Nicola Clerici *Editor*

Conservation of Andean Forests

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Foreword

Stretching from Venezuela to Chile, Andean forests are crucial ecosystems, representing outstanding reservoirs of biodiversity and habitats of unique endemic species. These forests provide vital services to society, by regulating global and regional climates, providing water, maintaining biodiversity, and supporting the well-being of millions of people and countless species. Yet, Andean forests are experiencing unprecedented threats in the face of the rapidly growing human population in the region. Increasing land use demands drive deforestation and habitat fragmentation, which is further exacerbated by agricultural expansion, mining, and illegal cropping. Furthermore, the converging effects of climate change and the spread of non-native plant species magnify the pressures on these fragile ecosystems. In light of these pressing challenges, it is imperative to recognize the urgent need for conservation efforts to protect Andean forests and their unique socio-ecological heritage.

This book provides an understanding of the ecological functioning of Andean forests, spacing from community to landscape ecology studies. It discusses the regional and global threats affecting them, and gives multidisciplinary reflections on their unique socio-ecological dynamics. *Conservation of Andean Forests* presents a synthesis of recent and relevant research on these key ecosystems, discussing in detail methodological approaches, and providing the complex background on Andean forest systems functioning.

The book is organized into 11 chapters, presenting research results and future implications, discussing case studies and research methods, and novel geospatial approaches. It is the goal of this book to stimulate new ideas for future work and help managers to take decisions, as well as to becoming a critical resource for students, new and experienced researchers, academics, and professionals working with forest ecosystems.

As Editor, I am indebted to all the recognized researchers who have contributed to this work, scientific reviewers, and Springer-Nature for agreeing to publish this book. Further, I thank Universidad del Rosario (Colombia) for supporting the Editor in realizing this initiative.

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About the Editor

Nicola Clerici is Full Professor of Ecology at the Faculty of Natural Sciences, Universidad del Rosario, Colombia. He holds a PhD in Ecology and an MSc in Remote Sensing. He is also Associate Editor of the *Landscape and Urban Planning* and *Remote Sensing in Ecology and Conservation* journals. His research interests are focused on conservation ecology, spatial modeling of ecological indicators, and ecosystem services mapping.

The Andean Flanks: Montane Cloud Forests' Untold Biocultural Heritage and Ecological Legacies

Fausto O. Sarmiento, Manuel Oliva Cruz, Christiam Aguirre, and Héctor Esquivel

1 Introduction

Throughout all western South America, from Patagonia to the circum-Caribbean and Venezuela, the great Andean cordillera (8500 km) extends parallel to the Pacific Ocean, which allows the presence of different thermal floors in most of its extension, with numerous forest types and a great diversity of flora and fauna typical of tropical montane cloud forests (TMCFs). Often the foothills begin at 500 meters above sea level (masl); however, among tropical forests, the dry tropical forest, the humid tropical forest, the subxerophytic formation (desert areas), and the Chaparral formation (elfin areas) are distinguished through but at different elevations. They are located between sea level and 1000 masl in the mountainous circum-Caribbean. The elevation belt between 1000 and 2400 masl is known as Subtropical or "*Subandina*" (Cuatrecasas, 1968) and as "*Premontano*" o "*Montano bajo*" (Holdridge, 1967). In Colombia, it is also known as the 'coffee zone' for the importance of this crop (*Coffea arabiga*) wherein the "coffee axis" zone—between Quindío, Risaralda, Caldas, and north Tolima, in this altitudinal range of

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1000–2000 masl—produces the bounty coffee harvest, the basis of the Colombian agrarian economy (Esquivel & Nieto, 2003). In Ecuador, this zone is often referred to as "*montaña*" on the western flanks towards the coasts of the Pacific Ocean and to Upper Amazonia on the eastern flanks towards the Atlantic Ocean (Sarmiento, 1987). In Perú, they occupy several regions, including the "*selva alta*", "*ceja de selva*", "*rupa-rupa*" and "*yunga*" (Vidal, 2014). In Bolivia, the flanks are generally referred to as "*los yungas*" (Kesler & Beck, 1991), while in Argentina they use the feminine *"las yungas*" (Brown et al., 1991). Sometimes, people inhabiting the Andean flanks are known with the *Kichwa* term of "*yumbu*" or "*sacha runa*" because of their affiliation with wild mountainscapes. These areas often incorporate the montane, colline, and piedmont mountain provinces' that are landscapes with extensive forest cover.

Due to great pressures exerted by the expansion of livestock, agriculture, urban planning, mining, and timber extraction, forests of this sub-Andean altitudinal strip are the most threatened of disappearing (Esquivel, 2012). In this altitudinal range, with the most moderate and preferred climates for making a living, agriculture and urbanization developed since pre-Columbian times in the mountainous regions of Central America (Guatemala, Nicaragua, Costa Rica, and Panamá) and in Venezuela, Colombia, Ecuador, Peru, and Bolivia, since the mild temperature ranges between 18 °C and 26 °C are common. The rise of cities such as Medellín, Bucaramanga, Ibagué, Armenia, Pereira, Manizales, Palmira, Cali, and Popayán in Colombia; Santo Domingo de los Tsáchila, Guaranda, Zaruma, Tena, Puyo, and Coca in Ecuador; Tambopata, Chachapoyas, Jaén, and Cajamarca in Peru; Cochabamba, Sucre, and Tarija in Bolivia; Olmué, Temuco, and Valdivia in Chile; and Jujuy, Tucumán, and Salta in Argentina exemplify these favorable settlement conditions, with various of those cities considered as the "garden of the republic."

According to biotic inventories, the greatest diversity of species is recorded in these Andean flanks; not having to withstand extreme temperatures, these montane elements can adapt more easily in the range that corresponds to the tropical zone (Esquivel & Nieto, 2003). The presence of relict forests in the sub-Andean belt, despite the priority dedication of these areas to crops like coffee (974,000 ha in Colombia, 200,000 ha in Venezuela, and 96,312 ha in Ecuador), cocoa (189,000 ha in Colombia, 65,000 ha in Venezuela, and 601,000 ha in Ecuador), sugar cane (400,000 ha in Colombia, 50,000 ha in Venezuela, and 130,677 ha in Ecuador), banana, cassava, arracacha, beans, peas and others in Colombia, Venezuela and Ecuador, mixed with plantations of *Pinus patula*, *P. radiata*, *Eucalyptus camaldulensis* and *E. globolus*, all this biological richness has motivated the organization of Environment ministries, Regional Corporations, various NGOs (non-governmental organizations), ecological groups, and civic movements, keenly working in conserving the biota of these relict forests in all the seven countries traversed by the TMCFs on the Andes Mountains. With the proliferation of 'narcoeconomics' in the era of cocaine and poppy exports, many areas within the 'Andean crescent' have been dedicated to the harvest of coca leaves from *kuka* shrubs (*Erytroxylum coca*), outcompeting traditional subsistence agriculture as livelihood practice in the mountainscape (Andreas & Sharpe, 1992). Counter to the illicit market pressure, the

increase of ethnotourism in the Andean flanks is being posited as a valid alternative pulse to benefit TMCFs conservation (see Textbox 1: *Kuka Umawa* Declaration to bridge science and society in the upper Amazon).

The ecological research of neotropical Andean flanks has significantly emphasized the then-dominant paradigm of systems ecology, solely on form, function, and change (Hamilton et al., 1994). Based on neutral models for ecosystem ecology, the Tropical Montane Cloud Forests (TMCFs) have been conceived as a 'black box' with unknown processes of throughput, receiving the inputs of intense solar radiation with high levels of $UV^{ß}$ radiation and abundant horizontal precipitation in the form of fog and mist, shrouding the mountainside or flank (Kappelle & Brown, 1991). As a result, the most significant outputs of the hydrological-based model were water and forest cover. Indeed, the TMCFs have always been taken as 'sponges' that capture humidity and accumulate hydric resources that are later utilized down slope when flowing with cascading rivers of white water (Bruijnzeel et al., 2010), which contributed to the establishment of the 'water tower' metaphor, particularly with the inclusion of the ice fields located on mountaintops, snow- and ice-caped 'towers', in the so-called "Third Pole," by the trifecta of polar research AAA (i.e., Arctic, Antarctic, Alpine). In the newer modeling approach of source-sink dynamics, the flanks have often been considered a transitional stage (Myster, 2023), with the presence of elevation-depletion gradients (either of temperature, precipitation, soil, or cloudiness, as we move down from the highlands towards the lowlands); this ecotonal characteristic of TMCFs, between high Andean and low coastal or Amazonian plains, has recently acquired scientific currency harboring biocultural diversity of microrefugia and offering a 'cultural bulge' (Sarmiento et al., 2022), mirroring Gentry's (1988) "tree-bulge "of diversity Fig. 1.

There is a new paradigm built into the premises of cultural landscapes on the TMCFs because of the evidence provided by functional ecology (*c.f.*, pull and push factors), paleoecology, archaeobotany (*c.f.*, pollen fossil and genomics), critical biogeography (*c.f.*, ecological legacies), and political ecology (*c.f.*, historicity and spatiality) of tropandean landscapes (Sarmiento & Sarmiento, 2021).The extent of the TMCFs on mountain flanks is still an active front of research, as different disciplinary angles provide either discrete boundaries of treeline, separating the montane from the alpine zones (Körner et al., 2011), or the joined transitional alpine treeline ecotone region, where forest to pasture transitions are often fuzzy (Malanson, 2023). The controversy about treeline becomes important in 'situated studies' as it depends on the location of the mountain flank (Körner & Hoch, 2023), whether in the northern or southern exposure aspect, the eastern or western orientation slope, or even the continental location of polar, temperate, or tropical locales, where a lot of influence can be exerted by human impacts creating a fire-prone or a teeth-prone boundary (Sarmiento & Frolich, 2002).

If the upper limit of the Andean flanks is hard to define to secure the extent of the TMCFs toward the highland grasslands, the difficulty is augmented when we approach the piedmont at the base of the mountain, surrounded by the lowland plains. This condition makes it necessary to consider two distinct boundaries on the flanks: the '*upper treeline*' and the '*lower treeline*.' There are more nuanced

Fig. 1 Morning view of the cerro *Puñay*, in Chimborazo province, Ecuador, as an example of the biocultural landscape of the *Kañari* and *Puruwa* nations, for whom the sacred mountain is equated as identity marker of their montane soul and origins, with one of the largest pyramids built on its summit. (Photo: Christiam Aguirre)

considerations for the classification of forests separated from the colline to the montane zones, especially in tropical and subtropical sites, containing either evergreen or moist forests, where a subclassification of the montane is in order (*e.g.*, the Andean, subandean, upper montane, lower montane, premontane, heath, peat, liana, bamboo forests, etc.) (Paulsch, 2002). The neotropical mountains also provide a considerable change in location according to the elevation/longitudinal gradient of the entire cordillera and the effect of atmospheric rivers and other air mass circulations that affect the location of the forest (i.e., the Massenerhebung effect, Föhn effect, Bernoulli effect, Venturi effect, Cascade effect, Barnum effect, etc.). Something that makes the entire neotropical flanks similar is the abundant plant and animal diversity harbored by the verdant, often associated with a green carpet that descends as a tapestry down the mountain slope with biotic vigor.

2 The Biological Richness of the Andean Flanks

The list of plant species is one of the most significant in the biotic inventories of the countries hosting tropandean landscapes. Whether in the Central American mountains or the northern and central Andes cordillera, there is a plethora of functional groups that allows a very complex system of natural elements to interact, creating a

mosaic of rich green broadleaf and evergreen tropical fronds and foliage. The objective of the chapter is not to list the botanical inventories of representative sites, but it is clearly important to gauge the massive presence of the vegetal component in the Andean flanks. As an example of such a rich catalog, we are only listing the arboreal species of the three cordilleras with sub-Andean forests of Colombia (Table 1). We include the local name as well as the customary usage of the tree to add notions of utilitarian application of the forest resource in the area. Also, the altitudinal range distribution of the plant is indicated so that a better grasping of the spatial distribution of trees makes an impressive mosaic of different species at various altitudes. This is an important front of study due to the notion that increased temperatures due to global warming tend to move the upper limit of the forest towards more extreme heights (Sarmiento et al., 2023); we observed that the forest itself is not moving upwards the slope, but those species adapted to withstand warmer weather are individually migrating upslope, changing the community composition but not the community structure of the flanks. However, it remains to be seen whether community function has somehow been affected by such upslope migration with the 'escalator effect' (Dangles, 2023). In the tropical Andes, it is easy to identify flagship species, often considered to be the countries' emblematic 'national' plant, such as cockspur coral of Paraguay (*Erythrina crista-galli*), red quebracho of Argentina (*Schinopsis balansae*), cantuta of Peru (*Cantua buxifolia*), maga of Puerto Rico (*Thespesia grandiflora*), quina of Ecuador (*Cinchona succirubra*), wax palm of Colombia (*Ceroxylum quindiuense*), araguaney of Venezuela (*Tabebuia chrisantha*), or the ice-cream-bean *'pakay'* of Bolivia (*Inga edulis*). Even species that have been identified as prone to psychedelics for narcotraffic, such as coca (*Erytroxylum coca*) or *aywashka* (*Banisteriopsis caapi),* are indicative of a massive concentration of TMCFs flora.

Note that forests of these great mountain ranges have been studied since colonial times (eighteenth century), in such a way that several of the expeditions carried out in countries through which the Andes cordillera now crosses were key to register its rich biota, starting with the first French Geodetic Mission (1735–1739) and the rich collections that started the exploration of these mountains (Capello, 2018). In northern South America, the Royal Botanical Expedition of the New Kingdom of Granada stands out, led by the naturalist José Celestino Mutis, for 33 years (1783–1816) which allowed the dissemination of some 20,000 species of plants, 24,000 excised for Herbaria, and some 5000 plates or paintings of plants, as well as about 7000 animals and a collection of wood, shells, resins, minerals, and skins. Added to all this is the publication "*El Arcano de la Quina*" (Mutis, 1828). In Ecuador, the researcher José Mejía del Valle y Lequerica stood out (lived from 1775 to 1813), adding to the collections made in 1802 by Alexander von Humboldt, Aimé Bonpland, and Francisco José de Caldas. In Peru, the Botanical Expedition of Hipólito Ruiz and José Antonio Pavón of 1777–1788 was of great renown; more than 3000 duly processed excised specimens and more than 2500 botanical drawings were obtained, deposited in the Royal Botanical Garden of Madrid and in the Royal Cabinet of Natural History of Madrid, with a contribution of 141 new genera and more than 500 new species; in 1794 they published "*Florae Peruvianae et Chilensis Prodomus*",

Table 1 Main tree species of Colombian tropandean forests, their common name, uses, and altitudinal range of distribution

Scientific name	Common name	Family	Utilitarian function	Altitudinal range
Adenaria floribunda	Coralito	Lytraceae	Restoration	1000–2500
Alsophila engelii	Sarro, helecho arbóreo	Cyatheaceae	Restoration	1500–2800
Aiphanes aculeata	Palma de corozo	Arecaceae	Wild food	500–1800
Albizia carbonaria	Pisquin, dormilón	Leguminosae	Restoration	1400–2800
Alibertia patinoi	borojó	Rubiaceae	Edible	0–1200
Alchornea glandulosa	Algodoncillo	Euphorbiaceae	Fuelwoodand charcoal	1000–2800
Alchornea grandiflora	Carcomo	Euphorbiaceae	Fuelwoodand charcoal	1000–2200
Alchornea latifolia	Álamo, chopo	Euphorbiaceae	Watershed protection	1900–3000
Anacardium excelsum	Caracolí, mijagua	Anacardiaceae	Watershed conservation	0–1600
Anacardium occidentale	Marañón, caujil, chura	Anacardiaceae	Edible	0–1300
Attalea butyracea	Palma de vino, cuesco	Arecaceae	Restaur. Edible	0–1500
Bactris gasipaes	Chontaduro, cachipay	Arecaceae	Rest., Edible	0–1600
Beilschmiedia tovarensis	Aguacatillo	Lauraceae	Timber harvest	500–2200
Bixa orellana	Achiote, bija	Bixaceae	Foodstuffand medicine	0–1700
Bombacopsis quinata	Ceiba roja, pochote	Malvaceae	Restoration, frames	0–1200
Bravaisia integerrima	Palodeagua, naranjillo	Acanthaceae	Restoration	700–2000
Billia rosea	Cariseco	Sapindaceae	Restoration	1000–2700
Brugmansia candida	Borrachero, floripond	Solanaceae	Scopolamine	600–3000
Barnadesia spinosa	Espino, erizo	Asteraceae	Living fence	1900–3600
Bulnesia carrapo	Guayacán bola	Zygophyllaceae	Timber harvest	0–1300
Bunchosia armeniaca	Ciruelo de perro	Malpighiaceae	Wild fruit	500–2000
Calliandra haematocephala	Carbonero rojo	Leguminosae	Ornamental, watershed conservation	0–2000
Calliandra magdalenae	Carbonero, quiebracho	Leguminosae	Watershed conservation	1000–2500

(continued)

Table 1 (continued)

Scientific name	Common name	Family	Utilitarian function	Altitudinal range
Calliandra purdiaei	Carbonero	Leguminosae	Watershed conservation	100–1600
Calliandra schultzei	Carbonero	Leguminosae	Watershed conservation	0–1500
Calocarpum mammosum	Sapote costeño, mamey colorado	Sapotaceae	Timber harvest y edible	0–1500
Capparis odoratissima	Naranjuelo, tablón	Capparidaceae	Timber harvest	0–1200
Cassia grandis	Cañafistulo rosado	Leguminosae	Timber harvest	0–1300
Cedrela montana	Cedro de montaña	Meliaceae	Timber harvest	1700–3000
Cedrela odorata	Cedro rosado	Meliaceae	Timber harvest	100–2000
Ceiba pentandra	Ceiba, cotton tree, kapok	Malvaceae	Shades and canoes	0–1500
Cestrum nocturnum	Azahar de noche	Solanaceae	Restoration	0–1800
Cereus hexagonus	Cardo, cirio	Cactaceae	Foodstuff	0–1300
Cespedesia macrophylla	Lengua de vaca, pacó	Ochnaceae	Restoration	0–1500
Cnidoscolus aconitifolia	Papayuelo, chicasquil	Euphorbiaceae	Fodder, living fence	0–1300
Chloroleucon bogotense	Angarillo	Leguminosae	Fodder and fuelwood	0–1200
Cinchona pubescens	Quina	Rubiaceae	Medicinal	600–3300
Condaminea corymbosa	Quino	Rubiaceae	Restoration	200–1500
Cinnamomun triplinerve	Laurel colorado, chaviaco	Lauraceae	Timber harvest, fruit for birds	1000–2000
Cecropia angustifolia	Yarumo, guarumo	Urticaceae	Restoration	200–2400
Cecropia telenitida	Yarumo blanco	Urticaceae	Restoration	1800–3000
Coussapoa villosa	Uvo, matapalo	Urticaceae	Restoration, fuelwood	1000–2600
Ceroxylum alpinum	Palma de cera	Arecaceae	Fruit for birds	1400–2000
Ceroxylon parvifrons	Palma de ramo	Arecaceae	Fruit for birds	2000–3200
Ceroxylon quindiuense	Palma de cera, palma de ramo, palma blanca	Arecaceae	Wax for torches	1800–3300
Ceroxylon sasaimae	Palma de cera	Arecaceae	Wild fruits	1400–1800
Chamaedorea linearis	Palmicho	Arecaceae	Restoration	500–2500
Chamaedorea pinnatifrons	Molinillo	Arecaceae	Restoration	0–3000
Clusia alata	Chagualo	Clusiaceae	Foodstuff birds	1100–3500

(continued)

Table 1 (continued)

Scientific name	Common name	Family	Utilitarian function	Altitudinal range
Clusia brachycarpa	Chagualo, gaque	Clusiaceae	Restoration	1000–3000
Clusia cuneifolia	Chagualo	Clusiaceae	Foodstuff birds	1000–2700
Clusia decussata	Cucharo, chagualo	Clusiaceae	Restoration	1500–2700
Clusia ducu	Cucharo	Clusiaceae	Restoration	1500–2700
Clusia ducuoides	Monedero	Clusiaceae	Restoration	1000–2800
Clusia multiflora	Gaque, chagualo	Clusiaceae	Restoration	1500–3000
Clusia orthoneura	Flor de cera	Clusiaceae	Ornamental	0–2500
Clusia minor	Incienso, gaque	Clusiaceae	Restoration	0–1800
Coccoloba obovata	Buche gallina, uvo	Polygonaceae	Restoration	0–1400
Codiaeum variegatum	Croto, buena vista	Euphorbiaceae	Ornamental	0–1500
Cavendishia bracteata	Quereme, uvo de monte	Ericaceae	Landslide avoidance	1000–3200
Cavendishia cordifolia	Quereme, uvo de monte	Ericaceae	Landslide avoidance	1400–3000
Cavendishia engleriana	Uvo de monte	Ericaceae	Edible fruits	200–2000
Cavendishia quereme	Quereme, uvo de monte	Ericaceae	Landslide avoidance and edible fruits	1000–1500
Citharexylum subflBirdscens	Quimulá, gavilán	Verbenaceae	Timber harvest	1100–2800
Coriaria ruscifolia	Uvita de monte	Coriariaceae	Toxic fruit	1400–2600
Cordia alliodora	Nogal cafetero	Boraginaceae	Timber harvest	500–2000
Cordia lutea	Biyuyo, biyuco	Boraginaceae	Ornamental	0–1500
Cordia muneco	Muñeco	Boraginaceae	Ornamental	0–1600
Cordia sebestena	No me olvides	Boraginaceae	Ornamental	0–1300
Curatella americana	Chaparro, peralejo, carne de fiambre	Dilleniaceae	Restorator, Fuelwoodand charcoal	0–1100
Crescentia cujete	Totumo	Bignoniaceae	Medicinal fruit	0–1400
Croton gossypifolius	Sangregado, drago	Euphorbiaceae	Reforestation	0–1300
Cupania cinerea	Guacharaco	Sapindaceae	Reforestation, fuelwood	300–1500
Clethra fagifolia	Chiriguaco, cargagua	Clethraceae	Timber harvest	1500–3000
Calophyllum brasiliense	Aceite, cachicamo	Clusiaceae	Timber harvest, fruto foodstuff fauna	0–1200
Cyathea caracasana	Helecho gigante, palma boba, sarro	Cyatheaceae	Soil conservation, handscraft	1600–3000

(continued)

Table 1 (continued)

Scientific name	Common name	Family	Utilitarian function	Altitudinal range
Cyathea arborea	Palma boba	Cyatheaceae	Soil conservation	1500–3000
Citharexylum subflBirdscens	Quimulá, gavilán	Verbenaceae	Tool handlers	1000–2800
Dicksonia sellowiana	Helecho gigante, sarro, palma boba	Dicksoniaceae	Soil conservation, handcrafts	1000–3800
Daphnopsis cestrifolia	Pela mano	Thymelaeaceae	Restoration, fuelwood	0–1500
Dussia macroprophyllata	Ubre de vaca	Leguminosae	Restoration, Foodstufffauna	1700–2600
Delonix regia	Acacio rojo	Leguminosae	Ornamental, fodder	0–1500
Enterolobium cyclocarpum	Piñón de oreja, orejero Dormilón	Leguminosae	Fodder furniture, medicine hemorroids	0–1300
Erythrina edulis	Chachafruto, balú	Leguminosae	Food, protein	1300–2800
Erythrina fusca	Cachimbo, ceibo	Leguminosae	Fodder and fences	800–2000
Erythrina poeppigiana	Cámbulo, minás	Leguminosae	Fodder, coffee shade	1000–2500
Erythrina rubrinervia	Chocho, siriguay	Leguminosae	Ornamental, fodder	1300–2600
Erythroxylum coca	Coca, hayuela, ipadá	Erythroxylaceae	Medicinal, energizer	0–1500
Erythroxylum ulei	Coca	Erythroxylaceae	Restorator	0–1600
Eugenia uniflora	Pitanga silvestre	Myrtaceae	Foodstuff and fences	0–1600
Euphorbia cotinifolia	Manzanillo de cercas	Euphorbiaceae	Living fence, caustic látex, honey	0–2000
Euphorbia caracasana	Manzanillo verde, Platero, lechero	Euphorbiaceae	Living fence, hney	0–2000
Ficus andicola	Caucho sabanero, uvo	Moraceae	Edible fruits, watershed conservation	1800–2800
Ficus dendrocida	Caucho matapalos	Moraceae	Restoration	0–1800
Ficus insipida	Higuerón, cachinguba	Moraceae	Látex antihelmíntic	0–1600
Ficus duquei	Caucho arepero	Moraceae	Ornamental, fence	0–1400
Freziera chrysophylla	Cerezo de monte	Pentaphylacaceae	Restoration, edible fruits	1500–3000
Garcinia madrunno	Madroño, machali	Clusiaceae	Restoration	500–2000

(continued)

Table 1 (continued)

Scientific name	Common name	Family	Utilitarian function	Altitudinal range
Genipa americana	Jagua, árbol tinta	Rubiaceae	Timber harvest, feet shaper	0–1300
Gliricidia sepium	Matarratón, piñón	Leguminosae	FodderLiving fence	0–1500
Guadua angustifolia	Guadua, guadua cebolla, paca	Poaceae	Erosion control, construction	0–2000
Guarea guidonia	Cedro macho, bilibil	Meliaceae	Timber harvest	0–1600
Gustavia speciosa	Chupo, jarapandiva	Lecythidaceae	Wild food	0–1600
Guazuma ulmifolia	Guazimo, aquiche	Malvaceae	Fire barrier	0–1300
Gynerium sagittatum	Caña brava, pintoc	Poaceae	Soil protection, constructions	0–2000
Guatteria lehmannii	Cargadero, garrapato	Annonaceae	Constructions, fuelwood, ties	1500–2500
Guettarda crispiflora	Huesito, frutepava, anís	Rubiaceae	Watershed protection, wild fruits	1000–3000
Gonzalagunia asperula	Frutepava	Rubiaceae	Restoration, wild fruits	300–2000
Gaultheria buxifolia	Mortiño, uvito	Ericaceae	Restoration, erosion avoidance	1500–2500
Gaultheria erecta	Mortiño, uvode monte	Ericaceae	Erosion avoidance	1400–3400
Gaiadendron punctatum	Platero	Loranthaceae	Restoration, living fences	1400–3800
Geonoma orbignyana	Palmilla	Arecaceae	Stem for canes, roofing support	500–3000
Geonoma undata	Palmicho	Arecaceae	Restoration	500–3500
Hamelia patens	Coralito, bencenuco	Rubiaceae	Restoration	800–1800
Hura crepitans	Mil pesos, tronador	Euphorbiaceae	Restoration	0–1400
Hymenaea courbaril	Algarrobo, pecueco	Leguminosae	Timber harvest, resine, ámbar courbaril	0–1300
Hedyosmun bomplandianum	Granizo y canelo	Chloranthaceae	Restoration, watershed protection	1800–3200
Handroanthus chrysanthus	Guayacán amarillo, araguaney, chicalá	Bignoniaceae	Timber harvest	0–2000

(continued)

Table 1 (continued)

Scientific name	Common name	Family	Utilitarian function	Altitudinal range
Hedyosmum goudotianum	Silvo-silvo, canelón	Chloranthaceae	Restoration, watershed conservation	1000–3000
Heliocarpus americanus	Balso blanco, melao majao, palo bobo	Malvaceae	Restoration, fuelwood	1000–2500
Hieronyma antioquensis	Candelo	Phyllanthaceae	Timber harvest, charcoal	1800–2900
Inga densiflora	Guamo machete,	Leguminosae	Restoration, foodstuff	0–1800
Inga edulis	Guamo rabo de mico	Leguminosae	Restoration. Food	0–1800
Inga lallensis	Guamo	Leguminosae	Constructions	1800–3000
Inga punctata	Guamo	Leguminosae	Wood and food	0–3000
Inga sierrae	Guamo peludo	Leguminosae	Fuelwood, charcoal	1500–2600
Ilex laurina	Cardenillo	Aquifoliaceae	Handcrafts, fuelwood	1500–3000
Ilex nervosa	Cardenillo	Aquifoliaceae	Wild foodstuff	1800–3000
Jacaranda caucana	Gualanday	Leguminosae	Ornamental	1000–2500
Juglans neotropica	Nogal, cedro negro	Juglandaceae	Timber harvest	1200–3200
Lafoensia punicifolia	Guayacán de Manizales, trompito	Lythraceae	Timber harvest, apícola, handcrafts	1200–3000
Leucaena leucocephala	Acacia Fodderra, panelo	Leguminosae	Restoration, fuelwood, fodder	0–1400
Ladenbergia magnifolia	Azuceno	Rubiaceae	Restoration, wild fruit	1500–3000
Ladenbergia macrocarpa	Azuceno	Rubiaceae	Restoration, wild fruit	1500–3000
Leandra subseriata	Niguito lanudo	Melastomataceae	Restoration	1500–2500
Lozania mutisiana	Laurelillo	Lacistemataceae	Restoration	0–2500
Licania cabrerae	(CR)	Chrysobalanaceae	Timber harvest	1900–2800
Licania octandra		Chrysobalanaceae	Living fence	600–1500
Machaerium capote	Capote, machetico	Fabaceae	Timber harvest	0–1300
Maclura tinctorea	Dinde, fustik	Moraceae	Fence posts	0–1500
Mammea americana	Mamey	Clusiaceae	Fruits	0–1500
Matisia cordata	Sapote	Malvaceae	Fruits	500–2000
Mauria heterophylla	Manzanillo	Anacardiaceae	Wild fruits	500–1800
Meliosma bogotana	Calabacillo	Sabiaceae	Wild fruits	1500–3000
Meliosma echeverriana	Calabacillo	Sabiaceae	Wild fruits	1900–3000

(continued)

Table 1 (continued)

Scientific name	Common name	Family	Utilitarian function	Altitudinal range
Matayba elegans	Zanca de mula	Sapindaceae	Restoration, fuelwood	1000–2500
Macleania stricta		Ericaceae	Restoration	350–2720
Macleania bullata	Chupe-quinde	Ericaceae	Talus protection	950–2900
Macleania rupestris	Uva camarona	Ericaceae	Fence, talus protection	1800–3300
Magnolia hernandezzi	Molinillo	Magnoliaceae	Timber harvest, fruto edible	1500–2600
Magnolia silvioi	Guanábano de monte	Magnoliaceae	Timber harvest	400–1500 (EN)
Magnolia espinalii	Molinillo	Magnoliaceae	Timber harvest	1900–2800
Meriania heptamera	Amarrabollo	Melastomataceae	Timber harvest y ornamental	1800–2800
Meriania nobilis	Amarrabollo	Melastomataceae	Restoration	1500–2500
Miconia asperrima	Niguito	Melastomataceae	Restoration	1500–2500
Miconia cladonia	Niguito	Melastomataceae	Foodstuff birds	1800–3000
Miconia jahnii	Niguito, tuno	Melastomataceae	Restoration	1500–2500
Miconia lehmannii	Niguito	Melastomataceae	Restoration	1800–3000
Miconia theizans	Niguito	Melastomataceae	Talus affirmation	1500–3000
Miconia albicans	Tuno	Melastomataceae	Restoration	1200–1900
Miconia caudata	Punta de lanza	Melastomataceae	Restoration	1000–2600
Miconia albicans	Canela de velho, tuno	Melastomataceae	Restoration	1000–2500
Miconia longifolia	Lengua de vaca, tuno	Melastomataceae	Watershed conservation	50–2900
Meriania nobilis	Amarrabollo	Melastomataceae	Restoration	1500–2500
Meriania peltata	Tuno rosado	Melastomataceae		1900–2800
Matisia lozanoi	Zapotillo	Malvaceae	Restoration	1900–2600
Montanoa quadrangularis	Arbo-loco, maguey	Asteraceae	Restoration, handcrafts	1.500–3000
Mollinedia tomentosa	Limonero silvestre	Monimiaceae	Restoration	400–2600
Muntingia calabura	Chichato	Muntingiaceae	Pionero y Foodstuffpara birds	0–1300
Myrsine guianensis	Cucharo, chagualo	Primulaceae	Para vigas y postes	0–2500
Myrsine coriacea	Cucharo blanco	Primulaceae	Timber harvest	1000–2200
Myrcia cucullata	Arrayán	Myrtaceae	Muebles y constru.	1000–2500
Myrcia popayanensis	Arrayán	Myrtaceae	Timber harvest y constructions	1500–2900

(continued)

Table 1 (continued)

Scientific name	Common name	Family	Utilitarian function	Altitudinal range
Myrcia splendens	Arrayán(hoja pequeña)	Myrtaceae	Restoration	1500–2500
Myrcia subsessilis	Arrayán	Myrtaceae	Restoration	100–2500
Myrcia complicata	Arrayán	Myrtaceae	Restoration	200–1800
Morella pubescens	Olivo de cera	Myricaceae	Restoration pioneer	1500–3.400
Myrcianthes rhopaloides	Guayabo de monte	Myrtaceae	Restoration, pioneer	1600–3500
Nectandra macrophylla	Aguacatillo	Lauraceae	Wild foodstuff birds	500–1500
Nectandra reticulata	Amarillo	Lauraceae	Timber harvest	0–1400
Nectandra acutifolia	Laurel amarillo	Lauraceae	Timber harvest	800–2500
Nectandra laurel	Laurel	Lauraceae	Timber harvest	500–3000
Notopleura macrophylla		Rubiaceae	Food	100–2500
Ocotea sericea	Quimula, amarillo	Lauraceae	Timber harvest	1400–3200
Ocotea micans	Laurel	Lauraceae	Timber harvest	1700–2500
Ocotea leucoxylon	Laurel	Lauraceae	Timber harvest	500–2500
Ochroma pyramidale	Balso tambor	Malvaceae	Erosion avoidance	0–1800
Opuntia schumannii	Tuna, penca, nopal	Cactaceae	Foodstuff	0–4000
Oreopanax cecropifolius	Mano de oso	Araliaceae	Protector	800–2900
Oreopanax capitatus	Cinco dedos	Araliaceae	Protector	200–2800
Oreopanax incisus	Mano de oso	Araliaceae	Protector	1500–2800
Oreopanax pes-ursi	Mano de oso	Araliaceae	Foodstuff birds	1000–2000
Oreopanax acerifolium	Mano de oso	Araliaceae	Protector	1200–1700
Oreopanax floribundum	Pategallina, papayo	Araliaceae	Musical instruments	1900–2900
Ochoterenae colombiana	Tambor	Anacardiaceae	Paper pulp	0–1500
Ormosia colombiana	Chocho, peonia	Leguminosae	Watershed protection	500–1600
Pachira insignis	Cacao de monte	Malvaceae	Food	0–1800
Palicourea acetosoides	Cafecillo, tinto	Rubiaceae	Wild fruit	1000–2500
Palicourea anceps	Tinto, bencenuco	Rubiaceae	Wild fruit	1000–2500
Palicourea angustifolia	Cafecillo, tinto	Rubiaceae	Fruto sivestre	1500–3100
Palicourea garciae	Aguadulce	Rubiaceae	Wild fruit	1500–3500

(continued)

Table 1 (continued)

Scientific name	Common name	Family	Utilitarian function	Altitudinal range
Palicourea perquadrangularis	Tinto, cafecillo	Rubiaceae	Wild fruit	500–2500
Palicourea pyramidale	Cafecillo	Rubiaceae	Wild fruit	200–2500
Palicourea thyrsiflora	Tinto, cafecillo	Rubiaceae	Wild fruit	1000–2500
Palicourea vaginata	Cafecillo, tinto	Rubiaceae	Wild fruit	1000–2400
Panopsis yolombo	Yolombó	Proteaceae	Fuelwood	1100–2600
Passiflora arborea	Gulupa de árbol	Passifloraceae	Foodstuff silviculture	500–1500
Pereskia bleo	Bledo, clarol	Cactaceae	Edible fruit	0–1500
Persea americana	Aguacate, cura, pelta	Lauraceae	Edible fruit	500–2000
Persea caerulea	Aguacatillo	Lauraceae	Soft wood	0–1800
Petrea pubescens	Chaparrito, flor azul	Verbenaceae	Honey	400–1500
Phyllanthus acuminatus	Grosella, cedrillo	Phyllanthaceae	Watershed protection	0–1600
Phyllanthus salviifolius	Cedrillo	Phyllanthaceae	Watershed protection	1700–3100
Piper aduncum	Cordoncillo	Piperaceae	Medicinal	0–2000
Piper archeri	Rabo de chucha	Piperaceae	Medicinal	1900–2800
Piper arboreum	Cordoncillo	Piperaceae	Medicinal	0–1700
Piper aequale	Cordoncillo	Piperaceae	Medicinal	0–2400
Piper artanthe	Cordoncillo	Piperaceae	Medicinal	1800–2900
Piper bredemeyerii	Cordoncillo	Piperaceae	Medicinal	0–1500
Piper crassinervium	Cordoncillo	Piperaceae	Medicinal	500–2400
Piper eriopodon	Cordoncillo	Piperaceae	Medicinal	1000–3000
Piper glabratum	Cordoncillo	Piperaceae	Medicinal	500–1500
Piper jericoense	Cordoncillo	Piperaceae	Medicinal	800–2100
Piper holtonii	Cordoncillo	Piperaceae	Medicinal	0–2400
Piper ibaguense	Cordoncillo	Piperaceae	Medicinal	500–2000
Piper imperiale	Cordoncillo	Piperaceae	Medicinal	0–2000
Piper tuberculatum	Cordoncillo	Piperaceae	Medicinal	0–2200
Piper sphaeroides	Cordoncillo	Piperaceae	Medicinal	1800–2200
Pithecellobium dulce	Payandé, chiminango	Leguminosae	Watershed protection	0–1400
Pithe. lanceolatum	Chiminango, gallineral	Leguminosae	Watershed protection	0–1500
Podocarpus magnifolius	Pino chaquiro, p. real	Podocarpaceae	Timber harvest	600–1900
Podocarpus oleifolius	Pino-chaquiro	Podocarpaceae	Timber harvest	1200–3000

(continued)

Table 1 (continued)

Scientific name	Common name	Family	Utilitarian function	Altitudinal range
Posoqueria latifolia	Jazmín naranjo	Rubiaceae	Timber harvest	0–1500
Pouroma bicolor	Caimaron, uvo	Urticaceae	Watershed conservation	200–1400
Prumnopitys montana	Pino de montaña	Podocarpaceae	Timber harvest	1800–3200
Pseudosamanea guachapele	Igua, cedrillo amarillo	Leguminosae	Timber harvest	0–1500
Psidium friedrichsthalianum	Guayabo agrio	Myrtaceae	Wild food	0–1500
Psidium guajava	Guayabo dulce	Myrtaceae	Food	0–2000
Pseudobombax septenatum	Majagua colorada, ceibo	Malvaceae	Watershed protection	0–1200
Psychotria carthagenensis	Cafeto, amiruca	Rubiaceae	Wild fruit	500–2000
Psychotria horizontalis	Cafetillo	Rubiaceae	Wild fruit	300–1500
Psychotria micrantha	Cafetillo	Rubiaceae	Erosion avoidance	200–1500
Psychotria poeppigiana	Beso de negra	Rubiaceae	Erosion avoidance	100–1500
Prunus opaca	Árbol bejuco	Rosaceae	Timber harvest	1800–3000
Quercus humboldtii	Roble	Fagaceae	Timber harvest	1500–3000
Rauvolfia leptophylla	Lechero	Apocynaceae	Timber harvest	0–2500
Retrophyllum rospigliosii	Pino chaquiro, hayuelo	Podocarpaceae	Timber harvest	1000–3000
Rhamnus sphaerosperma	Cabo de hacha	Rhamnaceae	Timber harvest	1500–2800
Rollinia muscosa	Anón cimarrón	Annonaceae	Edible fruit	0–1500
Rollinia edulis	Anón silvestre	Annonaceae	Wild fruit	0–1200
Ruagea glabra	Cedrillo	Meliaceae	Timber harvest	800–3000
Raimondia cherimolioides	Anón silvestre	Annonaceae	Edible fruit	900–2450
Salix humboldtiana	Sauce vela	Salicaceae	Watershed protection	0–3000
S. humboldtiana-f. llorón	Sauce llorón	Salicaceae	Living fase, barrier	1000–3000
Samanea saman	Samán, campano	Leguminosae	Timber harvest	0–1600
Sambucus nigra	Sauco	Sambucaceae	Medicinal	800–3000
Sapindus saponaria	Jaboncillo, chumbimbo	Sapindaceae	Washing clothes	0–1500
Sapium laurifolium	Lechillo	Euphorbiaceae	Reforestation	0–1700
Satyria warszewiczii	Uva de monte	Ericaceae	Erosion avoidance	1400–2600

(continued)

Table 1 (continued)

Scientific name	Common name	Family	Utilitarian function	Altitudinal range
Saurauia cuatrecasana	Dulomoco	Actinidiaceae	Erosion avoidance	1800–2900
Saurauia stapfiana	Dulumoco	Actinidiaceae	Erosion avoidance	1700–3200
Saurauia ursina	Dulumoco rojo	Actinidiaceae	Erosion avoidance	1500–2600
Schefflera quinduensis	Chaflera	Araliaceae	Ornamental, erosion control	1600–2800
Senna pistaciifolia	Alcaparro	Leguminosae	Fertilization	1500–2500
Senna reticulata	Martín Galvis, Dorance	Leguminosae	Medicinal	0–1800
Senna spectabilis	Vainillo, velero	Leguminosae	Erosion control	0–2000
Senegalia glomerata	Palo-bayo	Leguminosae	Fuelwood, timber harvest	0–1200
Styloceras laurifolium	Tijereto	Buxaceae	Wild food	1800–2800
Siparuna aspera	Limón de monte	Siparunaceae	Reforestation	500–3000
Siparuna lepidota	Limoncillo	Siparunaceae	Reforestation	1000–3000
Sloanea brevispina	Cadillo	Elaeocarpaceae	Reforestation	500–2000
Schinus molle	Falso pimiento	Anacardiaceae	Reforestation	1800–3000
Schinus terebenthifolius	Turbinto	Anacardiaceae	Wild fruit	1200–2500
Spondias mombin	Ciruelo hobo	Anacardiaceae	Wild fruit	0–1300
Solanum asperolanatum	Friegaplatos	Solanaceae	Wild fruit	500–3500
Solanum atropurpureum	Mancadera	Solanaceae	Wild fruit	500–2500
Solanum macranthum	Árbol de la papa	Solanaceae	Wild fruit	500–2000
Solanum ovalifolium	Friegaplatos	Solanaceae	Wild fruit	1500–3000
Solanum sycophanta	Arbol-tachuelo	Solanaceae	Reforestation	1000–2400
Solanum venosum	Lulo de monte	Solanaceae	Wild fruit	2000–3500
Stemmadenia grandiflora	Huevo de venado	Apocynaceae	Restoration	0–1300
Sterculia apetala	Camajón, camajorú	Malvaceae	Restoration	0–1300
Swartzia robiniifolia	Frijolillo	Leguminosae	Restoration	100–1300
Swartzia trianae	Frijolillo	Leguminosae	Restoration	200–1400
Swietenia macrophylla	Caobo	Meliaceae	Timber harvest	0–1500
Syagrus sancona	Chonta palma sancona	Arecaceae	Ornamental	0–1400
Tabebuia rosea	Ocobo, guayacán amarillo, flormorado	Bignoniaceae	Timber harvest	300–1800

(continued)

Table 1 (continued)

Scientific name	Common name	Family	Utilitarian function	Altitudinal range
Tabebuia rosea-alba	Ocobo blanco	Bignoniaceae	Timber harvest	500–1800
Talauma caricifragrans	Alpargate, quesocurao	Magnoliaceae	Timber harvest	1600–2400
Tara spinosa	Dividivi de tierra fría	Leguminosae	Fuelwood and charcoal	1600–2900
Tecoma stans	Chirlobirlo, fresnillo	Bignoniaceae	Ornamental	0–2500
Terminalia amazonia	Chipo, vara de león	Combretaceae	Timber harvest	0–1400
Tessaria integrifolia	Sauce playero	Asteraceae	Watershed conservation	0–2000
Tetrorchidium boyacanum	Palo blanco, arenillo	Euphorbiaceae	Timber harvest	1200–2300
Tetrorchidium rubrivenium	Aguamoso, arenillo	Euphorbiaceae	Timber harvest	0–1600
Thevetia peruviana	Cobalonga, abeto	Apocynaceae	Restoration	0–1500
Tibouchina lepidota	Siete cueros	Melastomataceae	Conservation	1700–2800
Tibouchina urvilleana	Nazareno	Melastomataceae	Conservation	1000–3000
Toxicodendron striatum	Pedro hernández	Anacardiaceae	Conservation	900–2300
Thibaudia andrei	Quereme	Ericaceae	Erosion avoidance	300–2600
Thibaudia archeri	Quereme	Ericaceae	Erosion avoidance	450–1500
Thibaudia floribunda	Quereme	Ericaceae	Erosion avoidance	1600–3600
Thibaudia pachyantha	Quereme	Ericaceae	Erosion avoidance	200–1300
Trema micrantha	Raspador, surrumbo	Cannabaceae	Erosion avoidance	0–2200
Tithonia diversifolia	Mirasol	Asteraceae	Fodder	1000–2400
Tournefortia scabrida	Guazimo blanco	Borraginaceae	Erosion avoidance	1000–3000
Tournefortia fuliginosa	Verdenegro	Borraginaceae	Restoration	1380–3700
Turpinia occidentalis	Mantequillo	Staphyleaceae	Restoration	100–3000
Trichanthera gigantea	Nacedero, madre de agua	Acanthaceae	Watershed protection	100–2000
Trichilia habanensis	Cedrillo, siguaraya	Meliaceae	Timber harvest, restoration	0–1500
Trichilia pallida	Caratero, cedrillo	Meliaceae	Restoration	200–1800
Trichospermum colombianum	Balso blanco	Malvaceae, subf. Tilioideae	Restoration	0–1300
Urera caracasana	Pringamosa, ortiga	Urticaceae	Restoration	500–2000

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