WWF Mexico-Telcel. Special Publication No. 1

Danaids:

The Marvelous Monarch Butterflies

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The WWF-Telcel Alliance

For almost two decades, the World Wildlife Fund (WWF) has supported the conservation of the Monarch butterfly's forests through the activities of its Mexican Forests Program. And since the establishment of the WWF-Telcel Alliance in 2003, WWF has participated in extensive, integrated efforts to search for and orchestrate solutions to problems within the Monarch region. The Alliance's activities include support for the Regional Monarch Butterfly Forum, forest monitoring, training, scientific research, communication, and support of sustainable tourism.

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Dedication

To Alla, one of the Danaids who chose not to return with the migration.

To my beautiful butterflies "Mary", "Fer," and "Normita" for being my life. To the memory of my mother. To my father and my brothers. To the people of the Reserve.

Acknowledgements

Many individuals of noble mind and persevering spirit have dedicated a significant part of their lives to understanding the marvelous Monarch butterfly. Much of the information within this book draws on their efforts. By way of tribute, we thank the scientists and conservationists who have dedicated their efforts to understanding the ecology of this butterfly and to its conservation: Fred † and Nora Urquhart, Ken Bruger †, Leonila Vázquez †, Héctor Pérez †, Donald Davis, John Powers, Lincoln P. Brower, Orley "Chip" Taylor, Bill Calvert, Karen Oberhauser, Homero Aridjis, Eligio García, Eglantina Canales, Rocío Treviño, Jordi Honey Rosés, Rodolfo Ogarrio, Pablo Ángeles, Israel Contreras, Juan Antonio Reyes, Mónica Missrie, Elizabeth Howard, Alfonso Alonso, José López, Armando Peralta, Isabel Ramírez, Martín Cruz, Karla Rodríguez, Adriana Valera, Eneida Montesinos, Guillermo Castilleja, Juan Bezaury, Susana Rojas, Rosendo Caro, Sergio Knaebel, Lee Pagni, William Toone, Julia Carabias and Vico Gutiérrez, as well as Michele Gangaware, Tim Lapage, Chuck Schnoll of the "Lighthawk" voluntary pilots' organization, and committed residents of the Monarch butterfly region.

The idea for this book arose during a February 2005 visit by WWF-Mexico staff with Carlos Slim Helú and Hector Slim Seade to El Rosario butterfly sanctuary. We are profoundly grateful to them for having inspired us to write it.

We also deeply appreciate the unconditional support of Omar Vidal, Director of WWF-Mexico, who has firmly backed the Monarch Program since the day he arrived, and Jatziri Pérez, Communications Coordinator of WWF–Mexico, who carefully reviewed the manuscript and offered invaluable suggestions. The book was enriched by the excellent suggestions and inspiration of Antonio Pérez Vieytez. Our thanks also to John Williams and Gabriela Ramirez Galindo for reviewing the translation.

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Prologue

Social responsibility is a commitment that, for Mexican firms, includes providing aid to diverse sectors of society and supporting individuals and entities dedicated to altruistic pursuits. Moreover, all of us who work at Telcel recognize the importance of conservation and sustainable resource management when it comes to improving social and economic conditions in Mexico. Environmental responsibility is therefore an important part of our mission.

Building on previous efforts in this area, WWF and Telcel decided to establish a strategic alliance to effectively help address some of the problems affecting the environment and, by extension, the people of our country. WWF is one of the world's most renowned and experienced non-governmental conservation organizations, with a mission to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

The first project we identified involved the conservation of the Monarch butterfly in its Mexican hibernation areas in the states of Mexico and Michoacán, an effort building on several conservation activities previously conducted within the Monarch region.

In November of each year, Monarchs travel 4,500 kilometers from Canada and the United States to reach their winter habitat in Mexico. Conserving Mexican forests is critical to ensuring that the Monarch's migratory phenomenon endures, with oyamel fir and pine forests of utmost importance because of the ideal microclimatic conditions they provide during the butterflies' stay. Local communities within these forests also play a fundamental role and, as owners of the forests that house the hibernation sanctuaries, are the Monarch's greatest natural allies.

Thanks to the WWF-Telcel Alliance, conservation and socio-economic development plans are being put into place to stop the loss and

deterioration of the forests and provide viable alternatives for the Monarch region's inhabitants. We at Telcel are committed to see these efforts succeed.

This publication is intended for everyone who has visited the Monarch butterflies and appreciates their marvelous migratory phenomenon—and especially for those who have not yet done so. If this book motivates even a few individuals to visit the Monarchs' region and to promote conservation of their marvelous migration, then Telcel will have gone a long way towards fulfilling its mission.

Daniel Hajj Aboumrad
Telcel General Director

Mexico City, April 2005

Preface

Butterflies are a symbol of constant change. Their transformation from egg to caterpillar to chrysalis, then to winged butterfly, offers a lesson to redefine ourselves several times throughout life in order to take flight.

Monarch butterflies are a symbol of extraordinary perseverance. Their amazing migration across thousands of kilometers offers a lesson on how to achieve goals that seem beyond our reach.

We look to this marvelous insect for lessons as we seek to improve our relationship with all the living beings with which we share the planet, and as we persevere in efforts to conserve Earth's greatest asset: living nature.

Carlos Galindo-Leal

Chapter 1

The Daughters of Danaus

The Monarch butterfly's official name in science is *Danaus plexippus*, which literally means "sleepy transformation." Scientific names usually derived from Latin or Greek, are enormously helpful: though occasionally hard to pronounce, they ensure that each species has a unique name that is internationally recognized, eliminating confusion when species are known by different common names across various regions and languages. The scientific name for Monarchs, which evokes the species' ability to hibernate and metamorphize, actually has its origins in Greek mythology.

What's in a Name?

According to the Greek legend, *Danaus* and *Aegyptus* (twin sons of King *Belus* and Queen *Anchinoe* of Egypt) each had 50 children. *Aegyptus*, King of Arabia, demanded that his 50 sons marry the 50 daughters (known as "*Danaids*") of his brother *Danaus*, King of Libya. But *Danaus* and his daughters refused, fleeing to the city of *Argus* in northeastern Greek Peloponnesus, where *Danaus* was made king. *Aegyptus* and his 50 sons, however, tracked them all the way to *Argus* and insisted on the

marriages. As a stalling tactic, *Danaus* consented. Then on the eve of the wedding, he armed his daughters with 50 knives and ordered the *Danaids* to kill their cousins. In time, *Danaus* worked out a clever plan to arrange proper marriages for his daughters: he required suitors to run a race and paired up his *Danaids* with the runners in the order that they crossed the finish line.

The only son of *Aegyptus* to survive the wedding night slaughter was *Lynceus*, who had been spared by *Danaus's* eldest daughter, *Hypermnestra*—a decision that prompted *Danaus* to imprison her briefly. Years later, *Lynceus* avenged the death of his brothers by killing *Danaus*. He and *Hypermnestra* went on to start the *Danaan* dynasty. *Artemisa*—Greek goddess of the forests and the hunt, twin sister of *Apollo*, and daughter of *Zeus*—eventually killed the other 49 *Danaids* for their crime: she banished them to the underworld and condemned them to an eternal punishment of filling leaky jars with water.

The long, migratory journey of the Monarch butterflies is reminiscent of both the *Danaids'* flight from *Aegyptus's* sons and the race *Danaus* organized to arrange his daughters' marriages—hence the first part of the scientific name.

Plexippus is the name of one of the unfortunate sons of *Aegyptus*. It is also the name of an Argonaut who set off with *Jason* on the *Argus* ship in search of the Golden Fleece—and who ended up getting speared by his nephew *Meleagrus* during a boar hunt in Caledonia. Like the Monarch butterflies, *Danaus* and *Plexippus* were adventurous travelers.

In 1758, Carl Linnaeus, the Swedish biologist who invented taxonomy—the science that deals with the principles, methods, and purposes of classifying species—named this butterfly as *Papilio plexippus*, a designation that was later changed to *Danaus plexippus*. This final choice for the Monarchs' scientific name captured the butterflies' migratory nature, its social behavior, as well as its ability to hibernate and metamorphize.

The name "Monarch" was given to the butterflies by European colonists in the United States and Canada in honor of King William III, Prince of Orange and King of England. They also colloquially referred to Monarchs as "King Billy," the "milkweed butterfly" and the "wanderer."

Close relatives of the Monarch include the Queen butterfly (*Danaus gilippus*) and the Soldier butterfly (*Danaus eresimus*).

Masters of the Planet

Insects are the planet's most successful group: with approximately 751,000 recognized species, they represent more than the half of the organisms described by scientists. What's more, biologists estimate that another 10 to 30 million insect species exist and are waiting to be described.

Insects emerged on the planet about 300 million years ago. Edward Wilson, a renowned expert on ants, has suggested that if insects and other arthropods (invertebrates with external skeletons and jointed appendages) did not exist, humanity would disappear within a few months: amphibians, reptiles, birds, and mammals all feed on insects; diverse plants with flowers need insects for pollination, and the process of recycling matter and nutrients from dead plants and animals back into nature relies on them. In short, essential processes for life depend on insects, making them true masters of the planet.

Butterflies belong to the group of insects known as "lepidopters" (butterflies and moths), a name that derives from the Greek *lepidos*, meaning scale, and *pteron*, meaning wing—indicating that butterflies are insects with wings with scales. Approximately 112,000 species of butterflies and moths are currently recognized. Along with beetles (290,000), bees (103,000) and flies and mosquitoes (98,000), butterflies and moths are among the most numerous and diverse groups of insects on the planet (Figure 1). And thanks to their beautiful colors, they are among the most well-known.

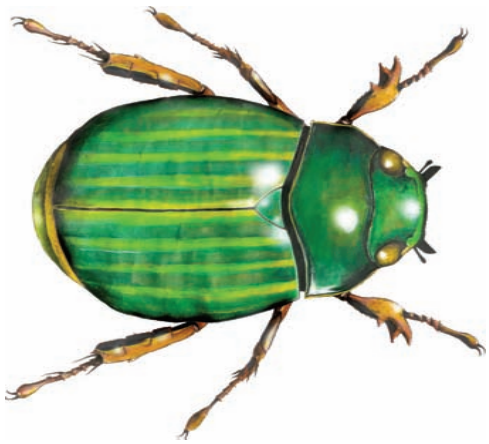


Figure 1. Beetles comprise the most diverse group of insects.

The Monarch butterfly originated in the American tropics almost two million years ago. Its North American migration is one of the world's most impressive natural phenomena given the massive number of butterflies travelling from central and northern United States and southern Canada in the eastern region of the Rocky Mountains.

A Magic Show in Four Acts

The Monarch's life cycle consists of four very distinct stages, each featuring magical feats of transformation. The duration of each stage varies according to the climate of the diverse areas in which the butterflies live (Figure 2).

Figure 2. Life cycle of the Monarch butterfly.

Tiny Eggs

The process begins with tiny eggs resembling miniature footballs, each approximately two millimeters long (about the size of a period at the end of a sentence) and weighing about 0.46 milligrams. The eggs are light yellow

or white in color and are found on the undersides of milkweed (*Asclepias*) plant leaves, the Monarchs' favorite food. Under normal circumstances, each female lays about 400 eggs onto leaves during this stage (Figure 3).

Figure 3. Tiny Eggs.

A Caterpillar is Born

After three or four days, worm-like caterpillars—also known as larvae—emerge, boasting bold white, black, and yellow stripes that encircle their bodies like shiny rings. While other species' larvae often feature colors to help them hide, the Monarch larvae's colors intentionally attract attention.

The caterpillars feed on the milkweed leaves onto which they were born, ingesting toxic substances that supply them with a natural defense against predators. Their colors warn any potential eaters: "pick something else on the menu! " The larval phase lasts from nine to 14 days time, during which the caterpillars shed their skin or "molt" five times. At the end of this stage, thanks to their voracious appetite, the caterpillars weigh 1.5 grams —more than 3,000 times that of their egg!

While each caterpillar possesses six pairs of eyes, it does not see very well and must rely heavily on a pair of antennae on its head for orientation. Caterpillars also have two protrusions on their rear abdomens similar to antennae. The caterpillar molts its skin five times as it grows (Figure 4).

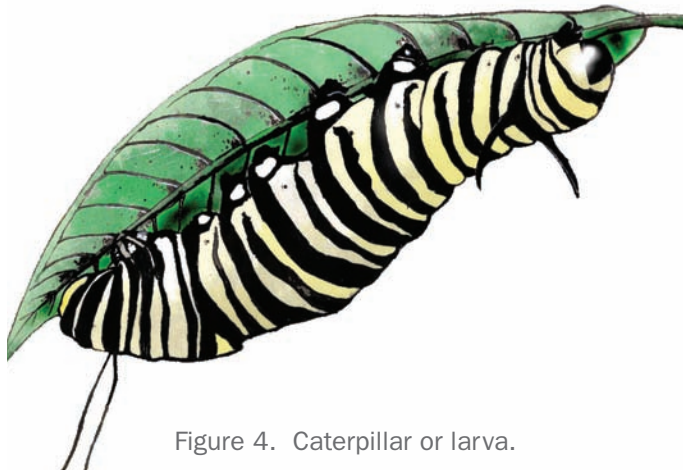


Figure 4. Caterpillar or larva.

Creating a Chrysalis

During its final molting, the caterpillar transforms itself into a chrysalis (also called a "pupa"), a cone-shaped, pistachio-colored sack with a rounded tip and a line of golden dots resembling jewels of a crown, arranged around the widest part of the sack. The green color of this chrysalis gradually becomes transparent, allowing onlookers to see the orange and black wings of the butterfly developing inside. This transformation, perhaps the most astonishing of the entire process, lasts approximately eight to 13 days (Figure 5).

Figure 5. Pupas or chrysalises.

The Adult Butterfly Emerges

Once the butterfly transformation inside the chrysalis is completed, it tears through the wrapping. The adult butterfly begins to emerge, freeing first its legs and antennae. It then hangs upside-down, waiting for its wings to extend, dry, and harden.

Adult Monarchs possess two pairs of brilliant reddish-orange wings, featuring black veins (wider on the females) and white spots along the edges. The undersides of the rear wings are dull yellow in color and feature the same vein patterns and spots. The Monarchs' wingspan is about 11 centimeters, and each butterfly weighs one quarter to three quarters of a gram. The males, which possess distinguishing black dots (*stigmata*) along the veins of their wings, are slightly larger than the females. These *stigmata* are scales that can produce pheromones (sexual hormones) to attract females, although migratory Monarchs seem not to use them.

The body of the butterfly consists of the head, the thorax, and the black-colored abdomen. The thorax and abdomen feature white spots similar to those on the wings, while both sides of the abdomen possess two long, white stripes. Two antennae protrude from the head, allowing the Monarch to get its bearings while its two eyes capture light and images. Like other insects, butterflies possess three pairs of legs. In the Monarch butterfly family, however, the front pair legs are so small that observers can easily overlook them (Figure 6).

Figure 6. Adult male (above) and female.

Adult butterflies develop sex organs within three days of emerging from their chrysalis and begin to reproduce only five days later. This cycle—mating, egg-laying, caterpillar, chrysalis, new generation of adults, then mating again—occurs repeatedly over approximately one month as the butterflies advance northward during spring and summer in the United States and Canada.

The generations of Monarchs that migrate possess only small quantities of sexual hormones, which delay the development of their sexual organs. These Monarchs only reproduce when temperatures rise during springtime in their hibernation areas, just before they begin their northward journey.

Once mating begins, the males fly up to females and attach their front legs to the female's wings in mid-air, giving rise to what appears to be a great struggle. This behavior is different from the less forceful approach used by Monarchs within United States and Canadian reproduction areas. Butterfly couples often fall to the ground while mating and need to take flight all over again to resume their nuptial acrobatics. Mating can last from a few minutes to 16 hours, during which the male transfers his sperm and nutrients to the female so she can produce fertile eggs.

The Methuselah Generation

Each adult butterfly lives only about four to five weeks. But one of the many wonders of the Monarchs is the annual creation of a unique "Methuselah generation." In the final days of summer, just before embarking on the southern migration, the Monarchs give birth to a very special generation of butterflies. Unlike their parents, grandparents, great-grandparents, and great-great-grandparents—all of which lived ephemeral lives measured in weeks—these newborn butterflies will survive seven or eight months. In human terms, given our average life span of 75 years, this would be like having children who lived to be 525 years old!

This generation performs the astounding feat of flying from Canada and the United States to the center of Mexico, eventually turning around to begin the journey back north again. Once they reach the United States, a kind of relay race begins: the short-lived offspring of the Methuselah generation, with only four or five weeks to live, continue the trek northward over several generations.

Adventurous Travelers

The Monarch is considered a cosmopolitan species, given that it is found in many places around the world. But it is only in North America that the extraordinary phenomenon of migration and hibernation takes place. The Monarch lives in the western hemisphere and was introduced to Hawaii and Australia in the 19th century. Within the Americas, Monarchs are found from the northern Canadian province of Saskatchewan (near the Great Lakes) to southern Peru and northwest Argentina, where it has been suggested that migratory movements may take place. In the Bermuda islands of the Atlantic Ocean, Monarchs can live up to 13 weeks.

Monarchs apparently hitched a ride on a ship across the Pacific Ocean to New Zealand in 1860 and have been sighted since in the Carolina Islands, the Marquesa Islands, and during winters in Australia. In 1880, Monarchs were documented in Tasmania, the Canary Islands, New Caledonia, the Maluku Islands, and the Solomon Islands in Oceania. Over the next 15 years Monarchs were discovered in Hong Kong, Taiwan, Java, Borneo, and the Philippines. There are also scientific reports of butterflies flying across the Atlantic and arriving in Ireland, England, and Spain.

Countryside Living

The lives and location of Monarchs are determined by the distribution of the milkweeds, a group of plants that are considered pesky weeds by farmers but an indispensable food source for Monarch caterpillars. Paradoxically, milkweeds thrive in zones that have been disturbed or modified by human activity—especially agricultural lands, where they grow among corn and soy fields within the United States and Canada.

The vast majority (90%) of Monarchs in the United States and Canada are born in rural settings, their eggs having been laid in agricultural fields where milkweeds are present. These farm habitats are generally wide-open areas that subject Monarchs to winds and drastic changes in temperature and humidity. Once Monarchs head off to their hibernation areas, however, they become significantly more demanding (remember *Danaus* and his daughters?). They soon require closed forests to protect them from winds and abrupt changes in temperature and humidity. In

Mexico, butterflies congregate within temperate oyamel fir forests at altitudes of over 3,000 meters above sea level; by contrast, along the coast of California they have had to settle in forest of Australian-introduced eucalyptus trees, which have replaced native forests. Apparently, Monarchs are more concerned with the protection provided by dense forests than with being around any particular tree species.

It is possible that milkweeds have expanded as the North American human population has increased: as agricultural zones develop, so do habitats for milkweeds. And as milkweed numbers rise, so too have populations of Monarch butterflies grown. This raises the questions: Have the millions of butterflies emigrating to Mexico been helped by human activities? Have there always been this many butterflies, or have numbers increased due to the growth of United States and Canadian agriculture?

A Spicy Entrée

Asclepius (also known as *Aesculapius*) was the son of *Apollo* and *Coronis*. *Apollo* killed *Coronis* for her infidelity, then ripped *Asclepius* from her womb. *Apollo* sent the child to be raised by and to learn healing arts from the centaur *Cheiron*, who was also the teacher and guide of *Achilles* and *Jason*. Over time, *Asclepius* began to surpass *Cheiron* as a healer, eventually becoming the god of medicine and healing with impressive abilities—including the power to resurrect the dead. But according to *Zeus*, father of *Apollo*, *Asclepius's* power to raise the dead went too far and was contrary to natural laws. *Zeus* thus struck down and killed his grandson with a bolt of lightning.

Milkweeds, colloquially named after the milky substance they contain, belong to a genus of plant known as *Asclepias*, which possess as many toxic properties as medicinal ones. These perennial plants—usually about 60 centimeters to one and a half meters in height—are toxic to varying degrees and have been used by humans to induce vomiting, to cure constipation, to relieve toothaches, to alleviate injuries and rheumatism, as an antiseptic, and even as poison to kill mice. Their use dates back over 3,500 years (Figure 7).

The toxic substances produced by milkweeds keep away herbivorous predators. They provide a highly effective defense, so much that milkweeds

Figure 7. Milkweed or *Asclepias*.

are frequently responsible for the poisoning of North American cattle. Milkweeds are also toxic for sheep, goats, horses, and ducks. Their powerful chemical defense stems from compounds called "cardiac glycosides," which are found in the leaves of dozens of plant families and affect the heart in various ways. Monarch butterflies, however, are capable of assimilating the toxins and storing them in their outer skin; covered with this powerful chemical defense, they themselves become highly protected from predators.

Like other butterflies, the Monarch is a picky specialist. Monarchs feed on only 27 of the 108 species of milkweed and, except on rare occasions, only lay their eggs on the leaves of four milkweed species:

Asclepias humistrata, *A. viridis*, *A. asperula*, and *A. syriaca*. Monarchs choose these particular species because they all possess intermediate concentrations of cardiac glycosides—a choice, in turn, that has largely determined where Monarchs are found within North America. During their spring reproduction cycle, Monarchs rely on three species of milkweed: Pinewoods (*A. humistrata*), Antelope horn (*A. viridis*) and spider (*A. asperula*); during summer reproduction, they favor the common milkweed (*A. syriaca*).

In addition to absorbing cardiac glycosides from milkweed as larvae, adults acquire a second chemical defense ("alkaloids") from flowers of the Asteraceae family such as sunflowers. The alkaloids are natural compounds produced by some plants that have been used in pharmacology and medicine as analgesics, anesthetics, hypnotics, cardiotonics, hypertensives, tranquilizers, hallucinogens, and more. Some of the best-known alkaloids are nicotine, caffeine, quinine, morphine, codeine, and atropine.

Research by Dr. Lincoln Brower and his colleagues on Monarch butterflies has shown that 12 bird species in nine families vomit after biting Monarchs. The bad experience of getting sick (not to mention the terrible flavor) has conditioned these birds to keep Monarchs off their diet.

Each Monarch's lifespan depends on the amount of energy stored during the larval stage, while its reproductive capacity depends on the nectar consumed as an adult. Moreover, the food consumed as larvae and as migratory adult determines its survival during hibernation. During migration, Monarchs stop in the afternoons to spend the night in areas with abundant flowering plants offering nectar, which they consume and convert into fats for energy reserves.

The Butterfly Eaters

Despite their powerful defenses, Monarchs are not without predators. Some species have developed an appetite for the "spicy" butterflies and a capacity to avoid being harmed by Monarchs' toxicity. The main predators of the butterflies in Monarch hibernation areas are the Scott's oriole and Black-backed Oriole (*Icterus parisorum* and *I. abeillei*) and the Black-headed Grosbeak (*Pheuticus melanocephalus*). Orioles selectively

feed on Monarch's thorax muscles and abdominal fat, without eating the toxic skin. Grosbeaks, on the other hand, gobble up the whole enchilada! Black-eared Deer mice (*Peromyscus melanotis*) have also evolved to feed on the "spicy" Monarch. Although the Monarch's chemical substances are toxic when injected into mice, they are not harmful when eaten (Figure 8). It is possible that the toxic concentrations in butterflies diminish after their long flight from the United States and Canada to Mexico.

Figure 8. The Black-backed Oriole and the Black-eared Mouse are two of the butterfly eaters.

Mimicry and Free Riding

Some other butterfly species take advantage of the Monarch's chemical defenses. The brilliant orange and black colors on the Monarch's wings signal that they are not edible, as do the stripes on larvae. To confuse predators, certain other non-toxic butterfly species, including the Viceroy butterfly (*Limenitis archippus*), have evolved to look exactly like Monarchs and to live among them. Predators assume they are toxic and move on. This interesting phenomenon is known as mimicry.

Chapter II

The Monarch of all Migrations

Migration is one of the most astonishing phenomena in nature. How do marine turtles find their way back to nesting beaches after swimming vast ocean distances for most of the year? How do tropical birds like warblers and thrushes manage to fly continental distances after reproducing, traveling all the way from northern Canada and the United States to Mexico and Central America to spend the winter? How do small, insect-eating bats of less than 15 grams navigate by night across large distances every season? It is one of nature's wonders that such small individuals can carry out such incredible feats.

Yet of all migrations by small creatures, few are as astonishing as the one performed by the Monarch butterfly. The embodiment of fragility, these insects travel between 2,000 and 4,500 kilometers or more between their starting and ending points—an unparalleled feat. What is even more remarkable is that butterflies that "return" to hibernation areas have actually never been there before. These are the great-great-great-grandchildren of those that performed the intrepid journey the year before from southeast Canada and the United States to central Mexico.

Scientists use the term migration to describe round-trip movements of species, whereas "dispersion" connotes movement in only one direction. Dispersion is an essential characteristic of plants and animals. Migration, on the other hand, is not such a common phenomenon. It occurs in different animal groups, and generally only adults migrate.

Migration is a phenomenon that is difficult to study and about which relatively little is known. Proper study requires following animals individually, which can be challenging. Collars or other tracking devices are often removed by animals or fall off over time. It is even more challenging to design a tracking device appropriate for a butterfly weighing less than a gram without affecting its flight and survival. This was the challenge facing Dr. Fred Urquhart, a Canadian pioneer in butterfly tracking. Currently, Dr. Orley "*Chip*" Taylor of the University of Kansas continues to build on this extraordinary work. Their perseverance, with the help of thousands of volunteers, has shed new light on the mystery of the Monarch migration.

Extreme Sports
Why do Monarchs Migrate?

Like several species of birds, bats, and whales, the Monarch butterfly of Canada and the United States migrates to places where climate is less extreme. Winters are too cold in places where butterflies reproduce; Monarchs would not be able to withstand either heavy snowfall or the absence of plants that larval caterpillars eat. Therefore, Monarchs head south each fall, where they stand a better chance of survival as well as a chance to "return" to reproductive areas in North America and give rise to future generations of reproductive adults that can complete the annual cycle.

The "Methuselah generation" of butterflies emerging from their chrysalises at the end of summer (the end of August) possess a different physiology and behavior than do other generations: they do not develop sexually for several months, and become social (join in groups) as they migrate south.

Short days (with less than 12 hours of light) and autumn cold weather (less than 68 Farenheit degrees) are the cause: they diminish the production of the juvenile hormone that initiates sexual maturation.

These Methuselah Monarchs undertake their trip southward with fatty deposits in tow, stored during the larval phase. Along the journey, they add to their energy reserves by sipping nectar from flowers—all of which allows them to survive through hibernation when they do not eat.

All Roads Lead to Rome?

How does an insect weighing half a gram make it to its hibernation site after flying for over 3,000 kilometers? The Monarch butterflies that migrate southward in the autumn are guided by the sun's orbit as they travel through North America. Even on cloudy days they stay on track thanks to an internal biological compass that functions according to the movement of the sun.

Due to the presence of small quantities of magnetite in their thorax, it was previously believed that the Earth's magnetic fields determined Monarchs' migration route. However, recent studies have demonstrated that butterflies prefer to guide themselves based on the sun's location in order to reach their hibernation areas.

Adventures and Dangers on the Journey

The butterflies hibernating within Mexican forests begin to head south or southwest in September and early October from their summer breeding areas in southeast Canada and the northern and central United States. Dr. Taylor has carried out a massive study on Monarch movements in the United States (for details and routes, see the Monarch Watch website at www.monarchwatch.org).

Once the butterflies cross the Mexican border via the state of Texas, they change their southward course and fly parallel to the Sierra Madre Oriental mountains (Figure 9).

At the end of September, the first Monarchs arrive in Mexico via the northern states of Coahuila, Nuevo León and Tamaulipas. At the beginning of October, Monarchs can be seen passing through Coahuila, then through Zacatecas, San Luis Potosí, Aguascalientes, Querétaro, Guanajuato, and Jalisco. Reports tracking the migration through each site have documented that butterflies prefer to perch on the same individual trees year after year. The organization Profauna A.C. has

compiled information from multiple sightings through its Correo Real initiative (www.profauna.org.mx) that tracks the Monarchs' route in Mexico.

Figure 9. Map of the north-south migration.

At the end of October and the beginning of November, after traveling for two months, butterflies settle into hibernation colonies in the mountains of central Mexico, where the states of Mexico and Michoacán meet.

Other migratory routes with different destinations exist. One is used by Monarchs that live in the western Rocky Mountains in the United States and that hibernate in the central and southern coasts of California. A third route leaves the North American continent from Florida, travels across the Antilles, enters Mexico's Yucatán Península then continues through Central America towards the continent's southern cone; this route, however, contains no hibernation site.

The migration moves at a pace of about 75 kilometeres a day, though there are some butterflies that have flown up to 130 kilometers in a day (Figure 10).

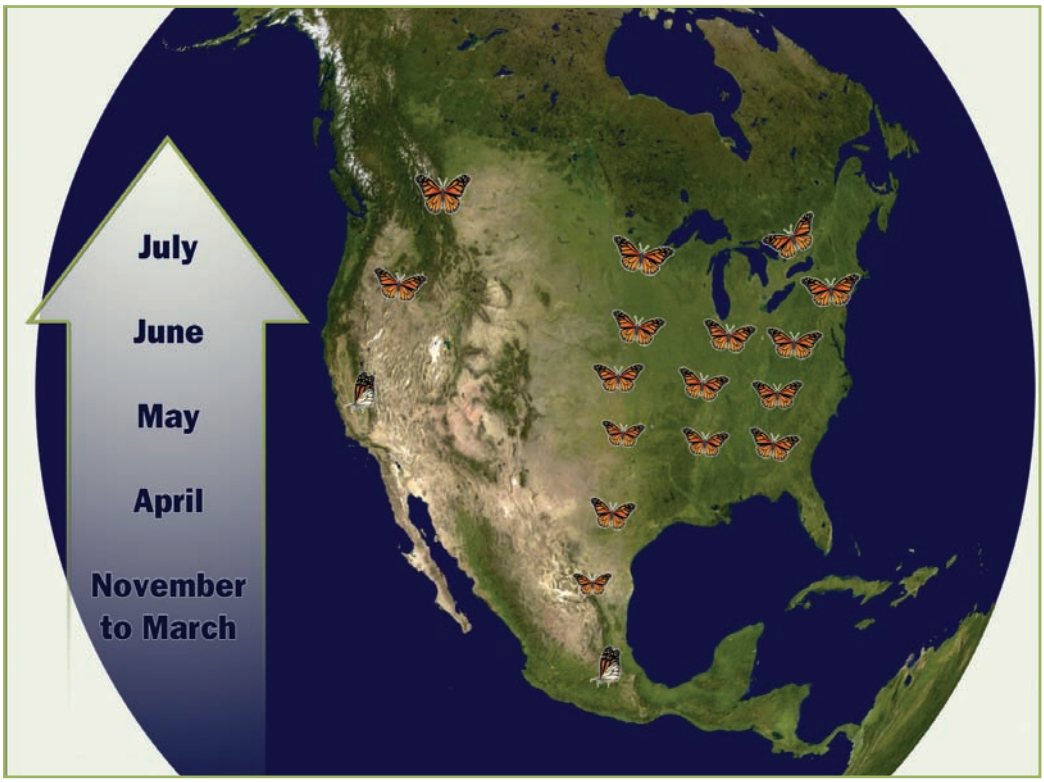


Figure 10. Map of the migration from south to north.

The Monarch is among the Earth's best glidders: throughout migration, it stores and replenishes energy every day by extracting the nectar from flowers it encounters along the way. Nevertheless, the butterflies also suffer from illnesses and infections that can be fatal, and must face other dangers including bad weather, predation by birds during hibernation, and large population losses due to winter storms.

North to South and Back Again

From mid-November until mid-February, the Monarchs' hibernation colonies remain relatively stable. They settle in the southwestern oyamel fir forests on slopes about 2,800 meters above sea level. During the

second half of February, when temperatures rise and humidity decreases in these forests, butterflies come down from the slopes and follow the direction of the brooks in search of more humid places. At the end of February, and in March, mating begins. Later in spring, the butterflies that have survived hibernation in Mexico head back towards the southern United States, traveling in the opposite direction from which they came.

Photo: L. Brower

Chapter III

The Winter Palace

Where do Monarch butterflies go during the winter? That was the question Frederick Urquhart spent his entire life pursuing. Dr. Urquhart was born on December 13, 1911, in Toronto, Canada, and was fascinated by butterflies from a very young age. That interest inspired him to study biology at the University of Toronto, where he excelled as a student and went on to receive his masters and doctorate degrees. Back then, little was known about the Monarch migration. Dr. Urquhart knew that thousands of Monarch butterflies flew south in September, but their ultimate destination remained a mystery.

Urquhart's first effort to track the Monarchs' migration route began in 1937, when he developed tiny labels for the butterflies' wings. He and his wife, Norah Patterson, used their house as a laboratory until he was offered a research position at the University of Toronto. In 1952, he founded an association to further Monarch migration studies and enlisted the support of thousands of volunteers to help tag butterflies. Among their discoveries were that Monarchs do not fly at night and that they can travel up to 130 kilometers in a single day! The Urquharts made numerous trips

following the southward migration from southern Canada to the Gulf of Mexico. In 1960, Dr. Urquhart published his now-famous monograph, "The Monarch Butterfly."

After almost 35 years of tireless efforts, the Urquharts published an announcement in a Mexico City newspaper seeking additional volunteers to help track Monarchs. In 1973, Ken Brugger—a 53-year old American in the textile business who had lived in Mexico since 1965—saw the note. Accompanied by his wife Catalina Aguado, Brugger set off on his motorcycle to track the butterflies. And on January 12, 1975, the Bruggers became the first to discover the Monarchs' hibernation areas in Mexico.

The first site they identified was Cerro Pelón (in the State of Mexico), followed by El Rosario and Chincua (in the state of Michoacán). Thanks to the Bruggers, Fred Urquhart finally got the chance in 1976 to see the hibernation areas he had spent nearly 40 years trying to find. In August of that year, Urquhart published an account of the discovery in National Geographic magazine without revealing the exact hibernation location. Dr. Urquhart passed away on November 3, 2002 at the age of 90.

The Hibernation Forests

The forests where Monarchs hibernate are part of Mexico's temperate ecosystems. The temperate forests are found in the high mountains of Mexico, including the Sierra Madres (Eastern, Western, and Southern) and the Transversal Volcanic Axis. The latter is a line of volcanoes stretching from coast to coast around the 19° parallel, including Orizaba Peak (5,650 m), Cofre de Perote (4,090 m), Malinche (4,460 m), Tláloc (4,150 m), Popocatépetl (5,450 m), Iztaccíhuatl (5,280 m), Nevado de Toluca (4,560 m), Nevado de Colima (4,340 m), and Tancítaro (4,160 m).

Northwest of the Nevado de Toluca are the Sierras de Chincua, El Campanario, and Chivatí-Huacal, whose northern portions reach the Mexican Plateau, and whose southern and western portions reach the Balsas river basin. These mountains are covered principally by oak forests (at an altitude of 2,900 meters above sea level), pine-oak and pine forests (1,500-3000 meters above sea level), and oyamel fir forests (2,400-3,600 meters above sea level). Other tree species include cedar (2,400-2,600 meters above sea level), as well as juniper thickets and meadows (Figure 11).

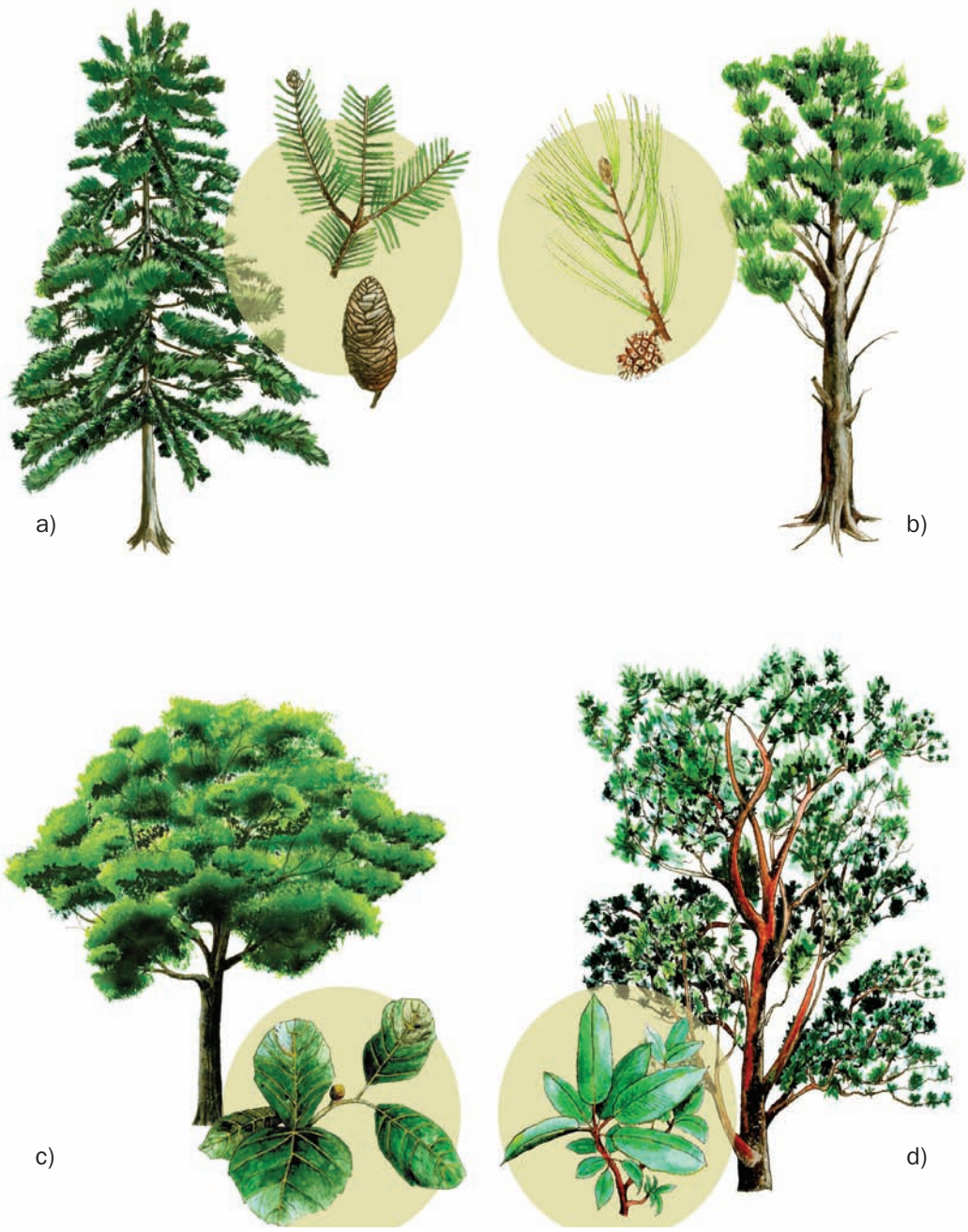


Figure 11. Dominant trees in the region: a) oyamel fir, b) pine, c) oak, and d) madrone.

Oyamel firs are only found in the highest mountains of Mexico, at altitudes between 2,400 and 3,600 meters, along slopes or in humid valleys. Oyamel fir forests may be limited to oyamels or may also include cedars, pines and oaks. The most common types of bushes are *Senecio*, *Eupatorium*, *Stevia*, *Baccharis* and *Archibaccharis*. Humidity within oyamel fir forests allows mosses and mushrooms to thrive on the forest floor, especially during the rainy season (Figure 12). These forests—thanks to "microclimates" (local environmental conditions) created by tree cover and forest structure—provide perfect spots for the migratory Monarchs' hibernation colonies. Environmental conditions within the forest—temperature, humidity, wind and sunlight—differ markedly from conditions outside the forest.

Figure 12. Various plants of the region: a) little broom, b) red myrtle, c) mosses and lichens, and d) mushrooms.

How Many Butterflies are There?

Once they reach the oyamel fir forests at the end of October and early November, the Monarchs cluster in different spots. At least 22 colonies of butterflies have been documented in the Monarch Butterfly Biosphere Reserve and surrounding areas. Nevertheless, only 12 of these areas are considered permanent colonies, five within the Reserve and seven in nearby areas.

Since the discovery of the Monarch colonies in Mexico, various attempts have been made to estimate total population numbers, although counting Monarchs has been extremely difficult due to the large number of butterflies. Since 1985, the common estimate had been 10 million butterflies per hectare, but a mass butterfly mortality event during the winter of 2001-2002 revealed that this figure seriously underestimated the actual number of Monarchs that hibernate in Mexico.

Determining the number of butterflies per hectare, however, is less important than understanding overall population trends. How do colonies change year to year? How does the size of colonies compare from one place to another? Answering these questions merely requires an index of relative abundance.

Since the 1980s, indirect measurements (indices) have been used to determine Monarch abundance, such as the surface area taken up by colonies or the number of trees occupied. These measurements are imperfect, as their relation to actual abundance may not be direct. For instance, some colonies can be densely populated but occupy very little space, whereas others can spread over large areas but be sparsely populated.

Similarly, all trees are not uniformly occupied. Some have trunks and branches covered with Monarchs, while others only contain a few. Even with its limitations, the measurement of total surface area occupied has been one of the most important and consistently applied methods, providing an overall view of changes in butterfly populations (Figure 13).

Monarch colonies in Mexico witness several phases of butterfly activity: arrival, occupation, movement, and dispersion. Measurements of total surface area occupied by Monarchs take place at the end of December, once colonies have been established. Throughout the 1990s, individual colonies occupied areas between 0.01 and 6.85 hectares, with

an average of 0.73 hectares. The colonies of Chincua and El Rosario in the state of Michoacán have consistently featured the largest areas covered by Monarchs.

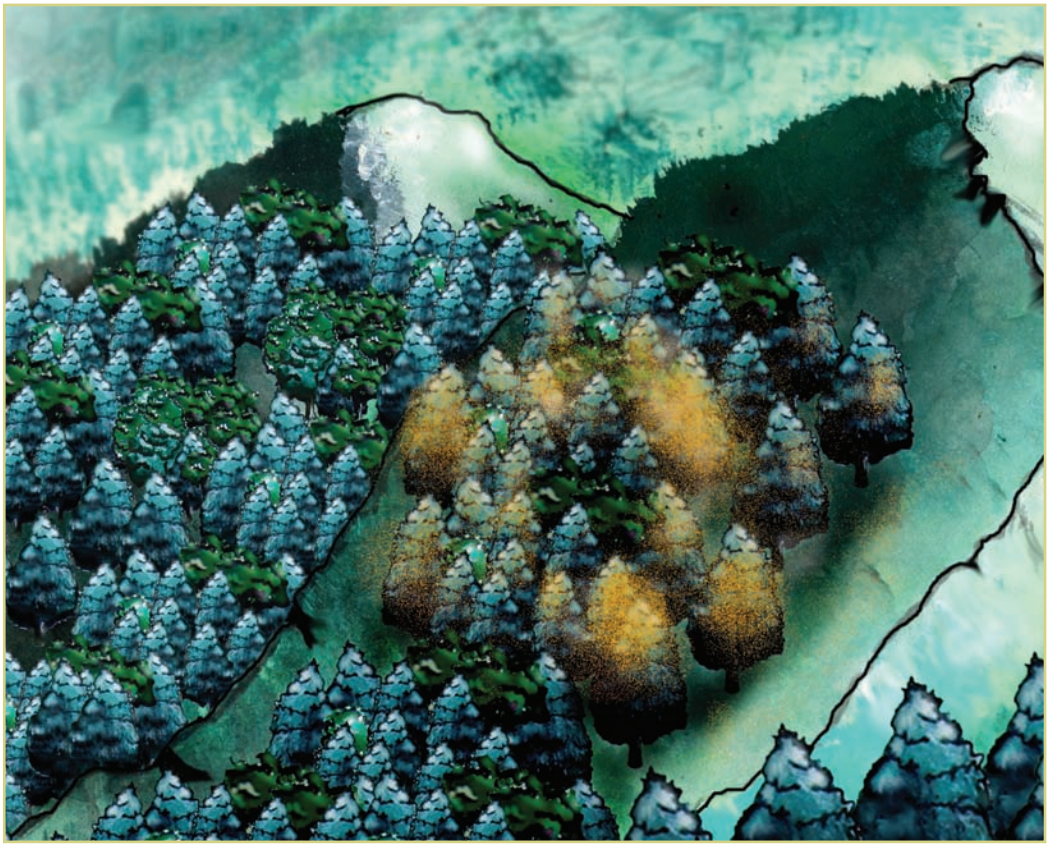


Figure 13. Monarch butterfly hibernation colony.

For annual comparisons of total butterfly abundance in December, the individual areas of all the colonies in hibernation spots are added together. Between 1993-1994 and 2006-2007, the total surface area covered by colonies has ranged from two to 20 hectares. The winter of 2004-2005 witnessed the smallest area covered by butterfly colonies since 1993, with a 77% average decrease from the winter of 2003-2004 (Figure 14).

What could cause the drastic changes in area occupied by Monarch butterflies hibernating in Mexico? Monarchs can be affected in several ways during their life cycle and migration. Despite their chemical

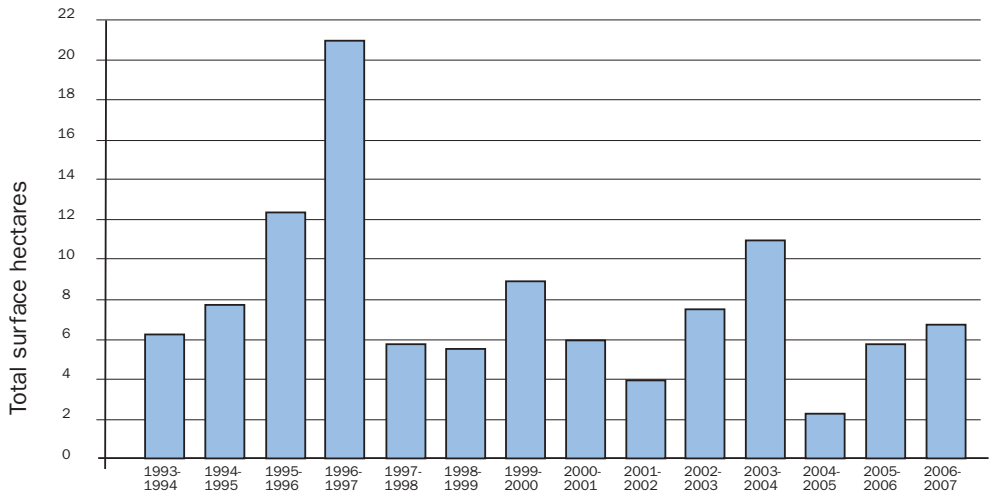


Figure 14. Total surface area of Monarch butterfly colonies between 1993-1994 and 2006-2007.

defenses, they face natural enemies throughout all of their diverse stages of development—from spiders and wasps to birds and mice that eat them. In addition, climatic conditions can severely affect the reproduction and survival of butterfly populations.

Other causes are directly linked to human activities. For instance, 90% of the Monarch population in the United States and Canada completes its life cycle in agricultural settings full of milkweed plants, the leaves of which are hosts to Monarch eggs and food source for larval caterpillars. But some agricultural zones have been transformed into towns, roads or shopping centers, destroying butterfly habitats. Moreover, farmers often use herbicides to eliminate milkweed plants, which they consider to be pesky weeds.

In recent years, the United States and Canada have increased the use of wide-spectrum extremely toxic herbicides (*Roundup*) to kill weeds. The use of these "super" herbicides is possible because more farms are planting crops highly resistant to these chemicals. But by reducing the amount of milkweed, these practices are also having an important negative effect on Monarch populations.

Monarchs have also suffered several high mortality events during their hibernation season in Mexico due to a combination of heavy rain

and extreme drops in temperature. Monarchs possess special substances in their blood that allow them to lower their tissue's freezing point, thus withstanding temperature decreases as low as 14˚C below zero—so long as there is no excess humidity in their bodies. When winter storms strike and butterflies are still wet from rains, the change in temperature can kill large portions of the population.

Events of this magnitude have occurred in recent decades, most recently during the winters of 2001-2002 and 2003-2004. Scientists believe that while death is part of the natural cycle, deforestation has diminished forest capacity to maintain the appropriate microclimate to protect Monarchs. Over the last decade in particular, deforestation and habitat degradation have negatively impacted various sanctuaries in the Monarch Butterfly Biosphere Reserve.

The Risks of Concentration

All species have diverse requirements during their life cycle, requirements that change during the various phases of growth, reproduction, gestation, dispersion, and survival. Resources required to meet migratory species' needs can be separated by a mere few feet or by hundreds of miles. A population's health is thereby affected by habitat quality conservation or deterioration across a broad geographic range. As such, the Monarch butterfly has been affected by the aforementioned pressures during all phases of its migratory journey—on its summer route through the United States and Canada, and during its winter migration period in Mexico.

The scales of change can be tipped more easily in certain places where most migratory populations are concentrated. As such, conservation of critical habitats for reproduction or survival is key to a population's future. Most Monarchs from

Figure 15. Butterfly colony.

eastern United States and southern Canada —scattered across thousands of square miles— cluster on relatively few hectares of forest within their Mexican hibernation areas. In the states of Mexico and Michoacán, the hibernation area consists of 10 to 12 areas that in total can cover up to 20 hectares. But the majority of hibernation areas do not even cover one hectare. In such areas where butterflies are so densely concentrated that tens of millions of Monarchs can be counted per hectare, the consequences of habitat loss or deterioration can be very serious (Figure 15).

As if that were not enough, these critical ecosystems are so fragile that the removal of only several key trees could modify the entire microclimate that butterflies have chosen after traveling thousands of kilometers. The density and structure of trees produce a sheltering environment with specific levels of temperature, humidity, wind, and other factors. Without these favorable conditions, butterflies are assaulted by a lethal combination of frosts and rainfall. In the words of Dr. Lincoln Brower, the forest simultaneously serves both as a "protective blanket and umbrella."

Living Together

The region's forests are home to a wide variety of animals typically found in temperate areas. Among the identified amphibian and reptile inhabitants are delicate salamanders (*Pseudoeurycea belli, P. robertsi*), unique axolotl salamanders (*Ambystoma rivulare*), tree frogs (*Hyla lafrentzi*), slippery lizards (*Sceloporus aeneus*), silent snakes (*Storeria storerioides*), and not so silent rattlesnakes (*Crotalus triseriatus*). Over 130 bird species also reside in these forests, including Green violet-ear and White-eared Hummingbirds (*Colibri thalassinus, Hylocharis leucotis*), the American Robin *(Turdus migratorius*), Grey-barred Wren (*Campylorhynchus megalopterus*), Long-Wood-Quail (*Dendrortyx macroura*), American Kestrel (*Falco sparverius*), Sharp-skinned Hawk (*Accipiter striatus)*, Cooper's Hawk (*Accipiter cooperi*), Red-tail Hawk (*Buteo jamaicensis*), Turkey Vulture (*Cathartes aura*), Hairy Woodpecker (*Picoides villosus),* Western Bluebird (*Sialia mexicana),* Slate-throated Redstart (*Myoborus miniatus*), Brown-backed Solitaire (*Myadestes occidentales),* Wilson's Warbler *(Wilsonia pusilla),* Red Warbler (*Ergaticus ruber*), Ruby-crowned Kinglet *(Regulus calendula),* Blue

Figure 16. Some birds of the region: a) American Robin, b) Grey-barren Wren, c) Long-tailed Tree-Quail, and d) Red-tail Hawk.

Mockingbird *(Melanotis caerulescens),* Black-headed Grosbeak (*Pheuticus melanocephalus*), and Black-backed Orioles (*Icterus parisorum, I. abeillei*) (Figure 16).

It is common to find the mounds of pocket gophers (*Pappogeomys spp.),* unmistakable droppings of rabbits *(Sylvilagus floridanus*) and gnawed pine cones indicating the presence of squirrels (*Sciurus aureogaster*). Some mammals are harder to detect due to their small size, such as tiny shrews (*Sorex saussurei*) and mice (*Peromyscus aztecas*, *P. maniculatus*, *Reithrodontomys chrysopsis, Microtus mexicanus*). And others are often

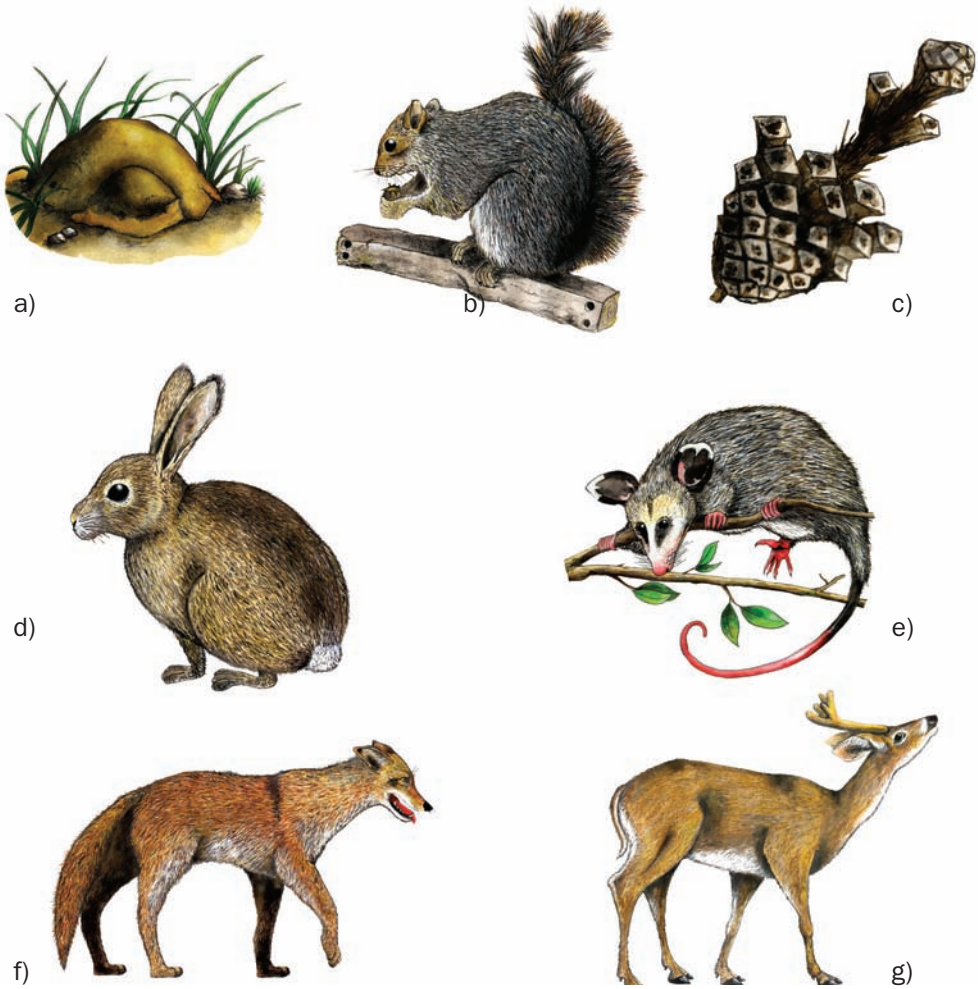


Figure 17. Various fauna and signs of their presence: a) pocket gopher, b) squirrel, c) gnawed pine cone, d) rabbit, e) opossum, f) coyote, and g) deer.

missed because they are nocturnal, such as opossums (*Didelphis virginiana*), armadillos (*Dasypus novemcinctus*), skunks (*Mephitis macroura*), and bats (*Pteronotus parnelli, Glossophaga mexicana*). Only rarely does one see coyotes (*Canis latrans*), deer (*Odocoileus virginianus*), or bobcats (*Lynx rufus*), all heavily hunted animals (Figure 17).

These species and many other invertebrates contribute to maintaining a healthy forest by recycling organic material, pollinating flowers, and scattering seeds. Mice and squirrels, for instance, often scatter mushroom spores that nourish the secondary roots of coniferous (cone-

bearing) trees (pines and firs). Without mushroom filaments, conifers cannot obtain the nutrients from the forest floor that they require for healthy growth. The mushrooms produce underground fruits with a strong scent that attracts rodents. Rodents pick at them, eat them, and scatter them widely, in turn fertilizing large parts of the forest. Through such ecological interactions, all the forests' species play important roles in maintaining forest health .

The Region's Unique Flora and Fauna

The mountains of the Transversal Volcanic Axis function like islands, since their highlands feature temperate ecosystems while the lowlands consist of dry, tropical ecosystems. Large portions of the lowlands have already been replaced by agriculture, cattle ranches or towns, contributing to an ever-greater isolation of local fauna and

a)

b)

Figure 18. Examples of endemic species: a) the Red Warbler and b) the Metorito vole.

flora. Isolation patterns over time have led to the evolution of unique or "endemic" species found only in small areas of Mexico.
Some of the species with limited distribution found in the Monarch region include a local maple (*Acer negundo* var. *mexicanum*), the Tarasco pine (*Pinus martinezii*), a species of axolotl salamander (*Ambystoma rivulare*), various other salamanders (*Pseuroerycea belli, P. robertsi*), the Mountain Amethyst-throated Hummingbird (*Lampornis amethystinus*), the Strickland Woodpecker (*Picoides stricklandi*), the White-striped Woodcreeper (*Lepidocolaptes leucogaster*), Grey-barred Wren (*Campylorhynchus megalopterus*), the Red Warbler (*Ergaticus ruber*), and the Metorito vole (*Microtus mexicanus*) (Figure 18).

Threatened and Endangered Neighbors

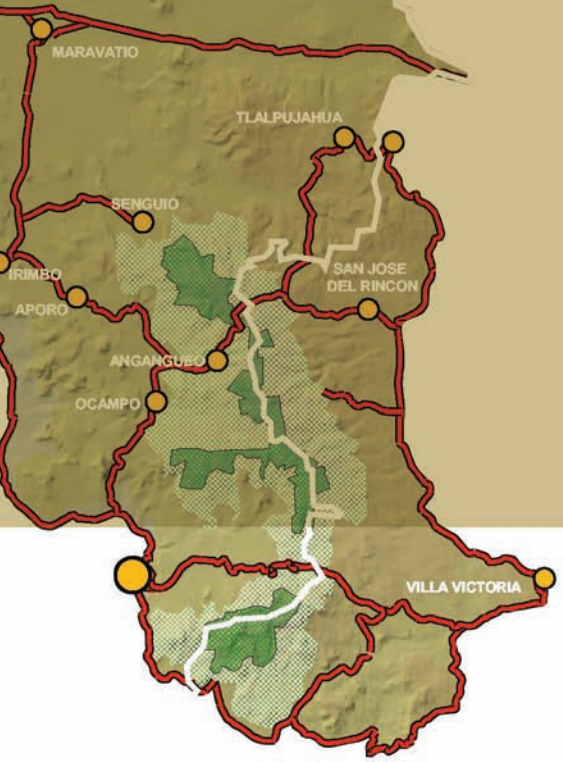
Monarch butterflies are not in danger of disappearing as a species, as their extensive distribution is not restricted to Mexico or even to the American continent. What is at risk, however, is the Monarchs' marvelous migratory phenomenon, a process with features that are totally unique in the entire animal kingdom. In fact, since 1983 the World Conservation Union (IUCN) has included the Monarchs' migration phenomenon in its **Threatened** category.

Other species of flora and fauna within the region are also considered to be at risk according to the Mexican Official Regulation (NOM-059-ECOL-2002), which classifies species as being either Endangered, Threatened, or Subject to Special Protection according to degree of risk. Species included in the regulation are subject to legal protection, and their capture or harvest requires special permits. The regulation also protects the habitats where such species live.

Species listed as **Subject to Special Protection** include: local maple (*Acer negundo mexicanum*), juniper (*Juniperus monticola*), gentian (*Gentiana spathacea*), Tarasco pine (*Pinus martinezii*), madrone (*Arbutus occidentalis*), Monarch butterfly (*Danaus plexippus*), Axolotl (*Ambystoma rivulare*), Scaly lizard (*Sceloporus grammicus microlepidotis*), Sharp-shinned Hawk (*Accipiter striatus*), Harris Hawk (*Parabuteo unicinctus*), Peregrine Falcon (*Falco peregrinus*), Long-tailed Wood-Quail (*Dendrortyx macroura*), and Diminutive woodrat (*Nelsonia neotomodon*).

Threatened species include Fly Agaric mushroom (*Amanita muscaria*), various other mushrooms (*Boletus edulis, Morchella conica, M. elata, M. esculenta*), American hornbeam (*Carpinus caroliniana*), and Pine-oak and Roberts' False salamanders (*Pseudoeurycea belli,* and *P. robertsi*) (Figure 19). The Sirimbo tree (*Tilia mexicana*) has been identified as **Endangered**.

Figure 19. Pine-oak salamander, threatened.



Chapter IV

Conserving Forests Benefits Us All

Conserving forests in the Mexican Monarch butterfly region provides local, regional, national, and international benefits. In addition to providing important present and potential economic benefits to the region's local communities and landowners (including through tourism), the conservation of these ecosystems is vital to the survival of many species of flora and fauna. It is also key to maintaining critical ecological processes and delivering environmental services such as abundant clean water and erosion prevention, services that rural populations throughout the watersheds depend on every day. Forests act as water factories, allowing precious water to be captured and delivered to towns within the region, including the cities of Toluca and Mexico City.

In addition to preserving biodiversity, forest ecosystems also deliver important global environmental services, including keeping large amounts of carbon dioxide, a major contributor to global warming, stored in trees and out of the atmosphere. They also play an important role in contributing to local and national economic growth. And they help to fulfill our spiritual and recreational needs. Yet since the 1950's we have reduced the quantity and quality of these forests.

As the main agents of forest loss and transformation in the Monarch butterfly region, we have changed the forest significantly through illegal logging, forest fires, overgrazing, and agricultural expansion.

Despite a wide array of conservation efforts, the region's trees have gradually been disappearing since 1970 due to the advance of agriculture and uncontrolled, excessive timber harvesting. Because of illegal logging, land use changes, and overexploitation of wood resources, the region's environmental health is now considered to be in critical condition.

The populations of some insects and other organisms—normally integral to a forest's natural functions—may explode due to human-induced forest degradation, turning them into major pests. Among such species are insects that prey on pines (*Dendroctonus mexicanus, D. adjunctus, D. parallelocollis, D. valens and Ips spp.*), those that peel away at oyamel bark (*Scolytus aztecus, Pseudohylesinus variegatus*), those that bore into tree buds (*Eucosoma sonomana, Rhyacionia frustrana*), burrowing pitch moths (*Synanthedon cardinalis*), pine defoliators (*Neodiprion vallicola*), cone beetles (*Conophthorus spp.*), and parasitic plants such as the Dwarf Mistletoe (*Arceuthobium globosum*) and the True Mistletoe (*Psittacanthus spp.*).

The main factors affecting the region's Monarch butterfly forests are, in order of importance: illegal logging by people from outside or within the region; legal timber harvesting that is poorly implemented; forest fires; and forest conversion for agriculture. Less obvious but nonetheless significant are activities like the harvesting of moss and mushrooms and overgrazing by sheep and cows. These activities affect forest composition, causing some types of bushes and herbs to increase and others to diminish—and thus triggering changes that can affect the ability of certain tree species to regenerate. Predation by wandering domestic dogs can also affect many wildlife species from squirrels to deer.

Finally, the impact of badly planned tourism in some of the sanctuaries is taking an increasing toll. Overuse of horses and the lack of clearly defined trails affect forest quality and lead to soil erosion. Moreover, some species with bur-like seeds (such as the shrub *Acaena elongata*) are hitching rides on people, cattle, sheep, and horses and spreading throughout the forest understorey. The overabundance of these species can also affect forest regeneration.

Local Populations: The Monarchs' Greatest Allies

More than 780,000 inhabitants reside within the 10 municipalities that comprise the Monarch Butterfly Biosphere Reserve, concentrated in the town centers of Angangueo, Contepec, Ocampo, Zitácuaro, Donato Guerra, San José del Rincón, and Villa de Allende. The indigenous groups represented by the Mazahua and Otomí communities make up one-fourth of the population (Figure 20).

Figure 20. Area residents play the most important role. Photo: Monarch Butterfly Biosphere Reserve.

The predominantly rural population is highly dispersed. More than half of the villages are made up of less than 100 inhabitants. On average, families have five children. The regional economy, formerly based on mining and forestry, currently faces job shortages that encourage many inhabitants to migrate seasonally. Illiteracy is high. Services are concentrated within town centers. Many villages lack electricity and water and must use firewood as their main source of fuel. The dominant economic activities are agriculture, cattle raising (cows and sheep), and forest activities. Agriculture is both seasonal (rain-fed) and irrigated. The

main seasonal crop is corn, and irrigated land produces wheat, oats, beans, avocados, peaches, potatoes, and peas. Some families grow vegetables and fruits in their backyards. Recently, the commercial cultivation of flowers using greenhouses has increased substantially.

Some communities have practiced forest management. The main species harvested are pines, oyamels, cedars, junipers, and oaks to produce pulp and firewood, as well as sawnwood, packing boxes, flooring, paneling, wardrobes, tables, chairs and other furniture, tool handles, toothpicks, and tongue depressors.

Many inhabitants of the region currently benefit from Monarch butterfly tourism. During the hibernation season, people from local communities and nearby towns receive income from lodging and tourist transportation services, hibernation colonies visitor fees, and the sale of handicrafts and food. Given the region's many other attributes and attractions, tourism could also provide an important source of revenue, even during the months when the Monarchs are not present. The area's beautiful landscapes and forests can be enjoyed year-round for day trips, camping, or stays in area cabins.

Forest conservation is critical to maintain suitable conditions for the Monarch butterfly hibernation and to ensure the survival of the important tourist industry associated with the remarkable phenomenon. But the butterflies are not the only reason to conserve forests; conserving forests produces numerous other benefits for everyone.

Protecting the Sanctuaries

The 1976 discovery of the Monarch hibernation areas sparked considerable interest in protecting North American Monarchs' overwintering grounds in Mexico (populations that migrate to the western United States and that spend winters along the California coast are far less numerous). Since then, three protection decrees have been enacted. The first decree (Reserve and Wildlife Refuge Zones, 1980) protected the hibernation areas without specifying the locations to be conserved and restricting extractive activities only during the hibernation season (from November to March).

The second decree (1986) tried to improve the situation by defining five isolated areas for protection along the border of the states of Mexico

and Michoacán, amounting to 16,110 hectares: Cerro Altamirano, Sierra Chincua, Sierra El Campanario, Cerros Chivatí-Huacal, and Cerro Pelón. Together these five areas were called the Special Monarch Butterfly Biosphere Reserve. Biosphere Reserves are a special category of protected area that include core and buffer zones. Extractive activities are banned in core zones, while sustainable activities are permitted within the surrounding buffer zones. The group of core zones totaled 4,491 hectares while the buffer zones added up to 11,619 hectares. The communities that own the forests rejected the imposition of this decree, however, setting forest fires in protest.

In 1996, the category of Special Biosphere Reserve was annulled, after which the five affected areas adopted a new name for the group: the Monarch Butterfly Natural Protected Area. In 1997, the North American Monarch Butterfly Conference was held in Morelia, Michoacán to discuss Monarch butterfly and habitat conservation within a trinational cooperative framework. The meeting included representatives of local *ejidos* (large tracts of land that are jointly owned by their residents) and communities affected by the decree that had opposed previous efforts within the protected area. Also represented were conservation and educational organizations that opposed the five-sanctuary plan for not going far enough to ensure Monarch conservation. To reach an agreement, it was proposed that the Reserve design be improved, the protected area be enlarged, and economic incentives be put into place for affected ejidos and local communities.

The third and most recent decree (2000) established the Monarch Butterfly Biosphere Reserve, with three core zones and two buffer zones that cover a total area of 56,259 hectares. This reconfiguration resulted from a proposal developed by a collaborative effort of several institutions headed by the Mexican Ministry of Environment, Natural Resources and Fishing (SEMARNAP) and WWF. The new Reserve united all five areas protected in the previous decree to ensure better protection of the area's ecological processes. The Reserve extends along the border of the states of Michoacán and Mexico and includes the municipalities of Temascalcingo, San José del Rincón, Donato Guerra, and Villa de Allende (in the State of Mexico) and Contepec, Senguio, Angangueo, Ocampo, Zitácuaro, and Áporo (in the state of Michoacán). Geographically it is located between 19º 59′ 42″ and 19º 18′ 32″ northern latitude and 100º 09′ 54″ and 100º 06′ 39″ western longitude (Figure 21).

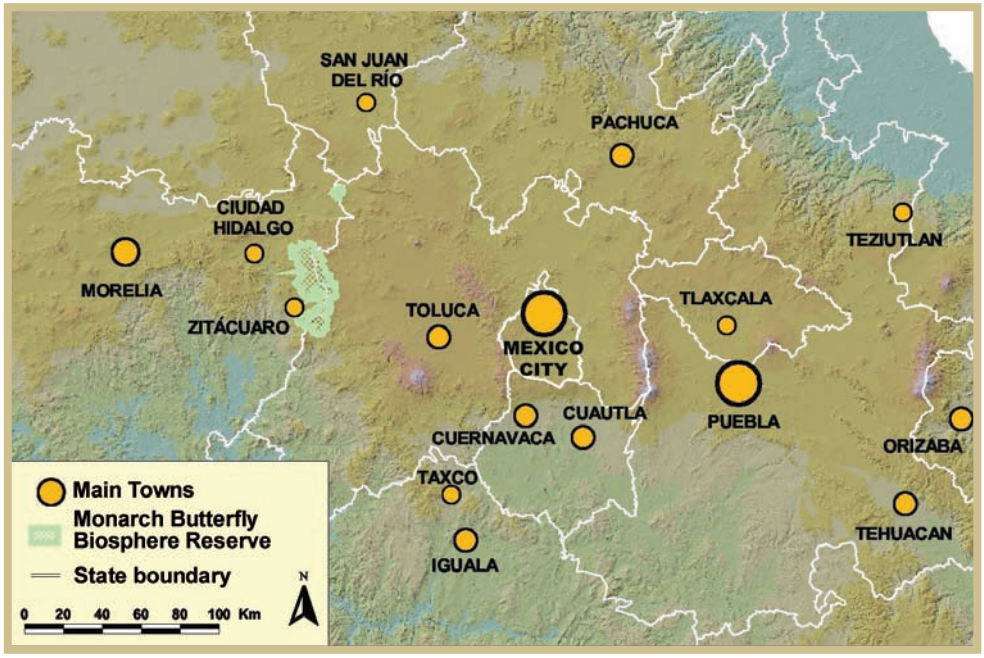


Figure 21. Location of Biosphere Reserve in the Transverse Neovolcanic Axis.

The three core zones (13,551 ha) encompass most of the butterflies' critical habitat. The northern core zone (588 ha) includes Cerro Altamirano (3,320 m altitude); the central core zone (9,671 ha) includes Sierra de Chincua, Sierra El Campanario (3,640 m altitude), and Sierra de Chivatí-Huacal (3,180 m altitude); the southern core zone (3, 339 ha) includes Cerro Pelón (3,500 m altitude). The core zones include part of the property of 38 communities in the States of Mexico and Michoacán and are surrounded by buffer zones that provide connectivity. Because the core zones allow only conservation and research activities, logging permits within 17 territories were rescinded. Incorporating lessons learned, this 2000 decree improved upon weaknesses in previous design and featured a provision for the participation and compensation of local communities which had been left without logging rights (Figure 22).

The mission of this Reserve—administered by the National Commission of Natural Protected Areas (CONANP) of the Mexican Ministry of Environment and Natural Resources (SEMARNAT) —is to establish strategies and natural resource management plans that ensure forest conservation and the maintenance of the environmental conditions needed by Monarchs for hibernation and reproduction.

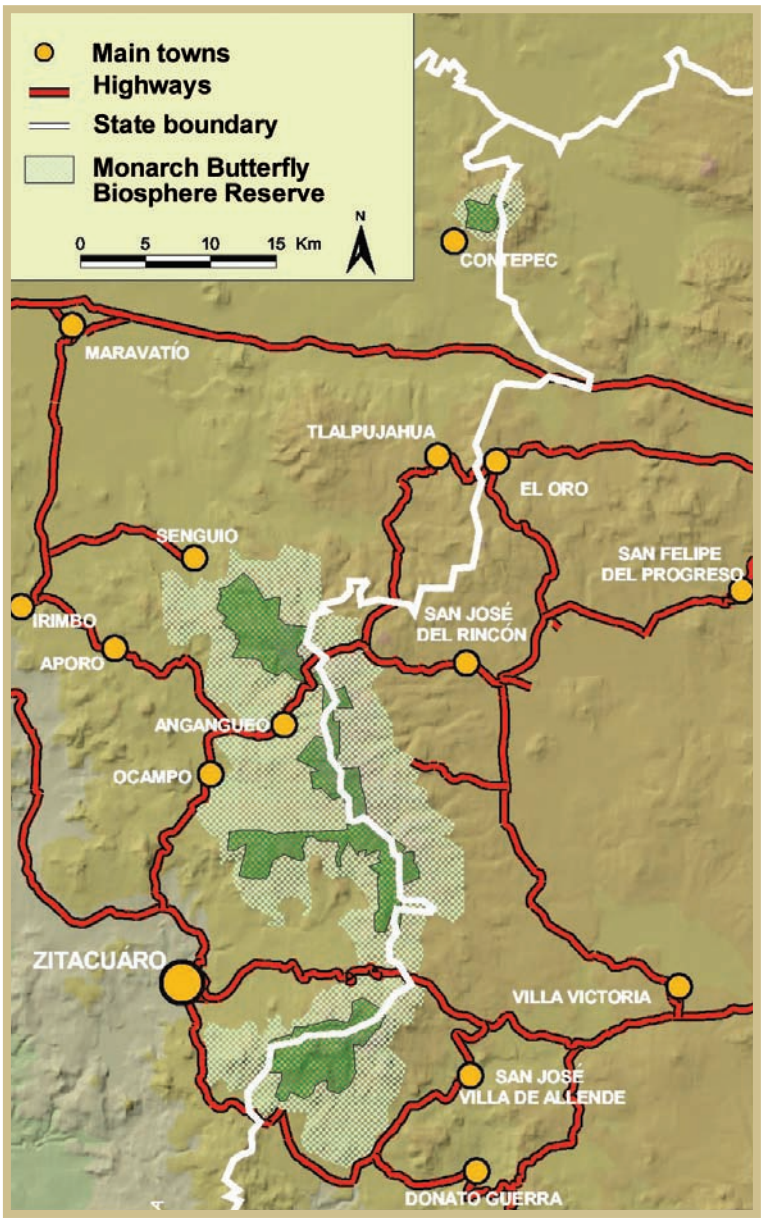


Figure 22. The Biosphere Reserve and its core zones.

The director of the Reserve regulates activities within the protected area and works with regional stakeholders to promote sustainable resource use. The Reserve is highly complex since it includes 93 owners—59 ejidos, 13 indigenous communities, and 21 small private properties (Figure 23).

Figure 23. Local communities participate in conservation efforts.
Photo: Carlos Galindo-Leal

The Monarch Fund

As part of the negotiations to establish the Monarch Butterfly Biosphere Reserve in 2000, an economic incentive system was set up under the auspices of the Monarch Butterfly Conservation Fund. A unique conservation mechanism in Mexico, the Fund was created as part of the proposal to enlarge the Reserve's protected area. Its two main objectives are: 1) to support the redefinition of Monarch Butterfly Biosphere Reserve boundaries; and 2) to encourage forest protection through economic incentives to local communities that own land in the Reserve. Today, 32 of the 38 communities in the Reserve's core area are involved in the Fund and the remainder have expressed interest in participating (Table 1).

Table 1. Land units in the Core Zone and their participation in the Monarch Fund

I.C.= Indigenous community, P.P.= Private property, Fr.= Fractions. The numbers represent approximate area in hectares. Federal property amounts to approximately 593 hectares.

	State of Mexico	Area (ha)		Michoacán	Area (ha)
Monarch Fund Participants					
1	Ejido La Mesa	726	1	I.C. Nicolás Romero	1,007
2	Ejido El Capulín	701	2	I.C. Donaciano Ojeda	697
3	I.C. San Pablo Malacatepec	117	3	Ejido Contepec	464
4	Ejido El Depósito	311	4	Ejido Nicolás Romero	455
5	P.P. Los Saucos	304	5	Ejido Senguio	439
6	P.P. Rancho Verde	303	6	I.C. Francisco Serrato	241
7	P.P. Cañada Seca	204	7	Ejido El Calabozo Fr. 1	272
8	Ejido San Juan Xoconusco	168	8	I.C. Curungueo	299
9	Ejido Mesas Altas Xoconusco	165	9	Ejido El Asoleadero	288
10	State Property	113	10	Ejido El Calabozo Fr. 2	352
11	Ejido Pueblo Nuevo Solís	110	11	Ejido Hervidero y Plancha	272
12	Ejido Cerrito Cárdenas	14	12	Ejido Cerro Prieto	242
			13	Ejido Chincua	182
			14	Ejido Jesús de Nazareno	171
			15	Ejido Santa Ana	134
			16	Ejido Los Remedios	119
			17	I.C. Carpinteros	106
			18	I.C. San Felipe los Alzati	55
			19	Ejido Rincón de Soto	32
			20	Ejido El Rosario	846
	Subtotal	**3,236**			**6,673**
Not Yet Participating in the Monarch Fund					
1	P.P. Monte de Catingo	89	1	I.C. Crescencio Morales	2,150
2	P.P. Catingo Fr. 3 y 4	71	2	I.C. San Cristóbal	281
3	Ejido Rosa de Palo Amarillo	48			
4	P.P. Catingo Fr. 1 y 2	47			
	Subtotal	**255**			**2,431**
	Total	**3,491**			**9,104**

The Monarch Fund received initial funding from a private United States foundation, the Mexican Government, and the state governments of Mexico and Michoacán. Grants are awarded to communities and landowners in the core area that honor their commitment to protect and participate in efforts to advance forest conservation on their properties.

The Monarch Fund—jointly managed by WWF and the Mexican Fund for the Conservation of Nature (FMCN)—features a multisectoral Technical Council that includes representatives of communities, of the state governments of Mexico and Michoacán, and of nongovernmental organizations. The Council meets every six months to review compliance with the agreements.

Every June, the Council reviews the annual forest monitoring findings based on aerial photography, satellite imagery, and site verification in the core areas. Economic incentives are granted to landowning communities that have complied with their commitments to refrain from cutting down trees. Such meticulous environmental monitoring within Mexico is unique to this Biosphere Reserve (Figure 24).

In November, the Council reviews the record of owners' participation in various forest conservation efforts (monitoring, fire prevention, watershed management and restoration) and delivers additional economic incentives (more modest than those awarded in June) to those who have actively participated in these activities. Since the Monarch Fund was created, approximately 1.8 million dollars have been granted to communities in incentives for forest conservation.

Although the Monarch Fund is relatively young, it has achieved impressive results. Its first victory came through participation in negotiations to enlarge the Reserve from 16,110 to 56,259 hectares. The Fund has also helped to halt environmental deterioration by keeping forests intact where individuals once held logging permits and helping to bring economic value to conservation activities in the process. Moreover, it has strengthened the hand of the Biosphere Reserve director, solidifying his regional position as a legitimate environmental authority locally and in the eyes of the international community. The implementation of the Monarch Fund has brought together communities, promoted better understanding of the region's diverse economic and social challenges, and strengthened the management capacity of local residents.

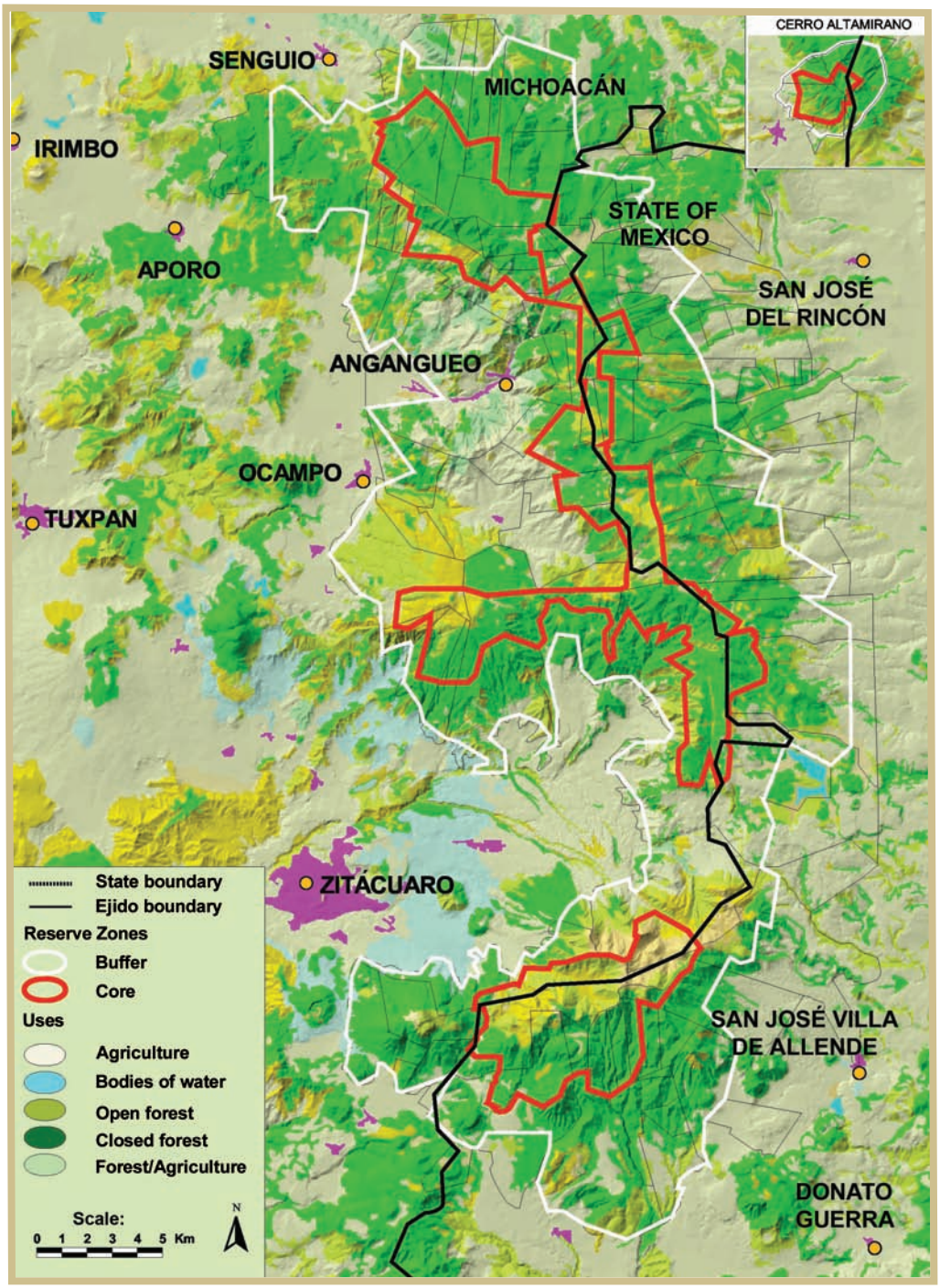


Figure 24. Vegetation in the Monarch Butterfly Region today.

Seeing the Forest through the Trees

Decisions to award economic incentives require verification that communities have complied with their commitments. During the first two years, incentives were granted in good faith and by common consent. Then in 2003, WWF—with the support of the Institute of Geography of the Autonomous National University of Mexico (UNAM) and of the Center for Conservation Biology (CCB) of Stanford University in California—launched a systematic forest-monitoring program in the core zone using aerial photography and satellite imagery to analyze changes due to logging.

While forest monitoring has revealed that most communities are complying with conservation agreements on their properties, it has also revealed the presence of logging in both buffer and core zones of the Reserve. Illegal logging poses new challenges for the Monarch Fund and for everyone interested in conserving the spectacular migratory phenomenon of the Monarchs.

How can the Monarch Fund stop and prevent forest exploitation in core and buffer zones? How can it distinguish between logging by landowners and that of third parties? How can it create even more incentives for communities to protect their forests through economic alternatives and innovative income-generating projects that provide concrete benefits in the short and medium term? These are some of the complex challenges that the Monarch Fund must confront and overcome.

Let's Join Our Wings: the Monarch Forum

Although numerous conservation initiatives exist—by towns and cities, states, nations, and by national and international non-governmental organizations—no single effort has been able to stop deforestation and environmental degradation within the Monarch butterfly region. Each of the institutions involved in the area brings strengths and weaknesses, making regional coordination indispensable to produce the kinds of synergies needed to create lasting and effective change.

Governmental agencies lend important support to the area's communities through programs and projects. But the most effective solutions to save the Monarch butterfly habitat must come through regional integration and coordination of conservation and development initiatives.

Moreover, the scale of action will have to be expanded if efforts are to succeed. In recent years, conservation activities have focused mainly on the core zones of the Monarch Butterfly Biosphere Reserve. While these are certainly the most important areas for butterfly hibernation, human pressures on butterfly habitats stem from regional socioeconomic challenges and human settlements outside the protected areas.

To prevent the harmful impact of illegal logging, land use changes, and uncontrolled urban expansion, it is imperative to think and act on a wider scale beyond the boundaries of the Reserve.

In 2004 the First Monarch Butterfly Regional Forum was organized by SEMARNAT, the state governments of Mexico and Michoacán, the Monarch Butterfly Biosphere Reserve, and WWF with support from Telcel. This periodic event was set up to foster coordination and collaboration among many stakeholders, to identify conservation and development priorities, to promote institutional transparency, and to build awareness about current challenges and opportunities for problem solving (Figure 25).

Figure 25. Symbol of the Monarch Forum.

The Forum featured 300 participants from local communities, government and non-governmental institutions, and the scientific community (Figure 26). The Forum's 10 working groups identified thematic and geographic priorities in the following areas: Community Strengthening, Law Enforcement, Protected Area Management, Land Use Planning, Forest Inventory, Income-generating Projects, Tourism, Environmental Education, Research, and International Coordination. A major conclusion of the Forum was that stopping illegal logging in the Reserve should be a top priority.

Figure 26. Working groups of the Monarch Butterfly Forum. Photo: Carlos Galindo-Leal

In every Forum (2004, 2005, 2006 and 2007) there has been participation and support from the Governors of the States of Mexico and Michoacán, as well as the Ministry of Environment. In 2006 the ambassador of the United States to Mexico participated as well.

To improve communication among the diverse participants, a website was designed (see www.foromonarca.net), which includes the Forum's objectives, participant contact information, meeting minutes, presentation

transcripts, and Memoirs of the First Forum. Details from the second Monarch Forum, held in 2005 in Morelia, Michoacán, and the third Monarch Forum, celebrated in 2006 in Temascalcingo, State of Mexico, are also available on the website. The success of the Forum in halting forest loss and contributing to regional sustainable development depends on the active participation of everyone.

Papalotzín: Flying with the Monarchs

Papalotzin—meaning "small butterfly" in the indigenous language Náhuatl (*Papalotl* meaning butterfly and *tzin* meaning tiny)—is the name that Francisco "*Vico*" Gutiérrez gave to his ultralight glider. Designed to look like a gigantic Monarch butterfly, the plane followed the Monarchs' migration in 2005 from Canada to the overwintering sanctuaries in Mexico (Figure 27). The goal of this incredible journey was to raise awareness throughout the world about the marvelous migratory phenomenon of the Monarchs and the adventures they face en route to their Mexican sanctuaries.

Figure 27. The ultralight Papalotzin. Photo: Andrew Donaldson

Born in Mexico City, Vico is a pioneer in hang gliding, paragliding and ultralight gliding and has been flying since he was 13 years old. Over the past 30 years he has traveled throughout Mexico, piloted Mexico's free flight team, and participated in more than ten world championships. Vico teaches free flight and ultralight gliding in Valle de Bravo and frequently shoots footage from his ultralight craft for commercial, documentary, and feature films. The proximity of his residence in Valle de Bravo to the Monarch butterfly colonies and his love of flight and adventure have only solidified his commitment to help conserve the marvelous Monarch migration. The Monarch symbolizes the interconnection of ecological processes over continental distances and the importance of conservation to our quality of life.

One of the products of Papalotzin journey is a video featuring the natural history of the Monarch butterfly, the migration from Canada to Mexico and the challenges to conserve this unique phenomena. You can obtain a video of this fantastic journey at www.papalotzin.com.

Chapter V

Paying a Visit to the Monarchs

You Are Part of the Legend

Step into the forest world of the Monarchs and you too can be transported into a magical, mythological world right out of Greek legend. As stewards of the planet, we can actively help the princess descendents of *Danaus* to fulfill their marvelous, timeless destiny to entertain and inspire. Together we can preserve the saga of *Danaus* and his daughters, honoring the Monarchs' tireless determination to undertake their long journey anew. We can ensure that our children have the chance to witness each phase of Monarch growth unfold, and to experience the murmur created when millions of these luminous, tiny colossuses collectively flutter their wings. We will assure the Monarchs' future if our conscience guides us to do so, if we open our hearts and help to conserve the sanctuaries that make their marvelous migration possible.

Visiting Season

The Monarchs' hibernation sanctuaries in the states of Mexico and Michoacán open to tourists the last week of November, once butterflies are almost fully established in the colonies. Thereafter, visitors can enjoy

the spectacular display until March. In December and January—when stable colonies have been established—the butterflies remain practically motionless in the trees' branches. Visitors can witness a tapestry of Monarchs flowing through the trunks and branches of the oyamel fir trees, with butterflies resembling dry leaves that resist falling to the ground.

During February and March, Monarchs approach reproductive maturity as temperatures rise, flutter away from the branches, and begin to perform an amazing show: millions of butterflies fly like clouds, shadowing the sky and filling the forests with the remarkable sound—a whisper of thousands of voices caused by the fluttering wings of so many butterflies that, miraculously, manage never to collide.

At the end of the hibernation stage during the second half of February, the butterflies begin to mate in Mexico, a phase that concludes in the spring when the females lay eggs in the southern United States. It is during this time, and even during their departure in March, that one can observe the remarkable "wedding flights." Once the male has mated, he flies off accompanied by his consort. Their nuptial acrobatics end up resembling a lovers' quarrel, in which the female seems intent on avoiding the male and hindering further reproductive activity—evoking the flight of the 50 daughters of Danaus as they were pursued by the 50 sons of Aegyptus.

How to Get There

The Monarch Butterfly Biosphere Reserve features four sanctuaries (El Rosario and Sierra Chincua in the State of Mexico, and Cerro Pelón and La Mesa in the state of Michoacán) that are open to the public and accessible by car or bus. If driving on your own from Mexico City, head towards Toluca (within the State of Mexico) until you reach Highway 15 (Carretera Federal No. 15). Take Highway 15 towards Morelia until you arrive to Zitácuaro, from which both El Rosario and Sierra Chincua butterfly sanctuaries can be easily reached (Figure 28).

To reach La Mesa and Capulín sanctuaries, take Highway 15 (Toluca-Morelia) until you come to Villa Victoria. From Villa Victoria, look for signs for the road to El Oro. Follow that road for approximately 25 km to the entrance of La Mesa sanctuary. To visit the Capulín Sanctuary, take Highway 15 past Villa Victoria for 15 km until you get to Miguel Alemán monument, then take the road towards Valle de Bravo. After another

20 km, look for a road to turn right towards the city of Donato Guerra, just after which you will reach the Capulín Sanctuary. From Morelia in Michoacán, take Highway 15 towards Queréndaro and Ciudad Hidalgo. About 9 km before Zitácuaro you will see signs for a road toward the Michoacán butterfly sanctuaries (El Rosario and Sierra Chincua). To visit La Mesa and Capulín sanctuaries in the State of Mexico, you must travel through Villa Victoria and Zitácuaro, respectively (see paragraph above).

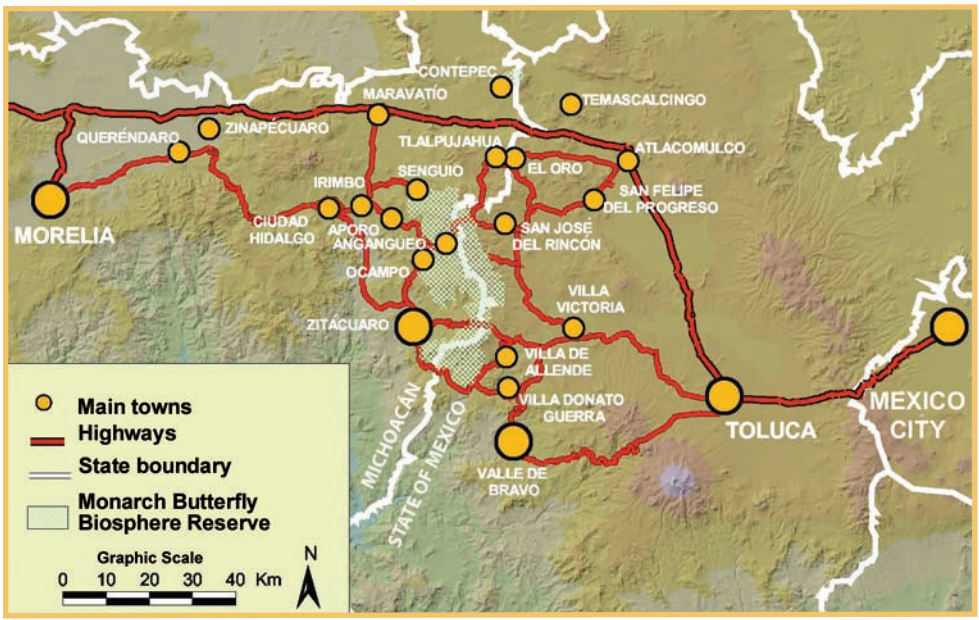


Figure 28. Routes to visit the Monarch butterflies.

Alternatively, from Morelia and Jalisco you can get to three of the sanctuaries (El Rosario, Sierra Chincua and La Mesa) via the Guadalajara-Mexico freeway ("Autopista"). Take the freeway to Maravatío, then head towards Ciudad Hidalgo. Before Ciudad Hidalgo you will see signs for the road to Irimbo, Áporo, and Angangueo, from which the sanctuaries can be easily accessed. From the opposite direction (from Mexico City), you can take the same freeway to Atlacomulco, then follow the route towards El Oro and Tlalpujahua. Once you reach Santa María, take the road towards Angangueo.

Another option is to take a bus from Mexico City to Zitácuaro. At least two commercial bus lines offer departures every half hour from the Terminal Poniente at the Metro Observatorio. From Zitácuaro, you can find transportation towards Ocampo, from which it is easy to find buses and minivans to El Rosario sanctuary.

To get to La Mesa sanctuary by bus from Mexico City, take the bus to Villa Victoria and San José del Rincón from the Terminal Poniente at the Metro Observatorio. Get off at "parada de Guadalupe" and take a taxi to the sanctuary. To visit the Cerro Pelón sanctuary, purchase tickets in Terminal Poniente to El Capulín, the ejido that provides tourist services. This town has its own bus station.

From Morelia, it is best to take a bus to Zitácuaro. To reach La Mesa sanctuary, take a bus to Villa Victoria, then another bus towards El Oro. The closest stop to the sanctuary is the "parada de Guadalupe." To visit El Capulín Sanctuary, it is easier to take a taxi (about 30 minutes) from Zitácuaro.

El Rosario "Campanario" Sanctuary (Michoacán)

From Mexico City, travel towards Morelia through Toluca, Villa Victoria, and Zitácuaro. About 9 km past Zitácuaro, take the road (San Felipe de los Alzati) towards Ocampo and Angangueo. Transportation is available for rent or hire in both Ocampo and Angangueo, or you can continue in your own vehicle to the sanctuary. School or commercial excursions may prefer to stop in Ocampo, where buses and mini-vans can be easily rented or hired to bring visitors to El Rosario sanctuary. The sanctuary is only 17 km from Ocampo via a paved highway (Figure 29).

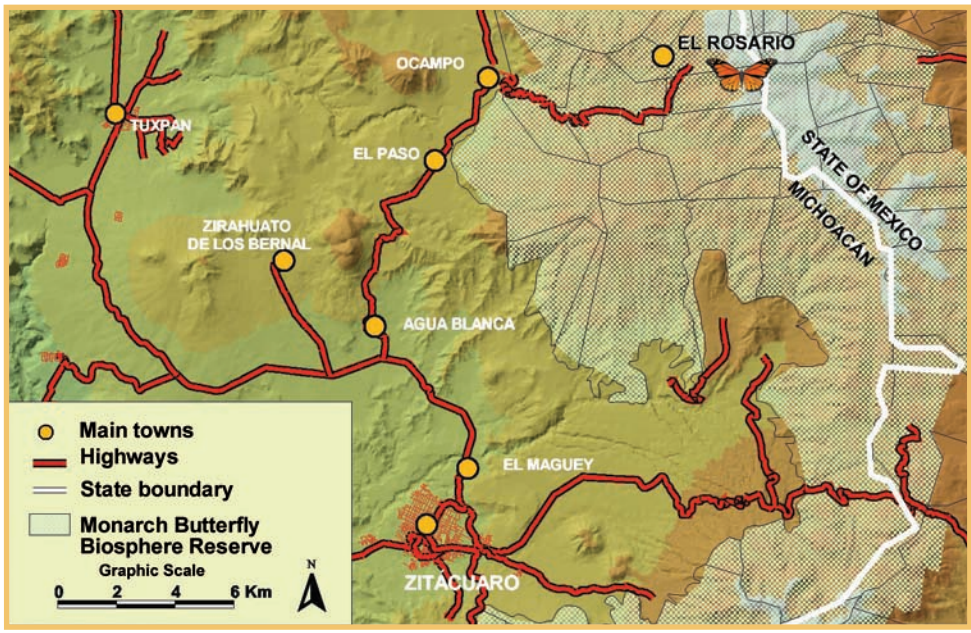


Figure 29. Route to El Rosario Sanctuary.

Sierra Chincua Sanctuary (Michoacán)

This sanctuary, open to the public since the mid-1990s, can be reached via the same route to Zitácuaro from Morelia and Mexico. In this case, however, travel 8 km past Angangueo towards San José del Rincón (State of Mexico), until you get to Llano de las Papas. There you will find the research center "Estación Central de Investigación de las Papas," which belongs to the Monarch Butterfly Biosphere Reserve. On the left is the ejido Cerro Prieto, which offers tourist services.

You can also travel by bus from Zitácuaro toward Angangueo, where taxis can take you to the sanctuary. Or you can take a direct bus from Zitácuaro to Tlalpujahua, getting off near the sanctuary entrance at Llano de las Papas (Figure 30).

From the State of Mexico by car, take the Toluca-Atlacomulco route and then head through El Oro and Tlalpujahua, from which you will find a direct route to Sierra Chincua.

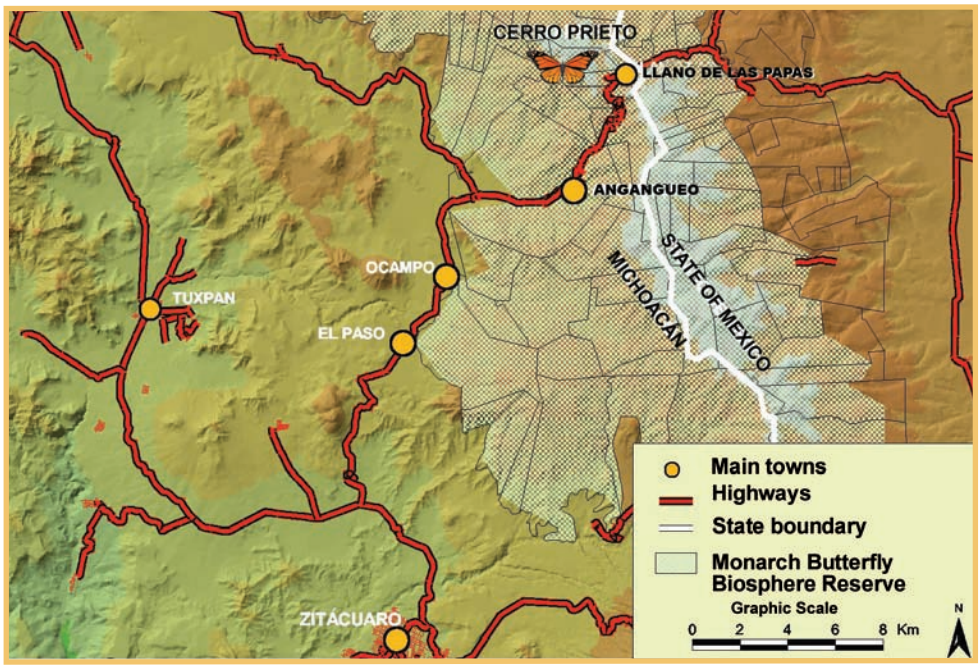


Figure 30. Route to Chincua sanctuary.

Cerro Pelón Sanctuary (State of Mexico)

This sanctuary can be accessed by car or bus from Mexico City and via taxi from Zitácuaro. Driving on your own from Mexico, Toluca or Villa Victoria, turn left about 15 km from Villa Victoria. In route to Valle de Bravo, take the road on the right towards Donato Guerra, then continue towards El Capulín.

Valle de Bravo can be reached using the same highway toward Villa Victoria and Zitácuaro, but you will turn left on the road towards Donato Guerra and El Capulín. From Zitácuaro, the sanctuary can be reached by exiting the highway towards Aputzio of Juárez and merging with the road towards El Capulín, the ejido that offers lodging in its tourist inn (Figure 31).

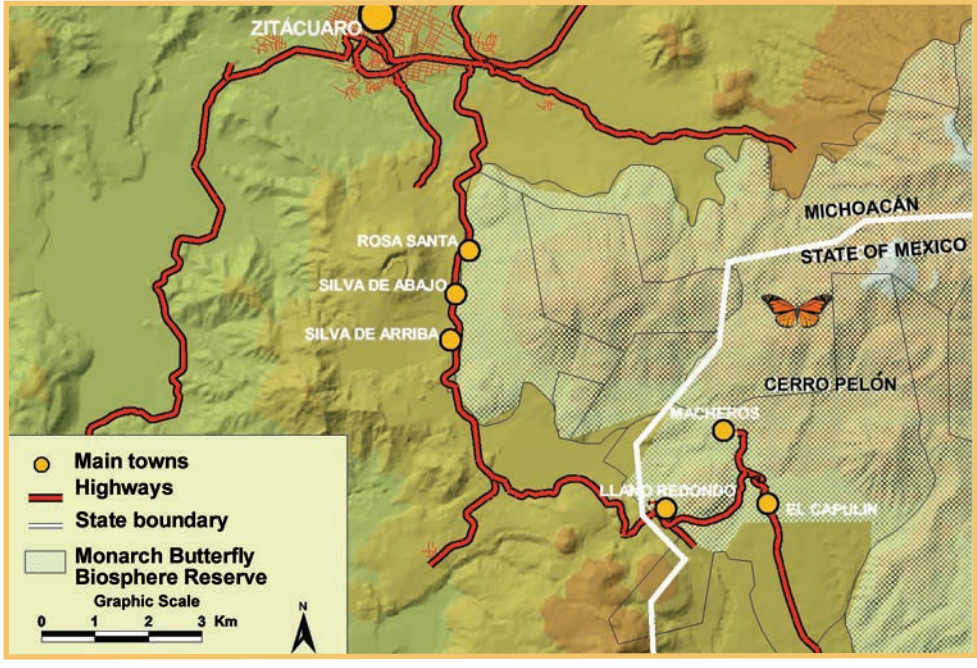


Figure 31. Route to Cerro Pelón sanctuary.

La Mesa Sanctuary (State of Mexico)

This sanctuary, in the ejido of the same name, can be accessed via the highway between Villa Victoria and El Oro—so you can travel by way of Toluca through Villa Victoria or from Toluca through Atlacomulco and El Oro. Once you arrive at "parada de Guadalupe," you may enter the grounds of La Mesa, which offers lodging for visitors.

From Michoacán, you can reach San Felipe de los Alzati and continue through Ocampo, Angangueo and San José del Rincón, then merging toward the right onto the El Oro-Villa Victoria highway. The "parada de Guadalupe" features an entrance to La Mesa. Alternatively, continue to Villa Victoria towards El Oro (Figure 32).

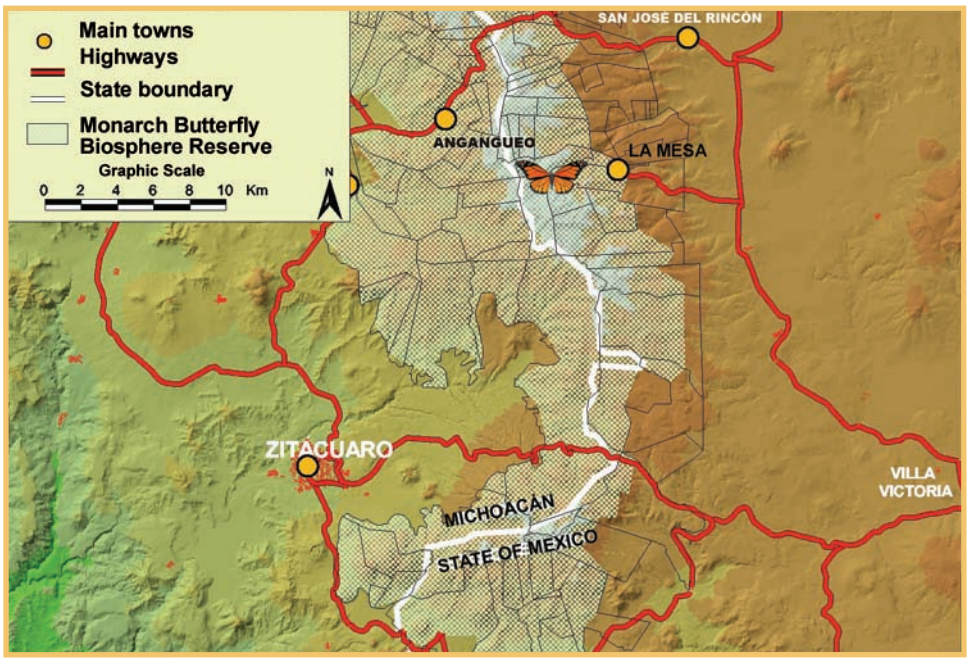


Figure 32. Route to La Mesa sanctuary.

Piedra Herrada Sanctuary (State of Mexico)

This sanctuary is located outside of the Monarch Butterfly Biosphere Reserve and is administered by the San Mateo Almomoloa ejido. From Mexico City and Toluca, head towards Valle de Bravo. Pass the turnoffs to Nevado de Toluca and Temascalcingo-Valle de Bravo in San Francisco Oxtotilpan, then continue another 10 km until you get to the Piedra Herrada Parador Turístico (tourist inn).

From the opposite direction (from Valle de Bravo), head towards Avándaro and Toluca. After passing a few villages including San Ramón and Los Saucos and the Club Campestre "El Santuario," you will arrive at the Parador Turístico. You can also take a bus at Terminal Observatorio in Mexico City towards Valle de Bravo, as the Parador Turístico is within walking distance of the highway (Figure 33).

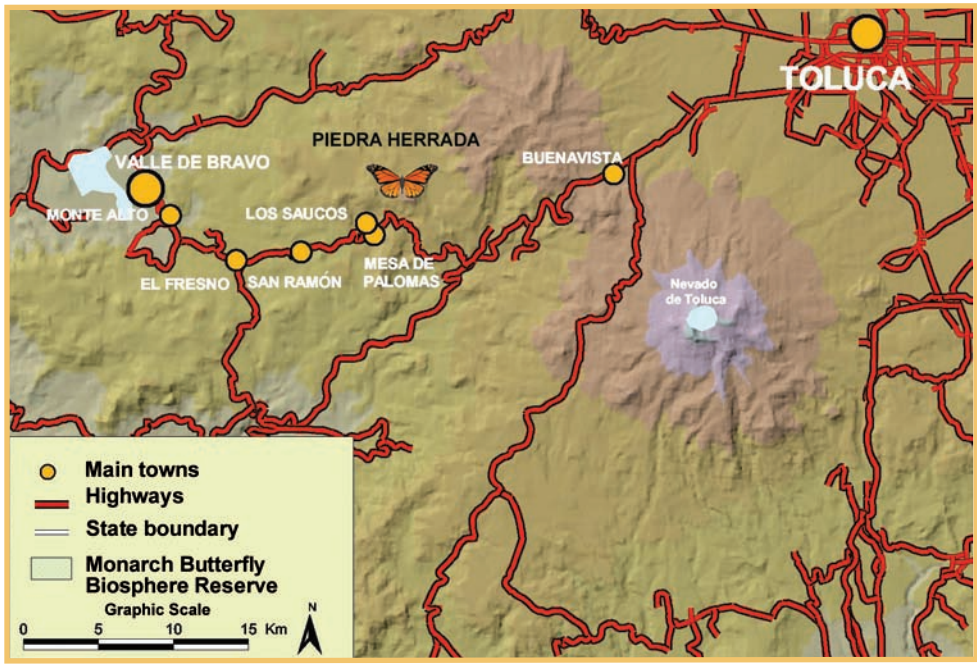


Figure 33. Route to Piedra Herrada sanctuary.

Etiquette during your Visit

The responsibility for the conservation of the Monarch butterfly originally fell primarily on Mexico, given that the majority of North American migratory butterflies congregate within oyamel fir forests in the states of Mexico and Michoacán. We now know, however, that the number of butterflies that end up hibernating in Mexico is determined by the generations of reproductive butterflies in Canada and the United States and their subsequent generations. As such, all three countries now recognize their shared responsibility in determining the Monarch's fate.

Everyone interested in preserving the planet's most numerous animal migration should join forces, together accepting the challenge to create a model of cooperation across borders.

When you visit the Monarch sanctuaries, you can help by following some simple rules of etiquette:

- Do not bother the butterflies resting in the trees. They have traveled a long journey to find a place to rest and survive the harsh winter.
- Keep at a distance of 50 meters from the trees filled with butterflies, and do not make noise when you are near the colonies.
- Do not throw trash and avoid harming the forest plants, especially small trees. Remember that the forest is an ecosystem in which all of the living things work together.
- To help prevent erosion and protect the forest floor, stay on designated paths for visiting the Monarchs.
- If you see someone bothering the butterflies or destroying anything within the sanctuaries, report it to one of the guides, to tourist authorities, or if necessary, to the appropiate authorities of the ejido.
- If you encounter tour guides or other tourist service providers not carrying out their work responsibly, please report them to the authorities. Those that suffer from irresponsible practices are the butterflies.
- As you travel through the Monarchs' region, or if you live within it, be sure to report incidents of illegal logging or any kind of threat to species within the forests. You can contact the Federal Attorney's Office of Environmental Protection (PROFEPA), as well as the Directorate of the Monarch Butterfly Biosphere Reserve.

PROFEPA
Edificio AJUSCO
Carretera Picacho-Ajusco 200
Col. Jardines en la Montaña
Delegación Tlalpan, C. P. 14210, México, D. F.
Tel. (55) 54-49-63-00
From within Mexico, call toll free: 01-800-008-42-00 or
01-800 PROFEPA (7703372)

To file complaints by Internet, visit www.profepa.gob.mx/denuncia_home.asp or send an email to: denuncias@correo.profepa.gob.mx

Head Office of the Monarch Butterfly Biosphere Reserve
Research Station Llano de las Papas
Angangueo, Michoacán (ask upon arrival for exact location)
mmonarca@conanp.gob.mx
Tel. (715) 156 85 80

Regional Office:
Calle Fray Bartolomé de las Casas 493
Centro Histórico
Morelia, Michoacán
Tel. (443) 312 00 90, 91 y 81

Chapter VI

Want to Know More?

Monarchs in Print

In English

Grace, E. S. 1997. **The World of the Monarch Butterfly**. Sierra Club Books for Children.

Oberhauser, K. S. y M. J. Solensky. 2004. **The Monarch Butterfly: Biology and Conservation**. Cornell University Press. Ithaca, New York.

Urquhart, F. A. 1976. **Found at Last: The Monarch's Winter Home**. National Geographic 150: 160-173.

In Spanish

Brower, L.P. 1999. **Para comprender la migración de la mariposa Monarca 1857-1995.** México. Disponible en internet. www.ine.gob.mx/ueajei/publicaciones/consultaPublicacion.html?id_pub=121&id_tema=&dir=Consultas

Galindo-Leal, C., E. Rendón Salinas, J. Honey-Roses y A. Martínez. 2004. **La Monarca de las Migraciones**. Pronatura 8 (Oct-Nov): 38-45

Rendón Salinas, E., J. Pérez, A. Ibarra y Carlos Galindo-Leal (Eds). 2005. **Memorias del Primer Foro Regional Mariposa Monarca, 2004**. www.foromonarca.net

Rendón E., A. Valera, G. Ramírez, J. Pérez y C. Galindo-Leal (Eds). 2006. **Memorias del Segundo Foro Regional Mariposa Monarca, 2005**.

Rendón E., G. Ramírez, J. Pérez y C. Galindo-Leal (Eds). 2007. **Memorias del Tercer Foro Regional Mariposa Monarca, 2006**.

SEMARNAT (Secretaría de Medio Ambiente y Recursos Naturales). 2001. **Programa de Manejo Reserva de la Biosfera Mariposa Monarca**. Subdirección General de Conservación y Manejo de Áreas Naturales Protegidas. México, D. F.

Oberhauser, K. S., M. Missrie, E. Rendón S., y E. García Serrano. 2003. **La mariposa Monarca: uniendo a un continente**. Monarch Butterfly Sanctuary Foundation. Roseville, Minnesota.

Monarchs in Cyberspace

In English

Dispatches from the Vanishing World. A website dedicated to preserving species and cultures, with information about the history of the discovery of Monarch hibernation areas. www.dispatchesfromthevanishingworld.com/pastdispatches/monarch

Ecology.info. Source of information on ecology with details on Monarchs www.ecology.info/monarch-butterfly.htm with an extensive bibliography. www.ecology.info/monarchbutterfly-page-6.htm

Journey North. Educational program centered around migrations of diverse species. www.learner.org/jnorth

Monarch Lab. University of Minnesota site with information about diverse aspects of Monarchs. www.monarchlab.umn.edu/research/Mig/mig.html

Monarch Larvae Monitoring Project. University of Minnesota site for the monitoring of Monarch butterfly populations. www.wlmp.org

Monarch Monitoring Project. Monitoring information from a research station in Cape May, New Jersey. www.concord.edu/dick/mon.html

Monarch Butterfly Sanctuary Foundation. Foundation that lends financial and scientific support to the conservation of Monarch butterfly forests. www.mbsf.org

Monarch Watch. University of Kansas Entomology Program site dedicated to education, conservation, and research of Monarchs. www.monarchwatch.org

Texas Monarch Project. Texas Environmental Studies Institute (TESI) website with educational activities on Monarch migration. www.rice.edu/armadillo/Ftbend/newfly.html

In Spanish

Comisión Nacional de Áreas Naturales Protegidas (CONANP). Management program of the Monarch Butterfly Biosphere Reserve. www.conanp.gob.mx/anp/pcm.php

El Correo Real. Information on the Monarch migration in Mexico. www.profauna.org.mx/Monarca/

Foro Regional Mariposa Monarca. A multi-sectorial, collaborative initiative dedicated to Monarch conservation. www.foromonarca.net

Secretaría del Medio Ambiente y Recursos Naturales (SEMARNAT). General information on Monarchs. www.semarnat. gob.mx/regiones/Monarcas/mariposa.shtml and the Reserve. www.semarnat. gob.mx/regiones/Monarcas/reserva.shtml

Sistema de Información Regional para el Desarrollo Sustentable Mariposa Monarca. SEMARNAT site with regional information on Monarchs. www.semarnat. gob.mx/michoacan/Monarca/

Secretaría de Ecología del Estado de México. Information with technical details on Monarchs. www.edomexico.gob.mx/se/Monarca/mariposa%20Monarca/info-tec.htm

Universidad Michoacana. Website dedicated to Monarch sanctuaries with regional information. www.ccu.umich.mx/mich/Monarca/mon-inicio.html

WWF-Mexico. Information on Monarch conservation activities. www.wwf.org.mx

Lodging and Other Attractions

A number of hotels located in cities and towns near the Reserve offer easy access to the various butterfly sanctuaries. In addition to the magnificent Monarch butterfly colonies, the surrounding area boasts many other tourist attractions (Figure 34).

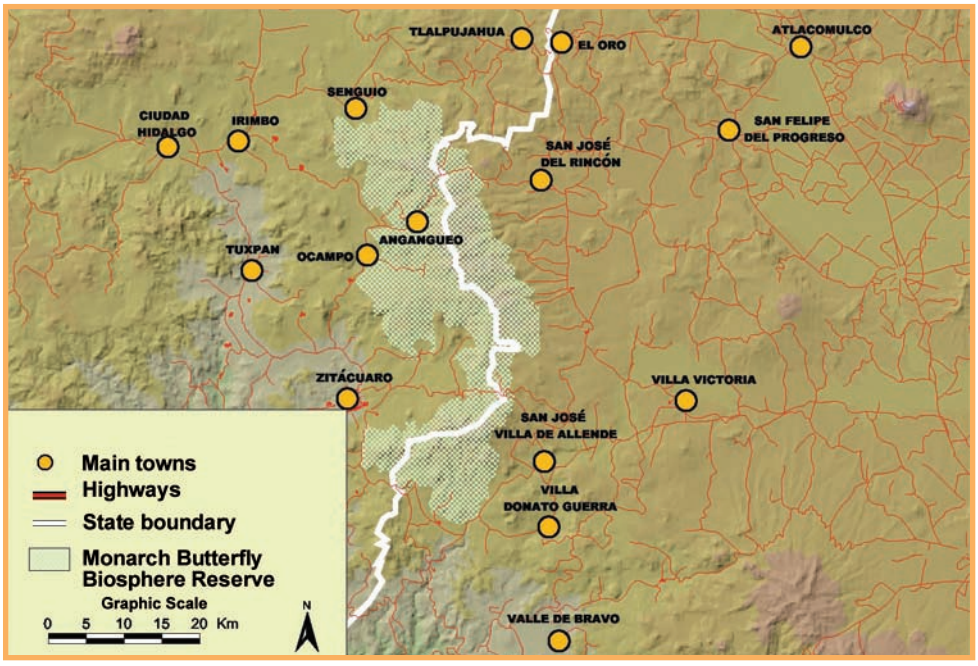


Figure 34. Nearby cities and towns featuring tourist attractions.

Zitácuaro, Michoacán

Hotel Villa Monarca Inn **** Highway Toluca-Morelia km 103.8. Tel. 01 (715) 153 53 46

Hotel Conquistador*** Leandro Valle Sur 2. Tel. 01 (715) 153 75 56

Hotel México *** Av. Revolución Sur 22. Tel. 01 (715) 153 28 22}

Nearby Attractions:

- El Palacio Municipal. The City Hall was built in the 19th century and features a mural portraying the history of Zitácuaro
- El Cerrito de la Independencia (Independence Hill)
- Pyramids of the Matlalzincan culture in Zirahuato, San Felipe de los Alzati
- La Iglesia de San Pancho. Church dating back to 1535 and now being restored, featuring unique stained glass windows made in Rome

- La Cascada de Enandio. Waterfall at the edge of the towns of Zitácuaro and Benito Juárez, located in the Balsas river basin and featuring a 100 meter drop
- La Cruz Atrial Monolítica. Monolithic Atrial Cross from the 17th century in the Iglesia de San Felipe de los Alzati
- La Capilla de la Candelaria. Chapel in San Felipe de los Alzati
- La Presa del Bosque. Dam where commercial fishing and aquatic sports events take place during the week of Easter
- El Monumento a Rayón. The Rayón Monument, next to a building where the American Supreme National Board was founded
- El Jardín de la Mora del Cañonazo (Garden of la Mora del Cañonazo)

Ocampo, Michoacán

Hotel Posada del Bosque, km 23, Ocampo. Tel. 01 (715) 151 02 51

Nearby Attractions:

- La Iglesia del Santo Niño de Atocha. Church in the downtown area
- Ex-Hacienda de Trojes (ex-Cattle Ranch)

Angangueo, Michoacán

Hotel Don Bruno*** Morelos 92. Col. El Rescate. Tel. 01 (715) 156 00 26

Nearby Attractions:

- Templo de la Inmaculada Concepción. Temple from the 18th century with an altar of Italian origin and images of the Virgin and Saint Joseph
- Museo de la Casa Parker. Casa Parker Museum with Saint Simon tunnel
- Ex-Hacienda de Jesús de Nazareno (ex-Cattle Ranch)
- El Mirador del Monumento al Minero (Monument to the Miner Lookout)

Tlalpujahua, Michoacán

Hotel Los Arcos, Barrio de Trigueros Jácome S/N. Tel. 01 (711) 158 03 50

Nearby Attractions:

- Parroquia de Nuestra Santísima Virgen del Carmen. Parish from the 18th century
- Museo de los Hermanos Rayón. Museum, former home of the Rayón family
- Museo Tecnológico Minero las Dos Estrellas (Mining Technology Museum)

- Iglesia Enterrada. Buried Church, ancient town church
- Workshops for stone carving and Christmas decorations

Ciudad Hidalgo, Michoacán

- Templo de San José. Temple of Saint Joseph from the 16th century, with atrial cross and baptismal font
- Grutas de Tziranda (caves)
- Presas de Pucuato, Sabaneta y Mata de Pinos (dams)
- Balnearios de aguas termales en Los Azufres. Spa with hot springs
- Balnearios de la Laguna Larga y la Laguna Verde (spas)
- Los Azufres geothermal plants of the Federal Electricity Commission

Tuxpan, Michoacán

Hotel Jardín, Juárez 45, corner of Benedicto López. Tel. 01(786) 155 03 03

- Templo de Santiago Apóstol. Temple from the 18th century
- Cascada del Salto del Moro (waterfall)
- Presa de Ziráhuato (dam)

Senguio, Michoacán

- Parroquia de San Pedro Apóstol (parish)
- Puente del Jardín Porfirio Díaz (garden bridge)
- Busto a Lázaro Cárdenas del Río (sculpture)
- Monumento en Homenaje al Valor de la Mujer (Monument to the Bravery of Women)

Irimbo, Michoacán

- Parroquia de San Mateo. Parish from the 16th century
- Zona arqueológica de San Francisco Epunguio (archaeological site)

Valle de Bravo, State of Mexico

Outstanding tourist center with a great variety of hotels and attractions, including:

- Mirador La Peña del Príncipe (lookout)
- Malecón y Embarcadero Municipal (boardwalk)
- Alameda del Pueblo (village boulevard)
- Casa de la Cultura (Cultural House)

- Cascada Avándaro (waterfall)
- Salto Velo de Novia. Park and Ecological Reserve
- Templo de Santa María Ahuacatlán y Cristo Negro (temple)
- Parroquia de San Francisco de Asís. Parish from the 17th century
- Jardín Central (Central Garden)
- Centro Cultural Joaquín Arcadio Pagaza (cultural center)
- Reserva de Monte Alto (Protected Reserve)
- Mercado de Artesanías (Handicrafts Market)
- Mercado Municipal (Town Market)

Villa Victoria, State of Mexico

- Presa de Villa Victoria (dam)
- Nuevo Bosque (forest)
- El Salto, at Dolores Vaquerías community

El Oro, State of Mexico

- Palacio Municipal. City Hall from the early 20th century
- Teatro Juárez. Theater, 1906-1907
- Antigua Estación del Ferrocarril (Old Train Station)
- La mina de Tiro Norte (mine)
- Las capillas de La Magdalena, Tapaxco y Santiago Oxtempan (chapels)
- Hacienda de Tultenango y Hacienda de la Jordana (Cattle Ranches)
- Museo de la Minería (Mining Museum)

Atlacomulco, State of Mexico

- Parque Isla de las Aves. Birds Island Park, in the J. Trinidad Fabela dam, 14 km from Atlacomulco
- Parroquia de Santa María de Guadalupe. Parish from the 17th century
- Plaza Arturo Vélez Martínez (square)
- Santuario del Señor del Huerto. Sanctuary. Neoclassical, 19th century
- Teatro del Pueblo (Town Theater)
- Centro Cultural Isidro Fabela (cultural center)

San Felipe del Progreso, State of Mexico

- Barrio de los Plateros en Palmillas (Silversmiths' Neighborhood)
- Centro Ceremonial Mazahua. Mazahua ceremonial center between Santa Ana Nichi-Fresno and Nichi-San Antonio de las Huertas

San José Villa de Allende, State of Mexico

- Campamento Vacacional Parque Villa de Allende Park (campground)
- Mazahuas handicrafts
- Iglesia de San José Villa de Allende (church)
- Haciendas de Salitre de Urendis y San Bartola (niter ranches)

Donato Guerra, State of Mexico

- Templo de la Asunción. Temple from the 17th century
- Cascada de El Salto (waterfall)
- Manantial de aguas sulfurosas El Molinito. Hot springs of sulphurous water
- La Peña (hill)

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