

World Heritage Sites

Protected Areas and World Heritage



MONARCH BUTTERFLY BIOSPHERE RESERVE MEXICO

The monarch butterfly makes, in stages, the longest annual migration of all insects and one of the longest regularly repeated migrations of any animal, and in spectacularly large numbers. Despite being a phenomenon of iconic significance to conservation, their hibernation forest is under threat from illegal logging.

COUNTRY

Mexico

NAME

Monarch Butterfly Biosphere Reserve

NATURAL WORLD HERITAGE SITE

2008: Inscribed on the World Heritage List under Natural Criterion vii.

STATEMENT OF OUTSTANDING UNIVERSAL VALUE

The UNESCO World Heritage Committee issued the following Statement of Outstanding Universal Value at the time of inscription:

Values

The Monarch Butterfly Biosphere Reserve World Heritage property protects key overwintering sites for the monarch butterfly. The overwintering concentration of butterflies in the property is a superlative natural phenomenon. The millions of monarch butterflies that return to the property every year bend tree branches by their weight, fill the sky when they take flight, and make a sound like light rain with the beating of their wings. Witnessing this unique phenomenon is an exceptional experience of nature.

Criterion (vii): The overwintering concentration of the monarch butterfly in the property is the most dramatic manifestation of the phenomenon of insect migration. Up to a billion monarch butterflies return annually, from breeding areas as far away as Canada, to land in close-packed clusters within 14 overwintering colonies in the oyamel fir forests of central Mexico. The property protects 8 of these colonies and an estimated 70% of the total overwintering population of the monarch butterfly's eastern population.

Integrity

The property includes more than half of the overwintering colonies of the monarch butterfly's eastern population. They provide a good sample of the areas that are essential for maintaining this superlative natural phenomenon. The maintenance of the standing forest and the microclimates that they create is the key management requirement, thus any threat to the forests is of utmost concern. Illegal logging is a known threat to the property with potential direct impacts on its Outstanding Universal Value. Public use has been increasing and the levels of visitation and infrastructure provided require careful control both in relation to impacts on the ecosystem and the quality of experience provided by the property to visitors. Due to its migratory nature, the maintenance of the overwintering phenomenon also requires attention to the conservation of the monarch butterfly by those countries through which it travels during its life cycle.

Protection and Management Requirements

The principal focus of protection and management should be to prevent illegal logging in the property. Priorities to achieve this include concerted planning and action between all relevant federal, state and local agencies, and work with local communities on environmental protection and the provision of alternative livelihoods to logging. As the overwintering phenomenon is a significant attractor to visitors, management also needs to be directed to achieving sustainable public use of the property. This should respect the quality of the visitor experience and promote benefit-sharing mechanisms for local communities as an incentive to enhance their support to the conservation of the property. Continued investment in coordinated continent-wide management of the migratory phenomenon is a further important dimension of site management. Achieving all of these priorities requires the provision of adequate and sustained institutional and financial support.

INTERNATIONAL DESIGNATION

2007: Designated Mariposa Monarca Biosphere Reserve under the UNESCO Man & Biosphere Programme (? ha).

IUCN MANAGEMENT CATEGORY

VI Managed Resource Protected Area

BIOGEOGRAPHICAL PROVINCE

Madrean-Cordilleran (1.21.12)

GEOGRAPHICAL LOCATION

The site consists of three mountain ridge reserves in the Transvolcanic mountains between the states of Michoacán and Mexico, about 100 km west and northwest of Mexico City. Chincua with Cerro Pelón: between 19°44'27"N to 19°18'32"W and 100°22'26"N to 100°09'107"W; and Altamirano: 19°59'42"N to 19°57'07"W and 100°09'54"N to 100°06'30"W.

DATES AND HISTORY OF ESTABLISHMENT

1975: Butterfly overwintering sites first discovered;

1980: Reserve and Wildlife Zone proclaimed by Presidential decree;

1986: Protected Area (16,100 ha) established by Presidential decree in the enlarged Reserve;

2000: The *Reserva de la Biosfera Mariposa Monarca* established at its present size;

2007: UNESCO MAB Reserve designated.

LAND TENURE

Owned by *ejidos* (rural cooperatives), local communities, private companies and individuals. Managed by the National Commission for Natural Protected Areas (CONAMP) with the states of Michoacan and Mexico, under the Ministry of the Environment and Natural Resources.

AREA

Core areas:	13,551.55 ha
Cerro Altamirano	588.475 ha
Cerro Chincua-Campanario-Chinati-Huaca	9,233.962 ha
Cerro Pelón	3,729.115 ha
Buffer areas:	42,707.49 ha

ALTITUDE

-2,000m - 3,640m (Cerro Campanario, Cerro Pelón: 3,500m, Cerro Altamirano, 3,220m).

PHYSICAL FEATURES

The nominated areas are in the oyamel fir *Abies religiosa* forest on the crest of a north-south ridge which forms part of the wide belt of mountains known as the Transverse Neovolcanic (Transvolcanic) Range which runs east-west across the centre of Mexico. The ~30 km long by ~2.5 km wide core zone of the large central complex is flanked by the core of the Cerro Pelón Reserve 6-14 km south and by that of the Cerro Altamirano Reserve 23-26 km north. Each is surrounded by a wide buffer zone which averages 12 km wide across the largest reserve. Biogeographically the Transvolcanic Range forms the southern limit of the Mexican Plateau and is near the southern limit of the Nearctic realm. Geologically, the range is part of a discontinuous belt of still volcanically active mountains which dates from Tertiary times, where deeply dissected basaltic flows cover pre-existing Mesozoic sediments. It is rich in minerals which have been mined in the past within the nominated site. One theory assumes that magnetic properties of the rock could influence the direction of the migrating butterflies. The steep ridge and valley topography contains many micro-environments. The light water-retaining soils are derived from volcanic ash enriched by abundant organic debris.

CLIMATE

The climate of the area is semi-temperate to temperate, dry to subhumid, depending on altitude, with summer rains, dry winters and mean annual temperatures between 8°C and 22°C. The lowest temperatures in the coldest month range from -10°C to 18°C. The mean annual precipitation varies

from 700mm to 1250mm. The variations in aspect and altitude in the mountains create a range of microclimates. The cloudy humid climate of the forest between November and April provides the most suitable environment for the overwintering butterflies during the long dry but sometimes stormy winters.

VEGETATION

The sites are in the southernmost Nearctic mountains, an area of wide biodiversity and high endemism both faunal and floral. The Reserve has 493 vascular plants and 49 fungus species. These include the endemic Mexican box elder *Acer negundo* var. *mexicanum* and *Pinus martinezii*. On the high ridges the dominant vegetation is coniferous forest, the most important tree in which is the Mexican or oyamel fir *Abies religiosa*. The specific *religiosa* refers to its cruciform branch tips. The relation of species to altitude in the Reserve is shown in this table from the nomination:

Forest Type	Max./Min. Heights	Species
Oyamel fir forest	3,600m - 2,400m	<i>Abies religiosa</i> , <i>Quercus</i> sp., <i>Alnus</i> sp., <i>Arbutus</i> sp., <i>Salix</i> sp. <i>Prunus</i> sp.
Pine-Oyamel forest	3,000m - 2,400m	<i>Abies religiosa</i> , <i>Arbutus grandulosa</i> , <i>Pinus pseudostrobus</i> , <i>Quercus spp.</i> , <i>Salix paradoxa</i> , <i>Agnus firmifolia</i> .
Pine forest	3,000m - 1,500m	<i>Pinus pseudostrobus</i> , <i>P.rudis</i> , <i>P.teocote</i> , <i>P.michoacana</i>
Oak forest	2,900m	<i>Quercus lauriana</i> , <i>Clethra mexicana</i> , <i>Alnus firmifolia</i> , <i>Salix paradoxa</i> , <i>Buddleja cordata</i> , <i>B.parvifolia</i> .
Cedar forest	2,600m - 2,400m	<i>Cupressus lindley</i> , <i>Alnus firmifolia</i> , <i>Salix paradoxa</i> , <i>Senecio angulifolius</i> , <i>Eupatorium</i> sp.

The dense cool oyamel forest, dominant and co-dominant between 2,400 and 3,600m, covers the last 2% of a once extensive range. It depends on high humidity but is resistant to low temperatures. Where the tracts are large and dense enough - larger than 10 km² and not less than about 400 trees per hectare - and above about 2,900m, they provide the precise conditions needed by the overwintering butterflies: sheltered from rain and cool enough to maintain their torpor, humid enough to prevent desiccation and forest fires, but not so cold as to kill them; near streams and on steep warm south-southwest-facing slopes, but not warm enough to prompt premature maturation. Freedom from disturbance is essential to their survival. But during the last quarter of the 20th century, logging and encroachment for agriculture have diminished the largest tract of this rare habitat by four-fifths, fragmenting it into islands of thinned woodland more easily invaded by rain, frost and disease. There is a ground cover of aromatic shrubs, Mexican sage, *Salvia divanorum*, *Senecio*, *Stevia* and *Montanoa* species which is also used by the butterflies.

FAUNA

The region is transitional between northern and central American forms, with a resulting high number of species and high degree of endemism. Within the Reserve 198 vertebrates are recorded, including the endemic Mexican vole *Microtus mexicanus*. There are 132 bird species, and at least three endemic salamanders, the Michoacán stream salamander *Ambystoma ordinarium* (EN), Bell's false brook salamander *Pseudoeurycea bellii* (VU) and *P. robertsi* (CR). The white tail deer *Odocoileus virginianus* is an attraction to tourists.

However, the monarch butterfly *Danaus plexippus* is its best known species. This is a robust member of the Nymphalidae, found especially in the latitude of the American Great Lakes but also in the northern Middle West, Texas and California, where their sole food plant, milkweed is abundant. There are some 100 species of *Asclepias*, the common milkweed *Asclepias syriaca* being the most widespread, and 27 others are known to be eaten by the butterfly larvae, notably swamp milkweed *A. incarnata* and butterfly weed *A. tuberosa*. These contain cardiac glycosides poisonous to other animals. An egg becomes a caterpillar in 3-8 days; 9 to 16 days later it pupates for a week before metamorphosis. The butterfly's normal life cycle is from 2 to 6 weeks and there are usually four to five generations a year, only the last of which leaves the country to hibernate abroad. They are

remarkable for their 3,500 to 4,000+km annual autumn migration from the northeast to their mountain overwintering forest in the centre of Mexico. During this flight, steering by circadian rhythms linked to sunlight, and planing on atmospheric currents, they travel an average of 129 km a day, first flying south-southwest until over the Sierra Madre in northern Mexico when they turn south-southeast to reach the *oyamel* forests. There they land within a 100 by 90 km area in close-packed clusters of no more than some 10 hectares each on twelve main mountain sites centred around the small Michoacán town of Angangueo.

They migrate in the last week of August and first week of September, triggered by the shortening of daylight and lowering temperatures. They store fat against the journey, but feed on nectar enroute and roost at night and in bad weather. They travel in a sexually immature condition termed reproductive diapause which enables them to live between 6-10 weeks and in the torpor of hibernation for seven to ten months. Millions, perhaps a billion, insects from wide areas of North America cluster densely on small areas of forest, turning the trees orange. They are susceptible to wet and cold conditions and millions die either on site or on the return, providing food for the two species of bird and five species of mice which can eat them without being repelled by the cardiac glycosides they ingest from the milkweed. As with other species, their toxicity is advertised by the bright coloration of both caterpillar and insect (which is mimicked by another species the viceroy *Limentis archippus*). After five months, at the end of March they move down the watershed, mate, and return some 1,500 km to the Gulf states, to lay their eggs and die. The next generation continues the cycle, returning north, no butterfly surviving to pass on experience of the trip. The far smaller Californian population migrates and hibernates locally.

CONSERVATION VALUE

The monarch butterfly makes the longest annual migration of all insects and one of the longest regularly repeated migrations of any animal, in spectacularly large numbers. But their destination is under threat. The Park lies within a Conservation International-designated Conservation Hotspot, a WWF Global 200 Eco-region, a BirdLife-designated Endemic Bird Area and overlaps a UNESCO Biosphere Reserve.

CULTURAL HERITAGE

These mountains historically divided the earlier Chichimec, Purépecha and Náhuatl cultures. From the 16th century, Spanish settlers exploited the forest minerals, resources and native people. Slavery was abolished in 1809 and the area became a centre of resistance in the War of Independence from Spain.

LOCAL HUMAN POPULATION

The mountains still separate Indian groups and are now inhabited mainly by Mazahua and Otomi people speaking Tarascan and Masahuan. One Mazahua community, Crescensio Morales, owns 5,989 ha, of the Cerro Pelón Reserve, 2,151 ha being in the core zone. The present population living within the buffer zones is well over 100,000 people in over 100 agrarian centres and 55 villages. 57 of these centres are collectively owned in rural cooperatives known as *ejidos*, 28 are smallholdings, 13 are communes and 2 are on national land. The small town of Angangueo (10,000 inhabitants) in the buffer zone, is surrounded by farming villages, which also cluster between the central and southern core reserves and at the south end of the southern Reserve. The population of the surrounding towns totalled 327,310 in 2003. The area around the reserves was still mined for minerals and logged by state-run companies into the 1990s. The area is poor but butterfly tourism has contributed notably to the local economy.

VISITORS AND VISITOR FACILITIES

Total annual visitation has risen from 30,000 in 1986-7 to 132,486 in 2005-6, a number which necessitates increased controls. There are five main sanctuaries, all of which have tourist campsites and camp fire sites, food-halls, shops, guided tours, signage, mountain bike paths, horse riding and W.C.s. El Rosario and Cerro Prieto also have interpretive centres, playgrounds and hostel or lodge. Access is by the highway from Mexico City to Zitácuaro where there is also a range of accommodation.

SCIENTIFIC RESEARCH AND FACILITIES

The overwintering sites were a scientific mystery until 1975 when, after a 30-year program of butterfly-tagging they were at last found on Cerro Pelón. Many studies have ensued, from American and Canadian universities: the nomination bibliography lists 120 papers and books on the subject. The

insect has prompted research into migration ecology, pest suppression, geo-magnetism and other factors influencing orientation, and their use as environmental indicators over its migration range,

MANAGEMENT

The Reserve is managed by the National Commission for Natural Protected Areas (CONAMP) following a management program drawn up in 2001 which is due to be revised during 2010. This provides for sustainable development and wildlife management, public use, monitoring and research, operation and legal requirements. It divided the Reserve into five zones: a Natural Resource core zone in which there may be no logging (32,740.902 ha) and a buffer zone in which controlled logging is allowed, divided between a sustainable Agro-ecosystem zone (9,602.789 ha), Special Use sub-zone (66,665 ha), Public Use sub-zone (259.601 ha) and Human Settlement sub-zone (37.541 ha). Tourism during the butterfly season is a major source of income, but in need of a well designed well implemented regional strategy to forestall opportunistic exploitation. However, competing pressures on the Reserve make protection difficult. Between 1971 and 2005, 3,995 hectares of forest were degraded despite the efforts of authorities and the local communities. Between 2000-2003 the Reserve lost 510 ha and from 2003 to 2005, 479 ha more, mostly to illegal logging. 61 saw mills are registered in the two states and there are 4 saw mill operations within the buffer area itself. These are opposed by local communities who see communal resources being cropped for private use and quotas illegally exceeded, but enforcement of the law is difficult. However, 13,190 hectares (23% of the site) had been reforested by 2008 (UNESCO, 2010).

The site is well funded. Between 2001 and 2004 over a million dollars was assigned by the Monarch Butterfly Conservation Fund, established by a donor from the U.S.A., the Federal and both state governments, WWF, the Mexican Fund for the Conservation of Nature, experts and local representatives. The money was used to support 31 *ejidos*, indigenous communities and small properties, and promote the conservation of 9,089 hectares in the Reserve core areas. Through the Fund communities receive compensation for non-extracted wood, and forest areas that have been conserved. The Monarch Butterfly Conservation Fund has bought up core zone logging permits, financed forest conservation and supported sustainable alternative livelihoods in core zone communities. To contribute to conservation of the area's natural resources and improve the economy of the local people, the National Institute of Ecology also created a pilot project for management of the non-timber forest products in the Reserve by inventorying them, assessing their vulnerability and exploring the options for their commercialisation. The negative impacts of tourism, very obvious before designation, are being mitigated, ecotourism centres remodelled and other infrastructural works completed. The Federal government has established programs for monarch butterfly protection in nine other Mexican states and the governments of Mexico, Canada and the USA have developed the North American Conservation Plan to protect and manage the butterflies' breeding habitats in North America and their overwintering sites in Mexico (UNESCO, 2010). Monitoring is programmed of butterfly numbers, colony size and migrations, forest area and quality, tourist impact, microclimate, global climatic effects and the social-economic conditions of the local people.

MANAGEMENT CONSTRAINTS

The critical threat to the property is illegal commercial logging which doubles that permitted, fragments the forest and over-thins the trees, leaving no chance for regeneration since it fells young trees for their low quality wood which is processed in the many local sawmills for chipboard. Logging also diminishes water supplies to local villagers. The State Party claims illegal logging is decreasing due to the anti-logging drive, patrols and community surveillance, regulation of timber storage sites, mills and transport, and seizures of illegal stock. The claim is difficult to substantiate. Although the area is protected, land tenure in the reserve is unchanged. Government protection limits the use of forest resources but without granting compensation or economic alternatives for the rural cooperatives (*ejidos*) which own them. The inevitable conflict has threatened the integrity of the Mexican fir forest. Other forest-related threats are uncontrolled access to forest resources and clearing for agriculture, tree-cutting for fuelwood, fires set during agricultural clearance, diversion of water supplies, tree diseases, poor forest management and inadequate law enforcement. The impacts of unorganised tourism have also proved difficult to moderate. The surrounding countryside has already been stripped bare by logging and clearance to become impoverished farmland. The butterflies are also threatened in the U.S.A. where birds have been their chief predators: the chemical sprays necessary to protect genetically modified crops poison their food plant.

COMPARISON WITH SIMILAR SITES

The main bases for comparison with similar existing World Heritage sites are:

- (vii) the exceptional natural phenomenon of mass butterfly aggregation and hibernation, in an area of high mountain scenery;
- (x) a habitat in an area of high biodiversity essential for the conservation of an iconic insect unusual for intergenerational long-distance migrations to a small area which is increasingly vulnerable to development. The whole migration process is of high scientific and educational value.

The site has many unique aspects, although transhumance and seasonal migration for breeding, over-wintering or food are common amongst birds, land animals, whales, turtles and fish, including even eels and locusts. The nomination cites comparable or even greater migrations:

Species	Migration	2-Way Distance (km)	Numbers (*correction)
Arctic tern <i>Sterna paradisae</i>	the Arctic to the Antarctic	35,000 *	30,000
Sooty shearwater <i>Puffins griseus</i>	New Zealand to Chile	18,000 *	20,000,000
California gray whale <i>Eschrichtius robustus</i>	Pacific Alaskan waters to Laguna San Ignacio, Baja California, Mexico	16,000 – 22,000	26,000
European eel <i>Anguilla anguilla</i>	Europe to the Sargasso Sea	5,000 - 6,000	Large
Loggerhead turtle <i>Caretta caretta</i>	Ascension I. to the Brazilian coast	4,200	90,000 nesting females worldwide, 2001
Chum salmon <i>Oncorhynchus keta</i>	Alaska to U.S.Pacific coastal rivers	3,200	3,391,000 Puget Sound

Only two of these occur at present in a World Heritage site: the sooty shearwater in the New Zealand Sub-Antarctic Islands, and the grey whale reproducing and over-wintering lagoons of El Vizcaino which also host blue whales, seals, sea lions, elephant seals and three turtle species. Many other birds (eg: ruff, terek sandpiper, short-tailed shearwater) also make long distance migrations. Underwater movements, such as of fish and of turtles which often breed on the shores of World Heritage sites are still not completely traced. By comparison, monarch butterfly movements are well recorded within North America where it migrates between Hudson's Bay and Florida as well as to Mexico. Of many butterfly migrations none compares with that to Mariposa Monarca for length, singularity and visibility on site.

STAFF

A total of 130 people from six organisations work in the Reserve: 9 from the National Commission of Protected Natural Areas (CONANP) who include the Director, two sub-directors and 6 department heads, for Biodiversity, Development, Forest Management, Operations, Education and Communications. There are 8 Michoacán state forest police, 95 federal police, 10 from GOES (Michoacán), 4 from Mexico State forest protection and 4 federal environmental protection attorneys. Continual training in conservation and management is conducted by government organizations.

BUDGET

The 2007 budget for the Reserves was 13,625,632 pesos (US\$1,231,985) derived primarily from the Federal grant to CONAMP of 5,514,903.06 pesos and from State governments and tourism. The direct income from tourism in 2006 was 4,481,305 pesos (US\$411,130). Between 2001 and 2004 over a million dollars (±10,400,000 pesos) was assigned by the Monarch Butterfly Conservation Fund to support 31 indigenous communities and promote the conservation of forest in the core zone. Between 2000 and 2008 32 landowners were paid 22,757,000 (US\$1,820,000) from the Monarch Fund in compensation for unused logging permits. Between 2003 and 2008 also, the National Forestry Commission paid local communities 3,898,857 pesos (±US\$ 378,530) for hydrological environmental services linked to the maintenance of forest cover. Several state programs (PROCOCODES, PET with others) paid 29 million pesos (±US\$1,820,000) to strengthen ecotourism and community development projects. In 2008 the budget for anti-logging activities was US\$238,000 (21,440 pesos) but could become much higher in 2009. The Mexican Fund for Nature Conservation provided 1,615,595 pesos (±US\$129,092) for two Participatory Surveillance Committees for 2009-2010 and 8,671,356 pesos (±US\$692,618) to support 16 community developments, sustainable

resource management, surveillance and restoration. With WWF, the Fund is establishing a trust to supply core funding for economic alternatives to logging (UNESCO, 2010).

LOCAL ADDRESSES

President, Comisión Nacional de Áreas Naturales Protegidas, Camino al Ajusco # 200, Colonia Jardines del Pedregal, Delegación Tlalpan, México D.F.C.P.14210.

Director, Reserva de la Biósfera de la Mariposa Monarca, Calle 5 de Mayo Sur No. 38 3er Piso, Col. Centro, C.P. 61500 Zitacuaro, Michoacán, Mexico.

REFERENCES

The principal source for the above information was the original nomination for World Heritage status.

Anderson, J. & Brower, L. (1996). Freeze-protection of overwintering monarch butterflies in Mexico: Critical role of forest as a blanket and an umbrella. *Ecological Entomology* 21: 107-16.

Brower, L. *et al.* (2002). Quantitative changes in forest quality in a principal over-wintering area of the monarch butterfly in Mexico: 1971-1999. *Conservation Biology* 16: 346-359.

Elvira Quesada, J. *et al.* (2007). *Monarch Butterfly Butterfly Biosphere Reserve World Heritage Site Nomination Document*. Comisión Nacional de Áreas Naturales Protegida, Medio Ambiente y Recursos Naturales, Mexico. [Contains a bibliography of 120 references]

Grace, E. (1997). *The World of the Monarch Butterfly*, Sierra Club Books, San Francisco.

Hilton-Taylor, C. (compiler) (2006). *IUCN Red List. of Threatened Species*. IUCN, Gland, Switzerland.

Missrie, M. (2000). *Monarch Butterfly Conservation Information*. Journey North. World Wildlife Fund/ Mexico.

Pérez, S., Taylor, O. & Jander, R. (1997). A sun compass in monarch butterflies. *Nature* 387: 29.

Reichstein, T. *et al.* (1968). Heart poisons in the monarch butterfly. *Science* 161: 861-864.

SEMARNAT- CONANP (2001). *Programa de Manejo Reserva de la Biosfera Mariposa Monarca, México*, Ministry of the Environment and Natural Resources, Mexico.

Taylor, L. (1986). The four kinds of migration. In Dan-thanarayan, W. [ed.]. *Insect Flight: Dispersal and Migration*. Springer-Verlag, Berlin. Pp. 265-280.

UNESCO World Heritage Committee (2010). *Report of the 34th Session of the Committee*. Paris.

Urquhart, F. (1976). Found at last: the monarch's winter home. *National Geographic Magazine* 150: 61-73.

Urquhart, F. & Urquhart, N. (1978). Autumnal migration routes of the eastern population of the monarch butterfly (*Danaus p. plexippus* L.; Danaidae; Lepidoptera) in North America to the overwintering site in the Neovolcanic Plateau of Mexico. *Canadian Journal of Zoology* 56: 1759-64.

Woodson, R. (1954). The North American species of *Asclepias* L. *Annals of the Missouri Botanical Garden*, 41:1-211.

DATE

September 2007, 7-2008, 10-2010, May 2011.