Flora of the core zones of the Monarch Butterfly Biosphere Reserve, Mexico: composition, geographical affinities and beta diversity

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Abstract

Background: Knowing the floristic composition of the Monarch Butterfly Reserve is a critical piece of information necessary for its conservation.

Question: i) How many plant species (total and endemic to Mexico) are found in the core zones of the Monarch Butterfly Biosphere Reserve (MBBR)? ii) What are the most frequent growth forms found in this reserve? iii) What is the species diversity for the different types of vegetation? and iv) What is the floristic similarity among the core zones?

Studied species: Ferns, Gimnosperms and Angiosperms.

Study site and years of study: The three core zone (Cerro Altamirano, Cerro Pelón and Chincua-Campanario-Chivati) of the MBBR were studied from 2000 to 2006.

Methods: A total of 49 field trips were conducted over three years (2004 to 2006) to the core zones, and previously collected specimens (2000-2003) were revised in the IEB herbarium. Beta diversity among the core zones was estimated by calculating Jaccard index (IJ).

Results: A total of 97 families, 337 genera, 694 species and 20 infraspecific categories were inventoried. Asteraceae (147 species) and Fabaceae (37), as well as *Salvia* (23), *Quercus* (12) and *Stevia* (12) were the most diverse taxa. Herbaceous plants were the predominant growth form (ca. 75 %). The vegetation types with the greatest number of species were forests dominated by *Quercus* (427) and by *Abies* (329). About 38 % of species documented are endemic to Mexico. The core zones show high beta diversity values (Jaccard index 0.03 to 0.11); more of the half of the total number of species documented (66.3 %) was found exclusively in one core zone.

Conclusions: The core zones are complementary in terms of plant conservation purposes and require similar conservation resources in order to secure important long-term maintenance of the biodiversity and forest cover that serve as winter refuges of the migrant Monarch butterfly populations.

Key words: endemism, growth forms, temperate forests, threatened species.

Flora de las áreas núcleo de la Reserva de la Biosfera Mariposa Monarca, México: composición, afinidades geográficas y diversidad beta.

Resumen

Antecedentes: Para conservar los sitios de hibernación de la mariposa monarca una fuente de datos relevante es inventariar las especies que se encuentran en cada área núcleo de la reserva.

Preguntas: i) ¿Cuántas especies (totales y endémicas de México) se encuentran en las áreas núcleo de la Reserva de la Biosfera de la Mariposa Monarca? ii) ¿Existe una forma de crecimiento más frecuente en esta reserva? iii) ¿Los tipos de vegetación que se encuentran en las áreas núcleo muestran un número similar de especies? y v) ¿Cuál es el grado de similitud florística entre las áreas núcleo?

Especie en estudio: Helechos, Gimnospermas y Angiospermas.

Sitio de estudio y fechas: Las tres áreas núcleo de la reserva (Cerro Altamirano, Cerro Pelón y la zona de Chincua-Campanario-Chivati), entre 2000 y 2006.

Métodos: Se realizaron 49 salidas de campo (2004-2006) a las áreas núcleo de la reserva y se revisaron, en el herbario IEB, especímenes previamente colectados entre 2000 y 2003. La diversidad beta entre las áreas núcleo fue estimada por medio del índice de Jaccard (IJ).

Resultados: En la reserva fueron registradas 97 familias, 337 géneros, 694 especies y 20 categorías infraespecíficas. Asteraceae (147) y Fabaceae (37), así como *Salvia* (23), *Quercus* (12) y *Stevia* (12) fueron los taxa más diversos. La forma de crecimiento preponderante fue la herbácea (ca. 75 %). Los tipos de vegetación que albergan el mayor número de especies son los bosques de *Quercus* (427) y los de *Abies* (329). Cerca del 38 % de las especies son endémicas de México. Las áreas núcleo presentan un valor alto de diversidad beta (índice de Jaccard entre 0.03 y 0.11); el 66.3 % de las especies se localizaron exclusivamente en una de éstas.

Conclusiones: Las áreas núcleo son complementarias en términos de la flora que albergan y requieren esfuerzos similares para conservar a largo plazo su biodiversidad y los refugios invernales de las poblaciones migrantes de la mariposa Monarca.

Palabras clave: bosques templados, endemismo, especies amenazadas, forma de crecimiento.

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The Monarch Butterfly Biosphere Reserve (MBBR) was established primarily to protect the forests used by the monarch butterfly (*Danaus plexippus* L.) as overwintering refuges. Consequently, the protection of this emblematic species has also promoted the conservation of the local flora and fauna coexisting in the area. Since 1986, when first established as the Reserva Especial de la Biosfera Mariposa Monarca, various floristic studies have been conducted within its boundaries (Mejía-Mendoza 1996, SEMARNAT 2001, Cornejo-Tenorio *et al*. 2003). Although these studies have documented from 142 to 423 species, Cornejo-Tenorio *et al*. (2003) estimated a greater number of species within the reserve.

These previous studies have provided important information regarding the plants (*e.g*. growth form), their distribution in different vegetation types and whether the species are endemic to Mexico. However, it is widely recognized that floristic lists require continuous taxonomic updating and this exercise is of particular relevance for those reported in the MBBR, especially when considering the important changes that have taken place in terms of the taxonomic circumscription of families (APG III 2009) or of genera that were previously considered a single taxon, but have now been segregated into various taxa. This latter situation is exemplified in the genus *Eupatorium*, Asteraceae (Schmidt & Schilling 2000).

The availability of an updated taxonomical list of plant species for the MBBR is of utmost importance, as well as the information concerning the number of species found in each core zone and the percentage of Mexican endemics. This information becomes even more urgent when consideration is given to the high degree of external threat for the vegetation of the reserve (Ramírez-Ramírez 2001, Brower *et al*. 2002, Vidal *et al*. 2014). As far as known, only Mejía-Mendoza (1996) has provided concrete information regarding the number of taxa in the sanctuaries, reporting the highest number in Sierra Chincua (55 families, 133 genera and 220 species), followed by Cerro Pelón (42, 96 and 132, respectively) and Cerro Altamirano (32, 72 and 102, respectively). Unfortunately, at present is not possible to support these figures since this unpublished study lacks botanical specimens deposited in herbaria.

Therefore, the objectives of the present study were to i) produce an updated list of the flora of the core zones of the MBBR that indicates the species growth form and the vegetation types in which these have been recorded ii) document the geographic affinities of the flora, highlighting endemic species to Mexico, and iii) compare of the degree of floristic similitude among the core zones.

Material and methods

Study area. The MBBR is located in the central-western part of Mexico, on the boundaries of the states of Michoacán and Estado de México, between the coordinates 19°18'-19°59' N and 100°06'-100°22' W. The reserve encompasses an area of 56,259 ha (Figure 1) and contains two buffer zones and three core zones (Altamirano, Cerro Pelón and Chincua-Campanario-Chivati; hereafter last core zone will be referred only as Chincua), which altogether comprise a total of 13,551 ha (Diario Oficial de la Federación 2000). The reserve presents mountains and intercalated ridges between small inter-montane valleys and grasslands, with an altitudinal interval that ranges from 2,400 to 3,600 m a.s.l. (SEMARNAT 2001). Physiographically, the reserve is situated in the morphotectonic province known as Trans-Mexican Volcanic Belt (Ferrusquía-Villafranca 1993), which is characterized by the presence of extrusive igneous rocks of andesites, basalts, granites, rhyolites and tuffs. The main soils found in the region are Andosols and with a lower frequency there are Cambisols, Regosols and Vertisols. The regional climate is warm temperate with dry winter (Cw in the Köppen-Geiger climate classification system *sensu* Kottek *et al*. 2006), with summer rains. The total annual precipitation ranges from 700 to 1,250 mm with average annual temperatures that range from 8 to 22 °C. The vegetation types described for the reserve are: *Abies* forests, *Pinus* forests, *Pinus-Quercus* forests, *Quercus* forests, tropical montane cloud forests, scrublands and grasslands (Espejo-Serna *et al*. 1992, Soto-Núñez & Vázquez-García 1993, Mejía-Mendoza 1996, SEMARNAT 2001, Cornejo-Tenorio *et al*. 2003, Giménez-de Azcárate *et al*. 2003).

Data analysis. The floristic composition of the MBBR was produced from the species list of Cornejo-Tenorio *et al*. (2003) and a revision of material deposited in the herbarium of the Insti-

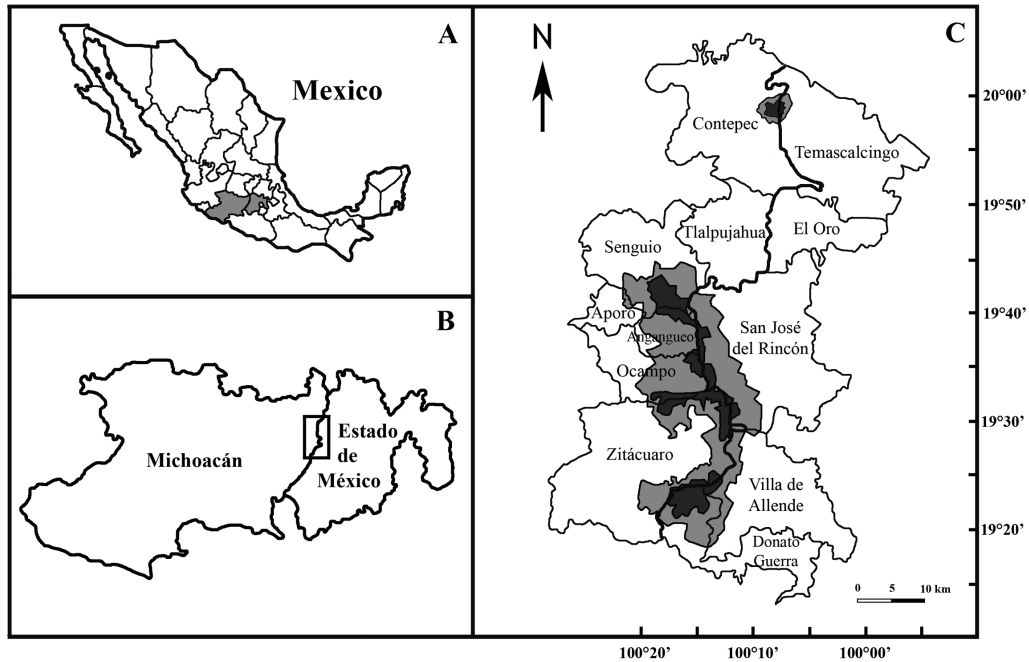

Figure 1. Location of the Monarch Butterfly Biosphere Reserve. **A)** Location of the States of Michoacán and Estado de México in Mexico (grey areas), **B)** The rectangle indicates the area of the Reserve within the States of Michoacán and Estado de México, **C)** Municipalities within the Reserve, light grey corresponds to the buffer zones and darker grey to the core zone of the Reserve (modified of Ramírez-Ramírez *et al*. 2006); core zones: bottom (Cerro Pelón), middle (Chincua-Campanario-Chivati) and top (Cerro Altamirano).

tuto de Ecología, AC, of the Centro Regional del Bajío (IEB). Additionally, from 2004 to 2006, a total of 49 field trips were conducted in order to collect other botanical material, exploring only the core zones of the reserve. All botanical samples were obtained and processed according to conventional techniques (Lawrence 1951, Lot & Chiang 1986). Several families published in the series Flora del Bajío y de Regiones Adyacentes (*e.g*. Rzedowski & Calderón de Rzedowski 2003, 2005, 2008) and the Flora Fanerogámica del Valle de México (Calderón de Rzedowski & Rzedowski 2001) were used for the identification of specimens, as well as the comparison with specimens deposited in the herbarium IEB. Specialists were required to identify some species. The first and second duplicates of the 3,684 vouchers collected are deposited in the herbaria of the Instituto de Biología de la Universidad Nacional Autónoma de México (MEXU) and in the IEB, respectively. Duplicates of these vouchers were sent to other herbaria. Some species reported by Cornejo-Tenorio *et al*. (2003) associated with roads and secondary vegetation were excluded from the present study: *Chenopodium ambrosioides* L. (Chenopodiaceae), *Dalea thouinii* Schrank (Fabaceae), *Lepidium virginicum* L. (Brassicaceae), *Malva parviflora* L. (Malvaceae), *Polygonum lapathifolium* L. (Polygonaceae), *Reseda luteola* L. (Resedaceae), *Solanum cardiophyllum* Lindl. (Solanaceae) and *Verbena litoralis* Kunth (Verbenaceae).

The floristic list is ordered alphabetically by family, genus, species and sub-specific categories, following the classification system proposed by Christenhusz *et al*. (2011a) for the ferns and related groups, Christenhusz *et al*. (2011b) for the gymnosperms and the APG III (2009) for the flowering plants. The species name was taken from the database The Plant List (2013); when the binary name was indicated as "not resolved", the name accepted by the Missouri Botanical Garden (Tropicos, 2014) was included. In order to determine the conservation status or risk category of the species, we consulted the NOM-059-SEMARNAT-2010 (Diario Oficial de la Federación 2010).

Floristic affinities were determined based on the current distribution of the species, were assigning to the following categories: i) Endemic (present only within Mexico), ii) North American (Mexico, reaching United States of America and Canada), iii) Central American (Mexico to Panama and the Antilles), iv) South American (Mexico to South America), and v) broad distribution (species found in the second, third and/or fourth of the above categories, or even in other continents). Different floras, taxonomic and monographic reviews, as well as the Tropicos (2014) database, were consulted in order to obtain the geographic distribution of the species (*e.g*. Villarreal 1998, Rzedowski & Calderón de Rzedowski 2003, 2005, 2008, 2011, Espejo-Serna *et al*. 2010a, b, Rzedowski *et al*. 2011, González-Elizondo & González-Elizondo 2014).

Beta diversity among the core zone was estimated by calculating the values of the Jaccard (I_J) index for total and endemic species. Selection of this algorithm was based on the recommendation of Jost *et al*. (2004), using the formulas:

$$I_J = \frac{a}{a+b+c}$$

where *a* is the number of species shared among the samples under comparison, while *b* and *c* represent the number of species registered to sample 1 and 2, respectively.

Results

Floristic composition, growth form and vegetation types. The flora of the core zones of the reserve includes 97 families, 337 genera and 694 species, of which 20 correspond to infra-specific taxa (Appendix). The list consists mainly of the angiosperm group, of which 77 % correspond to the eudicotyledons and 14.7 % the monocotyledons, while the ferns and gymnosperms account for 7.3 and 1 %, respectively (Table 1). The family Asteraceae is the most diverse, with around 20 % of the total of genera and species documented (Table 2). The 10 families with the higher number of species contained 46.6 % of the genera and 51.3 % of the species. In terms of the genera, *Salvia* (Lamiaceae) is the most diverse, with 23 species. The genera with more species, mainly belong to the most diverse families (Table 2), except for *Sisyrinchium* (Iridaceae) and *Tillandsia* (Bromeliaceae).

The most important components of the MBBR flora are the endemic species (38.3 %), followed by those of broad distribution with nearly 23 % (Table 3). A total of 64 families (66 %) and 147 genera (43.6 %) contain endemic species. The family Asteraceae and the genus *Salvia* have the highest number of species restricted to Mexico (Table 2). When the entire flora is taken into account the North America affinities presented the lower frequency.

Table 1. Vascular plant richness in the Monarch Butterfly Biosphere Reserve.

Taxonomic groups	Families	Genera	Species	Taxa infraspecífics
Ferns	10	21	51	1
Gimnosperms	2	4	7	-
Angiosperms	-	-	-	-
Monocotyledons	14	58	102	2
Eudicotyledons	71	254	534	17
Total	**97**	**337**	**694**	**20**

Table 2. Families and genera with the highest number of species in the flora of the Monarch Butterfly Biosphere Reserve. Endemic species are indicated in parenthesis.

Family	Number of genera	Number of species	Genus (Family)	Number of species
Asteraceae	63 (35)	147 (75)	*Salvia* (Lamiaceae)	23 (15)
Fabaceae	18 (8)	37 (14)	*Quercus* (Fagaceae)	12 (7)
Lamiaceae	6 (3)	32 (19)	*Stevia* (Asteraceae)	12 (7)
Poaceae	16 (2)	27 (3)	*Ageratina* (Asteraceae)	11 (5)
Solanaceae	6 (5)	22 (10)	*Solanum* (Solanaceae)	10 (1)
Apiaceae	10 (5)	19 (10)	*Desmodium* (Fabaceae)	9 (3)
Caryophyllaceae	8 (2)	19 (3)	*Senecio* (Asteraceae)	9 (5)
Pteridaceae	7 (1)	19 (1)	*Sisyrinchium* (Iridaceae)	9 (5)
Rosaceae	10 (5)	17 (6)	*Cheilanthes* (Pteridaceae)	8 (0)
Orchidaceae	13 (3)	17 (3)	*Tillandsia* (Bromeliaceae)	7 (5)
Total	**157 (69)**	**356 (144)**		**110 (53)**

Table 3. Geographic affinities of the species of the Monarch Butterfly Biosphere Reserve (total flora and per core zone).

Geographic affinities	Number of species (%)	Number of species in core zones (%)		
		Altamirano	Cerro Pelón	Chincua
Mexico	266 (38.3)	157 (37.7)	92 (36.5)	127 (35.9)
Mexico and North America	34 (5)	24 (5.8)	4 (1.5)	12 (3.4)
Mexico and Central America	148 (21.3)	79 (19)	73 (29)	81 (22.8)
Mexico and South America	86 (12.4)	52 (12.5)	47 (18.7)	53 (15)
Broad distribution	160 (23)	104 (25)	36 (14.3)	81 (22.9)

The herbaceous plants represent the most abundant growth form in the reserve, with 515 species, which constitutes 74.2 % of the total flora, followed by the shrubs (73 species, 10.5 %), trees (49, 7.1 %), climbers (37, 5.3 %), epiphytes (10, 1.4 %), hemiparasites (6, 0.9 %) and parasites (4, 0.6 %). Included in the climbers are those plants that present herbaceous and/or woody stems, since this characteristic is often difficult to determine because this can be age or size-dependent. The species reported as woody climbers are *Archibaccharis hirtella* (Asteraceae), *Celastrus pringlei* (Celastraceae), *Clematis dioica* (Ranunculaceae), *Cyclanthera integrifoliola* (Cucurbitaceae) as well as *Solandra guttata* and *Solanum appendiculatum* (both Solanaceae). However, *C. pringlei* sometimes occurs as a shrub or small tree with hanging branches. One other species that may become a climbing plant of up to 10 m in height is *Salvia gesneriiflora* (Lamiaceae), although in this study it is included in the shrubs, since the climbing condition was only observed in Cerro Pelón.

Table 4. Total number of species, endemic to Mexico and exclusive to a particular vegetation type (percent in parenthesis), in the Monarch Butterfly Biosphere Reserve.

Vegetation types	Species		
	Total	Endemics	Exclusives
Quercus forest	427 (61.5)	160 (60.2)	195 (50.1)
Abies forest	329 (47.4)	128 (48.2)	85 (22)
Tropical montane cloud forest	184 (26.5)	66 (25)	35 (9)
Grassland	125 (18)	32 (12)	54 (14)
Pinus-Quercus forest	90 (13)	29 (11)	18 (4.5)
Pinus forest	49 (7.1)	22 (8.3)	5 (1.3)
Juniperus scrubland	9 (1.3)	3 (1.1)	0

When we compared vegetation types that host the highest number of species (total, endemic and exclusive (species collected only within one vegetation type)), we observed that these attributes follow a similar pattern, in which the *Quercus* and *Abies* forests respectively, had the highest number of species, while those with the lowest numbers of species were the *Pinus* forest

Table 5. Core zone of the Monarch Butterfly Biosphere Reserve indicating surface, altitudinal interval and forest types contained within them. Abbreviations. Vegetation type: A (*Abies* forest), G (grassland), J (*Juniperus* scrubland), M (tropical montane cloud forest), P (*Pinus* forest), PQ (*Pinus-Quercus* forest), Q (*Quercus* forest).

Core zones (surface)	Altitudinal range	Vegetation types	Families	Genera	Species
Altamirano (588 ha)	2700-3320 m	A, G, J, PQ, Q.	72	229	416
Cerro Pelón (3,729 ha)	2300-3500 m	A, G, J, M, P, PQ, Q.	73	162	252
Chincua (9,233 ha)	2600-3640 m	A, G, J, M, P, PQ.	71	205	354

and the *Juniperus* scrubland (Table 4). The exclusive species accounted for 56.4 % of the total number, while those recorded in only two vegetation types accounted for almost 23.6 %. The remaining species were found in three to five vegetation types. It is noteworthy that no single species was present across all of the vegetation types.

Floristic similitude among the core zones. The three core zones host an almost identical number of families, but there are marked differences in terms of the number of species. The Altamirano zone presented higher numbers of species, followed by Chincua and Cerro Pelón; the last core zone had the least number of genera (Table 5). The core zones of the reserve appear to be similar in terms of the vegetation types represented (Table 5); however, the richness and composition of the plants are dissimilar. We found statistically significant differences in the number of species presented in each core zone ($\chi^2 = 216.25$, d.f. = 2, $P < 0.001$). As a rule, all core zones showed higher numbers of endemic species in comparison with other categories of geographic distribution (Table 3); in general, the other geographic affinities categories showed the same position previously obtained for entire flora.

Of the 694 species, 460 (66.3 %) are found in one core zone only, 140 (20.2 %) in two and 94 (13.5 %) in all three zones. When species exclusive to one only one core zone are considered, Altamirano has 215 species, and Chincua and Cerro Pelón has 151 and 91, respectively. Likewise, endemic species share among three core zones is scarce (only 27 species). Therefore, beta diversity among these areas is high (0.03-0.11), regardless of whether this attribute is estimated with for entire flora or endemic taxa (Table 6).

Table 6. Beta diversity values (Jaccard index) among the core zones of the Monarch Butterfly Biosphere Reserve (total species on the upper diagonal and endemic species on the lower diagonal).

Core zone	Altamirano	Chincua	Cerro Pelón
Altamirano	***	0.09	0.05
Chincua	0.11	***	0.05
Cerro Pelón	0.03	0.06	***

Discussion

Floristic composition, growth form and vegetation types. When we compare our results to those of Cornejo-Tenorio *et al*. (2003), the updated list of the MBBR is increased by nearly 40 % in terms of number of species. The three most important families with the highest number of species are still Asteraceae, Fabaceae and Lamiaceae, but have increased in species numbers by 30, 54 and 34 %, respectively. These families are among the ten most diverse of the flora of Mexico (Villaseñor 2003), with Asteraceae in first place. This result was to be expected, since Mexico is considered the main center of diversification of this family (Turner & Nesom 1993). Another aspect to consider is that the MBBR presents vegetation types in which Asteraceae usually reaches high numbers of species, especially in temperate forests (Turner & Nesom 1993). The low representation of the Fabaceae in the study area is due, in part, to the fact that this family presents its greatest species diversity in tropical forests (Sousa and Delgado 1993).

In terms of the genera, *Salvia* and *Stevia* remain in first and second place, with an increase of 43.5 and 33.3 % relative to the data presented by Cornejo-Tenorio *et al*. (2003). Rzedowski (1991a) indicates that in the montane regions with a cool and semi-humid climate, a species rich flora has evolved in which various genera, such as *Eupatorium*, *Muhlenbergia*, *Quercus*, *Salvia*, *Sedum*, *Senecio* and *Stevia*, are notable. Regarding these taxa, *Salvia* is the second most diverse at the national level (Villaseñor 2004). Recently, Martínez-Gordillo *et al*. (2013) estimated 307 species (nearly 76 % endemics) for this genus. In accordance with those figures, the MBBR hosts almost 7.5 % of the Mexican salvias and 36 % of 64 species listed for Michoacán (Cornejo-Tenorio & Ibarra-Manríquez 2011). A similar figure exists for the genus *Quercus* since the reserve hosts almost 7 % of the 161 species of the genus recorded in Mexico, and 38 % of those recorded for Michoacán (Valencia-Á. 2004). A notable issue is that Altamirano core zone is the only known site for the recollection of *Q. greggii* in Michoacán (Romero-Rangel *et al*. 2014).

In relation to growth forms, we found the same pattern described by Cornejo-Tenorio *et al*. (2003), with a marked dominance of herbaceous plants (74.8 %), followed by shrubs (9.6 %). This coincides with information on the flora of Mexico; where nearly 61 % of the components corresponds to herbaceous plants (Villaseñor & Ortiz 2014).

The Mexican flora showed an important percent of endemic species, which vary from 48 to nearly 60 % (Rzedowski 1991b, Villaseñor & Ortiz 2014). In this respect, the percentage (36 %) of endemic herbs plants found in the MBBR is lower. However, notable percentages of endemism are recorded within the group of epiphytes (70 %) and hemiparasites (83 %) in the reserve. In the case of the epiphytes, this percentage may be explained by the contribution of *Tillandsia* (Table 2) since nearly 70 % of the species of this genus recorded in Mexico are endemics (Espejo-Serna *et al*. 2004).

The vegetation types with the highest number of species in the MBBR are the forests of *Quercus*, of *Abies* and the tropical montane cloud forest. The percentage of exclusive species found in these forests is variable, with the *Quercus* forest notable in this aspect since 50 % of the 194 species associated with this forest type are not found in the any other vegetation type. Challenger (1998) indicated that the floristic composition of the pine (*Pinus*) and oak (*Quercus*) forests of Mexico is highly variable from one site to another, even within the same region. This is due to the environmental heterogeneity presented by these forests and to their complex biogeographic history. With regard to the floristic composition of *Abies* forests, Sánchez-González *et al*. (2005) compared exclusivity across 12 sites on the Trans-Mexican Volcanic Belt and found that only 8 % of the species were shared with the majority of the sites, a value that should not be minimized since some of these are abundant species which define the forest structure. In the MBBR, grasslands are the vegetation type with the third highest number of exclusive species. It should be noted that these communities host interesting species, some of very restricted distribution, such as *Sisyrinchium conzattii*, known only in the highest mountains of Distrito Federal, Estado de México and Michoacán (Calderón de Rzedowski & Rzedowski 1985). For the latter state, this species presents a conservation challenge since it has only been recorded in the grasslands of Sierra Chincua, where populations are very scarce (Espejo *et al*. 2010b).

Floristic similitude among the core zones. The main vegetation types considering their number of species in the MBBR (*Quercus*, of *Abies* and the tropical montane cloud forests) showed the same rank position for the endemic component (Table 3), reflecting that documented at national level by Rzedowski (1991b) and Villaseñor & Ortiz (2014). The floristic affinities in the flora of the MBBR are not easily compared, since the categories of geographic affinities often differ among biogeographic studies. In this sense, Sánchez-González *et al*. (2005) found that 32 % of the species of the *Abies* forest of the mountain Tláloc (Estado de México) are endemic to Mexico, and 31 % extend to Central America. The *Abies* forests in our study site has a similar pattern, as these distribution categories represent 39.2 and 21.9 %, values that are also similar to those found for the entire flora (Table 4).

The high values of beta diversity between core zones cannot be explained by their differences in area (Table 4). One factor to consider is that they share various vegetation types (fir forest, pine-oak forest, *Juniperus* scrubland and grassland) but differ in some, particularly in the presence of tropical montane cloud forest. Moreover, it is very important to consider the different roles of each vegetation type with a detailed appraisal of the areas they occupy within each core zone and the differences in environmental factors. This type of appraisal should be implemented in the near future. Likewise, a more profound floristic exploration of Cerro Pelón is required, because during the study period the conditions were unfavorable for this task, especially in the tropical montane cloud forest. To illustrate this fact, we point out that the micro-endemic species *Perymenium ibarrarum* Rzed. & Calderón, which is found in this core zone, has recently been described based only in the specimens of Ibarra-Manríquez (5,160) and Cornejo Tenorio (Rzedowski & Calderón de Rzedowski 2011).

This degree of floristic exclusivity that can be observed of the core zones is really important (Table 6). Another approach to corroborate the floristic differences among core zones is the presence of 12 species placed under some category of protection in terms of conservation status or risk by the Mexican government environmental policy (NOM-059-ECOL-2010), seven of these are found in only one core zone (Cerro Pelón, *Carpinus caroliniana*, *Populus sima-*

roa, *Rhynchostele cervantesii* and *Zinowiewia concinna*; Chincua, *Comarostaphylis discolor*, *Juniperus monticola* and *Trifolium wormskioldii*). Four species are shared by Altamirano and Chincua zones (*Dahlia scapigera*, *Gentiana spathacea*, *Monotropa hypopitys* and *Furcraea parmentieri*), whit only *Cupressus lusitanica* has been recorded in all three core zones.

Finally, it is important to emphasize the fact that the core zones of the MBBR include more than just the *Abies* forests that serve as winter refuges for the Monarch butterfly; but are also important reservoirs of plant biodiversity, either for Mexican endemics or for other species under some protective category of conservation risk. Our study also demonstrates that is extremely important to consider that the core zones are complementary in terms of plant conservation and require realistic and urgent efforts in order to secure their long-term maintenance.

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Literature cited

Bremer B, Bremer K, Chase MW, Fay MF, Reveal JL, Soltis DE, Soltis PS, Stevens PF. 2003. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. *Botanical Journal of the Linnean Society* **161**:105-121. DOI: 10.1111/j.1095-8339.2009.00996.x

Brower LP, Castilleja G, Peralta A, Lopez-Garcia J, Bojorquez-Tapia L, Diaz S, Melgarejo D, Missrie M. 2002. Quantitative changes in forest quality in a principal overwintering area of the Monarch Butterfly in Mexico, 1971-1999. *Conservation Biology* **16**:346-359. DOI: 10.1046/j.1523-1739.2002.00572.x

Calderón de Rzedowski G, Rzedowski J. 1985. *Sisyrinchium conzattii* (Iridaceae), una nueva especie de las altas montañas del centro de México. *Phytologia* **58**:371-376.

Calderón de Rzedowski G, Rzedowski J. 2001. Flora Fanerogámica del Valle de México. Pátzcuaro: Instituto de Ecología A.C., Comisión Nacional para el Conocimiento y Uso de la Biodiversidad.

Challenger A. 1998. Utilización y conservación de los ecosistemas terrestres de México: Pasado, presente y futuro. México DF: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad.

Christenhusz JM, Zhang X-C, Schneider H. 2011. A linear sequence of extant families and genera of lycophythes and ferns. *Phytotaxa* **19**:7-54.

Christenhusz JM, Reveal JL, Farjon A, Gardner MF, Mill RR, Chase MW. 2011. A new classification and linear sequence of extant gymnosperms. *Phytotaxa* **19**:55-70.

Cornejo-Tenorio G, Casas A, Farfán B, Villaseñor JL, Ibarra-Manríquez G. 2003. Flora y vegetación de las zonas núcleo de la Reserva de la Biosfera Mariposa Monarca, México. *Boletín de la Sociedad Botánica de México* **73**:43-62.

Cornejo-Tenorio G, Ibarra-Manríquez G. 2011. Diversidad y distribución del género *Salvia* (Lamiaceae) en Michoacán, México. *Revista Mexicana de Biodiversidad* **82**:1279-1296.

Diario Oficial de la Federación. 2000. Decreto por el que se declara área natural protegida, con el carácter de Reserva de la Biosfera, la región denominada Mariposa Monarca, ubicada en los municipios de Temascalcingo, San Felipe del Progreso, Donato Guerra y Villa de Allende en el Estado de México, así como en los municipios de Contepec, Senguio, Angangueo, Ocampo, Zitácuaro y Aporo en el Estado de Michoacán, con una superficie total de 56,259-05-07.275 hectáreas. México DF: Secretaría del Medio Ambiente, Recursos Naturales y Pesca.

Diario Oficial de la Federación. 2010. Norma Oficial Mexicana NOM-059-SEMARNAT-2010, Protección ambiental - Especies nativas de México de flora y fauna silvestres - Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio - Lista de especies en riesgo. México DF: Secretaría de Medio Ambiente y Recursos Naturales.

Espejo-Serna A, Brunhuber-Menéndez JL, Segura-Warnholtz G, Ibarra-Caballero J. 1992. La vegetación de la zona de hibernación de la mariposa monarca (*Danaus plexippus* L.) en la Sierra Chincua. *Tulane Studies in Zoology and Botany. Supplementary Publication* **1**:79-99.

Espejo-Serna A, López-Ferrari AR, Ramírez-Morillo I, Holst BK, Luther HE, Till W. 2004. Checklist of Mexican bromeliaceae with notes on species distribution and levels of endemism. *Selbyana* **25**:33-86.

Espejo-Serna A, López-Ferrari AR, Ramírez-Morillo I. 2010a. Flora del Bajío y de regiones adyacentes, Fascículo 165 Bromeliaceae. Pátzcuaro: Instituto de Ecología AC.

Espejo-Serna A, López-Ferrari AR, Ceja-Romero J. 2010b. Flora del Bajío y de regiones adyacentes, Fascículo 166 Iridaceae. Pátzcuaro: Instituto de Ecología AC.

Ferrusquía-Villafranca I. 1993. Geology of Mexico: a synopsis. *In*: Ramamoorthy TP, Bye R, Lot A, Fa J, eds. *Biological diversity of Mexico: origins and distribution*. Oxford: Oxford University Press, 3-107.

Giménez-de Azcárate J, Ramírez MI, Pinto M. 2003. Las comunidades vegetales de la Sierra de Angangueo (estados de Michoacán y México, México): clasificación, composición y distribución. *Lazaroa* **24**:87-111.

González-Elizondo MS, González-Elizondo M. 2014. Ericaceae. Flora del Bajío y de regiones adyacentes, Fascículo 183. Instituto de Ecología A.C., Pátzcuaro, Michoacán, México.

Jost L, Chao A, Chazdon RL. 2004. Compositional similarity and β (beta) diversity. *In*: Magurran AN, McGill BJ, eds. *Biological diversity: frontiers in measurement and assessment*. Oxford: Oxford University Press, 66-84.

Kottek M, Grieser J, Beck C, Rudolf B, Rubel F. 2006. World map of the Köppen-Geiger climate classification updated. *Meteorologische Zeitschrift* **15(3)**: 259-263. DOI: 10.1127/0941-2948/2006/0130

Lawrence GHM. 1951. *Taxonomy of vascular plants*. New York: Macmillan & St James Press.

Lot A, Chiang F (comp.). 1986. Manual de herbario. Administración y manejo de colecciones, técnicas de recolección y preparación de ejemplares botánicos. México DF: Consejo Nacional de la Flora de México AC.

Martínez-Gordillo M, Fragoso-Martínez I, García-Peña MR, Montiel O. 2013. Géneros de Lamiaceae de México, diversidad y endemismo. *Revista Mexicana de Biodiversidad* **84**:30-86. DOI: 10.7550/rmb.30158

Mejía-Mendoza MM. 1996. Caracterización de las colonias de la Mariposa Monarca (*Danaus plexippus* L.) en la Reserva Especial de la Biosfera en el Estado de Michoacán, México. Tesis Profesional, Universidad Michoacana de San Nicolás de Hidalgo. Michoacán.

Ramírez-Ramírez I. 2001. Cambios en las cubiertas del suelo en la Sierra de Angangueo, Michoacán y Estado de México, 1971-1994-2000. *Investigaciones Geográficas, Boletín del Instituto de Geografía, UNAM* **45**: 39-55.

Ramírez-Ramírez, M.I., Miranda-Guerrero, R. and Zubieta-Hernández, R. 2006. Vegetación y cubiertas del suelo. Serie Cartográfica Monarca. Volumen I. Vegetación y cubiertas del suelo. Reserva de la Biósfera Mariposa Monarca, México. Monarch Butterfly Sanctuary Foundation and Instituto de Geografía, UNAM.

Romero-Rangel S, Rojas-Zenteno EC, Rubio-Licona LE. 2014. Fagaceae. Flora del Bajío y de regiones adyacentes, Fascículo 181. Instituto de Ecología A.C., Pátzcuaro, Michoacán, México.

Rzedowski J. 1991. Diversidad y orígenes de la flora fanerogámica de México. *Acta Botanica Mexicana* **14**:3-21.

Rzedowski J. 1991. El endemismo en la flora fanerogámica mexicana: una apreciación analítica preliminar. *Acta Botanica Mexicana* **15**:47-64.

Rzedowski J, Calderón de Rzedowski G. 2003. Flora del Bajío y de regiones adyacentes, Fascículo 112, Valerianaceae. Pátzcuaro: Instituto de Ecología AC.

Rzedowski J, Calderón de Rzedowski G. 2005. Flora del Bajío y de regiones adyacentes, Fascículo 135, Rosaceae. Pátzcuaro: Instituto de Ecología AC.

Rzedowski J, Calderón de Rzedowski G. 2008.. Flora del Bajío y de regiones adyacentes, Fascículo 157, Compositae. Tribu Heliantheae I (géneros *Acmella-Jefea*). Pátzcuaro: Instituto de Ecología AC.

Rzedowski J, Calderón de Rzedowski G. 2011. Dos especies nuevas de *Perymenium* (Compositae-Heliantheae) del centro de México. *Acta Botanica Mexicana* **97**:57-63.

Rzedowski J, Calderón de Rzedowski G, Carrillo-Reyes P. 2011.. Flora del Bajío y de regiones adyacentes, Fascículo 172, Compositae. Tribu Heliantheae II (géneros *Lagascea-Zinnia*). Pátzcuaro: Instituto de Ecología AC.

Sánchez-González A, López-Mata L, Granados-Sánchez D. 2005. Semejanza florística entre los bosques de *Abies religiosa* (H.B.K.) Cham. & Schltdl. de la Faja Volcánica Transmexicana. *Investigaciones Geográficas, Boletín del Instituto de Geografía* **56**:62-76.

Schmidt GJ, Schilling EE. 2000. Phylogeny and biogeography of *Eupatorium* (Asteraceae: Eupatorieae) based on nuclear ITS sequence data. *American Journal of Botany* **87**: 716-726.

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SEMARNAT (Secretaría del Medio Ambiente y Recursos Naturales). 2001. Programa de Manejo Reserva de la Biosfera Mariposa Monarca. México DF: Comisión Nacional de Áreas Protegidas.

Soto-Núñez JC, Vázquez-García L. 1993. Vegetation types of Monarch butterfly overwintering habitat in Mexico. *In*: Malcolm SB, Zalucki MP, eds. *Biology and conservation of the Monarch Butterfly*., Los Angeles, Natural History Museum of Los Angeles County, 287-293.

Sousa M, Delgado A. 1993. Mexican Leguminosae: Phytogeography, endemism, and origins. *In*: Ramamoorthy TP, Bye R, Lot A, Fa J, eds. *Biological Diversity of Mexico: origins and distribution*. Oxford: Oxford University Press, 459-511.

The Plant List. 2013. Version 1.1. Published on the Internet; http://www.theplantlist.org/ (última fecha de consulta, 20 de febrero de 2014).

Tropicos. 2014. Missouri Botanical Garden. <www.tropicos.org.> (consultado 13 de enero al 21 de febrero de 2014).

Turner BL, Nesom GL. 1993. Biogeography, diversity, and endangered or threatened status of Mexican Asteraceae. *In*: Ramamoorthy TP, Bye R, Lot A, Fa J, eds. *Biological Diversity of Mexico: origins and distribution*. Oxford: Oxford University Press, 559-575.

Valencia-Á S. 2004. Diversidad del género *Quercus* (Fagaceae) en México. *Boletín de la Sociedad Botánica de México* **75**:33-53.

Vidal O, López-García J, Rendón-Salinas E. 2014. Trends in deforestation and forest degradation after a decade of monitoring in the Monarch Butterfly Biosphere Reserve in Mexico. *Conservation Biology* **28(1)**:177-186. DOI: 10.1111/cobi.12138

Villarreal QJA. 1998. Gentianaceae. Flora del Bajío y de regiones adyacentes, Fascículo 65. Instituto de Ecología A.C., Pátzcuaro, Michoacán, México.

Villaseñor JL. 2003. Diversidad y distribución de las Magnoliophyta de México. *Interciencia* **28**:160-167.

Villaseñor JL. 2004. Los géneros de plantas vasculares de la flora de México. *Boletín de la Sociedad Botánica de México* **75**:105-135.

Villaseñor JL, Ortiz E. 2014. Biodiversidad de las plantas con flores (División Magnoliophyta) en México. *Revista Mexicana de Biodiversidad* **85**:134-142. DOI: 10.7550/rmb.31987

Appendix. Checklist of the core areas in the Monarch Butterfly Biosphere Reserve, Mexico. Abbreviations. Vegetation types: **A** (*Abies* forest), **G** (grassland), **J** (*Juniperus* scrubland), **M** (tropical montane cloud forest), **P** (*Pinus* forest), **PQ** (*Pinus-Quercus* forest), **Q** (*Quercus* forest). Core zones: **Alt** (Altamirano), **Pel** (Cerro Pelón), **Chi** (Chincua-Campanario-Chivati). Geografical affinities: **BD** (Broad distribution), **CA** (Central America), **END** (Endemic of Mexico), **NA** (North America), **SA** (South America). For each family, their number of genera and species is found in parenthesis; the values are separated by slash.

Taxa	Growth form	Vegetation type	Core zone	Geografical affinity
FERNS				
ASPLENIACEAE (1/6)				
Asplenium castaneum Schltdl. & Cham.	Herb	A	Chi	SA
A. cuspidatum Lam.	Herb	M	Pel	SA
A. hallbergii Mickel & Beitel	Herb	PQ	Chi	END
A. monanthes L.	Herb	A, M, PQ, Q	Alt, Chi, Pel	BD
A. polyphyllum Bertol.	Herb	A, Q	Alt, Chi	SA
A. praemorsum Sw.	Herb	M	Pel	SA
ATHYRIACEAE (1/1)				
Athyrium palmense (Christ) Lellinger	Herb	A	Chi	CA
BLECHNACEAE (1/1)				
Woodwardia spinulosa M. Martens & Galeotti	Herb	M	Pel	CA
CYSTOPTERIDACEAE (1/2)				
Cystopteris fragilis (L.) Bernh.	Herb	A, M, PQ, Q	Alt, Chi, Pel	BD
C. millefolia Mickel & Tejero	Herb	M, Q	Pel	END
DENNSTAEDTIACEAE (1/1)				
Pteridium aquilinum (L.) Kuhn var. *feei* (W. Schaffn. ex Fée) Maxon	Herb	M, PQ	Pel	CA
DRYOPTERIDACEAE (4/9)				
Dryopteris cinnamomea (Cav.) C. Chr.	Herb	Q	Alt	END
D. rossii C. Chr.	Herb	M	Pel	END
D. wallichiana (Spreng.) Hyl.	Herb	A, M	Chi, Pel	BD
Elaphoglossum hartwegii (Fée) T. Moore	Herb	M, Q	Alt, Pel	SA
E. pringlei (Davenp.) C. Chr.	Herb	Q	Alt	END
Phanerophlebia macrosora (Baker) Underw.	Herb	A	Pel	CA
Polystichum distans E. Fourn.	Herb	M	Chi	CA
P. fournieri A.R. Sm.	Herb	M	Pel	CA
P. turrialbae Christ	Herb	A	Chi	SA
OPHIOGLOSSACEAE (2/2)				
Botrychium virginianum (L.) Sw.	Herb	Q	Alt	END
Ophioglossum crotalophoroides Walter	Herb	Q	Alt	BD
POLYPODIACEAE (2/8)				
Pleopeltis astrolepis (Liebm.) E. Fourn.	Herb	A, Q	Alt, Chi	BD
P. polylepis (Roem. ex Kunze) T. Moore	Herb	Q	Alt	END
Polypodium fraternum Schltdl. & Cham.	Herb	M	Pel	CA
P. guttatum Maxon	Herb	Q	Alt	END
P. madrense J. Sm.	Herb	A, M, Q	Alt, Chi, Pel	END
P. platylepis Mett. ex Kuhn	Herb	A	Pel	SA
P. plebeium Schltdl. & Cham.	Herb	Q	Pel	CA
P. polypodioides (L.) Watt var. *aciculare* Weath.	Herb	Q	Alt	CA
PTERIDACEAE (7/19)				
Adiantum andicola Liebm.	Herb	A, M, PQ, Q	Alt, Chi, Pel	SA
A. braunii Mett. ex Kuhn	Herb	A, Q	Alt, Chi	SA
A. capillus-veneris L.	Herb	M	Pel	BD
A. poiretii Wikstr.	Herb	A, M, PQ, Q	Alt, Chi, Pel	BD
Anogramma leptophylla (L.) Link	Herb	M, Q	Pel	BD

Appendix. Continuation.

Taxa	Growth form	Vegetation type	Core zone	Geografical affinity
A. novogaliciana Mickel	Herb	A	Alt	END
Argyrochosma incana (C. Presl) Windham	Herb	Q	Alt	BD
Astrolepis sinuata (Lag. ex Sw.) D.M. Benham & Windham	Herb	Q	Alt	BD
Cheilanthes angustifolia Kunth	Herb	Q	Alt	CA
C. arizonica (Maxon) Mickel	Herb	Q	Alt	BD
C. bonariensis (Willd.) Proctor	Herb	Q	Alt	BD
C. chaerophylla (M. Martens & Galeotti) Kunze	Herb	A, Q	Alt	SA
C. farinosa (Forssk.) Kaulf.	Herb	M, Q	Alt, Pel	BD
C. lendigera (Cav.) Sw.	Herb	G, Q	Alt	BD
C. pyramidalis Fée	Herb	Q	Alt	CA
C. villosa Davenp. ex Maxon	Herb	Q	Alt	NA
Pellaea cordifolia (Sessé & Moc.) A.R. Sm.	Herb	Q	Alt	NA
P. ternifolia (Cav.) Link	Herb	Q	Alt	BD
Pteris orizabae M. Martens & Galeotti	Herb	M, Q	Pel	CA
WOODSIACEAE (1/2)				
Woodsia canescens (Kunze) Mett.	Herb	Q	Alt	END
W. mollis (Kaulf.) J. Sm.	Herb	Q	Alt	CA
GIMNOSPERMS				
CUPRESSACEAE (2/3)				
Cupressus lusitanica Mill.	Tree	A, M, Q	Alt, Chi, Pel	BD
Juniperus deppeana Steud.	Tree	A, Q	Chi	NA
J. monticola Martínez	Shrub	A, J, PQ	Chi	END
PINACEAE (2/4)				
Abies religiosa (Kunth) Schltdl. & Cham.	Tree	A, M, Q	Alt, Chi, Pel	CA
Pinus hartwegii Lindl.	Tree	A	Chi	CA
P. leiophylla Schiede ex Schltdl. & Cham.	Tree	A, M, Q	Alt, Pel	NA
P. pseudostrobus Lindl.	Tree	A, Q	Chi, Pel	CA
ANGIOSPERMS				
MONOCOTYLEDONS				
ASPARAGACEAE (5/8)				
Echeandia durangensis (Greenm.) Cruden	Herb	Q	Alt	END
E. flavescens (Schult. & Schult. f.) Cruden	Herb	G	Chi	END
E. mexicana Cruden	Herb	Q	Alt	END
E. nana (Baker) Cruden	Herb	Q	Alt, Chi	END
Furcraea parmentieri (Roezl) García-Mend.	Herb	A	Alt, Chi	END
Manfreda pringlei Rose	Herb	Q	Alt	END
Milla biflora Cav.	Herb	Q	Alt	BD
Prochnyanthes mexicana (Zucc.) Rose	Herb	Q	Alt	END
BROMELIACEAE (2/8)				
Tillandsia andrieuxii (Mez) L.B. Sm.	Epiphyte	A, Q	Alt	END
T. erubescens Schltdl.	Epiphyte	Q	Alt	END
T. macdougallii L.B. Sm.	Epiphyte	M	Chi	END
T. prodigiosa (Lem.) Baker	Epiphyte	A, P	Pel	END
T. recurvata (L.) L.	Epiphyte	Q	Alt	BD
T. usneoides (L.) L.	Epiphyte	Q	Alt	BD
T. violacea Baker	Epiphyte	M, Q	Chi, Pel	END
Viridantha lepidosepala (L.B. Sm.) Espejo	Epiphyte	Q	Alt	END
COMMELINACEAE (7/8)				
Commelina coelestis Willd.	Herb	Q	Alt	SA
C. dianthifolia Delile	Herb	Q	Alt	NA
C. orchioides Booth ex Lindl.	Herb	A, G	Chi	CA

Appendix. Continuation.

Taxa	Growth form	Vegetation type	Core zone	Geografical affinity
Gibasis pulchella (Kunth) Raf.	Herb	A, M, Q	Alt, Chi, Pel	END
Tinantia erecta (Jacq.) Fenzl	Herb	M, Q	Alt, Pel	SA
Tradescantia commelinoides Schult. & Schult. f.	Herb	M, PQ, Q	Pel	CA
Tripogandra purpurascens (Schauer) Handlos	Herb	Q	Alt	SA
Weldenia candida Schult. f.	Herb	A, G	Chi	CA
CRASSULACEAE (3/7)				
Echeveria fulgens Lem.	Herb	P	Pel	END
E. secunda Booth ex Lindl.	Herb	A, P, Q	Alt, Chi	END
Sedum bourgaei Hemsl.	Herb	A	Chi	END
S. jaliscanum S. Watson	Herb	Q	Alt	END
S. napiferum Peyr.	Herb	A	Chi	END
S. tortuosum Hemsl.	Herb	A	Pel	END
Villadia mexicana (Schltdl.) Jacobsen	Herb	A, M	Chi, Pel	END
CYPERACEAE (4/9)				
Bulbostylis capillaris (L.) Kunth ex C.B. Clarke	Herb	Q	Alt	BD
B. juncoides (Vahl) Kük. ex Herter	Herb	Q	Alt	BD
Carex peucophila Holm	Herb	G	Chi	SA
Cyperus aggregatus (Willd.) Endl.	Herb	Q	Alt	BD
C. manimae Kunth var. *asperrimus* (Liebm.) Kük.	Herb	Q	Alt	BD
C. seslerioides Kunth	Herb	P, Q	Alt, Chi	BD
C. tenerrimus J. Presl & C. Presl	Herb	Q	Alt	SA
Eleocharis acicularis (L.) Roem. & Schult.	Herb	G	Chi	BD
E. bonariensis Nees	Herb	G	Chi	SA
DIOSCOREACEAE (1/1)				
Dioscorea triandria Sessé & Moc.	Climber	Q	Alt	END
ERIOCAULACEAE (1/1)				
Eriocaulon benthamii Kunth	Herb	G	Chi	NA
IRIDACEAE (2/10)				
Orthrosanthus exsertus (R.C. Foster) Ravenna	Herb	A	Chi	CA
Sisyrinchium angustissimum (B.L. Rob. & Greem.) Greenm. & C.H. Thomps.	Herb	Q	Alt	END
S. cernuum (E.P. Bicknell) Kearney	Herb	G	Chi	NA
S. convolutum Nocca	Herb	A, M, Q	Alt, Chi, Pel	SA
S. conzattii Calderón & Rzed.	Herb	G	Chi	END
S. scabrum Schltdl. & Cham.	Herb	A, G	Chi	SA
S. schaffneri S. Watson	Herb	G	Chi	END
S. serrulatum (E.P. Bicknell) Espejo & López-Ferr.	Herb	G	Chi	END
S. tenuifolium Humb. & Bonpl. ex Willd.	Herb	G	Chi	CA
S. tolucense Peyr.	Herb	Q	Alt	END
JUNCACEAE (2/3)				
Juncus arcticus Willd.	Herb	G	Chi	BD
J. ebracteatus E. Mey.	Herb	G	Chi	SA
Luzula caricina E. Mey.	Herb	G	Chi	CA
LILIACEAE (1/1)				
Calochortus purpureus (Kunth) Baker	Herb	Q	Alt	END
MELANTHIACEAE (1/1)				
Anticlea frigida (Schltdl. & Cham.) Zomlefer & Judd	Herb	A	Chi	END

Appendix. Continuation.

Taxa	Growth form	Vegetation type	Core zone	Geografical affinity
ORCHIDACEAE (12/17)				
Aulosepalum pyramidale (Lindl.) M.A. & Dix & M.W. Dix	Herb	Q	Alt	CA
Corallorhiza maculata Raf.	Herb	A, Q	Alt	BD
C. odontorhiza (Willd.) Nutt.	Herb	Q	Alt	BD
C. striata Lindl. var. *involuta* (Greenm.) Freudenst.	Herb	Q	Alt	END
Deiregyne eriophora (B.L. Rob. & Greenm.) Garay	Herb	PQ	Chi	CA
Funkiella hyemalis (A. Rich. & Galeotti) Schltr.	Herb	A, G, M	Chi	CA
Galeoglossum tubulosum (Lindl.) Salazar & Soto Arenas	Herb	PQ	Chi	CA
Govenia utriculata (Sw.) Lindl.	Herb	A, PQ, Q	Alt, Chi	SA
Habenaria entomantha (Lex.) Lindl.	Herb	A, Q	Alt, Chi, Pel	SA
Hexalectris grandiflora (A. Rich. & Galeotti) L.O. Williams	Herb	Q	Alt	NA
Malaxis fastigiata (Rchb.f.) Kuntze	Herb	Q	Alt	SA
M. macrostachya (Lex.) Kuntze	Herb	A, PQ	Chi	BD
M. unifolia Michx.	Herb	Q	Alt	BD
Oberonia brachystachys Lindl.	Herb	Q	Alt, Pel	BD
Platanthera brevifolia (Greene) Senghas	Herb	Q	Alt	END
Rhynchostele cervantesii (Lex.) Soto Arenas & Salazar	Epiphyte	Q	Pel	END
Sarcoglottis schaffneri (Rchb.f.) Ames	Herb	PQ, Q	Chi, Pel	CA
POACEAE (16/27)				
Aegopogon cenchroides Humb. & Bonpl. ex Willd.	Herb	M, Q	Alt, Pel	SA
A. tenellus (DC.) Trin.	Herb	Q	Alt	BD
Agrostis bourgeaei E. Fourn.	Herb	G	Chi	END
A. ghiesbreghtii E. Fourn.	Herb	G	Chi	CA
Brachypodium mexicanum (Roem. & Schult.) Link	Herb	A, M, Q	Alt, Chi, Pel	SA
Bromus exaltatus Bernh.	Herb	G	Chi	CA
Cinna poiformis (Kunth) Scribn. & Merr.	Herb	G	Chi	SA
Festuca amplissima Rupr. ex Galeotti	Herb	A, Q	Alt	SA
F. breviglumis Swallen	Herb	G	Chi	CA
F. tolucensis Kunth	Herb	G	Alt	SA
Lycurus phalaroides Kunth	Herb	Q	Alt	BD
Muhlenbergia implicata (Kunth) Trin.	Herb	Q	Alt	SA
M. macroura (Kunth) Hitchc.	Herb	A, G, Q	Alt	CA
M. minutissima (Steud.) Swallen	Herb	Q	Alt	BD
M. robusta (E. Fourn.) Hitchc.	Herb	Q	Alt	CA
Panicum bulbosum Kunth	Herb	Q	Alt	BD
Peyritschia pringlei (Scribn.) S.D. Koch	Herb	A, G	Chi	SA
Piptochaetium fimbriatum (Kunth) Hitchc.	Herb	G	Chi	BD
P. virescens (Kunth) Parodi	Herb	A, PQ, Q	Alt, Pel	CA
Poa annua L.	Herb	A	Alt, Chi, Pel	BD
P. pratensis L.	Herb	G	Chi	BD
Setaria parviflora (Poir.) Kerguélen	Herb	G	Chi	BD
Trisetum palmeri Hitchc.	Herb	M	Pel	END
T. spicatum (L.) K. Richt.	Herb	G	Chi	BD
T. virletii E. Fourn.	Herb	A, P, Q	Alt, Chi, Pel	END

Appendix. Continuation.

Taxa	Growth form	Vegetation type	Core zone	Geografical affinity
Vulpia myuros (L.) C.C. Gmel.	Herb	A, G, Q	Alt, Chi	BD
Zeugites americanus Willd.	Herb	M	Pel	SA
SMILACACEAE (1/1)				
Smilax moranensis M. Martens & Galeotti	Climber	A, M, PQ, Q	Chi, Pel	CA
EUDICOTYLEDONS				
ACANTHACEAE (1/1)				
Dyschoriste microphylla (Cav.) Kuntze	Herb	Q	Alt	END
ADOXACEAE (2/3)				
Sambucus nigra L.	Tree	A	Chi	BD
Viburnum acutifolium Benth.	Shrub	M, Q	Pel	END
V. microphyllum (Oerst.) Hemsl.	Shrub	A	Chi	END
AMARANTHACEAE (2/3)				
Chenopodium incisum Poir.	Herb	A, Q	Alt	BD
Gomphrena serrata L.	Herb	G	Alt	BD
Iresine diffusa Humb. & Bonpl. ex Willd.	Herb	A, M, PQ, Q	Pel	BD
APIACEAE (10/19)				
Arracacia atropurpurea (Lehm.) Benth. & Hook. f. ex Hemsl.	Herb	A, M	Chi, Pel	CA
A. rigida J.M. Coult. & Rose	Herb	A, Q	Chi, Pel	END
Cyclospermum leptophyllum (Pers.) Sprague	Herb	A	Chi	BD
Daucus montanus Humb. & Bonpl. ex Schult.	Herb	A, G, M, Q	Al, Ch, Pel	SA
Donnellsmithia juncea (Humb. & Bonpl. ex Spreng.) Mathias & Constance	Herb	M, PQ, Q	Alt, Pel	SA
D. mexicana (B.L. Rob.) Mathias & Constance	Herb	Q	Alt	END
Eryngium alternatum J.M. Coult. & Rose	Herb	A, G, M, Q	Alt, Chi, Pel	END
E. bonplandii F. Delaroche	Herb	A, M, P	Alt, Chi	END
E. carlinae F. Delaroche	Herb	A, G, M, Q	Alt, Chi, Pel	CA
E. columnare Hemsl.	Herb	PQ	Pel	END
E. monocephalum Cav.	Herb	Q	Alt	END
E. serratum Cav.	Herb	Q	Alt	END
E. subacaule Cav.	Herb	A, G	Chi	END
Lilaeopsis schaffneriana (Schltdl.) J.M. Coult. & Rose	Herb	G	Chi	BD
Osmorhiza mexicana Griseb.	Herb	A	Pel	SA
Prionosciadium thapsoides (DC.) Mathias	Herb	A, G, Q	Alt, Chi	CA
Rhodosciadium tolucense (Kunth) Mathias	Herb	A, Q	Alt, Chi	END
Tauschia alpina (J.M. Coult. & Rose) Mathias	Herb	A, Q	Alt, Chi	END
T. nudicaulis Schltdl.	Herb	A	Chi	SA
APOCYNACEAE (3/7)				
Asclepias linaria Cav.	Herb	G, Q	Alt	NA
A. otarioides E. Fourn.	Climber	Q	Alt	END
A. ovata M. Martens & Galeotti	Herb	Q	Alt	END
A. pringlei (Greenm.) Woodson	Herb	Q	Alt	END
Gonolobus uniflorus Kunth	Climber	Q	Alt	CA
Matelea chrysantha (Greenm.) Woodson	Climber	Q	Alt	END
M. nummularia (Decne.) Woodson	Herb	Q	Alt	END
AQUIFOLIACEAE (1/1)				
Ilex brandegeeana Loes.	Tree	P	Pel	CA
ARALIACEAE (1/1)				
Oreopanax xalapensis (Kunth) Decne. & Planch.	Tree	M, P, Q	Pel	CA

Appendix. Continuation.

Taxa	Growth form	Vegetation type	Core zone	Geografical affinity
ASTERACEAE (63/147)				
Achillea millefolium L.	Herb	G	Chi	BD
Acourtia humboldtii (Less.) B.L. Turner	Herb	A	Alt	END
A. turbinata (La Llave & Lex.) Reveal & R.M. King	Herb	A, M, PQ, Q	Alt, Chi, Pel	END
Ageratina areolaris (DC.) Gage ex B.L. Turner	Shrub	M, PQ, Q	Alt, Chi, Pel	CA
A. chiapensis (B.L. Rob.) R.M. King & H. Rob.	Shrub	P	Pel	CA
A. glabrata (Kunth) R.M. King & H. Rob.	Shrub	A, PQ, Q	Alt, Chi	END
A. grandifolia (Regel) R.M. King & H. Rob.	Shrub	A	Chi	CA
A. isolepis (B.L. Rob.) R.M. King & H. Rob.	Shrub	A, Q	Al, Ch, Pel	END
A. mairetiana (DC) R.M. King & H. Rob.	Shrub	A, M, PQ, Q	Al, Ch, Pel	CA
A. oligocephala (DC.) R.M. King & H. Rob.	Herb	A	Alt	END
A. pazcuarensis (Kunth) R.M. King & H. Rob.	Herb	A, P	Ch, Pel	CA
A. petiolaris (Moc. & Sessé ex DC.) R.M. King & H. Rob.	Shrub	Q	Alt	END
A. pichinchensis (Kunth) R.M. King & H. Rob.	Herb	Q	Alt	SA
A. rhomboidea (Kunth) R.M. King & H. Rob.	Shrub	A, Q	Alt, Chi	END
Ageratum corymbosum Zuccagni ex Pers.	Herb	M, Q	Alt, Pel	BD
Alloispermum scabrum (Lag.) H. Rob.	Herb	Q	Alt	CA
Archibaccharis hieracioides (S.F. Blake) S.F. Blake	Herb	A	Chi	END
A. hirtella (DC.) Heering	Climber	A, M, PQ, Q	Alt, Chi, Pel	CA
A. serratifolia (Kunth) S.F. Blake	Shrub	A, M, Q	Alt, Pel	CA
Artemisia ludoviciana Nutt.	Herb	Q	Alt	BD
Aster moranensis Kunth	Herb	A, Q	Alt	CA
Baccharis conferta Kunth	Shrub	A, J, M, PQ, Q	Alt, Chi, Pel	END
B. heterophylla Kunth	Shrub	J, M, Q	Alt, Chi, Pel	CA
B. multiflora Kunth	Shrub	A, Q	Alt, Chi	END
B. pteronioides DC.	Shrub	A, Q	Alt	NA
Barkleyanthus salicifolius (Kunth) H. Rob. & Brettell	Shrub	A, G, J	Chi	BD
Bidens anthemoides (DC.) Sherff	Herb	A, G	Chi	END
B. pilosa L.	Herb	A, G,M, Q	Alt, Chi, Pel	BD
B. ostruthioides (DC.) Sch. Bip.	Herb	A, G, M	Chi, Pel	CA
B. triplinervia Kunth	Herb	A, G	Alt, Chi	SA
Brickellia cavanillesii (Cass.) A. Gray	Herb	PQ	Pel	END
B. nutanticeps S.F. Blake	Herb	A, Q	Alt, Chi	END
B. pedunculosa (DC.) Harc. & Beaman	Herb	A, P, Q	Alt, Chi	END
B. pendula (Schrad.) A. Gray	Herb	A	Chi	END
B. secundiflora (Lag.) A. Gray	Herb	A, M, Q	Alt, Pel	END
B. veronicifolia (Kunth) A. Gray	Shrub	Q	Alt	END
Chionolaena salicifolia (Bertol.) G.L. Nesom	Herb	A	Chi	CA
Chromolaena pulchella (Kunth) R.M. King & H. Rob.	Herb	Q	Alt	END
Chromolepis heterophylla Benth.	Herb	A, G	Chi	END
Cirsium anartiolepis Petr.	Herb	A, M, P	Alt, Chi, Pel	END
C. ehrenbergii Sch. Bip.	Herb	A, G	Chi	END
C. jorullense (Kunth) Spreng.	Herb	A, G	Chi	END
C. subcoriaceum (Less.) Sch. Bip. ex Sch. Bip.	Herb	A, P	Chi, Pel	CA
Conyza coronopifolia Kunth	Herb	A, G, Q	Alt, Chi	SA
C. filaginoides (DC.) Hieron	Herb	Q	Alt	BD
Coreopsis petrophiloides B.L. Rob. & Greenm.	Shrub	A, P	Chi, Pel	CA

Appendix. Continuation.

Taxa	Growth form	Vegetation type	Core zone	Geografical affinity
Cosmos bipinnatus Cav.	Herb	Q	Alt	BD
C. parviflorus (Jacq.) Pers.	Herb	Q	Alt	NA
C. scabiosoides Kunth	Herb	A, Q	Alt, Chi	END
Cotula mexicana (DC.) Cabrera	Herb	G	Chi	SA
Dahlia coccinea Cav.	Herb	PQ, Q	Alt, Chi	SA
D. rudis P.D. Sorensen	Herb	M	Chi	END
D. scapigera (A. Dietr.) Knowles & Westc.	Herb	A, P, Q	Alt, Chi	END
D. sorensenii H.V. Hansen & Hjert.	Herb	A, Q	Alt, Chi	END
Digitacalia jatrophoides (Kunth) Pippen	Herb	Q	Alt	END
Dyssodia papposa (Vent.) Hitchc.	Herb	Q	Alt	BD
D. pinnata (Cav.) B.L. Rob.	Herb	Q	Alt	END
Erigeron canadensis L.	Herb	A	Chi	BD
E. delphinifolius Willd.	Herb	Q	Alt	END
E. galeottii (A. Gray) Greene	Herb	A, P	Alt, Chi	END
E. karvinskianus DC.	Herb	PQ	Pel	BD
Galinsoga parviflora Cav.	Herb	A, M, Q	Alt, Pel	BD
G. quadriradiata Ruiz & Pav.	Herb	Q	Alt	BD
Gamochaeta americana (Mill.) Wedd.	Herb	A, G, PQ, Q	Alt, Chi, Pel	BD
Helenium scorzoneraefolium (DC.) A. Gray	Herb	A, G, J	Chi	CA
Heliopsis procumbens Hemsl.	Herb	A, G	Chi	END
Heterosperma pinnatum Cav.	Herb	G, Q	Alt	BD
Hieracium crepidispermum Fr.	Herb	A	Chi	NA
H. dysonymum S.F. Blake	Herb	A, Q	Alt, Chi, Pel	END
Iostephane heterophylla (Cav.) Benth.	Herb	Q	Alt	END
Jaegeria glabra (S. Watson) B.L. Rob.	Herb	G	Chi	END
J. hirta (Lag.) Less.	Herb	A, M, Q	Alt, Chi, Pel	SA
Laennecia schiedeana (Less.) G.L. Nesom	Herb	A, Q	Alt, Chi, Pel	BD
L. sophiifolia (Kunth) G.L. Nesom	Herb	A, Q	Alt, Chi	BD
Laphangium luteoalbum (L.) Tzvelev	Herb	A	Chi	BD
Lasianthaea aurea (D. Don) K.M. Becker	Herb	Q	Alt	END
Leibnitzia lyrata (Sch. Bip.) G.L. Nesom	Herb	Q	Alt	BD
Melampodium longifolium Cerv. ex Cav.	Herb	Q	Alt	END
M. perfoliatum (Cav.) Kunth	Herb	PQ	Pel	BD
M. repens Sessé & Moc.	Herb	A	Chi	END
Mexerion sarmentosum (Klatt) G.L. Nesom	Herb	A	Chi, Pel	END
Montanoa grandiflora DC. Sch. Bip. ex Hemsl.	Shrub	Q	Alt	CA
Osbertia stolonifera (DC.) Greene	Herb	A, M	Chi, Pel	CA
Packera bellidifolia (Kunth) W.A. Weber & Á. Löve	Herb	A, G	Chi	END
P. sanguisorbae (DC.) C. Jeffrey	Herb	A, G, M, P, Q	Alt, Chi, Pel	END
Perymenium berlandieri DC.	Shrub	PQ	Pel	END
P. ibarrarum Rzed. & Calderón	Shrub	M	Pel	END
Pinaropappus roseus (Less.) Less.	Herb	Q	Alt	NA
Piqueria pilosa Kunth	Herb	A, G, Q	Alt, Chi	END
P. trinervia Cav.	Herb	A, M, Q	Alt, Chi, Pel	CA
Porophyllum viridiflorum (Kunth) DC.	Shrub	Q	Alt, Chi	END
Psacalium peltatum (Kunth) Cass.	Herb	A, M	Chi, Pel	END
Pseudognaphalium attenuatum (DC.) Anderb.	Herb	A, M	Pel	SA
P. oxyphyllum (DC.) Kirp.	Herb	A, Q	Alt, Chi, Pel	CA
P. semilanatum (DC.) Anderb.	Herb	A, Q	Alt, Chi	END
P. viscosum (Kunth) Anderb.	Herb	A, M	Chi, Pel	BD

Appendix. Continuation.

Taxa	Growth form	Vegetation type	Core zone	Geografical affinity
Psilactis brevilingulata Sch. Bip. ex Hemsl.	Herb	G	Alt	BD
Roldana albonervia (Greenm.) H. Rob. & Brettell	Shrub	A, PQ, Q	Alt, Chi, Pel	END
R. angulifolia (DC.) H. Rob. & Brettell	Shrub	A, M, Q	Alt, Chi, Pel	END
R. barba-johannis (DC.) H. Rob. & Brettell	Shrub	A, M, Q	Alt, Chi, Pel	CA
R. michoacana (B.L. Rob.) H. Rob. & Brettell	Herb	Q	Alt	END
R. reticulata (DC.) H. Rob. & Brettell	Herb	A	Pel	END
R. sinuata B.L. Turner	Shrub	A, P, Q	Alt, Chi, Pel	END
Rumfordia floribunda DC.	Shrub	A, M, P, PQ, Q	Pel	END
Sabazia humilis (Kunth) Cass.	Herb	G, M	Chi	END
Schkuhria pinnata (Lam.) Kuntze ex Thell.	Herb	Q	Alt	BD
Senecio andrieuxii DC.	Shrub	A	Chi	CA
S. callosus Sch. Bip.	Herb	A, M, PQ	Alt, Chi, Pel	CA
S. cinerarioides Kunth	Shrub	A, G, J	Alt, Chi	END
S. helodes Benth.	Herb	G	Chi	END
S. inaequidens DC.	Herb	Q	Alt	BD
S. suffultus (Greenm.) McVaugh	Herb	M	Pel	END
S. stoechadiformis DC.	Herb	A, M, P, Q	Alt, Chi, Pel	END
S. toluccanus DC.	Herb	A, G, M	Chi, Pel	END
S. vulgaris L.	Herb	A	Chi	BD
Sigesbeckia jorullensis Kunth	Herb	A, M	Alt, Chi, Pel	SA
Simsia amplexicaulis (Cav.) Pers.	Herb	Q	Alt	CA
Sonchus asper (L.) Hill	Herb	A	Chi	BD
S. oleraceus (L.) L.	Herb	A, M	Chi, Pel	BD
Stevia elatior Kunth	Herb	Q	Alt	SA
S. jorullensis Kunth	Herb	G, Q	Alt, Chi	CA
S. lucida Lag.	Shrub	A	Chi	SA
S. monardifolia Kunth	Herb	A, M	Chi, Pel	END
S. origanoides Kunth	Herb	PQ	Pel	END
S. pilosa Lag.	Herb	G	Alt	END
S. purpusii B.L. Rob.	Herb	A	Chi	END
S. salicifolia Cav.	Shrub	A, PQ, Q	Alt, Chi	END
S. serrata Cav.	Herb	G, Q	Alt	BD
S. stricta Hornem.	Herb	Q	Alt	END
S. subpubescens Lag.	Shrub	PQ	Alt	END
S. viscida Kunth	Herb	Q	Alt	BD
Tagetes foetidissima Hort. ex DC.	Herb	A, M	Chi, Pel	CA
T. lucida Cav.	Herb	Q	Alt, Chi	CA
T. lunulata Ortega	Herb	Q	Alt	END
T. micrantha Cav.	Herb	G, M, Q	Alt, Pel	NA
Taraxacum campylodes G.E. Haglund	Herb	A, Q	Alt, Chi	BD
Trigonospermum annuum McVaugh & Lask.	Herb	Q	Alt	CA
Verbesina grayii (Sch. Bip.) Benth. ex Hemsl.	Shrub	A, M	Pel	END
V. hypomalaca B.L. Rob. & Greenm.	Herb	Q	Alt	END
V. klattii B.L. Rob. & Greenm.	Shrub	M	Pel	END
V. oncophora B.L. Rob. & Seaton	Shrub	A, M, P, Q	Alt, Chi, Pel	END
V. seatonii S.F. Blake	Herb	Q	Alt	END
V. virgata Cav.	Shrub	Q	Alt	END
Viguiera hemsleyana S.F. Blake	Herb	Q	Alt	END
V. sessilifolia DC.	Herb	Q	Alt	END
V. urticiformis (DC.) Hemsl.	Herb	Q	Alt	END
Zinnia peruviana (L.) L.	Herb	G, Q	Alt	BD

Appendix. Continuation.

Taxa	Growth form	Vegetation type	Core zone	Geografical affinity
BEGONIACEAE (1/1)				
Begonia gracilis Kunth	Herb	Q	Alt	CA
BETULACEAE (2/3)				
Alnus acuminata Kunth subsp. *arguta* (Schltdl.) Furlow	Tree	Q	Alt, Pel	CA
A. acuminata Kunth subsp. *glabrata* (Fernald) Furlow	Tree	P	Pel	END
A. jorullensis Kunth subsp. *jorullensis*	Tree	A, M, PQ, Q	Alt, Pel	CA
Carpinus caroliniana Walter	Tree	M, PQ, Q	Pel	BD
BORAGINACEAE (3/4)				
Hackelia mexicana (Schltdl. & Cham.) I.M. Johnst.	Herb	A, M	Alt, Chi, Pel	SA
Lithospermum distichum Ortega	Herb	A, Q	Alt, Chi	CA
L. strictum Lehm.	Herb	A	Chi	END
Macromeria pringlei Greenm.	Herb	Q	Alt	END
BRASSICACEAE (9/9)				
Brassica rapa L.	Herb	G, Q	Alt, Chi	BD
Capsella bursa-pastoris (L.) Medik.	Herb	A	Chi	BD
Cardamine flaccida Cham. & Schltdl.	Herb	A, G	Chi	CA
Descurainia virletii (E. Fourn.) O.E. Schulz	Herb	A	Chi	END
Eruca vesicaria (L.) Cav.	Herb	G, Q	Alt, Chi	BD
Lepidium gerloffianum Vatke ex Thell.	Herb	A	Chi	CA
Pennellia longifolia (Benth.) Rollins	Herb	M	Chi	NA
Romanschulzia arabiformis (DC.) Rollins	Herb	G	Chi	END
Nasturtium officinale R. Br.	Herb	G	Chi	BD
CACTACEAE (1/1)				
Heliocereus schrankii (Zucc. ex Seitz) Britton & Rose	Epiphyte	Q	Pel	CA
CALCEOLARIACEAE (1/1)				
Calceolaria mexicana Benth.	Herb	A, G	Chi	SA
CAMPANULACEAE (3/9)				
Diastatea micrantha (Kunth) McVaugh	Herb	A, G, M, Q	Alt, Chi, Pel	SA
D. tenera (A. Gray) McVaugh	Herb	M	Pel	CA
D. virgata Scheidw.	Herb	A, M	Pel	END
Heterotoma lobelioides Zucc.	Herb	A, M	Pel	CA
Lobelia cardinalis L.	Herb	G	Chi	BD
L. gruina Cav.	Herb	A, Q	Alt	END
L. laxiflora Kunth	Herb	A, M, PQ, Q	Alt, Chi, Pel	CA
L. longicaulis Brandegee	Herb	A	Chi	CA
L. nana Kunth	Herb	G	Alt, Chi	SA
CAPRIFOLIACEAE (2/8)				
Symphoricarpos microphyllus Kunth	Shrub	A, Q	Alt, Chi	BD
Valeriana barbareifolia M. Martens & Galeotti	Herb	Q	Alt	CA
V. naidae Barrie	Climber	A, M	Chi, Pel	END
V. pulchella M. Martens & Galeotti	Herb	A, P, Q	Alt, Chi	CA
V. scandens L. var. *candolleana* (Gardner) C.A. Mull.	Climber	M	Pel	SA
V. sorbifolia Kunth	Herb	M	Pel	BD
V. urticifolia Kunth	Herb	M, Q	Alt, Pel	SA
V. vaginata Kunth	Herb	A	Chi	END
CARYOPHYLLACEAE (8/19)				
Arenaria bourgaei Hemsl.	Herb	A, G, PQ, Q	Alt, Chi, Pel	SA

Appendix. Continuation.

Taxa	Growth form	Vegetation type	Core zone	Geografical affinity
A. lanuginosa (Michx.) Rohrb.	Herb	A, M, Q	Alt, Chi, Pel	BD
A. lycopodioides Willd. ex Schltdl.	Herb	G	Chi	CA
A. reptans Hemsl.	Herb	A	Chi	SA
Cerastium glomeratum Thuill.	Herb	A	Chi	BD
C. nutans Raf.	Herb	A	Alt, Chi	BD
C. vulcanicum Schltdl.	Herb	A	Chi	CA
Drymaria effusa A. Gray	Herb	A	Chi	NA
D. excisa Standl.	Herb	M	Pel	END
D. laxiflora Benth.	Herb	A, Q	Chi, Pel	BD
D. malachioides Briq.	Herb	A, M, Q	Alt, Chi, Pel	END
D. multiflora Brandegee	Herb	Q	Alt, Pel	CA
D. villosa Schltdl. & Cham.	Herb	A, M, Q	Alt, Chi, Pel	SA
Minuartia moehringioides (Moc. & Sessé ex DC.) Mattf.	Herb	Q	Alt	END
Sagina saginoides (L.) H. Karst.	Herb	A	Chi	BD
Silene laciniata Cav.	Herb	A	Chi	NA
Spergula arvensis L.	Herb	G, Q	Alt, Chi	BD
Stellaria cuspidata Willd. ex Schltdl.	Herb	A, Q	Alt, Chi, Pel	BD
S. media (L.) Vill.	Herb	P	Chi	BD
CELASTRACEAE (2/2)				
Celastrus pringlei Rose	Climber	M, PQ, Q	Pel	SA
Zinowiewia concinna Lundell	Tree	M	Pel	END
CISTACEAE (1/1)				
Helianthemum glomeratum (Lag.) Lag. ex Dunal	Herb	A, Q	Alt	BD
CLETHRACEAE (1/1)				
Clethra mexicana DC.	Tree	A, M, PQ, Q	Alt, Chi, Pel	SA
CONVOLVULACEAE (2/6)				
Dichondra argentea Humb. & Bonpl. ex Willd.	Herb	Q	Alt	BD
D. brachypoda Wooton & Standl.	Herb	Q	Alt	NA
Ipomoea dumetorum Willd. ex Roem. & Schult.	Climber	Q	Alt	BD
I. madrensis S. Watson	Climber	Q	Alt	END
I. orizabensis (G. Pelletan) Ledeb. ex Steud.	Climber	Q	Alt	CA
I. purpurea (L.) Roth	Climber	Q	Alt	BD
CORNACEAE (1/1)				
Cornus disciflora Moc. & Sessé ex DC.	Tree	P, PQ, Q	Pel	CA
CUCURBITACEAE (1/2)				
Cyclanthera integrifoliola Cogn.	Climber	M	Pel	CA
C. tamnoides (Willd.) Cogn.	Climber	M	Pel	END
ERICACEAE (6/12)				
Arbutus arizonica (A. Gray) Sarg.	Tree	Q	Alt	NA
A. bicolor S. González, M. González & P. D. Sørensen	Tree	A	Chi	END
A. tessellata P.D. Sorensen	Tree	A, Q	Alt	END
A. xalapensis Kunth	Tree	A	Chi	CA
Arctostaphylos pungens Kunth	Shrub	A, Q	Alt	NA
Chimaphila umbellata (L.) Nutt.	Herb	A, PQ, Q	Alt, Chi	BD
Comarostaphylis discolor (Hook.) Diggs subsp. *discolor*	Tree	A	Chi	CA
C. discolor (Hook.) Diggs subsp. *rupestris* (B.L. Rob. & Seaton) Diggs	Shrub	A, PQ, Q	Alt, Chi	END

Appendix. Continuation.

Taxa	Growth form	Vegetation type	Core zone	Geografical affinity
C. longifolia (Benth.) Klotzsch	Tree	A, M, Q	Alt, Chi, Pel	END
Gaultheria erecta Vent.	Shrub	A	Pel	END
G. myrsinoides Kunth	Shrub	A	Chi	SA
Monotropa hypopitys L.	Parasite	A	Alt, Chi	BD
M. uniflora L.	Parasite	A	Chi	BD
EUPHORBIACEAE (4/10)				
Acalypha subviscida S. Watson	Herb	M	Pel	CA
Croton adpressus C. Wright & Griseb.	Shrub	G	Alt	CA
C. morifolius Willd.	Shrub	G, Q	Alt	BD
Euphorbia dentata Michx.	Herb	Q	Alt	BD
E. furcillata Kunth	Herb	A, Q	Alt, Chi	END
E. graminea Jacq.	Herb	Q	Alt	BD
E. hirta L.	Herb	Q	Alt	BD
E. macropus (Klotzsch & Garcke) Boiss.	Herb	Q	Alt	BD
E. sphaerorhiza Benth.	Herb	A, Q	Alt	END
Stillingia zelayensis (Kunth) Müll. Arg.	Herb	Q	Alt	CA
FABACEAE (18/37)				
Astragalus lyonnetii Barneby	Climber	PQ	Pel	END
A. micranthus Desv.	Climber	A	Chi	END
A. oxyrhynchus Hemsl.	Climber	G	Chi	END
Calliandra grandiflora (L'hér.) Benth.	Shrub	Q	Alt	BD
Cologania broussonetii (Balb.) DC.	Climber	PQ, Q	Alt, Pel	SA
C. obovata Schltdl.	Climber	Q	Alt	NA
Crotalaria bupleurifolia Schltdl. & Cham.	Herb	Q	Alt	END
Dalea bicolor Willd.	Herb	A, Q	Alt	NA
D. reclinata (Cav.) Willd.	Herb	Q	Alt	END
Desmodium alamanii DC.	Herb	Q	Alt	END
D. aparines (Link) DC.	Climber	Q	Alt	CA
D. densiflorum Hemsl.	Shrub	M	Pel	END
D. grahamii A. Gray	Herb	Q	Alt	NA
D. molliculum (Kunth) DC.	Herb	Q	Alt	SA
D. neomexicanum A. Gray	Herb	Q	Alt	BD
D. retinens Schltdl.	Herb	Q	Alt	BD
D. uncinatum (Jacq.) DC.	Herb	Q	Alt	BD
D. volubile (Schindl.) B.G. Schub. & McVaugh	Herb	Q	Alt	END
Erythrina leptorhiza DC.	Herb	Q	Alt	END
Eysenhardtia polystachya (Ortega) Sarg.	Shrub	Q	Alt	NA
Indigofera thibaudiana DC.	Herb	Q	Alt	CA
Lathyrus parviflorus Roth	Climber	Q	Alt	NA
Lotus repens (G. Don) Sessé & Moc. ex Standl. & Steyerm.	Herb	Q	Alt	END
Lupinus elegans Kunth	Herb	A, G, Q	Alt, Chi, Pel	CA
L. mexicanus Lag.	Herb	A	Chi, Pel	BD
L. montanus Kunth	Herb	A, M, P, Q	Alt, Chi, Pel	SA
L. splendens Rose	Herb	A, M, P, Q	Alt, Chi, Pel	END
L. uncinatus Schltdl.	Herb	A, Q	Alt, Chi	END
Macroptilium gibbosifolium (Ortega) A. Delgado	Herb	Q	Alt, Pel	BD
Medicago polymorpha L.	Herb	Q	Alt	BD
Phaseolus coccineus L.	Climber	M, Q	Alt, Pel	BD
P. pedicellatus Benth.	Climber	M	Pel	END
P. pluriflorus Maréchal & Alt.	Climber	Q	Alt	END

Appendix. Continuation.

Taxa	Growth form	Vegetation type	Core zone	Geografical affinity
T. amabile Kunth var. *mexicanum* (Hemsl.) D. Heller & Zohary	Herb	A, M, Q	Alt, Chi, Pel	BD
T. wormskioldii Lehm.	Herb	A	Chi	BD
Vicia americana Willd.	Climber	A	Chi	BD
Zornia diphylla (L.) Pers.	Herb	G	Alt	BD
FAGACEAE (1/12)				
Quercus candicans Née	Tree	Q	Alt, Pel	CA
Q. castanea Née	Tree	Q	Alt	CA
Q. crassifolia Bonpl.	Tree	Q	Alt	CA
Q. crassipes Bonpl.	Tree	M, Q	Alt, Pel	END
Q. deserticola Trel.	Tree	Q	Alt	END
Q. glabrescens Benth.	Tree	PQ	Pel	END
Q. greggii (A. DC.) Trel.	Tree	Q	Alt	END
Q. laeta Liebm.	Tree	Q	Alt	END
Q. laurina Bonpl.	Tree	A, M, PQ, Q	Alt, Chi, Pel	CA
Q. martinezii C.H. Mull.	Tree	Q	Pel	END
Q. obtusata Bonpl.	Tree	A, PQ, Q	Alt, Pel	END
Q. rugosa Née	Tree	A, M, PQ, Q	Alt, Chi	BD
GARRYACEAE (1/1)				
Garrya laurifolia Benth.	Tree	A, M, Q	Alt, Chi, Pel	CA
GENTIANACEAE (3/6)				
Gentiana bicuspidata (G. Don) Briq.	Herb	G	Chi	END
G. spathacea Kunth	Herb	A, PQ, Q	Alt, Chi	END
Gentianella amarella (L.) Harry Sm. subsp. *hartwegii* (Benth.) J.M. Gillett	Herb	G	Chi	END
G. amarella (L.) Börner subsp. *mexicana* (Griseb.) J.M. Gillett	Herb	G	Chi	END
Halenia brevicornis (Kunth) G. Don	Herb	A, M, Q	Alt, Chi, Pel	SA
H. plantaginea (Kunth) G. Don	Herb	A, Q	Alt, Chi	END
H. pringlei B.L. Rob. & Seaton	Herb	A	Chi	END
GERANIACEAE (2/8)				
Erodium cicutarium (L.) L'hér.	Herb	A, G	Chi	BD
E. moschatum (L.) L'hér.	Herb	Q	Alt	BD
Geranium cruceroense R. Knuth	Herb	A	Chi	END
G. deltoideum Rydb.	Herb	A	Chi	END
G. latum Small	Herb	A, Q	Alt, Pel	END
G. lilacinum R. Knuth	Herb	A	Chi, Pel	END
G. potentillifolium DC.	Herb	A, Q	Alt, Chi	END
G. seemannii Peyr.	Herb	A, G, M, PQ, Q	Alt, Chi, Pel	SA
GROSSULARIACEAE (1/1)				
Ribes ciliatum Humb. & Bonpl. ex Roem. & Schult.	Shrub	A, J	Chi	CA
HYDROPHYLLACEAE (2/2)				
Nama prostrata Brand	Herb	A, M	Chi, Pel	END
Phacelia platycarpa (Cav.) Spreng.	Herb	A, PQ	Chi, Pel	CA
HYPERICACEAE (1/2)				
Hypericum philonotis Schltdl. & Cham.	Herb	G, Q	Alt, Chi	CA
H. silenoides Juss.	Herb	G, Q	Alt, Chi, Pel	SA
HYPOXIDACEAE (1/1)				
Hypoxis mexicana Schult. & Schult. f.	Herb	A, G, M, Q	Alt, Chi, Pel	END
LAMIACEAE (6/32)				
Clinopodium macrostemum (Moc. & Sessé ex Benth.) Kuntze	Herb	A, M, Q	Chi, Pel	END

Appendix. Continuation.

Taxa	Growth form	Vegetation type	Core zone	Geografical affinity
Lepechinia caulescens (Ortega) Epling	Herb	A, G, M, Q	Alt, Chi, Pel	CA
Prunella vulgaris L.	Herb	A, G	Alt, Chi	BD
Salvia albocaerulea Linden	Shrub	A, M	Pel	END
S. amarissima Ortega	Herb	Q	Alt	END
S. carnea Kunth	Herb	A, M, P, PQ	Chi, Pel	SA
S. curviflora Benth.	Herb	Q	Alt	END
S. elegans Vahl	Herb	A, M, P, PQ, Q	Alt, Chi, Pel	END
S. fulgens Cav.	Herb	A, M, P, PQ, Q	Alt, Chi, Pel	END
S. gesneriiflora Lindl. & Paxton	Shrub	A	Chi	END
S. helianthemifolia Benth.	Herb	A, M	Chi, Pel	END
S. hirsuta Jacq.	Herb	Q	Alt	END
S. iodantha Fernald	Shrub	A, M, P, PQ, Q	Chi, Pel	END
S. laevis Benth.	Herb	Q	Alt	END
S. lavanduloides Kunth	Herb	A, M, P, PQ, Q	Alt, Chi, Pel	CA
S. melissodora Lag.	Shrub	G	Alt	END
S. mexicana L. var. *mexicana*	Herb	A, M, PQ, Q	Alt, Chi, Pel	END
S. mexicana L. var. *minor* Benth.	Herb	A, M, Q	Chi, Pel	END
S. microphylla Kunth	Herb	A, PQ	Chi	BD
S. patens Cav.	Herb	Q	Alt	CA
S. plurispicata Epling	Herb	A	Chi	END
S. polystachya Cav.	Herb	G, Q	Alt	CA
S. prunelloides Kunth	Herb	A	Alt, Chi	END
S. purpurea Cav.	Herb	Q	Alt	CA
S. reptans Jacq.	Herb	G	Alt	BD
S. stricta Sessé & Moc.	Herb	A	Alt	END
S. tiliifolia Vahl	Herb	Q	Alt	BD
Scutellaria dumetorum Schltdl.	Herb	PQ, Q	Alt	CA
Stachys coccinea Ortega	Herb	A, M, P, PQ, Q	Alt, Chi, Pel	BD
S. keerlii Benth.	Herb	Q	Alt	END
S. moorei B.L. Turner	Herb	A, Q	Alt, Chi	END
S. radicans Epling	Herb	A, G	Chi	SA
S. sanchezii Rzed. & A. García	Herb	A, Q	Alt, Chi	END
LENTIBULARIACEAE (1/1)				
Pinguicula moranensis Kunth var. *neovolcanica* Zamudio	Herb	M, Q	Alt, Pel	END
LINACEAE (1/2)				
Linum mexicanum Kunth	Herb	Q	Alt	END
L. orizabae Planch.	Herb	A, M, Q	Alt, Chi, Pel	END
LORANTHACEAE (1/2)				
Cladocolea diversifolia (Benth.) Kuijt	Hemi-parasite	A, Q	Alt	END
C. loniceroides (Tiegh.) Kuijt	Hemi-parasite	Q	Pel	END
LYTHRACEAE (1/2)				
Cuphea aequipetala Cav.	Herb	A, G, Q	Alt, Chi, Pel	CA
C. bustamanta Lex.	Herb	M, P, Q	Pel	END
MALVACEAE (3/3)				
Fuertesimalva limensis (L.) Fryxell	Herb	Q	Alt	SA
Kearnemalvastrum subtriflorum (Lag.) D.M. Bates	Herb	M	Pel	CA
Sida haenkeana C. Presl	Herb	Q	Alt	CA
MELASTOMATACEAE (1/1)				
Monochaetum calcaratum (DC.) Triana	Shrub	M, Q	Pel	END

Appendix. Continuation.

Taxa	Growth form	Vegetation type	Core zone	Geografical affinity
OLEACEAE (2/2)				
Forestiera phillyreoides (Benth.) Torr.	Shrub	Q	Alt	NA
Fraxinus uhdei (Wenz.) Lingelsh.	Tree	M, Q	Alt, Chi, Pel	BD
ONAGRACEAE (4/8)				
Epilobium ciliatum Raf.	Herb	A	Chi	BD
Fuchsia microphylla Kunth	Shrub	A, PQ	Chi	CA
F. obconica Breedlove	Shrub	A, M	Pel	END
F. thymifolia Kunth	Shrub	A, M, Q	Alt, Chi, Pel	CA
Lopezia racemosa Cav.	Herb	A, M, P, Q	Alt, Chi, Pel	CA
Oenothera deserticola (Loes.) Munz	Herb	A, G, PQ, Q	Alt, Chi	END
O. pubescens Willd. ex Spreng.	Herb	A, G	Chi	BD
O. rosea L'hér. ex Aiton	Herb	A	Chi	BD
OROBANCHACEAE (6/11)				
Agalinis peduncularis (Benth.) Pennell	Herb	Q	Alt	CA
Buchnera obliqua Benth.	Herb	Q	Alt	BD
Castilleja moranensis Kunth	Herb	A	Chi	END
C. tenuiflora Benth.	Herb	A, M, P, PQ, Q	Alt, Chi, Pel	BD
C. scorzonerifolia Kunth	Herb	A, G, P, Q	Alt, Chi, Pel	BD
Conopholis alpina Liebm.	Parasite	A, PQ, Q	Alt, Pel	BD
Lamourouxia dasyantha (Cham. & Schltdl.) W.R. Ernst	Herb	Q	Alt	END
L. multifida Kunth	Herb	M, Q	Alt, Pel	CA
L. rhinanthifolia Kunth	Herb	PQ, Q	Alt, Chi	END
L. xalapensis Kunth	Herb	A, M, P	Pel	CA
Pedicularis mexicana Zucc. ex Bunge	Herb	G	Chi	END
OXALIDACEAE (1/4)				
Oxalis alpina (Rose) Rose ex R. Knuth	Herb	A, Q	Alt, Chi	BD
O. corniculata L.	Herb	A, Q	Alt, Chi	BD
O. divergens Benth. ex Lindl.	Herb	A	Chi	CA
O. jacquiniana Kunth	Herb	A	Alt, Chi	CA
PAPAVERACEAE (2/2)				
Argemone platyceras Link & Otto	Herb	A	Chi	NA
Bocconia frutescens L.	Shrub	A, M	Pel	BD
PASSIFLORACEAE (1/2)				
Passiflora exsudans Zucc.	Climber	Q	Alt	END
P. pavonis Mast.	Climber	M	Pel	CA
PENTAPHYLACACEAE (2/2)				
Cleyera integrifolia (Benth.) Choisy	Tree	M	Chi	END
Ternstroemia lineata DC.	Tree	A, M, P, Q	Pel	END
PHRYMACEAE (1/1)				
Mimulus glabratus Kunth	Herb	A, G	Chi	BD
PHYTOLACCACEAE (1/1)				
Phytolacca icosandra L.	Herb	A, M, P, PQ, Q	Alt, Chi, Pel	SA
PIPERACEAE (1/4)				
Peperomia basiradicans G. Mathieu	Herb	A	Chi	END
P. campylotropa A.W. Hill	Herb	A, J, M, Q	Alt, Chi, Pel	CA
P. galioides Kunth	Herb	A, Q	Pel	SA
P. hispidula (Sw.) A. Dietr.	Herb	A, M, Q	Chi, Pel	SA
PLANTAGINACEAE (6/15)				
Gratiola oresbia B.L. Rob.	Herb	G	Chi	CA
Mecardonia procumbens (Mill.) Small	Herb	Q	Alt	BD
Penstemon campanulatus (Cav.) Willd.	Herb	A, Q	Alt, Chi, Pel	SA
P. gentianoides (Kunth) Poir.	Herb	A	Chi	CA

Appendix. Continuation.

Taxa	Growth form	Vegetation type	Core zone	Geografical affinity
P. miniatus Lindl.	Herb	M, Q	Alt, Pel	END
P. roseus (Cerv. ex Sweet) G. Don	Herb	A, G, PQ, Q	Alt, Chi	END
Plantago alismatifolia Pilg.	Herb	Q	Alt	END
P. australis Lam.	Herb	A, G, M, PQ	Chi	BD
P. major L.	Herb	A, Q	Chi, Pel	BD
P. nivea Kunth	Herb	A, Q	Alt, Chi	CA
Sibthorpia repens (Mutis ex L.) Kuntze	Herb	A	Chi, Pel	SA
Veronica americana Schwein. ex Benth.	Herb	G	Chi	NA
V. arvensis L.	Herb	G	Chi	BD
V. peregrina L. subsp. *xalapensis* (Kunth) Pennell	Herb	G	Chi	BD
V. serpyllifolia L.	Herb	A, PQ	Chi	BD
POLEMONIACEAE (2/2)				
Loeselia mexicana (Lam.) Brand	Herb	A, G, Q	Alt	NA
Polemonium mexicanum Cerv. ex Lag.	Herb	A	Chi	END
POLYGALACEAE (2/3)				
Monnina ciliolata Sessé & Moc. ex DC.	Shrub	A, M, P, PQ, Q	Alt, Ch , Pel	CA
Polygala myrtilloides Willd.	Herb	A, Q	Alt	END
P. scoparia Kunth	Herb	Q	Alt	CA
POLYGONACEAE (2/3)				
Polygonum aviculare L.	Herb	G	Chi	BD
Rumex acetosella L.	Herb	A, Q	Alt, Chi	BD
R. crispus L.	Herb	G	Chi	BD
PORTULACACEAE (1/1)				
Claytonia perfoliata Donn ex Willd.	Herb	A, Q	Alt, Chi	BD
PRIMULACEAE (1/1)				
Anagallis arvensis L.	Herb	G	Chi	BD
RANUNCULACEAE (3/6)				
Clematis dioica L.	Climber	A, Q	Alt, Chi	SA
Ranunculus dichotomus Moc. & Sessé ex DC.	Herb	A, G	Chi	SA
R. peruvianus Pers.	Herb	G	Chi	SA
R. petiolaris Kunth ex DC.	Herb	G, Q	Alt	BD
Thalictrum gibbosum Lecoy.	Herb	Q	Alt	END
T. pubigerum Benth.	Herb	Q	Alt	END
RHAMNACEAE (2/3)				
Ceanothus caeruleus Lag.	Shrub	A, M, Q	Alt, Chi, Pel	CA
Frangula microphylla (Humb. & Bonpl. ex Schult.) Grubov	Shrub	Q	Alt	END
F. mucronata (Schltdl.) Grubov	Tree	M	Chi	CA
ROSACEAE (10/17)				
Acaena elongata L.	Shrub	A, G, J, M, Q	Alt, Chi, Pel	SA
Cercocarpus macrophyllus C.K. Schneid	Shrub	PQ	Chi	END
Crataegus mexicana Moc. & Sessé ex DC.	Tree	P, PQ, Q	Alt, Pel	SA
Fragaria vesca L. subsp. *bracteata* (A. Heller) Staudt	Herb	A, PQ	Chi	BD
Holodiscus pachydiscus (Rydb.) Standl.	Tree	M	Pel	END
Lachemilla aphanoides (Mutis ex L. f.) Rothm.	Herb	A, G, Q	Alt, Chi, Pel	SA
L. procumbens (Rose) Rydb.	Herb	A, M, PQ, Q	Alt, Chi, Pel	CA
L. sibbaldiifolia (Kunth) Rydb.	Herb	Q	Alt	CA
Malacomeles denticulata (Kunth) G.N. Jones	Shrub	Q	Alt	BD

Appendix. Continuation.

Taxa	Growth form	Vegetation type	Core zone	Geografical affinity
Potentilla candicans Humb. & Bonpl. ex Nestl.	Herb	G	Chi	END
P. rubra Willd. ex Schltdl.	Herb	G	Chi	END
Prunus brachybotrya Zucc.	Tree	M, PQ, Q	Pel	CA
P. prionophylla Standl.	Tree	A	Chi	END
P. serotina Ehrh. subsp. *capuli* (Cav. ex Spreng.) McVaugh	Tree	A, Q	Alt, Chi	SA
P. serotina Ehrh. subsp. *serotina*	Tree	A, G, Q	Alt, Chi	AD
Rubus adenotrichus Schltdl.	Climber	P, Q	Pel	SA
R. cymosus Rydb.	Climber	A, M, PQ	Pel	END
R. liebmannii Focke	Climber	M	Pel	CA
RUBIACEAE (6/10)				
Bouvardia longiflora (Cav.) Kunth	Shrub	Q	Alt	CA
B. ternifolia (Cav.) Schltdl.	Herb	G, PQ, Q	Alt, Chi, Pel	NA
Crusea coccinea DC.	Herb	M, Q	Pel	CA
C. diversifolia (Kunth) W.R. Anderson	Herb	Q	Alt	BD
C. longiflora (Willd. ex Roem. & Schult.) W.R. Anderson	Herb	M, Q	Alt, Pel	CA
Didymaea alsinoides (Cham. & Schltdl.) Standl.	Herb	A, M, Q	Alt, Chi, Pel	CA
Galium aschenbornii S. Schauer	Climber	A, PQ, Q	Alt, Chi	SA
G. mexicanum Kunth	Climber	Q	Alt	BD
Houstonia wrightii A.Gray	Herb	G, Q	Alt, Chi	NA
Mitchella repens L.	Herb	A	Chi	BD
SALICACEAE (2/2)				
Populus simaroa Rzed.	Tree	Q	Pel	END
Salix paradoxa Kunth	Tree	A, M, Q	Alt, Chi, Pel	END
SANTALACEAE (2/5)				
Arceuthobium abietis-religiosae Heil	Parasite	A	Chi	END
Phoradendron brachystachyum (DC.) Nutt.	Hemi-parasite	PQ	Pel	END
P. decipiens Kuijt	Hemi-parasite	Q	Alt	END
P. galeottii Trel.	Hemi-parasite	Q	Alt	END
P. reichenbachianum (Seem.) Oliv.	Hemi-parasite	Q	Alt, Chi	CA
SAXIFRAGACEAE (1/1)				
Heuchera orizabensis Hemsl.	Herb	M	Pel	END
SCROPHULARIACEAE (1/3)				
Buddleja cordata	Tree	A, M, Q	Alt, Chi, Pel	CA
B. parviflora Kunth	Shrub	A, M, Q	Alt, Chi, Pel	CA
B. sessiliflora Kunth	Shrub	P	Pel	NA
SOLANACEAE (6/22)				
Cestrum anagyris Dunal	Shrub	A, M, PQ	Alt, Chi, Pel	CA
C. nitidum M. Martens & Galeotti	Shrub	A, M, Q	Alt, Pel	END
C. roseum Kunth	Shrub	M, P	Pel	SA
C. thyrsoideum Kunth	Shrub	A, M, P, Q	Alt, Chi, Pel	END
Jaltomata procumbens (Cav.) J.L. Gentry	Herb	A, M, Q	Alt, Chi, Pel	SA
Lycianthes moziniana (Dunal) Bitter	Herb	Q	Alt	END
L. rzedowskii E. Dean	Herb	PQ	Pel	END
Physalis coztomatl Dunal	Shrub	A	Chi	END
P. orizabae Dunal	Herb	A, Q	Alt, Chi, Pel	END

Appendix. Continuation.

Taxa	Growth form	Vegetation type	Core zone	Geografical affinity
P. sulphurea (Fernald) Waterf.	Herb	Q	Alt	END
P. volubilis Waterf.	Herb	A, Q	Alt, Chi	END
Solandra guttata D. Don	Climber	M, Q	Pel	END
Solanum americanum Mill.	Herb	Q	Alt	BD
S. appendiculatum Dunal	Climber	A, M, P, PQ, Q	Pel	CA
S. brachystachys Dunal	Shrub	Q	Pel	CA
S. demissum Lindl.	Herb	A, Q	Alt, Chi	CA
S. nigrescens M. Martens & Galeotti	Herb	A, M, Q	Alt, Chi, Pel	SA
S. nigricans M. Martens & Galeotti	Tree	M	Pel	CA
S. nudum Dunal	Herb	PQ	Pel	SA
S. pubigerum Dunal	Shrub	A, M, P, PQ, Q	Alt, Chi, Pel	SA
S. stoloniferum Schltdl. & Bouché	Herb	Q	Alt	NA
S. verrucosum Schltdl.	Herb	Q	Alt	END
STYRACACEAE (1/1)				
Styrax argenteus C. Presl var. *ramirezii* (Greenm.) Gonsoulin	Tree	M, P, PQ, Q	Pel	SA
SYMPLOCACEAE (1/1)				
Symplocos citrea Lex. ex La Llave & Lex.	Tree	PQ	Pel	END
URTICACEAE (2/4)				
Phenax hirtus (Sw.) Wedd.	Herb	M	Pel	SA
Urtica chamaedryoides Pursh	Herb	A	Chi	BD
U. praetermissa V.W. Steinm.	Herb	A, M	Chi, Pel	END
U. urens L.	Herb	A	Chi	BD
VERBENACEAE (4/7)				
Glandularia teucriifolia (M. Martens & Galeotti) Umber	Herb	A, Q	Alt	CA
Lippia mexicana G.L. Nesom	Shrub	M, P, Q	Alt, Pel	END
Priva mexicana (L.) Pers.	Herb	Q	Alt	CA
Verbena carolina L.	Herb	Q	Alt	BD
V. gracilis Desf.	Herb	A, G, Q	Alt, Chi	NA
V. menthifolia Benth.	Herb	Q	Alt	BD
V. recta Kunth	Herb	A, Q	Alt, Chi	END
VIOLACEAE (2/5)				
Hybanthus verbenaceus (Kunth) Loes.	Herb	Q	Alt	BD
Viola grahamii Benth.	Herb	A, M, PQ, Q	Alt, Chi, Pel	CA
V. guatemalensis W. Becker	Herb	A, G	Chi	CA
V. humilis Kunth	Herb	A, Q	Alt, Chi, Pel	END
V. painteri Rose & House	Herb	A, Q	Alt	END