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EPIPHYTE DIVERSITY IN A TROPICAL ANDEAN FOREST – RESERVA BIOLÓGICA SAN FRANCISCO, ZAMORA-CHINCHIPE, ECUADOR

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Abstract. High diversity and abundance of epiphytes are one of the special characteristics of tropical montane cloud forests. Although epiphytes, apart from their important role as structural elements in this ecosystem, play an important role in the hydrological balance, few detailed studies on epiphyte vegetation exist. In the area of Reserva Biológica San Francisco in Southern Ecuador, a detailed inventory of the epiphytes along four altitudinal transects at 1800-3150m was carried out. The research area holds one of the most species-rich epiphyte floras in the world. So far at least 627 epiphyte species have been recorded. Monocotyledons are most important, with orchids alone accounting for 50% of all species. Species numbers change considerably along the altitudinal gradient. In the lower montane forest between 1850 and 2100 m, 340 epiphyte species were recorded, compared with 283 in the upper montane forest (2100–2450 m), 120 in the subalpine elfin forest (2450–2650 m), and only four species in *Páramo* areas above the timberline. The highest epiphyte diversity can always be found in the uppermost branch area of the tree canopy. This zone is particularly colonized by orchids, and in contrast to other tropical montane forests, bromeliads, ferns and Ericaceae can be found abundantly in this zone too. All other families colonize mainly the lower stem zone. *Accepted 16 August 2001.*

Key words: *Tropical montane forest, epiphytes, distribution, altitudinal gradient.*

INTRODUCTION

Tropical mountain forests are among the most species-rich ecosystems worldwide. Particularly the eastern Andean region represents one of the most distinct "biodiversity-hotspots" (Myers *et al.* 2000). In striking contrast to tropical lowland rainforests, these tropical montane forests have received only marginal attention in science and society until recently, despite their ecological and economical importance as water catchments and erosion barriers. Due to increased population pressure and resource use (firewood, mineral resources, pastures, agriculture), montane forests are disappearing more and more rapidly. Most studies carried out in tropical ecosystems have focused on lowland rainforests, and most research stations are located there (Leigh 1999). Even there, very little is known about the regeneration processes in the ecosystem (Finegan 1996), and almost nothing about its functioning. In tropical montane ecosystems, studies have concentrated mainly on the alpine zone, whereas the often-inaccessible forest belt with its extreme species richness has hardly been studied (Gentry 1995, Webster 1995). Although Andean forests host extremely high numbers of species (Barthlott *et al.* 1996, Ibisch 1996), often comparable to or higher than species counts for Amazonian areas (Balslev *et al.* 1998), no comprehensive studies of a tropical mountain forest ecosystem have been undertaken. Even broad-focused projects like "Ecoandes" in Colombia (Hammen *et al.* 1983, 1989a,b; Hammen & Ruiz 1984; Hammen & Dos Santos 1995) included the forest regions only marginally. Moreover, although the majority of the vascular flora in tropical forests belongs to non-woody life forms (Gentry & Dodson 1987, Ibisch 1996, Balslev *et al.* 1998, Galeano *et al.* 1999), most vegetation studies have focused entirely on woody species (Gentry 1988, 1995; Kitayama 1992; Aiba & Kitayama 1999). The few publications concerning the mountain forest vegetation of Ecuador mainly contain species lists, or mention the montane region in a brief comparison with the forests of the Amazon basin (Grubb *et al.* 1963, Grubb & Whitmore 1966, Ek 1997). Initial attempts to bring the existing scattered data together were made only recently (Hamilton *et al.* 1994, Churchill *et al.* 1995).

One of the characteristics of Neotropical mountain forests is the extreme abundance of epiphytes

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(Richards 1952, Madison 1977). Although they have fascinated botanists for centuries, they remain poorly known taxonomically and ecologically. Detailed knowledge of the epiphyte flora exists only for few regions in Bolivia (Ibisch 1996) and Venezuela (Engwald 1999). The work presented here was designed to document the vascular epiphyte flora in an Ecuadorian mountain forest.

STUDY AREA

The border region of Ecuador and Peru is one of the most biologically diverse areas worldwide, and thus a "biodiversity-hotspot" *par excellence*. Low passes in the Andean chain allow an easy exchange between the floras and faunas of the Amazon Basin and the Pacific lowlands. Additionally, the region shows a rapid transition between the humid mountain forests of the northern Andes and the dry, deciduous forests of the northern Peruvian lowlands. Until recently the Podocarpus National Park and the study area have been almost unknown scientifically. A few studies deal with the flora of Loja province (Espinosa 1948a, b; Emperaire & Friedberg 1990; Øllgaard & Madsen 1993; Ulloa & Jørgensen 1993; Jørgensen & Ulloa 1994; Madsen & Øllgaard 1994; Bussmann & Lange 1998; Jørgensen & León-Yanez 1999), or provide short descriptions of the area and its vegetation (Espinosa 1989/92; Madsen 1989, 1991; Jørgensen 1991; Bøgh 1992). The most recent new approach for the classification of the vegetation of Ecuador (Sierra 1999) lists all montane forests between 1800 and 3000 m altitude as "bosque de neblina montano", without further distinction.

Studies of composition and regeneration of the forest vegetation of Reserva Biológica San Francisco (ECSF) have been carried out since 1997 as part of the German Science Council Project "Functionality in a tropical mountain forest: Diversity, dynamic processes and use-potential."

Reserva Biológica San Francisco (ECSF) is located between the provincial capitals Loja and Zamora. It covers 1000 ha of the northern slopes of Cordillera de Consuelo, at 03°58′18′′S, 079°04′44′′W, in Zamora-Chinchipe Province, Ecuador, adjacent to the 146200 ha Podocarpus National Park (Fig. 1), the only protected area in southern Ecuador. Ranging from 1800 to 3150 m, it contains a complete pristine transect of the montane forest of the region, as well as comparable anthropogenically disturbed areas in close vicinity. The topography is extremely steep with slope inclinations reaching in places 90°, and mainly ranging from 40 to 60°.

In the southern part of Ecuador and the north of Peru a number of lower ridges with deep and dry valleys are found. The highest elevation is 4600 m and for the most part 4000 m is not exceeded (Jørgensen & Ulloa 1994). The area is the lowest part of the Andes near the equator. While the substrates of the northern Andes are of Quaternary volcanic origin, the southern part is composed of pre-Cretaceous to Tertiary material (Hall 1977). The geological substrate consists mainly of sandstones and phyllites, the soils of Dystrudepts, Humaquepts and Petraquepts (Schrumpf 1999).

Emck (in prep.) reports an average annual precipitation of about 2500 mm at lower altitudes, and more than 5000 mm in the uppermost regions of the reserve, with mean annual temperatures of 15–17 °C and 11–12 °C respectively (Fig. 1). Dense clouds or mist covers particularly the peak regions most times of the year. The main rainfall occurs in March-July, followed by a "dry" (but by no means arid) season, which can lead to a negative water balance especially during the months of October-January.

MATERIALS AND METHODS

Fieldwork has been conducted in an ongoing effort since September 1995, allowing revisits to all plots during all seasons of the year, including a strong El Niño/La Niña cycle in 1997/98. After a detailed floristic inventory based on random samples, fourteen plots 20 x 50 m (1000 m^2) were established at intervals of 200 m altitude, following two transects, to investigate the stand structure of the area. Height and diameter at breast height (dbh) of all living and dead tree species with a dbh > 10cm were measured. In each plot five additional sub-plots of 2 × 2 m were established, to obtain data on tree regeneration.

Additionally, non-permanent phytosociological plots (307 in natural forest areas, 76 plots on natural landslides and 40 on anthropogenically-induced landslides) were established, following the method of Braun-Blanquet (1964) as described by Mueller-Dombois & Ellenberg (1974), modified by Hammen *et al.* (1989b). Plot location was chosen in ecologically and physiognomically representative and homogeneous forest areas. The plot size chosen (at least 400 m^2 in forest areas, and 2 m^2 on landslides) was always larger than the minimum areas determined,

but was small enough to keep environmental factors in the plots uniform. Generally plots were square-shaped, bur frequently other shapes had to be chosen, particularly in linear habitats such as ridges, ravines, landslides, or roadsides.

Presence/absence of all species was registered in each plot, where terrestrial and epiphytic species were treated separately. Epiphytic species were collected from fallen trees and branches as well as by climbing randomly selected trees, with 8 m trimming poles, and by observation through binoculars (also outside the plots to allow a more complete survey of the epiphyte flora). At nine sites at different altitudes, the epiphyte flora of selected trees was completely mapped, and the distribution in the Johansson Zones registered (Johansson 1974).

Vouchers of all species encountered in the research area (but not in every single plot) were collected, and have been deposited at the herbarium of the Estación Científica San Francisco (ECSF), the Herbario Reinaldo Espinosa Loja (LOJA), the National Herbarium of Ecuador (QCNE), and the Herbario de la Pontifica Universidad Catholica Quito (OCA). The nomenclature follows Jørgensen & León-Yanez 1999.

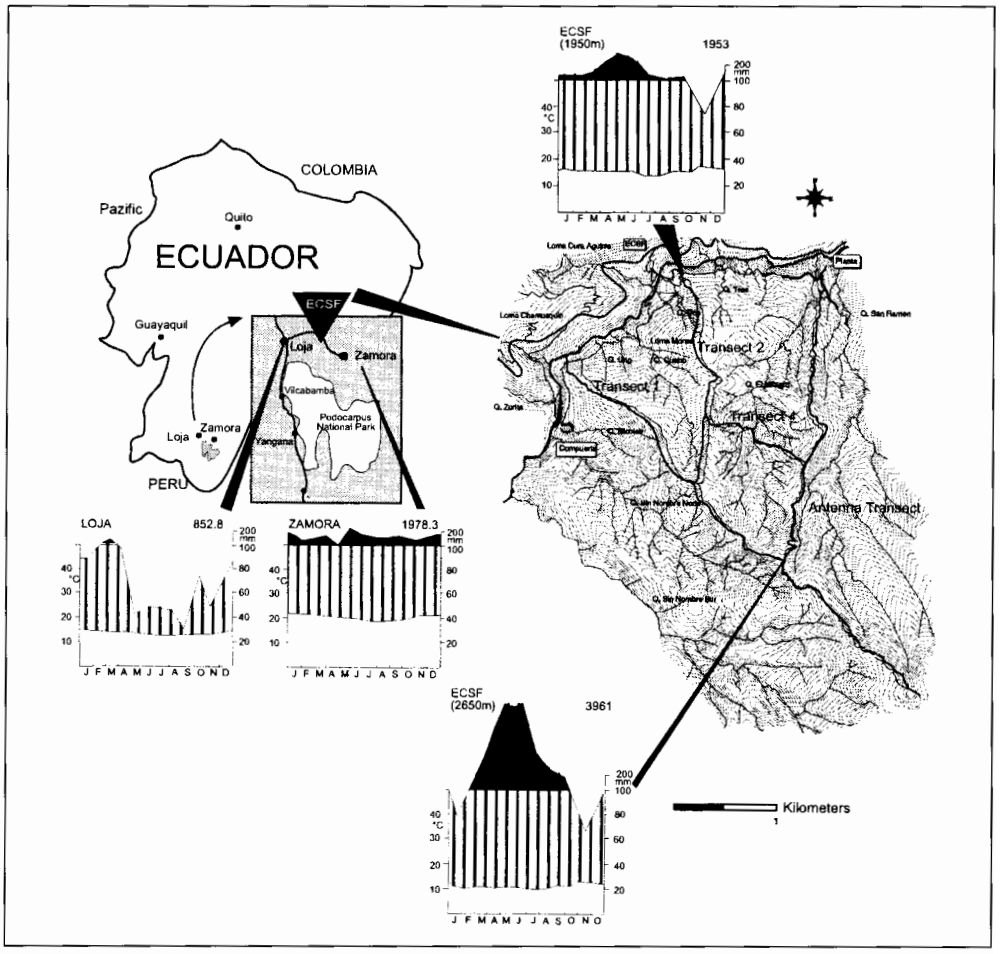

FIG. 1. Study area in Southern Ecuador.

RESULTS

Forest formations. The "montane broad-leaved forest" (*Ocotea – Nectandra* forest, Bussmann 2001), is the prevalent forest formation at altitudes from 1850–2100 m, extending up to 2300 m at the bottom of wind-protected riverine valleys (Bussmann 2001). Characterized by a highly diverse, 2-storied tree stratum, this formation can be encountered mainly on very steep slopes with an inclination of 30–50° or more, as well as in almost inaccessible valleys. The upper tree stratum reaches 25 m, with emergent trees up to 35 m tall in riverine valleys.

At altitudes above 2100 m, up to about 2750 m, the "upper montane forest" (*Purdiaea nutans – Myrica pubescens – Myrsine andina* forest), a monotypic formation with only one tree stratum, with stems between 5–10 m, sometimes up to 15 m tall, replaces the *Ocotea-Nectandra* forest. Lowland species gradually disappear completely. The canopy is completely dominated by the twisted stems of *Purdiaea nutans* (Cyrillaceae), which has its main distribution in northern Peru. A very diverse stratum of small treelets and shrubs occurs, formed by Myrsinaceae, Myricaceae, a multitude of small Melastomataceae, Cunoniaceae, Clethraceae, many Clusiaceae and Aquifoliaceae.

The uppermost forest belt of the study area is formed by the "subalpine-elfin forest", which closely resembles the Bolivian "*Jalca*". This formation, more like an impenetrable bushland than a forest, is closely dovetailed with the adjacent *Páramo* region. From an altitude of 2450 m, patches of *Jalca* already occur in the upper montane forest. The crowns of the dominant species, only 1–2 m wide – particularly Cunoniaceae, Clusiaceae, Clethraceae and many small Melastomataceae – form a very dense canopy, allowing little light to reach the ground. The stems of these "trees" thus protrude from a meter-deep carpet of mosses, and in contrast to the rich woody flora almost no herbal species are found in the ground layer.

Epiphyte diversity and distribution. A total of 627 epiphyte species has been registered in Reserva Biológica San Francisco so far. Orchidaceae (318 species), Bromeliaceae (77), and Polypodiaceae (61 species) were the largest groups of vascular epiphytes. The number of epiphyte species varied considerably between forest types (Appendix 1, Fig. 2), and a typical decrease of species richness with altitude can be observed.

In the lower montane forest, where many lowland species persisted, still 340 epiphyte species were encountered. This was underlined by the high diversity of Bromeliaceae (48 species), Araceae (21), and Piperaceae (15 species). Half of all Araceae genera found at ECSF occurred only in these lower regions. Orchids were still the dominant epiphyte group (153 species), with again almost half the genera restricted to this re-

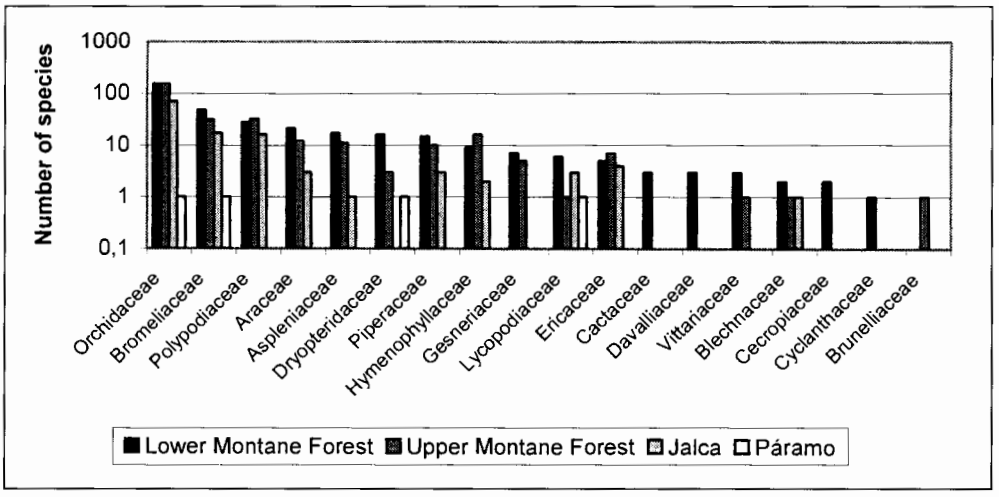

FIG. 2. Epiphyte families at the Reserva Biológica San Francisco (ECSF).

gion. Polypodiaceae (28 species) and Dryopteridaceae (16 species) were other importanr families.

In the upper montane forest, the species number quickly started to decline. The most important families remained the same, but they decreased in species. Notable exceptions were the orchids. Particularly Pleurothallidinae (*Lepanthes*, 32 species; *Pleurothallis* 25 species) had their main distribution in these misty forests. Small epiphytic Polypodiacean genera like *Terpsichore* and *Melpomene* were also most species-rich at mid-altitudes, while Hymenophyllaceae also had their center here, where air humidity was highest.

Only 120 epiphyte species were recorded in the subalpine elfin forest or "Jalca". Lowland families like Araceae and Piperaceae had disappeared, Bromelian and orchid diversity had declined. In the other forest types orchids accounted for 45–54 % of epiphytes. In the Yalca, their importance grew to 58 percent. This came very close to the findings of Bøgh (1992), who found 138 species in one plot in the nearby Cajanuma area. The páramo areas were negligible with regard to epiphyte distribution, only four species reaching these high altitudes.

The highest epiphyte diversity could always be found in the upper and mid-crown areas of the host trees. These zones were parricularly colonized by orchids, though bromeliads, ferns and Ericaceae could be found abundantly in this zone too. Most other families colonize mainly the lower stem zone. In the lower montane forest and Jalca a specific host preference was not observed, whereas in the upper montane forest the highest epiphyte diversity was found on specimens of *Purdiaea nutans*, the dominant canopy species.

CONCLUSIONS

Orchids and ferns are the most species-rich groups in Andean cloud foresrs (Atwood 1984), and were also encountered as the most important epiphyte groups in all forest formations at ECSF. Although epiphytes were found in all Johansson Zones the tree base zone and the middle and upper canopy are most heavily colonized by epiphytes. This is in line with other studies (e.g., ter Steege & Cornelissen 1989, Ibisch 1996, Engwald 1999). With 627 epiphyte species found so far (Appendix 2), Reserva Biológica is one of the most epiphyte-rich areas worldwide. Only the Bolivian yungas might match this diversity. Ibisch (1996) estimates 600 species for this region, and found 230 species in a small transect from 2100 to 2300 m altitude. Other Neotropical studies documented much lower epiphyte numbers. Engwald (1999) found 120 species in La Carbonara in Venezuela (2300 m), and only 53 species in Surumoni (100 m) in the Orinoco basin. McDade *et al.* (1994) documented 380 species from La Selva in Costa Rica (130 m), Ingram *et. al.* (1995) 332 species from Monteverde Cloud Forest Reserve (1400 m), *Catling et al.* (1989) reported 68 species from Guatemala, ter Steege *et al.* (1989) 86 species from lowland Guyana (100 m), and Gentry & Dodson (1987) reported 238 species from Rio Palenque in Ecuador (200 m). Also in Ecuador, in the montane forests of Otonga (Nowicki 1998) and Guajalito (Rauer 1995), both at altitudes of 2000 m, 196 and 166 vascular epiphytes were found. This clearly shows that tropical lowland forests have a very reduced epiphyte diversity, and that the main level of vascular epiphyte richness can be observed in Andean montane forests at altitudes of 2000–2400 m.

Not much is known about the distribution of epiphytes in other regions, and the ecology of most species is unknown, so much more data from these regions are required for comparison.

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REFERENCES

Aiba, S., & K. Kitayama. 1999. Structure, composition and species diversity in an altitude-substrate matrix of rain forest tree communities on Mount Kinabalu, Borneo. Plant Ecology 149: 139–157.

Atwood, J.T. 1984. A floristic study of Volcán Mombacho, Department of Grenada, Nicaragua. Ann. Mo. Bot. Gard. 71: 191–209.

Balslev, H., Valencia, R., Paz y Miño, G., Christensen, H., & I. Nielsen. 1998. Species count of vascular plants in one hectare of humid lowland forest in Amazonian Ecuador. Pp. 585–594 *in* Dallmeier, F., & J.A. Comiskey (eds.). Forest biodiversity in North, Central, and South America, and the Caribbean. Unesco, Paris.

Barthlott, W., Lauer, W., & A. Placke. 1996. Global distribution of species diversity in vascular plants: towards a world map of phytodiversity. Erdkunde 50: 317–327.

Bøgh, A. 1992. Composition and distribution of the vascular epiphyte flora of an Ecuadorian montane rainforest. Selbyana 13: 25–34.

Braun-Blanquet, J. 1964. Pflanzensoziologie, 3rd edition. Wien.

Bussmann, R.W. 2001. The montane forests of Reserva Biológica San Francisco Zamora-Chinchipe, Ecuador – vegetation zonation and natural regeneration. Die Erde 132: 11–24.

Bussmann, R.W., & S. Lange. 1998. Expedición Rapido Asesso Cordillera Sabanilla – Invenrario floristico. ECSF/INEFAN, Loja/Quito.

Catling, P.M., & L.P. Lefkovitch. 1989. Associations of vascular epiphytes in a Guatemalan cloud forest. Biotropica 21: 35–40.

Churchill, S.P., Balslev, H., Forero, E., & J.L. Luteyn (eds.). 1995. Biodiversity and Conservation of Neotropical Montane Forests. Wiley.

Ek, R.C. 1997. Botanical diversity in the tropical rain forest of Guayana. Tropenhos-Guayana series 4: 1–237.

Emperaire, L., & C. Friedberg. 1990. Relevées floristiques des regions Piura Perou et de Loja Ecuateur. Orstrom, Paris.

Engwald, S. 1999. Diversität und Ökologie der vaskulären Epiphyten in einem Berg- und einem Tieflandregenwald in Venezuela. PhD diss., Univ. Bonn, Bonn, Germany.

Espinosa, B. 1948a. Estudios botanicos en el sur del Ecuador. I. Loja-Catamayo-Malacatos-Vilcabamba. Loja.

Espinosa, B. 1948b. Estudios botanicos en el sur del Ecuador. II. Herbarium Universitatis Loxoensis Primer Inventario. Loja.

Espinosa, G.D.A. (ed.). 1989/1992. Parque Nacional Podocarpus. Boletín informativo sobre biología, conservación y vida silvestre vol. 1–3. Loja.

Finegan, B. 1996. Pattern and process in neotropical secondary rain forest: the first 100 years of succession. TREE 11: 119–124.

Galeano, G., Suárez, S., & H. Balslev. 1999. Vascular plant species count in a wet forest in the Chocó area on the Pacific coast of Colombia. Biodiv. Conserv. 7: 1563–1575.

Gentry, A.H. 1988. Changes in plant community diversity and floristic composition on environmental and geographical gradients. Ann. Mo. Bot. Gard. 75. 1–34.

Gentry, A.H. 1995. Patterns of diversity and floristic composition in neotropical montane forests. Pp. 103–126 *in* Churchill, S.P., Balslev, H., Forero, E., & J.L. Luteyn (eds.). Biodiversity and conservation of Neotropical montane forests. New York Botanical Garden, Bronx.

Gentry, A.H., & C.H. Dodson. 1987. Contribution of nontrees to species richness of a tropical rain forest. Biotropica 19: 149–156.

Grubb, P.J., Lloyd, J.R., Pennington, T.D., & T.C. Whitmore. 1963. A comparison of montane and lowland rain forest in Ecuador – The forest structure, physiognomy, and floristics. J. Ecol. 51: 567–601.

Grubb, P.J., & T.C. Whitmore. 1966. A comparison of montane and lowland rain forest in Ecuador – II. The climate and its effects on the distribution and physiognomy of the forests. J. Ecol. 54: 303–333.

Hall, M. 1977. El volcanismo en el Ecuador. Abya Yala, Quito.

Hamilton, L.S., Juvik, J.O., & F.N. Scatena (eds.) 1994. Tropical Montane Cloud Forests. Ecological Studies 110. New York.

Hammen, T. van der, Perez Precario, A., & E.P. Pinto (eds.). 1983. Studies on tropical Andean ecosystems. Vol. 1. Vaduz.

Hammen, T. van der, & P.M. Ruiz (eds.). 1984. Studies on tropical Andean ecosystems. Vol. 2. Vaduz.

Hammen, T. van der, Diaz-Piedrahita, S., & V.J. Alvarez (eds.). 1989a. Studies on tropical Andean ecosystems. Vol. 3. Vaduz.

Hammen, T. van der, Mueller-Dombois, D., & M.A. Little. 1989b. Manual of Methods for Mountain Transect Studies. Unesco, Paris.

Hammen, T. van der, & A.G. Dos Santos (eds.). 1995. Studies on tropical Andean ecosystems. Vol. 4. Vaduz.

Ibisch, P.L. 1996. Neotropische Epiphytendiversität – das Beispiel Bolivien. Archiv naturwissenschaftlicher Dissertationen 1, Wichl.

Ingram, S.W., Ferrel-Ingram, K., & N.M. Nadkarni. 1995. Epiphytes of the Monteverde cloud forest reserve. The Bromeliad Identification Center, Sarasota, Florida.

Johansson, D.R. 1974. Ecology of vascular epiphytes in west African rain forests. Act. Phyt. Suec. 59: 1–136.

Jørgensen, P.M. 1991. Species composition and present extension of Andean forest above 2,400 m altitude in Ecuador. Ph.D. diss., Univ. Aarhus, Aarhus, Denmark.

Jørgensen, P.M., & C. Ulloa U. 1994. Seed plants of the high Andes of Ecuador – a checklist. AAU Reports 34: 1–443.

Jørgensen, P.M., & S. León-Yanez (eds.). 1999. Catalogue of the vascular plants of Ecuador. Monographs in Systematic Botany from the Missouri Botanical Garden: 75. Missouri Botanical Garden, St. Louis.

Kitayama, K. 1992. An altitudinal transect study of the vegetation on Mount Kinabalu, Borneo. Vegetation 102: 149–171.

Leigh, E.G. 1999. Tropical forest ecology – a view from Barro Colorado Island. Oxford.

Madison, M. 1977. Vascular epiphytes: their Systematic Occurrence and Salient Features. Selbyana 2: 1–13.

Madsen, J.E. 1989. Aspectos generales de la flora y vegetacion del Parque Nacional Podocarpus. Boletin informativo sobre biologia, conservacion y vida silvestre 1: 59–74.

Madsen, J.E. 1991. Floristic composition, structure and dynamics of an upper montane rain forest in Southern Ecuador. Ph.D. diss., Univ. Aarhus, Aarhus, Denmark.

Madsen, J.E., & B. Øllgaard. 1994. Floristic composition, structure and dynamics of an upper montane rain foresr in Southern Ecuador. Nord. J. Bot. 14: 403–423.

McDade, L.A., Bawa, K.S., Hespenheide, H.A., & G.S. Hartshorn (eds.). 1994. La Selva – Ecology and natural history od a neotropical rain forest. Chicago.

Mueller-Dombois, D., & H. Ellenherg. 1974. Aims and methods of vegetation ecology. New York.

Myers, N., Mittermeier, R.A., Mittermaier, C.G., da Fonseca, G.A.B., & J. Kent. 2000. Biodiversity hotspots for conservation priorities. Nature 40: 853–858.

Nowicki, C. 1998. Diversität epiphytischer und terrestrischer Pflanzen eines ecuadorianischen Bergnebelwaldes. M.Sc. thesis, Univ. Bonn, Bonn, Germany.

Øllgaard, B., & J.E. Madsen. 1993. Inventario preliminar de las especies vegetales en el Parque Nacionál Podocarpus. Revista de Difusión Técnica y Cientifica de la Facultad de Ciencias Agrícolas, Universidad Nacional de Loja 22/23 1/2: 66–87.

Rauer, G. 1995. Epiphytische Orchidaceae eines westandinen Bergregenwaldes in Ecuador. M.Sc. thesis, Univ. Bonn, Bonn, Germany.

Richards, P.W. 1952. The tropical rain forest. New York: Cambridge.

Schrumpf, M. 1999. Genese, Klassifikation und Nährstoffgehalte tropischer Böden entlang eines Höhentransekts an der Andenostabdachung Südecuadors. M.Sc. thesis Univ. Bayreuth, Bayreuth, Germany.

Sierra, R. (ed.). 1999. Propuesta preliminar de un sistema de clasificación de vegetación para el Ecuador Continental. INEFAN, Quito.

ter Steege, H., & J.H.C. Cornelissen. 1989. Distribution and ecology of vascular epiphytes in lowland rain forest of Guyana. Biotropica 214: 331–339.

Ulloa U., C., & P.M. Jørgenson 1993. Arboles y arbustos de los Andes del Ecuador. AAU Reports 30: 1–263.

Webster, G.L. 1995. The Panorama of Neotropical cloud forest. Pp. 53–78 *in* Churchill, S.P., Balslev, H., Forero, E., & J.L. Luteyn (eds.). Biodiversity and conservation of Neotropical montane forests. New York Botanical Garden, Bronx.

APPENDIX 1: Epiphyte families and species per genus at the Reserva Biológica San Francisco (ECSF) and their altitudinal distribution.

Family / Genus	Lower Montane Forest	Upper Montane Forest	*Jalca*	*Páramo*	Total species number
Araceae	21	12	3		30
Anthurium	13	10	3		21
Caladium	1	1			1
Monstera	1				1
Philodendron	2	1			2
Rhodospatha	2				2
Stenospermation	2				3
Aspleniaceae	17	11	1		21
Asplenium	17	11	1		21
Blechnaceae	2	1	1		3
Blechnum	2	1	1		3
Bromeliaceae	48	31	17	1	77
Aechmea	2				2
Guzmania	13	10	2		25
Mezobromelia	1	1	1	1	1
Pitcairnia	6	1			7
Racinaea	12	3	8		17
Tillandsia	11	13	6		20
Vriesea	3	3			5
Brunelliaceae		1			1
Brunellia		1			1
Cactaceae	3				3
Rhipsalis	3				3
Cecropiaceae	2				1
Coussapoa	2				1
Cyclanthaceae	1				1
Cyclanthus	1				1
Davalliaceae	3				3
Nephrolepis	3				3
Dryopteridaceae	16	3		1	20
Bolbitis	1				1
Elaphoglossum	9	3			12
Oleandra	1				1
Peltapteris	1				1
Polybotrya	4				4
Woodsia				1	1
Ericaceae	5	7	4		11
Anthopterus	1				1
Disterigma		3	3		3
Macleania		1			1
Oreanthes	1				1
Orthaea		1			1
Psammisia	1				1
Satyria	1				1
Semiramisia	1	1			1
Sphyrospermum		1	1		1

Family / Genus	Lower Montane Forest	Upper Montane Forest	*Jalca*	*Páramo*	Total species number
Gesneriaceae	7	5			11
Alloplectus	1	1			2
Anetanthus					1
Codonanthe	1	1			1
Columnea	4	2			5
Drymonia		1			1
Pearcea	1				1
Hymenophyllaceae	9	16	2		25
Hymenophyllum	5	13	1		16
Trichomanes	4	3	1		9
Lycopodiaceae	6	1	3	1	11
Huperzia	6	1	3	1	11
Ophioglossaceae	1				1
Cheiroglossa	1				1
Orchidaceae	153	152	70	1	318
Ackermannia	2				2
Ada	3				3
Anguloa	1				1
Barbosella		1			1
Brachionidium	2	4	3		9
Bulbophyllum	1				1
Chaubardia	1				1
Chaubardiella	1				1
Chondrorhyncha	3				3
Chrysocycnis	2				2
Cischweinfia	1				1
Cochlioda	1	1			1
Comparettia	2				2
Cryptocentrum		2			2
Cypholoron		1	1		1
Cyrtidiorchis		1	1		1
Dichaea	1	2			3
Draconanthes			2		2
Dracula	2	1			3
Dresslerella	2				2
Dryadella	1	1			2
Elleanthus	2				3
Epidendrum	20	12	3	1	34
Fernandezia	1	1	2		4
Galeottia	1				1
Hofmeisterella	1				1
Kefersteinia	2				2
Koellensteinia			1		1
Lankesterella			1		1
Lepanthes	28	32	8		48
Lepanthopsis	5		2		7
Lockhartia	2				2
Lycaste	1				1
Masdevallia	9	12	3		23
Maxillaria	16	20	8		37

Family / Genus	Lower Montane Forest	Upper Montane Forest	*Jalca*	*Páramo*	Total species number
Myoxanthus	3	1			4
Octomeria	1	1			2
Odontoglossum		8	8		10
Oliveriana	1				1
Oncidium	1	2			3
Otoglossum		1	1		1
Pachyphyllum		3	3		4
Pityphyllum	1	1	1		2
Platystele	3	1	1		5
Pleurothallis	16	25	13		44
Polystachya	1				1
Ponthievia	1	1			2
Porroglossum	1				1
Restrepiopsis	3	1	1		4
Salpistele		1			1
Sarcoglottis			1		1
Scaphyglottis		1	1		1
Stelis		5	3		5
Trichosalpinx	3	9	2		12
Trisetella	4				5
Piperaceae	15	10	3		28
Peperomia	15	10	3		28
Polypodiaceae	29	32	16		61
Campyloneurum	8	2	1		11
Ceradenia		2	1		3
Cochlidium	1	1			2
Dicranoglossum	1				1
Enterosora		1			1
Grammitis		1			1
Lellingeria	2	2	1		4
Melpomene		6	6		6
Microglossa	1				1
Microgramma	2				2
Niphidium		1			1
Pecluma	3	2			4
Phlebodium	1				1
Pleopeltis	1	1			1
Polypodium	6	4			1
Terpsichore	2	8	7		12
Zygophlebia	1	1			1
Vittariaceae	3	1			3
Antrophyum	1				1
Vittaria	2	1			2
TOTAL	340	283	120	4	627

APPENDIX 2. Epiphyte species at the Reserva Biológica San Francisco (ECSF).

Araceae
Anthurium breviscapum Schott
Anthurium coerulescens Engl.
Anthurium corrugatum Sodiro
Anthurium dombeyanum Brogn. ex Schott
Anthurium flavolineatum Sodiro
Anthurium grubbii Croat
Anthurium harlingianum Croat
Anthurium incomptum Madison
Anthurium incurvatum Engl.
Anthurium lennardii Croat
Anthurium lingua Sodiro
Anthurium longegeniculatum Engl.
Anthurium myosuroides (Kunth) Endl.
Anthurium obtusum (Engl.) Grayum
Anthurium ovatifolium Engl.
Anthurium penningtonii Crot
Anthurium rugulosum Sodiro
Anthurium scandens (Aublet.) Engl.
Anthurium truncicola Engl.
Anthurium variegatum Sodiro
Anthurium versicolor Sodiro
Caladium bicolor (Aiton) Vent.
Monstera lechleriana Schott
Philodendron herthae K. Krause
Philodendron verrucosum L. Mathieu ex Schott
Rhodospatha ammonifolium (Poepp.) Schott
Rhodospatha latifolia Poepp.
Stenospermation adsimile Sodiro
Stenospermation angustifolium Hemsl.
Stenospermation longipetiolatum Engl.
Aspleniaceae
Asplenium aethiopicum (Burm.f.) Bech.
Asplenium auriculatum Sw.
Asplenium auritum Sw.
Asplenium cirrhatum Rich. Ex Willd.
Asplenium ecuadorense Stolze
Asplenium feei Kunze ex Fée
Asplenium flabellulatum Krause
Asplenium foeniculatum Kunth.
Asplenium harpeodes Kunze
Asplenium hastatum Klotzsch ex Kunze
Asplenium monanthes L.
Asplenium pteropus Kaulf.
Asplenium pululahuae Sodiro
Asplenium repens Hook.
Asplenium riparium Liebm.
Asplenium rutaceum (Willd.) Mett.
Asplenium serra Langsd. & Fisch.
Asplenium sessilifolium Desr.
Asplenium stuebelianum Hieron.
Asplenium theciferum (Kunth.) Mett.
Asplenium tricholepis Rosenst.
Blechnaceae
Blechnum acutum (Desr.) Mett.
Blechnum ensiforme (Liebm.) C. Chr.
Blechnum fragile (Liebm.) C.V. Morton & Lellinger
Bromeliaceae
Aechmea drakeana André
Aechmea involucrata André
Aechmea vetchii Baker
Guzmania aequatorialis L.B. Sm.
Guzmania asplundii L.B. Sm.
Guzmania besseae H. Luther
Guzmania candelabrum (André) André ex Mez
Guzmania condorensis H. Luther
Guzmania confusa L.B. Sm.
Guzmania conifera (André) André ex Mez
Guzmania diffusa L.B. Sm.
Guzmania foetida Rauh
Guzmania fusispica Mez & Sodiro
Guzmania garciaensis Rauh
Guzmania gloriosa (André) André ex Mez
Guzmania killipiana L.B. Sm.
Guzmania lychnis L.B. Sm.
Guzmania morreniana (Linden Hortus) Mez
Guzmania multiflora (André) Anfré ex Mez
Guzmania osyana (E. Morren) Mez
Guzmania paniculata Mez
Guzmania poortmanii (André) André
Guzmania sanguinea (André) André ex Mez
Guzmania sibundoyorum L.B. Sm.
Guzmania squarrosa (Mez & Sodiro) L.B. Sm. & Pittendr.
Guzmania vanvolxemii (André) André ex Mez
Guzmania variegata L.B. Sm.
Mezobromelia bicolor L.B. Sm.
Mezobromelia capituligera (Grieseb.) J.R. Grant
Mezobromelia fulgens L.B. Smith
Pitcairnia alata L.B. Sm.
Pitcairnia andreetae H. Luther
Pitcairnia devansayana André & Baker
Pitcairnia heterophylla (Lindl.) Beer
Pitcairnia hirtzii H. Luther
Pitcairnia maidifolia (C. Morren) Decne.
Pitcairnia riparia Mez
Racinaea blassii (L.B. Sm.) M.A. Spencer & L.B. Sm.
Racinaea dielsii (Harms) H. Luther

Racinaea euryelytra J.R. Grant
Racinaea flexuosa (Baker) M.A. Spencer & L.B. Sm.
Racinaea gilmartiniae (L.B. Sm.) M.A. Spencer & L.B. Sm.
Racinaea homostachya (André) M.A. Spencer & L.B. Sm.
Racinaea multiflora (Benth.) M.A. Spencer & L.B. Sm.
Racinaea pallidoflavens (Mez) M.A. Spencer & L.B. Sm.
Racinaea pectinata (André) M.A. Spencer & L.B. Sm.
Racinaea penlandii (L.B. Sm.) M.A. Spencer & L.B. Sm.
Racinaea pugiformis (L.B. Sm.) M.A. Spencer & L.B. Sm.
Racinaea schumanniana (Wittm.) J.R. Grant.
Racinaea seemannii (Baker) M.A. Spencer & L.B.Sm.
Racinaea tetrantha (Ruiz & Pav.) M.A. Spencer & L.B. Sm.
Racinaea tripinnata (Baker) M.A. Spencer & L.B. Sm.
Racinaea undulifolia (Mez) H. Luther
Tillandsia aequatorialis L.B. Sm.
Tillandsia asplundii L.B. Sm.
Tillandsia barbeyana Wittm.
Tillandsia barthlottii Rauh
Tillandsia biflora Ruiz & Pav.
Tillandsia buseri Mez
Tillandsia clavigera Mez
Tillandsia complanata Benth.
Tillandsia confinis L.B. Sm.
Tillandsia denudata André
Tillandsia dichrophylla L.B. Sm.
Tillandsia fendleri Grieseb.
Tillandsia floribunda Kunth
Tillandsia ionochroma André ex Mez
Tillandsia laminata L.B. Sm.
Tillandsia latifolia Meyen
Tillandsia polyantha Mez & Sodiro
Tillandsia pyramidata André
Tillandsia recurvata (L.) L.
Tillandsia reversa L.B. Sm.
Tillandsia stenoura Harms
Tillandsia straminea Kunth
Tillandsia tovarensis Mez
Tillandsia wurdackii L.B. Sm.
Vriesea appendiculata (L.B. Sm.) L.B. Sm.
Vriesea fragans (André) L.B.Smith
Vriesea tequendamae (André) L.B. Sm.
Brunelliaceae
Brunellia inermis Ruiz. & Pav.
Cactaceae
Rhipsalis baccifera (J.S. Meld.) Stearn
Rhipsalis kirbergii Barthlott
Rhipsalis micranta (Kunth) DC.
Cecropiaceae
Coussapoa crassivenosa Mildbr.
Coussapoa villosa Poepp. & Endl.
Cyclanthaceae
Cyclanthus bipartidus Poir.
Davalliaceae
Nephrolepis cordifolia (L.) C. Presl.
Nephrolepis pectinata (Willd.) Schott
Nephrolepis pendula (Raddi) J. Sm.
Dryopteridaceae
Bolbitis lindegii (Mett.) Ching.
Elaphoglossum andreanum Christ.
Elaphoglossum ciliatum (C. Presl.) T. Moore
Elaphoglossum crassipes (Hieron) Diels
Elaphoglossum cuspidatum (Willd.) T. Moore
Elaphoglossum decorum (Kunze) T. Moore
Elaphoglossum erinoceum (Feé) Moore
Elaphoglossum isophyllum (Sod.) H. Christ.
Elaphoglossum muscosum (Sw.) T. Moore
Elaphoglossum ovatum (Hook. & Grev.) T. Moore
Elaphoglossum paleaceum (Hook. & Grev.) Sledge
Elaphoglossum platyphyllum Presl.
Elaphoglossum preselianum (Feé) H. Christ
Elaphoglossum pseudoboryanum Mickel
Oleandra pilosa Hook.
Peltapteris peltata (Sw.) C.V. Morton
Polybotrya alfredii Brade
Polybotrya altescandens C. Chr.
Polybotrya appressa R.C. Moran
Polybotrya polybotryoides (Baker) H. Christ.
Woodsia montevidensis (Spreng.) Hieron.
Ericaceae
Anthopterus gentryi Luteyn
Disterigma acuminatum (Kunth.) Nied.
Disterigma codonanthum S.F. Blake
Disterigma empetrifolium (Kunth.) Drude
Macleania farinosa Mansf.
Oreanthes buxifloius Benth.
Pernettya prostrata (Cav.) DC.
Psammisia columbiensis Hoerold
Semiramisia speciosa (Benth.) Klotzsch
Sphyrospermum buxifolium Poepp. & Endl.
Themistoclesia cordifolium Benth.
Gesneriaceae
Alloplectus peruvianus (A. Zahlbr.) L.P. Kvist & L.E. Skog.
Alloplectus tetragonus (Oerst.) Hanst.

Codonanthe erubescens Wiehler
Columnea albiflora L.P. Kvist & L.E. Skog
Columnea fuscihirta L.P. Kvist & L.E. Skog
Columnea guttata Poepp.
Columnea nervosa (Klotzsch ex Oerst.) Hanst.
Columnea strigosa Benth.
Drymonia serrulata (Jacq.) Mart.
Hymenophyllaceae
Hymenophyllum amabile C.V. Morton
Hymenophyllum dependens C.V. Morton
Hymenophyllum fucoides (Hedw.) C.V. Morton
Hymenophyllum hirsutum (L.) Sw.
Hymenophyllum lobatoalatum Klotzsch
Hymenophyllum microcarpum Desr.
Hymenophyllum multialatum C.V. Morton
Hymenophyllum myriocarpum Hook.
Hymenophyllum polyanthes (Sw.) Sw.
Hymenophyllum ruizianum (Klotzsch) Kuntze.
Hymenophyllum superbum C.V. Morton
Hymenophyllum trichomanoides Bosch
Hymenophyllum trichophyllum Kunth.
Hymenophyllum tunbringense (L.) Sm.
Hymenophyllum undulatum (L.) Sw.
Hymenophyllum verecundum C.V. Morton
Trichomanes capillaceum L.
Trichomanes cristatum Kaulf.
Trichomanes elegans (Rich.) Bosch
Trichomanes hymenophylloides Bosch
Trichomanes lucens Sw.
Trichomanes polypodioides L.
Trichomanes pyxidiferum L.
Trichomanes radicans Sw.
Trichomanes reptans Sw.
Lentibulariaceae
Utricularia jamesoniana Oliv.
Lycopodiaceae
Huperzia campania B. Øllg
Huperzia capillaris (Sodiro) Holub
Huperzia ericifolia (C.Presl.) Holub.
Huperzia filiformis (Sw.) Holub.
Huperzia heteroclita (Desr. & Poir.) Holub
Huperzia linifolia (L.) Trevisan
Huperzia linifolia (L.) Trevisan var. *tenuifolia* Nessel & B. Øllg.
Huperzia sarmentosa (Spring) Trevis.
Huperzia subulata (Desr. Ex Poir.) Holub
Huperzia tenuis (Humb. & Bonpl. ex Willd.) Trevis
Huperzia wilsonii (Underw. & F.E. lloyd) B. Øllg.
Ophioglossaceae
Cheiroglossa palmata (L.) C. Presl.
Orchidaceae
Ackermannia caudata (Ackermann) Dodson & Escobat
Ackermannia palaorae (Dodson & Hirtz) Dodson & Escobar
Ada brachypus (Rchb. f.) N.H. Williams
Ada glumacea (Lindl.) N.H. Williams
Ada medozae Dodson
Anguloa uniflora Ruiz & Pav.
Barbosella cucullata (Lindl.) Schltr.
Brachionidium andreettae Luer & Hirtz
Brachionidium ballatrix Luer & Hirtz
Brachionidium dalstroemii Luer
Brachionidium elegans Luer & Hirtz
Brachionidium ephemerum Luer & Hirtz
Brachionidium hirtzii Luer
Brachionidium pteroglossum Luer
Brachionidium rugosum Luer & Hirtz
Brachonidium loxense Luer
Bulbophyllum steyermarkii Foldats
Chaubardia heteroclita (Poepp. & Endl.) Dodson & D.E. Benn
Chaubardiella dalessandroi Dodson & Dalström
Chondrorhyncha embreei Dodson & Neudecker
Chondrorhyncha viridisepala Senghas
Chondrorhyncha vollesii G. Gerlach, Neudecker & Seeger
Chrysocycnis lehmannii Rolfe
Chrysocycnis schlimii Linden & Rchb. f.
Cischweinfia suarezii Dodson
Cochleanthes flabelliformis (Sw.) R.E. Schult & Garay
Cochlioda rosea (Lindl.) benth.
Cochlioda vulcanica (Rchb. f.) Benth. & Hook. f. ex B.D. Jacks.
Comparettia falcata Poepp. & Endl.
Comparettia speciosa Rchb, f.
Crossoglossa dalessandroi (Dodson) Dodson
Crossoglossa dalstroemii (Dodson) Dodson
Crossoglossa hirtzii Dodson ex Dodson
Crossoglossa liparioides (Finet) Dodson
Cryptocentrum lehmannii (Rchb. f.) Garay
Cryptocentrum pergracile Schltr.
Cypholoron frigida Dodson & Dressler
Cyrtidiorchis alata (Lindl.) Rauschert
Dichaea lagotis Rchb. f.
Dichaea laxa (Ruiz & Pav.) Poepp. & Endl.
Dichaea longa Schltr.
Draconanthes aberrans (Schltr.) Luer
Draconanthes bufonis (Luer & Hirtz) Luer
Dracula dalessandroi Luer
Dracula lotax (Luer) Luer
Dracula simia (Luer) Luer

Dresslerella caesariata Luer
Dresslerella hirsutissima (C. Schweinf.) Luer
Dryadella perpusilla (Krzl.) Luer
Dryadella simula (Rchb. f.) Luer
Elleanthus conifer (Rchb. f. & Warcz.) Rchb. f.
Elleanthus lateralis Garay
Elleanthus oellgaardii Dodson
Epidendrum acuminatum Ruiz & Pav.
Epidendrum allenii L.O. Williams
Epidendrum alpicolum Rchb. f.
Epidendrum amethystinum Rchb. f.
Epidendrum apaganum Mansf.
Epidendrum arbusculum Lindl.
Epidendrum armeniacum Lindl.
Epidendrum calanthum Rchb.f & Warsc.
Epidendrum catillus Rchb.f. & Warsz.
Epidendrum coryophorum (Kunth) Rchb. f.
Epidendrum cristatum Ruiz & Pav.
Epidendrum cuencanum Schltr.
Epidendrum densifolium Kraenzl.
Epidendrum elleanthoides Schltr.
Epidendrum excisum Lindl.
Epidendrum ferrugineum Ruiz. & Pav.
Epidendrum geminiflorum Kunth
Epidendrum globiflorum F. Lehm.& Kraenzl.
Epidendrum gramineum Lindl.
Epidendrum jajaense Rchb. f.
Epidendrum lacustre Lindl.
Epidendrum lechleri Rchb. f.
Epidendrum macrostachyum Lindl.
Epidendrum mancum Lindl.
Epidendrum odontospathum Rchb. f.
Epidendrum pachychilum Kraenzl.
Epidendrum perigracile Schltr.
Epidendrum polystachyum Kunth
Epidendrum purum Lindl.
Epidendrum ramosum Jacq.
Epidendrum repens Cogn.
Epidendrum rupestre Lindl.
Epidendrum scabrum Ruiz & Pav.
Epidendrum tridens Poepp. & Endl.
Fernandezia ionanthera (Rchb. f. & Warsz.) Schltr.
Fernandezia maculata Garay & Dunst.
Fernandezia sanguinea (Lindl.) Garay & Dunstery
Fernandezia subbiflora Ruiz & Pav.
Galeottia acuminata (C. Schweinf.) Dressler & Christenson
Hofmeisteriella eumicroscopica (Rchb. f.) Rchb. f.
Kefersteinia pellita Rchb. f. ex Dodson & D.E. Benn.
Kefersteinia sanguinolenta Rchb. f.
Koellensteinia ionoptera Linden & Rchb. f.
Lankesterella orthantha (Kraenzl.) Garay
Lepanthes acarina Luer
Lepanthes aculeata Luer
Lepanthes adelphe Luer & Hirtz
Lepanthes agglutinata Luer
Lepanthes alticola C. Schweinf.
Lepanthes angulata Luer & Hirtz
Lepanthes auriculata Luer
Lepanthes aurita Luer
Lepanthes ballatrix Luer
Lepanthes caloura Luer & Hirtz
Lepanthes campodostele Luer & Hirtz
Lepanthes cassidea Rchb. f.
Lepanthes cauda-avis Luer
Lepanthes contingens Luer
Lepanthes curiosa Luer
Lepanthes dalessandroi Luer
Lepanthes dictyon Luer & Hirtz
Lepanthes disjuncta Luer & Hirtz
Lepanthes drymocharis Luer & Hirtz, ined.
Lepanthes ejecta Luer & Hirtz
Lepanthes eresipes Luer & Hirtz
Lepanthes flexuosa Luer
Lepanthes floripecten (Rchb. f.) Ames
Lepanthes focalis Luer
Lepanthes fusiformis Luer
Lepanthes gargantua Luer
Lepanthes hirtzii Luer
Lepanthes homotaxis Luer
Lepanthes ictalurus Luer
Lepanthes inamoena Luer
Lepanthes intosa Luer
Lepanthes intricata Luer
Lepanthes micropetala L.O. Williams
Lepanthes monitor Luer
Lepanthes monoptera Lindl.
Lepanthes narcissus Luer & Hirtz
Lepanthes necopina Luer & Hirtz
Lepanthes nummularia Rchb. f.
Lepanthes papyrophylla Rchb. f.
Lepanthes polytricha Luer
Lepanthes series Luer & Hirtz
Lepanthes stalactites Luer & Hirtz
Lepanthes tachirensis Foldats
Lepanthes via-incarum Luer & Hirtz
Lepanthes wagneri Rchb. f.
Lepanthes xenos Luer & Hirtz
Lepanthes yanganae Luer & Hirtz
Lepanthes zamorensis Luer & Hirtz
Lepanthopsis acetabulum Luer

Lepanthopsis acuminata Ames
Lepanthopsis apoda (Garay & Dunst.) Luer
Lepanthopsis culiculosa Luer
Lepanthopsis floripecten (Rchb. f.) Ames
Lepanthopsis hirtzii Luer
Lepanthopsis vinacea C. Schweinf.
Lockhartia biserrata (Rich.) Christenson & Garay
Lockhartia longifolia (Lindl.) Schltr.
Lycaste ciliata (Ruiz & Pav.) Lindl. ex Rchb. f.
Masdevallia amaluzae Lier & Malo
Masdevallia ampullacea Luer & Andreetta
Masdevallia anachaeta Rchb. f.
Masdevallia carruthersiana F. Lehm. & Kraenzl.
Masdevallia citrinella Luer & Malo
Masdevallia corderoana F. Lehm. & Kraenzl.
Masdevallia dalessandroi Luer
Masdevallia fractiflexa F. Lehm. & Kraenzl.
Masdevallia lilacina Koeninger
Masdevallia macropus F. Lehm. & Kraenzl.
Masdevallia mendozae Luer
Masdevallia parvula Schltr.
Masdevallia persicina Luer
Masdevallia picta Luer
Masdevallia picturata Rchb. f.
Masdevallia rosea Lindl.
Masdevallia roseola Luer
Masdevallia sernae Luer & Escobar
Masdevallia setacea Luer & Malo
Masdevallia teaguei Luer
Masdevallia trochilus Linden & André
Masdevallia uncifera Rchb. f.
Masdevallia xanthina Rchb. f.
Maxillaria acuminata Lindl.
Maxillaria acutifolia Lindl.
Maxillaria aggregata (Kunth) Lindl.
Maxillaria alpestris Lindl.
Maxillaria arachnites Rchb. f.
Maxillaria aurea (Poepp. & Endl.) L.O.Williams
Maxillaria breviscapa Poepp. & Endl.
Maxillaria calantha Schltr
Maxillaria densifolia (Poepp. & Endl.) Rchb. f.
Maxillaria discolor (Lodd. ex Lindl.) Rchb. f.
Maxillaria disticha (Lindl.) C. Schweinf.
Maxillaria ecuadorensis Schltr.
Maxillaria elegantula Rolfe
Maxillaria exaltata (Kraenzl.) C. Schw.
Maxillaria graminifolia (Kunth) Rchb. f.
Maxillaria imbricata Barb. Rodr.
Maxillaria irrorata Rchb. f.
Maxillaria jamesonii (Rchb. f.) Garay & C. Schweinf.
Maxillaria jenischiana (Rchb. f.) C. Schweinf.
Maxillaria klugii C. Schweinf.
Maxillaria longipes Lindl.
Maxillaria luteo-rubra (Lindl.) Rchb. f.
Maxillaria mapirensis (Kraenzl.) L.O. Williams
Maxillaria marginata Fenzl
Maxillaria multicaulis (Poepp. & Endl.) C. Schweinf.
Maxillaria nervosa Rolfe
Maxillaria ochroleuca Lodd. ex Lindl.
Maxillaria pastense Rchb. f.
Maxillaria perryae Dodson
Maxillaria poikilothece Schltr.
Maxillaria polyphylla Rchb. f.
Maxillaria porrecta Lindl.
Maxillaria pulla Linden & Rchb. f.
Maxillaria stenophylla Rchb. f.
Maxillaria striata Rolfe
Maxillaria xantholeuca Schltr.
Maxillaria yanganensis Dodson
Myoxanthes affinis (Lindl.) Luer
Myoxanthes ceratothallis (Rchb. f.) Luer
Myoxanthes monophyllus Poepp. & Endl.
Myoxanthes priapus Luer
Myoxanthes uxoris (Luer) Luer
Octomeria callosa Luer
Octomeria grandiflora Lindl.
Odontoglossum angustatum Lindl.
Odontoglossum astranthum Linden & Rchb. f.
Odontoglossum aureum (Lindl.) Rchb. f.
Odontoglossum cristatellum Rchb. f.
Odontoglossum cruentum Rchb. f.
Odontoglossum gracile Lindl.
Odontoglossum myanthum Lindl.
Odontoglossum pardinum (Lindl.) Lindl.
Odontoglossum ramosissimum Lindl.
Odontoglossum retusum Lindl.
Oliveriana brevilabia (C. Schweinf.) Dressler & N.H. Wiliams
Oncidium hartwegii Lindl.
Oncidium heteranthum Poepp. &Endl
Oncidium macranthum Lindl.
Otoglossum brevifolium (Lindl.) Garay & Dunst.
Pachyphyllum cristallinum Lindl.
Pachyphyllum falcifolium Rchb. f.
Pachyphyllum hartwegii Rchb. f.
Pachyphyllum peperomioides Kraenzl.
Pitiphyllum laricinum (Kraenzl.) Schltr.
Pitiphyllum pinioides Sweet
Platystele acicularis Luer & Hirtz
Platystele aculeata Luer
Platystele dodsonii Luer
Platystele orectoglossa P. Ortiz

Platystele oxyglossa (Schltr.) Garay
Pleurothallis adelae Luer
Pleurothallis antennifera Lindl.
Pleurothallis aves-seriales Luer & R. Escobar
Pleurothallis batillacea Luer
Pleurothallis bivalvis Lindl.
Pleurothallis canaligera Rchb. f.
Pleurothallis cernua Luer
Pleurothallis crocodiliceps Rchb. f.
Pleurothallis cylindrica (Luer) Luer
Pleurothallis dalessandroi Luer
Pleurothallis dasypetala Luer & Hirtz
Pleurothallis deflexa Luer
Pleurothallis derengularis (Barbosa Rodriguez) Luer
Pleurothallis diminuata Luer
Pleurothallis divaricans Schltr.
Pleurothallis dunstervillei Foldats
Pleurothallis elagans Lindl.
Pleurothallis erinacea Rchb. f.
Pleurothallis fastidiosa Luer
Pleurothallis floribunda Poepp. & Endl.
Pleurothallis galeata Lindl.
Pleurothallis laevigata Lindl.
Pleurothallis laminata Luer
Pleurothallis ligulata Lindl.
Pleurothallis lilijae Foldats
Pleurothallis linguifera Lindl.
Pleurothallis loranthophylla Rchb. f.
Pleurothallis pachypus (F. Lehm. & Kraenzl.) Garay
Pleurothallis patateensis Luer
Pleurothallis peroniocephala Luer
Pleurothallis picta Lindl.
Pleurothallis pulchella Luer
Pleurothallis rabei Foldats
Pleurothallis revoluta (Ruiz & Pav.) Garay
Pleurothallis rubens Lindl.
Pleurothallis salpingantha Luer & Hirtz
Pleurothallis sclerophylla Lindl.
Pleurothallis spiralis (Ruiz & Pav.) Lindley
Pleurothallis stelidiopsis Luer
Pleurothallis talpinaria Rchb. f.
Pleurothallis taxis Luer
Pleurothallis tunguraguae F. Lehm. & Kraenzl.
Pleurothallis vegrandis Luer & Dodson
Pleurothallis verbiformis Luer
Polystachya nana (Poepp. & Endl.) Rchb. f.
Ponthievia andicola Rchb. f.
Ponthievia maculata Lindl.
Poroglossum schramii Luer
Restrepiopsis inaequalis Luer & R. Escobar
Restrepiopsis monetalis (Luer) Luer
Restrepiopsis pandurata Luer
Restrepiopsis tubulosa (Lindl.) Luer
Salpistele dielsii (Mansf.) Luer
Scaphosepalum dalstroemii Luer
Scaphyglottis bicornis (Lindl.) Garray
Scaphyglottis stellata Lodd. ex Lindl.
Stelis bicornis Lindl.
Stelis flexuosa Lindl.
Stelis nexiopus Garay
Stelis purpurea (Ruiz & Pav.) Willd.
Stelis pusilla Hook.
Trichosalpinx acremona (Luer) Luer
Trichosalpinx arbuscula (Lindl.) Luer
Trichosalpinx berlineri (Luer) Luer
Trichosalpinx chamaelepanthes (Rchb. f.) Luer
Trichosalpinx dependens (Luer) Luer
Trichosalpinx dirhamphis (Luer) Luer
Trichosalpinx dura (Lindl.) Luer
Trichosalpinx intricata (Lindl.) Luer
Trichosalpinx pumila (Luer) Luer
Trichosalpinx robleorum (Luer) Luer
Trichosalpinx systremmata (Luer) Luer
Trichosalpinx tenuis (C. Schweinf.) Luer
Trisetella abbreviata Luer
Trisetella didyma (Luer) Luer
Trisetella pantex (Luer) Luer
Trisetella scobina Luet
Trisetella triglochin (Rchb. f.) Luer

Piperaceae

Peperomia acuminata Ruiz & Pav.
Peperomia angularis C. DC.
Peperomia angustata Kunth
Peperomia blanda (Jacq.) Kunth
Peperomia cluvea Sodiro
Peperomia crotalophora Trel.
Peperomia dolabriformis Kunth var. *brachyphylla* Rauh.
Peperomia eburnea Sodiroi
Peperomia ecuadorensis C. DC.
Peperomia emarginella (Sw. ex Wikstr.) C. DC.
Peperomia emarginulata C. Dc.
Peperomia enantiostachya C. DC.
Peperomia espinosae Yunck.
Peperomia fraseri C. Dc.
Peperomia glabellata (Sw.) A. Dietr.
Peperomia guttata Sodiro
Peperomia hispidula (Sw.) A. Dietr.
Peperomia jamesoniana C. DC.
Peperomia laxiflora Kunth
Peperomia macrostachya (Vahl.) A. Dietr.
Peperomia obtusifolia (L.) A. Dietr.

Peperomia peltigera C. DC.
Peperomia rotundata Kunth
Peperomia stilifera Yunck.
Peperomia striata Ruiz & Pav.
Peperomia tetraphylla (G. Forst.) Hook. & Arn.
Peperomia tetraquetra Sodiro
Peperomia trichopus Trelease
Polypodiaceae
Campyloneurum angustifolium (Sw.) Feé
Campyloneurum brevifolium (Lodd. ex Link) Link
Campyloneurum coarctatum (Kuntze) Fée
Campyloneurum cochense (Hieron) Ching.
Campyloneurum fasciale (Humb. & Bonpl. ex Willd.) C. Presl.
Campyloneurum magnificum T. Moore.
Campyloneurum ophiocaulon (Klotzsch) Fée
Campyloneurum pascoensis R.M. Tryon & A.F. Tryon
Campyloneurum phyllitidis (L.) C. Presl.
Campyloneurum repens (Munsel) C.Presl.
Campyloneurum spheodes (Kunze ex Klotsch) Fée
Ceradenia curvata (Sw.) L.E. Bishop
Ceradenia dendrodoxa L.E. Bishop
Ceradenia melanopus (Grev. & Hook.) L.E. Bishop
Cochlidium pumilum Massee ex C. Chr.
Cochlidium serrulatum (Sw.) L.E. Bishop
Dicranoglossum furcatum (L.) Sm.
Enterosora parietina (Klotsch) L.E. Bishop
Grammitis bryophila (Maxon) F. Seym.
Lellingeria hirsuta A.R. Sm. & R.C. Moran
Lellingeria major (Copel.) A.R. Sm. & R.C. Moran
Lellingeria myosuroides (Sw.) A.R. Sm. & R.C. Moran
Lellingeria subsesillis (Baker) A.R.Sm. & R.C. Moran
Melpomene anfractuosa (Kunze ex Klotzsch) A.R. Sm. & R.C. Moran
Melpomene assurgens (Maxon) A.R. Sm. & R.C. Moran
Melpomene firma (J. Sm.) A.R. Sm. & R.C. Moran
Melpomene moniliformis (Lag. ex Sw.) A.R. Sm. & R.C. Moran
Melpomene pseudonutans (H. Christ & Rosenst.) A.R. Sm. & R.C. Moran
Melpomene sodiroi (H. Christ & Rosenst.) A.R. Sm. & R.C. Moran
Microglossa lycopodioides (L.) Copel.
Microgramma fuscopunctata (Hook.) Vareschi
Microgramma percussa (Cav.) de la Sota
Micropolypodium truncicola (Klotzsch) A.R. Sm.
Niphidium longifolium (Cav.) Lellinger
Pecluma consimilis (Mett.) M.G. Price
Pecluma curvans (Mett.) M.G. Price.
Pecluma divaricata (E.Fourn.) Michel & Beitel
Pecluma eurybasis (C.Chr.) M.G. Price
Pecluma pastazensis (Hieron.) R.C. Moran
Pecluma ptilodon (Kze.) Price
Pleopeltis macrocarpa (Bory ex Willd.) Kaulf.
Polypodium caceresii Sodiro
Polypodium coriaceum L.
Polypodium fraxinifolium Jacq.
Polypodium latissimum R.C. Moran & B. Øllg.
Polypodium levigatum Cav.
Polypodium remotum Desr.
Polypodium sessilifolium Desr.
Polypodium subandinum Sod.
Polypodium thyssanolepis A. Braun ex Klotsch
Polypodium triseriale Sw.
Terpsichore alsopteris (C.V. Morton) A.R. Sm.
Terpsichore asplenifolia (L.) A.R. Sm.
Terpsichore chrysleri (Proctor ex Copel.) A.R. Sm.
Terpsichore culturata (Bory. ex Willd.) A.R. Sm.
Terpsichore dependens (Baker) A.R. Sm.
Terpsichore heteromorpha (Hook. & Grev.) A.R. Sm.
Terpsichore jamesonioides (Fée) A.R. Sm.
Terpsichore lanigera (Desr.) A.R. Sm.
Terpsichore semihirsuta (Klotsch) A.R. Sm.
Terpsichore sensilis (Fée) A.R. Sm.
Terpsichore subtilis (Kuntze ex Klotsch) A.R. Sm.
Terpsichore variabilis (Mett. ex Kuhn) A.R. Sm.
Zygophlebia mathewsii (Kunze ex Mett.) L.E. Bishop
Vittariaceae
Antrophyum lineatum (Sw.) Kaulf.
Vittaria gardeniana Feé
Vittaria graminifolia Kaulf.