Human Cultures and Plant Diversity in the Mountains of Mexico: An Introduction

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Abstract

This chapter introduces the whole book. It is dedicated to analyze interactions between peoples and plants in the mountain regions of an eminently mountainous country: Mexico. Most of the Mexican territory are mountains that for thousands of years have harbored an extraordinarily high diversity of plants, human cultures, and ecosystems. Richness of native vascular plants has been documented to be more than 23,000 species, which, together with the introduced plants conform a diversity that has been estimated to be nearly 30,000 plant species. Humans have occupied the territory that currently is Mexico since nearly 24,000 years ago. Such long history, the influence of several waves of human occupation, and the predominant mountainous ecosystems favored a high cultural diversification, which is currently represented by peoples speakers of nearly 290 languages. The interaction of these biological and cultural diversities has configured a rich ethnobotanical knowledge, which has maintained valuable expressions disseminated throughout the Mexican territory. The biocultural richness of Mexico is especially high in the mountain regions, which have been refuges of both native peoples and biodiversity. This book gathers studies from different regions representing the mosaic of ecosystems and cultures of Mexico. The first part shows case studies at community and regional levels documenting the role of plants in people's subsistence, their knowledge, and management forms. The second part is dedicated to synthesizing taxonomic, ethnobotanical, and

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A. Casas, J. J. Blancas Vázquez (eds.), *Ethnobotany of the Mountain Regions of Mexico*, Ethnobotany of Mountain Regions, https://doi.org/10.1007/978-3-030-99357-3_1

ecological information of a selected group of plant genera that are rooted in Mexican cultures. The two parts of the book aspire to provide a piece of the vast universe of experiences developed by humans interacting with plants in the mountain regions of Mexico.

Introduction

Mountains are earth's abrupt elevations, usually more than 300 m of altitude with respect the surrounding areas, with surface commonly smaller than plateaus and larger than hills (Gerrard 1990). Microenvironments in these areas are highly diverse since in short distances temperature, rainfall, and atmospheric pressure may change drastically, as well as soils and vegetation (Gerrard 1990; Funnell and Parish 2001; Funnell and Price 2003). Mountains and highlands usually harbor high biodiversity, with a marked richness of species assembling in a variety of vegetation types and forming highly heterogenous ecosystems. In fact, mountains are considered hotspots of biodiversity of the world (Körner 2004; Payne et al. 2017; Körner and Spehn 2020). But, in addition, hundreds of millions of people currently inhabit these areas of the planet. These people and their ancestors have learned very much about the peculiarities of such variable environments, and developed a high diversity of interactions with the ecosystems and their components as well as techniques and strategies to live in them (Stepp et al. 2005; Payne et al. 2017). Throughout human history the mountainous landscapes have favored isolations of human groups and, consequently, their cultural and linguistic diversification. Therefore, mountains are scenarios and reservoirs of an extraordinary biocultural diversity (Stepp et al. 2005).

Mexico is the setting of a complex geological history. It is a mountainous country with a marked and predominant rugged relief. Nearly 15% of the terrestrial territory of the country is constituted by narrow coastal plains which, together with the Yucatán Peninsula, or Yucatán Platform, are the main plain lowlands; but the remaining area is elevated. About 70% of the Mexican territory has 800 m of altitude or more (Ferrusquía-Villafranca 1994). Going from the coastal plains into the inland, soon appear complex mountain systems dominating the landscape from north to south. The mountain chains are followed by plateaus of considerable elevation and variable extents, traversed and surrounded by more mountains (Fig. 1). The mountain chains of the Eastern and Western Sierras Madre and the Transvolcanic Belt are expressions of an extraordinary scenario of tectonic activity and vulcanism that have configured the geographic relief characterizing this mountainous country (Ferrusquía-Villafranca 1994). But Southern Mexico is also plenty of complex mountainous systems. In the west the Sierra Madre del Sur is the most extended, which joins with smaller systems, among them the Sierra de Juárez (Fig. 1). In the east, the Sierra de Santa Martha in Southern Veracruz is one of the most outstanding, and then in South Central Mexico the system called Sierra Madre de Chiapas gives a peculiar configuration to mountainous landscapes with elevated intermountain valleys and plateaus (Fig. 1). The altitudinal gradients and topographic diversity

Fig. 1 General orography of Mexico showing the main mountain systems in yellow brackets and the main plainlands indicated in green labels. The Central Plateau is divided into northern and southern areas by the Transversal Sierras. The Yucatán Peninsula and the Coastal Plainlands of the Gulf of Mexico and the Pacific Ocean are the real lowland plan areas of Mexico, which are nearly 15% of the Mexican territory, the rest are mountainous systems and elevated plateaus. About 70% of the terrestrial surface of Mexico is at elevations higher than 800 m

associated to the relief, the extraordinary edaphic and climatic variation, as well as the latitudinal gradient and the confluence of the Nearctic and Neotropical biogeographic regions have influenced the high diversity of ecosystems that occur in Mexico, which makes it one of the most biodiverse countries of the world (Graham 1994; Rzedowski 1994; Toledo and Ordóñez 1994; Fig. 2).

The history of humans in this setting has been ancient. The recent finding of Ardelean et al. (2020) in the Chiquihuite cave in the state of Zacatecas provides evidence to support the argument that humans have been present in the Mexican territory for 24,000 to probably 30,000 years. As documented by several archaeological studies, several waves of humans arrived into the Americas and some occupied parts of the territory of Mexico at different times (Madsen 2015; Williams and Madsen 2020; Shillito et al. 2020; Ardelean et al. 2020; Becerra-Valdivia and Higham 2020). Languages and cultures have therefore different origins and histories and then established in Mexico continued diversifying. The diversification was favored by the diffusion and occupation of the also diverse ecosystems, as well as progressive local adaptations and isolation (Buchanan et al. 2016; Hamilton et al. 2019; Crevels and Muysken 2020). The result of such history is the current occurrence of nearly 290 languages (Eberhard et al. 2022) that

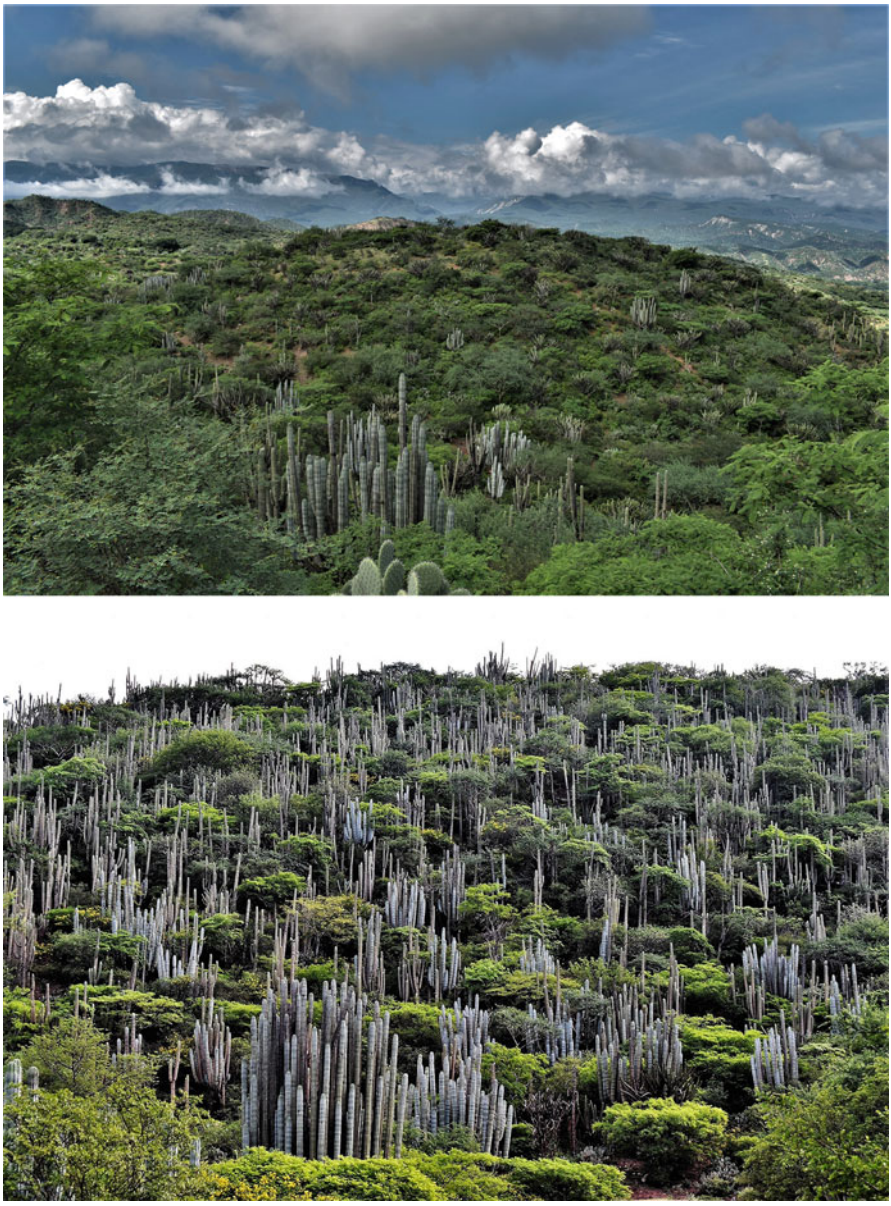

Fig. 2 A general aspect of the biodiversity that can be found in the mountain regions of Mexico. In the case illustrated, the semiarid mountains surrounding the Tehuacán-Cuicatlán Valley, Central Mexico. (Photos: Francisco Javier Rendón-Sandoval (IIES, UNAM))

derived from several main trunks of linguistic families. The current diversity of languages and cultures is extraordinarily high, one of the highest in the Americas. But the mosaic of cultures existing before the arrival of the European conquerors was even more

complex. It has been estimated that the depopulation of Mexico after the Spanish conquest was from 80–90% in several regions, which determined the extirpation of a significant portion of cultures and languages existing in this country in pre-Columbian times (Howell 2002).

The Biocultural Diversity of the Mountains of Mexico

Diversity of ecosystems, biodiversity and diversity of cultures, and a long time of cultural history, such is the context of one of the regions with the highest biocultural diversity of the Americas. What ethnobotanical and, in general, ethnobiological studies currently document are biocultural expressions derived from such history of interactions between peoples and ecosystems. Knowledge on the relationships of the ecosystem components, people's views about the meaning of these interactions and their influence on human life, as well as the techniques mediating the interactions between humans and ecosystems are all elements of the cultures conformed throughout time. It is the history of interactions among peoples and nature and among peoples themselves. Thousands of years of history of the interactions among peoples of the called New World, and then centuries of interaction with peoples coming from the Old World. Throughout such long history it has been configured the biocultural diversity existing in Mexico, in highlands and lowlands, in mountains and plains (Figs. 3 and 4).

Most Mexican peoples have lived and currently live in the highlands. The past and present settlements are a constellation of towns occupying the largest area of the territory: mountain regions. The influence of mountains has therefore been crucial in

Fig. 3 Nahua people interact with mountainous rainforest ecosystems in the lowlands of the Sierra Negra, Puebla. The boy is collecting the edible inflorescences of the palm *Chamaedorea tepejilote*. (Photo: Francisco Javier Rendón-Sandoval (IIES, UNAM))

Fig. 4 People interacting with mountain ecosystems of temperate forests. An aspect of mushrooms collecting by a P'uhrépecha woman in pine-oak forests of the mountains surrounding the Pátzcuaro Lake, in Michoacán. (Photo: Berenice Farfán-Heredia (Universidad Intercultural Indígena de Michoacán, UIIM))

Mexican people's life, even for those living in coastal plains and altiplanos. The most common patterns of settlements are establishing of villages in the middle of the cold highlands and the warm lowlands. Peoples living in the coastal plains use to migrate and interchange products with people of the highlands and vice versa. Separating peoples of mountains, piedmont, and valleys is difficult since they all have been historically interconnected, interacting with highland and lowland ecosystems directly, seasonally migrating or interchanging products from one area to another. Therefore, peoples of the mountainous regions are partly peoples of the lowlands or the plains and vice versa. Mexico is a mountainous country, and their ecosystems and human cultures are eminently mountainous (Fig. 5).

The Book

This book examines interactions between peoples and plants of mountainous ecosystems and their connections with the plains and lowlands (Fig. 6). It is in part the continuation of the book *Ethnobotany of Mexico* published previously (Lira et al. 2016), and it is also in part one of the windows of the series *Ethnobotany of the Mountain Regions* to which this book belongs (Paniagua-Zambrana and Bussmann 2020; Batsatsashvili et al. 2020a, b; Abbasi and Bussmann 2021; Kunwar et al. 2021; Franco 2021).

We have gathered studies that represent the human cultures and particular plant groups representing the mountain regions of Mexico. The book comprises two main parts. The first one is dedicated to examining ethnobotanical aspects of communities and regions harboring human cultures of the mountains. The second part is dedicated to analyzing plant groups representative of mountainous ecosystems and that have been in interaction with peoples for long time, becoming important components of their culture.

Fig. 5 Ixcatec people, inhabiting the mountainous areas of Oaxaca. Men of Santa María Ixcatlán weaving handcrafts with the palm *Brahea dulcis*. (Photo: Selene Rangel-Landa (IIES, UNAM))

The first part starts with this introductory chapter and then it is followed by the chapter ▶ "Ethnobotanical Knowledge in Mexico: Use, Management, and Other Interactions Between People and Plants" written by Caballero et al., which shows a general panorama of the ethnobotanical information documented for Mexico. It is based on the construction of a research strategy designed 40 years ago to carry on communitarian and regional ethnobotanical studies and systematize them in the first database of ethnobotanical information constructed in Mexico. The authors summarize information on use and management of nearly 8000 plant species, estimating that the total could be more than 11,000 species. In addition, the authors identify the regions and cultural groups that have been more studied and those that need more research efforts, emphasizing the need to dedicate more attention to aspects of plant management. Chapter ▶ "Wild, Weedy and Domesticated Plants for Food Security and Sovereignty" analyzes the role of wild, weedy, and domesticated plants in diet among rural people from different regions. The authors (Casas et al.) gather several case studies showing that after thousands of years of practicing horticulture and agriculture and more than a century of industrialization, rural communities continue to practice gathering of wild and weedy plants complementing their diet based on agricultural products. These authors found cases in which wild and weedy plants may be 8–24% of the components of the annual diet, the variation being influenced by multiple social, economic, and cultural factors, mainly changes in land use,

Fig. 6 Women and mountains. People of the Sierra Mixe in Tahuitoltepec, Oaxaca, a region of outstanding biocultural diversity. (Photo: Ana Isabel Moreno-Calles (Escuela Nacional de Estudios Superiores-Morelia, UNAM))

migration, monetarization of their economy, and outstandingly, cultural discrimination. The loss of wild and weedy edible products is accompanied by the inclusion of fast food and health problems, therefore the authors put into perspective the importance of conserving and recovering traditional food as central strategy for food sovereignty.

In chapter ▶ "Wixaritari or Huichol Ethnobotany of the Southern Sierra Madre Occidental in Mexico," Cedano-Maldonado et al. review ethnobotanical information among the Wixaritari or Huichol people in the Western Sierra Madre of Mexico. The Wixaritari have maintained their ethnic identity and ancestral social, political, educational, and religious structure, for over hundreds of years. The authors documented their traditional knowledge and worldview over the useful plants they interact with. In addition, the authors provide a regional inventory of nearly 600 plant species used by these people and identify factors influencing loss of the Wixaritari culture and priority areas to conduct ethnobotanical research.

In the fifth and sixth chapters Bye and Linares (▶ "Ethnobotany in the Sierra Tarahumara, Mexico: Mountains as Barriers, Conduits, and Generators of Plant-People Interactions and Relationships") and Camou-Guerrero et al. (▶ "Rarámuri Ethnobotany: Peasant Subsistence and Biodiversity Conservation at Local Scale") provide regional and communitarian perspectives, respectively, of ethnobotanical

knowledge and plant management practices of the Rarámuri or Tarahumara people in the Western Sierra Madre of Northern Mexico. Both studies analyze at different scales the role of plants in the Rarámuri subsistence, processes that have affected their lives and deterioration of their ecosystems. Also, the communitarian responses and initiatives to maintain their culture and territory, and the role of ethnobotanical research to support such efforts.

Chapter ▶ "Wild Food and Traditional Knowledge of the Kumiai from Baja California" is dedicated to show the spectrum of wild food and traditional knowledge of the Kumiai from Baja California, a cultural group with few studies available. The authors (Gutiérrez-Sánchez and Leyva-Aguilera) carried out a case study about food, edible resources, and customs from an ethnographic approach. They illustrate the relationship between resources of the mountain and the coast through ancestral corridors that at present people recognize to be part of their cultural landscape, and the importance of recovering it for their food sovereignty.

Chapters ▶ "Mazahua Ethnobotany: Traditional Ecological Knowledge, Management, and Local People Subsistence," ▶ "Risk Management of Availability of Plant and Fungi Resources Among the Purépecha in Michoacán, Central-Western Mexico," ▶ "Agroforestry Complexes in the Mountain Regions of Mexico," and ▶ "Traditional Ecological Knowledge and Biodiversity Conservation in the Tierra Caliente Region of Michoacán," comprise studies of the mountainous regions of the state of Michoacán in Central Western Mexico. The scenarios are complex mountainous areas where the Western Sierra Madre and the Transversal Volcanic Belt are imbricated. Chapters ▶ "Mazahua Ethnobotany: Traditional Ecological Knowledge, Management, and Local People Subsistence" and ▶ "Risk Management of Availability of Plant and Fungi Resources Among the Purépecha in Michoacán, Central-Western Mexico," prepared by Farfán-Heredia and Casas, provide case studies of ethnobotany among the Mazahua and P'uhrépecha people. The study of the Mazahua was conducted in the Monarch Butterfly Biosphere Reserve, an important area for conservation of world natural heritage where these people are the main stewards. Then, these authors analyze aspects of the ecological knowledge in relation to management of plants and fungi. They describe and examine the relation of plant management as an expression of risk management that is conducted by the P'uhurépecha of the Pátzcuaro Lake region.

In chapter ▶ "Agroforestry Complexes in the Mountain Regions of Mexico" Moreno-Calles et al. show a panorama of their studies on agroforestry systems in different mountainous regions of Mexico. The authors emphasize the importance of these systems as reservoirs of biodiversity, maintained, managed, and domesticated there. Also, they analyze agrobiodiversity and food production systems as keystones for food sovereignty in the regions studied as well as in the whole country. Chapter ▶ "Traditional Ecological Knowledge and Biodiversity Conservation in the Tierra Caliente Region of Michoacán" is dedicated to analyzing the traditional ecological knowledge and its role in biodiversity conservation in the Tierra Caliente region of Michoacán. The region studied by Rangel-Landa et al. is part of the Biosphere Reserve Zicuirán-Infiernillo, an important area of the Balsas River region managed by mestizo people, which is reservoir of diverse tropical dry forest and

other vegetation types. The authors discuss current and potential actions considered by local people to contribute to the conservation and restoration of natural areas.

In chapter ▶ "Preserving Healthy Eating Habits: *Quelites* in the Food System of a Nahua Mountain Community, Mexico," Sánchez-Ramos et al. report their study about the importance of the traditional green vegetables of Mexico called quelites (a term derived from the Nahuatl word "quilitl") in food systems. They identify their healthy properties and the importance to promote the maintenance of this diverse group of plants. They analyze the case of a Nahua community, but their analysis, reflections, and conclusions are extendable to numerous communities of Mexico that traditionally consume quelites.

Chapter ▶ "Ethnobotany of the Sierra Norte de Puebla" summarizes ethnobotanical information of the Sierra Norte de Puebla. Basurto et al. provide a panorama of studies conducted in the region for more than 30 years. It is one of the most studied regions from ethnobotanical approaches and the results and methods have influenced the ethnobotany of Mexico. It is a valuable work based upon an inventory of more than 1000 species of useful plants. In the neighboring region, the Sierra de Zongolica, which as the Sierra Norte de Puebla is part of de Eastern Sierra Madre, López Binnqüist et al. (▶ "Wool Textiles of the Sierra de Zongolica, Mexico. The Reshaping of Craft Traditions and Biocultural Landscapes") show the results of their study on wool textiles, emphasizing the role of plants used in the craft traditions and the perspectives for reshaping the activities, based on an approach of biocultural landscapes.

In chapter ▶ "Floristic Diversity on Rubber Plantations and their Importance for Subsistence at Foothill Landscapes of Mexico" López-Acosta et al. report their study on the floristic diversity occurring in rubber plantations of foothill landscapes in Uxpanapa, Veracruz. This area, originally with tropical rain forest, was transformed (nearly 80% of the original forest cover was cleared in the last 50 years) for establishing rubber plantations, orange plantations, and grasslands. The authors analyzed the vegetation associated to rubber plantations, finding that an important diversity of native plant species is maintained in those systems. They found the presence of 197 plant species which are managed by local people because of their utility for subsistence, which in turn favors conservation of other species and the restoration of the area.

In chapter ▶ "Ethnobotanical Science in the Clouds: Useful Plants of Northeastern Oaxaca, Mexico" Rendón-Aguilar et al. communicate a general panorama of the ethnofloristic richness of Northeastern Oaxaca. The state of Oaxaca is one of the most biocultural diverse areas of Mexico. The authors systematized information from previous studies and directly investigated sites of the northeast. They gathered ethnobotanical information from the mountainous regions surrounding the Tehuacán-Cuicatlán Valley, the Sierra Mixe and the Selva Zoque, where eight indigenous peoples have lived in the area for thousands of years, outstandingly the Zapotec, Mixe, Mazatec, and Mixtec. The ethnofloristic inventory is nearly 800 species, mainly medicinal, edible, and ornamental plants. This is one of the most important regional inventories of ethnobotanical knowledge of the mountains of

Mexico, and the authors emphasize the role of plants on local people's life and the role of people as local safeguards of biodiversity.

In chapter ▶ "Ethnobotany of the Highlands of Chiapas" Ruan-Soto et al. report a synthesis of their studies on ethnobotany of the Highlands of Chiapas. This region is a biocultural mosaic of ecosystems and cultures in the mountains of Southern Mexico. The region is covered by different vegetation types dominated by pine and oak species. There, the Maya-related Tsotsil, Tseltal, and Tojol-ab'al indigenous groups have developed a deep knowledge on the regional biodiversity. The authors show a general panorama of the diversity of wild and domesticated, native, and exotic plant species used by these people to satisfy their basic needs of food, fuel, medicine, ornamental, and other purposes (Fig. 7).

Chapter ▶ "Ethnobotanical Knowledge and the Patterns of Plant Use and Management in the Sierra de Huautla Biosphere Reserve and the Chichinautzin Biological Corridor in Morelos, Mexico" is dedicated to summarizing the ethnobotany of the Sierra de Huautla and the Chichinautzin Biological Corridor in the state of Morelos (Fig. 8). These are natural protected areas constituting reservoirs of tropical dry forest and other vegetation types and are also the territory of Nahua and Mestizo communities. In this chapter, Blancas et al. focus their attention on documenting aspects of knowledge, use, and management of the regional flora. The state of Morelos is in part in the Transvolcanic Belt and in part in the Balsas River Basin, one of the areas with the greatest biocultural wealth in Mexico, with a high number of endemic species. Although the European invasion produced great changes in the indigenous forms of cultivation and on the landscape of the region, great civilizations such as the Olmec, Tlahuica, and Mexica that flourished there maintained their cultural heritage. Plants use and management of the current human communities are expressions of those cultures and ethnobotany may significantly contribute to conserve their biocultural memory.

Chapter ▶ "Ethnobotany of the Nahua People: Plant Use and Management in the Sierra Negra, Puebla, Mexico," is dedicated to the Sierra Negra in the state of Puebla, which is a mountainous region that forms part of the Sierra Madre del Sur. The Sierra Negra harbors a great diversity of ecosystems and vegetation types like pine, pine-oak, cloud forest, rain forest, tropical dry forest, and xerophytic scrub. In addition, in this region the Nahua, Mazatec, Popoloca, and mestizos people coexist and interact. These peoples have remained relatively isolated from other regions and the multiple and diverse management of the ecosystems are part of their strategies to deal with such isolation. In this chapter, Blancas et al. document a wide spectrum of forms of use and management of plants, considering the region as an important biocultural refuge (Fig. 9).

In chapter ▶ "Ixcatec Ethnobotany: Plant Knowledge in the Mountains Surrounding the Tehuacán Valley" Rangel-Landa and Casas synthesize information of nearly 20 years of studies of the Ixcatec ethnobotany. The Ixcatec people live in Santa María Ixcatlán, in the mountains surrounding the Tehuacán-Cuicatlán Valley. The Ixcatec is an Otomanguean language in process of extinction, with only 12 speakers alive. This situation has motivated efforts from several scholars and institution to contribute to conserve the people's biocultural memory and language. The chapter

Fig. 7 People and plants in the Highlands of Chiapas, where the Tsotsil and Tseltal have developed an extraordinary ethnobotanical knowledge. (Photos: Felipe Ruán-Soto (Universidad de Ciencias y Artes de Chiapas))

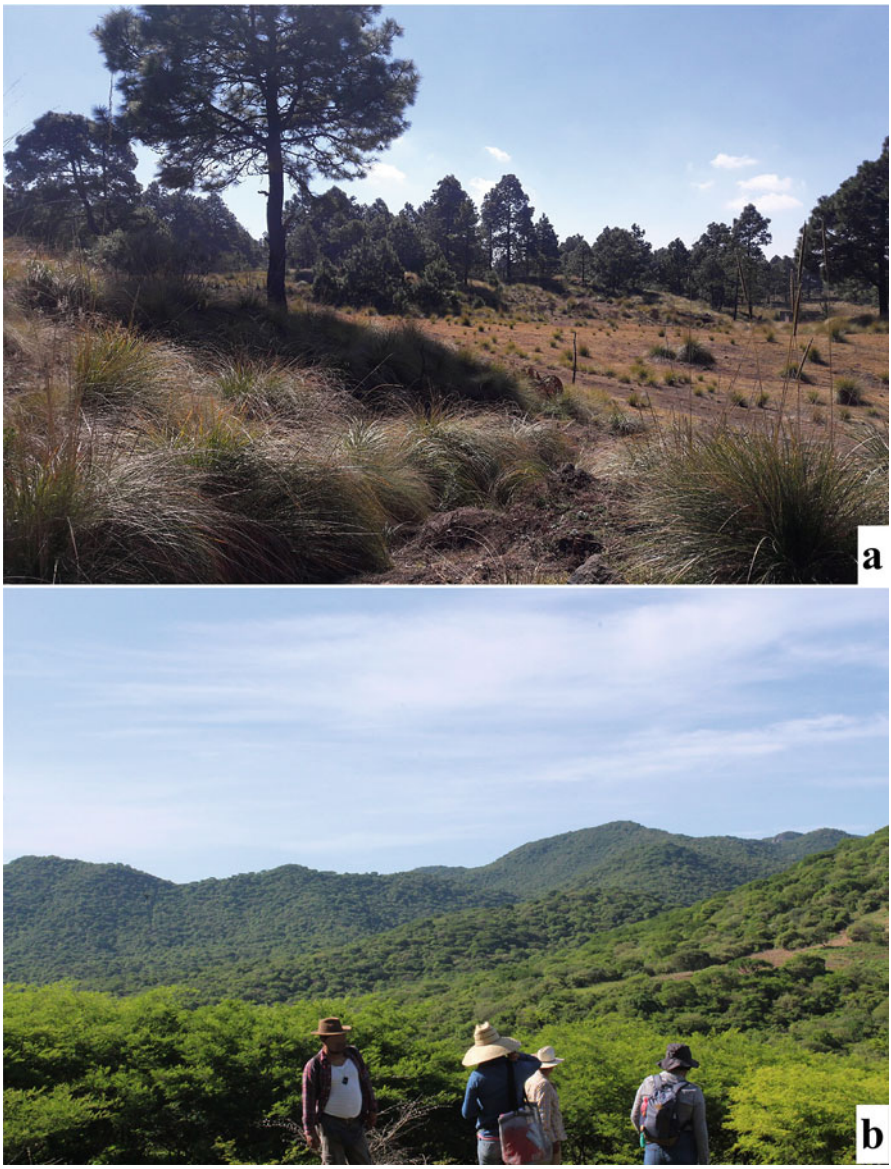

Fig. 8 Landscapes in the Chichinautzin Biological Corridor (**a**), and the Sierra de Huautla in the state of Morelos, México (**b**). These are natural protected areas constituting reservoirs of pine-oak forest and tropical dry forest that are the territory of Nahua and Mestizo communities. (Photos (**a**) Araceli Tegoma Coloreano and (**b**) Luis Sánchez Méndez)

summarizes information on plant knowledge, nomenclature, classification, use, and management of plants, analyzing the role of wild and cultivated species in people's subsistence. Also, the authors discuss the role of ethnobotanical studies and the ways

Fig. 9 General aspect of the landscape in the Sierra Negra, where Nahua, Mazatec, Popoloca, and mestizo people have interacted with a high diversity of ecosystems and plant species throughout long time. (Photo: Javier Rendón-Sandoval (IIES, UNAM))

these can interact with other disciplines to contribute to conserving the Ixcatec biocultural memory.

In chapter (▶ "Ethnobotanical Knowledge Within the Sierra Gorda, Querétaro, Mexico") Hernández-Sandoval and Castillo-Gómez gathered information from different studies including their own work for decades in this region. The Sierra Gorda is a portion of the Eastern Sierra Madre, with tropical, temperate, and semiarid vegetation used and managed by several cultures, outstandingly the Nya'xu (Northern Pame), Teenek (Huastec), Ximpeces, Uzá' (Chichimeco-jonaz), and Hñöñho (Semidesert Otomí). The authors report 739 useful plant species from 19 vegetation types and five types of agroecosystems, providing an extraordinary panorama of the ethnobotany of that mountainous region. As in other regions, the authors found that most useful pants are obtained from tropical deciduous forest, oak forest, and piedmont scrub, but they also recorded that numerous species are gathered from secondary vegetation.

In chapter ▶ "Biocultural Ethnobotany of the Zapotec Mountains of Oaxaca" Vásquez-Dávila et al. analyze the ethnobotany of the mountain landscape of Oaxaca, the state of Mexico with the highest biocultural diversity. This and other chapters of this book provide complementary views of such a fascinating kaleidoscope that Oaxaca constitutes. Following Alcorn (1991), the authors confirm that most biodiversity is harbored in the lands managed by traditional marginal human groups. They illustrate this fact through case studies in the mountains of Oaxaca. The

chapter describes the sacrality of the mountains and illustrates it through ethnographic information on agriculture and use of medicinal plants in two communities of the Sierra, analyzing the tensions between local people and external agents.

In chapter ▶ "Cuicatec Ethnobotany: Plants and Subsistence in San Lorenzo Pápalo, Oaxaca" Solís-Rojas and Casas report their ethnobotanical study with the Cuicatec of San Lorenzo Pápalo, Oaxaca. The Cuicatec are cultural and linguistically related with the Mixtec but formed a separate branch some thousands of years ago. Recently, the authors (Solis-Rojas and Casas 2019) reported ethnobiological Cuicatec information on fauna, and the current chapter reports the corresponding part of ethnobotanical studies. The role of plants in people's subsistence is analyzed, contextualizing their views, nomenclature, and classification system in relation to the management practices and other interactions between local people and ecosystems. The role of wild, weedy, and domesticated plant species in the Cuicatec subsistence is also reviewed. In several chapters referred to above, the traditional markets are outstanding places to document biocultural diversity. These are areas where products from highlands and lowlands are obtained by peoples, making possible an important ecological complementarity (Fig. 10).

The second part of the book is dedicated to review groups of plants representative of the Mexican cultures. These chapters are organized by genus in alphabetical order. We start this part with a group of aromatic plants of the genus *Agastache*, contributed by Carrillo-Galván and Bye (▶ "*Agastache* spp. Lamiaceae. Important Species of Hyssop in Mexico"); these plants are widely used for medicinal purposes, some of them with signs of domestication. Then, we continue with a review of the genus *Agave*, elaborated by Torres-García et al. ("*Agave* spp. Agavaceae"). This is an important group of plants with overwhelming diversity and presence in Mexican landscapes, with long history of interaction with humans and rooted in their cultures. Dozens of species have been used as food, for their fiber, their sap to prepare fermented beverages, and, more recently, their stems, which are cooked to prepare mescal spirits. Most species used are wild, extracted from forests and their overuse in some areas has determined important dangers over populations. Nowadays, conservation of several types of forests in Mexico are linked to correct planning of using agaves. The chapter provides a general panorama of these plants, their ethnobotany and ecology, and the challenges for their conservation.

Then, Mapes et al. review the useful species of genus *Amaranthus*, a group of plants providing edible grains and vegetables since ancient times. Some species are domesticated and others are weedy plants providing valuable food. Cristina Mapes has conducted important studies on the management and domestication of *Amaranthus* species of Mexico for decades. Therefore, the chapter offers an interesting window to this interesting group of plants.

Amphipterygium is a genus of the family Anacardiaceae, whose four species growing in tropical dry forests of Mexico have outstanding medicinal properties. Particularly noteworthy is the cuachalalate (*A. adstringens*), since its bark is widely used for gastric ulcers and is sold in markets of Mexico. Beltrán-Rodríguez and Bye describe this species and some aspects of its use, ecology, and needs for its conservation. Paizanni-Guillén and Douterlungne (▶ "*Aristolochia* spp. Aristolochiaceae")

Fig. 10 Traditional markets, impressive reservoirs of biocultural diversity, spaces where people from lowlands and highlands interchange their products and allow ecological complementarity. In the top, aspect of a seller in Cuetzalan, the main town of the Northern Sierra of Puebla. In the bottom, aspect of the variety of products interchanged in the market of Chilapa, in the Mountain of Guerrero region. (Photos: Ignacio Torres-García (ENES-Morelia, UNAM))

continue the series analyzing the genus *Aristolochia*, a group of plants characterized by the presence of a high diversity of secondary compounds associated to traditional medicine, now explored by scientists for its great pharmaceutical potential.

Palms of the genus *Brahea* spp. are among the most ancient plants associated to human remains, as suggested by archaeological discoveries by Ardelean et al. (2020).

Its diversity in Mexico is outstanding and the fiber, edible fruit, and fibrous stems of the species forming the genus have been widely used by Mexican cultures This genus is reviewed by Andrade-Erazo et al. Then, Blancas et al. provide a panorama of the species of the important genus *Bursera*. Species of this genus provide multiple benefits to people, wood, firewood, medicine, and, outstandingly, the resin called copal, which is deeply linked to the ceremonial life of Mesoamerican and Aridoamerican peoples from ancient times to the present.

Capsicum is a group of plants iconic of the Mexican culture. Aguilar-Meléndez et al. provide a valuable review of the taxonomy, ethnobotany, and evolutionary aspects related to the domestication of these plants. The authors of this chapter have been working in an ambitious project of a series of books gathering aspects on the natural and cultural history of the chili peppers, two of them (Aguilar Meléndez et al. 2018; Vásquez-Dávila et al. 2022) were recently published. Thus, the chapter is an extraordinary link to those important works.

Andrade-Erazo and Miranda Gamboa reviewed another important genus of palms: *Chamaedorea*. This genus provides several benefits to humans, the inflorescences of some species are edible (Fig. 3), very much appreciated, and, in general, these palms are valued worldwide for ornamental purposes. It is a genus with extraordinary diversity in the Mexican territory, deeply rooted in several cultures and nowadays threatened for their intense harvest from forests. This is a reason why these palms have been important systems of population ecology studies motivated to identify sustainable thresholds of harvest rates (Hernández-Barrios et al. 2015; Jansen et al. 2018).

Bowls have been crucial artifacts in human cultures, some of them preceding the ceramic. Among the most important are the *Lagenaria siceraria* fruits which were early introduced from the Old World, species of the genus *Cucurbita* and the native gourd trees of the genus *Crescentia*. In the Mexican territory, *Crescentia alata* and *C. cujete* are the species of this genus that are available and have been important part of Mexican cultures. Aguirre-Dugua and Casas give a review of taxonomic and ethnobotanical information of these species which is linked with their studies on domestication and phylogeography of these plants in the neotropics (Aguirre-Dugua et al. 2012, 2013, 2018).

The genus *Cucurbita* has an especial place in the cultures of the Americas. Species of this genus have been used as bowls, food, medicine, and are important components of the iconic milpa systems associated with maize and beans. Lira et al. prepared a review of taxonomic, ethnobotanical, and evolutionary studies conducted by their group for decades. It is a valuable contribution that allows connecting the reader with taxonomic challenges and questions related to the origins and domestication of these important plants.

Escontria chiotilla is an arborescent candelabriform cactus whose fruits are widely appreciated by cultures of the semiarid areas of Central Mexico. *Escontria* is a monospecific genus and in this chapter Casas (▶ "*Escontria chiotilla* (F. A. C. Weber ex K. Schum.) Rose Cactaceae") provides a general panorama of ethnobotanical and ecological information related to the interactions between people and

these plants. Also, Casas provides information about the economic importance of this species, challenges for conservation, and the relevance of the local experience of management for this purpose.

Elizondo-Salas et al. (▶ "*Gaultheria acuminata* Schltdl. and Cham. Ericaceae") present an overview of the use and management of *Gaultheria acuminata* Schltdl. and Cham. ERICACEAE, an important medicinal plant from the Sierra de Zongolica (the central area of the Eastern Sierra Madre is called this way). *G. acuminata* is a key resource in many communities, since it is an important medicinal plant with commercial value at regional scale, but also has a prominent role in the cosmovision and symbolism of the Nahua people.

The Mesoamerican cotton *Gossypium hirsutum* has been extraordinarily important for its fiber to Mesoamerican peoples from pre-Columbian times to the present. Currently this species of cotton is one of the most important crops worldwide. Several species of the genus occur in Mexico, maintaining interactions with cultivated cotton. The research group of Dr. Ana Wegier, leading this chapter, has made relevant contributions to understand the genetic interactions among these species and their role in the process of domestication. In this chapter Alavez et al. review taxonomic, ethnobotanical, ecological, and evolutionary information of 13 species of the genus, including the crop species *G. hirsutum* and *G. barbadense*, which allow the readers a general panorama of the importance of these plants, and it is a connection with the fascinating studies carried out by the authors.

Beltrán-Rodríguez et al. elaborated a general overview of the genus *Hintonia* in Mexico. These are species whose bark has medicinal uses, mainly as a febrifuge and for treating other ailments. The case of *H. latiflora* stands out since it constitutes an important nontimber forest product of tropical deciduous forest.

The American wild or false laurel *Litsea glaucescens* Kunth is one outstanding nontimber forest product. It is a spice very much appreciated in Mexico and other countries of the world. Commercializing its leaves is a profitable activity that enhances unsustainable harvesting practices that endanger entire populations in some areas. Ortega-Meza et al. (▶ "*Litsea glaucescens* Kunth Lauraceae") examine use and management strategies of this species in different areas, bringing ethnobotanical, ecological, and economic information. The chapter allows the readers general insights about the species, the interactions, the problems, and views for attending need for the species conservation.

Jimeno-Sevilla and Elizondo-Salas (▶ "*Magnolia mexicana* DC. Magnoliaceae") address the case of the *Magnolia mexicana* DC. MAGNOLIACEAE, regionally known as "yoloxóchitl," which is used for several purposes, mainly medicinal. It is a tree that inhabits cloud forest and rainforests in the mountainous area of Veracruz, Mexico. This species is classified as vulnerable in the IUCN list, therefore some conservation strategies are documented and discussed, both in wild vegetation and in some agroecosystems.

Melothria is a genus of the Cucurbitaceae widely spread in the Americas. In Mexico species of this genus are appreciated as food, harvested from wild and weedy

areas. Fruits are consumed raw (with cucumber-like flavor) or cooked (sometimes substituting green tomatoes in sauces). Guerrero-Torres et al. summarize information that provides a general panorama of the ethnobotany of species of this genus.

Myrtillocactus is a genus of candelabriform shrubby or arborescent cacti. All species produce edible fruit and flowers, which are collected from wild populations, but some species receive different forms of management, and at least two species (*M. geometrizans* and *M. schenckii*) have signs of incipient domestication. Blancas and Casas show in the chapter dedicated to this genus a review of ethnobotanical and ecological information on use and management of these plants.

Vásquez-Dávila et al. (2022) address the genus *Nicotiana*, which is made up of species of annual or perennial plants, widely used in Mexico for multiple purposes, highlighting medicinal, ritual, and ornamental uses. An overview of nine species is presented, emphasizing the case of *N. tabacum*.

Delgado-Salinas and Torres-Colín address the case of the genus *Phaseolus*, important food resources of various cultures in Mexico. The use of dry seeds and pods stands out, which, together with corn, are part of the basic diet of the Mexican population. The authors provide information about the use of wild relatives and several varieties of *P. vulgaris.*

Martínez et al. address taxonomic and ethnobotanical information of the genus *Physalis*, whose complexity and diversity are part of different cultures of Mexico. The green tomato *P. philadelphica* is the best known and studied species of this genus, but other species are in the background of several indigenous cultures. Most species described have edible uses and a vast culinary complex throughout Mexico, but some species have in addition other uses, mainly medicinal.

Polaskia chichipe and *P. chende* are candelabriform cacti used and managed by people of the Tehuacan Valley. In this chapter Casas reviews information generated by his research team about these species in relation to their main use for their edible fruit, and the management practices including gathering of fruit from the wild, the silvicultural management of populations in agroforestry system, and, in the case of *P. chichipe*, its cultivation in plantations in regional homegardens. Ethnobotanical, morphological and ecological information is provided to analyze the incipient levels of domestication identified in the managed populations.

Martínez-Ballesté et al. address the genus *Sabal*, palms of the Arecaceae family, whose leaves are widely used as construction material from pre-Hispanic times to the present. Some species of the genus *Sabal* are outstanding plant resources in regional cultures, especially for the Maya of the Yucatán Peninsula. Information is provided on past and present uses, as well as the different ways in which they are managed in wild vegetation and in agroecosystems.

Lira et al. review the genus *Sechium*, whose species are important food resources in mountainous areas of Mexico since pre-Hispanic times. *Sechium edule* is one of the species that has the greatest morphological diversity, which in part has been

promoted by human management. In addition to edible uses, these vines have uses as veterinary medicine, as well as fodder for livestock.

Torres-García et al. address the *Solanum* genus, which is one of the most complex and diverse plant group of the Solanaceae family. The authors emphasize the medicinal and edible uses, as well as the management strategies that have been documented among various peoples and cultures that inhabit mountainous areas in Mexico.

Ruenes-Morales et al. (► "*Spondias mombin* L. *Spondias purpurea* L. *Spondias radlkoferi* J. D. Smith Anacardiaceae") evince the ethnobotanical importance of the *Spondias* genus, whose species are mainly used for their fruits. In addition, they have a complex traditional nomenclature that includes the great diversity of shapes, colors, flavors, and ways of preparation. The implications of the diversity of forms of management are also addressed, which have led to domestication processes from the incipient to the most intense management and selection.

Alvarado Sizzo and Casas review ethnobotanical and ecological information of the genus *Stenocereus*, which is formed by shrubby and arborescent cacti widely used for their edible fruits. The genus is naturally distributed from the Southern USA to the arid and semiarid regions of Colombia and Venezuela. Mexico is the main area of diversity of the genus and species have been part of several cultures inhabiting xerophytic vegetation and tropical dry forest areas. Fruits of practically all species are appreciated and gathered from wild populations but plants of some species receive silvicultural management in agroforestry systems or in live fences. Species like *S. griseus*, *S. pruinosus*, *S. stellatus*, *S. fricii*, and *S. queretaroensis* show signs of domestication and the authors summarize the information available to document this aspect.

Vega et al. review the genus *Vanilla*, whose best-known species is *V. planifolia*, with which various edible products are made and it is one of the most important crops of the world. However, in this section other lesser-known species are considered, all of them locally important genetic resources with economic and biocultural relevance.

Finally, Mota-Cruz et al. provide an overview of the ethnobotanical importance of the *Zea* genus, whose wild, weedy, ruderal, and domesticated species have forged the identity of various Mesoamerican cultures, especially those distributed in Mexico. The case of *Zea mays* ssp. *mays* is emblematic, not only because Mexico is the center of origin of the species, but also because of the diversity and complexity of interactions that humans have established with it throughout its evolutionary history. In addition, in the context of climate change, knowledge of the various species is crucial for the conservation of the genetic diversity of the *Zea* genus.

Acknowledgments The authors thank CONACYT for financial support to the project A1S-14306, as well as support from the GEF Project ID 9380 CONABIO-GEF-FAO/RG023 "Manejo y domesticación de agrobiodiversidad en Mesoamérica: Bases para la soberanía alimentaria sustentable," and PAPIT, UNAM (project IN206520 and IN224023).

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