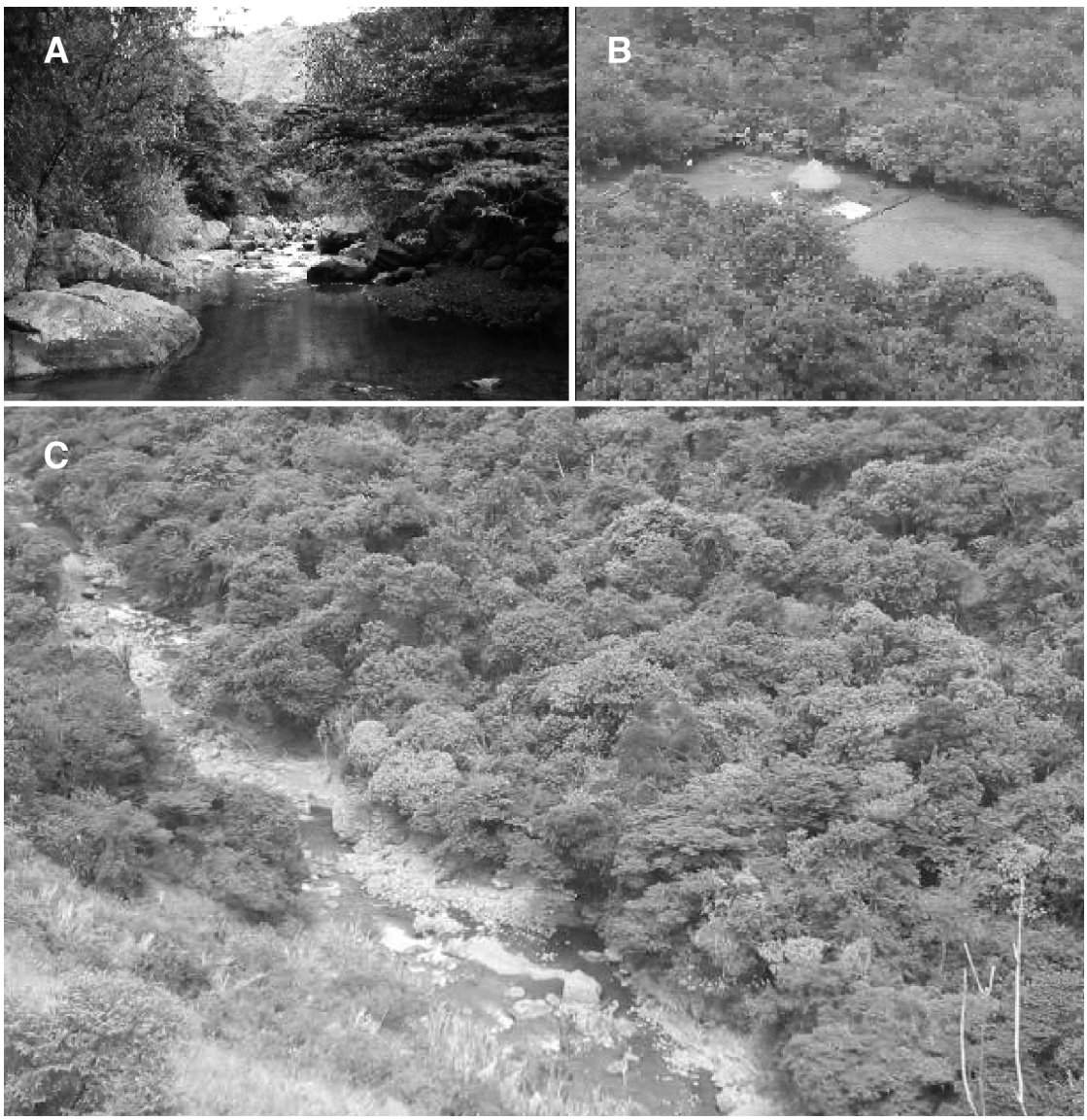


FIGURE 2. A - Cali River. B - Botanic Garden. C - Cali River and Tropical dry Forest. The totality of the flora of the botanical garden constitutes a germplasm bank of native pioneering species ideal to advance reforestation processes in the interandean river valleys. About 20-25 tree species were identified as promissory for ecological restoration and enrichment processes along Andean hillsides.

an assisted regeneration process. The elements of the strategy include: viewing of prepared video of the orchids of the Cali area; Jinkana observation games to spot and identify the orchids which enrich the Botanic Garden orchid collection; student visits to the Garden´s orchidarium, and to the orchid stand along the interpretive nature trail; preparation of orchid herbaria by students of the local schools.

Results

HISTORY OF THE REGENERATION PROCESS**.** By 1910, the inauguration date of the first hydroelectrical power plant of Cali, the native vegetation had been totally eliminated. A combination of reason explain this forest conversion: large demand of wood charcoal by the 25,000 inhabitants of Cali; removal of native veg-

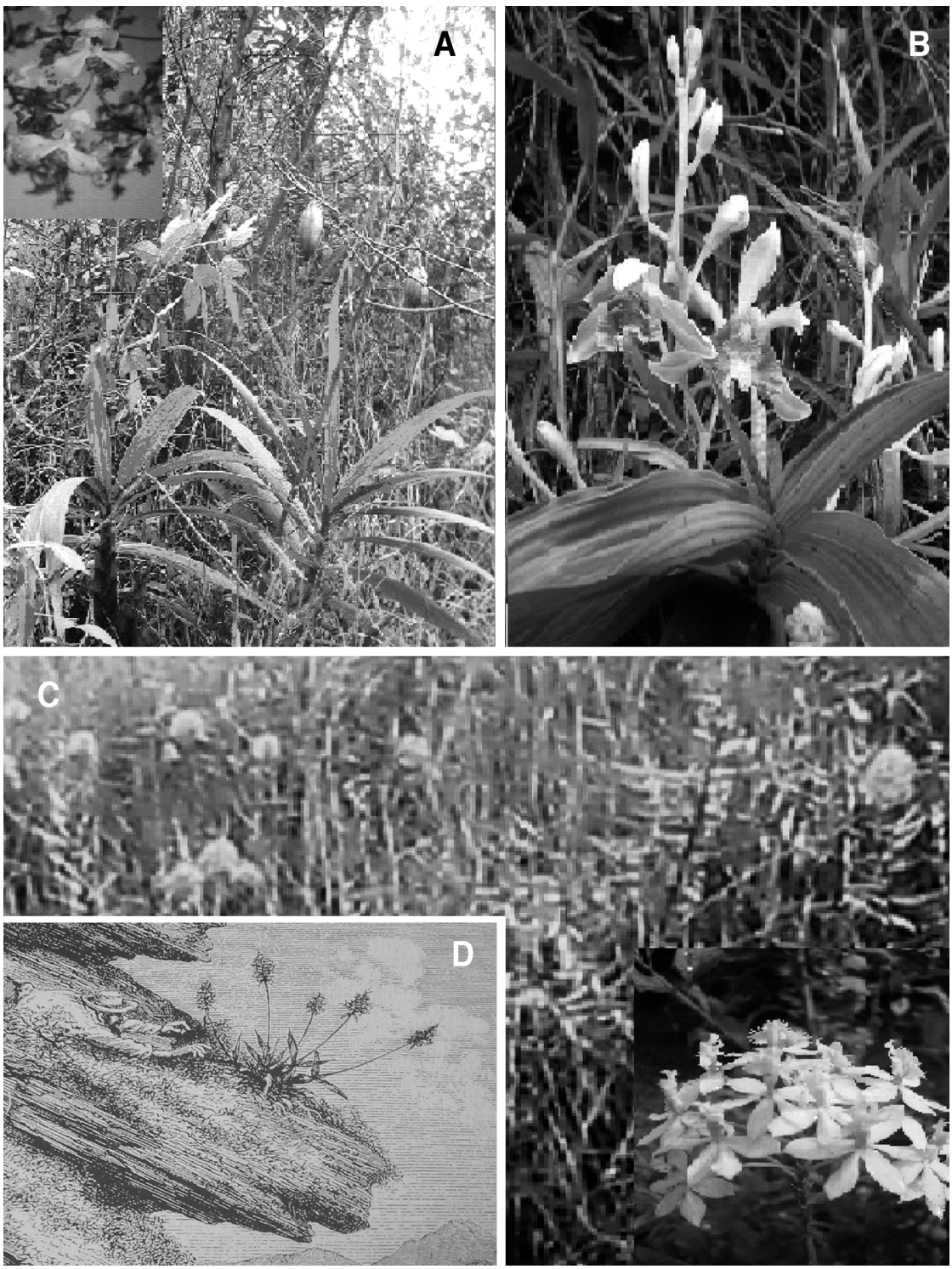


FIGURE 1. Species of open terrains and rocky outcrops. A – *Cyrtopodium punctatum*. B – *Sobralia* sp. C – *Epidendrum xanthnium*. D. *Schomburgkia* sp.

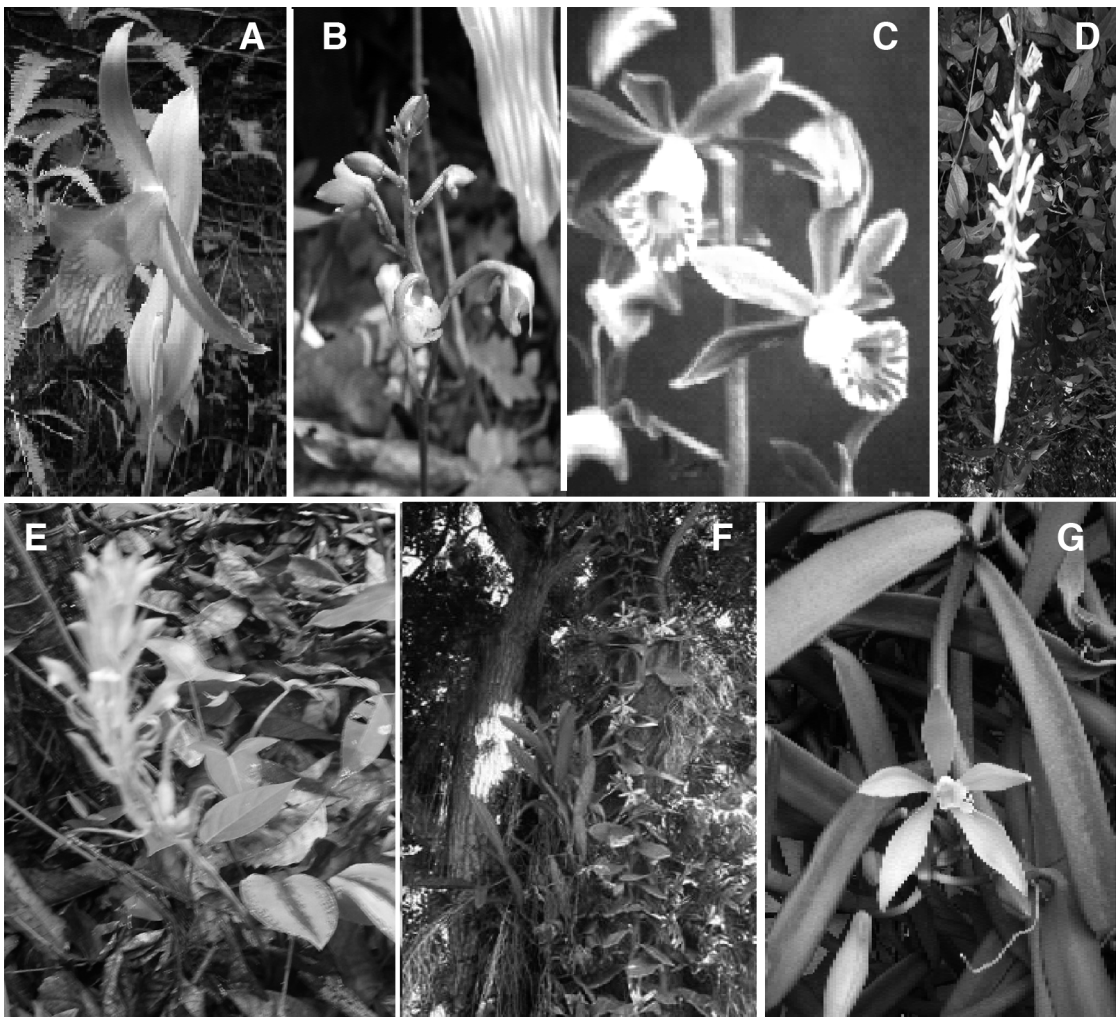
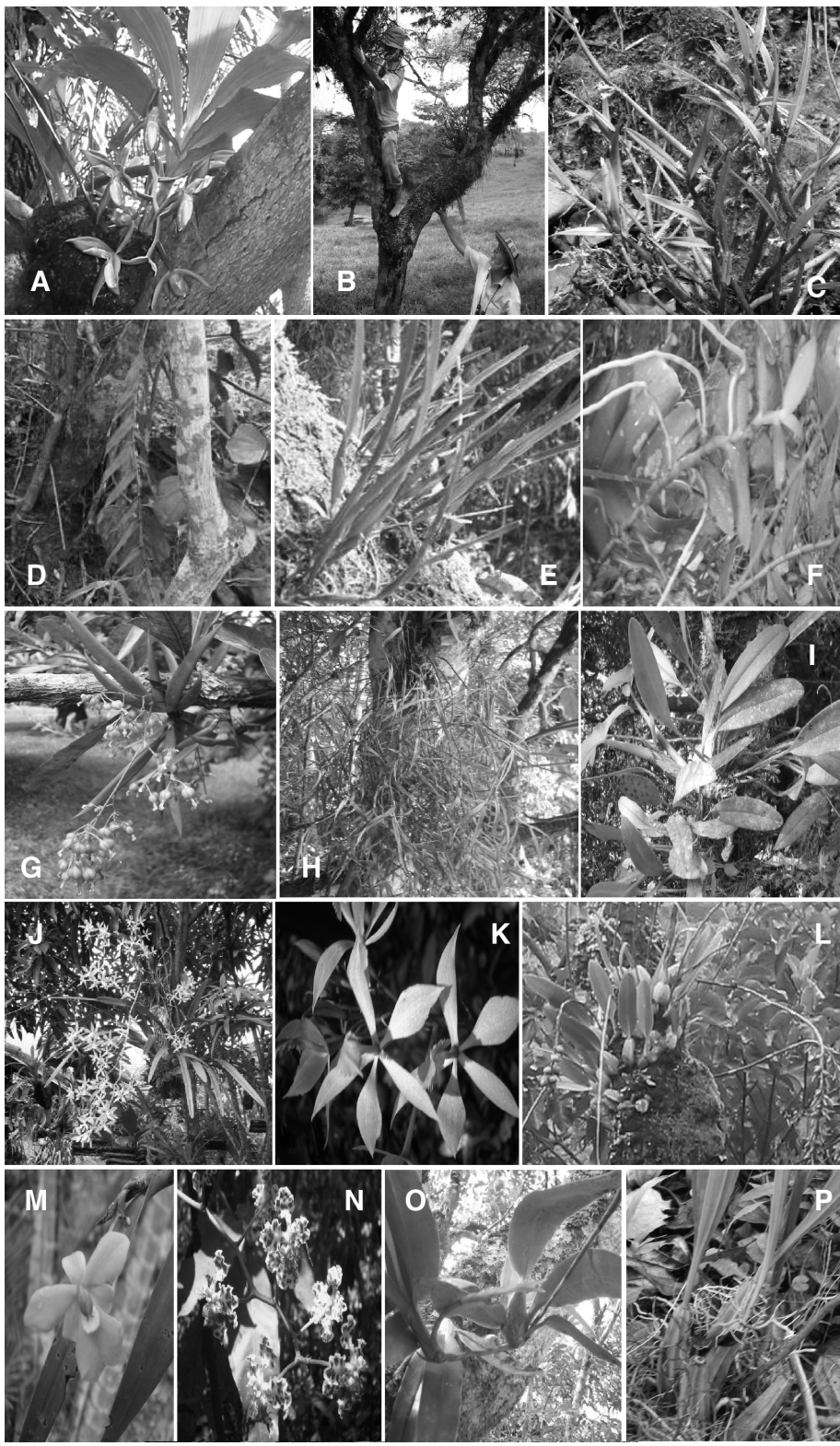


FIGURE 2. Terrestrial (A-E) and climbing (F-G) species: A – *Cleistes* sp. B – *Oeceoclades maculata*. C – *Galeandra beirichii*. D – Spiranthes sp. E – *Pelexia* sp. F – *Vanilla pompona*. G- *Vanilla odorata*.

etation during the construction of the water conduction channels to the power plants; use of round logs for construction of roads; use of hardwoods for the construction of railroad ties; use of fires to clear land for agriculture and cattle ranching; and dry season natural forest fires. Between 1910 and 1930 the regeneration process was rather slow, even though the water channel and the river provided complete protection from forest fires generated outside and above the water channels to the vegetation undergoing regeneration within the forest. The most vigorous regeneration occurred in the last fifty years, when most homes were using electricity instead of charcoal for cooking purposes. The vegetation we see today includes mature trees of 20 meters! The photographic evidence of the watershed also provides evidence that the forest of the Garden is not a recent relict but a vigorous regeneration favored by the water channels and the river which isolated two forest fragments one of 11.5 hectares (now the Botanical Garden) and a 26 hectare plot just a couple of kilometers west of the Garden. Thus, the forest cover found today in the CBG (and in various places in the basin) is the consequence of vigorous regeneration processes. A continuous secondary succession process has taken place which started in an opened field dominated by grasses with little arboreal vegetation and rather distant sources of plants for colonization more than four kilo-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meters and at least 300 meters of altitudinal difference to the nearest continuous forest patch.

THE TROPICAL DRY FOREST. The Tropical dry Forest (Bs-T) is a vegetation formation with continuous forest cover between 0-1,000 m in altitude and temperatures above 24º C and average annual rainfall between 700 and 2,000mm, with one or two dry periods per year (Espinal 1985; Murphy & Lugo 1986; Institute von Humboldt 1997). The Bs-T represents about 50% of the forested areas of Central America and 22% of South America (Murphy & Lugo 1986). In Colombia this formation is found in the Caribbean region and in the interandean valleys of the rivers Magdalena and Cauca in an area which presumably covered about 8,146,000 hectares (Espinal & Montenegro 1977). The Tropical dry Forest is one of the most threatened ecosystems of the Neotropics (Janzen 1987). In Colombia it is one of the most degraded and fragmented, with estimates of present total cover of less than 1.5% of the original cover (Etter 1993). Of this total the greatest proportion is found in the arid peri-caribbean belt with more than 6 million hectares and the NorAndean -Chocó-Magdalena province with about one million hectares (Espinal and Montenegro 1977;Hernández et al. 1992). The dry forest of the upper Cauca river valley, the main tributary of the Magdalena river, originally covered about 300,000 hectares in the Department of Valle del Cauca. Presently, the dry forest has practically disappeared to the advance of sugarcane cultivation, the major economic crop of the State. It is estimated that the cover of this formation in the Cauca Valley is less than 3,000 hectares with documented reductions of 66% between 1957 and 1986 (CVC 1994). Only a few forest relicts remain, all below 16 hectares each. The situation is only slightly less dramatic along the piedmont areas of the Central and Western Andean ranges where a few remnants and regenerated forests exist

FIGURE 3. Epiphytic species. A- *Catasetum tabulare.* B- *Dimerandra* sp. C - *Cladobium violaceum*. D – *Epidendrum* sp. E – *Epidendrum* sp. F – *Campylocentrum* sp. G. *Trizeuxis falcata*. H– *Epidendrum* sp. I – *Stelis* sp. J –*Encyclia ceratistes*. K – *Epidendrum* cf.*flexuosum*. L – *Bulbophyllum meridense.* M – *Dimerandra emeraginata*. N – *Oncidiun carthagenense*. O – *Maxillaria* sp. P. *Coryanthes* sp.

THE TROPICAL DRY FOREST OF THE MIDDLE CALI RIVER WATERSHED. The species found at the CBG and middle Cali river comprise an arrangement of secondary succession species, with a level of species richness comparable to those of other dry forests formations in the Cauca River valley (Gonzalez and Devia 1995, Orejuela 2006). The total number of 49 tree species is lower than the average number of 58.1, n= 8 sites) found by Gentry (1995). The forest of the Garden shows a notorious dominance of six tree species which in terms of numbers are ranked as follows: Arrayán (*Myrcia popayanensis*), Laurel Jigua (*Cynammomum triplinerve*), Sangregao (*Crotón gossypifolius*), Guácimo (*Guazuma ulmifolia*), Chiminango (*Pithecellobium dulce*) y Chagualo (*Clusia sp*). The vegetation of the lower stratum is heavily dominated by Cordoncillo *Piper sp* and Anamú (*Petiveria alliacea*) Phytolaccaceae family, *Croton* and individual plants of the dominant middle and upper strata. Associated to the forest there is a profusion of climbing and liana species. Among these species the Aristolochia (two species), Passiflora (four species) and Cucurbitaceae are noteworthy. The species of medium levels are: Sangregao (*Croton* two species), Arrayán (*Myrcia*, two species), Guava (*Psidum guajava*), Verraquillo (*Trema micrantha*), Carbonero (*Calliandra pittieri*), Jigua (*Cynammomum*), Guácimo (*Guazuma*), *Leucaena*, Chagualo (*Clusia*), *Solanum* and *Miconia* spp (Orejuela 2006b).

THE CBG FOREST COMPARED WITH MATURE RELICT FORESTS. In comparisons with other forests found in the Andean piedmont areas of similar size and level of connectivity with other forest fragments the CBG registers slightly lower species richness and the species composition differs in several key species. For example, in the municipality of Jamundi just south of Cali, the Ecological Reserve of Miravalle, in the Calichal river (afflue nt of the Jamundí river), and the piedmont forests along the Rio Claro (Hacienda La Novillera) the dominant species are Cascarillo (*Laderbergia magnifolia*), Tumbamaco (*Didimopanax morototoni*), Niguitos (*Miconia spp*), Balso (*Ochroma lagopus*), Ceiba (*Ceiba pentandra*), Caracolí (*Anacardium excelsum*), Algarrobo (*Hymenaea courbaril*), *Madroño (Garcinia madruno), Dinde (Maclura* tinctoria), Cañafístula (*Cassia grandis*), Cedro (*Cedrella odora-*

TABLE 1. Orchid species present and growth mode presented in the Cali river basin.

Growth mode	Species
1. Open terrain and rocky outcrop	*Cyrtopodium paniculatum*
	Sobralia
	Epidendrum xanthinum
	Schomburgkia cf. *superba*
2. Terrestrial	*Cleistes rosea*
	Galeandra beyrichii
	Oceoclades maculata
	Pelexia sp.
	Spiranthes sp. (?)
	Catasetum ochraceum
3. Climbers	*Vanilla odorata*
	Vanilla pompona
4. Epiphytic	*Catasetum tabulare*
	Dimerandra emarginata (stenopetala)
	Epidendrum spp
	Maxillaria spp
	Cladobium
	Lepanthes
	Ornithocephalus
	Stelis
	Trixeusis falcata
	Enciclia ceratistes
	Epidendrum cf. *flexuosum*
	Bulbophyllum meridense
	Oncidium carthagenense
	Campylocentrum micranthum
	Coryanthes sp .

ta), Samán (*Albizzia saman*), Catasetum *tabulare*, Orejero *(Enterolobium cyclocarpum*), Azulito (*Petrea rugosa*), Siete Cueros *(Machaerium capote),* Guáimaro (*Brosimum alicastrum*), Caimo (*Chrysophyllum argenteum)*, Guácano (*Oxandra espintana*), Cámbulo (*Erythrina glauca* and *E. poeppigiana*), Cachimbo or Pízamo (*Erythina*), Palma cuesco (*Attalea* (*Scheelea) butyraceae*), Rose and Yellow Guayacanes (*Tabebuia rosea* and *T. chrysantha*), Totocal (*Achatocarpus nigricans*). Although this zone is slightly wetter (1.300 a 1.400 mm) than the Cali river basin (900-1,000mm), the difference in species composition is notorious in the presence of mature tropical dry forest species. The relict forest of the valley floor and the piedmont areas showed a vegetation typical of late stages of the ecological succession.

Discussion

The age of continuous regeneration processes is an important factor in the species composition of a secondary forest. The early pioneering species have special competitive and reproductive abilities.

Their capacity to establish themselves in harsh conditions is remarkable. This was evidenced in the site where the Cali Botanical Garden is located today. In addition to being good dispersers and colonizers, they are tolerant to difficult climatic and edaphic conditions like solar exposure, scarcity of nutrients, compacted soils. Many species are also tolerant of forest fires or they are opportunistic to take advantage of the bursts of nutrients following the fire events. Additionally, it is the experience of the authors that these species recuperate rapidly after the foraging voracity of Harvester Ants (*Atta cephalotes*). This relative tolerance or resistance confers them short and medium term advantages over competing plant species. When the species of plants establish themselves in the plot, they benefit directly from the soil improvement the ants bring to the sites. It is noteworthy that the six dominant species in the Garden are also among the species most readily consumed by the ants!

Should there be more orchid species in the Cali river watershed? In the absence of previous inventories of species one would have to say that since the forest was completely cleared late in the IXX century and early in the XX the number of orchid species would have depended on the kind of regeneration process which took place since that period. After the major disturbance of the forest to establish the water conduction channel for the hydroelectric power plant, the cleared area was left alone. The initial forest received the benefit of passive protection year after year, during a period that is evident today. The forested area enclosed between the Cali river and the water channel formed a solid fire break and the forest regeneration process advanced unchecked. The result is a regenerated forest with trees which reach 20m The fact that the forests of this part of the watershed are loosely interconnected with premontane (subtropical) and lower montane forests provide a biological corridor where many plant and animal species move. The possibilities for establishment of orchids is favored by the wind currents which move up and down the corridor on a daily basis with seasons was moderate to strong winds. Therefore, there has been opportunities for species enhancement during nearly one century.

A likely answer to the question could be that there are relatively few orchid species present in the watershed. Without doubt this is true for the regenerated forest compared with a similar sized relictual forest. Such relictual forest still exist in the Rio Claro, Jamundí and Pance rivers. In these three forests, the number of species is considerably higher than in the Cali river at any given altitudinal range. However, if one considers forest regenerations of the same age, it is almost sure that the protected forest of the Cali river corridor would have not only more tree species but also many more orchid species. With all certainty the presence of a diversified vegetation in different growth forms (canopy trees, understory trees and shrubs, ground vegetation, lianas and climbers and epiphytes and hemiepiphytes) would have the potential to host a greater richness of orchids as well. The higher humidity and the greater amount of shade favored by mature forests also favors the presence of orchids, particularly the epiphytic kinds. The effect of the prolongued deforestation, with a relatively long period before the succesional process could gain momentum, slowed down the orchid species packing process. This early period of the secondary succession was also characterized by a temporary loss of orchid pollinator species.

Conclusions and recommendations

It is clear that under suitable protective conditions even a highly degraded forest will develop toward a reasonably diversified state. Along with the forest regeneration process, the orchid species will also profit, both in terms of the species numbers and density of individual populations. But additionally, should there be a variety of ecosystem types in the watershed characterized by forests of various stages of maturity, gallery and riparian vegetation, presence of microwatershed systems with opened areas, with grasslands and rocky outcrops, one would have a situation which would favour a solid accumulation of species. From this consideration, the following recommendations are offered:

- To use the identified pioneer species of the tropical dry forest as ideal germplasm of native species to promote vegetation enrichment and restorative

processes in degraded interandean valley floors and hillsides. Only in the Cauca River valley these areas cover in excess of 200,000 hectares.

- To enrich the forest of the Cali Botanical garden and surrounding areas along the biological corridor of the Cali river with species (including the orchids) found in nearby relicts of mature tropical dry forest. These enrichments would in a sense mimic advanced stages of secondary regeneration. Nursery trials with these species would be of paramount importance.
- To promote the conservation of regenerated forests in all altitudinal levels in the interandean river valleys, particularly where the vegetation cover has been most severely affected by human activities, like in the piedmont areas (1.000-1.300m, coffee belt region (1,300-1,700m) and in the sugar cane zone (1,000m). The connexion of these two areas through biological corridors would generate great environmental and socio-economic benefits.
- To favor forest regeneration processes where extensive cattle ranching is presently being conducted. There are important sustainable silvopastoral alternatives available which would intensify the cattle production with significant reductions in the area devoted to pastures.
- To use the native orchids of the tropical dry forest as key elements of an environmental interpretation program in the Cali Botanical Garden. Similar orchid gardens could be established as school projects in the city.
- To develop and maintain an intensive effort to reduce forest fires in the watershed.
- To prevent the excessive clearing of road banks which frequently become festooned with orchids species.

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LITERATURE CITED

CVC. 1994. Informe 90-7. Comparación de la cobertura de bosques y Humedales entre 1957 y 1986 con delimitación de las comunidades naturales críticas del valle geográfico del Río Cauca. Cali, Documento interno. CVC.

Espinal, L.S. 1985. Geografía ecológica del departamento de Antioquia Revista de la Facultad Nacional de Agronomía, 38 (1): 24-39.

Espinal, L.S. & E. Montenegro. 1977**.** Formaciones vegetales de Colombia. Instituto Geográfico Agustín Codazzi, Bogotá, pp 201 .

Etter, A. 1993. Diversidad ecosistémica en Colombia hoy. Pp 43-61 in Nuestra diversidad biótica. CEREC & Fundación Alejandro Angel Escobar.

Gentry, A.H. 1995. Diversity and floristic composition of neotropical dry forest. Pp. 116-194. in: Tropical deciduous Forest Ecosystem. S. Bullock, E. Medina & H.A. Mooney (eds). Cambridge Univ. Press, Cambridge.

González, S. & W. Devia. 1995. Caracterización fisionómica de la flora de un bosque seco secundario en el corregimiento de Mateguadua, Tuluá, Valle. Cespedesia Vol 20 No 66: 35-63.

Hernandez, C., T. Walschburger, R. Ortiz & A. Hurtado, 1992. Sobre origen y distribución de la biota suramericana y colombiana. Pp. 55-104 in: Diversidad biológica en Iberoamerica, G. Halffter (compiler). Programa Iberoamericano de Ciencia y Tecnología para el Desarrollo, Instituto de Ecología, Secretaría de Desarrollo, Mexico, D.F., Mexico.

Instituto Alexander von Humboldt (Programa de Inventario de la Biodiversidad, Grupo de Exploraciones y Monitoreo Ambiental GEMA). 1997. El Bosque seco Tropical (Bs-T) en Colombia.

Janzen, D.H. 1987. Insect diversity of a Costa Rican dry forest: Why keep it. Biol. Journal Linn. Soc. 30: 343-356.

Murphy, P.G. & A.E. Lugo. 1986. Ecology of tropical dry forest. Ann. Rev. Ecol. Syst. 17 : 67-68 .

Orejuela, J. 2005. An integrated approach to orchid conservation in Colombia: what do orchids, hummingbirds, bears, potable water, and indigenous land rights have in common? 2nd International Orchid Conservation Congress, Sarasota, Florida, USA. Selbyana 26 1-(2):32-45.

Orejuela, J.E. 2006. The Cali Botanical Garden and the Conservation of Ecosystems in the Cali River basin, Cali, Colombia. Lyonia March, 2006. WWW.lyonia.org/view Article.php?articleID=472.