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The family Gesneriaceae as example for the Biological extinction in Western Ecuador

La familia Gesneriaceae como ejemplo de Extinción biológica en el Occidente del Ecuador

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Abstract

A large component of the unique vegetation of western Ecuador is the Gesneriaceae. A total of 107 species of the family have been recorded as native to this area of ca. 80000 km2, with 23 endemic to western lowland Ecuador. Forty-two of the 107 species have also been found on Andean slopes above 1000 m elevation in western Ecuador, 75 in western Colombia, 25 in Central America and 27 in the Amazon basin including upper eastern Andean slopes. Habitat destruction threatens 36 of the 107 species, and 24 of these species are rare or absent elsewhere, and are thus endangered in their entire range. The threatened Gesneriaceae of western Ecuador are mostly either restricted to isolated ridges covered with low elevation cloud forests or were distributed in the once extensive moist forests in the central, western and southern parts of the Ecuadorian coast. If the present deforestation rate continues, however, all but the most common and somewhat weedy species will be endangered. Also, if the Gesneriaceae are indicative of the status of the flora of flowering plants below 1000 m elevation in western lowland Ecuador, nearly 500 endemic species may be extinct or endangered in the region, and another 1000+ species may equally disappear from western Ecuador. Key words. Ecuador, Phytogeography, Gesneriaceae, Gasteranthus, Extinction, Endemism, Distribution.

Resumen

Un componente importante de la vegetación extraordinaria diversa de la costa de Ecuador, son las Gesneriaceae. De esa familia se ha registrado 107 especies nativas en un área de aproximadamente 80000 km2, desde el nivel del mar hasta 1000 m. de altura. De estas 107 especies, 42 también crecen en las faldas andinas occidentales de Ecuador encima de 1000 m. de altura, y en Colombia oriental, Centro América y la cuenca Amazónica respectivamente se encuentran 75, 25 y 27 de las especies de la costa de Ecuador. La destrucción de habitas amenazan 36 de las 107 especies, y 24 de las especies amenazadas son ausente o escaso afuera de la costa, y entonces están en peligro de extinción. La mayoría de las Gesneriaceae amenazadas del Ecuador occidental están limitadas a colinas aisladas cubiertas con bosques de neblina, o fueron distribuidas en los bosques antes distribuidos en las partes centrales, occidentales y del sur de la costa Ecuatoriana, en general zonas recibiendo entre 2000 y 3000 mm. precipitación anual, y actualmente convertido a agricultura. Al contrario, relativamente pocas especies de los bosques más húmedos en la parte norte de la costa esta amenazados, reflejando en parte, que la mayoría de estas especies estén distribuidas también en la parte occidental de Colombia, en muchos casos hasta Centro América. Sin embargo, si la tasa actual de deforestación sigue, todas excepto las más comunes y algunas especies herbosas estarían en peligro de extinción. Además, si las Gesneriaceae serán indicativas del estado de la flora de plantas florales de la costa de Ecuador, casi 500 especies endémicas pueden ser extintas o en peligro de extinción en la zona, y otras 1000+ especies pueden extinguirse de la costa de Ecuador. Palabras clave: Ecuador, Fitogeografia, Gesneriaceae, Gasteranthus, Extinción, Endemismo, Distribución.

Introduction

Western Ecuador is one of the places in the world where biodiversity is considered most at risk (e.g. Myers 1988, 1990; Parker & Carr 1992). For a relatively small area of ca. 80000 km2, western Ecuador has several unique, geographically small, and isolated forest types (Harling 1979), a high percentage of plants known no where else, and is an area that has been severely deforested (Dodson & Gentry 1991; Sierra 1999; Valencia et al. 2000). Until now there have been few detailed studies of larger representative groups of plants or animals that may demonstrate the extent of extinction or endangerment apparently caused by habitat destruction in western Ecuador.

A large component of the vegetation of Western Ecuador is the Gesneriaceae, a flowering plant family of mostly herbs, sub-shrubs, and epiphytes, often constituting a large and colorful element in tropical and subtropical rain- and cloud-forests. The family has more than 2500 species with under half of them in the Neotropics, and in Ecuador there occur more than 210 species of Gesneriaceae (Skog & Kvist 1997), and 107 of these are or were native to the elevations below 1000 m in western Ecuador. Of the 107 species nearly half are usually epiphytic, and 23 are endemic to western lowland Ecuador (i.e. below 1000 m). A closer look at these 107 species has shown that more than a third of the Gesneriaceae flora of western Ecuador is already threatened, and that these species mainly occurred in low-elevation cloud forests and moist lowland forests, now mostly converted to agriculture.

The present study was stimulated partly by the revision of the Gesneriaceae genus *Gasteranthus* (Skog & Kvist 2000), a work which itself was inspired by the impressive number of apparently narrowly endemic taxa of *Gasteranthus* in western Ecuador. For example, six species of *Gasteranthus* had been reported to be endemic to the cloud forest at the same isolated ridge at 600 m elevation known as Centinela (Gentry & Dodson 1987; Gentry 1989, 1992; Dodson & Gentry 1991). The work on *Gasteranthus* confirmed that the genus has its diversity center in western Ecuador, and that many of its species are endangered. In addition, the recent discovery of another low elevation cloud forest in the Cordillera Mache-Chindul (Parker & Carr 1992) with many Gesneriaceae, e.g., five species of *Gasteranthus* (Skog & Kvist 2000) illustrated the richness of the former forest cover probably prevalent throughout much of Western Ecuador, as well as the threat that exists to the remaining remnant vegetation. This forest, surrounding the Bilsa Biological Reserve, is located in the coastal mountain range, Cordillera Mache-Chindul, south of the town of Esmeraldas. In 1996 the Bilsa Biological Reserve was included in the newly established 70000 hectare large Mache-Chindul Ecological Reserve.

Dodson & Gentry (1991) defined western lowland Ecuador (Figure 1) as the area between the Pacific to the west, the 900 m contour line of the western Andean Cordillera to the east, the Colombian border to the north, and the Peruvian border to the south, for a total area of ca. 80000 km2. The inclusion of the Gesneriaceae found up to 1000 m elevation only expands the size of the study area marginally. By looking at the status of the Gesneriaceae in western Ecuador, and investigating the total distribution patterns of the species found in the area, we can demonstrate the extent to which the Gesneriaceae may be representative of the status of the entire flora in western Ecuador, as well as conservation priorities for the region.

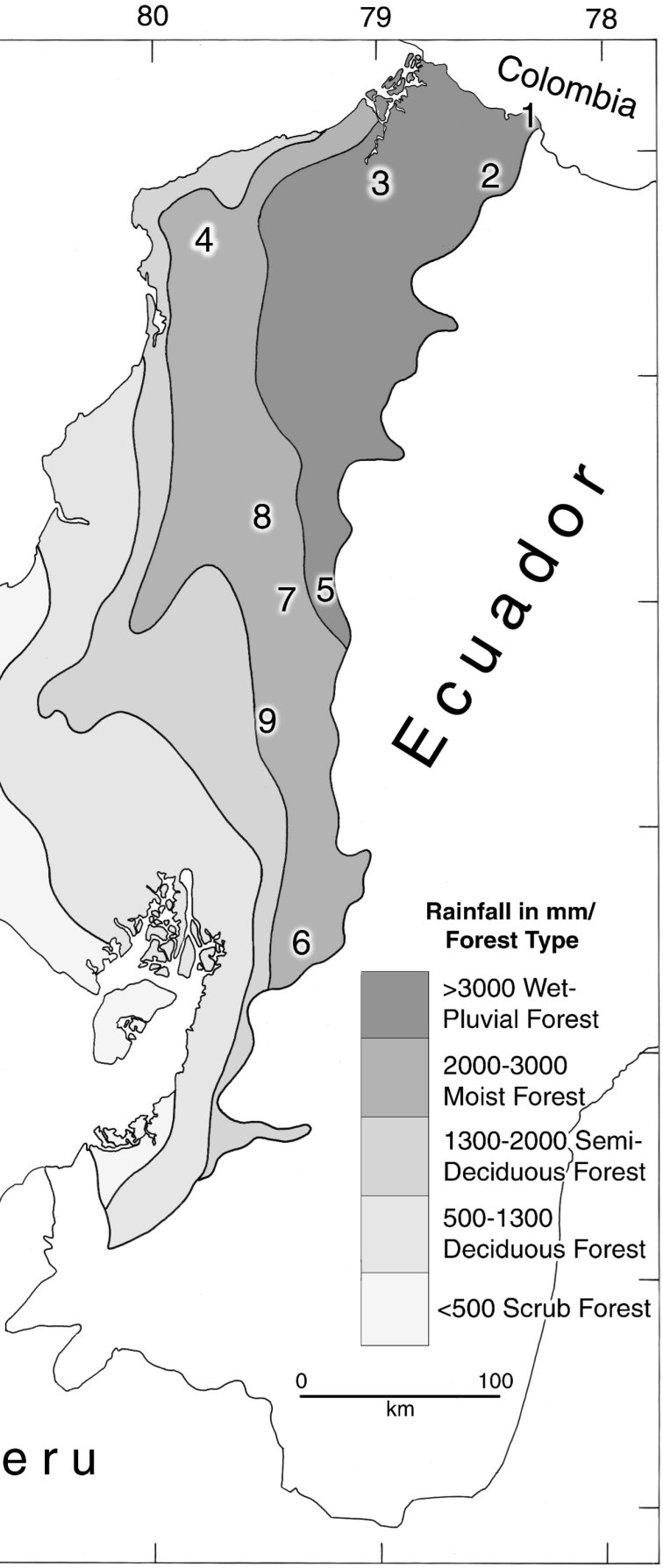
80
79
78
Colombia
Ecuador
Peru
1
2
3
4
5
6
7
8
9
Rainfall in mm/
Forest Type
>3000 Wet-
Pluvial Forest
2000-3000
Moist Forest
1300-2000 Semi-
Deciduous Forest
500-1300
Deciduous Forest
<500 Scrub Forest
0
100
km

Figure 1. Map of western Ecuador below 1000 m elevation showing the distribution of pluvial, wet, moist, semi-deciduous, and deciduous forests. The localities referred to with numbers are the following: 1) San Marcos; 2) Lita; 3) Zapallo Grande; 4) Bilsa Biological Station; 5) Centinela Ridge; 6) Manta Real; 7) Río Palenque; 8) Congóma Grande; and 9) Jauneche.
Figura 1. Mapa del occidente de Ecuador abajo de 1000 m de altura mostrando la distribución de los bosques pluviales, húmedos, semi deciduo y deciduos. A las localidades referidas se le han consignado los siguientes números: 1) San Marcos; 2) Lita; 3) Zapallo Grande; 4) Bilsa Biological Station; 5) Centinela Ridge; 6) Manta Real; 7) Río Palenque; 8) Congóma Grande; and 9) Jauneche.

Topography, climate, and phytogeographic isolation can together explain the unique vegetation of western lowland Ecuador. The Andes isolate the coast from the extensive Amazonian forests to the east. To the south the arid Peruvian coast is nearly devoid of any vegetation, except desert shrubs and dry forests near the Ecuadorian border. To the north, the Pacific coastal Chocó region of Colombia, is among the most humid places in the world, receiving annually more than 8000 mm of precipitation, resulting in wet/pluvial forest cover. The gradient between the climatic and vegetational extremes found in Peru and Colombia is consequently found in the relatively small intervening area of western lowland Ecuador. The driest areas in Ecuador along the Peruvian border and the southwestern coast are covered with desert thorn scrub forests (Figure 1). Further to the north, as well as closer to the Andean slopes, these desert scrub forests are first replaced by strongly seasonal, deciduous dry forests and thereafter by increasingly humid semi-evergreen and evergreen moist forests. Finally, wet forests defined as having more than 3000 mm of annual precipitation (according to Gentry 1978, 1982) stretch along the Andean slopes. The wet forests are extensive in the north near the Colombian border, but further to the south they gradually reduce to a narrow belt on the lower Andean slopes. Pluvial forests, defined as having more than 5000 mm of annual precipitation, are only found on the lower Andean slopes near the Colombian border.
Local topography adds further variation to the climatic and vegetational variation in western Ecuador. Parallel to the coast stretches a range of coastal hills that rarely exceed 800 m in elevation, and along the Andean slopes isolated front ridges also rise nearly to this elevation (Figure 2). These ridges are almost constantly shrouded in clouds due to the orographic uplift of warm air from the Pacific Ocean. The constant layer of clouds may explain how forests having a unique higher elevation physiognomy are here present at remarkably low elevations. Foster (in Parker & Carr 1992) noticed that western Ecuador usually has two layers of clouds resulting in distinct low- and high elevation cloud forests. The low elevation cloud forests are located between ca. 500 and 900 m elevation and the latter from ca. 1800 m elevation and up to the tree limit. The low elevation cloud forests, in particular, are fairly small and for the most part geographically isolated. An example is Centinela Ridge, an isolated front range located approx. 20 km west of the Andean slopes (see (Figure 2), which formerly was covered with low elevation cloud forest, which now has been converted to agriculture (Dodson & Gentry 1991). Extant low-elevation cloud forests are found above 500 m in the Bilsa Biological Station area located in the coastal mountain range, the Cordillera Mache-Chindul (see (Figure 2). Nearer the see, however, clouds may condense at even lower elevations on exposed slopes and hills rising less than 100 m above the surrounding landscape. Even the driest parts of southwestern Ecuador otherwise dominated by cacti and dry deciduous forests, may include small and scattered patches of luxuriant and green, more humid vegetation on low hills.


Andes
Amazon lowland
0 50 100 200
Kilometers

Figure 2. Contour map of Western Ecuador. Both the western Andean slopes and the much lower coastal Montañas de Mache appear. The isolated foothill range, including Centinela ridge, found in southern Pichincha and northern Los Ríos provinces, has been outlined with a box.
Figura 2. Mapa topográfico del Occidente del Ecuador. Se ve ambos las faldas Andinas occidentales y a largo de la costa el más bajo Montañas de Mache.

Deforestation and extant forests

Since World War II the Ecuadorian population has nearly quadrupled from about three million to more than 12 million inhabitants with the subsequent increase in demand for farmland. This demand in combination with intensive road construction has resulted in colonization and extensive deforestation throughout the coastal region (Dodson & Gentry 1991). Thus, more than 95 % of the semi-deciduous and moist forests of the central and southern parts of the coast forests have disappeared because the climates and the soils of these areas are particularly suitable for intensive agriculture. Today these fertile soils are used mostly for large-scale, export-oriented production of bananas, cacao, and palm oil, rather than small-scale subsistence farms. The drier deciduous forests are protected to some extent by an unpredictable and scanty precipitation, but nearly all extant dry forests are severely disturbed by grazing, firewood collection, charcoal production, lumber extraction, annual burning, and subsistence agriculture.

Only in parts of Esmeraldas province and northern Manabí do some tracts of moist forest remain, while only small patches persist to the south. Apart from the established Sistema de Areas Protegidas the only protected areas are small patches of forest such as the Río Palenque Science Center [87 hectares] (Dodson & Gentry, 1978), Jauneche [130 hectares] (Dodson et al. 1985), La Perla Forest [250 hectares] and the Reserva ENDESA [85 hectares]. Just 25 years ago there still remained much wet forest in western Ecuador, but since then lumbering and road building have been particularly devastating. Logging operations were followed by colonization which converted large tracts of forest to farming and cattle raising. Numerous scattered palms, however, still bear witness to the recent deforestation. What wet forest still remains begins north of the Guayllabamba River, on the border between the provinces of Pichincha and Imbabura, and stretches along the Andean foothills northward through Imbabura, Esmeraldas and Carchi provinces (Figure 3). Much of these forests are in an ecological reserve protecting the eastern, higher parts of the Cayapa River watershed, but wet forests also remain further down-river mostly in areas reserved for the Cayapa indigenous peoples. Further to the north on the Colombian border an established reserve, protecting the Awa indigenous people, may protect most of the Ecuadorian pluvial forests, as well as adjacent areas in Colombia, although a new road to the coast has facilitated encroachment into the remaining wet and pluvial forests outside the reserve, and very possibly also inside the reserve.

There now remains only one significant tract of humid forest south of the Esmeraldas-Guayllabamba River-system (Figure 3). In 1992 Conservation International reported the presence of ca. 200 km2 of very humid forests in the Montañas de Mache south of the town of Esmeraldas, and the forest was rapidly being cut in from all sides. More recently CDC [Centro de Datos para la Conservación] (1995) reported 400 km of extant forest in this area. This forest has since become known as Bilsa for the river (headwaters of Río Bilsa) from where researchers first entered the area. Areas in Bilsa above ca. 500 m elevation are covered with low-elevation cloud forest. Fortunately a considerable part of this area has been purchased by the private conservation foundation "Jatun Sacha", to establish the currently 3000 ha Bilsa Biological Reserve. In 1996 a total of 70000 ha, including the Bilsa Biological Reserve, was included in the newly established Mache-Chindul Ecological Reserve, which should end the granting of timber concessions. However, the impact of colonists may not be significantly reduced as most of the reserve area was already disturbed and privately owned. Recently, too, a new road was completed on the western borders of the Reserva Ecológica Mache-Chindul along the coast of Esmeraldas, which will allow access for logging and colonization on the western side of the reserve. The flora at Bilsa Biological Station and surrounding areas has been intensively collected since 1994 (Clark 1997), and many species originally known only from the Centinela Ridge or other recently destroyed low elevation cloud forests, have been found to occur at the Bilsa Biological Reserve, as well as some apparently endemic species. According to Parker & Carr (1992) there also remain a few other low-elevation cloud forests in the coastal hills further to the south of Bilsa, as well as along the Andean slopes. Relatively few Gesneriaceae have been collected from these probably biologically diverse and unique forests, and since the report by Parker & Carr (1992) particularly the Andean slope forest remnants may have been destroyed.

[[figure filename="Figure3.jpg" caption="Figure 3. Extant forest vegetation in western lowland Ecuador according to satellite imaging. Gray areas are those regions still covered with forest, while white areas have been deforested (or never had forest). Due to the dense cloud-cover no satellite-images were available of the very humid northeastern areas shaded with a lighter gray, but these areas remain mostly forested. Note the 1000 m contour line on

the western Andean slopes.
Figura 3. Vegetación de bosque existente en el occidente bajo del Ecuador de acuerdo a imagen satelital. Las áreas grises son regiones cubiertas aún con bosque, mientras las zonas blancas han sido deforestadas (o que nunca han tenido bosque). Debido a la presencia de muchas nubes no había imágen satélite de zonas muy húmedas en el norte (mostrado con un gris mas claro), pero esas áreas todavía son boscosas. Nota la línea de contorno de 1000 m en las faldas andinas.
State of knowledge of western Ecuadorian Gesneriaceae
There may occur ca. 1200 Gesneriaceae in the New World, and the most species rich countries are Ecuador and Colombia with ca. 210 and 400 species, respectively (Skog & Kvist 1997; Kvist et al. 1998). Panama although smaller is also extremely rich for its size with 150 species (Skog 1979). The diversity of the Gesneriaceae generally correlates with increasing precipitation and humidity, and the family is consequently particularly abundant in northwestern Ecuador, western and northwestern Colombia, and parts of Panama. The eastern Andean montane forests and adjacent wet lowland forests also have many species of Gesneriaceae, but relatively few species occur in Amazon forests away from the mountains.
Approximately 50 % and 75 % of the species of Gesneriaceae found in Ecuador and Colombia (Kvist et al. 1998), respectively, belong to genera that are poorly known so that species delimitation is problematic. Fortunately, few taxonomic problems remain with the Gesneriaceae distributed in the western lowland Ecuador, making it meaningful to analyze the status and distribution of the species found in that region. The most speciose genus in Ecuador, *Columnea* with approx. 60 epiphytic species, was recently extensively studied (Kvist & Skog 1993; Smith 1994; Skog & Kvist 1994, 1998). *Gasteranthus* represented by 26 terrestrial species in western Ecuador, has just been revised (Skog & Kvist 2000), and the genera *Heppiella*, *Cremosperma*, *Reldia*, *Kohleria,* and *Pearcea* have also been studied recently (Kvist 1990; Kvist & Skog 1988, 1989, 1992, 1996). Others of the larger and often problematic genera, *e.g.*, *Alloplectus*, *Drymonia*, and *Paradrymonia* are mostly represented by well-delimited species in the region. The poorest understood genera in lowland western Ecuador may be *Besleria* and *Monopyle*, but these genera may comprise fewer than 10 species, and *Nautilocalyx*, a particularly difficult genus in the Amazon basin, does not occur in the region.

Results

A total of 109 species of Gesneriaceae have been recorded from elevations below 1000 m in western Ecuador. Two commonly cultivated but rarely collected species, *Episcia cupreata*, and *Gloxinia perennis*, are probably not native to the region, and have been excluded from the analysis. This leaves 19 genera (of the 30 known from Ecuador) and 107 species, with *Columnea*, *Gasteranthus*, and *Drymonia* being the most speciose genera having 35, 15 and 14 species, respectively (Appendix A). A few of the 107 species, notably *Alloplectus ichthyoderma*, *Columnea mastersonii*, *Gasteranthus columbianus*, *G*. *lateralis*, and *Heppiella ulmifolia*, are very rare below 1000 m elevation, but common, at least locally, at higher elevations in western Ecuador. Some of these species may thus only disperse occasionally to lower elevations, rather than be represented here with persistent populations. These latter species, however, are included in the analysis presented in Appendix A. Here, the conservation status of each of the 107 species native to western lowland Ecuador is estimated (in the columns 2 and 3). Also included in Appendix A is information on the geographical ranges of all 107 species (columns 4 to 7), the habitats of each of these species (columns 8 to 10), identity of the species recorded from nine western Ecuadorian forests (columns 1* to 9*), and which species are or have been in cultivation (column 10*). The geographical locations of the nine forests from where the Gesneriaceae have been recorded are indicated in Figure 1 (with the numbers 1 to 9), and Appendix B presents baseline data concerning each of these nine forest localities and the study of their Gesneriaceae.
[[Tables 1 to 5

summarize and present information from Appendix A.
[[Table 1]] summarizes the conservation status of the 107 species known from western lowland Ecuador, rated as Critically Endangered, Endangered, Vulnerable, or Not Threatened (based on the estimates provided in column 2 of Appendix A). A species is presumed Critically Endangered if maximally a single population are known to survive (we avoid the term extinct considering that even in severely deforested regions relict populations occasionally persist for some time in remnants of vegetation at slopes and in ravines). Endangered species are known or expected to remain in

a few locations threatened by deforestation. Vulnerable species are relatively uncommon but occur in forest types of which some extensive tracts still remain, but will become endangered if the present deforestation continues, e.g., encroaching into the wet forests of the "Cotocachi-Cayapa Ecological Reserve" and the pluvial forests of the "Awa Ethnic Forest Reserve". Finally, Not Threatened species are common and widespread and may thrive in secondary forests or in even more disturbed or degraded vegetation, e.g., *Columnea angustata* and *C. byrsina* as epiphytes at isolated trees in pastures, and *Kohleria spicata* on exposed roadsides. The numbers of species referred to each of these four status categories appear in [[Table 1]]. Of the 107 species recorded from western lowland Ecuador 10 are estimated to be critically endangered in the region, 26 to be endangered, 45 to be vulnerable and only 26 are probably not threatened.

[[Table 1]] also summarizes the global conservation status of the 107 Gesneriaceae found in western Ecuador (based on the estimates provided in column 3 of Appendix A). Species endemic to western lowland Ecuador logically get the same local and global conservation status, but species found elsewhere are mostly presumed to be globally less threatened than locally in lowland western Ecuador. Columns 4 to 7 in Appendix A show which species found below 1000 m elevation in western Ecuador, which also have been recorded from the following areas: 1) Above 1000 m elevation in western Ecuador, 2) in western or northwestern Colombia, 3) in Central America, and 4) in the Amazon basin defined as any record east of the Andean range. The frequency of the species within each of these four geographical areas is ranked as Rare, Uncommon, Occasional, or Common. Less frequent, as well as less distributed, species (in columns 4 to 7 in Appendix A) are obviously estimated to be more globally at risk (in column 3) than more frequent and widespread species. Twenty-four of the 107 species are estimated to be globally critically endangered/ endangered ([[Table 1]]), compared to the 36 species estimated to be locally critically endangered/ endangered, and the corresponding numbers for globally vulnerable and not threatened species are 28 (vs. 45) and 55 (vs. 26), respectively.

Status	Locally	Globally
a: Critically Endangered	10	7
b: Endangered	26	17
c: Vulnerable	45	28
d: Not Threatened	26	55

Table 1. Conservation status of the 107 Gesneriaceae species recorded below 1000 m elevation in Western Ecuador, both locally and throughout their entire ranges (globally).
Tabla 1. Estado de Conservación de las 107 especies de Gesneriaceae registradas bajo 1000 m en el occidente de Ecuador, ambos local y global.

[[Table 2]] summarizes data concerning the distributions of the 107 coastal lowland Gesneriaceae species elsewhere. Forty-two of the species have also been recorded from above 1000 m in western Ecuador, 75 from western and northwestern parts of Colombia, 25 from Central America, and 27 in the Amazon basin on the eastern side of the Andes. Twenty-five species occur in none of these four areas, but only 23 are endemic to western lowland Ecuador since *Columnea isernii* and *Columnea microsepala* both reach extreme northwestern Peru, and the latter also occurs in Venezuela. The conservation status of the 23 endemic species also appears in [[Table 2]]. Seven species are presumed to be critically endangered (probably mostly extinct) and another 14 species to be endangered, and the latter two species to be vulnerable, implying that ca. 90% of the endemic species apparently are extinct or endangered.[[Table 2]] also summarizes the conservation status within western lowland Ecuador of the Gesneriaceae species the area shares with each of the four above-mentioned geographical areas. Relatively few of these are presumed to be critically endangered/ endangered in coastal lowland Ecuador (less than 25 % in all four cases), demonstrating that the endemic species of lowland western Ecuador are much more endangered than the more widely distributed species. Eleven species presumed to be locally extinct or endangered in lowland western Ecuador also occur in western Colombia, and a large number of vulnerable Ecuadorian species (40) also occur in the forests along the Pacific coast of Colombia. Many fewer endangered and vulnerable species occur in the other three areas, and it may be particularly remarkable that only two of the 36 Gesneriaceae species presumed to be critically endangered/ endangered below 1000 m elevation, have been recorded from western Andean slope forests above 1000 m. In addition, none of the 24 species presumed to be globally endangered/ endangered have been recorded here, from Central America or from the Amazon basin, while western lowland Ecuador shares two globally endangered species with western Colombia ([[Table 2]]). However, in the latter country these two species are both limited to the extreme southwest near the border with

Ecuador in the department of Nariño.

	Lowland Endemic	Coastal Montane	Western Colombia	Central America	Amazon Basin
Total number	23	42	75	25	27
a: Critically Endangered	7 (7)	2 (0)	2 (0)	1 (0)	1 (0)
b: Endangered	14 (14)	2 (0)	9 (2)	4 (0)	5 (0)
c: Vulnerable	2 (2)	21 (8)	40 (21)	6 (2)	8 (4)
d: Not Threatened	0 (0)	17 (34)	24 (52)	14 (23)	13 (23)

Table 2. Conservation status of 23 Gesneriaceae species endemic in western lowland Ecuador, as well as the species shared with coastal montane forests of Ecuador, western and northwestern Colombia, Central America, and the Amazon basin. For all five species groups the numbers that are presumed to be critically endangered, endangered, vulnerable, and not threatened are given. The corresponding numbers for their global conservation status are shown in parentheses.
Tabla 2. Estado de Conservación de 23 especies de Gesneriaceae endémicas en el occidente bajo del Ecuador, así como también las especies compartidas con los bosques montaHosos del Ecuador, Occidente y nor-occidente de Colombia, Centro América y la Cuenca Amazónica. Para los cinco grupos de especies son dados números de especies que se presumen que están en peligro de extinción, amenazadas, vulnerables, y no amenazadas. Los números correspondientes para su conservación global son mostrados en paréntesis.

[[Table 3]] summarizes the forest categories in which the 107 species of Gesneriaceae have been recorded in lowland western Ecuador, and estimates how common they were in these forests before the massive deforestation began (based on the information provided in columns 8 to 10 in Appendix A). Three forest categories are distinguished: 1) wet and pluvial forests receiving more than 3000 mm rainfall annually; 2) dry to moist forests receiving less than 3000 mm annually; and 3) low-elevation cloud forests (precipitation undocumented but forests nearly permanently shrouded in clouds making them permanently humid). The number of Gesneriaceae species recorded from these three forest categories in lowland coastal Ecuador are 71, 52, and 64, respectively ([[Table 3]]), implying that most species occur in the wet forests, fewer in the cloud forests and even fewer in the moist forests. However, the 36 presumed extinct or endangered species predominantly occur in the two latter less speciose forest types. Only 11 of them have been recorded from wet (to pluvial) forests, while 19 and 27 have been recorded from moist (to dry) forests and cloud forests, respectively. The 24 species presumed to be globally extinct or endangered, as well as to the 23 endemic species of western lowland Ecuador, are also poorly represented in the wet forests, but strongly represented in the other two forest categories ([[Table 3]]). Cloud forests tend to be surrounded by moist or wet forests, and Gesneriaceae species primarily found in the latter forests will occasionally grow in cloud forests. Vice versa, species that are common in cloud forests are also often found in other forests, but here typically restricted to permanently humid places in ravines with streams or near waterfalls rather than in the general understory. The principal habitat of the latter species thus is cloud forests, while ravines in other forest types may be characterized as secondary habitats. Low-elevation cloud forests is the principal habitat of 12 of the 23 species endemic to coastal lowland Ecuador, while the corresponding numbers for wet and moist forests are eight and three species, respectively ([[Table 3]]).

	Total	Wet-pluvial forest	Dry-moist forest	Cloud forest
Total number of species	107	71	52	64
Locally vulnerable	45	38	10	20
Locally endangered	36	11	19	27
Globally endangered	24	3	13	20
Endemic to coastal lowland	23	5	13	19
Main habitat of 23 endemics	--	3	8	12

Table 3. The numbers of Gesneriaceae species recorded from each of three forest categories in western lowland Ecuador (as well as total numbers), and the number that are vulnerable, endangered or critically endangered locally as well as globally, and endemic. The number of the 23 endemic species that have each of the three forest categories as their main habitat is also given.
Tabla 3. Los números de especies de Gesneriaceae registradas en cada uno de las tres categorías de bosques en el occidente bajo del Ecuador (así como también los números totales), y los números que son vulnerables, en peligro de extinción o en peligro critico de extinción a nivel local así como también global, y endémicas. Los números de las 23 especies endémicas que tienen cada una de las tres categorías de bosques y su hábitat principal son dados también.

[[Table 4]] summarizes the number of Gesneriaceae species recorded from each of nine forest localities in western lowland Ecuador. These represent wet to pluvial, cloud, and moist forests (based on the columns 1* to 9* in Appendix A, with no. 1-3, 4-6, and 7-9 representing wet to pluvial, dry to moist, and cloud forests, respectively; according to information in Appendix B). The driest of the nine forests, the semi-deciduous forest at Jauneche, has many fewer species than the other eight more humid forests. The largest numbers of species have been recorded from the cloud forests of Bilsa, but this is probably partly because the Gesneriaceae have been sought particularly intensively here, and partly due to the much larger size of the Bilsa study site (e.g., 3000 ha. compared with 87 ha. in Río Palenque). It is likely that there in fact occur even more species in the pluvial to wet forests near the Colombian border, represented by San Marcos and Lita (Figure 1). In terms of the number of species Centinela Ridge, with 24 species, does not appear particularly diverse (although this forest almost certainly had additional species that probably never were recorded). Despite that fact the largest numbers of endemic (11) as well as presumed globally extinct and endangered species (11) and the second largest number of locally extinct or endangered species (12) have been recorded from Centinela Ridge. The corresponding numbers from Bilsa are nine, 10, and 14 respectively ([[Table 4]]). The values from Río Palenque are 10, nine and nine, and the remaining six localities have many fewer endangered and endemic species.

	Number of species	Critically endangered or endangered		Coastal lowland Endemics	
		Local	Global	At coast	At locality
1. San Marcos	41	2	1	2	1
2. Lita	38	1	0	2	0
3. Zapallo Grande	30	3	1	2	1
4. Bilsa	44	14	10	9	1
5. Centinela Ridge	24	12	11	11	1
6. Manta Real	19	6	2	2	0
7. Río Palenque	29	9	9	10	0
8. Congóma Grande	18	3	2	2	0
9. Jauneche	4	0	0	0	0

Table 4. The number of Gesneriaceae species recorded from each of nine named forests areas in western lowland Ecuador, and the number of endangered and endemic species at each locality.
Tabla 4. El número de especies de Gesneriaceae registradas en cada una de los nueve bosques nombrados en el occidente bajo del Ecuador, y el número de especies que se presumen amenazadas o en peligro de extinción y especies endémicas en cada localidad.

[[Table 5]] summarizes the species native to western lowland Ecuador that are cultivated or previously have been in cultivation (based on column 10* in Appendix A). Fifty-four of the 107 species found in the region are currently in cultivation, but another 18 species previously grown have apparently disappeared from living collections. Four of the seven species that may be globally extinct in their native habitats have been cultivated. Two of these four species, *Gasteranthus atratus*, and *Paradrymonia lacera*, continue to be grown, and may thus in the future be re-introduced to natural habitats, but the remaining two species, *Columnea asteroloma* and *Gasteranthus macrocalyx*, have apparently disappeared from all living collections, as well as from their natural habitats, and may thus be irrevocably lost. [[Table 5]] also shows that the more common (not threatened) species are more likely to be in cultivation, than the rarer presumable extinct or endangered species. More than 80 % of the former group have been in cultivation (61 of 73 species) but only approx. 40 % of the latter group (10 of 24 species), and currently ca. 60 % and ca. 30 % of the two groups are in cultivation, respectively.

	Cultivated currently	Cultivated previously	Total
Total species number	54	18	72
A: Critically endangered (7)	2	2	4
B: Endangered (17)	5	1	6
C: Vulnerable (28)	13	4	17
D: Not Threatened (55)	33	11	44

Table 5. Numbers of the 107 Gesneriaceae found in western lowland Ecuador currently and previously in cultivation, and the global conservation status of these species.
Tabla 5. Números de las 107 Gesneriaceae encontradas en el occidente bajo del Ecuador, actual y anterior en cultivo y el estado de conservación global de estas especies.

Discussion
Pluvial and wet forests have a high diversity of Gesneriaceae. For example, in the pluvial forests of San Marcos (Fig. 1, number 1) ca. 40 % of the Ecuadorian lowland Gesneriaceae have been collected (Table 4), including some that may be restricted to exposed ridges with low-elevation cloud forests. San Marcos is located along the bordering river with Colombia, so it is no surprise that species found here also occur in Colombia. Lita and Zapallo Grande are nearly as humid as San Marcos, but located farther from the Colombian border (Fig.1, numbers 2 & 3). However, the species found in these two places also tend to occur northward into Colombia. The wet and pluvial forests thus have few Gesneriaceae species endemic to Ecuador, but in Colombia many of these species apparently are restricted to the adjacent southwestern department of Nariño. However, most of these shared species are distributed further northward along the Colombian Pacific coast, and a considerable number reach Central America. As a consequence, relatively few Gesneriaceae from the diverse wet and pluvial forests are presumed to be globally endangered/ endangered.
Fewer Gesneriaceae have been recorded from the once extensive moist and dry forests, i.e., forests receiving less than 3000 mm of annual precipitation. However, more than half of the species presumed to be endangered or extinct have been recorded from these forests, although fewer than half of the endemic species have these forests as their principal habitat (Table 3). The Gesneriaceae are abundant in the more humid of the moist forests. For example, 29 species of Gesneriaceae have been reported from Río Palenque with nearly 3000 mm of annual precipitation (Table 4). In contrast, only four species occur in Jauneche with 1800 mm of annual precipitation (Table 4), supporting the fact

that it is the moist evergreen forests, with more than 2000 mm of precipitation that are rich in Gesneriaceae, and that few Gesneriaceae occur in the drier forests. Only two species, *Columnea isernii* and *Sinningia warmingii*, appear to be adapted to a seasonal climate, probably being dormant during the dry season, and re-sprouting in the early part of the rainy season. Another three species, *Columnea manabiana*, *C. microsepala*, and *C. schimpffii*, have also been collected mainly in areas with seasonal forests, but here they apparently grow in patches of more humid vegetation found on exposed hills and slopes.

Low elevation cloud forests harbor more than half of both the endemic and the globally extinct and endangered species (Table 3). Judging from the local floras of Gesneriaceae, there actually exist two floristically different types of low-elevation cloud forests in western Ecuador. The cloud forests observed on an exposed hill west of San Marcos near the Colombian border were remarkable in having six different species of the terrestrial genus *Cremosperma* (Kvist & Skog 1988), including three that have not been collected elsewhere in Ecuador, but all six occur in western Colombia. *Cremosperma* species are otherwise relatively rare in Ecuador. In the cloud forests further to the south and west, including Centinela Ridge, Manta Real, and the Bilsa Biological Station, only a single *Cremosperma* species occurs, and there instead the dominant terrestrial Gesneriaceae genus is *Gasteranthus*. Unfortunately, cloud forests that may be rich in *Cremosperma* are poorly known, but the genus is diverse throughout Pacific slope Colombia, and here *Cremosperma* is also found mainly in low elevation cloud forests. Species found in low-elevation cloud forest with high *Cremosperma* diversity are thus likely also to occur in western Colombia. In contrast, the cloud forests where *Gasteranthus* is exceedingly well represented are apparently restricted to Ecuador, and have a particularly high percentage of endemic as well as endangered and species; *e.g.*, half of the 24 species recorded from Centinela Ridge (Table 4). The distribution patterns of the Gesneriaceae thus strongly substantiate the claim by Dodson & Gentry (1991) that Centinela Ridge was in fact unique. This cloud forest apparently had more endangered and endemic species than any other correspondingly small forest in western Ecuador, and at least one Gesneriaceae species, *Gasteranthus extinctus*, may never have occurred elsewhere (Skog & Kvist 2000). Bilsa Biological Station is the only other of the nine localities that probably has a truly endemic species, in this case a recently discovered undescribed *Drymonia*. In contrast, two species that only have been collected from San Marcos and Zapallo Grande (Table 4) are both likely to have wider distributions, since extensive relatively similar forests surround these two localities.

The diversity of *Gasteranthus* in western Ecuador is truly remarkable. Of the 36 species in the genus 24 have been recorded from western Ecuador, and 15 of these from elevations below 1000 m elevation. *Gasteranthus* has actually both speciated below in the low-elevation cloud forests at approx. 600 m elevation, and above in the high-elevation cloud forests mostly between 1800 and 2200 m elevation. Ten species are adapted to low-elevation cloud forests and another different 12 species to high-elevation cloud forests, and the remaining few species have wider distributions in western Ecuador (Skog & Kvist 2000). The six species that were found at Centinela Ridge were all adapted to cloud forest, and five of them have also been found in other cloud forests mainly further to the south, including *G. carinatus* as far to the south as El Oro province. None of the six Centinela Ridge species, however, occur in the coastal hill cloud forests of the Bilsa Biological Station. Here, another four cloud forest adapted species occur, as well as a species that is more common and widespread in moist and wet forests. Three species found at the Bilsa Biological Station are endemic to the range of coastal hills, while the most common cloud forest species at Bilsa, *G*. *crispus*, has also been found along creeks in some wet and moist forests elsewhere in western Ecuador, *e.g.*, at Río Palenque and Congóma Grande.

Dodson & Gentry (1991) suggest that there may have existed many "Centinelas" on isolated ridges along the Andean slopes, each with a large number of endemic and now mostly extinct species. If that statement is true a considerable number of *Gasteranthus* species may have gone extinct before they were ever collected. There may have existed a few more species of *Gasteranthus* in western Ecuador than those recognized in the recent revision (Skog & Kvist 2000), but we doubt that many unrecorded species have disappeared. Centinela Ridge and the Bilsa Biological Station cloud forest probably were the two richest low-elevation cloud forests in the region (ignoring possible extant more northern cloud forests along the still mostly unexplored lower western Andean slopes of the Imbabura, Esmeraldas and Carchi provinces). Contour maps of western Ecuador show that Centinela and adjacent ridges on the border between Pichincha and Los Ríos provinces, are the largest and most isolated low-elevation front ridges along the entire western Andean slope (Figure 2). In addition, the higher montane forests and cloud forests at the Andean slopes west of Centinela are also extraordinarily rich in Gesneriaceae, including another six *Gasteranthus* species (Skog & Kvist 2000). To the south the diversity of the Gesneriaceae decreases. In the

low elevation cloud forest of Manta Real located 200 km south of Centinela Ridge on the border between Cañar and Azuay provinces (Figure 1) occur 18 mostly common and widespread Gesneriaceae, including only two western lowland Ecuador endemics, in contrast to 11 at Centinela Ridge (Table 4). Manta Real has only one species of *Gasteranthus*, and only three species of this genus have been found in Andean low-elevation cloud forests in southeastern Ecuador (in the provinces of Cañar, Azuay and El Oro), while Centinela Ridge had eight *Gasteranthus* species. It can be argued that the Bilsa cloud forest is probably the richest cloud forest that has existed in the coastal hill range. The Bilsa Biological Station is located in the northern part of the coastal hill range surrounded by the wettest lowland forests (Figure 1). To the south the ridges become surrounded by increasingly dry forests with much fewer Gesneriaceae, and probably also with fewer species of the other plant families that tend to speciate in isolated cloud forests. *Gasteranthus* also exemplifies this trend in the coastal hill range. Five species occur to the north in the provinces of Esmeraldas and northern Manabí, but apparently only two *Gasteranthus* species occur in southern Manabí and adjacent northwestern Guayas (Figure 1).

Our estimates of the status of the species of Gesneriaceae found in western lowland Ecuador are based on our present, in many ways somewhat limited, knowledge of their distribution, taxonomy, and ecology. Additional collections and discoveries will thus probably prove that some species are, in reality, more common and widespread, and consequently less at risk than estimated here. Despite that limitation, it is probably not too pessimistic to estimate that more than a third of the species found in western lowland Ecuador are extinct or endangered in the region. Three factors add to that conclusion: 1) we have been taxonomically conservative interpreting poorly understood complexes as a single widespread and variable species, *e.g.*, *Monopyle macrocarpa* and *Napeanthus robustus*, and future studies may thus circumscribe additional species in such complexes; 2) some additional rare and endemic Gesneriaceae will probably yet be discovered; and, 3) some extinct (or soon to be extinct) species may not be represented by any herbarium vouchers, or there may exist a few and relatively faulty vouchers that taxonomists will hesitate to assign species names. In the revision of *Gasteranthus* (Skog & Kvist 2000) a couple of odd, older collections are treated as extreme variants of recognized species, although these vouchers might in fact represent undescribed but probably already extinct species.

In 1991 Dodson & Gentry estimated that 6300 species of flowering plants are native to western lowland Ecuador, and that 20 % of them (or ca. 1260 species) are endemic to the region. Similar to the estimations of Dodson & Gentry we find that approx. 20 % of the Gesneriaceae are endemic, and that more than 90 % of the endemic species (20 of 22 species) are extinct or endangered. However, in contrast to the 1991 estimates of Dodson & Gentry, Joergensen & León (1999) and Valencia et al. (2000) reported 4463 plant species native to western lowland Ecuador (defined as below 1000 m) and that only ca. 538 species (or 12%) were endemic to the coastal region. This estimation is significantly less than the percentage of endemic plans to Ecuador as a whole (26% on average for all of Ecuador). If the Gesneriaceae are representative of the entire flora of flowering plants using the estimates from Dodson & Gentry, then more than 1000 endemic species may thus already be extinct or endangered in western lowland Ecuador, but using the figures from the more recent reports by Joergensen & León and Valencia et al. we arrive at a total of somewhere between 400 and 500. In addition, we find that more than a third of all the Gesneriaceae native to lowland western Ecuador may be extinct or endangered in the region, corresponding to more than 2000 species in the entire flora using the Dodson and Gentry estimates, but much less using the more recent data. Is the Gesneriaceae, in reality, representative of the status of the entire flora of lowland western Ecuador? The family is very well-represented in the severely threatened cloud forests, as well as in the moist evergreen forests that also have been largely destroyed, suggesting that the Gesneriaceae may be even more endangered, than the average resident of the local flora, which is borne out by comparing the numbers of endangered Gesneriaceae with the more recent figures. However, we may also come to the opposite conclusion that may be supported by the facts that the Gesneriaceae are nearly absent from the drier forests, which also have been seriously degraded, and that few Gesneriaceae from the wet and pluvial forests are estimated to be endangered, because the latter species tend to be relatively widespread (Table 3). Other families may thus have higher percentages of endemic and endangered species in Ecuadorian wet and pluvial forests than the Gesneriaceae. But, one fact that we are sure of is that the endemism for Gesneriaceae (20 % in coast Ecuador) is significantly higher than the most recent estimates for endemic plans in coastal Ecuador as an entity (12%). Therefore, Gesneriaceae may, on the average, be at least as endangered or more so than the entire local flora, suggesting a likely mass extinction of the above-mentioned proportions in western lowland Ecuador.

It took a decade before the figures presented by Dodson & Gentry were looked at in depth. Current knowledge can also be shown compared to the previous decade by the example that in 1986 Gentry predicted that there were 90 endemic species on the single ridgeline of Centinela. Almost all of those narrow Centinela endemics have shown up in

the Cordillera Mache-Chindul (Clark, pers. obs.) and Lita (Dodson & Gentry 1991). The results shown by Valencia et al. (2000) in the Libro Rojo reports that Centinela only comprised five endemic species, and not the 90 initially predicted by Gentry (1986).

Conclusions

More than a third of the 107 species of Gesneriaceae species found in western lowland Ecuador are estimated to be extinct or endangered, including nearly all 23 endemic species of the region. The status of the Gesneriaceae may be relatively representative of the status of the entire flora, suggesting a mass-extinction of flowering plants in western Ecuador. The conservation status thus is grim, but something can still be done.

The endangered Gesneriaceae are mostly found either in moist forest having an annual precipitation between 2000 and 3000 mm, or in low-elevation cloud forest. The last remnants of these forest types should immediately be identified and fully protected. These areas are mostly small, but Gesneriaceae are also often found in isolated areas of suitable habitats; most notably in the low-elevation cloud forests. Many species may thus survive even with only a small fraction of the original forest cover preserved. Habitats that already have been strongly disturbed should also be searched for patches of vegetation left on slopes and in ravines. Endangered species may still survive there, and the vegetation may recover given an adequate protection. The situation is worst along the Andean slopes where hardly any low-elevation cloud forests are known to survive, and the only hope thus may be the partial recovery of disturbed remnants, which urgently need to be located and protected. In fact, while finishing this paper one presumed extinct species, *Gasteranthus timidus*, was rediscovered in a cloud forest remnant in Los Ríos province. In the coastal hill range there remains low elevation cloud forest at the Bilsa Biological Station, at Cerro Pata de Pájaro, in the Machalilla National Park, and probably also in the little known Coloncho Hills southwest of Machalilla (Figure 1). It is evidently urgent to protect all these forests, and also to enforce the protection. In spite of the legal protection, subsistence activities have continued to degrade the forests in the Machalilla National Park, and timber companies may still succeed to reverse the recent establishment of the Mache-Chindul Ecological Reserve including the Bilsa Biological Station.

There still remain (compare Figure 1 and 3) considerable tracts of wet and pluvial forests being highly diverse in Gesneriaceae and many other groups of plants as well. Harvesting for plywood extraction should not be allowed to devastate these biologically extremely rich forests. It is extremely important to protect and preserve the Cotocachi-Cayapa Ecological Reserve, which is floristically poorly known, but certainly protects a high percentage of the species found in wet forests.

It is also important to promote and support a sustainable, locally based management of the wet and humid forests surviving outside existing conservation units. The Gesneriaceae may be relatively good indicators of a successful forest resource management, which preserve much of the local biodiversity. Deforestation that interrupt nutrient- and water cycles and change the microclimate significantly, tend to eliminate all but a few hardy Gesneriaceae. However, Gesneriaceae are relatively tolerant of some disturbance, and many thrive in cocoa plantations and small clearings such as recuperating slash-and-burn fallow. Besides many other Gesneriaceae are found in extreme habitats such as exposed ridges, steep slopes, and ravines, little influenced by subsistence activities, but vulnerable to massive deforestation. The Awa Ethnic Forest Reserve located in the pluvial forests near the Colombian border exemplifies a community-based way of forest management, which allows much biodiversity to persist. In the Cayapa River system downstream from the Cotocachi-Cayapa Ecological Reserve both moist and wet forests are managed by African-Americans as well as populations of indigenous people.

Endangered Gesneriaceae in cultivation may be re-reintroduced into their natural habitats in the future.

Growing plants of Gesneriaceae (commonly known as the African Violet family) is popular among many amateur growers, and about half of the species recorded in lowland western Ecuador are in cultivation, including three species that may be totally extinct in their natural habitats (Table 5). Unfortunately, another two presumed extinct species gradually disappeared from all living collections. More coordination and information among growers, both in botanical institutions and amateur growers will be necessary in order to limit the risk of losing endangered cultivated species. Endangered species should also be sought in order to locate possible surviving populations; an obvious place to search is at Centinela Ridge or nearby ridges. It is likely that remnant populations of the seven globally extinct or endangered species that once occurred here may remain, but probably not for much longer. Currently, only one of these seven species, the remarkable *Gasteranthus atratus*, remains in cultivation, but two of the others, *Columnea*

asteroloma and *Gasteranthus macrocalyx,* had previously been in cultivation.

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Appendix A

[[Table 6a]], [[Table 6b]], [[Table 6c]], [[Table 6d]]

Column:	2	3	4	5	6	7	8	9	10	1*	2*	3*	4*	5*	6*	7*	8*	9*	10*
	Current status		Extra-coastal distribution				Coastal forest habitats			Ecuadorian forest localities									Cult.
	Coast	Range	Coastal	Pacific	Central	Amazon	Wet	Moist	Cloud	San	Lita	Zapa	Bils	Cent	Mant	Rio	Cong	Jaun	
	Local	Global	Montane	Colombia	America	basin	>3,000	<3,000	Fog										
tus (8)																			
nii	c	d	C	B			B	B	B		X		X		X	X	X		X
derma	a	d	D	D	C	D		A											(x)
saeus	b	c			B	B	A		A						X				
nensis	c	d	A	D	C		B		B	X	X	X	X						(x)
ei	d	d	C	B			C		C	X	X	X		X	X	X	X		(x)
eri	c	d	D	D			C		B	X	X	X	X						
onoides	c	d	D	C		D	A		A	X	X	X							(x)
v. A	b	b					A			X									
(4)																			
ayi	c	d		D			B					X							(x)
ta	c	d				C	B												
oides	d	d	C	C		C	C	B		X									(x)
nsis	b	d		C	C		B		B				X		X				
hemis (1)																			
ichstaliana	d	d		D	D		B	C				X						X	X
nthe (2)																			
folia	d	d		D	C	D	B	D	B			X	X			X			X
a	d	d		B	C	D	A	C	B		X		X			X			X
ea (35)																			
tata	d	d		C	B	C	C	D	C		X	X	X	X		X	X		X
loma	a	a						A	A					X		X			(x)
ata	b	d		C			B					X							(x)
a	c	d	C	C			B			X									X
	c	c	C			A	A												X
biana	b	c		B			A					X							X
ilis	c	c		A	C		B				X	X							X
ea	d	d	D	C			C	D	C	X	X	X	X				X		X
a	c	c		A			B			X									(x)
calyx	c	c		A			B			X	X								(x)
tifolia	c	c	A	C			B			X									
ae	b	b		A				B	B					X		X			X
i	a	b						A											
yeriana	c	d		C	B		A		A		X		X						X
stiana	c	c		C			B	C	A	X		X	X	X	X	X	X		X

Part 1. Gesneriaceae recorded below 1000 m elevation in western Ecuador, with information on their current status, their overall distributions, their habitats, their occurrence in 9 selected localities, and current or previous cultivation.

Parte 1. Las Gesneriaceae registradas debajo de 1000 m de altura en Ecuador occidental, y para cada especie información con respecto del estado de conservación actual, habitas, la presencia en 9 localidades particulares, y su existencia en cultivo actualmente o antes.

Column:	2	3	4	5	6	7	8	9	10	1*	2*	3*	4*	5*	6*	7*	8*	9*	10*
	Current status		Extra-coastal distribution				Coastal forest habitats			Ecuadorian forest localities									Cult.
	Coast	Range	Coastal	Pacific	Central	Amazon	Wet	Moist	Cloud	San	Lita	Zapa	Bils	Cent	Mant	Rio	Cong	Jaun	
	Local	Global	Montane	Colombia	America	basin	>3,000	<3,000	Fog										
ea (35)																			
	c	c	A	A			B			X	X								
nnii	c	d		D			A			X									
nervosa	c	d		B			A			X									
biana	b	b						B											X
rsonii	a	c	C				A												(x)
inalis	d	d	D	C			A	C	B		X	X	X						X
	d	d	C	C			C	A	C	X			X	X	X	X			X
sepala	c	d	A					C	A					X					
iflora	c	c	A	A			B		B	X	X		X						X
iana	c	c		A			A			X									(x)
flora	c	d		D			B				X								(x)
	d	d	D	D			D	D	C	X	X	X	X	X	X	X	X		X
rimarginata	c	c		B			A					X							
acuta	d	d	D	D			D	D	D	X	X	X	X	X		X	X		X
bracteata	b	b					A					X							
calyx	c	d		C			C			X	X								X
pfffii	b	b						C	A						X				X
ulata	d	d	B	A			B	D	C		X	X	X	X	X	X			X
ta	b	c		A			A				X								
a	c	d	A	C			C			X	X								X
perma (9)																			
panum	c	d		C			A				X								
uens	c	d	A	B		B			B	X									
tissimum	c	d	B	D			C		A	X									
dum	c	c		A					A	X									X
cola	c	c		A					A	X									
e	c	d		B			A		A	X									
ides	c	c		A					A	X									
vv. A	b	b							C				X	X	X				
vv. B	c	c		A			A				X								
a (3)																			
	d	d	C	C	B	A	B	C	C	X		X	X		X		X		X
iferum	d	d	B	C	D	D		C	B				X		X			X	X
um	d	d	B	A	A	D	B	C	B	X		X	X		X		X		X

Part 2. Gesneriaceae recorded below 1000 m elevation in western Ecuador, with information on their current status, their overall distributions, their habitats, their occurrence in 9 selected localities, and current or previous cultivation.

Parte 2.Las Gesneriaceae registradas debajo de 1000 m de altura en Ecuador occidental, y para cada especie información con respecto del estado de conservación actual, habitas, la presencia en 9 localidades particulares, y su existencia en cultivo actualmente o antes.

Column:	2	3	4	5	6	7	8	9	10	1*	2*	3*	4*	5*	6*	7*	8*	9*	10*
	Current status		Extra-coastal distribution				Coastal forest habitats			Ecuadorian forest localities									Cult.
	Coast	Range	Coastal	Pacific	Central	Amazon	Wet	Moist	Cloud	San	Lita	Zapa	Bils	Cent	Mant	Rio	Cong	Jaun	
	Local	Global	Montane	Colombia	America	basin	>3,000	<3,000	Fog										
nia (14)																			
olectoides	d	d		C	C		C	C	A			X	X			X	X		X
hidodroma	b	c		A			A		B	X			X						X
acea	d	d	B	C	C		C	C			X	X				X	X		X
dorensis	b	b						B	A				X			X			X
oti	c	d	B	B			B												X
niosa	b	b						A	A				X			X			X
rophylla	c	d	A	C	D	C	A	B	A		X	X	X			X	X		X
doloma	b	b						B	A				X			X	X		X
ulata	d	d		D	D	D	B	C		X	X	X			X	X		X	X
alvae	d	d		C	C		B	B	A	X	X		X	X		X	X		X
egata	c	c		C		C	A												X
zewicziana	d	d	B	C	D	D	B	B		X	X	X	X			X	X		X
ov. A	a	c		B				A	A										
ov. B	b	b							A				X						
anthus (15)																			
tus	a	a							B					X					X
ensis	b	b							B				X						
ratus	d	d	A	A		C	B	C	B		X	X	X	X	X	X	X		X
natus	a	a						A	B					X		X			
mbianus	c	c	B	B			A			X									
linus	c	d	C	B		D	C	C		X	X	X							X
us	b	b					A	A	C				X	X		X	X		(x)
ctus	a	a							A					X					
alis	b	c	B				A												
ocalyx	a	a						A	B					X		X			(x)
nnis	a	a							B					X					
ensis	d	d	D	C			C	B			X								
lus	b	b							A				X						
dus	b	b						A	A					X					
sus	b	b		A					B				X						

Part 3. Gesneriaceae recorded below 1000 m elevation in western Ecuador, with information on their current status, their overall distributions, their habitats, their occurrence in 9 selected localities, and current or previous cultivation.

Parte 3. Las Gesneriaceae registradas debajo de 1000 m de altura en Ecuador occidental, y para cada especie información con respecto del estado de conservación actual, habitas, la presencia en 9 localidades particulares, y su existencia en cultivo actualmente o antes.

Column:	2¤	3¤	4¤	5¤	6¤	7¤	8¤	9¤	10¤	1*¤	2*¤	3*¤	4*¤	5*¤	6*¤	7*¤	8*¤	9*¤	10*¤
	Current·status¤		Extra-coastal·distribution¤				Coastal·forest·habitats¤			Ecuadorian·forest·localities¤									Cult.¤
s¤	Coast¤	Range¤	Coastal¤	Pacific¤	Central¤	Amazon¤	Wet¤	Moist¤	Cloud¤	San·¤	·Lita¤	Zapa¤	Bils¤	Cent¤	Mant¤	Rio¤	Cong¤	Jaun¤	¤
	Local¤	Global¤	Montane¤	Colombia¤	America¤	basin¤	>3,000¤	<3,000¤	Fog¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤
ia·(1)¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤
soni¤	c¤	c¤	¤	A¤	¤	¤	B¤	B¤	C¤	X¤	¤	X¤	X¤	X¤	¤	X¤	¤	¤	X¤
lia·(1)¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤
folia¤	c¤	d¤	D¤	D¤	¤	D¤	¤	A¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	(x)¤
ia·(3)¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤
qualis¤	c¤	d¤	B¤	D¤	¤	¤	B¤	¤	A¤	¤	X¤	¤	X¤	¤	¤	¤	¤	¤	X¤
ata¤	d¤	d¤	D¤	D¤	D¤	B¤	C¤	D¤	¤	X¤	X¤	¤	X¤	¤	X¤	X¤	¤	¤	X¤
sa¤	c¤	c¤	C¤	A¤	¤	¤	¤	B¤	B¤	¤	¤	¤	X¤	¤	¤	¤	¤	¤	X¤
yle·(2)¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤
rocarpa¤	d¤	d¤	B¤	C¤	B¤	C¤	B¤	D¤	B¤	X¤	X¤	¤	X¤	X¤	X¤	¤	¤	X¤	X¤
roana¤	c¤	c¤	¤	¤	¤	¤	B¤	B¤	C¤	X¤	X¤	X¤	X¤	X¤	¤	X¤	¤	¤	X¤
nthus·(2)¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤
demus¤	c¤	d¤	¤	D¤	D¤	C¤	¤	C¤	C¤	¤	¤	¤	X¤	¤	¤	¤	¤	¤	(x)¤
stus¤	b¤	d¤	¤	B¤	C¤	C¤	¤	B¤	B¤	¤	¤	¤	X¤	X¤	X¤	¤	X¤	¤	(x)¤
rtonia·(1)¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤
a¤	c¤	d¤	A¤	C¤	A¤	¤	B¤	¤	¤	X¤	X¤	¤	¤	¤	¤	¤	¤	¤	X¤
rymonia·(3)¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤
ta¤	c¤	c¤	¤	¤	¤	¤	B¤	¤	¤	¤	X¤	¤	¤	¤	¤	¤	¤	¤	X¤
cyrta¤	b¤	b¤	¤	¤	¤	¤	¤	A¤	B¤	¤	¤	¤	X¤	X¤	¤	X¤	¤	¤	X¤
ra¤	a¤	a¤	¤	¤	¤	¤	¤	A¤	A¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	X¤
a·(1)¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤
ricata¤	b¤	c¤	¤	¤	¤	A¤	¤	A¤	A¤	¤	¤	¤	¤	¤	X¤	¤	¤	¤	X¤
¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤
tiflora¤	b¤	d¤	¤	B¤	B¤	C¤	¤	¤	A¤	¤	¤	¤	X¤	¤	¤	¤	¤	¤	¤
gia·(1)¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤
mingii¤	b¤	d¤	A¤	¤	¤	D¤	¤	A¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	X¤

Part 4. Gesneriaceae recorded below 1000 m elevation in western Ecuador, with information on their current status, their overall distributions, their habitats, their occurrence in 9 selected localities, and current or previous cultivation.
Parte. 4. Las Gesneriaceae registradas debajo de 1000 m de altura en Ecuador occidental, y para cada especie información con respecto del estado de conservación actual, habitas, la presencia en 9 localidades particulares, y su existencia en cultivo actualmente o antes.

Column 1 lists the 19 genera and the 107 species (for authorities see Joergensen & León (1999)) recorded as native to the area. Species endemic to lowland western Ecuador in bold.
Column 2 estimates their current status in lowland western Ecuador (local) and Column 3 their current overall status (global). The codes are the following: a) Critically endangered; b) Endangered; c) Vulnerable; and d) Not threatened.
Columns 4, 5, 6, and 7 indicate the species that have also been recorded in western Ecuador above 1,000 m elevation, in western or northwestern Colombia, in Central America, and in the Amazon basin (including the eastern Andean slopes), respectively. In addition, their frequency in these regions is indicated with the following codes: A) Rare; B) Uncommon; C) Occasional; and D) Common.
Column 8, 9, and 10 indicate the species in western lowland Ecuador that occur in pluvial or wet forests (precipitation >3000 mm), in dry or moist forests (precipitation <3000 mm), or in cloud forests (fog), respectively. In addition, their frequency in these habitats is indicated applying the same codes as in the Columns 4 to 7.
Columns 1* to 9* indicate the species that have been collected in each of the following nine localities located below 1000 m in western Ecuador: San Marcos, Lita, Zapallo Grande, Bilsa Biological Station, Centinela Ridge, Manta Real, Río Palenque, Congóma Grande, and Jauneche, respectively. Background data on these localities appear in Appendix B.
Column 10* indicates the species occurrence in cultivation, currently as well as previously (the latter marked in parentheses).
Appendix B

[[Table 7a]], [[Table 7b]], [[Table 7c]], [[Table 7d]]

Column 1	2	3	4	5	6	7	8	9	10	1*	2*	3*	4*	5*	6*	7*	8*	9*	10*
	Current status		Extra-coastal distribution				Coastal forest habitats			Ecuadorian forest localities									Cult.
	Coast	Range	Coastal	Pacific	Central	Amazon	Wet	Moist	Cloud	San	Lita	Zapa	Bils	Cent	Mant	Rio	Cong	Jaun	
	Local	Global	Montane	Colombia	America	basin	>3,000	<3,000	Fog										
Alloplectus (8)																			
... *dodsonii*	c	d	C	B			B	B	B		X		X		X	X	X		X
... *ichtyoderma*	a	d	D	D	C	D		A											(x)
... *medusaeus*	b	c			B	B	A		A						X				
... *panamensis*	c	d	A	D	C		B		B	X	X	X	X						(x)
... *sprucei*	d	d	C	B			C		C	X	X	X		X	X	X	X		(x)
... *teucheri*	c	d	D	D			C		B	X	X	X	X						
... *tetragonoides*	c	d	D	C		D	A		A	X	X	X							(x)
... *sp. nov. A*	b	b					A			X									
Besleria (4)																			
... *barclayi*	c	d		D			B					X							(x)
... *miniata*	c	d				C	B												
... *solanoides*	d	d	C	C		C	C	B		X									(x)
... *tambensis*	b	d		C	C		B		B				X		X				
Chrysothemis (1)																			
... *friedrichstaliana*	d	d		D	D		B	C				X							X
Codonanthe (2)																			
... *crassifolia*	d	d		D	C	D	B	D	B			X	X			X			X
... *uleana*	d	d		B	C	D	A	C	B		X		X			X			X
Columnea (35)																			
... *angustata*	d	d		C	B	C	C	D	C		X	X	X	X		X	X		X
... *asteroloma*	a	a						A	A					X		X			(x)
... *bilabiata*	b	d		C			B					X							(x)
... *byrsina*	c	d	C	C			B			X									X
... *ciliata*	c	c	C			A	A												X
... *colombiana*	b	c		B			A					X							X
... *dissimilis*	c	c		A	C		B				X	X							X
... *eburnea*	d	d	D	C			C	D	C	X	X	X	X				X		X
... *filifera*	c	c		A			B			X									(x)
... *fimbricalyx*	c	c		A			B			X	X								(x)
... *gigantifolia*	c	c	A	C			B			X									
... *herthae*	b	b		A				B	B					X		X			X
... *isernii*	a	b						A											
... *kalbreyeriana*	c	d		C	B		A		A		X		X						X
... *kienastiana*	c	c		C			B	C	A	X		X	X	X	X	X	X		X

Part 1. Baseline data concerning 9 localities in western Ecuador. Figure 1 shows their location, and the species of Gesneriaceae recorded from each of the nine localities appear from Appendix A (Columns 1* to 9*) (Climatic data from Cañadas C. 1983).

Parte 1. Datos básicos con respecto de 9 localidades en el Ecuador occidental. La figura 1 muestra la ubicación de las localidades, y en el apéndice A (Columnas 1* a 9*) aparecen las especies de Gesneriaceae registradas en cada una de las 9 localidades (datos climáticos de Cañadas C. 1983).

Column 1	2	3	4	5	6	7	8	9	10	1*	2*	3*	4*	5*	6*	7*	8*	9*	10*
	Current status		Extra-coastal distribution				Coastal forest habitats			Ecuadorian forest localities									Cult.
	Coast	Range	Coastal	Pacific	Central	Amazon	Wet	Moist	Cloud	San	Lita	Zapa	Bils	Cent	Mant	Rio	Cong	Jaun	
	Local	Global	Montane	Colombia	America	basin	>3,000	<3,000	Fog										
Columnea																			
laevis	c	c	A	A			B			X	X								
lehmannii	c	d		D			A			X									
longinervosa	c	d		B			A			X									
manabiana	b	b						B											X
mastersonii	a	c	C				A												(x)
medicinalis	d	d	D	C			A	C	B		X	X	X						X
microsepala	c	d	A					C	A					X					
minor	d	d	C	C			C	A	C	X			X	X	X	X			X
minutiflora	c	c	A	A			B		B	X	X		X						X
nariniana	c	c		A			A			X									(x)
parviflora	c	d		D			B				X								(x)
picta	d	d	D	D			D	D	C	X	X	X	X	X	X	X	X		X
purpurimarginata	c	c		B			A					X							
rubriacuta	d	d	D	D			D	D	D	X	X	X	X	X		X	X		X
rubribracteata	b	b					A					X							
rubricalyx	c	d		C			C			X	X								X
schimpffii	b	b						C	A						X				X
spathulata	d	d	B	A			B	D	C		X	X	X	X	X	X			X
sulcata	b	c		A			A				X								
tenella	c	d	A	C			C			X	X								X
Cremosperma (9)																			
castroanum	c	d		C			A				X								
congruens	c	d	A	B		B			B	X									
hirsutissimum	c	d	B	D			C		A	X									
humidum	c	c		A					A	X									X
muscicola	c	c		A					A	X									
nobile	c	d		B			A		A	X									
reldioides	c	c		A					A	X									
sp. nov. A	b	b							C				X	X	X				
sp. nov. B	c	c		A			A				X								
Diastema (3)																			
affine	d	d	C	C	B	A	B	C	C	X		X	X		X		X		X
racimiferum	d	d	B	C	D	D		C	B				X		X			X	X
scabrum	d	d	B	A	A	D	B	C	B	X		X	X		X		X		X

Part 2. Baseline data concerning 9 localities in western Ecuador. Figure 1 shows their location, and the species of Gesneriaceae recorded from each of the nine localities appear from Appendix A (Columns 1* to 9*) (Climatic data from Cañadas C. 1983).

Parte 2. Datos básicos con respecto de 9 localidades en el Ecuador occidental. La figura 1 muestra la ubicación de las localidades, y en el apéndice A (Columnas 1* a 9*) aparecen las especies de Gesneriaceae registradas en cada una de las 9 localidades (datos climáticos de Cañadas C. 1983).

Column 1	2	3	4	5	6	7	8	9	10	1*	2*	3*	4*	5*	6*	7*	8*	9*	10*
	Current status		Extra-coastal distribution				Coastal forest habitats			Ecuadorian forest localities									Cult.
	Coast	Range	Coastal	Pacific	Central	Amazon	Wet	Moist	Cloud	San	Lita	Zapa	Bils	Cent	Mant	Rio	Cong	Jaun	
	Local	Global	Montane	Colombia	America	basin	>3,000	<3,000	Fog										
Drymonia (14)																			
... *alloplectoides*	d	d		C	C		C	C	A			X	X			X	X		X
... *brochidodroma*	b	c		A			A		B	X			X						X
... *coriacea*	d	d	B	C	C		C	C			X	X				X	X		X
... *ecuadorensis*	b	b						B	A				X			X			X
... *killipii*	c	d	B	B			B												X
... *laciniosa*	b	b						A	A				X			X			X
... *macrophylla*	c	d	A	C	D	C	A	B	A		X	X	X			X	X		X
... *rhodoloma*	b	b						B	A				X			X	X		X
... *serrulata*	d	d		D	D	D	B	C		X	X	X			X	X		X	X
... *turrialvae*	d	d		C	C		B	B	A	X	X		X	X		X	X		X
... *variegata*	c	c		C		C	A												X
... *warszewicziana*	d	d	B	C	D	D	B	B		X	X	X	X			X	X		X
... *sp. Nov. A*	a	c		B				A	A										
... *sp. Nov. B*	b	b							A				X						
Gasteranthus (15)																			
... *atratus*	a	a							B					X					X
... *bilsaensis*	b	b							B				X						
... *calcaratus*	d	d	A	A		C	B	C	B		X	X	X	X	X	X	X		X
... *carinatus*	a	a						A	B					X		X			
... *columbianus*	c	c	B	B			A			X									
... *corallinus*	c	d	C	B		D	C	C		X	X	X							X
... *crispus*	b	b					A	A	C				X	X		X	X		(x)
... *extinctus*	a	a							A					X					
... *lateralis*	b	c	B				A												
... *macrocalyx*	a	a						A	B					X		X			(x)
... *perennis*	a	a							B					X					
... *quitensis*	d	d	D	C			C	B			X								
... *tenellus*	b	b							A				X						
... *timidus*	b	b						A	A					X					
... *villosus*	b	b		A					B				X						

Part 3. Baseline data concerning 9 localities in western Ecuador. Figure 1 shows their location, and the species of Gesneriaceae recorded from each of the nine localities appear from Appendix A (Columns 1* to 9*) (Climatic data from Cañadas C. 1983).

Parte 3. Datos básicos con respecto de 9 localidades en el Ecuador occidental. La figura 1 muestra la ubicación de las localidades, y en el apéndice A (Columnas 1* a 9*) aparecen las especies de Gesneriaceae registradas en cada una de las 9 localidades (datos climáticos de Cañadas C. 1983).

Column 1	2	3	4	5	6	7	8	9	10	1*	2*	3*	4*	5*	6*	7*	8*	9*	10*
	Current status		Extra-coastal distribution				Coastal forest habitats			Ecuadorian forest localities									Cult.
	Coast	Range	Coastal	Pacific	Central	Amazon	Wet	Moist	Cloud	San	Lita	Zapa	Bils	Cent	Mant	Rio	Cong	Jaun	
	Local	Global	Montane	Colombia	America	basin	>3,000	<3,000	Fog										
Gloxinia (1)																			
··· *dodsonii*	c	c		A			B	B	C	X		X	X	X		X			X
Heppiella (1)																			
··· *ulmifolia*	c	d	D	D		D		A											(x)
Kohleria (3)																			
··· *inaequalis*	c	d	B	D			B		A		X		X						X
··· *spicata*	d	d	D	D	D	B	C	D		X	X		X		X	X			X
··· *villosa*	c	c	C	A				B	B				X						X
Monopyle (2)																			
··· *macrocarpa*	d	d	B	C	B	C	B	D	B	X	X		X	X	X			X	X
··· *sodiroana*	c	c					B	B	C	X	X	X	X	X		X			X
Napeanthus (2)																			
··· *apodemus*	c	d		D	D	C		C	C				X						(x)
··· *robustus*	b	d		B	C	C		B	B				X	X	X		X		(x)
Neomortonia (1)																			
··· *rosea*	c	d	A	C	A		B			X	X								X
Paradrymonia (3)																			
··· *binata*	c	c					B				X								X
··· *hypocyrta*	b	b						A	B				X	X		X			X
··· *lacera*	a	a						A	A										X
Phinaea (1)																			
··· *divaricata*	b	c				A		A	A						X				X
Reldia (1)																			
··· *minutiflora*	b	d		B	B	C			A				X						
Sinningia (1)																			
··· *warmingii*	b	d	A			D		A											X

Part 4. Baseline data concerning 9 localities in western Ecuador. Figure 1 shows their location, and the species of Gesneriaceae recorded from each of the nine localities appear from Appendix A (Columns 1* to 9*) (Climatic data from Cañadas C. 1983).

Parte 4. Datos básicos con respecto de 9 localidades en el Ecuador occidental. La figura 1 muestra la ubicación de las localidades, y en el apéndice A (Columnas 1* a 9*) aparecen las especies de Gesneriaceae registradas en cada una de las 9 localidades (datos climáticos de Cañadas C. 1983).

1) San Marcos
Location: Carchi province. Valley located Andean slopes and a western front ridge.
Altitude: 500-1000 m.
Precipitation: Probably exceeding 5000 mm.
Vegetation: Pluvial premontane forests and locally, above 800 m, cloud forests.
Status: Included in Awa Ethnic Forest Reserve, and managed by indigenous people.
Information: Fieldwork by Kvist in 1983 (Kvist 1986; Barfod & Kvist 1996), and more recent collections by many others.
2) Lita
Location: On the border between Imbabura, Carchi, and Esmeraldas provinces.
Altitude: 500-900 m.
Precipitation: Ca. 4000 mm.
Vegetation: Wet premontane forests.

Status: No protection, rapidly being destroyed along Ibarra-San Lorenzo road.
Information: Visited by Dunn in 1995, Clark in 2001 and 2002; and by many other collectors in recent years.
3) Zapallo Grande
Location: In Esmeraldas province along the Cayapa River.
Altitude: 100-200 m.
Precipitation: Ca. 4000 mm.
Vegetation: Wet lowland rain forest and secondary vegetation.
Status: Not protected, managed by the Cayapa indigenous people and African-American villagers.
Information: Fieldwork by Kvist in 1982 and 1983 (Kvist 1986; Barfod & Kvist 1996).
4) Bilsa Biological Station
Location: Southwestern Esmeraldas province south of the town of Esmeraldas.
Altitude: 300-700 m.
Precipitation: Measured to 1500 mm, but not including fog.
Vegetation: Cloud forest above 500 m, and wet and moist forests below 500 m.
Status: Ca. 3000 ha included in Bilsa Biological Station, and in 1996 included in the Mache-Chindul Ecological Reserve. Surrounding forests until now rapidly being destroyed, but the status of reserve may limit the destruction.
Information: Intensive field work by Clark and co-workers from 1994 (Clark 1997).
5) Centinela Ridge
Location: Isolated ridge located on border between Pichincha and Los Ríos provinces.
Altitude: Ca. 600 m.
Precipitation: Not recorded but very humid.
Vegetation: Cloud forest along the ridge.
Status: Converted to agriculture. Vegetation may survive on slopes and in ravines.
Information: Herbarium collections mostly made by Dodson and collaborators based at nearby Río Palenque Biological Station.
6) Manta Real
Location: On border between Cañar and Azuay provinces.
Altitude: 250-600 m.
Precipitation: Not recorded but apparently very humid.
Vegetation: Cloud forest and below wet forest.
Status: Bosque Protector Molleturo-Mullopungo
Information: Field work by Clark and Dunn in 1996 and Clark in 2001.
7) Río Palenque
Location: In Los Ríos province between Santo Domingo and Quevedo, west of Centinela Ridge.
Altitude: 200-300 m.
Precipitation: Ca. 2800 mm.
Vegetation: Moist (nearly wet) evergreen rain forest.
Status: Approx. 100 ha. of forest protected, but region otherwise deforested.
Information: Flora of Rio Palenque (Dodson & Gentry 1978).
8) Congóma Grande
Location: In Pichincha province, Colorado indigenous peoples reserve southwest of Santo Domingo.
Altitude: 200-300 m.
Precipitation: Not known but probably somewhat less than in in Santo Domingo de los Colorados (2900 mm) located 20 km towards the northeast.
Vegetation: Moist evergreen rain forest, but strongly disturbed.
Status: Probably now completely deforested.
Information: Field work by Kvist in 1982 and 1983 (Kvist 1986; Barfod & Kvist 1996).
9) Jauneche
Location: In Los Ríos province south of Quevedo.
Altitude: 200-300 m.
Precipitation: Ca. 1800 mm.

Vegetation: Moist, semi-deciduous rain forest.
Status: 138 ha. of forest protected, but region otherwise deforested.
Information: Flora of Jauneche (Dodson et al. 1985).