

Ecology

Synanthropic species of Asteraceae in Michoacán, Mexico

Especies sinantrópicas de Asteraceae en Michoacán, México

Alma Delia Ruiz-Acevedo ^a, José Luis Villaseñor ^b, Mireya Burgos-Hernández ^a,
Ebandro Uscanga-Mortera ^a, Heike Vibrans ^{a, *}

^a Colegio de Postgraduados, Posgrado en Botánica, Carretera México-Texcoco Km 36.5, Montecillo, 56230 Texcoco, Estado de México, Mexico

^b Universidad Nacional Autónoma de México, Instituto de Biología, Departamento de Botánica, Tercer Circuito s/n, Ciudad Universitaria, Coyoacán, 04510 Ciudad de México, Mexico

*Corresponding author: heike@colpos.mx (H. Vibrans)

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Abstract

To study synanthropic plants (weeds), they need to be separated from non-weeds, a difficult task due to the existing gradient in nature. A representative family of the Mexican flora (Asteraceae) and a state very rich in species (Michoacán) are used as a model for this task and additional analyses. A total of 357 weeds are listed based on a critical review of specimens and bibliographic information, as well as defined criteria. In addition, tribes, growth forms, and geographic similarities with other states are examined for endemic, more widespread native, and introduced weeds. The main difficulty in differentiating weeds from non-weeds was the lack of accurate habitat information on herbarium labels. Most species grew in both disturbed and natural environments. Nearly half were endemic to the country, with only 4% introduced. The major Asteraceae tribes had relatively similar proportions of weeds, but exotics were concentrated in the tribe Cichorieae. Floristic similarities were mainly towards south-central Mexico. Most species were herbs and less than half annuals. We contribute to the delimitation and understanding of synanthropic species.

Keywords: Weeds; Tribes; Growth forms; Life forms; Native; Endemic; Introduced

Resumen

Para estudiar las plantas sinantrópicas (malezas), hay que separarlas de no malezas, una tarea difícil debido al gradiente existente en la naturaleza. Se utiliza como modelo una familia representativa de la flora mexicana (Asteraceae) y una entidad federativa muy rica en especies (Michoacán) para esta tarea y análisis adicionales. Se enlistan 357 malezas basado en una revisión crítica de ejemplares e información bibliográfica, así como criterios definidos. Además, se examinan las tribus, las formas de crecimiento y las similitudes geográficas con otros estados para malezas endémicas, nativas con distribución más amplia, e introducidas. La principal dificultad para diferenciar a las malezas de las no malezas era la falta de información precisa sobre el hábitat en las etiquetas de herbario. La mayoría de las especies crecían tanto en entornos perturbados como naturales. Casi la mitad eran endémicas del

país, con sólo 4% introducidas. Las principales tribus de Asteraceae tenían proporciones relativamente similares de malezas, pero las exóticas se concentraban en la tribu Cichorieae. Las similitudes florísticas se daban principalmente hacia el centro-sur de México. La mayoría de las especies eran hierbas y menos de la mitad anuales. Contribuimos a la delimitación y comprensión de las especies sinantrópicas.

Palabras clave: Malezas; Tribus; Formas de crecimiento; Formas de vida; Nativa; Endémica; Introducida

Introduction

Synanthropic vegetation thrives under human disturbance. Its composition is determined by climate and soil, but also by the type and intensity of disturbance (Rzedowski & Rzedowski, 2004). The species of these communities - weeds - are sometimes undesirable and can cause considerable economic harm (Hamill et al., 2004). However, they also have important ecological functions (Vibrans, 2016).

Weeds are commonly defined as “plants growing where they are not wanted, or undesirable” (Monaco et al., 2002); however, this definition is subjective, ambiguous, and not useful for understanding the biology of this group of plants. Here, we use the ecological concept: weeds are those species that can establish populations (obligatorily or facultatively) in places strongly disturbed by humans, without being cultivated. These may be cultivated fields (segetal or agrestal weeds) or ruderal environments (e.g., roadsides and field edges, surroundings of human settlements, urban vegetation, or vacant lots) (Baker, 1967; Rzedowski & Rzedowski, 2004). This definition of a weed species helps delimitation, though the degree of human disturbance remains a source of imprecision.

Synanthropic plants have unusual dynamics, as they converge, diverge, and evolve with crops; they depend on disturbance to stabilize their communities (Mahaut et al., 2020). However, many weeds inhabit not only environments disturbed by humans, but also by nature (e.g., water, landslides, tree falls, floods, hurricanes, fires, animals). Many species are even known from stable natural vegetation, although data on the proportions are lacking. Apparently, weedy species in natural vegetation are observed particularly in regions where weeds co-evolved with agriculture (Zohary, 1973), though good documentation is lacking.

Separating weeds from non-weeds is difficult, given the overlaps in nature, but it is a necessary task for studying these species as a group. Generally, classification as a weed is based on observations and unquantified herbarium data. It tends to be arbitrary and non-reproducible. Thus, it is desirable to develop clear criteria for classifying a species as a weed. Then, the ecology, biogeography, evolution, and interaction with human activities of these species can

be explored. A significant number of native weeds have evolved in Mexico and its cultural region, Mesoamerica, which includes parts of Central America. According to Espinosa-García et al. (2004a, b), 2,814 species are considered weeds, of which 2,197 (78%) are native.

Asteraceae Bercht. et J. Presl (Compositae Giseke nom. alt.) is representative of plant diversity in Mexico (Villaseñor et al., 2007). It is the most species-rich family in the country with 3,113 species and endemism of 63.9% (Villaseñor, 2018). Composites include a wide array of growth forms, which are distributed throughout the territory and all habitat types, including disturbed ones (Rzedowski, 1991). Based on morphological and molecular characters, the family is organized into tribes (Villaseñor, 1993); the most species-rich tribes in Mexico are Heliantheae, Eupatorieae, and Astereae (Villarreal & Villaseñor, 2004).

The state of Michoacán ranks fifth in Asteraceae richness, with 837 species. This richness is due to variations in climate, soil, and topography, as well as its position on the limits of several biogeographic regions (Villaseñor, 2018). Of these 837 species, one-third—282—have been reported previously as weeds (Villaseñor & Espinosa, 1998), positioning Michoacán as the state with the highest number of reported weeds, followed by Jalisco.

Here, we provide an updated list of Asteraceae weeds in Michoacán. The selection was based on standardized criteria. We quantify the proportion of growth forms, habitats, and biogeographic aspects for weeds that are endemic to Mexico, native but not restricted to Mexico, and introduced, as well as the floristic similarity of the weeds of Michoacán with other states of Mexico. In addition, the proportion of weeds per tribe is considered.

Materials and methods

Michoacán lies in the central-western part of Mexico (20°23'38.40" - 17°54'54.00" N, 100° 3'46.80" - 103°44'16.80" W), bordering Jalisco and Guanajuato to the north, Querétaro in the northeast, Estado de México and Guerrero to the east, the Pacific Ocean to the south, and Colima and Jalisco to the west (Fig. 1). It has a surface area of 58,599 km², 3% of the country (INEGI, 2015).

The Nearctic and Neotropical biogeographic regions converge in the study area (Conabio, 1997), as well as 4

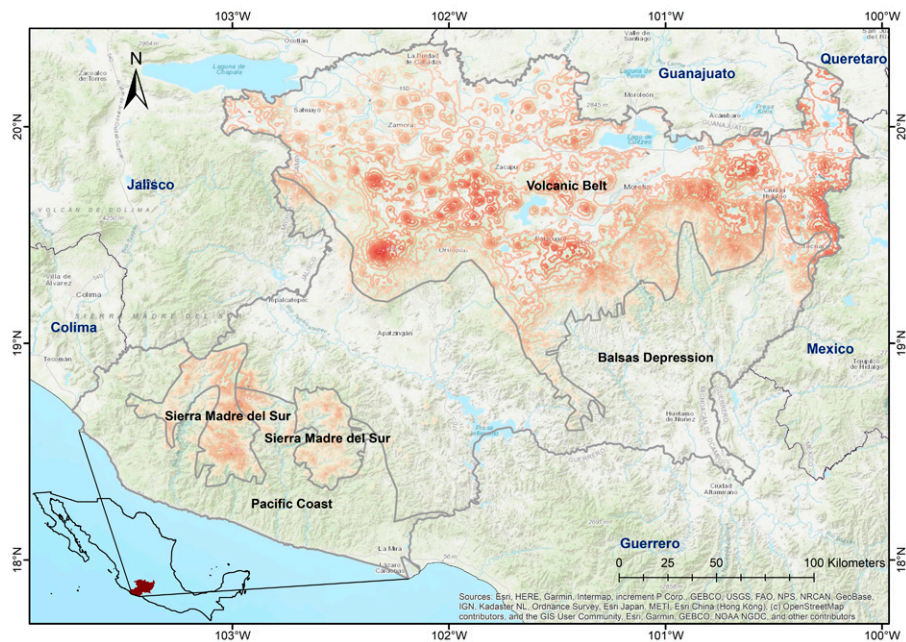


Figure 1. The state of Michoacán and its biogeographic provinces (modified from Conabio, 1997).

biogeographic provinces, the Volcanic Belt, Pacific Coast, Balsas Depression, and the Sierra Madre del Sur (Fig. 1; Conabio, 1997). Also, it has a variable topography. As a result, it is one of the most phytodiverse states (Villaseñor & Ortiz, 2014), and the 5 main biomes recognized for Mexico occur in Michoacán.

Mountainous terrain covers 62% of the territory. The highest elevation is the Pico Tancítaro (3,857 m); the coastline is 208 km long (Flores & Priego, 2011). Average annual rainfall varies from 400 to 2,000 mm (Vidal-Zepeda, 1990). A warm sub-humid climate (Aw) dominates in the central and southern parts (García, 1998), with seasonally dry tropical forests occupying 50% of the state surface (Villaseñor & Ortiz, 2014). Luvisols are the most important soil type, followed by vertisols and another 14 soil types (INEGI, 2014, based on the World Reference Base for Soil Resources). Volcanic subsoil from the Cenozoic is found on 33% of the state's surface; sedimentary and metamorphic rocks predominate in the south (Marín & Torres-Ruata, 1990). Rainfed and irrigated agriculture occupies about 35% of the area; in the tropics, cattle pastures are common and cover 6.2% of the state's area (INEGI, 2016).

We used primary and secondary sources of information to identify weed species. Primary data sources were herbarium labels of field collections. Problems may arise in the acquisition and interpretation of label data since not all collectors include habitat information or only record the

biome without indicating the degree of disturbance. The habitat information may be found in various label fields like observations, ecology, geofom, microenvironment, etc., which makes systematization more difficult (James et al., 2018; Moreno & Allkin, 1988).

Secondary data sources were mainly floras and taxonomic treatments that included information on habitat. The origin of this information was usually not specified; it might also have been based on herbarium specimens or simply on observations by the specialists (Appendix).

Preliminary list. We worked with a database of all Asteraceae from Michoacán, managed and curated by one of the authors, an Asteraceae specialist (Villaseñor, unpublished data). It consisted of 13,641 records and 785 species (Fig. 2). The data derived mainly from the collections of the National Herbarium (MEXU) but included partial information from the herbaria CHAPA, CIMI, EBUM, ENCB, HUMO, IBUG, IEB, LL, MICH, MO, NY, SLPM, TEX, US, and XAL (herbaria acronyms according to Thiers, updated continuously). This data set was cross-checked with an unpublished list of known weeds in Mexico (Villaseñor & Espinosa, in preparation, an updated version of Villaseñor & Espinosa, 1998). This list was based on information from herbarium and literature sources, not all supported with specimens, with relatively broad and country-wide criteria. This process resulted in 426 species and 8,384 records of potential weeds in Michoacán. An additional search of the entire

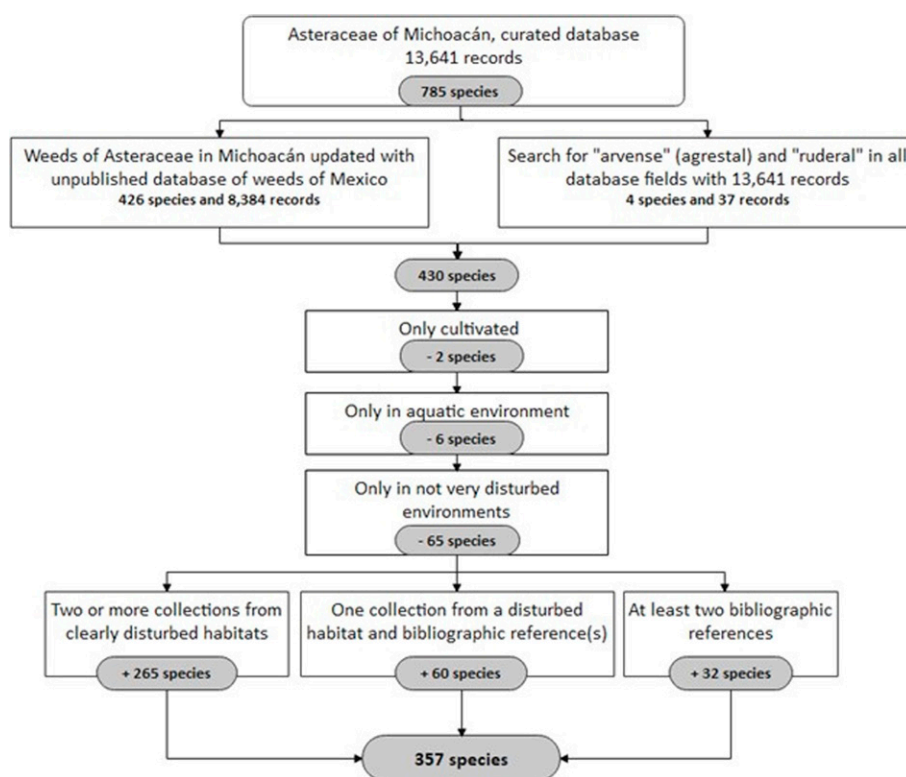


Figure 2. Diagram illustrating the selection of synanthropic Asteraceae species from Michoacán.

source database for habitat indications of either segetal or ruderal sites, but for species not found in the unpublished source list of weeds of Mexico, resulted in 4 more species and 37 records. Thus, the preliminary list of weeds of Michoacán consisted of 430 species and 8,421 records.

Final list. The preliminary list was critically reviewed to confirm or reject occurrence in human-made habitats in Michoacán. A species was included in the Michoacán weed list if at least 2 independent sources of information confirmed the ability to grow in highly disturbed environments. These sources could either be herbarium labels with clear indications of disturbed habitat or the description of the habitat in regionally relevant Floras.

The habitat information of the following Floras was used: Flora del Bajío y de Regiones Adyacentes (Cabrera & Rzedowski, 2018; García & Koch, 1995; Redonda-Martínez, 2013, 2016; Rzedowski et al., 2011; Rzedowski & Rzedowski, 1995, 1997, 2008; Villarreal, 2003; Villarreal et al., 2006), Flora Fanerogámica del Valle de México (Rzedowski et al., 2005), Flora Novogaliciana (McVaugh, 1984), the website Malezas de México (Vibrans, 2006 onwards), the work on Compositae in the synanthropic flora of Mexico (Rzedowski, 1993), and some additional

publications, such as Flora Mesoamericana (Pruski & Robinson, 2018) and some taxonomic treatments of groups.

Habitat information from labels was extracted for the 8,421 records of the preliminary list from IBdata v3 (IBdata, 2021). We excluded species that were only known as cultivated (*Artemisia absinthium* L. and *Leucanthemum lacustre* (Brot.) Samp.) or aquatic/subaquatic (*Bidens laevis* (L.) Britton, Sterns & Pogg., *Jaegeria macrocephala* Less., *Leucosyris riparia* (Kunth) Pruski & R.L. Hartm., *Melampodium bibracteatum* S. Watson, *Solidago paniculata* DC., and *Tagetes persicifolius* (Benth.) B.L. Turner), which resulted in 422 species and 8,360 records. Of these, only 6,539 records had habitat information. After an individual review of the label images on the IBData site, 1,739 additional indications of disturbed habitat were retrieved that had not been captured in the database.

The habitat information from the labels was classified into 2 types of environments. The first was predominantly natural or semi-natural ("NAT") and the second was heavily disturbed ("WEED" for weeds). Semi-natural environments were included in the NAT category because disturbance is less intense and recurrent (Harlan & de Wet, 1965), although they may be the sources of some weed

species (Vibrans, 2002), and generally have a composition of their own (Martorell et al., 2017; Rzedowski, 2006). The natural or semi-natural category included all types of forest, mangroves, natural palm groves, shrublands, as well as grasslands if the label did not indicate they were induced or planted, and high-elevation grasslands. Sites described as logged forests or forests with disturbed vegetation, etc., were also considered semi-natural vegetation. Some examples of label information that were considered to refer to semi-natural vegetation were the following: “heavily logged forest 15 to 20 years ago or so”, “low deciduous forest, disturbed, with *Bursera*, *Caesalpinia*, *Lonchocarpus*”, or “hillside with oak forest vegetation, forest in disturbance, probably replacing pine forest”.

Some other open vegetation types were also included in (semi-) natural vegetation. Examples were clearings or forest edges, cliffs, rocks or lava flows (“pedregal”), canyons, riverbanks, shores, wetlands, or volcanic craters. Examples of descriptions of open vegetation included in the natural category were “clearings in the middle of *Abies* forest”, “at the edge of moist forest”, “*Pinus* and *Abies* forest, on rocks”, “tropical deciduous forest, on outcrops of igneous rock”, or “oak forest on lava flow”.

Plants growing in human-transformed and heavily disturbed habitats were considered weedy. They included habitats described as segetal (“arvense”), crops, plantations, ruderal, roadsides, dam banks, canals or ditches, field edges, near crops, reforestation areas, pastures or induced grassland, urbanized sites or near houses, wastelands, embankments, or secondary vegetation without indicating a secondary forest. A total of 3,192 different habitat descriptions were assigned to the 2 classes (Supplementary material 1).

We found at least 2 collection records from clearly disturbed sites for 265 species (Fig. 2). Another 60 species were added based on one label and additional bibliographic support for that habitat. Others (32 species) were added even without clear label information, but with at least 2 independent literature references indicating that they may behave as agrestal or ruderal weeds in adjacent regions. We discarded 65 species that had information from only 1 source (e.g., literature or a single label without clear information). We always found literature support for single collections from a clearly disturbed habitat.

For the resulting 357 weed species, we gathered the following information from the literature: tribe (Funk et al., 2009), geographic distribution (native, but with distribution outside Mexico; endemic to Mexico; introduced), distribution by state in Mexico, geographic origin of the introduced species, as well as their life cycle and growth form (Appendix). Correlations were examined with linear regression analysis, and floristic similarity

between states with the Sorensen-Dice similarity index, constructing a dendrogram with the UPGMA clustering method.

Results

From the preliminary list of 430 possible weed species of the Asteraceae, 73 (17%) were eliminated: 2 were only cultivated, 6 were aquatic or subaquatic, and 65 could not be documented as growing in disturbed environments in the state. As a result, 357 species were recognized as weeds for this state (Appendix).

Most synanthropic species also grew in less disturbed habitats; only 27% of all records were from clearly disturbed sites (Appendix), and a very low number, 2.7%, from crop fields (segetal weeds). Only 22% of the species (80; Appendix) grew mainly in disturbed sites and 16 species were found exclusively in disturbed sites. Of this number, 7 species had only 1 record, 5 species 2, 2 species 3 (*Verbesina serrata* Cav. and *Conyza bonariensis* (L.) Cronquist), and 1 species 5 records (*Helminthoteca echioides* (L.) Holub). *Lactuca serriola* L., an introduced species, was the most common weed growing exclusively in disturbed environments with 16 records.

Heliantheae had the highest number of weed species in Michoacán (83, Supplementary material 2); Liabeae (*Sinclairia glabra* (Hemsl.) Rydb.) and Mutisieae (*Leibnitzia lyrata* (D. Don) G.L. Nesom) had the least with only 1 species. For the state, no synanthropic species of the tribes Arctotideae, Calenduleae, Chaenactideae, Gochnatieae, Madieae, and Onoserideae were found. However, among the genera with the highest number of species, none belonged to the most species-rich tribe; the most outstanding were *Melampodium* L. (tribe Millerieae, with 19 species), *Stevia* Cav. (Eupatorieae, with 18 species), and *Pseudognaphalium* Kirp. (Gnaphalieae, with 14 species, Appendix).

The number of weed species per tribe correlated significantly with the total number of species of the tribe in Mexico (including non-weeds) ($R^2 = 0.86$, $p < 0.0001$, Fig. 3). This correlation was even higher when comparing only species in Michoacán ($R^2 = 0.89$, $p < 0.0001$). An exception was the tribe Eupatorieae with a relatively low proportion of weeds; this was also the tribe with the most species removed from the original list (26 species).

Native weed species (including endemics) dominated in Michoacán. Of the 357 accepted species, 342 (96%) were native and 150 (44%) endemic to Mexico. Heliantheae had the highest number of native and endemic species (83 and 42, respectively). Some tribes with relatively few species had a high proportion of endemic weeds, for example, Gnaphalieae and Cardueae (Table 1).

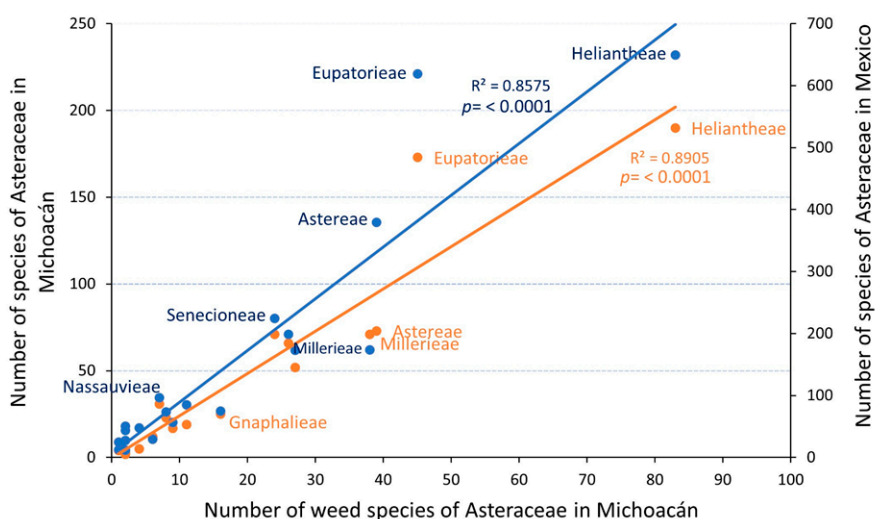


Figure 3. Relationship between the weedy and total number of species of Asteraceae by tribe in Michoacán and Mexico. The orange line and dots are for the data from Michoacán, and the blue line and dots compare weed data from Michoacán with all species known from Mexico.

Table 1

Comparison of native and endemic Asteraceae weeds of Michoacán by tribe and those reported for Mexico.

Tribe	Native species in Mexico (weeds and non-weeds) (Villaseñor, 2018)	Endemic species in Mexico (weeds and non-weeds)	Native weeds in Michoacán (absolute number and percent)	Endemic weeds in Michoacán (absolute number and percent)
Heliantheae	649	464	83 (12.8)	42 (9.1)
Eupatorieae	619	433	49 (7.9)	19 (4.4)
Astereae	378	200	39 (10.3)	10 (5.0)
Millerieae	174	131	38 (21.8)	15 (11.5)
Tageteae	172	112	27 (15.7)	12 (10.7)
Coreopsidaeae	199	144	26 (13.1)	11 (7.6)
Senecioneae	219	165	22 (10.0)	16 (9.7)
Gnaphalieae	71	25	15 (21.1)	5 (20.0)
Vernonieae	72	47	8 (11.1)	6 (12.8)
Nassauvieae	97	83	7 (7.2)	5 (6.0)
Cardueae	46	28	7 (15.2)	6 (21.4)
Cichorieae	68	19	5 (7.4)	1 (5.3)
Bahieae	48	23	4 (8.3)	2 (8.7)
Anthemideae	14	3	2 (14.3)	0
Inuleae	12	15	2 (8.0)	0
Mutisieae	13	7	1 (7.7)	0
Neurolaeneae	28	19	2 (7.1)	0
Perityleae	51	40	2 (3.9)	0
Helenieae	44	14	2 (4.5)	0
Liabeae	25	15	1 (4.0)	0
Sum	3,012	1,987	342 (11.4)	150 (7.5)

Table 2

Introduced weeds in Michoacán by tribe and geographic origin, according to Villaseñor et al. (2012).

Tribe (number of species in Mexico/in Michoacán)	Species/origin/number of records
Anthemideae (9/4)	<i>Cotula australis</i> (Spreng.) Hook. f. /Oceania/5 <i>Soliva anthemifolia</i> (Juss.) Sweet /South America/3 <i>Soliva sessilis</i> Ruiz et Pav. /South America/3 <i>Tanacetum parthenium</i> (L.) Sch. Bip. /Asia, Europe/15
Cardueae (3/2)	<i>Carthamus tinctorius</i> L. /Europe/3 <i>Cynara cardunculus</i> L. /Africa, Asia and Europe/2
Cichorieae (7/6)	<i>Helminthotheca echioides</i> (L.) Holub /Africa, Europe/5 <i>Lactuca serriola</i> L. /Europe/16 <i>Sonchus asper</i> (L.) Hill /Asia, Europe/4 <i>Sonchus oleraceus</i> L. /Africa, Asia, Europe/18 <i>Taraxacum officinale</i> F.H. Wigg. /Europe/18 <i>Tragopogon porrifolius</i> L. /Asia, Europe/1
Gnaphalieae (1/1)	<i>Pseudognaphalium luteoalbum</i> (L.) Hilliard y B.L. Burt /Asia, Europe/9
Senecioneae (2/2)	<i>Senecio inaequidens</i> DC. /Africa/19 <i>Senecio vulgaris</i> L. /Asia, Europe/3
Sum (22/15)	

The pattern of endemic weeds was like that of all weeds, but they were found in fewer tribes (13). The correlation by tribe between the number of endemic weeds in Michoacán and all endemic species (weeds and non-weeds) in Mexico was high ($R^2 = 0.77$) and increased when only species endemic to Mexico and documented from Michoacán were considered ($R^2 = 0.87$).

We found 15 species of introduced or exotic weeds in the state (4.2% of all weedy species) distributed in 5 tribes (Table 2), all herbaceous. The tribes with the highest number of introduced species had few native species, particularly Cichorieae (5 genera, 6 introduced species, and only 5 native species). This tribe had only 1 species endemic to Mexico (*Lactuca brachyrrhyncha* Greenm.). Eleven of the 15 introduced species were native to Europe, and 7 of these were also distributed in Asia, and 3 in Africa. The South American species belonged to the tribe Anthemideae (*Soliva anthemifolia* (Juss.) Sweet and *S. sessilis* Ruiz & Pav.); *Senecio inaequidens* DC. came from Africa and *Cotula australis* (Spreng.) Hook. f. from Oceania.

Weed species native to Michoacán were shared mainly with neighboring states, particularly the Estado de México (324). States located in mountain ranges such as the Volcanic Belt and the Sierra Madre del Sur had the highest similarity (Figs. 4, 5). The number of shared species decreased towards the north; for

example, Michoacán shared only 28 species with Baja California (Figs. 4, 5). Only a few species were known from all 32 federal states: *Artemisia ludoviciana* Nutt., *Bidens pilosa* L., *Conyza canadensis* (L.) Cronquist, and *Symphotrichum expansum* (Poepp. ex Spreng.) G.L. Nesom.

The Mexican endemic weed species showed a pattern similar to widespread native weeds. However, Guerrero and Oaxaca had less floristic similarity. Michoacán shared the highest number of endemic weeds with the Estado de México and Jalisco (136 and 135 species, respectively, Fig. 6). The endemic species with the widest distribution was recorded in 28 states (*Stevia organoides* Kunth). The state with the lowest number of shared species was Quintana Roo (only *Montanoa grandiflora* Alamán ex DC., also recorded in 22 states).

Of the 150 weed species endemic to Mexico, 11 (3.4%) had a more restricted distribution and were limited to Michoacán and its neighboring states (Table 3). They belonged to 5 tribes, particularly Heliantheae. As with the endemic species, the closest relationship was with Jalisco (10 species) and Estado de México (6) (Fig. 7).

The weeds of Michoacán were mainly herbaceous (79%) (Table 4), a little more than half of them perennial (56.9%). Annual herbs occupied second place, and a small part was biannual or behaved as both annual and perennial. A sizeable proportion was woody (19.3%).

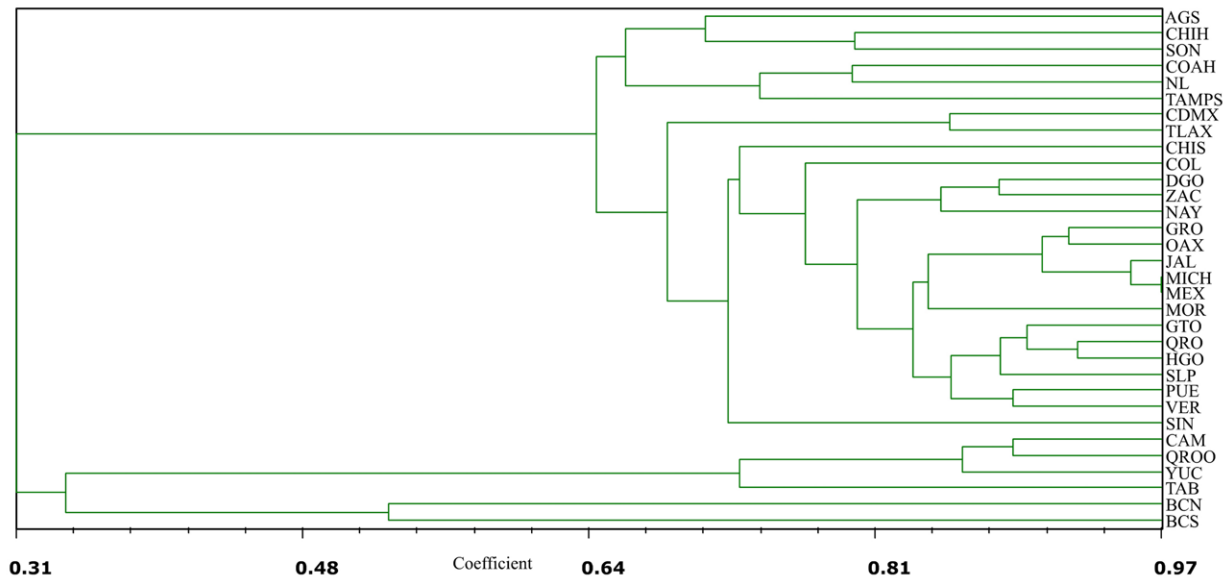


Figure 4. Native weed species of Michoacán and their floristic similarity with other federal states of Mexico. Similarity index used: Sorensen-Dice, clustering method: UPGMA.

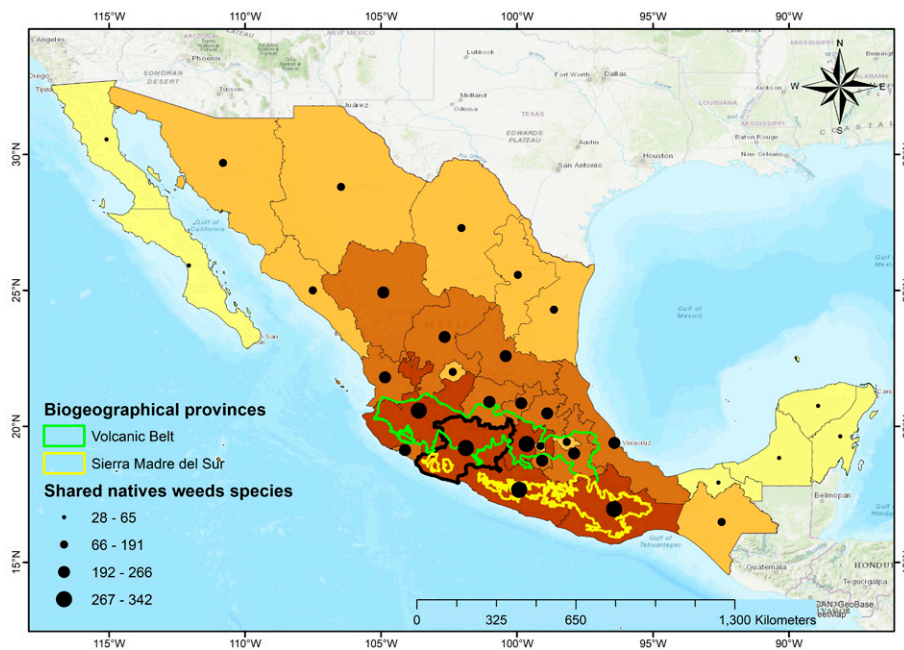


Figure 5. Michoacán native weeds (endemic and non-endemic) shared with other states of Mexico.

Discussion

We found no previous work that separated weeds and non-weeds in a standardized and therefore reproducible

way. This may be due to the intrinsic difficulties of such a distinction (Lema, 2017). In nature, species live on gradients with different levels and types of adaptation to disturbance, both natural and human. These gradients make

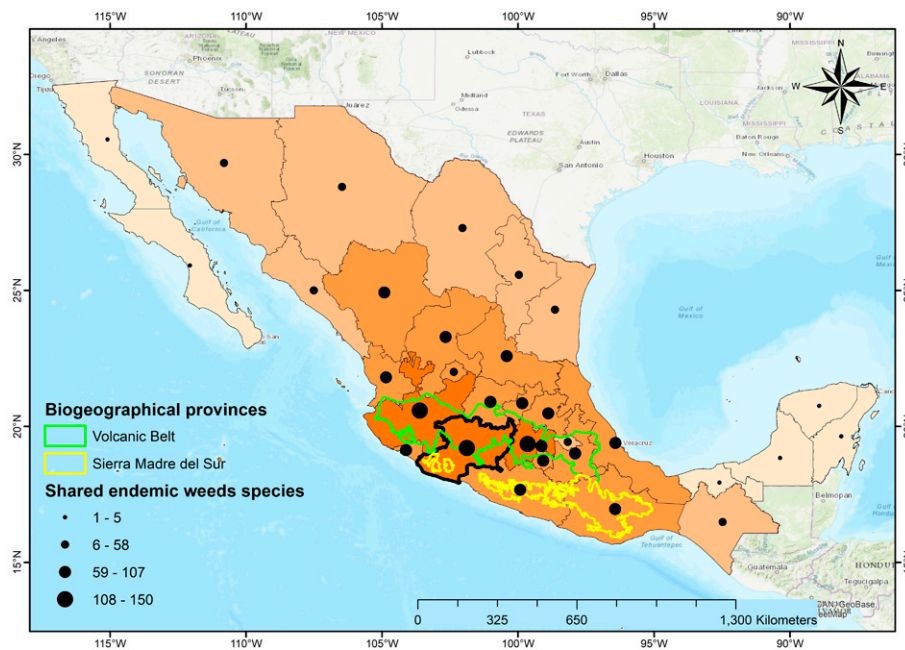


Figure 6. Mexican endemic weeds of Michoacán shared with other Mexican states.

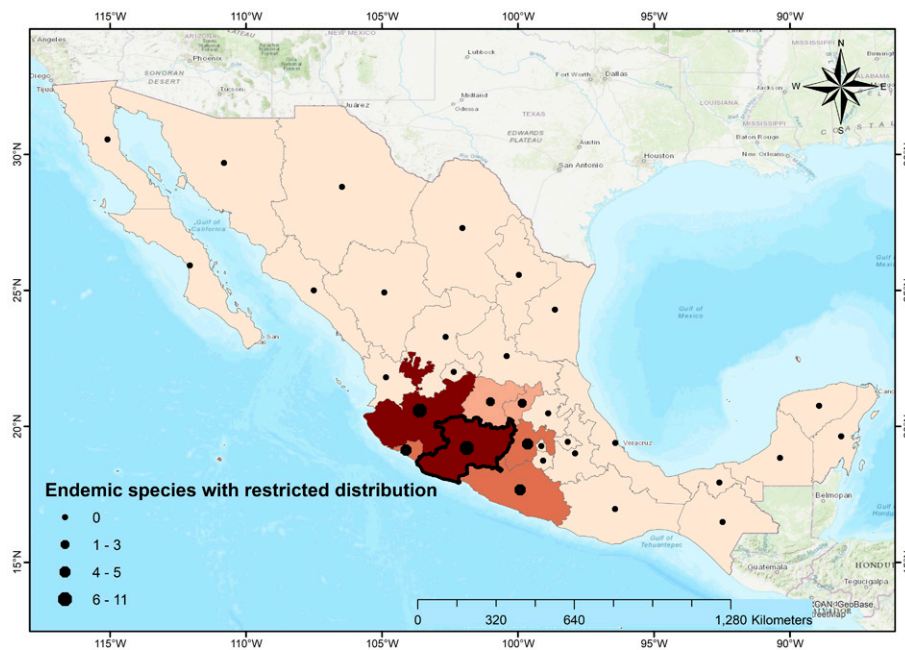


Figure 7. Mexican endemic weeds in Michoacán with restricted distribution and shared with neighboring states.

a clear separation between weeds and non-weeds difficult and will always be arbitrary to an extent; however, this arbitrariness is reduced with a clear definition of what is considered a weed. As mentioned in the introduction, here

any species that could grow and establish populations in environments heavily disturbed by humans was considered a weed (Baker, 1974; Hanan & Vibrans, 2015; Rzedowski & Rzedowski, 2004).

Table 3

Asteraceae endemic weeds known only from Michoacán and neighboring states, based on Villaseñor (2016).

Tribe	Species (distribution by state in addition to Michoacán)
Coreopsideae	<i>Bidens pringlei</i> Greenm. (Col., Jal., Méx.)
	<i>Chrysanthellum keilii</i> B.L. Turner (Jal.)
	<i>Chrysanthellum michoacanum</i> B.L. Turner (Jal.)
Eupatorieae	<i>Stevia nelsonii</i> B.L. Rob. (Col., Gto., Jal., Mex., Qro.)
Heliantheae	<i>Aldama michoacana</i> (B.L. Turner et F.G. Davies) E.E. Schill. y Panero (Gro., Jal., Méx.)
	<i>Lasgacea aurea</i> Stuessy (Col., Gto., Gro., Jal., Qro.)
	<i>Montanoa imbricata</i> V.A. Funk (Gro.)
	<i>Verbesina pietatis</i> McVaugh (Jal., Qro.)
Millerieae	<i>Melampodium dicoelocarpum</i> B.L. Rob. (Col., Gro., Jal., Mex.)
Tageteae	<i>Flaveria robusta</i> Rose (Col., Jal.)
	<i>Pectis luckoviae</i> D.J. Keil (Gro., Méx.)

Col. = Colima, Gro. = Guerrero, Gto. = Guanajuato, Jal. = Jalisco, Mex. = Estado de México, Qro. = Querétaro.

Table 4

Growth form and life cycle of the Michoacán weeds.

Growth form	Cycle	Number of species (%)
Tree	perennial	3 (0.8)
Shrub	perennial	66 (18.5)
Subshrub	perennial	5 (1.4)
Herb	perennial	129 (36.1)
Herb	annual or perennial	21 (5.9)
Herb	annual o biannual	8 (2.2)
Herb	annual	125 (35.0)
Sum		357 (100)

Other problems that had to be solved in a standardized way were lack of information, ambiguous information on herbarium labels or database records, as well as collection bias. Additionally, there were species in the gray or overlapping part of the gradient. These problems were solved by requiring 2 independent sources with information on their presence in heavily disturbed sites.

About one-sixth of the species cited as weeds in the literature from the region could not be confirmed as such. For example, some shrub species were part of pioneer vegetation and naturally disturbed sites but were not actually common components of transformed landscapes (Rzedowski, 2006). Most of the species removed from the

preliminary list were Eupatorieae, a tribe with numerous shrubby species that can grow along forest edges or roadsides, without being very weedy (García et al., 2011).

A few excluded species were common weeds known from neighboring regions, but no specimens were found to document their presence in the state, perhaps due to insufficient collections. Examples are *Ambrosia artemisiifolia* L., *Parthenium incanum* Kunth, *Grindelia subdecurrens* DC. (Villaseñor and Espinosa, 1998), or *Ageratum conyzoides* L. (Villaseñor, 2016). The collection bias was also marked, as collectors generally avoid disturbed sites, especially cultivated areas (Carvajal, 1982). However, although weeds (and especially arborescent weeds) are under-collected, the proportion of collections in disturbed environments does tend to reflect the degree of synanthropy (Hanan et al., 2016).

The final list presented here contains species that can behave as weeds. It is probably incomplete, mainly because of insufficient data, a common problem with megadata (Hortal et al., 2015). The number is likely to increase with better documentation. However, we suggest that our criteria (2 independent, unambiguous, and relevant records from heavily disturbed environments) can serve as a model for future work. Additionally, we urge collectors and databases to improve habitat information. Information on the general vegetation type of a site is useful, but disturbance level should also be included in herbarium labels and database fields.

In Michoacán, almost half (43%) of all Asteraceae were synanthropic. The proportion for the whole country is only 17% (Villaseñor, 2018; Villaseñor & Espinosa

García, 1998). This can be explained by differences in the size of the distribution areas —weedy species are much more widespread on average than non-weedy ones (Espinosa-García et al., 2004a). More than half of the Michoacán weeds were registered nationally as weeds for the same reason (219 of 411; Rzedowski, 1993).

This study adds more than a hundred Asteraceae species of weeds to those previously reported for the state (Villaseñor & Espinosa, 1998) and for all of Mexico (Rzedowski, 1993) (132 and 138 more, respectively). Seven species considered by Villaseñor and Espinosa (1998) were not confirmed, although their presence was documented. They were not included because they lacked evidence for synanthropic behavior in the state.

There are no comparable data from other federal states of Mexico, except for Querétaro (Colmenero et al., 2001). These authors reported 81 weed species of the family, that is, only a quarter of those recorded for Michoacán. Up to now, Michoacán is the state with the highest number of Asteraceae weeds in Mexico, confirming a statement by Villaseñor and Espinosa (1998).

Few weed species (4.5%) were documented exclusively from heavily disturbed environments, and most of them with few records. Of these, *Conyza bonariensis* (L.) Cronquist and *Simsia lagasciformis* DC. had previously been shown to be restricted to disturbed environments (Rzedowski, 1993). Only a quarter of the species had more than half of the collections in this type of environment. This partially reflected the above-mentioned collection bias towards more natural environments (Carvajal, 1982). However, it also shows that in Mexico, ruderal and agrestal species are embedded in the vegetation of the adjacent landscape and depend at least partially on functional traits of species with non-weedy behavior (Bourgeois et al., 2019; Metcalfe et al., 2019; Munoz et al., 2020).

Similar results have been reported in the Near East, where most weeds are also found in other vegetation types (Holzner, 1978; Zohary, 1973). The results contrast with the more evident separation between weeds and non-weeds in central and northern Europe (Holzner, 1978) or the United States (Sutherland, 2004). This may perhaps be explained by the history of agriculture. In its region of origin, species preadapted to anthropized environments coevolved as crop weeds, then migrated along with the crops. The communities gradually impoverished but specialized, depending on environmental filters such as crop or soil type and climate (Fried et al., 2010; Smart et al., 2006).

Generally, taxonomic groups are related, having characteristics in common as well as predictive value (McNeill, 1976). So, if weeds are required to have certain characteristics (Baker, 1974), one would expect them to be

concentrated in certain tribes. However, the results of this study do not show such concentration.

The weedy species were distributed in 20 of the 26 tribes of Compositae known from Mexico (Villaseñor, 2018); the 6 tribes without synanthropic species were species-poor. Generally, in Michoacán roughly half of the species in each tribe were weedy, though with some variation; endemic weeds also had a relatively constant proportion. The percentages at the national level were also proportional (range between 3.9% and 21.8%, with an average of 11.6%), but lower because of the more restricted distribution areas of non-weedy species on average (Espinosa-García et al., 2004a). The only exception was Cichorieae, a tribe with few species but with a high proportion of weeds and exotics (Villaseñor, 2018).

Some authors have proposed that weeds require specific characteristics to compete and colonize new environments (Baker, 1974), which can, however, be highly variable (Basu et al., 2004; Hanan et al., 2016). This study shows that weeds can develop in different tribes independently, perhaps because the functional spaces of weeds are not clearly delimited from non-weeds (Bourgeois et al., 2019).

Under the criteria used in this work, the species-rich tribe Eupatorieae had a relatively low proportion of weeds. It consists mainly of perennial herbs or shrubs, often in forest edges or clearings (García et al., 2011), where differentiation between weeds and non-weeds is particularly difficult. Also, the most species-rich tribes did not necessarily contain the most weed-rich genera; *Melampodium* (tribe Millerieae), for example, was the genus with the largest number of weedy species (19) but belonged to a medium-sized tribe; it grows widely in transformed landscapes at different levels of disturbance (Hanan et al., 2016). Rzedowski (1993) highlights a group of incipient weed genera, which were indeed well represented as weeds in Michoacán, e.g., *Stevia* Cav. (18), *Brickellia* Raf. (9), and *Erigeron* L. (7).

In Michoacán, native weeds predominated (Rzedowski, 1991). Almost half (44%) of them were endemic to Mexico (at a national level this percentage reaches 63.9% according to Villaseñor [2018]), but this was to be expected, given the generally larger distribution area of weeds.

The proportion of introduced species (4.2%) was much lower than that reported by Espinosa-García et al. (2004b) for the whole Mexican weed flora, with 28%. The differences are probably explained by differences in the proportion of introduced species between families (Brassicaceae, Fabaceae, or Poaceae have a considerably higher share of exotics; Villaseñor & Magaña [2006]). Most introduced species of the Asteraceae were native to Europe and the Mediterranean, which may be explained by the history of commerce (Villaseñor & Espinosa-García,

2004). All were herbs, as occurs in other floras (Arianoutsou et al., 2010; Garcillán et al., 2013; Weber et al., 2008), perhaps because this life form is well-represented in weeds and has some (pre-) adaptation to disturbed habitats.

The floristic composition reflects the history of biotic exchanges between regions and shared ecological conditions (Garcillán et al., 2013). Comparisons provide information on possible factors that determine such similarities. The weed flora of Michoacán was most similar to that of neighboring states, a similarity that decreased as distance increased (Nekola & White, 1999). However, we found stronger similarity with the western states located along the Volcanic Belt and the Sierra Madre del Sur (Guerrero and Oaxaca). They included regions known for their early settlements and agriculture (Zizumbo & Colunga, 2008), high proportions of endemism (Estrada-Márquez et al., 2021), and the greatest richness of Asteraceae (Villaseñor et al., 2005).

There were relatively few (11) endemic weed species with restricted distribution, but it is interesting that they exist at all. Rzedowski (2020) in the Flora del Bajío y de regiones adyacentes highlights some of them as species restricted to the Balsas Depression (*Chrysanthellum keilli* B.L. Turner and *C. michoacanum* B.L. Turner) or to the Volcanic Belt (*Verbesina pietatis* McVaugh). Estrada-Márquez et al. (2021) consider *Bidens pringlei* Greenm. and *Verbesina pietatis* as restricted to the same areas. It is likely that these species are examples of relatively recently evolved weed species.

Weed species in Michoacán were mostly herbs (79%). Short life cycles facilitate growth in frequently disturbed open environments (Díaz et al., 2016). However, a considerable number of woody plants could also grow in highly disturbed sites, as occurs in other parts of the world, such as France (Fried et al., 2009). They should be examined in more detail.

In temperate regions, ruderals are mostly perennial hemicytophytes or geophytes whereas agrestals are

typically annual therophytes (Bourgeois et al., 2019; Holzner, 1978), a pattern that was repeated here. The better representation of ruderal areas (roadsides, etc.) in the collections possibly increased the representation of perennials (63%), as cultivated areas (segetals) were severely under-collected.

Lack of quality information and collection biases limit the correct classification of species into weedy and non-weedy. However, herbarium data are good approximations when the information is reliable (Hanan et al., 2016). This study is based on fully verified data, especially taxonomic identification. It is likely that other species that were not included due to lack of evidence will have to be added in the future.

This study proposes criteria to identify weedy species in a systematic, reproducible way and includes a species list based on these criteria. Michoacán harbors a high number of native and endemic Asteraceae weed species, with a very low proportion of introduced plants. Most species grow in both disturbed sites and natural vegetation. This indicates the existence of a wide variety of biological traits that allow plants to live in transformed environments, reflected also by the relatively similar proportion of weeds in the different tribes. Floristic similarities with neighboring states point to close relationships within the western and southern parts of Mexico, a region with a long history of disturbance associated with human settlements and agriculture.

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Appendix. List of weed species of Asteraceae in Michoacán. The superscript indicates the references. Native: species considered native to the region but distributed outside of Mexico; endemic: endemic to Mexico; endemic with restricted distribution: species only distributed in Michoacán and adjacent federal states; introduced: origin outside of the geographical region.

Species	Tribe	Growth form	Biogeographical status: native, endemic, endemic with restricted distribution, introduced	Total number of records	Records from disturbed habitats
<i>Achillea millefolium</i> L. ^{1,2,3f,4,5}	Anthemideae	Perennial herb	Native	10	4
<i>Acmella radicans</i> (Jacq.) R.K. Jansen ^{1,2,3g}	Heliantheae	Annual herb	Native	25	10
<i>Acmella repens</i> (Walter) Rich. ^{1,2,3g,4}	Heliantheae	Perennial herb	Native	54	19

Appendix.

Species	Tribe	Growth form	Biogeographical status: native, endemic, endemic with restricted distribution, introduced	Total number of records	Records from disturbed habitats
<i>Acourtia fruticosa</i> (La Llave) B.L. Turner	Nassauvieae	Shrub	Endemic	32	5
<i>Acourtia humboldtii</i> (Less.) B.L. Turner	Nassauvieae	Annual or perennial herb	Endemic	23	4
<i>Acourtia moschata</i> (La Llave) DC.	Nassauvieae	Subshrub	Endemic	12	2
<i>Acourtia reticulata</i> (Lag. ex D. Don) Reveal & R.M. King ²	Nassauvieae	Perennial herb	Native	31	7
<i>Adenophyllum aurantium</i> (L.) Strother		Perennial herb	Endemic	10	2
Tageteae					
<i>Adenophyllum cancellatum</i> (Cass.) Villarreal ^{1,3h}	Tageteae	Annual herb	Endemic	8	5
<i>Adenophyllum porophyllum</i> (Cav.) Hemsl. ^{3h}	Tageteae	Annual herb	Native	22	8
<i>Adenophyllum pulcherrimum</i> (Strother) Villarreal ^{3h}	Tageteae	Annual herb	Endemic	1	1
<i>Ageratina adenophora</i> (Spreng.) R.M. King & H. Rob. ^{2,4}	Eupatorieae	Shrub	Native	40	14
<i>Ageratina areolaris</i> (DC.) Gage ex B.L. Turner	Eupatorieae	Shrub	Native	73	4
<i>Ageratina brevipes</i> (DC.) R.M. King & H. Rob.	Eupatorieae	Shrub	Endemic	10	3
<i>Ageratina deltoidea</i> (Jacq.) R.M. King & H. Rob. ^{1,2,4,5}	Eupatorieae	Perennial herb	Endemic	3	0
<i>Ageratina glabrata</i> (Kunth) R.M. King & H. Rob.	Eupatorieae	Shrub	Endemic	48	6
<i>Ageratina mairetiana</i> (DC.) R.M. King & H. Rob.	Eupatorieae	Shrub	Native	92	12
<i>Ageratina petiolaris</i> (Moc. & Sessé ex DC.) R.M. King & H. Rob. ^{2,4}	Eupatorieae	Shrub	Endemic	24	10
<i>Ageratina pichinchensis</i> (Kunth) R.M. King & H. Rob. ^{1,2}	Eupatorieae	Shrub	Native	6	1
<i>Ageratum corymbosum</i> Zuccagni ⁵	Eupatorieae	Perennial herb	Native	84	27
<i>Ageratum houstonianum</i> Mill. ^{1,2,5,6}	Eupatorieae	Annual herb	Native	1	0
<i>Aldama buddlejiformis</i> (DC.) E.E. Schill. & Panero ^{3d}	Heliantheae	Perennial herb	Endemic	11	4
<i>Aldama dentata</i> La Llave ^{1,2,3g,4,5}	Heliantheae	Annual herb	Native	41	25
<i>Aldama ghiesbreghtii</i> (Hemsl.) E.E. Schill. & Panero	Heliantheae	Perennial herb	Endemic	54	4
<i>Aldama linearis</i> (Cav.) E.E. Schill. & Panero ⁴	Heliantheae	Perennial herb	Endemic	16	11
<i>Aldama michoacana</i> (B.L. Turner & F.G. Davies) E.E. Schill. & Panero ⁵	Heliantheae	Annual herb	Endemic with restricted distribution	24	11
<i>Aldama pachycephala</i> (DC.) E.E. Schill. & Panero ⁴	Heliantheae	Perennial herb	Endemic	12	7
<i>Aldama palmeri</i> (A. Gray) E.E. Schill. & Panero	Heliantheae	Annual herb	Endemic	8	3
<i>Alloispermum integrifolium</i> (DC.) H. Rob. ¹	Millerieae	Shrub	Native	24	3
<i>Alloispermum scabrum</i> (Lag.) H. Rob. ^{3g}	Millerieae	Perennial herb	Native	58	6
<i>Ambrosia canescens</i> A. Gray ^{2,3g,4,5}	Heliantheae	Perennial herb	Endemic	2	1
<i>Ambrosia cumanensis</i> Kunth ^{1,2}	Heliantheae	Perennial herb	Native	24	15
<i>Aphanostephus ramosissimus</i> DC. ^{1,2,4,5}	Astereae	Annual or perennial herb	Native	14	7
<i>Archibaccharis asperifolia</i> (Benth.) S.F. Blake ^{2,4}	Astereae	Perennial herb	Native	26	4
<i>Archibaccharis hirtella</i> (DC.) Heering	Astereae	Subshrub	Native	29	3
<i>Archibaccharis schiedeana</i> (Benth.) J.D. Jacks.	Astereae	Subshrub	Native	16	3
<i>Archibaccharis serratifolia</i> (Kunth) S.F. Blake ^{1,4}	Astereae	Perennial herb	Native	44	3

Appendix.

Species	Tribe	Growth form	Biogeographical status: native, endemic, endemic with restricted distribution, introduced	Total number of records	Records from disturbed habitats
<i>Artemisia ludoviciana</i> Nutt. ^{1,2,3f,4,5}	Anthemideae	Perennial herb	Native	28	10
<i>Astranthium orthopodum</i> (B.L. Rob. & Fernald) Larsen ^{2,5}	Astereae	Annual or biannual herb	Endemic	52	19
<i>Baccharis conferta</i> Kunth ⁴	Astereae	Shrub	Native	57	9
<i>Baccharis heterophylla</i> Kunth ^{2,5}	Astereae	Shrub	Native	106	17
<i>Baccharis multiflora</i> Kunth	Astereae	Shrub	Native	34	4
<i>Baccharis pteronioides</i> DC. ^{2,4,5}	Astereae	Subshrub	Native	30	15
<i>Baccharis salicifolia</i> (Ruiz & Pav.) Pers. ^{1,2,5}	Astereae	Shrub	Native	23	10
<i>Baccharis sordescens</i> DC. ⁴	Astereae	Shrub	Endemic	2	1
<i>Baccharis thesioides</i> Kunth	Astereae	Subshrub	Native	7	2
<i>Baccharis trinervis</i> (Lam.) Pers. ^{2,5}	Astereae	Shrub	Native	6	2
<i>Baltimora geminata</i> (Brandege) Stuessy ^{2,5,13}	Heliantheae	Annual herb	Native	1	0
<i>Barkleyanthus salicifolius</i> (Kunth) H. Rob. & Brettell ^{1,2,4,5}	Senecioneae	Shrub	Native	80	32
<i>Bidens aequisquama</i> (Fernald) Sherff ^{3g}	Coreopsidaeae	Perennial herb	Endemic	70	8
<i>Bidens anthemoides</i> (DC.) Sherff ^{1,2,3g,4}	Coreopsidaeae	Annual or perennial herb	Endemic	17	0
<i>Bidens aurea</i> (Aiton) Sherff ^{1,2,3g,4,5}	Coreopsidaeae	Perennial herb	Native	56	21
<i>Bidens bigelovii</i> A. Gray ^{1,2,3g,4,5}	Coreopsidaeae	Annual herb	Native	20	2
<i>Bidens odorata</i> Cav. ^{1,2,3g,4,5}	Coreopsidaeae	Annual herb	Native	72	27
<i>Bidens pilosa</i> L. ^{1,2,3g,4,5}	Coreopsidaeae	Annual herb	Native	14	4
<i>Bidens pringlei</i> Greenm. ⁵	Coreopsidaeae	Perennial herb	Endemic with restricted distribution	6	2
<i>Bidens riparia</i> Kunth ^{2,5,6}	Coreopsidaeae	Annual herb	Native	5	0
<i>Bidens serrulata</i> (Poir.) Desf. ^{1,2,3g,4}	Coreopsidaeae	Annual herb	Endemic	10	1
<i>Bidens triplinervia</i> Kunth ^{1,2,3g,4,5}	Coreopsidaeae	Perennial herb	Native	55	10
<i>Blumea viscosa</i> (Mill.) V.M. Badillo ^{2,3c,5}	Inuleae	Perennial herb	Native	5	1
<i>Brickellia diffusa</i> (Vahl) A. Gray ^{2,5}	Eupatorieae	Annual herb	Native	10	1
<i>Brickellia eupatorioides</i> (L.) Shinners	Eupatorieae	Perennial herb	Native	4	3
<i>Brickellia filipes</i> B.L. Rob. ^{2,5}	Eupatorieae	Annual herb	Endemic	1	0
<i>Brickellia glandulosa</i> (La Llave) McVaugh	Eupatorieae	Shrub	Native	5	2
<i>Brickellia paniculata</i> (Mill.) B.L. Rob. ^{2,5}	Eupatorieae	Shrub	Native	4	0
<i>Brickellia pedunculosa</i> (DC.) Harc. & Beaman	Eupatorieae	Perennial herb	Endemic	31	4
<i>Brickellia pendula</i> (Schrad.) A. Gray	Eupatorieae	Shrub	Endemic	18	2
<i>Brickellia secundiflora</i> (Lag.) A. Gray ^{1,2}	Eupatorieae	Shrub	Endemic	26	8
<i>Brickellia veronicifolia</i> (Kunth) A. Gray ^{2,4}	Eupatorieae	Shrub	Native	1	0
<i>Calea ternifolia</i> Kunth ²	Neurolaeneae	Shrub	Native	6	2
<i>Calea urticifolia</i> (Mill.) DC. ^{3g}	Neurolaeneae	Shrub	Native	14	5
<i>Calyptocarpus vialis</i> Less. ^{1,2,3g,4,5}	Heliantheae	Perennial herb	Native	5	3

Appendix.

Species	Tribe	Growth form	Biogeographical status: native, endemic, endemic with restricted distribution, introduced	Total number of records	Records from disturbed habitats
<i>Calyptocarpus wendlandii</i> Sch. Bip. ^{1,2}	Heliantheae	Perennial herb	Native	1	1
<i>Carminatia recondita</i> McVaugh ¹	Eupatorieae	Annual herb	Native	22	7
<i>Carthamus tinctorius</i> L. ^{2,3a}	Cardueae	Annual herb	Introduced	3	1
<i>Chromolaena collina</i> (DC.) R.M. King & H. Rob. ²	Eupatorieae	Shrub	Native	43	9
<i>Chromolaena odorata</i> (L.) R.M. King & H. Rob. ^{1,2}	Eupatorieae	Perennial herb	Native	26	12
<i>Chrysanthellum indicum</i> DC. ^{2,3g,5}	Coreopsidaeae	Annual herb	Native	14	3
<i>Chrysanthellum keilii</i> B.L. Turner ^{2,12}	Coreopsidaeae	Annual herb	Endemic with restricted distribution	2	1
<i>Chrysanthellum michoacanum</i> B.L. Turner ^{2,5}	Coreopsidaeae	Annual herb	Endemic with restricted distribution	2	0
<i>Chromolaena pulchella</i> (Kunth) R.M. King & H. Rob.	Eupatorieae	Perennial herb	Endemic	27	9
<i>Cirsium acantholepis</i> (Hemsl.) Petr. ^{3a,4,5}	Cardueae	Perennial herb	Endemic	4	1
<i>Cirsium anartiolepis</i> Petr.	Cardueae	Perennial herb	Endemic	40	3
<i>Cirsium ehrenbergii</i> Sch. Bip. ^{3a,4}	Cardueae	Perennial herb	Endemic	42	3
<i>Cirsium pascuarensense</i> (Kunth) Spreng. ⁴	Cardueae	Perennial herb	Endemic	6	4
<i>Cirsium raphilepis</i> (Hemsl.) Petr. ^{1,2,3a,4}	Cardueae	Perennial herb	Endemic	12	6
<i>Cirsium velatum</i> (S. Watson) Petr. ^{2,3a,5}	Cardueae	Perennial herb	Endemic	25	6
<i>Conyza bonariensis</i> (L.) Cronquist ^{1,2,4,5}	Astereae	Annual herb	Native	3	3
<i>Conyza canadensis</i> (L.) Cronquist ^{1,2,3j,4,5}	Astereae	Annual herb	Native	32	22
<i>Conyza coronopifolia</i> Kunth ^{1,2,4,5}	Astereae	Annual herb	Native	44	14
<i>Conyza laevigata</i> (Rich.) Pruski ^{2,5}	Astereae	Annual herb	Native	2	0
<i>Conyza microcephala</i> Hemsl. ^{2,4}	Astereae	Perennial herb	Endemic	14	4
<i>Conyza sumatrensis</i> (Retz.) E. Walker ⁶	Astereae	Annual herb	Native	1	1
<i>Coreopsis petrophiloides</i> B.L. Rob. & Greenm.	Coreopsidaeae	Shrub	Endemic	23	2
<i>Cosmos bipinnatus</i> Cav. ^{1,2,3g,4,5}	Coreopsidaeae	Annual herb	Native	50	25
<i>Cosmos carvifolius</i> Benth.	Coreopsidaeae	Perennial herb	Endemic	7	2
<i>Cosmos crithmifolius</i> Kunth ^{2,4}	Coreopsidaeae	Perennial herb	Native	26	2
<i>Cosmos diversifolius</i> Otto ^{2,4}	Coreopsidaeae	Perennial herb	Native	2	1
<i>Cosmos pacificus</i> Melchert ¹	Coreopsidaeae	Annual herb	Endemic	24	8
<i>Cosmos parviflorus</i> (Jacq.) Pers. ^{1,2,3g,4,5}	Coreopsidaeae	Annual herb	Native	21	5
<i>Cosmos scabiosoides</i> Kunth ^{1,5}	Coreopsidaeae	Perennial herb	Endemic	91	14
<i>Cosmos sulphureus</i> Cav. ^{1,2,3g,5}	Coreopsidaeae	Annual herb	Native	17	7
<i>Cotula australis</i> (Spreng.) Hook. f. ^{1,2,3f,4,5}	Anthemideae	Annual herb	Introduced	5	3
<i>Cynara cardunculus</i> L. ^{1,2,3a}	Cardueae	Perennial herb	Introduced	2	2
<i>Dahlia coccinea</i> Cav. ^{1,3g}	Coreopsidaeae	Perennial herb	Native	137	29
<i>Dahlia neglecta</i> Saar	Coreopsidaeae	Perennial herb	Endemic	10	2
<i>Dahlia sorensenii</i> H.V. Hansen & Hjert. ¹¹	Coreopsidaeae	Perennial herb	Native	14	1
<i>Delilia biflora</i> (L.) Kuntze ^{2,3g,5}	Heliantheae	Annual herb	Native	17	4

Appendix.

Species	Tribe	Growth form	Biogeographical status: native, endemic, endemic with restricted distribution, introduced	Total number of records	Records from disturbed habitats
<i>Dendroviguiera sphaerocephala</i> (DC.) E.E. Schill. & Panero	Heliantheae	Shrub	Endemic	10	5
<i>Dugesia mexicana</i> (A. Gray) A. Gray ^{1,2,3g,4}	Heliantheae	Perennial herb	Endemic	1	0
<i>Dyssodia papposa</i> (Vent.) Hitchc. ^{1,2,3h,4,5}	Tageteae	Annual herb	Native	22	10
<i>Dyssodia pinnata</i> (Cav.) B.L. Rob. ^{2,4,5}	Tageteae	Perennial herb	Endemic	8	2
<i>Dyssodia tagetiflora</i> Lag. ^{1,2,3h,5}	Tageteae	Perennial herb	Endemic	39	18
<i>Eclipta prostrata</i> (L.) L. ^{1,2,3g,5}	Heliantheae	Annual herb	Native	23	6
<i>Erechtites hieracifolius</i> (L.) Raf. ex DC. ^{1,2}	Senecioneae	Annual herb	Native	2	2
<i>Eremosis tomentosa</i> (Lex.) Gleason ^{3e}	Vernonieae	Shrub	Endemic	34	11
<i>Eremosis triflosculosa</i> (Kunth) Gleason ^{2,5}	Vernonieae	Shrub	Native	3	1
<i>Eremosis villaregalis</i> (Carvajal) Pruski ^{3e}	Vernonieae	Shrub	Endemic	10	2
<i>Erigeron delphinifolius</i> Willd. ^{2,4,5}	Astereae	Annual or perennial herb	Native	38	12
<i>Erigeron galeottii</i> (A. Gray ex Hemsl.) Greene ^{2,4}	Astereae	Perennial herb	Endemic	34	1
<i>Erigeron karvinskianus</i> DC. ²	Astereae	Perennial herb	Native	9	6
<i>Erigeron longipes</i> DC. ^{1,2,4,5}	Astereae	Perennial herb	Native	67	27
<i>Erigeron polycephalus</i> (Larsen) G.L. Nesom ⁵	Astereae	Perennial herb	Endemic	3	2
<i>Erigeron pubescens</i> Kunth ¹	Astereae	Perennial herb	Native	6	2
<i>Erigeron velutipes</i> Hook. & Arn. ^{2,5}	Astereae	Annual herb	Endemic	10	4
<i>Euphrosyne partheniifolia</i> DC. ^{1,4}	Heliantheae	Annual or perennial herb	Endemic	4	1
<i>Flaveria robusta</i> Rose ^{2,5}	Tageteae	Shrub	Endemic with restricted distribution	1	1
<i>Flaveria trinervia</i> (Spreng.) C. Mohr ^{1,2,3i,4,5}	Tageteae	Annual herb	Native	10	4
<i>Fleischmannia pycnocephala</i> (Less.) R.M. King & H. Rob. ^{1,2}	Eupatorieae	Perennial herb	Native	2	0
<i>Fleischmannia sonora</i> (A. Gray) R.M. King & H. Rob.	Eupatorieae	Perennial herb	Native	15	3
<i>Florestina lobata</i> B.L. Turner	Bahieae	Annual herb	Endemic	5	3
<i>Florestina pedata</i> (Cav.) Cass. ^{1,2,3i,4,5}	Bahieae	Annual herb	Native	39	14
<i>Galeana pratensis</i> (Kunth) Rydb. ^{2,3i,5}	Perityleae	Annual herb	Native	47	14
<i>Galinsoga longipes</i> Canne ^{1,3g}	Millerieae	Annual herb	Endemic	5	2
<i>Galinsoga parviflora</i> Cav. ^{1,2,3g,4,5}	Millerieae	Annual herb	Native	109	43
<i>Galinsogeopsis scopulorum</i> (M.E. Jones) I.H. Lichter-Marck ^{1,2,3i,5}	Perityleae	Annual herb	Native	2	0
<i>Gamochaeta americana</i> (Mill.) Wedd. ^{1,2,5}	Gnaphalieae	Annual or biannual herb	Native	53	17
<i>Gamochaeta falcata</i> (Lam.) Cabrera ^{2,4,5}	Gnaphalieae	Annual herb	Native	4	1
<i>Grindelia inuloides</i> Willd. ^{2,4,5}	Astereae	Perennial herb	Endemic	5	2
<i>Guardiola mexicana</i> Bonpl. ^{1,5}	Millerieae	Perennial herb	Endemic	53	9
<i>Guardiola tulocarpus</i> A. Gray ⁵	Millerieae	Shrub	Endemic	6	2

Appendix.

Species	Tribe	Growth form	Biogeographical status: native, endemic, endemic with restricted distribution, introduced	Total number of records	Records from disturbed habitats
<i>Helenium mexicanum</i> Kunth ^{2,3i,4}	Helenieae	Annual or biannual herb	Native	17	10
<i>Helenium quadridentatum</i> Labill. ^{2,3i,5}	Helenieae	Annual or biannual herb	Native	1	1
<i>Helianthus annuus</i> L. ^{1,2,3g,4}	Heliantheae	Annual herb	Native	3	2
<i>Heliopsis annua</i> Hemsl. ^{2,3g,5}	Heliantheae	Annual herb	Endemic	14	10
<i>Heliopsis bupthalmoides</i> (Jacq.) Dunal ^{2,6}	Heliantheae	Perennial herb	Native	8	1
<i>Heliopsis procumbens</i> Hemsl. ^{2,5}	Heliantheae	Perennial herb	Endemic	11	1
<i>Helminthotheca echioides</i> (L.) Holub ^{1,2,4}	Cichorieae	Annual or perennial herb	Introduced	5	5
<i>Heterosperma pinnatum</i> Cav. ^{1,2,3g,4,5}	Coreopsideae	Annual herb	Native	36	11
<i>Heterotheca inuloides</i> Cass. ^{1,2,4,5}	Astereae	Perennial herb	Endemic	25	5
<i>Hieracium abscissum</i> Less. ^{3k}	Cichorieae	Perennial herb	Native	53	2
<i>Hieracium crepidispermum</i> Fr. ^{3k}	Cichorieae	Perennial herb	Native	16	5
<i>Hieracium schultzi</i> Fr. ^{3k,4}	Cichorieae	Perennial herb	Native	22	5
<i>Hymenostephium cordatum</i> (Hook. & Arn.) S.F. Blake ^{2,3g}	Heliantheae	Perennial herb	Native	32	2
<i>Hymenostephium tenue</i> (A. Gray) E.E. Schill. & Panero ^{2,5}	Heliantheae	Annual herb	Native	6	1
<i>Jaegeria hirta</i> (Lag.) Less. ^{1,2,3g,4,5}	Millerieae	Annual herb	Native	94	19
<i>Koanophyllon albicaule</i> (Sch. Bip. ex Klatt) R.M. King & H. Rob. ⁶	Eupatorieae	Shrub	Native	4	1
<i>Lactuca brachyrrhyncha</i> Greenm. ¹⁰	Cichorieae	Perennial herb	Endemic	3	1
<i>Lactuca serriola</i> L. ^{1,2,3k,4}	Cichorieae	Annual or perennial herb	Introduced	16	16
<i>Laennecia filaginoides</i> DC. ^{2,4,5}	Astereae	Annual herb	Native	21	2
<i>Laennecia gnaphalioides</i> (Kunth) Cass. ²	Astereae	Annual or perennial herb	Native	4	2
<i>Laennecia schiedeana</i> (Less.) G.L. Nesom ⁴	Astereae	Annual or perennial herb	Native	30	3
<i>Laennecia sophiifolia</i> (Kunth) G.L. Nesom ^{1,2,4}	Astereae	Annual herb	Native	23	10
<i>Lagascea aurea</i> Stuessy	Heliantheae	Annual herb	Endemic with restricted distribution	22	3
<i>Lagascea decipiens</i> Hemsl. ^{2,5}	Heliantheae	Shrub	Native	3	1
<i>Lagascea helianthifolia</i> Kunth ^{1,5}	Heliantheae	Shrub	Native	69	13
<i>Lagascea mollis</i> Cav. ^{1,2,5}	Heliantheae	Annual herb	Native	18	14
<i>Lasianthaea aurea</i> (D. Don) K.M. Becker ^{2,3d,5}	Heliantheae	Perennial herb	Endemic	23	6
<i>Lasianthaea ceanothifolia</i> (Willd.) K.M. Becker ^{3d,6}	Heliantheae	Shrub	Endemic	11	2
<i>Lasianthaea crocea</i> (A. Gray) K.M. Becker ^{1,3d}	Heliantheae	Shrub	Endemic	11	1
<i>Lasianthaea helianthoides</i> DC. ^{2,5}	Heliantheae	Shrub	Endemic	6	1
<i>Lasianthaea macrocephala</i> (Hook. & Arn.) K.M. Becker ^{1,5}	Heliantheae	Shrub	Endemic	5	1
<i>Lasianthaea palmeri</i> (Greenm.) K.M. Becker ^{2,3d,5}	Heliantheae	Perennial herb	Endemic	6	2

Appendix.

Species	Tribe	Growth form	Biogeographical status: native, endemic, endemic with restricted distribution, introduced	Total number of records	Records from disturbed habitats
<i>Leibnitzia lyrata</i> (D. Don) G.L. Nesom ^{2,6}	Mutisieae	Perennial herb	Native	5	0
<i>Melampodium americanum</i> L. ^{2,3d,5}	Millerieae	Annual herb	Native	30	13
<i>Melampodium aureum</i> Brandegee	Millerieae	Perennial herb	Endemic	15	3
<i>Melampodium dicoelocarpum</i> B.L. Rob. ⁵	Millerieae	Annual herb	Endemic with restricted distribution	9	3
<i>Melampodium divaricatum</i> (Rich.) DC. ^{1,2,3d,4,5}	Millerieae	Annual herb	Native	87	47
<i>Melampodium glabrum</i> S. Watson ^{2,3d,4}	Millerieae	Annual herb	Endemic	15	6
<i>Melampodium gracile</i> Less. ^{2,3d,5}	Millerieae	Annual herb	Native	11	3
<i>Melampodium linearilobum</i> DC. ^{2,5}	Millerieae	Annual herb	Native	18	10
<i>Melampodium longifolium</i> Cerv. ex Cav. ^{2,4}	Millerieae	Annual herb	Endemic	4	1
<i>Melampodium longipes</i> (A. Gray) B.L. Rob. ^{5,6}	Millerieae	Annual herb	Endemic	1	0
<i>Melampodium longipilum</i> B.L. Rob.	Millerieae	Annual herb	Native	4	2
<i>Melampodium microcephalum</i> Less. ^{2,3d,5}	Millerieae	Annual herb	Native	40	18
<i>Melampodium montanum</i> Benth.	Millerieae	Perennial herb	Native	27	4
<i>Melampodium paniculatum</i> Gardner ^{2,6}	Millerieae	Annual herb	Native	1	0
<i>Melampodium perfoliatum</i> (Cav.) Kunth ^{2,3d,4,5}	Millerieae	Annual herb	Native	63	39
<i>Melampodium pilosum</i> Stuessy ⁵	Millerieae	Perennial herb	Endemic	33	12
<i>Melampodium repens</i> Sessé & Moc. ^{1,2,3d,4}	Millerieae	Annual herb	Endemic	14	5
<i>Melampodium sericeum</i> Lag. ^{1,2,3d,5}	Millerieae	Annual herb	Native	66	42
<i>Melampodium strigosum</i> Stuessy ^{2,3d}	Millerieae	Annual herb	Native	3	1
<i>Melampodium tenellum</i> Hook. & Arn. ^{2,5}	Millerieae	Annual herb	Endemic	1	0
<i>Melanthera nivea</i> (L.) Small ^{1,2,3d,5}	Heliantheae	Perennial herb	Native	3	1
<i>Mikania cordifolia</i> (L. f.) Willd. ^{2,6}	Eupatorieae	Perennial herb	Native	1	0
<i>Mikania micrantha</i> Kunth ^{2,5}	Eupatorieae	Perennial herb	Native	1	0
<i>Milleria quinqueflora</i> L. ^{1,2,3d,5}	Millerieae	Annual herb	Native	19	9
<i>Montanoa bipinnatifida</i> (Kunth) K. Koch ^{1,2,3d}	Heliantheae	Shrub	Endemic	10	3
<i>Montanoa frutescens</i> Mairet ex DC. ^{2,3d,4,5}	Heliantheae	Shrub	Endemic	7	1
<i>Montanoa grandiflora</i> Alamán ex DC. ^{2,3d}	Heliantheae	Shrub	Endemic	36	8
<i>Montanoa imbricata</i> V.A. Funk ^{2,3d,5}	Heliantheae	Shrub	Endemic with restricted distribution	4	1
<i>Montanoa karwinskii</i> DC. ^{2,5}	Heliantheae	Shrub	Endemic	6	1
<i>Montanoa leucantha</i> (Lag.) S.F. Blake ^{2,3d,5}	Heliantheae	Shrub	Native	23	4
<i>Montanoa tomentosa</i> Cerv. ^{2,3d,4,5}	Heliantheae	Shrub	Native	3	0
<i>Packera sanguisorbae</i> (DC.) C. Jeffrey ⁴	Senecioneae	Perennial herb	Endemic	90	7
<i>Packera toluccana</i> (DC.) W.A. Weber & A. Löve ⁴	Senecioneae	Perennial herb	Endemic	67	4
<i>Parthenium bipinnatifidum</i> (Ortega) Rollins ^{1,2,3d,4,5}	Heliantheae	Annual herb	Native	9	8
<i>Parthenium hysterophorus</i> L. ^{1,2,4,5}	Heliantheae	Annual herb	Native	13	10
<i>Pectis haenkeana</i> (DC.) Sch. Bip. ⁹	Tageteae	Annual or perennial herb	Endemic	3	1

Appendix.

Species	Tribe	Growth form	Biogeographical status: native, endemic, endemic with restricted distribution, introduced	Total number of records	Records from disturbed habitats
<i>Pectis leavenworthii</i> Standl.	Tageteae	Perennial herb	Endemic	10	5
<i>Pectis linifolia</i> L. ²	Tageteae	Annual herb	Native	14	4
<i>Pectis luckoviae</i> D.J. Keil	Tageteae	Annual herb	Endemic with restricted distribution	19	9
<i>Pectis prostrata</i> Cav. ^{1,2,3h,5}	Tageteae	Annual herb	Native	13	4
<i>Pectis uniaristata</i> DC. ⁵	Tageteae	Annual herb	Native	7	2
<i>Pinaropappus roseus</i> (Less.) Less. ^{1,2,3k,4,5}	Cichorieae	Perennial herb	Native	48	12
<i>Piqueria pilosa</i> Kunth	Eupatorieae	Perennial herb	Endemic	50	3
<i>Piqueria triflora</i> Hemsl. ^{2,5}	Eupatorieae	Annual herb	Endemic	9	1
<i>Piqueria trinervia</i> Cav. ^{1,2,5}	Eupatorieae	Perennial herb	Native	56	11
<i>Plectocephalus rothrockii</i> (Greenm.) D.J.N. Hind ^{1,2,3a,6}	Cardueae	Annual or perennial herb	Native	2	1
<i>Pluchea carolinensis</i> (Jacq.) G. Don ^{1,2}	Inuleae	Shrub	Native	17	3
<i>Podachaenium eminens</i> (Lag.) Sch. Bip. ^{2,5,6}	Heliantheae	Tree	Native	9	0
<i>Porophyllum linaria</i> (Cav.) DC. ²	Tageteae	Annual herb	Endemic	2	1
<i>Porophyllum macrocephalum</i> DC. ^{1,2,3h,5}	Tageteae	Annual herb	Native	18	3
<i>Porophyllum punctatum</i> (Mill.) S.F. Blake	Tageteae	Shrub	Native	22	10
<i>Porophyllum viridiflorum</i> (Kunth) DC.	Tageteae	Shrub	Endemic	44	9
<i>Psacalium amplifolium</i> (DC.) H. Rob. & Brettell	Senecioneae	Perennial herb	Endemic	6	2
<i>Psacalium cirsifolium</i> (Zucc.) H. Rob. & Brettell ⁵	Senecioneae	Perennial herb	Endemic	20	3
<i>Psacalium megaphyllum</i> (B.L. Rob. & Greenm.) Rydb. ⁵	Senecioneae	Perennial herb	Endemic	28	4
<i>Psacalium palmeri</i> (Greene) H. Rob. & Brettell ⁵	Senecioneae	Perennial herb	Endemic	18	2
<i>Psacalium peltatum</i> (Kunth) Cass.	Senecioneae	Perennial herb	Endemic	41	6
<i>Psacalium platylepis</i> (B.L. Rob. & Seaton) H. Rob. & Brettell ⁵	Senecioneae	Perennial herb	Endemic	2	1
<i>Psacalium sinuatum</i> (Cerv.) H. Rob. & Brettell ⁴	Senecioneae	Perennial herb	Endemic	44	11
<i>Pseudelephantopus spicatus</i> (Aubl.) Rohr ^{2,3e,5}	Vernonieae	Perennial herb	Native	15	10
<i>Pseudognaphalium attenuatum</i> (DC.) Anderb. ^{2,6}	Gnaphalieae	Perennial herb	Native	12	1
<i>Pseudognaphalium bourgovii</i> (A. Gray) Anderb. ⁵	Gnaphalieae	Annual herb	Endemic	8	2
<i>Pseudognaphalium canescens</i> (DC.) Anderb. ^{2,5}	Gnaphalieae	Perennial herb	Native	5	1
<i>Pseudognaphalium chartaceum</i> (Greenm.) Anderb. ^{2,4,5}	Gnaphalieae	Annual or biannual herb	Endemic	13	3
<i>Pseudognaphalium conoideum</i> (Kunth) Anderb. ^{2,4}	Gnaphalieae	Annual herb	Endemic	4	1
<i>Pseudognaphalium greenmanii</i> (S.F. Blake) Anderb. ⁶	Gnaphalieae	Annual or biannual herb	Native	3	1
<i>Pseudognaphalium inornatum</i> (DC.) Anderb. ^{2,4,5}	Gnaphalieae	Annual or perennial herb	Endemic	20	6
<i>Pseudognaphalium liebmannii</i> (Sch. Bip. ex Klatt) Anderb. ^{2,5}	Gnaphalieae	Annual or perennial herb	Native	36	3

Appendix.

Species	Tribe	Growth form	Biogeographical status: native, endemic, endemic with restricted distribution, introduced	Total number of records	Records from disturbed habitats
<i>Pseudognaphalium luteoalbum</i> (L.) Hilliard & B.L. Burt ^{1,2,4}	Gnaphalieae	Annual herb	Introduced	9	3
<i>Pseudognaphalium oxyphyllum</i> (DC.) Kirp. ⁵	Gnaphalieae	Annual or perennial herb	Native	21	4
<i>Pseudognaphalium roseum</i> (Kunth) Anderb. ⁴	Gnaphalieae	Perennial herb	Native	32	5
<i>Pseudognaphalium semilanatum</i> (DC.) Anderb. ^{2,5}	Gnaphalieae	Annual herb	Endemic	21	3
<i>Pseudognaphalium stramineum</i> (Kunth) Anderb. ^{2,4,5}	Gnaphalieae	Annual herb	Native	3	0
<i>Pseudognaphalium viscosum</i> (Kunth) Anderb. ^{1,2,4,5}	Gnaphalieae	Annual or biannual herb	Native	15	4
<i>Psilactis asteroides</i> A. Gray ^{2,4,5}	Astereae	Annual or perennial herb	Native	9	5
<i>Psilactis brevilingulata</i> Sch. Bip. ex Hemsl. ^{1,2,4,5}	Astereae	Annual or perennial herb	Native	16	5
<i>Roldana angulifolia</i> (DC.) H. Rob. & Brettell	Senecioneae	Shrub	Native	89	7
<i>Roldana barba-johannis</i> (DC.) H. Rob. & Brettell ⁴	Senecioneae	Shrub	Native	43	3
<i>Roldana candicans</i> (Née) Villaseñor, S. Valencia & Coombes	Senecioneae	Perennial herb	Native	59	2
<i>Roldana heracleifolia</i> (Hemsl.) H. Rob. & Brettell ^{2,5}	Senecioneae	Perennial herb	Endemic	35	9
<i>Roldana lobata</i> La Llave ⁴	Senecioneae	Perennial herb	Endemic	18	1
<i>Roldana mexicana</i> (McVaugh) H. Rob. & Brettell ⁵	Senecioneae	Perennial herb	Endemic	45	4
<i>Roldana sessilifolia</i> (Hook. & Arn.) H. Rob. & Brettell ⁴	Senecioneae	Perennial herb	Endemic	31	4
<i>Roldana suffulta</i> (Greenm.) H. Rob. & Brettell	Senecioneae	Perennial herb	Endemic	20	2
<i>Sabazia humilis</i> (Kunth) Cass. ^{1,2,4}	Millerieae	Annual herb	Endemic	4	1
<i>Salmea oligocephala</i> Hemsl. ^{3d}	Heliantheae	Shrub	Endemic	6	2
<i>Sanvitalia ocyroides</i> DC. ⁵	Heliantheae	Annual herb	Native	1	1
<i>Sanvitalia procumbens</i> Lam. ^{1,2,4,5}	Heliantheae	Annual herb	Native	17	11
<i>Schkuhria pinnata</i> (Lam.) Kuntze ^{1,2,3i,4,5}	Bahieae	Annual herb	Native	70	29
<i>Schkuhria schkuhrioides</i> (Link & Otto) Thell. ^{1,2,3i,4,5}	Bahieae	Annual herb	Endemic	11	5
<i>Sclerocarpus divaricatus</i> (Benth.) Hemsl. ^{2,5}	Heliantheae	Annual herb	Native	9	2
<i>Sclerocarpus multifidus</i> Greenm.	Heliantheae	Annual herb	Endemic	3	2
<i>Sclerocarpus papposus</i> (Greenm.) Feddema ^{2,8}	Heliantheae	Annual herb	Endemic	8	1
<i>Sclerocarpus uniserialis</i> (Hook.) Hemsl. ^{1,2}	Heliantheae	Annual or perennial herb	Native	16	12
<i>Senecio callosus</i> Sch. Bip. ⁵	Senecioneae	Perennial herb	Native	60	7
<i>Senecio cinerarioides</i> Kunth ⁴	Senecioneae	Shrub	Endemic	27	3
<i>Senecio inaequidens</i> DC. ¹	Senecioneae	Perennial herb	Introduced	19	5
<i>Senecio stoechadiformis</i> DC. ^{2,4,5}	Senecioneae	Perennial herb	Endemic	127	27
<i>Senecio vulgaris</i> L. ^{1,2,4}	Senecioneae	Annual herb	Introduced	3	1
<i>Sigesbeckia agrestis</i> Poepp. & Endl. ^{1,2,5}	Millerieae	Annual herb	Native	20	8
<i>Sigesbeckia jorullensis</i> Kunth ^{1,2,4}	Millerieae	Perennial herb	Native	43	7

Appendix.

Species	Tribe	Growth form	Biogeographical status: native, endemic, endemic with restricted distribution, introduced	Total number of records	Records from disturbed habitats
<i>Simsia amplexicaulis</i> (Cav.) Pers. ^{1,2,4,5}	Heliantheae	Annual herb	Native	25	13
<i>Simsia annectens</i> S.F. Blake ¹	Heliantheae	Annual herb	Endemic	18	6
<i>Simsia foetida</i> (Cav.) S.F. Blake ²	Heliantheae	Annual herb	Native	9	4
<i>Simsia lagasciformis</i> DC. ^{2,5}	Heliantheae	Annual herb	Native	2	2
<i>Simsia sanguinea</i> A. Gray ^{1,2}	Heliantheae	Perennial herb	Native	6	3
<i>Sinclairia glabra</i> (Hemsl.) Rydb. ^{3b}	Liabeae	Shrub	Native	11	4
<i>Smallanthus maculatus</i> (Cav.) H. Rob. ^{1,2,4,5}	Millerieae	Perennial herb	Native	14	4
<i>Soliva anthemifolia</i> (Juss.) Sweet ^{2,3f}	Anthemideae	Annual or perennial herb	Introduced	3	2
<i>Soliva sessilis</i> Ruiz & Pav.	Anthemideae	Annual herb	Introduced	3	2
<i>Sonchus asper</i> (L.) Hill ^{1,2,3k,4,5}	Cichorieae	Annual or perennial herb	Introduced	4	3
<i>Sonchus oleraceus</i> L. ^{1,2,3k,4,5}	Cichorieae	Annual or perennial herb	Introduced	17	10
<i>Stevia aschenborniana</i> Sch. Bip. ^{1,7}	Eupatorieae	Annual herb	Endemic	2	0
<i>Stevia caracasana</i> DC. ^{2,5}	Eupatorieae	Perennial herb	Native	28	5
<i>Stevia connata</i> Lag. ^{1,6}	Eupatorieae	Perennial herb	Native	7	0
<i>Stevia elatior</i> Kunth ^{1,5}	Eupatorieae	Perennial herb	Native	24	3
<i>Stevia incognita</i> Grashoff	Eupatorieae	Perennial herb	Native	3	2
<i>Stevia lucida</i> Lag. ⁶	Eupatorieae	Shrub	Native	15	1
<i>Stevia micrantha</i> Lag. ^{1,2}	Eupatorieae	Annual herb	Native	12	6
<i>Stevia monardifolia</i> Kunth	Eupatorieae	Perennial herb	Endemic	50	3
<i>Stevia nelsonii</i> B.L. Rob. ^{2,5}	Eupatorieae	Shrub	Endemic with restricted distribution	6	0
<i>Stevia organoides</i> Kunth	Eupatorieae	Perennial herb	Endemic	33	4
<i>Stevia ovata</i> Willd. ²	Eupatorieae	Perennial herb	Native	35	3
<i>Stevia porphyrea</i> McVaugh	Eupatorieae	Perennial herb	Endemic	3	2
<i>Stevia salicifolia</i> Cav.	Eupatorieae	Shrub	Native	23	3
<i>Stevia serrata</i> Cav. ^{1,2,4,5}	Eupatorieae	Perennial herb	Native	74	18
<i>Stevia subpubescens</i> Lag. ⁴	Eupatorieae	Shrub	Endemic	27	2
<i>Stevia tomentosa</i> Kunth ¹	Eupatorieae	Perennial herb	Endemic	2	1
<i>Stevia trifida</i> Lag.	Eupatorieae	Perennial herb	Endemic	11	2
<i>Stevia viscida</i> Kunth ^{2,5}	Eupatorieae	Perennial herb	Native	24	3
<i>Symphyotrichum expansum</i> (Poepp. ex Spreng.) G.L. Nesom ^{2,4,5}	Astereae	Annual herb	Native	44	18
<i>Symphyotrichum moranense</i> (Kunth) G.L. Nesom ¹	Astereae	Perennial herb	Native	20	4
<i>Tagetes erecta</i> L. ^{1,2,3h}	Tageteae	Annual herb	Native	106	42
<i>Tagetes filifolia</i> Lag. ^{1,2,3h,4,5}	Tageteae	Annual herb	Native	36	11
<i>Tagetes foetidissima</i> DC. ^{1,2,3h,4,5}	Tageteae	Annual herb	Native	29	7

Appendix.

Species	Tribe	Growth form	Biogeographical status: native, endemic, endemic with restricted distribution, introduced	Total number of records	Records from disturbed habitats
<i>Tagetes lucida</i> Cav. ^{1,2,3h,4,5}	Tageteae	Perennial herb	Native	81	23
<i>Tagetes lunulata</i> Ortega ^{1,2,3h,4,5}	Tageteae	Annual herb	Endemic	36	16
<i>Tagetes micrantha</i> Cav. ^{1,2,3h,4,5}	Tageteae	Annual herb	Native	26	6
<i>Tagetes subulata</i> Cerv. ^{2,3h,5}	Tageteae	Annual herb	Native	14	6
<i>Tagetes tenuifolia</i> Cav.	Tageteae	Annual herb	Native	9	3
<i>Tanacetum parthenium</i> (L.) Sch. Bip. ^{1,2,3f}	Anthemideae	Perennial herb	Introduced	12	4
<i>Taraxacum officinale</i> F.H. Wigg. ^{1,2,3k,4,5}	Cichorieae	Perennial herb	Introduced	18	9
<i>Tithonia diversifolia</i> (Hemsl.) A. Gray ^{1,2,5}	Heliantheae	Perennial herb	Native	5	3
<i>Tithonia rotundifolia</i> (Mill.) S.F. Blake ^{1,2,5}	Heliantheae	Annual herb	Native	29	13
<i>Tithonia tubiformis</i> (Jacq.) Cass. ^{1,2,4,5}	Heliantheae	Annual herb	Native	22	15
<i>Tragopogon porrifolius</i> L. ^{1,6}	Cichorieae	Annual or biannual herb	Introduced	1	1
<i>Tridax coronopifolia</i> (Kunth) Hemsl. ^{1,2,4,5}	Millerieae	Annual or perennial herb	Endemic	20	12
<i>Tridax mexicana</i> A.M. Powell ^{2,5}	Millerieae	Perennial herb	Endemic	4	3
<i>Tridax platyphylla</i> B.L. Rob. ^{2,5}	Millerieae	Annual herb	Native	17	6
<i>Tridax procumbens</i> L. ^{1,2,5}	Millerieae	Perennial herb	Native	2	1
<i>Tridax trilobata</i> (Cav.) Hemsl. ^{1,2,4}	Millerieae	Annual herb	Endemic	12	7
<i>Trigonospermum annuum</i> McVaugh & Lask. ^{2,5}	Millerieae	Annual herb	Native	18	6
<i>Trigonospermum melampodioides</i> DC.	Millerieae	Perennial herb	Native	30	6
<i>Trixis inula</i> Crantz ^{2,4,5}	Nassauvieae	Shrub	Native	1	0
<i>Trixis mexicana</i> Lex. ^{1,2}	Nassauvieae	Shrub	Endemic	36	6
<i>Trixis michuacana</i> Lex. ⁵	Nassauvieae	Shrub	Endemic	19	2
<i>Verbesina breedlovei</i> B.L. Turner ²	Heliantheae	Shrub	Endemic	4	1
<i>Verbesina crocata</i> (Cav.) Less. ^{1,2}	Heliantheae	Tree	Native	13	6
<i>Verbesina fastigiata</i> B.L. Rob. & Greenm. ²	Heliantheae	Shrub	Endemic	48	15
<i>Verbesina montanoifolia</i> B.L. Rob. & Greenm. ^{2,5}	Heliantheae	Shrub	Endemic	35	6
<i>Verbesina myriocephala</i> Sch. Bip. ex Klatt ^{2,6}	Heliantheae	Perennial herb	Native	5	1
<i>Verbesina pietatis</i> McVaugh	Heliantheae	Perennial herb	Endemic with restricted distribution	8	2
<i>Verbesina serrata</i> Cav. ¹	Heliantheae	Shrub	Endemic	3	3
<i>Verbesina sphaerocephala</i> A. Gray ²	Heliantheae	Shrub	Endemic	42	14
<i>Verbesina tetraptera</i> (Ortega) A. Gray ⁴	Heliantheae	Perennial herb	Endemic	14	3
<i>Verbesina virgata</i> Cav. ⁴	Heliantheae	Shrub	Endemic	19	1
<i>Vernonanthura cordata</i> (Kunth) H. Rob.	Vernonieae	Tree	Endemic	34	9
<i>Vernonanthura liatroides</i> (DC.) H. Rob.	Vernonieae	Perennial herb	Endemic	19	7
<i>Vernonanthura serratuloides</i> (Kunth) H. Rob. ²	Vernonieae	Perennial herb	Endemic	23	7
<i>Vernonia alamanii</i> DC. ^{2,3e}	Vernonieae	Perennial herb	Endemic	112	22

Appendix.

Species	Tribe	Growth form	Biogeographical status: native, endemic, endemic with restricted distribution, introduced	Total number of records	Records from disturbed habitats
<i>Viguiera dentata</i> (Cav.) Spreng. ^{1,2,4,5}	Heliantheae	Perennial herb	Native	27	12
<i>Wedelia acapulcensis</i> Kunth ^{2,6}	Heliantheae	Perennial herb	Native	12	0
<i>Xanthium strumarium</i> L. ^{1,2,4,5}	Heliantheae	Annual herb	Native	5	3
<i>Xanthocephalum benthamianum</i> Hemsl. ⁵	Astereae	Annual herb	Endemic	2	1
<i>Xanthocephalum centauroides</i> Willd.	Astereae	Annual herb	Endemic	2	2
<i>Zinnia americana</i> (Mill.) Olorode & A.M. Torres ^{2,5}	Heliantheae	Annual herb	Native	11	4
<i>Zinnia angustifolia</i> Kunth ^{2,5}	Heliantheae	Perennial herb	Endemic	1	0
<i>Zinnia bicolor</i> (DC.) Hemsl. ^{2,5}	Heliantheae	Annual herb	Endemic	2	0
<i>Zinnia elegans</i> Jacq. ^{1,2}	Heliantheae	Annual herb	Native	32	16
<i>Zinnia flavicoma</i> (DC.) Olorode & A.M. Torres ^{2,5}	Heliantheae	Annual herb	Endemic	19	8
<i>Zinnia haageana</i> Regel ^{1,2,5}	Heliantheae	Annual herb	Endemic	36	17
<i>Zinnia peruviana</i> (L.) L. ^{1,2,4,5}	Heliantheae	Annual herb	Native	35	13
<i>Zinnia purpusii</i> Brandegees ¹	Heliantheae	Annual herb	Endemic	2	2
<i>Zinnia zinnioides</i> (Kunth) Olorode & A.M. Torres ⁵	Heliantheae	Annual herb	Endemic	3	1

1 Vibrans (2006), 2 Rzedowski (1993), 3a García and Koch (1995), 3b Redonda-Martínez (2013), 3c Redonda-Martínez (2016), 3d Rzedowski et al. (2011), 3e Rzedowski and Rzedowski (1995), 3f Rzedowski and Rzedowski (1997), 3g Rzedowski and Rzedowski (2008), 3h Villarreal (2003), 3i Villarreal et al. (2006), 3j Silva-Sáenz (2017), 3k Rzedowski (1997), 4 Rzedowski et al. (2005), 5 McVaugh (1984), 6 Pruski and Robinson (2018), 7 Villagómez-Flores et al. (2018), 8 Villaseñor and Hinojosa-Espinosa (2011), 9 Villarreal et al. (2008), 10 Flores-Huitzil et al. (2020), 11 Castro-Castro et al. (2015), 12 Turner (1988), and 13 Stuessy (1973).

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