



## Evaluation of ecological restoration activities carried out at the Monarch Butterfly hibernation sites in Mexico during 2012 – 2017

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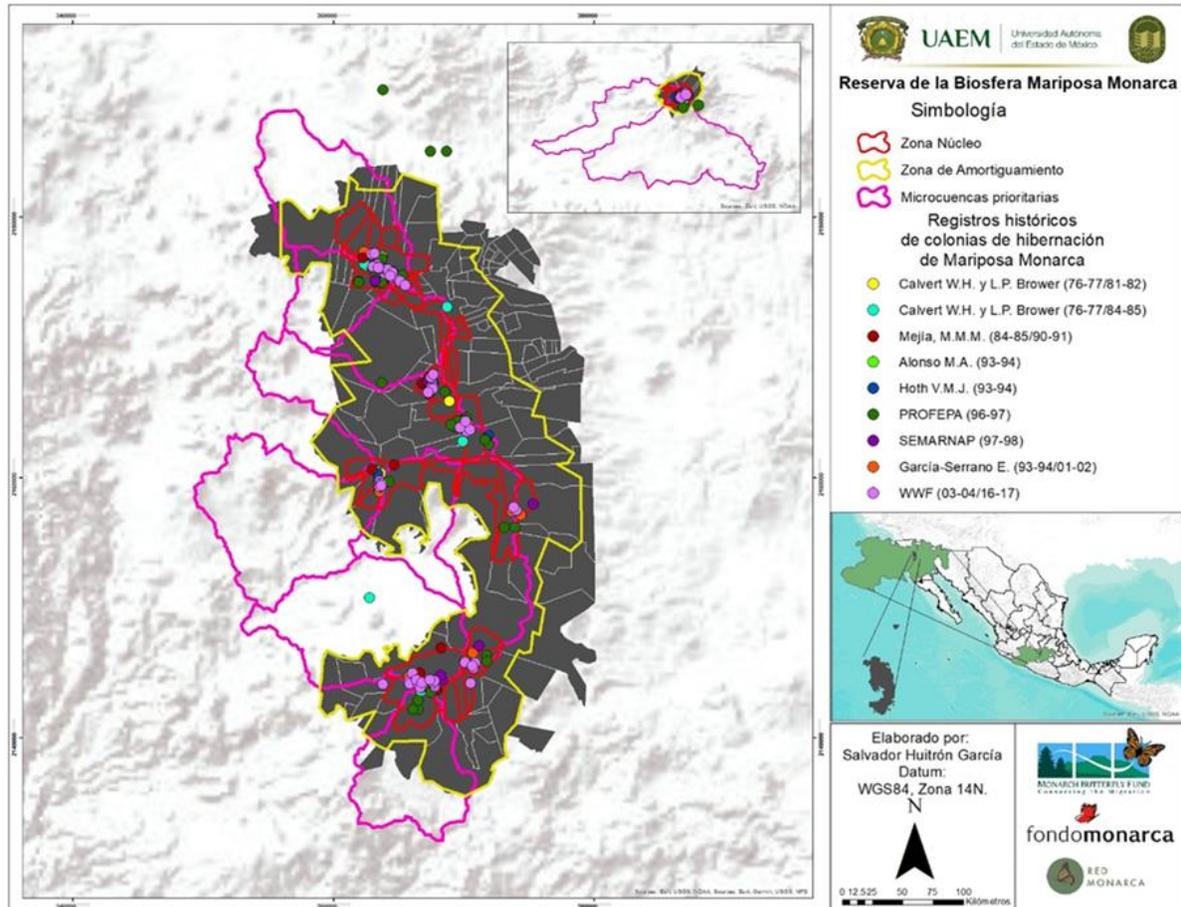
### Summary

Four decades after the discovery of the Monarch Butterfly overwintering sites in Mexico, the Monarch Butterfly Biosphere Reserve (MBBR) has been impacted by various environmental disturbances that have degraded the forests used by the monarch butterfly to overwinter. Given the environmental, social, and economic importance of the MBBR various federal and state government of Mexico institutions, civil society organizations, scientists, ejidos, indigenous communities and private properties have invested money, time, and work, in ecological restoration activities on the protected area. However, the impact of forest recovery activities is usually not assessed systematically.

That is why from November 2018 to July 2019, Monarch Butterfly Fund, agreed to fund the current project which seeks to evaluate and characterize the approaches and strategies related to the restoration of the monarch butterfly hibernation sites in Mexico carried out by indigenous communities during the period 2012-2017. From September to November 2018, historical records of monarch butterfly colonies published by Calvert, 1982; Calvert and Brower 1985; Mejia, 1991; Alonso, 1994; Hoth, 1994; Federal Office for Environmental Protection (PROFEPA), 1997; Environment, Natural Resources and Fisheries Ministry (SEMARNAP), now SEMARNAT, 1998; García-Serrano, 2002 and World Wildlife Fund (WWF), 2017. The 766 records identified during nearly 40 years of monitoring overwintering sites in



Mexico were organized into a database by author, Natural Protected Area (ANP), sanctuary, state, type of property, site, year and geographical location (Figure 1 ).



**Figure 1.** Historical records of the monarch butterfly colonies and priority micro watersheds for the conservation of the overwintering sites of monarch butterflies in Mexico.

Based on the historical records of monarch butterfly colonies, protected area surface and priority micro-watersheds for overwintering site conservation, as well as dynamics of the monarch butterfly colonies, 10 micro-watersheds were identified (Figure 1) and 24 priority agricultural areas for overwintering (Figure 2).

The Ocampo micro-watershed is the most important one, containing 18% of the total historical records of monarch butterfly overwintering sites. It is the second micro-watershed with more protected surface, 66% located in the core and buffer areas of the MBBR and where the El Rosario ejido colony is found which is considered as one of the most important for conservation in Mexico.

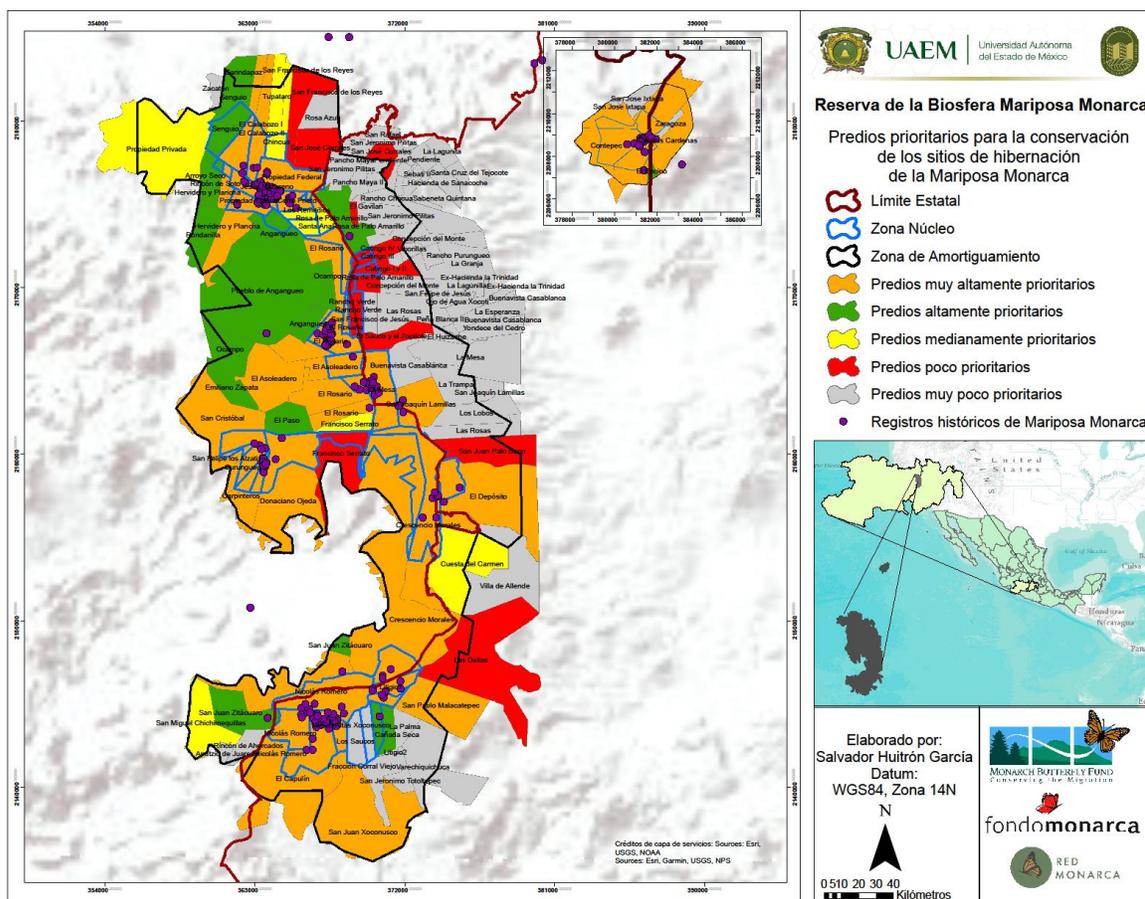
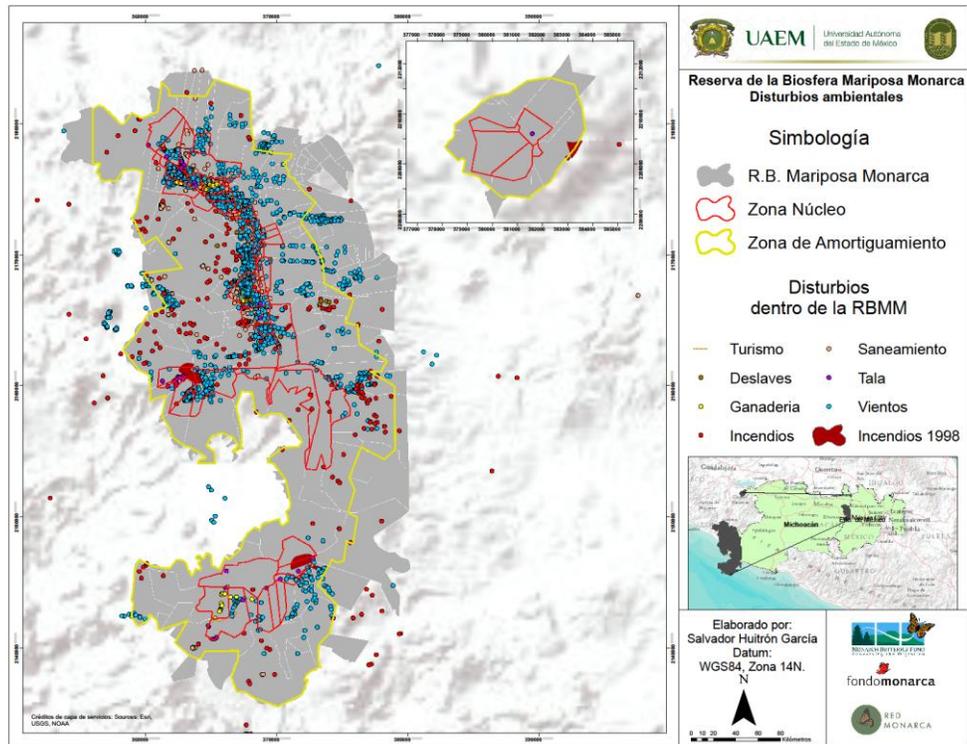


Figure 2. Priority agrarian areas for the conservation of monarch butterfly overwintering sites in Mexico.

Information from six federal and state government institutions about environmental disturbances in the MBBR was organized, 3906 records were analyzed; of these 444 records were forest fires, 14 landslides, 1980 of trees blown away by the wind, 365 tourism-related records, 1028 records of forest cleaning, i.e. removing debris, dead branches, etc. (saneamiento), 39 illegal logging records and 36 livestock records (Figure 3).





**Figure 3.** Environmental disturbances in the MBBR during 2012 – 2017.

On the other hand, 27 Management Best Practices Programs of the properties in the core zone were reviewed, as well as information on payments for Hydrological Environmental Services, Forestry and Wood Management Program and the results of the Special Program for the Restoration of the Priority Micro-watersheds of the Cutzamala-La Marquesa System to identify the conservation, restoration and protection actions of the MBBR. Like the disturbances, the 1828 records of the activities performed by the various programs were located spatially in the MBBR (Figure 4).

The most important programs were: Special Program for the Restoration of the Priority Micro-watersheds of the Cutzamala-La Marquesa System of the National Forestry Commission (CONAFOR); the Concurrent Funds of CONAFOR and the Monarch Fund; Environmental Compensation Program, Creole Corn Conservation, Conservation for Sustainable Development, Temporary Employment, Natural Protected Area Management, Biological Monitoring in Natural Protected Areas, Recovery and Repopulation of Species at Risk and Community Surveillance. For the 2012 – 2017 period, an investment of more than 200 million pesos (aprox, \$10,321,220 USD) for conservation, restoration, and protection of natural resources activities in the MBBR was estimated.

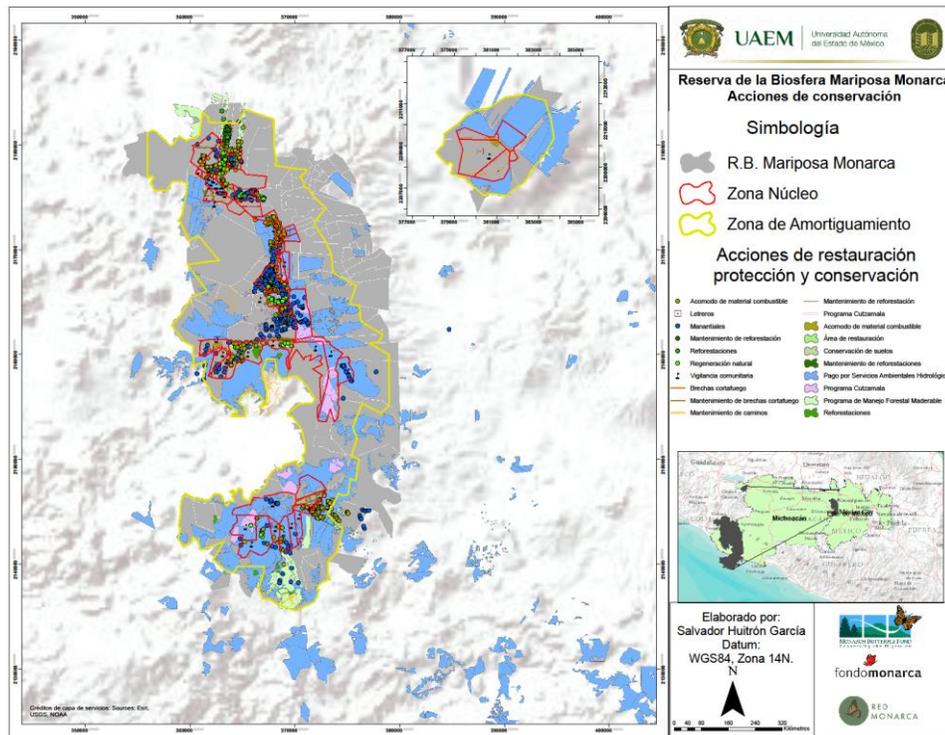


Figure 4. Conservation, restoration, and protection activities in the MBBR recorded during 2012 – 2017.

Recommendations of this paper include:

- Update the database of historical records of overwintering monarch butterflies in Mexico yearly.
- Use the micro-watersheds determined in this project to guide future projects for the conservation of the overwintering habitat of the overwintering monarch butterflies with the participation of the owners of the forests.
- Consider the map of priority properties for the conservation of the monarch butterfly of the MBBR to focus conservation assistance.
- Use databases on environmental disturbances and restoration activities for management decision-making in the MBBR.
- Use the environmental disturbance maps to guide the appropriate projects and techniques for site restoration within the MBBR.
- Use the ecological restoration activity maps for the distribution of efforts to restore forests to an optimal state in the MBBR.
- Have information of the polygons of restoration activities and environmental disturbances allows us to obtain results that can be quantified in the long term, as is the case with activities geared to forest recovery.
- Update thematic mapping of activities carried out and disturbances in MBBR regularly.

- Carry out monitoring activities on the impact of livestock and tourism within the MBBR
- Strengthen monitoring and evaluation of natural regeneration in the MBBR's forests.
- Strengthen Best Management Practice Programs with a climate change adaptation approach, because they are a direct source of information about the conservation status of the properties within the core zone of the MBBR.
- Strengthen the Temporary Employment Program to maintain and improve early detection of the various disturbances that arise in the Reserve.
- Recover and improve the Special Program for the Restoration of the Priority Micro-watersheds of the Cutzamala-La Marquesa System strategy, in order to promote multi-year active restoration activities.
- Promote and perform the protection and use of nurse plants/species to obtain a greater degree of survival in reforested and natural regeneration areas.
- Develop the Ecological Restoration Best Practices Plan in the MBBR.
- Develop and update the MBBR's Environmental Information System regularly.

