

# Mexico's FLORISTIC Diversity<sup>1</sup>

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**I**t is a well-established fact, repeatedly mentioned in recent years, that Mexico's floristic wealth is particularly large. The most notable criteria that make this evident are three: the diversity of natural plant communities (ecosystems and landscapes), the diversity of life forms and the number of different species.

With regard to its natural communities, Mexico's flora is outstanding because it includes most of the world's known ecosystems. In the best known and most quoted anthology dealing with this subject, *Los tipos de vegetación de México* (Mexico's Types of Vegetation), the renowned Mexican botanists Faustino Miranda and Efraín Hernández Xolocotzi determined that the country is home to 32 major kinds of vegetation. Such diversity of natural communities in a single country occurs only in other ecologically privileged regions, such as India, Peru or Australia.

Thus, in order of descending humidity, in Mexico we can travel from evergreen tropical forests or jungles in warm and humid

zones with almost five meters of annual precipitation (such as the Los Tuxtlas region in Veracruz) to extremely dry deserts (in Sonora, for example) where barely a few millimeters of rain fall over a period of years. Between these extremes, we find jungles of varying degrees

Mexico's flora is special, due both to its wealth and uniqueness.

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Photos by Patricio Robles Gil



The fame of the diversity of biotypes found in Mexico's arid areas is well deserved.

of humidity and deserts ranging from the very exuberant —such as in certain parts of the Tehuacán Valley— to those of Sonora.

Similarly, classified by altitude, we can travel from areas of coastal vegetation or from the tropical rain forest at sea level, rising through different pine and oak forests or other deciduous or evergreen broad-leaved forests, to reach alpine meadows on the very highest ground. In addition to these gradients of moisture and altitude, we must consider the effects of latitude, mountain orientation and an infinite variety of local conditions, as well as soil types, that generate plant communities such as savannas, palm groves, mangrove swamps, grasslands, vegetation growing on saline or gypseous soils, Mediterranean-type scrubland, reed groves and a wide array of aquatic and subaquatic communities. Different recent studies of Mexico's

vegetation —particularly those by Mexico's most knowledgeable botanist, Jerzy Rzedowski— provide relatively simplified systems for classifying this diversity that nevertheless still emphasize the enormous richness of the communities.

#### BIOTYPES

Regarding the life forms or biotypes, understood as the morphological types that give plants their appearance (and which, in general, are the expression of the plant's response to environmental conditions), their diversity confirms the privileged situation of Mexico's flora. This has been best documented in arid zones, where the levels attained are truly spectacular. Among these communities, Faustino Miranda has identified 43 kinds of plant life. The following examples

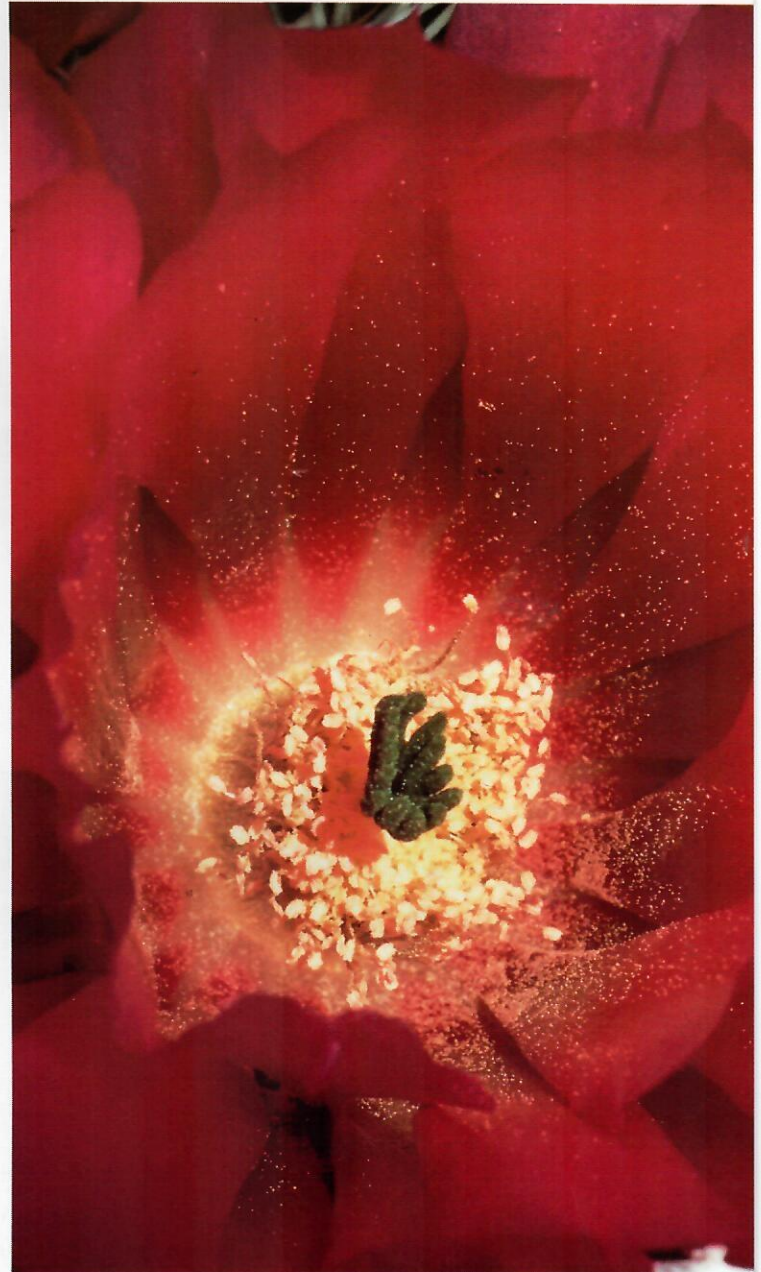
may serve to illustrate the diversity of life forms: the barrel cactus, which can be enormous or small; prickly pears, either tree-sized or tiny; the giant cardon (one of which was chosen to typify Mexican flora at the Seville World's Fair and earned worldwide acclaim); the Spanish bayonet (or "desert palm"); an enormous variety of rosette-shaped plants, such as the agaves; fleshy, spherical, partially buried plants such as the peyote; the walking-stick cholla; the enormous saguaro; the sotol; the boojum tree; and the ocotillo; the echeverias; countless kinds of shrubs; and even twisted dwarf trees such as the Parry pinyon pine.

The fame of the biotype diversity in Mexico's arid areas is well deserved; that of other communities, although less well known, is also surprising. The following are examples found in the tropical rain forests: 50-meter-high trees, fleshy vines, epiphytic cacti (which live on other plants), ground-dwelling and epiphytic orchids, enormous palm trees with leaves eight meters long, herbaceous creepers, semi-epiphytic strangler trees, strictly epiphytic trees, climbing palms and enormous bromelias, to mention just the most notable biotypes. Once again, few nations on earth besides Mexico have such a variety of life forms. Rzedowski mentions South Africa as the only possibly comparable case.

#### ESTIMATES OF MEXICO'S FLORISTIC WEALTH

There is no national catalogue that would allow us to count the number of species that make up our flora, nor is there a national list to directly identify those species or their distribution across the country. Consequently, to gain an idea of the number of species, we must use estimates reached by indirect methods. The one used most frequently in recent years is that of the Mexican ecologist Víctor Manuel Toledo, who calculated the spectacular number of 30,000 species. More recently, Toledo has adjusted his estimate to 33,000. These calculations have received all the publicity deserved by a flora of such magnitude; his figures would mean that Mexico has a floristic wealth similar to that of China, for example.

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Estimates of the number of species in Mexico go from 17,000 to 33,000.



However, other recent calculations, particularly those by Jerzy Rzedowski and by Rodolfo Dirzo and Guillermina Gómez, differ from Toledo's estimates. Rzedowski calculates that Mexico's total recognized flora must be around 18,000 species; Dirzo and Gómez made a detailed count of all the species recorded for the country applying a series of corrective factors to their result, to reach a figure of 17,000, very close to Rzedowski's estimate. Since estimates place unrecorded species at around 20 percent of the total, the figures suggested by Rzedowski and by Dirzo and Gómez rise to 21,660 and 20,500 species, respectively. These figures would seem to indicate that Toledo's published result of 33,000 species must be taken with caution. However, it does still point to Mexico's having one of the planet's richest flora, more varied than those of, for example, the United States, Canada, the former Soviet Union or India.

The estimates referred to above include only vascular plants. An additional number, albeit small, would have to be added to include non-vascular plants.

TAXONOMIC DISTRIBUTION

It would be useful to make one further point regarding the distribution of Mexico's floristic richness from a taxonomic point of view, Rzedowski estimates that six families account for approximately 40 percent of the total number of genera and species, and that the most important of these are the composities and grasses, the cacti and the legumes. Furthermore, in addition to their great ecological and evolutionary importance, these families are also of great interest, either currently or potentially, from the economic

point of view. The grass family, for example, includes grasses and cereals; the legume family includes a large number of timber and food-yielding species, along with many that are capable (with the help of bacteria) of absorbing nitrogen from the soil and incorporating it into their tissues; among the cacti there are many edible and ornamental species.

In addition, emphasis should be placed on another important element in the analysis of biological diversity and its conservation: endemism. This term



The diversity of natural plant communities and life forms, plus the number of species, determine floristic diversity.

refers to the restricted distribution of a given taxonomic group. Endemic groups may occupy relatively large areas —such as a region, state, island or continent— and each contains plants from a single taxonomic category, which may be a species, a genus, a family, etc. Thus, for example, in Mexico and its neighboring areas to the north and south, there are six endemic families: the *Canotiaceae*, the *Fouquieriaceae*, the

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*Polcospermataceae*, the *Pterostemonaceae*, the *Simmondsiaceae*, and the *Lacandoniaceae*. The *Lacandoniaceae*, for example, are endemic to the northern part of the Lacandon Jungle, and the distribution of the only known species of this family, *Lacandonia schismatica*, is restricted to an area barely covering a few hectares within that region.

What makes endemism interesting is the fact that endemic species are elements exclusive to a particular, unique flora, that their extinction in the area they inhabit would be irreversible, and that the characteristics of such species, including their potential use to man, only exist in such locations.

The number of endemic genera included within Mexico's flora is estimated at 230, or around 10 percent of the country's total. However, the exact magnitude of the nation's species endemism is not known and we must rely on indirect estimates that, although probably too conservative, are still illuminating. The total number of endemic species in the Mexico of today is estimated at 9,300, equal to 52 percent of the estimated total of 18,000 species. This number rises to 12,900 if the areas adjacent to Mexico to the north and south are included to form a natural ecological area.

Available data on particular taxonomic groups also indicate a figure of around 50 percent. For example, the figure for the *Malvaceae* is 50 percent, for the *Leguminosae* it is 52 percent, and for *Asteraceae* it is 50 percent or more.

The conservative nature of the estimation for endemic species in Mexico is shown by the fact that approximately 20 percent of the country's flora is still unknown and many of these unidentified species will doubtless have limited distribution.

This great floristic wealth and the notable degree of endemism (approximately half of its species) allow us to attest



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that Mexico's flora is special, not only in quantitative terms, but also because of its uniqueness. The reasons for this uniqueness, which are either well known or can be inferred easily, are the following:

1. The country's geographical location: the Tropic of Cancer, which cuts across half the nation's territory, delimits a large tract of arid zones to the north and another area with a warm, wet climate to the south. This in turn determines the presence



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of types of flora typical of those climates.

2. The country's complex topography: the enormous profusion of mountains creates many different climatic conditions and encourages the presence of a wide variety of ecological conditions.

3. The enormous abundance of different soil types.

4. Historical reasons (mainly —although not exclusively— on a geological time scale. Most significantly, for several tens of millions of years, Mexico has served as a bridge for the passage of flora from North America to South America and vice versa.

#### A FORMIDABLE CONTRIBUTION TO THE WORLD

The tremendous flow of plant forms across the geographical bridge, the diversity of ecological conditions and the time scale involved gave rise to the vast universe of Mexican flora, comprised of species of both tropical and northern origin, along with a large number of species that have evolved *in situ*. Many of the latter have spread to other parts of the world, but

many are still unique species and their distribution is restricted to this country.

In the light of these descriptions, it is not surprising that the world owes a disproportionately large share of its flora to Mexico. If this phenomenon is seen in terms of the number of species, the most conservative estimates indicate that Mexico's flora could well account for 10 percent of the world's total, and that half this percentage corresponds to species exclusively

found in this country. Besides this quantitative consideration, we should bear in mind that, with its flora, this country has made —and has an enormous potential for continuing to make— a formidable contribution to the world: corn, for example, and the flowers of many ornamental plants found across the globe. In summary, our flora is an enormously rich national and universal heritage, which deserves priority attention and whose neglect would be historically irresponsible both nationally and universally.

This great floristic diversity is not distributed uniformly across the country. Although sufficient information to precisely document the distribution of Mexico's floristic wealth does not exist, a general overview can be offered.

#### DISTRIBUTION OF BOTANICAL DIVERSITY

The regions south and southeast contain the greatest floristic diversity. In particular, the region with the highest concentration of species is found in Chiapas and Oaxaca, from where two strips rise northwards

with a gradual reduction in their floristic diversity as they go: the first of these points towards the center of Veracruz, and the second towards Sinaloa and Durango. This tendency for decreasing floristic richness to the north can also be seen as we approach the Yucatán peninsula which is notably floristically poorer in comparison with Chiapas or Oaxaca. Very generally, we can identify a pattern of greater richness in the warm and humid climates (the tropical trend) located to the south of the Tropic of Cancer than in the areas associated with the strip of land to the north.

Another notable pattern in the distribution of botanical diversity deals with ecology, since floristic richness varies with the kind of ecosystem in question. To appreciate this in simple terms, we can categorize the flora into large groups of ecosystems: xerophilous scrublands and grasslands; coniferous and oak forests; cloud forests or mesophilous forests; and tropical communities of evergreen or deciduous forests. If we consider the share of the nation's territory covered by each of these and count the number of species they contain, we will see that xerophilous scrublands and grasslands, together with coniferous and oak forests, make a proportionately poor contribution, whereas the contribution made by tropical ecosystems is greater than would be expected. Nevertheless, the most notable instance of botanical richness is to be found in the mesophilous cloud forests of the mountainous regions, which, although covering barely one percent of the country's surface area, contain 10 percent of its flora.

In summary, the great floristic richness of tropical vegetation is notable. This can be seen by making reference to the jungles of Los Tuxtlas in Veracruz, a region that is home to plant species that number

only slightly fewer than the total flora of the British Isles, which covers an area 30,000 times greater. Finally, we must not forget that the ecosystems of the scrublands and grasslands and those of the coniferous and hardwood forests, although accounting for a low proportion in absolute terms, still contain an enviable diversity of flora. Thus, the coniferous forests house some 35 species, a figure that is probably higher than any other region on the planet. There can also be no doubt that these Mexican ecosystems are the point of origin and distribution of many of the species belonging to this group currently found throughout the world.

We shall now conclude with a review of the geographical and ecological distribution of endemisms of the flora. First of all, we must point out that

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the distribution of endemisms bears no relation to that of floristic richness: the largest number of endemic families and genera are found in xerophilous ecosystems. With regard to endemic species, it is the coniferous and oak forests that account for the largest proportion, followed by xerophilous

scrub and grasslands and by deciduous forests. In contrast, the evergreen forests come last with only five percent of Mexico's endemic species.

In addition to the predominance of the areas of arid vegetation in regard to endemism, the endemic species found in the following geographical regions are also worthy of note: the Baja California peninsula, where 25 percent of all the species are endemic (explicable in part by its arid climate), some offshore islands such as Guadalupe (21 percent of the species) and the Revillagigedo Archipelago (26 percent), the Balsas Basin and, more locally, the peaks of the high mountains and areas with very selective soils such as gypseous or highly saline ones. 