

Floristic composition of the cloud forest of the Bicentenario Reserve, Zongolica, Veracruz, México



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Abstract

Background: The Bicentenario Reserve (BR) located in Sierra de Zongolica, Veracruz, includes 63 hectares of cloud forest (cf) which lacks of systematic floristic studies, but the Sierra proposed as an area for bird conservation.

Questions: i) Is the floristic composition of the BR taxonomical rich? ii) How the growth forms are represented in this Reserve? iii) Has the BR endemic or threatened species?

Studied species: Vascular plants.

Study site and years of study: The BR was explored from March 2011 to October 2012.

Methods: Botanical samples from each species considered different were collected and processed according to conventional procedures to be identified with the use of taxonomic tools, and consults with specialist. Analysis of the richness, life forms, endemism and threatened species were made.

Results: We recorded 401 species, distributed in 272 genera and 102 families, being the most diverse Orchidaceae, Asteraceae, Fabaceae and Piperaceae; whilst *Peperomia*, *Tillandsia*, *Polypodium*, *Quercus* and *Solanum* are the genera with the highest number of species. Sixty-nine species are endemic to Mexico, but six are restricted to Veracruz. We found 23 new records for the municipality of Zongolica, *Quercus ghiesbreghtii* in the cf for the first time, and *Q. furfuraceae* for Veracruz; 86 species are threatened.

Conclusions: The BR has a high floristic richness compared to other areas with cf in Mexico, revealing the importance to complete the floristic studies along the Sierra de Zongolica. Due the high number of threatened species in the BR its long-term conservation acquires a greater importance.

Key words: conservation, endemism, growth forms, threatened species.

Resumen

Antecedentes: La Reserva del Bicentenario (BR) ubicada en la Sierra de Zongolica, Veracruz, contiene 63 hectáreas de bosque mesófilo (bm) que carece de estudios florísticos sistemáticos, mientras que la sierra se ha propuesto como área para la conservación de las aves.

Preguntas: i) ¿La composición florística de la BR es rica taxonómicamente? ii) ¿Cómo están representadas las formas de crecimiento en esta Reserva? iii) ¿La RB tiene especies endémicas o en peligro de extinción?

Especies en estudio: Plantas Vasculares.

Sitio de estudio y fechas: La BR fue explorada de marzo de 2011 a octubre de 2012.

Métodos: Muestras botánicas de cada especie considerada diferente se colectaron y procesaron con procedimientos convencionales para ser identificadas con herramientas taxonómicas y consulta con especialistas. Se realizaron análisis de la riqueza de especies, formas de crecimiento, endemismo y especies en riesgo.

Resultados: Registramos 401 especies, distribuidas en 272 géneros y 102 familias; Orchidaceae, Asteraceae, Fabaceae y Piperaceae son las más diversas, mientras que los géneros *Peperomia*, *Tillandsia*, *Polypodium*, *Quercus* y *Solanum* tienen el mayor número de especies. Sesenta y nueve especies son endémicas de México y seis están restringidas a Veracruz. Encontramos 23 registros nuevos para el municipio de Zongolica, *Quercus ghiesbreghtii* por primera vez en bm, *Q. furfuraceae* en Veracruz y 86 especies amenazadas.

Conclusiones: La RB tiene una alta riqueza florística comparada con otras áreas de México con bm, revelando la importancia de completar los estudios florísticos de la Sierra de Zongolica. Debido a alto número de especies amenazadas en la RB su conservación a largo plazo adquiere gran importancia.

Palabras clave: conservación, endemismo, especies amenazadas, forma de crecimiento.

Author Contributions

This paper is derived from the bachelor's thesis of L. A. Castillo-Hernández guided by H. Flores-Olvera as the main adviser. Both conducted fieldwork and contributed to the content and revisions of the paper.

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The cloud forest (cf) (*sensu* Rzedowski 1978a) is a set of plant communities distributed along the mountains, having diverse structures, floristic affinities and species compositions (CONABIO 2010). They have a discontinuous distribution, but they occupy an area of 0.5 to 1 % of the national territory (González-Espinosa *et al.* 2011, Gual-Díaz & González-Medrano 2014). The cf concentrate a high floristic richness which goes from 2,500 to 2,822 species; the highest per unit of surface among all vegetation types in Mexico (Rzedowski 1996, Villaseñor 2010). The largest extension of cf is located in the Sierra Madre Oriental, the Sierra Norte de Oaxaca, the Sierra Madre del Sur, the Northern Chiapas mountains and the Sierra Madre de Chiapas (González-Espinosa *et al.* 2011). This vegetation is severely threatened due to land use change, which has reduced its original cover by half (Challenger 1998) and due to only 12 % of the cover in Mexico being protected (Ponce-Reyes *et al.* 2012).

Studies on cf have focused on both floristic and structural aspects in at least 83 localities in the country (Ruiz-Jiménez *et al.* 2012), but specially in Chiapas (Ramírez-Marcial 2001), State of Mexico (López-Pérez *et al.* 2011), Guerrero (Meave *et al.* 1992; Catalán-Everástio *et al.* 2003), Hidalgo (Luna *et al.* 1994, Alcántara-Ayala & Luna-Vega 2001, Ponce-Vargas *et al.* 2006), Jalisco (Sánchez-Rodríguez *et al.* 2003), Oaxaca (Acosta-Castellanos 1997, Mejía-Domínguez *et al.* 2004, Ruiz-Jiménez *et al.* 2000, Lorea & Munn 2005), Morelos (Luna-Vega *et al.* 1989), Querétaro (Cartujano *et al.* 2002) and Tamaulipas (Cavazos-Camacho 2000).

In the state of Veracruz, the cf covers approximately 135,271 ha, with approximately 2,028 plant species (Castillo-Campos *et al.* 2011). The majority of the 19 studies on this vegetation type focus on the central zone of the state (Ruiz-Jiménez *et al.* 2012). The Sierra de Zongolica, located in the central zone of the state, is part of the physiographic province of the Sierra Madre del Sur (Medina-Chena *et al.* 2010). The biological exploration of the zone has been focused mainly on the knowledge of birds being proposed as an Important Area for Bird Conservation (AICA 15 Sierra de Zongolica) (Arizmendi & Márquez-Valdemar 2000).

Regarding the botanical studies of the Sierra de Zongolica, Vázquez-Torres (1977) identified six vegetation types and contributed a list of 290 species. The floristic studies have mainly focused on the study of the epiphytes of the cloud forest in La Quinta Ecological Reserve, Zongolica (Flores-Méndez 2008, Viccon-Esquivel 2009). Etnobotanical studies of the region emphasize the cultural richness in Tlaquilpa (Pérez-Pacheco 1992, López & Reyes 1997), Astacinga (Navarro-Pérez & Avendaño-Reyes 2002), Soledad Atzompa (Trueba-Sánchez 2009) and Tequila (Mata-Labrada 2011, Martínez-Bolaños 2012). Montoy-Koh (2010) recorded 94 plant species in the Sierra de Zongolica useful for bees (*Apis mellifera* L.) 69 of them from the cf.

In the study of the cf of Mexico, CONABIO (2010) classifies the forests of the Huautla-Zongolica subregion of Sierra Norte de Oaxaca, where the area of this study is located, as forests of low quality and under a high threat, since the area is highly affected by degradation processes and by deforestation due to the demand of agricultural lands.

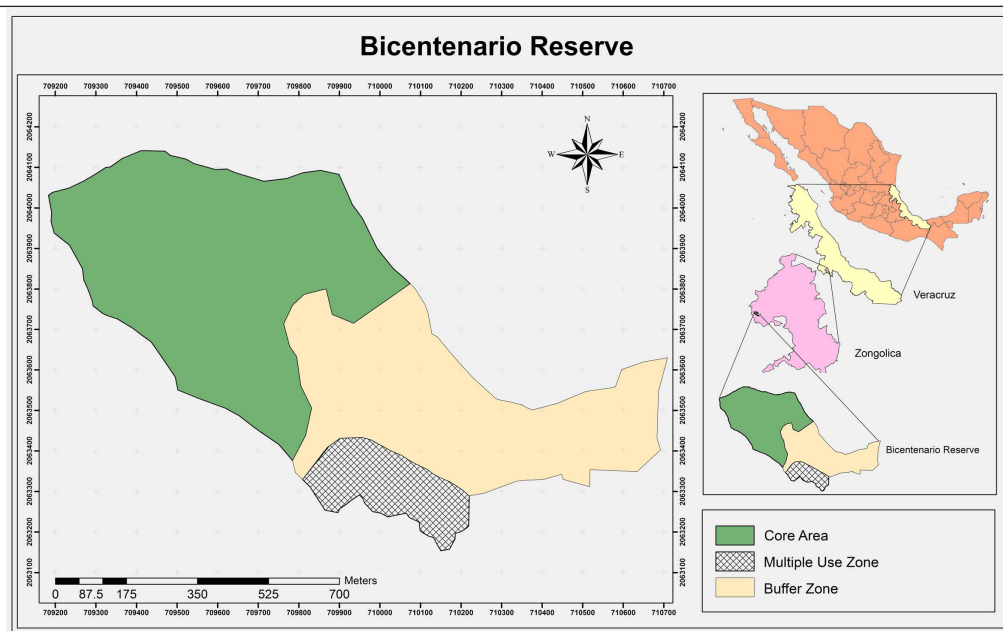
As a contribution to evaluate the plant richness of the Bicentenario Reserve, and to know the value for conservation we aim: i) to know the floristic composition of the BR, ii) to know the growth forms of the area, and iii) to document if there are endemic and/or threatened species to the area.

Material and methods

Area of study. The Bicentenario Reserve (Figure 1) is located northeast of the municipality of Zongolica (Figure 1B), between 18° 39' 01.89" and 18° 39' 27.36" North and 97° 00' 35.6" and 97° 0' 55.62" West, along an altitudinal interval of 1,313 to 1,560 m. It belongs to the Instituto Tecnológico Superior of Zongolica (Figure 2A) and was decreed as an Área Privada de Conservación on March 30th, 2009; it benefits about 2,000 inhabitants (Rodríguez-Luna *et al.* 2011). The Reserve has an extension of 63 ha and is divided in three zones: Core Area, Multiple Use Zone and Buffer Zone (Figure 1). The Reserve borders the *ejido* Olla Chica to the East and Northeast, whilst the rest adjoins private terrains.

Physiographically, the Bicentenario Reserve is located in the province of the Sierra Madre del Sur, within the subprovince of the Sierras Orientales, whose northern portion is known as Sierra de Zongolica, which is less abrupt than the rest of the subprovince and where Cretaceous

Figure 1. Area of study. **A)** Location of the Bicentenario Reserve. **B)** Zonification (map modified from the one from the ITZ).



calcareous rocks predominate, giving it affinity to the Sierra Madre Oriental (Medina-Chena *et al.* 2010). The soil is a luvisol (INEGI 2009).

According to data from the Zongolica meteorological station (18° 40' 00" N, 97° 00' 00" W; 1,294 meters above sea level), the climate is humid template with rains along the year. The mean annual precipitation is 2,770 mm, and the mean annual temperature is 17.5 °C, being May the warmest month (26.4 °C) and February the coldest (7.7 °C). The mean annual number of days with mist is 48.4 (SMN, 2014) and the climate formula is C(fm)b(e) (García 1973). Regarding hydrography, the La Compañía stream is located in the southeastern limit of the area of study (Figure 2B).

Field- and deskwork. We explored the Bicentenario Reserve from March 2011 to October 2012 during nine field walks, lasting two to four days each. All the paths of the Reserve were walked in each visit. The entire plants in the case of herbs or branches of shrubs and trees, were collected from species considered distinctively different along the paths, selecting the individuals in the best state of flowering and/or fructification. The botanical samples collected were pressed in the field and dried out later at the Herbario Nacional de México (MEXU). The specimens were identified in the Departamento de Botánica, in the Instituto de Biología, UNAM, with the available tools, such as electronic keys; Milliken *et al.* 2009 onwards, Nixon 2001-2002; regional floras, especially the Flora de Veracruz (Gómez-Pompa & Sosa 1978-1991, Sosa 1992-2005; Castillo-Campos 2006-2013), Flora of Guatemala (McVaugh 1963, Nash & Williams 1976,

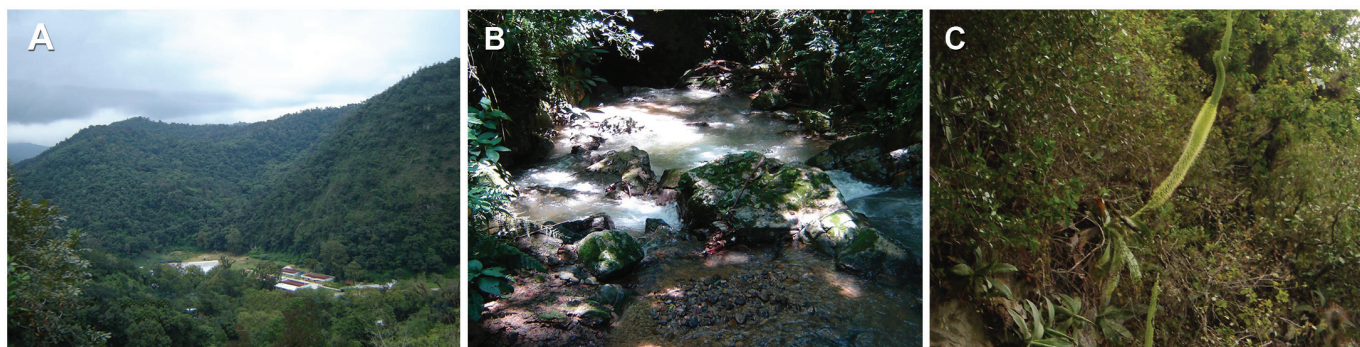


Figure 2. Area of study. **A)** View of the Instituto Tecnológico and the Reserve surroundings. **B)** La Compañía stream. **C)** *Agave gomez-pompa*, endemic species to Amatlán and Zongolica, Veracruz.

Standley & Steyermark 1946-1958, Standley & Williams 1961-1962, 1975. Standley *et al.* 1970-1974.), Flora del Bajío y de Regiones Adyacentes (Rzedowski & Calderón de Rzedowski 1985-2013), Flora Mesoamericana (Davidse *et al.* 1994, 1995, 2009, 2012), Flora de Nicaragua (Stevens *et al.* 2009), and specialized literature such as The Pteridophytes of Mexico (Mickel & Smith 2004), Trees and Shrubs of Mexico (Standley 1920-1926); species revisions and plant descriptions (*e.g.* Rzedowski 1978b, Zavala-Chávez 1989, Valencia 1995, González-Villarreal 2005, McMillan *et al.* 2006, Ibarra-Manríquez *et al.* 2012). Determinations were checked against specimens at MEXU, and images of mainly type specimens from electronic pages such as Tropicos.org and JSTOR Global Plants (2000-2013). In the cases of problematic specimens for determination experts in several groups were consulted (see acknowledgements).

In order to know the areas of distribution of the species founded in the BR, the same references used for specimen determination were consulted, as well as Luna-Vega *et al.* (2004), Villaseñor (2010), González-Espinosa *et al.* (2011), Viccon-Esquivel & Krömer (2012), Vergara-Rodríguez (2013). In order to know the risk categories of the species in the Bicentenario Reserve, the Norma Oficial Mexicana-NOM 059 (SEMARNAT 2010) and The Red List of Mexican Cloud Forest Trees (González-Espinosa *et al.* 2011) were consulted.

The first duplicates of the voucher specimens were deposited in MEXU. Duplicates of these vouchers were deposited in the Instituto Tecnológico Superior de Zongolica (ITZ), the Herbario del Instituto de Ecología A.C. (XAL), and the Missouri Botanical Garden (MO).

The list of the species identified follows APG III (Stevens 2001 onwards) for the Angiosperm families, and Mickel & Smith (2004) for pteridophytes. The species are listed alphabetically by the groups Monilophyta, Lycopodiophyta, Pinophyta and Magnoliophyta. The species names were standardized according to The International Plant Name Index.

Results

Floristic Composition. We collected 641 botanical specimens which represent 102 families, 272 genera and 401 species (Appendix 1 and Table 1). Among the groups of vascular plants, Magnoliophyta is the most numerous, followed by Monilophyta and Lycopodiophyta, whilst Pinophyta is represented by only one species (Table 1). Regarding the species number, the most diverse families are Orchidaceae with 36 (9 %), Asteraceae with 30 (7.5 %), Fabaceae with 22 (5.5 %), Rubiaceae and Polypodiaceae both with 17 each (4.2 %), Bromeliaceae with 16 (4 %), Piperaceae with 15 (3.7 %), Malvaceae and Solanaceae both with 13 each (3.2 %) and Fagaceae with 11 (2.7 %). The rest of the families includes 211 species, corresponding to 52.6 % (Table 2). The most rich families in number of genera are Asteraceae with 27 (9.9 %), Orchidaceae with 23 (8.5 %), Fabaceae with 18 (6.6 %), Rubiaceae with 16 (5.9 %), Malvaceae with 7 (2.6 %), Polypodiaceae and Poaceae both with 6 each (2.2 %), Lamiaceae, Melastomataceae, Pteridaceae and Urticaceae all with 5 each (1.8 %); the remaining families have 149 genera, representing 54.8 % (Table 2). The genera with the largest number of species are *Peperomia*, *Quercus*, *Tillandsia*, *Polypodium* and *Solanum* (Table 2). The predominant growth form is herbaceous with 135 species (33.67 %), followed by trees with 82 (20.45 %), epiphytes with 79 (19.70 %), shrubs with 72 (17.96 %), climbers with 29 (7.23 %), arborescent with 2 (0.50 %), holoparasites and hemiparasites both with 1 (0.25 %) species each (Table 3).

Forest characterization. Trees of *Liquidambar styraciflua* up to 20 meters height are better represented in the core area, while in the lowest part of the Reserve and along the La Compañía

Table 1. Vascular plant richness (percent in parenthesis) in the Bicentenario Reserve, Zongolica, Veracruz.

Group	Number of species	Number of genera	Number of families
Monilophyta	42 (10.47)	26 (9.56)	12 (11.77)
Lycopodiophyta	3 (0.75)	2 (0.74)	2 (1.96)
Pinophyta	1 (0.25)	1 (0.37)	1 (0.98)
Magnoliophyta	355 (88.53)	243 (89.34)	87 (85.29)
TOTAL	401	272	102

Table 2. Families and genera with the highest number of species in the Bicentenario Reserve, Zongolica, Veracruz.

Family	Number of genera/species	Genus (Family)	Number of species
Asteraceae	27/30	<i>Peperomia</i> (Piperaceae)	11
Orchidaceae	23/36	<i>Quercus</i> (Fagaceae)	11
Fabaceae	18/22	<i>Tillandsia</i> (Bromeliaceae)	11
Rubiaceae	16/17	<i>Polypodium</i> (Polypodiaceae)	9
Malvaceae	7/13	<i>Solanum</i> (Solanaceae)	7
Polypodiaceae	6/17	<i>Salvia</i> (Lamiaceae)	5
Poaceae	6/8	<i>Miconia</i> (Melastomataceae)	4
Lamiaceae	5/10	<i>Epidendrum</i> y <i>Prosthechea</i> (Orchidaceae)	4/4
Melastomataceae	5/8	<i>Smilax</i> (Smilacaceae)	4
Pteridaceae	5/6	<i>Piper</i> (Piperaceae)	4
Urticaceae	5/6	<i>Ipomoea</i> (Convolvulaceae)	4
Bromeliaceae	4/16	<i>Maxillaria</i> y <i>Jacquinella</i> (Orchidaceae)	3/3
Solanaceae	4/13	<i>Saurauia</i> (Actinidiaceae)	3
Piperaceae	2/15	<i>Cestrum</i> (Solanaceae)	3
Fagaceae	1/11	<i>Desmodium</i> (Fabaceae)	3
Total	134/227	Total	93

stream (Figure 2B), *Platanus mexicana* is the tallest tree. In the buffer zone *Pinus pseudostrobus* var. *apulcensis* is among the tallest trees with approximately 18 m. This layer is composed by species of *Carpinus*, *Citharexylum*, *Clethra* (Figure. 3I), *Clusia* (Figure 3F), *Cornus*, *Hedyosmum*, *Myriocarpa*, *Myrsine*, *Ocotea*, *Oreopanax*, *Ostrya*, *Phyllonoma* (Figure 3E), *Picramnia*, *Prunus*, *Quercus*, *Rhamnus*, *Saurauia*, *Symplocos*, *Ternstroemia*, *Trema*, *Turpinia*, *Viburnum*, etc. Species of *Bunchosia*, *Deppea*, *Erythrina*, *Hampea*, *Heliocarpus*, *Ilex*, *Juglans*, *Litsea*, *Nectandra* (Figure 3A), *Nyssa*, and *Tilia* can also be found. Arborescent ferns species of *Alsophila* and *Cyathea* up to 3 or 4 meters height can be found. Towards the lowest parts of the Reserve, species of *Ficus* are present while in the southeastern slope close to the La Compañía stream (Figure 2B) we find *Arachnothryx* aff. *buddleioides*, *Myrcianthes fragans*, *Perrottetia longistylis*, *Platanus mexicana*, *Siparuna thecaphora* and *Sommeria arborescens*.

In the more pronounced slopes, rupicolous species, such as *Agave ellemetiana*, *A. gomez-pompae* (Figure 2C), *Echeveria rubromarginata* and *Tillandsia grandis* are found. The epiphytes are very rich, growing in dense groups on the trunks and branches of the trees; among them there are many orchids, bromeliads, ferns and Piperaceae and Araceae species from the genera *Asplenium*, *Brassia*, *Campyloneurum*, *Catopsis*, *Elaphoglossum*, *Epidendrum*, *Huperzia*, *Jacquinella*, *Maxillaria*, *Monstera*, *Nidema*, *Peperomia*, *Phlebodium*, *Polypodium*, *Sedum*, *Sobralia* and *Tillandsia*. The holoparasites and hemiparasites found in the Reserve are *Conocepholis alpina* and *Phoradendron nervosum*, respectively, the latter being better represented in the zones where the Reserve borders with coffee plantations and paths.

Table 3. Life forms in the Bicentenario Reserve, Zongolica, Veracruz.

Growth forms	Number of species
Herb	135
Tree	82
Epiphyte	79
Shrub	72
Climber	29
Arborescent	2
Hemiparasite	1
Holoparasite	1
Total	401

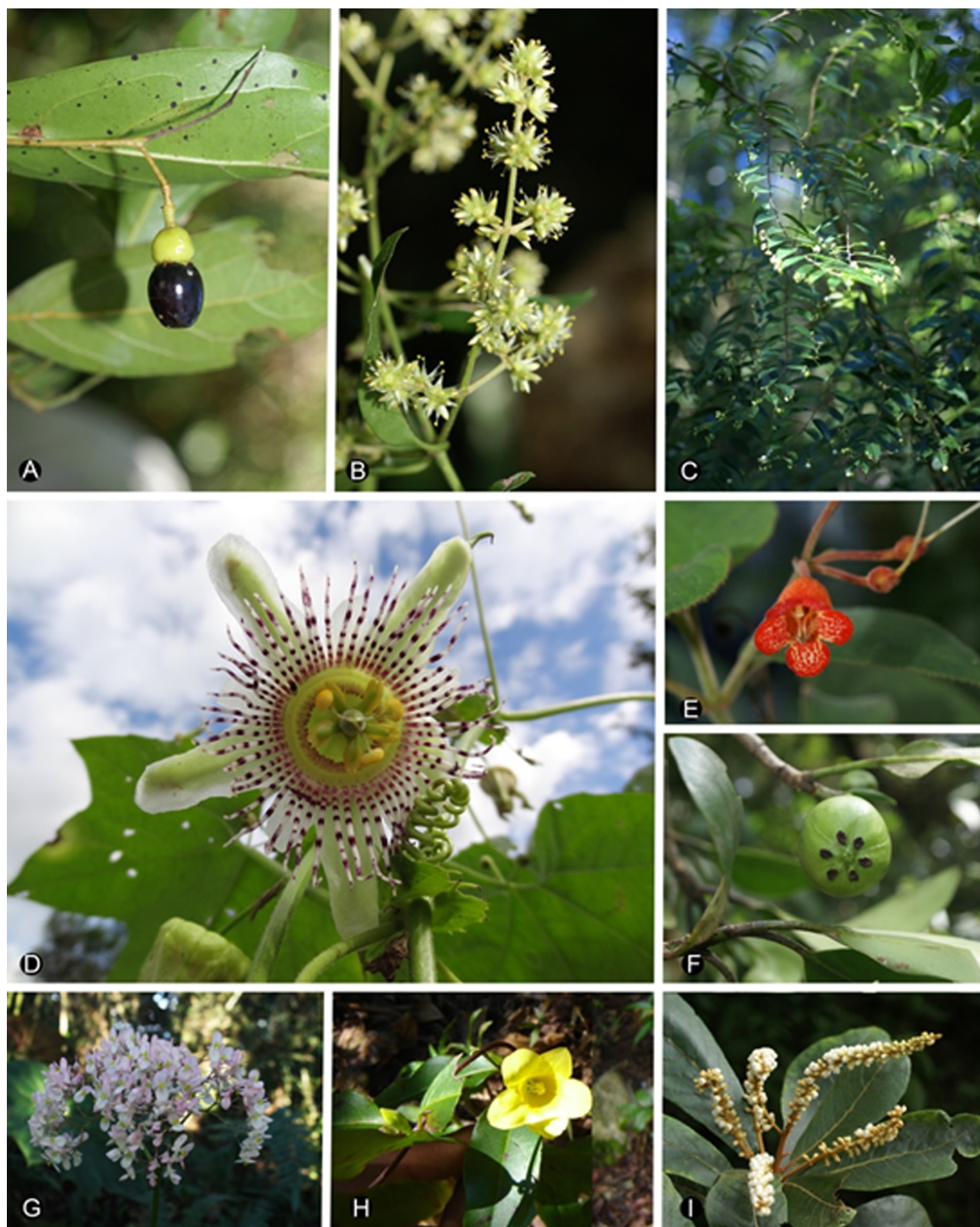


Figure 3. Some species of the flora of the Bicentenario Reserve. **A)** *Nectandra salicifolia*, near threatened. **B)** *Iresine hebanthoides*, endemic to México. **C)** *Phyllonoma laticuspis*, vulnerable. **D)** *Passiflora adenopoda*. **E)** *Moussonia deppeana*. **F)** *Clusia flava*. **G)** *Begonia barkeri*, endemic to Veracruz and Puebla. **H)** *Gelsemium sempervirens*. **I)** *Clethra macrophylla*, endemic to México. Photographies A-F by Helga Ochoterena Booth, G. by Alejandro Torres Montúfar, and H by Luis Alfonso Castillo-Hernández.

The buffer zone and borders of the Reserve, have species of shrubs of the genera *Aphelandra*, *Ardisia*, *Bartlettina*, *Cestrum*, *Chiococca*, *Conostegia*, *Gaultheria*, *Lepidaploa*, *Lyonia*, *Miconia*, *Mimosa*, *Moussonia* (Figure 3E), *Palicourea*, *Piper*, *Psychotria*, *Rogiera*, *Xylosma* and *Zapoteca*. Among the climbers, both the herbaceous and woody ones, the best represented are *Archibaccharis schiedeana*, *Cologania broussonetii*, *Clitoria mexicana*, *Gelsemium sempervirens* (Figure 3H), *Helicotropis linearis*, *Iresine hebanthoides* (Figure 3B), *Passiflora adenophora* (Figure 3D), *Rhynchosia longeracemosa*, *Selenicereus hamathus*, *Smilax* spp, *Toxicodendron radicans*, *Valeriana candolleana* and *Vitis* spp. The herbaceous plants are species of *Achimenes*, *Anthurium*, *Begonia* (Figure 3G), *Chamaedorea*, *Coccocypselum*, *Cuphea*, *Desmodium*, *Elaphoglossum*, *Govenia*, *Habenaria*, *Lisianthus*, *Oldenlandia*, *Peperomia*, *Polypodium*, *Salvia*, *Sticherus*, *Thelypteris*, *Tradescantia* and *Tripogandra* in addition to species of Asteraceae.

Species under risk category. Out of the 401 species collected in the Reserve, 86 of them (21.44 %) are included in some of the categories in the NOM 059 (SEMARNAT 2010) or in The Red List of Mexican Cloud Forest Trees (González-Espinosa *et al.* 2011); four of them are cited in both lists: *Litsea glaucescens*, *Juglans pyriformis*, *Carpinus caroliniana* and *Ostrya virginiana*. Ten species are listed under some of the risk categories proposed in the NOM 059 (SEMARNAT 2010); two of them are in risk of extinction (P): *Litsea glaucescens* and *Tilia americana* var. *mexicana*; five are threatened (A): *Psilotum complanatum*, *Juglans pyriformis*, *Chamaedorea schiedeana*, *Carpinus caroliniana* and *Tillandsia tricolor*, whilst three are under special protection: (Pr) *Cyathea divergens* var. *tuerckheimii*, *Alsophila firma* and *Ostrya virginiana*. Out of the 80 species found in The Red List of Mexican Cloud Forest Trees categories (González-Espinosa *et al.* 2011), seven of them are Endangered (EN), 19 Vulnerable (VU), 10 Near Threatened (NT), 43 Least Concern (LC) and one Data Deficient (DD) (see Appendix 1).

Endemism. The Bicentenario Reserve contains 69 species that distributes only within the borders of Mexico and represent the 17.2 % of the total found species (see Appendix 1). Six of them are known only from some parts of the state of Veracruz: *Agave gomez-pompae* (Figure 2C) from Amatlán and Zongolica; *Clethra tuxtlensis* from Los Tuxtlas and Zongolica; *Erythrina berenices* from Chiconquiaco, Yecuatla, Xalapa, San Andrés Tuxtla and Zongolica; *Quercus ghiesbreghtii* from Yecuatla, Ixhuatlán de los Reyes and Zongolica, as well as *Hampea integerrima* and *Cuphea nitidula* which are known from the central zone of the state.

New records. In the Bicentenario Reserve, were found 23 species that extend its distribution into the municipality of Zongolica. For example, *Quercus furfuraceae* is a new report for the state of Veracruz, since its distribution was considered previously only for Michoacán, Puebla (Valencia-A 2004), Oaxaca and San Luis Potosí (Villaseñor 2010). *Quercus dysophylla* was only known from the municipalities of Acultzingo, Huayacocotla and Tlalnelhuayocan, Veracruz; *Quercus ghiesbreghtii*, was only known from Yecuatla and Ixhuatlán de los Reyes, Veracruz, and it is the first record in a cloud forest, since it is not cited for this type of vegetation by Villaseñor (2010) or Valencia-A & Gual-Díaz (2014). Other species that extend their distribution into the Zongolica municipality in the present contribution are *Cornus excelsa* known from Huayacocotla, Orizaba and Xalapa, *Gelsemium sempervirens* from Acajete, Atzalan, Banderilla, Calchualco, Chiconquiaco, Coatepec, Huayacocotla, Huatusco, Jilotepec, Naolinco, Rafael Lucio, Soteapan, Tlacolulan, Tlalnelhuayocan, Xalapa and Xico, *Nyssa sylvatica* from Atzalan, *Peperomia consoquitlana* from Atoyac, Coatepec, Ixtaczoquitlan, Jilotepec, Naolinco, Orizaba, San Andrés Tuxtla and Xalapa, *P. epidendron* from Orizaba, Tenochtitlan, Tlacotepec de Mejia and Totula, *Ponthieva rinconii* from Coetzala, *Racinaea ghiesbreghtii* from Coatepec, Huatusco, Jilotepec, Tlalnelhuayocan, Xalapa and Xico.

Discussion

In the Bicentenario Reserve a group of families that Rzedowski (1996) considered as thriving preferentially in the cloud forest, or whose genera can thrive exclusively or almost exclusively in the cloud forest, is found. Among the former, there are Actinidiaceae, Aquifoliaceae, Begoniaceae, Clethraceae, Cornaceae, Cyatheaceae, Gesneriaceae, Gleicheniaceae, Lauraceae, Lycopodiaceae, Marattiaceae, Monimiaceae, Myrsinaceae, Orchidaceae, Piperaceae, Selaginellaceae,

Staphyleaceae, Symplocaceae and Theaceae (Pentaphylacaceae). And among the ones whose genera thrive in the cloud forest are Chloranthaceae, Hamamelidaceae (=Altingiaceae) and Nys-saceae (=Cornaceae). Some of the tree genera with a quantitatively importance in the cloud forest (Rzedowski 1996) found in the Bicentenario Reserve are *Alnus*, *Carpinus*, *Clethra*, *Cornus*, *Juglans*, *Liquidambar*, *Nyssa*, *Oreopanax*, *Prunus*, *Quercus*, *Symplocos* and *Ternstroemia*.

The cf of the Bicentenario Reserve contains a rich floristic composition with at least 401 species of vascular plants, representing the 16.4 % of the floristic richness estimated for this vegetation type in Mexico by Rzedowski (1996), or 14.21 % of the richness estimated by Villaseñor (2010) and the 19.77 % out of the total species number recorded in the cf in the state of Veracruz (Castillo-Campos *et al.* 2011). This richness is high, taking into account the reduced sampling area (63 ha = 0.63 km²) compared to other areas studied in the state of Veracruz, such as Teocelo, where Luna *et al.* (1988) recorded 271 species in approximately 21 km² (= 2,100 ha); Huayacocotla, where Juárez-Medina (2008) recorded 494 species from the information of three previous works and their samplings in 20 km² (= 2,000 ha), or La Cortadura, Coatepec, where García-Franco *et al.* (2008) recorded 258 species in 3,000 m² (= 0.3 ha, = 0.003 Km²). In Hidalgo, 336 species were recorded in Tlanchinol (Luna *et al.* 1994), 359 in Lolotla (Ponce-Vargas *et al.* 2006), 287 in Eloxochitlan and 233 in Tahuelompa (Alcántara-Ayala & Luna-Vega 2001). In the cf of Landa de Matamoros (Querétaro), Cartujano *et al.* (2002) recorded 774 species while studying an area of approximately 54 km² and a greater sampling effort, with 14 monthly field walks, from March 1998 to April 2000, each lasting four to five days.

The high number of fern species (pteridophytes and related) found in the Bicentenario Reserve can be an indicator that the forest is conserved, since ferns require very particular environmental conditions for their growth, such as intense shade and high humidity (Williams-Linera 2012). These are the reasons for which ferns are represented by a larger number of species in the cf than in any other vegetation type (Challenger 1998). The presence of arborescent ferns in the Reserve shows low perturbation conditions for a long time period, in addition to them being a distinctive characteristic of the cf, due to their absence in any other type of primary vegetation (Challenger 1998, Luna *et al.* 2001).

Regarding growth forms, the highest numbers of species are herbs, which are better represented in the buffer zone, since logging and transit of people are common in this part of the Reserve. The borders of the Reserve favor the diversification of herbs, whereas in the core area a lower number of herbs was found. Luna *et al.* (2001) consider that the low amount of light penetrating the cf prevents the development and diversification of herbs, whereas its development is favored in the margins and they diversify as the disturbance increases.

The sampling of *Quercus furfuracea* for the first time in the state of Veracruz, of *Quercus ghiesbreghtii* for the first time in a cf, as well as of *Peperomia consoquitlana*, *P. epidendron*, *Quercus dysophylla*, *Q. ghiesbreghtii*, and other species which extend their known distribution into the Zongolica municipality exemplifies the need to explore the zone, which would remarkably improve the phytogeographical analyses.

It is interesting to emphasize that in the taxonomical treatments of some families of the Flora de Veracruz the presence of some species is not recorded for Zongolica, so they also extend their distribution into this municipality (e.g., *Cornus excelsa*, *Nyssa sylvatica*, *Racinaea ghiesbreghtii* and *Gelsemium sempervirens*). In this work, species of epiphytes not recorded by Flores-Méndez (2008), Viccon-Esquivel (2009), or Viccon-Esquivel & Krömer (2012) for Zongolica were found. Among them *Asplenium praemorsum*, *Catopsis morreniana*, *Dryopteris patula*, *Echeveria rosea*, *Mainthium macrophyllum*, *Maxillaria cucullata*, *Myoxanthus congestus*, *Peperomia galioides*, *P. pililimba*, *P. rhexiifolia*, *Polypodium fraterum*, *P. plesiosorum*, *Prosthechea cochleata*, *P. chondylobulbon*, *Sedum botterii*, *Stelis emarginata*, *Tillandsia leiboldiana* and *Xylobium sulfuri-num*, increasing the epiphyte diversity in the municipality, even though the mentioned authors reported a greater number of species not found in the area of study.

Due to the deterioration of the vegetation in a large part of the Sierra de Zongolica and to the Reserve terrain currently being private property, it is common to find species that according to literature thrive in perturbed places, such as *Bidens squarrosa*, *Cyclospermum leptophyllum*, *Elephantopus mollis*, *Fleischmannia pycnocephala*, *Gaultheria acuminata*, *Lantana camara*, *Miconia mexicana*, *Psidium guajava*, *Sida rhombifolia*, *Triumfetta bogotensis*, *Verbena carolina*,

Witheringia solanacea and *Viguiera cordata*. The presence of other species such as *Conostegia xalapensis* indicate that a secondary succession is under process, whereas other such as *Epidentrum radicans* and *Erigeron karvinskianus* are ruderals. Nonetheless, these are mainly found in the paths of the buffer zone, in the multiple-use zone and in the borders of the Reserve, where there is a larger transit of people and so the amount of light penetrating the forest is higher. In the Bicentenario Reserve there are seven introduced species *Hypoestes phyllostachya*, *Ocimum campechianum*, *Ricinus communis* and *Trifolium repens*, from the Old World (Villaseñor & Espinosa-García 2004), *Impatiens walleriana* from South America, *Eriobotrya japonica* native from China (Pankhurst 2009) and *Kalanchoe pinnata* introduced from Africa and Madagascar (Brunner 2009). These species are still scarce and are found in the borders of the Reserve or in the buffer zone.

The presence in the Bicentenario Reserve of 86 species included in the NOM-059 (SEMARNAT 2010) and in the The Red List of Mexican Cloud Forest Trees (González-Espinosa *et al.* 2011) stress the importance of the reservation as a biodiversity refuge, protecting species of great importance in the Mexican flora. As Martínez-Camilo *et al.* (2012) mention, the role performed by a protected area, the Bicentenario Reserve in this case, in the conservation of biodiversity acquires a greater importance when the species under threat, in danger of extinction or in another risk category, are known. Based on this information it is possible to promote more appropriate conservation policies, focused on the species that need them, that is why these species need special attention and why actions for their conservation and preservation in the ecosystem should be taken.

Conclusions

This first contribution to the knowledge of the flora of the cf in the Bicentenario Reserve in particular and in the Zongolica municipality in general, emphasizes its high floristic richness, with 401 species, 272 genera and 102 families of vascular plants, representing the 19.77 % of the total species number recorded in the cf of the state of Veracruz and between 14.21 and 16.04 % of the floristic richness estimated for this vegetation type in Mexico.

Despite the cf of the region having been cataloged as of low quality, the remnant flora, according to the results of this work, contains a high species richness, with 69 species endemic to Mexico, out of which eight are endemic to the state of Veracruz, as well as species in some risk category and species never before recorded for the zone. The conservation of the Reserve should be a priority, nonetheless because it has ten species considered in the NOM 059 (SEMARNAT, 2010) and 80 in The Red List of Mexican Cloud Forest Trees (González-Espinosa *et al.* 2011).

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Appendix 1. Floristic composition of the Bicentenario Reserve, Zongolica, Veracruz. Voucher number refers to the collections of the first author (LA Castillo-Hernández), except those of the Instituto Tecnológico de Zongolica marked as ITS. Categories in the NOM 059-SEMARNAT (2010): **P** (risk of extinction), **A** (threatened), **Pr** (special protection). The Red List of Mexican Cloud Forest Trees Categories (González-Espinosa *et al.* 2011): **EN** (endangered), **VU** (vulnerable), **NT** (near threatened), **LC** (least concern), **DD** (data deficient). * = endemic to Mexico.

Taxa	Voucher number	Growth form	NOM 059	The Red List of Mexican Cloud Forest Trees Categories
MONILOPHYTA				
Aspleniaceae				
<i>Asplenium cuspidatum</i> Lam.	322	Epiphyte		
<i>Asplenium miradorensense</i> Liebm.	416	Herb		
<i>Asplenium praemorsum</i> Sw.	160	Epiphyte		
Cyatheaceae				
<i>Cyathea divergens</i> var. <i>tuerckheimii</i> (Maxon) R.M. Tryon	337	Arborescent	Pr	
<i>Alsophila firma</i> (Baker) D.S. Conant	336	Arborescent	Pr	
Dennstaedtiaceae				
<i>Pteridium aquilinum</i> (L.) Kuhn	ITSZ	Herb		
Dryopteridaceae				
<i>Dryopteris patula</i> (Sw.) Underw.	562	Epiphyte		
* <i>Elaphoglossum sartorii</i> (Liebm.) Mickel	581, 584, 612	Herb		
* <i>Elaphoglossum vestitum</i> (Schltdl. & Cham.) T. Moore	578	Epiphyte		
<i>Phanerophlebia remotispora</i> E.Fourn.	102, 280, 545	Herb		
<i>Polystichum distans</i> E.Fourn.	526	Herb		
Gleicheniaceae				
<i>Sticherus palmatus</i> (W.Schaffn. ex E. Fourn.) Copel	100, 308	Herb		
Marattiaceae				
<i>Marattia laxa</i> Kunze	534	Herb		
Polypodiaceae				
<i>Campyloneurum angustifolium</i> Fée	284, 605	Epiphyte		
<i>Campyloneurum xalapense</i> Fée	604, 614	Epiphyte		
<i>Niphidium crassifolium</i> (L.) Lellinger	99	Epiphyte		
<i>Pecluma alfredii</i> (Rosenst.) M.G.Price	603	Epiphyte		
<i>Pecluma plumula</i> (Humb. & Bonpl. ex Willd.) M.G.Price	716	Herb		
<i>Phlebodium areolatum</i> (Humb. & Bonpl. ex Willd.) J.Sm.	46, 48, 243	Epiphyte		
<i>Pleopeltis angusta</i> var. <i>stenoloma</i> Farw.	393	Herb		
<i>Pleopeltis crassinervata</i> T.Moore	162-A, 244	Epiphyte		
<i>Polypodium conterminans</i> Liebm.	307	Herb		
<i>Polypodium fraternum</i> Schltdl. & Cham.	585	Epiphyte		
* <i>Polypodium lepidotrichum</i> (Fée) Maxon	525	Herb		
<i>Polypodium plebeium</i> Schltdl. & Cham.	51, 606	Epiphyte		
<i>Polypodium plesiosorum</i> Kunze	162-B, 576	Epiphyte		
<i>Polypodium polypodioides</i> (L.) Watt	552	Herb		
<i>Polypodium rhodopleuron</i> Kunze	564, 721	Epiphyte		
<i>Polypodium subpetiolatum</i> Hook.	613	Epiphyte		
* <i>Polypodium villagranii</i> Copel.	728	Herb		

Appendix 1. Continuation.

Taxa	Voucher number	Growth form	NOM 059	The Red List of Mexican Cloud Forest Trees Categories
Psilotaceae				
<i>Psilotum complanatum</i> Sw.	350	Epiphyte	A	
Pteridaceae				
<i>Adiantum andicola</i> Liebm.	101	Herb		
<i>Llavea cordifolia</i> Lag.	129	Herb		
<i>Pityrogramma ebenea</i> (L.) Proctor	ITSZ	Herb		
<i>Pteris cretica</i> L.	563	Herb		
<i>Pteris longifolia</i> L.	601	Herb		
<i>Vittaria bradeorum</i> Rosenst.	481	Epiphyte		
Schizaeaceae				
<i>Anemia phyllitidis</i> (L.) Sw.	161	Herb		
Tectariaceae				
<i>Tectaria heracleifolia</i> (Willd.) Underw.	717	Herb		
Thelypteridaceae				
<i>Thelypteris oligocarpa</i> (Humb. & Bonpl. ex Willd.) Ching	586	Herb		
<i>Thelypteris hispidula</i> (Decne.) C.F.Reed	524	Herb		
<i>Thelypteris ovata</i> var. <i>lindheimeri</i> (C.Chr.) A.R.Sm.	24	Herb		
LYCOPODIOPHYTA				
Lycopodiaceae				
<i>Huperzia pithyoides</i> (Schltdl. & Cham.) Holub	357-A	Epiphyte		
<i>Huperzia taxifolia</i> (Sw.) Trevis.	357-B	Epiphyte		
Selaginellaceae				
<i>Selaginella stellata</i> Spring	16, 96	Epiphyte		
PINOPHYTA				
<i>Pinus pseudostrobus</i> var. <i>apulcensis</i> (Lindl.) Shaw	Pinaceae 78, 79, 500	Tree		
MAGNOLIOPHYTA				
Acanthaceae				
<i>Aphelandra schiedeana</i> Schltdl. & Cham.	108, 270	Shrub		
<i>Hypoestes phyllostachya</i> Baker	175	Herb		
<i>Justicia pectoralis</i> Jacq.	22	Herb		
<i>Odontonema callistachyum</i> (Schltdl. & Cham.) Kuntze	487	Shrub		
Actinidiaceae				
<i>Saurauia leucocarpa</i> Schltdl.	453	Tree		VU
* <i>Saurauia pedunculata</i> Hook.	277, 468, 544	Tree		VU
* <i>Saurauia scabrida</i> Hemsl.	588	Tree		NT
Adoxaceae				
<i>Sambucus nigra</i> subsp. <i>canadensis</i> (L.) Bolli	472	Shrub		LC
* <i>Viburnum tiliifolium</i> (Oerst.) Hemsl.	83, 171, 230	Tree		VU
Alstroemeriaceae				
<i>Bomarea edulis</i> (Tussac) Herb.	267	Herb		
Altingiaceae				
<i>Liquidambar styraciflua</i> L.	455	Tree		LC

Appendix 1. Continuation.

Taxa	Voucher number	Growth form	NOM 059	The Red List of Mexican Cloud Forest Trees Categories
Amaranthaceae				
<i>Iresine diffusa</i> Humb. & Bonpl. ex Willd.	19, 288, 289, 295	Herb		
* <i>Iresine hebanthoides</i> Suess.	296, 328	Climber		
Anacardiaceae				
<i>Rhus terebinthifolia</i> Schltdl. & Cham.	278	Shrub		
<i>Toxicodendron radicans</i> (L.) Kuntze	434	Climber		
Apiaceae				
<i>Cyclospermum leptophyllum</i> (Pers.) Sprague ex Britton & P.Wilson	443	Herb		
<i>Sanicula liberta</i> Cham. & Schltdl.	348	Herb		
Apocynaceae (Asclepiadaceae)				
<i>Asclepias curassavica</i> L.	436	Herb		
Aquifoliaceae				
* <i>Ilex condensata</i> Turcz.	516	Tree		
<i>Ilex</i> sp.	315	Tree		
Araceae				
<i>Anthurium scandens</i> (Aubl.) Engl. subsp. <i>scandens</i>	557	Epiphyte		
<i>Anthurium schlechtendalii</i> Kunth	182, 406	Herb		
<i>Monstera deliciosa</i> Liebm.	149	Epiphyte		
* <i>Syngonium sagittatum</i> G.S.Bunting	346	Epiphyte		
Araliaceae				
<i>Hydrocotyle mexicana</i> Schltdl. & Cham.	163	Herb		
<i>Oreopanax capitatus</i> (Jacq.) Decne. & Planch.	252, 394, 499, 561	Tree		NT
Areaceae				
* <i>Chamaedorea schiedeana</i> Mart.	148, 299, 356	Herb	A	
Asparagaceae				
* <i>Agave ellemeeitiana</i> Jacobi	360	Herb		
* <i>Agave gomezpompae</i> Cházaro & Jimeno-Sevilla	359	Herb		
<i>Maianthemum macrophyllum</i> (M.Martens & Galeotti) LaFrankie	505	Epiphyte		
Asteraceae				
<i>Acourtia veracruzana</i> B.L.Turner	425	Herb		
<i>Ageratina ligustrina</i> (DC.) R.M.King & H.Rob.	273, 386	Shrub		
<i>Ageratum houstonianum</i> Mill.	20	Herb		
<i>Aldama dentata</i> La Llave	118, 730	Herb		
<i>Alloispermum integrifolium</i> (DC.) H.Rob.	6, 382, 489	Herb		
<i>Archibaccharis hirtella</i> (DC.) Heering	313	Climber		
<i>Archibaccharis schiedeana</i> (Benth.) J.D.Jacks.	145, 146, 297, 301	Climber		
<i>Bartlettina tuerckheimii</i> (Klatt) R.M.King & H.Rob.	398, 400	Shrub		
<i>Bidens odorata</i> Cav. var. <i>odorata</i>	150	Herb		
<i>Bidens squarrosa</i> Kunth	168, 729	Climber		
<i>Calyptocarpus wendlandii</i> Sch.Bip.	113, 542	Herb		

Appendix 1. Continuation.

Taxa	Voucher number	Growth form	NOM 059	The Red List of Mexican Cloud Forest Trees Categories
<i>Critonia hospitalis</i> (B.L.Rob.) R.M.King & H.Rob.	383, 495	Tree		
<i>Dahlia coccinea</i> Cav.	139	Herb		
<i>Decachaeta incompta</i> (DC.) R.M.King & H.Rob.	247	Shrub		
<i>Elephantopus mollis</i> Kunth	14, 384	Herb		
<i>Erigeron karvinskianus</i> DC.	13, 426	Herb		
<i>Fleischmannia pycnocephala</i> (Less.) R.M. King & H.Rob.	11, 261, 316, 404, 497	Herb		
<i>Fleischmanniopsis leucocephala</i> (Benth.) R.M.King & H.Rob.	475	Shrub		
<i>Hymenostephium cordatum</i> (Hook. & Arn.) S.F.Blake	287, 549, 722	Herb		
<i>Lagascea helianthifolia</i> Kunth	366	Shrub		
* <i>Leiboldia serrata</i> (D.Don) Gleason	362, 402	Shrub		
<i>Lepidaploa tortuosa</i> (L.) H.Rob.	268, 401	Shrub		
<i>Piqueria trinervia</i> Cav.	200, 428	Herb		
* <i>Roldana oaxacana</i> (Hemsl.) H.Rob. & Brettell	409	Herb		
<i>Roldana schaffneri</i> (Sch.Bip. ex Klatt) H.Rob. & Brettell	8, 496	Shrub		
* <i>Schistocarpha bicolor</i> Less.	407	Shrub		
<i>Tagetes filifolia</i> Lag.	179	Herb		
<i>Telanthophora grandifolia</i> (Less.) H.Rob. & Brettell	338	Tree		
<i>Tetrachyron manicatum</i> Schltdl.	387, 501	Shrub		
<i>Verbesina turbacensis</i> Kunth	724	Shrub		
Balsaminaceae				
<i>Impatiens walleriana</i> Hook.f.	574	Herb		
Begoniaceae				
* <i>Begonia barkeri</i> Knowles & Westc.	335, 392	Herb		
<i>Begonia</i> sp.	345	Herb		
Betulaceae				
<i>Alnus acuminata</i> Kunth	537	Tree		LC
<i>Carpinus caroliniana</i> Walter	71	Tree	A	NT
<i>Ostrya virginiana</i> (Mill.) K.Koch	73	Tree	Pr	NT
Bromeliaceae				
<i>Catopsis morreniana</i> Mez	228	Epiphyte		
<i>Catopsis sessiliflora</i> (Ruiz & Pav.) Mez	53, 566	Epiphyte		
<i>Pitcairnia heterophylla</i> (Lindl.) Beer	460	Epiphyte		
* <i>Racinaea adscendens</i> (L.B.Sm.) M.A. Spencer & L.B.Sm.	ITSZ	Epiphyte		
* <i>Racinaea ghiesbreghtii</i> (Baker) M.A. Spencer & L.B.Sm.	98	Epiphyte		
<i>Tillandsia butzii</i> Mez	464	Epiphyte		
<i>Tillandsia grandis</i> Schltdl.	583	Herb		
* <i>Tillandsia heterophylla</i> E.Morren	522	Herb		
<i>Tillandsia juncea</i> (Ruiz & Pav.) Poir.	ITSZ	Epiphyte		
* <i>Tillandsia kirchhoffiana</i> Wittm.	97	Epiphyte		

Appendix 1. Continuation.

Taxa	Voucher number	Growth form	NOM 059	The Red List of Mexican Cloud Forest Trees Categories
<i>Tillandsia leiboldiana</i> Schltdl.	70	Epiphyte		
<i>Tillandsia multicaulis</i> Steud.	188-B	Epiphyte		
<i>Tillandsia punctulata</i> Schltdl. & Cham.	363	Epiphyte		
<i>Tillandsia schiedeana</i> Steud.	ITSZ	Epiphyte		
<i>Tillandsia tricolor</i> Schltdl. & Cham.	58	Epiphyte	A	
<i>Tillandsia viridiflora</i> (Beer) Baker	593	Epiphyte		
Cactaceae				
* <i>Selenicereus hamatus</i> (Scheidw.) Britton & Rose	521	Herb		
Campanulaceae				
<i>Lobelia laxiflora</i> Kunth	5, 306	Herb		
<i>Lobelia xalapensis</i> Kunth	17	Herb		
Cannabaceae (Ulmaceae)				
<i>Trema micrantha</i> (L.) Blume var. <i>micrantha</i>	555, 600	Tree		LC
Caprifoliaceae (Valerianaceae)				
<i>Valeriana candolleana</i> Gardner	135, 424, 490	Climber		
Caryophyllaceae				
<i>Drymaria gracilis</i> Schltdl. & Cham.	590	Herb		
Chloranthaceae				
<i>Hedyosmum mexicanum</i> C.Cordem.	210, 532	Tree		LC
Clethraceae				
* <i>Clethra macrophylla</i> M.Martens & Galeotti	246, 385	Tree		LC
* <i>Clethra tuxtlensis</i> L.M.González	61, 310, 395, 523	Tree		LC
Clusiaceae				
<i>Clusia flava</i> Jacq.	35, 198	Tree		LC
Commelinaceae				
<i>Callisia monandra</i> (Sw.) Schult. & Schult.f.	177	Herb		
<i>Commelina diffusa</i> Burm.f.	442	Herb		
<i>Tradescantia zanonii</i> (L.) Sw.	45, 323	Herb		
<i>Tripogandra serrulata</i> (Vahl) Handlos	44, 255	Herb		
Convolvulaceae				
<i>Ipomoea batatas</i> (L.) Lam.	180, 317	Climber		
* <i>Ipomoea funis</i> Schltdl. & Cham. var. <i>funis</i>	342	Climber		
<i>Ipomoea indica</i> (Burm.) Merr.	181	Climber		
<i>Ipomoea mairetii</i> Choisy	372	Climber		
Cornaceae				
<i>Cornus excelsa</i> Kunth	281, 515	Tree		LC
<i>Nyssa sylvatica</i> Marshall	528	Tree		LC
Crassulaceae				
* <i>Echeveria rosea</i> Lindl.	463	Epiphyte		
* <i>Echeveria rubromarginata</i> Rose	103	Herb		
<i>Kalanchoe pinnata</i> (Lam.) Pers.	21	Herb		
* <i>Sedum botterii</i> Hemsl.	293, 432	Epiphyte		
Cyperaceae				
<i>Carex</i> aff. <i>standleyana</i> Steyerf.	520	Herb		
<i>Carex polystachya</i> Sw. ex Wahlenb.	304	Herb		
<i>Cyperus tenuis</i> Sw.	176, 616	Herb		

Appendix 1. Continuation.

Taxa	Voucher number	Growth form	NOM 059	The Red List of Mexican Cloud Forest Trees Categories
<i>Rhynchospora aristata</i> Boeckeler	190, 567	Herb		
<i>Rhynchospora radicans</i> (Schltdl. & Cham.) H.Pfeiff. subsp. <i>radicans</i>	60	Herb		
Dioscoreaceae				
<i>Dioscorea mexicana</i> Scheidw.	548	Climber		
Dipentodontaceae				
<i>Perrottetia longistylis</i> Rose	351, 599	Tree		LC
Ericaceae				
<i>Chimaphila maculata</i> (L.) Pursh	509	Herb		
<i>Gaultheria acuminata</i> Schltdl. & Cham.	80, 476	Shrub		LC
<i>Lyonia squamulosa</i> M.Martens & Galeotti	314, 456	Shrub		NT
<i>Vaccinium leucanthum</i> Schltdl.	530	Tree		EN
Euphorbiaceae				
<i>Acalypha</i> sp.	242, 291	Herb		
<i>Cnidoscolus multilobus</i> (Pax) I.M.Johnst.	462	Tree		LC
<i>Euphorbia graminea</i> Jacq.	312	Herb		
<i>Ricinus communis</i> L.	591	Shrub		
Fabaceae				
<i>Acacia angustissima</i> (Mill.) Kuntze var. <i>angustissima</i>	551	Tree		
<i>Canavalia villosa</i> Benth.	380, 570	Climber		
<i>Centrosema pubescens</i> Benth.	158	Climber		
<i>Chamaecrista rufa</i> Britton & Rose	106	Herb		
<i>Clitoria mexicana</i> Link	167, 207, 379	Climber		
<i>Cologania pulchella</i> Kunth	157	Climber		
<i>Crotalaria sagittalis</i> L.	253	Herb		
<i>Desmodium caripense</i> (Kunth) G.Don	164	Herb		
* <i>Desmodium helleri</i> Peyr.	271, 365, 367, 368, 422	Herb		
<i>Desmodium psilophyllum</i> Schltdl.	110	Herb		
<i>Diphyssa floribunda</i> Peyr.	361-B	Tree		NT
* <i>Erythrina berenices</i> Krukoff & Barneby	361-A	Tree		
<i>Helicotropis linearis</i> (Kunth) A.Delgado	334	Climber		
<i>Inga vera</i> Willd.		Tree		LC
<i>Mimosa albida</i> Humb. & Bonpl. ex Willd. var. <i>albida</i>	151, 199, 378	Shrub		
* <i>Phaseolus glabellus</i> Piper	119, 405	Climber		
<i>Rhynchosia longeracemosa</i> M.Martens & Galeotti	109, 238, 572	Climber		
<i>Senna hirsuta</i> (L.) H.S.Irwin & Barneby	569	Herb		
* <i>Senna foetidissima</i> var. <i>grandiflora</i> (Benth.) H.S.Irwin & Barneby	156, 374	Shrub		
<i>Senna septemtrionalis</i> (Viv.) H.S.Irwin & Barneby	503	Shrub		
<i>Trifolium repens</i> L.	465	Herb		
<i>Zapoteca portoricensis</i> (Jacq.) H.M.Hern. subsp. <i>portoricensis</i>	41, 282, 446, 715	Shrub		LC

Appendix 1. Continuation.

Taxa	Voucher number	Growth form	NOM 059	The Red List of Mexican Cloud Forest Trees Categories
Fagaceae				
* <i>Quercus</i> aff. <i>glabrescens</i> Benth.	104	Tree		VU
* <i>Quercus</i> aff. <i>sartorii</i> Liebm.	609	Tree		
<i>Quercus candicans</i> Née	130, 414	Tree		VU
<i>Quercus castanea</i> Née	169, 220, 272, 507	Tree		
* <i>Quercus dysophylla</i> Benth.	269	Tree		
<i>Quercus elliptica</i> Née	92, 49	Tree		VU
* <i>Quercus furfuracea</i> Liebm.	187	Tree		
* <i>Quercus ghiesbreghtii</i> M.Martens & Galeotti	568	Tree		
* <i>Quercus obtusata</i> Bonpl.	77	Tree		LC
* <i>Quercus polymorpha</i> Schltdl. & Cham.	239, 610, 611	Tree		EN
* <i>Quercus sartorii</i> Liebm.	607	Tree		EN
Gelsemiaceae (Loganiaceae)				
<i>Gelsemium sempervirens</i> (L.) J.St.-Hil.	276, 364	Climber		
Gentianaceae				
* <i>Lisianthus nigrescens</i> Schltdl. & Cham. var. <i>nigrescens</i>	94	Herb		
Gesneriaceae				
<i>Achimenes antirrhina</i> (DC.) C.V.Morton	183, 565-B	Herb		
<i>Achimenes grandiflora</i> (Schltdl.) DC.	565-A	Herb		
<i>Columnea schiedeana</i> Schltdl.	471	Epiphyte		
<i>Moussonia deppeana</i> (Schltdl. & Cham.) Klotzsch ex Hanst.	132, 262	Shrub		
Heliconiaceae				
<i>Heliconia adflexa</i> (Griggs) Standl.	538	Herb		
Hypericaceae				
<i>Hypericum hypericoides</i> (L.) Crantz	88, 403	Shrub		
<i>Vismia baccifera</i> (L.) Triana & Planch.	554	Tree		LC
Hypoxidaceae				
<i>Hypoxis decumbens</i> L.	111, 215	Herb		
Iridaceae				
* <i>Sisyrinchium schaffneri</i> S.Watson	18	Herb		
Juglandaceae				
* <i>Juglans pyriformis</i> Liebm.	533	Tree	A	EN
Lamiaceae				
<i>Hyptis atrorubens</i> Poit.	331	Herb		
<i>Hyptis mutabilis</i> (Rich.) Briq.	127, 339	Herb		
<i>Ocimum campechianum</i> Mill.	3, 93, 122, 125	Herb		
<i>Prunella vulgaris</i> L.	539	Herb		
* <i>Salvia filipes</i> Benth.	486	Shrub		
<i>Salvia karwinskii</i> Benth.	435	Shrub		
* <i>Salvia longispicata</i> M.Martens & Galeotti	126	Herb		
<i>Salvia mocinoi</i> Benth.	38, 131, 258	Herb		
<i>Salvia purpurea</i> Cav.	222, 423, 726	Shrub		
<i>Stachys lindenii</i> Benth.	594	Herb		

Appendix 1. Continuation.

Taxa	Voucher number	Growth form	NOM 059	The Red List of Mexican Cloud Forest Trees Categories
Lauraceae				
<i>Litsea glaucescens</i> Kunth	251, 473	Tree	P	VU
<i>Nectandra salicifolia</i> (Kunth) Nees	283	Tree		NT
<i>Ocotea helicterifolia</i> (Meisn.) Hemsl.	461	Tree		VU
* <i>Ocotea psychotrioides</i> Kunth	413	Tree		EN
Lythraceae				
<i>Cuphea hyssopifolia</i> Kunth	353, 354	Shrub		
* <i>Cuphea nitidula</i> Kunth	42, 196	Herb		
Malpighiaceae				
<i>Bunchosia lindeniana</i> A.Juss.	279, 411, 553-A	Tree		LC
<i>Bunchosia biocellata</i> Schltdl.	735	Shrub		
Malvaceae				
<i>Anoda cristata</i> (L.) Schltdl.	10, 373	Herb		
* <i>Hampea integerrima</i> Schltdl.	33, 300	Tree		NT
<i>Heliocarpus americanus</i> L.	420	Tree		LC
<i>Heliocarpus appendiculatus</i> Turcz.	469	Tree		LC
<i>Heliocarpus mexicanus</i> (Turcz.) Sprague	128	Shrub		LC
<i>Pavonia schiedeana</i> Steud.	154	Shrub		
* <i>Pavonia uniflora</i> (Sessé & Moc.) Fryxell	285, 369	Shrub		
<i>Sida glabra</i> Mill.	1, 136	Herb		
<i>Sida rhombifolia</i> L.	399, 491	Shrub		
* <i>Tilia americana</i> var. <i>mexicana</i> (Schltdl.) Hardin	575	Tree	P	
<i>Triumfetta bogotensis</i> DC.	112, 485	Shrub		
<i>Triumfetta grandiflora</i> Vahl	28, 311, 457	Shrub		
<i>Triumfetta semitriloba</i> Jacq.	30	Shrub		
Melastomataceae				
<i>Arthrostemma ciliatum</i> Pav. ex D.Don	559-A	Shrub		
<i>Conostegia xalapensis</i> (Bonpl.) D.Don ex DC.	433, 466	Shrub		LC
<i>Heterocentron subtriplinervium</i> (Link & Otto) A.Braun & C.D.Bouché	134, 508	Shrub		
<i>Miconia affinis</i> DC.	39, 89	Shrub		
<i>Miconia desmantha</i> Benth.	72, 492	Shrub		
<i>Miconia glaberrima</i> (Schltdl.) Naudin	410	Shrub		LC
<i>Miconia mexicana</i> (Bonpl.) Naudin	32, 90, 206, 234	Tree		VU
* <i>Tibouchina galeottiana</i> (Naudin) Cogn.	527, 559-B	Herb		
Monimiaceae				
<i>Mollinedia viridiflora</i> Tul.	529	Tree		VU
Moraceae				
<i>Dorstenia contrajerva</i> L.	719, 720	Herb		
<i>Ficus aurea</i> Nutt.	558	Tree		LC
<i>Ficus velutina</i> Humb. & Bonpl. ex Willd.	560	Tree		LC
<i>Pseudolmedia glabrata</i> (Liebm.) C.C.Berg	454	Tree		LC
Myrtaceae				
<i>Eugenia</i> sp.	347	Tree		
<i>Myrcianthes fragrans</i> (Sw.) McVaugh	504, 615	Tree		

Appendix 1. Continuation.

Taxa	Voucher number	Growth form	NOM 059	The Red List of Mexican Cloud Forest Trees Categories
<i>Psidium guajava</i> L.	540	Tree		
Onagraceae				
<i>Lopezia racemosa</i> Cav.	2, 4, 115, 178	Herb		
<i>Oenothera rosea</i> L'Hér. ex Aiton	173, 543	Herb		
Orchidaceae				
<i>Brassia verrucosa</i> Lindl.	512	Epiphyte		
<i>Coelia triptera</i> (Sm.) G.Don ex Steud.	470	Epiphyte		
<i>Dichaea glauca</i> (Sw.) Lindl.	69	Epiphyte		
<i>Dichaea neglecta</i> Schltr.	63	Epiphyte		
<i>Elleanthus cynarocephalus</i> (Rchb.f.) Rchb.f.	66, 227	Epiphyte		
<i>Epidendrum radicans</i> Pav. ex Lindl.	91, 211	Herb		
<i>Epidendrum ramosum</i> Jacq.	249, 480, 571	Epiphyte		
<i>Epidendrum repens</i> Cogn.	235, 303	Epiphyte		
<i>Epidendrum veroscriptum</i> Hágsater	166	Epiphyte		
* <i>Gongora galeata</i> (Lindl.) Rchb.f.	598	Epiphyte		
<i>Govenia mutica</i> Rchb.f.	54, 186	Herb		
<i>Habenaria odontopetala</i> Rchb.f.	320	Herb		
<i>Isochilus major</i> Schltdl. & Cham.	59	Epiphyte		
<i>Jacquinella equitantifolia</i> (Ames) Dressler	459	Epiphyte		
* <i>Jacquinella leucomelana</i> (Rchb.f.) Schltr.	333	Epiphyte		
<i>Jacquinella teretifolia</i> (Sw.) Britton & P.Wilson	202	Epiphyte		
<i>Leochilus carinatus</i> (Knowles & Westc.) Lindl.	52	Epiphyte		
<i>Lycaste aromatica</i> (Graham) Lindl.	531	Epiphyte		
<i>Lycaste deppei</i> (Lodd.) Lindl.	546	Epiphyte		
<i>Malaxis histionantha</i> (Link, Klotzsch & Otto) Garay & Dunst.	547	Herb		
<i>Maxillaria cucullata</i> Lindl.	329-A	Epiphyte		
<i>Maxillaria meleagris</i> Lindl.	329-B	Epiphyte		
<i>Maxillaria variabilis</i> Bateman ex Lindl.	159, 189, 205	Epiphyte		
<i>Myoxanthus congestus</i> (A.Rich. & Galeotti) Soto Arenas	332	Epiphyte		
<i>Nemaconia graminifolia</i> Knowles & Westc.	142, 327	Epiphyte		
<i>Nidema boothii</i> (Lindl.) Schltr.	427, 478	Epiphyte		
* <i>Ponthieva rinconii</i> Salazar	114, 573	Herb		
<i>Prosthechea chondylobulbon</i> (A.Rich. & Galeotti) W.E.Higgins	292	Epiphyte		
<i>Prosthechea cochleata</i> (L.) W.E.Higgins	107, 219,	Epiphyte		
<i>Prosthechea ochracea</i> (Lindl.) W.E.Higgins	57, 75, 274	Epiphyte		
<i>Prosthechea pseudopygmaea</i> (Finet) W.E.Higgins	580	Epiphyte		
<i>Sobralia macrantha</i> Lindl.	65	Epiphyte		
<i>Stelis emarginata</i> (Lindl.) Soto Arenas & Solano	47	Epiphyte		
<i>Stelis platystylis</i> (Schltr.) Solano & Soto Arenas	204, 233, 479	Epiphyte		
* <i>Trichocentrum pachyphyllum</i> (Hook.) R. Jiménez & Carnevali	412	Herb		
<i>Xylobium sulfurinum</i> (Lem.) Schltr.	597	Epiphyte		
Orobanchaceae				
<i>Castilleja arvensis</i> Schltdl. & Cham.	12	Herb		

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Taxa	Voucher number	Growth form	NOM 059	The Red List of Mexican Cloud Forest Trees Categories
<i>Conopholis alpina</i> Liebm.	452	Holoparasite		
Oxalidaceae				
<i>Biophytum dendroides</i> (Kunth) DC.	361-C	Herb		
Passifloraceae				
<i>Passiflora adenopoda</i> DC.	377, 725	Climber		
* <i>Passiflora konzattiana</i> Killip	62	Climber		
Pentaphragmaceae				
* <i>Ternstroemia sylvatica</i> Schltdl. & Cham.	82, 217	Tree		VU
Phyllanthaceae				
<i>Phyllanthus compressus</i> Kunth	438	Herb		
Phyllonomaceae				
<i>Phyllonoma laticuspis</i> (Turcz.) Engl.	26-B, 302	Tree		VU
Phytolaccaceae				
<i>Phytolacca purpurascens</i> A.Braun & C.D.Bouché	592	Shrub		
<i>Phytolacca rivinoides</i> Kunth & C.D.Bouché	397	Shrub		
Picramniaceae (Simaroubaceae)				
<i>Picramnia antidesma</i> Sw.	165, 488, 608	Tree		
Piperaceae				
* <i>Peperomia consoquitlana</i> C.DC.	55,85,86, 121, 213, 550	Epiphyte		
<i>Peperomia dendrophila</i> Schltdl. & Cham.	56, 321	Epiphyte		
<i>Peperomia donaguiana</i> C.DC.	216, 294	Herb		
* <i>Peperomia epidendron</i> C.DC.	477, 553-B, 723	Herb		
<i>Peperomia galioides</i> Kunth	236	Epiphyte		
* <i>Peperomia liebmannii</i> C.DC.	141, 318	Herb		
<i>Peperomia obtusifolia</i> (L.) A.Dietr.	120	Epiphyte		
<i>Peperomia quadrifolia</i> (L.) Kunth	140	Epiphyte		
<i>Peperomia rhexiifolia</i> Moritz ex C.DC.	358	Epiphyte		
<i>Peperomia sanjoseana</i> C.DC.	214	Herb		
<i>Peperomia tetraphylla</i> Hook. & Arn.	325	Epiphyte		
<i>Piper aduncum</i> L.	587	Shrub		LC
<i>Piper amalago</i> L.	37, 40, 123	Shrub		
<i>Piper glabrescens</i> (Miq.) C.DC.	144, 275	Shrub		
<i>Piper umbellatum</i> L.	579	Shrub		
Plantaginaceae				
<i>Plantago australis</i> subsp. <i>hirtella</i> (Kunth) Rahn	15	Herb		
<i>Russelia coccinea</i> (L.) Wettst.	248, 381	Shrub		
Platanaceae				
<i>Platanus mexicana</i> Moric.	418	Tree		NT
Poaceae				
<i>Arundinella deppeana</i> Nees ex Steud.	431	Herb		
<i>Dichanthelium laxiflorum</i> (Lam.) Gould	203	Herb		
<i>Lasiacis nigra</i> Davidse	241	Herb		
<i>Lasiacis scabrior</i> Hitchc.	518	Herb		
<i>Lasiacis</i> sp.	286	Herb		
* <i>Muhlenbergia gigantea</i> (E. Fourn.) Hitchc.	172	Herb		

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Taxa	Voucher number	Growth form	NOM 059	The Red List of Mexican Cloud Forest Trees Categories
<i>Oplismenus hirtellus</i> (L.) P.Beauv.	143	Herb		
<i>Panicum polygonatum</i> Schrad.	519	Herb		
Polemoniaceae				
<i>Loeselia glandulosa</i> (Cav.) G.Don	371	Herb		
Polygalaceae				
<i>Polygala paniculata</i> L.	184, 192	Herb		
<i>Monnina sylvatica</i> Schltdl. & Cham.	449	Shrub		
Primulaceae				
* <i>Ardisia liebmannii</i> Oerst. subsp. <i>Liebmannii</i>	34, 326	Shrub		VU
<i>Ardisia</i> sp.	341	Tree		
<i>Myrsine coriacea</i> (Sw.) R.Br. subsp. <i>coriacea</i>	209, 429	Tree		LC
<i>Parathesis</i> aff. <i>donnell-smithii</i> Mez	582	Tree		NT
Ranunculaceae				
<i>Clematis grossa</i> Benth.	212, 419	Climber		
<i>Thalictrum pubigerum</i> Benth.	174, 218	Herb		
Rhamnaceae				
* <i>Rhamnus pompana</i> M.C.Johnst. & L.A.Johnst.	43, 439, 451	Tree		VU
Rosaceae				
<i>Eriobotrya japonica</i> (Thunb.) Lindl.	556	Tree		
<i>Prunus brachybotrya</i> Zucc.	84, 376	Tree		VU
<i>Rubus coriifolius</i> Liebm.	467	Shrub		
Rubiaceae				
<i>Arachnothryx buddleioides</i> (Benth.) Planch.	535	Tree		VU
<i>Bouvardia ternifolia</i> (Cav.) Schltdl.	185, 223, 245, 263, 265	Shrub		
<i>Chiococca phaenostemon</i> Schltdl.	74,237	Climber		DD
<i>Coccocypselum hirsutum</i> Bartl. ex DC.	81, 232	Herb		
<i>Crusea calocephala</i> DC.	117, 483	Herb		
<i>Deppea grandiflora</i> Schltdl.	444	Tree		VU
<i>Galianthe brasiliensis</i> subsp. <i>angulata</i> (Benth.) E.L. Cabral & Bacigalupo	152	Shrub		
* <i>Galium seatonii</i> Greenm.	254	Herb		
<i>Hoffmannia nicotianifolia</i> (M.Martens & Galeotti) L.O. Williams	266,355	Shrub		
* <i>Mexotis latifolia</i> (M.Martens & Galeotti) Terrell & H.Rob.	155	Herb		
* <i>Oldenlandia microtheca</i> (Schltdl. & Cham.) DC.	95, 250,319	Herb		
<i>Palicourea padifolia</i> (Humb. & Bonpl. ex Schult.) C.M.Taylor & Lorence	23, 27,260	Shrub		LC
<i>Psychotria galeottiana</i> (M.Martens) C.M. Taylor & Lorence	31	Shrub		VU
<i>Psychotria trichotoma</i> M.Martens & Galeotti	26-A, 224	Shrub		LC
* <i>Rogiera ligustroides</i> (Hemsl.) Borhidi	67, 256	Shrub		
<i>Sommeria arborescens</i> Schltdl.	352, 536	Tree		EN
<i>Spermacoce remota</i> Lam.	153, 484	Herb		
Rutaceae				
<i>Zanthoxylum melanostictum</i> Schltdl. & Cham.	513	Tree		LC

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Taxa	Voucher number	Growth form	NOM 059	The Red List of Mexican Cloud Forest Trees Categories
<i>Zanthoxylum petenense</i> Lundell	718	Tree		
Salicaceae				
<i>Xylosma flexuosa</i> (Kunth) Hemsl.	29, 208, 502	Shrub		LC
Santalaceae				
<i>Phoradendron nervosum</i> Oliv.	194, 421	Hemiparasite		
Siparunaceae				
<i>Siparuna thecaphora</i> (Poepp. & Endl.) A.DC.	437, 595	Tree		LC
Smilacaceae (Liliaceae)				
<i>Smilax bona-nox</i> L.	448, 498	Climber		
<i>Smilax moranensis</i> M.Martens & Galeotti	7, 441, 447	Climber		
<i>Smilax mollis</i> Humb. & Bonpl. ex Willd.	64, 240, 324, 391	Climber		
<i>Smilax subpubescens</i> A.DC.	493	Climber		
Solanaceae				
* <i>Cestrum elegans</i> (Brongn.) Schltdl.	133, 195, 231, 259, 290, 408	Shrub		
<i>Cestrum nocturnum</i> L.	226	Shrub		LC
<i>Cestrum tomentosum</i> L.f.	197, 298	Tree		
<i>Physalis gracilis</i> Miers	445	Herb		
* <i>Physalis stapelioides</i> (Regel) Bitter	390, 482	Herb		
<i>Solanum aphyodendron</i> S.Knapp	375, 450	Tree		LC
<i>Solanum chrysotrichum</i> Schltdl.	430	Shrub		LC
<i>Solanum lanceolatum</i> Cav.	25, 494	Shrub		LC
<i>Solanum myriacanthum</i> Dunal	50	Shrub		
<i>Solanum nigrescens</i> M.Martens & Galeotti	370	Herb		
<i>Solanum schlechtendalianum</i> Walp.	221	Shrub		LC
<i>Solanum</i> sp.	343	Shrub		
<i>Witheringia solanacea</i> L'Hér.	36, 514	Shrub		
Staphyleaceae				
<i>Turpinia insignis</i> (Kunth) Tul.	76, 458	Tree		EN
Symplocaceae				
<i>Symplocos limoncillo</i> Bonpl.	68, 511	Tree		VU
Urticaceae				
<i>Boehmeria caudata</i> Sw.	440	Tree		LC
<i>Myriocarpa longipes</i> Liebm.	344, 388	Tree		LC
<i>Phenax hirtus</i> (Sw.) Wedd.	589	Shrub		
<i>Pilea microphylla</i> (L.) Liebm.	87, 188	Herb		
<i>Pilea pubescens</i> Liebm.	147, 517	Herb		
<i>Urera caracasana</i> (Jacq.) Gaudich. ex Griseb.	602	Tree		LC
Verbenaceae				
<i>Citharexylum mocinoi</i> D.Don	305, 396, 389	Tree		LC
<i>Lantana camara</i> L.	9	Shrub		
<i>Lantana hirta</i> Graham	137	Shrub		
<i>Lippia myriocephala</i> Schltdl. & Cham.	105, 193	Shrub		LC
<i>Verbena carolina</i> L.	541	Herb		
Vitaceae				
<i>Vitis popenoei</i> J.L.Fennell	510, 596	Climber		
<i>Vitis tiliifolia</i> Humb. & Bonpl. ex Schult.	474	Climber		