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Mexico Tropical Forest and Biodiversity Assessment



April 2013

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Mexico Tropical Forest and Biodiversity Assessment

US Foreign Assistance Act, Section 118/119 Report
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Cover Photos: Top Left: Mixed vegetation in Oaxaca (credit: Daniel Griswold). Top Right; Logs in a clearing in Yucatan Province (credit: Scott Solberg). Bottom: Mahogany stump and evidence of poor silvicultural practice in Yucatan (credit: Scott Solberg).

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Acronyms

US$	US Dollars
°C	Degrees Celsius
ADS	Automated Directive System
AMJB	Mexican Association of Botanical Gardens (*Asociación Mexicana de Jardines Botánicos*)
ANP	National Protected Areas (*Áreas Naturales Protegidas*)
ANUIES	National Association of Universities and Higher Education Institutions (*Asociación Nacional de Universidades e Instituciones de Educación Superior*)
APF	Permanent Forest Area (*Área Forestal Permanente*)
AZCARM	Mexican Association of Zoos, Animal Nurseries, and Aquaria (*Asociación de Zoológicos y Acuarios de México*)
BOD	Biological Oxygen Demand
CBD	Convention on Biological Diversity
CBM	Mesoamerican Biological Corridor (*Corredor Biológico Mesoamericano*)
CBMMs	Mexican Mesoamerican Biological Corridors
CC	Climate Change
CCMSS	Mexican Civil Council on Sustainable Forestry
CDM	Clean Development Mechanism
CDI	National Commission for the Development of Indigenous People (*Comisión Nacional para el Desarrollo de los Pueblos Indígenas*)
CEC	Commission for Environmental Cooperation
CEP	Public Center Research
CFE	Community Forestry Enterprises
CI	Conservation International
CIA	United States Central Intelligence Agency
CICESE	Center for Scientific Research and High Education of Ensenada (*Centro de Investigación Científica y de Educación Superior de Ensenada*)
CICY	Center for Scientific Research of Yucatán (Centro de Investigación Científica de Yucatán)
CIEco	Center for Research on Ecosystems (*Centro de Investigaciones en Ecosistemas*)
CIFOR	Center for International Forestry Research
CIMMYT	International Center for the Improvement of Corn and Wheat (*Centro Internacional de Mejoramiento de Maíz y Trigo*)
CITES	Convention on the International Trade of Endangered Species of Wild Fauna and Flora
CNA	National Water Commission (*Comisión Nacional de Agua*)
COD	Chemical Organic Demand
CONABIO	National Commission for the Knowledge and Use of Biodiversity (*Comisión Nacional para el Conocimiento y Uso de la Biodiversidad*)
CONACYT	National Council on Science and Technology (*Consejo Nacional de Ciencia y Tecnología*)
CONAPO	National Population Council (*Consejo Nacional de Población*)
CONAFOR	National Forestry Commission (*Comisión Nacional Forestal*)
CONAGUA	National Water Commission (*Comisión Nacional de Agua*)

CONANP	National Commission of Natural Protected Areas (*Comisión Nacional de Áreas Naturales Protegidas*)
CONAPESCA	National Commission on Agriculture and Fisheries (*Comisión Nacional de Agricultura y Pesca*)
D.F.	Federal District (*Distrito Federal*)
DGIRA	General Direction for Environmental Risk and Impact (*Dirección General de Impacto y Riesgo Ambiental*)
DGETA	General Direction of Agricultural Technology Education (*Dirección General de Educación Tecnológica Agropecuaria*)
DGVS	General Direction for Wildlife (*Dirección General de Vida Silvestre*)
DNA	Deoxyribonucleic acid
EA	Environmental Assessment
EES	Environmental Education for Sustainability (*Educación Ambiental para la Sustentabilidad*
EFC	Community Forest Enterprises (*Empresa Forestales Comunitaria*)
EIA	Environmental Impact Assessment
ELUP	Ecological Land Use Plan
EMMP	Environmental Mitigation and Monitoring Plan
EO	Equitable Origin
EPA	United States Environmental Protection Agency
FAA	Foreign Assistance Act
FANP	Mexican Fund for Natural Protected Areas
FAO	Food and Agriculture Organization
FCF	Faculty of Forest Sciences (*Facultad de Ciencias Forestales*)
FMCN	Mexican Fund for the Conservation of Nature (*Fondo Mexicano para la Conservación de la Naturaleza*)
FSC	Forest Stewardship Council
GCC	Global Climate Change
GCM	Models of General Circulation (*Modelos de Circulación General*)
GDP	Gross Domestic Product
GEF	Global Environmental Fund
GHG	Green House Gasses
GMO	Genetically Modified Organism
GOM	Government of Mexico
Ha	Hectare
ICCC	Inter-ministerial Commission for Climate Change
IE	Institute of Ecology of the UNAM (*Instituto de Ecología de la UNAM*)
IEE	Initial Environmental Examination
IMTA	Mexican Institute for Water Technology (*Instituto Mexicano de Tecnología del Agua*)
INE	National Institute of Ecology (*Instituto Nacional de Ecología*)
INECC	National Institute of Ecologic and Climate Change (*Instituto Nacional de Ecología y Cambio Climático*)
INEGI	National Institute of Statistics and Geography (*Instituto Nacional de Estadísticas y Geografía*)
IP	Preventive Report (*Informe Preventivo*)

IUCN	International Union for the Conservation of Nature
IWC	International Whaling Commission
LBOGM	Law of Biosafety and Genetically Modified Organism
LEDS	Low Emissions Development Strategy
LGEEPA	General Law of Environmental Equilibrium and Protection (*Ley General de Equilibrio Ecológico y Protección al Ambiente*)
MBC	Mesoamerican Biological Corridor
MLED	Mexico Low Emissions Development Program
MIA	Environmental Impact Manifest (*Manifestación de Impacto Ambiental*)
mm	Millimeters
M-REDD	Mexico Reduced Emissions from Deforestation and Degradation (*Reducción de Emisiones por Deforestación y Degradación, programa México*)
MRV	Monitoring, Reporting and Verification
NAFTA	North Atlantic Free Trade Agreement
n.d.	No Date
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration (US Government Institution)
NOM	Mexican Official Norm (*Norma Oficial Mexicana*)
NRM	Natural Resource Management
OECD	Organization for Economic Cooperation and Development
PGR	Mexican Attorney General's Office (*Procuraduría General de la República*)
PERSUAP	Pesticide Evaluation Report and Safer Use Action Plan
PhD	Doctor of Philosophy
POEGT	General National Ecological Territorial Planning Program (*Programa de Ordenamiento Ecológico General del Territorio*)
POET	Ecological Territorial Planning Program (*Programa de Ordenamiento Ecológico del Territorio*)
POP	Persistent Organic Pollutant
PROARBOL	Mexican Federal Government Forest and Vegetation Conservation and Restoration Program
PROBOSQUE	Forest Protection Agency of the State of Mexico (*La Protectora de Bosques del Estado de México*)
PROCAMPO	Direct Rural Support Program (*Programa de Apoyos Directos al Campo*)
PROCEDE	Program for Certification of *Ejido* Rights and Title Granting (*Programa de Certificación de Derechos Ejidales y Titulación)*
PROFEPA	Federal Attorney General for Environmental Protection (*Procuraduría General de Protección al Ambiente*)
PRONAFOR	National Forest Program (*Programa Nacional Forestal*)
REDD+	Reducing Emissions from Deforestation and Forest Degradation (*Reducción de Emisiones por Deforestación y Degradación*)
REIA	Regulation on Environmental Impact Assessment (*Reglamento en Materia de Evaluación de Impacto Ambiental*)
SAGARPA	Ministry of Agriculture, Cattle, Rural Development and Fisheries (*Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación*)
SEDESOL	Ministry of Social Development (*Secretaría de Desarrollo Social*)

SEMARNAT	Ministry of Environment and Natural Resources (*Secretaría de Medio Ambiente y Recursos Naturales*)
SEP	Ministry of Education (*Secretaría de Educación Pública*)
SFNA	Under Secretariat for Development and Environmental Regulation (*Subsecretaría de Fomento y Normatividad Ambiental*)
SLIMF	Small and Low Intensity Managed Forests
SMTN	Sun Mountain International
SNI	National System of Researchers (*Sistema Nacional de Investigadores*)
SNIB	National System of Information on Biodiversity (*El Sistema Nacional de Información sobre Biodiversidad*)
SOW	Scope of Work
SRE	Ministry of Foreign Affairs (*Secretaría de Relaciones Exteriores*)
SSPPA	Under Secretariat of Environmental Planning and Policy (*Subsecretaría de Planeación y Política Ambiental*)
TNC	The Nature Conservancy
TOR	Terms of Reference
TSS	Total Suspended Solids
UANL	Autonomous University of Neuvo Leon (*Universidad Autónoma de Nuevo León*)
UDP	Urban Development Plan
UMA	Management Unit for Sustainable Use of Wildlife (*Unidad de Manejo para la Conservación de Vida Silvestre*)
UNAM	National Autonomous University of Mexico (*Universidad Nacional Autónoma de México*)
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
USAID	United States Agency for International Development
USD	United State Dollar
USFS	United States Forest Service
USG	United States Government
WWF	World Wildlife Fund

Executive Summary

Purpose of the Report

The purpose of this report is to analyze the actions necessary in Mexico to achieve conservation and sustainable management of tropical forests and the conservation of biodiversity, and the extent to which the actions proposed by the Agency meet the needs thus identified. The recommendations of the report will contribute to the formulation of the USAID/Mexico Country Development Strategy of 2013-2018.

Sections of the Report

The report has six sections: introduction; geography of Mexico; status of tropical forests and biodiversity; threats to tropical forests and biodiversity; necessary actions to conserve tropical forests and biodiversity; and conclusions and recommendations.

Methodology

The threats to Mexico's biodiversity and tropical forests were investigated upon based on the following five categories of threats: (1) habitat loss and degradation; (2) over-exploitation; (3) spread of invasive species; (4) pollution of habitats; and (5) climate change.

The actions necessary to achieve conservation and sustainable management of tropical forests and biodiversity were investigated based on the following 12 categories of conservation actions: (1) conservation within protected areas; (2) conservation outside protected areas; (3) policies, laws and regulations; (4) governance; (5) education; (6) science and technology; (7) financial incentives and markets; (8) support of citizenry; (9) land use planning and regulation; (10) security of rights; (11) management of conflicts; and (12) environmental impact assessment.

Based on field observations in Pueblo, Oaxaca, Chiapas, Veracruz, Yucatan, and Michoacán as well as a review of relevant reports and literature, and interviews with knowledgeable informants, 24 priority necessary conservation actions were identified.

These 24 priority conservation actions were ranked according to the criteria established by USAID/Mexico. These criteria concern the action's: consistency with the USAID/Mexico program's goals and objectives; probability of producing impacts; correlation with USAID's comparative advantages; urgency for achieving conservation in Mexico; and linkages with other activities of the USAID/Mexico country strategy.

Based on these criteria and on the content of USAID/Mexico's draft country strategy, recommendations were formulated for implementing the highest ranked priority conservation actions in the Yucatan Peninsula.

Status of Mexico's Biodiversity and Tropical Forests

This report uses a broad classification of Mexico's vegetation with nine terrestrial categories: (1) Mangroves; (2) Mediterranean Forests Woodlands and Scrub; (3) Temperate Coniferous Forest; (4) Tropical and Subtropical Coniferous Forests; (5) Tropical and Subtropical Moist Broadleaf Forest; (6) Tropical and Subtropical Dry Broadleaf Forest; (7) Tropical and

Subtropical Grasslands; (8) Savannas and Shrublands; (9) Deserts and Xeric Shrublands. The report uses a classification of Mexico's marine ecosystems with three categories: (1) Coral Reefs; (2) Coastal Waters; and (3) Open Ocean

Mexico covers only 1.4% of the globe's terrestrial surface, but has the fourth largest species diversity in the world, harboring 10% to 12% of all species known to science. It also has high rates of endemism. The high number of species and especially the high number of endemic species are largely due to Mexico's high diversity of ecosystems, the result of its varied topography and climates that have created many unique microhabitats. Forty-nine of these species are likely to be extinct, 475 species are known to be in risk of extinction and 896 are considered threatened with extinction.

The genetic diversity of Mexico's plants and animals is probably high across taxonomic groups, although most of this genetic diversity has not been fully studied, with the exception of plants with economic value such as corn and cotton.

Threats to Mexico's Biodiversity and Tropical Forests

The loss and degradation of habitats is the most severe threat to Mexico's forests and to its biodiversity. The original 193,175,740 ha of natural vegetation in Mexico has been reduced to 140,988,079 ha, a decrease of 27%. The greatest loss in area has been of the temperate forest. The original area of tropical rainforest has been reduced from 25,480,042 ha to 15,151,162. Most of the remaining forest is highly fragmented and degraded. Pollution of aquatic and soil habitats, over-exploitation of plants and animals, the introduction and spread of invasive species, and rapid climate change are the other threats to Mexico's biodiversity and tropical forests. A rise in sea level of one meter due to climate change would affect 7 to 9% of the Mexico's current terrestrial area.

Conservation Opportunities for USAID/Mexico

The 24 priority necessary conservation actions that the report identifies are potential conservation opportunities for USAID/Mexico. The table below lists these actions in three groups. The actions in Group 1 mostly closely adhere to the USAID/Mexico criteria, the actions in Group 3 adhere to them the least, and the actions in Group 2 fall in-between.

Table 1 Groups of Priority Actions Based on USAID Criteria

Group 1 15 points	Group 2 10-15 points	Group 3 <10 points
Action 7: Expand biological corridors	Action 1: Increase ANPs	Action 2: Increase ex-situ conservation;
Action 8: Align public policies with conservation priorities	Action 3: Prepare ANP management plans	Action 5: Strengthen UMA's regulations:
Action 11: Implement technical training	Action 4: Reconcile protected and human needs	Action 6: Strengthen watershed commissions
Action 15: Expand conservation communication programs;	Action 13: Make conservation knowledge accessible to decision-makers	Action 9: Strengthen inter-ministerial committees
Action 17: Exchange knowledge of territorial planning	Action 14: Improve conservation incentives;	Action 10: Reorganize SEMARNAT
Action 20: Assist *ejidos* to conserve biodiversity & forests	Action 16: Complete territorial planning	Action 12: Increase federal budget for conservation research
Action 22: Integrate land use planning and conflict management.		Action 18: Integrate ecological territorial planning with urban development
		Action 19: Integrate municipal and marine territorial plans;
		Action 21: Regularize ownership rights in ANPs
		Action 23: Revise MIA processes
		Action 24: Increase participation in MIAs

USAID Mexico could finance one or more of these necessary conservation actions at a national or sub-national level. If USAID/Mexico chooses to finance necessary conservation actions at a sub-national level, the report recommends that it focus its assistance for conservation on the Yucatan Peninsula, for the following reasons:

- Extensive areas of contiguous forest remain in the Yucatán Peninsula and harbor species that cannot survive in the fragments of forests that occur in other parts of Mexico;
- The wood in the remaining forest of the Yucatán contains high volumes of carbon; to the extent that this forest is eliminated or degraded this sequestered carbon will be emitted into the atmosphere;
- The Yucatán forest contains high levels of biodiversity; the destruction or degradation of this forest will severely affect this biodiversity;
- The Yucatán forest is being degraded and eliminated at an accelerating rate, as *ejidos* are subdivided and sold to private owners;
- The Yucatán forest contains commercially valuable tree species, including mahogany and Spanish cedar. Silvicultural practices can increase the proportion and growth rates of these species of trees, thereby increasing the value of forest land, making it more competitive with other potential land uses;

- The application of silvicultural practices would also increase the rate of growth of commercially valuable trees in the forest, thereby increasing the rate of sequestration of atmospheric carbon and sequestering atmospheric carbon for a long period of time;
- A commercially more valuable forest can finance costs involved in its protection, whereas a protected area without commercial products requires constant financial subsidies, which frequently are not available;
- The Yucatán forest affects water flows from the Yucatán peninsula into the off-shore marine ecosystems, such as reefs, which also provide habitat for a large variety of living organisms, many of them threatened by extinction;
- The tourist industry of the Yucatán, which is extremely important to Mexico's economy in general and to the economy of the Yucatán in particular, depends on the conservation of the Yucatán's natural environment in many ways, from the preservation of an attractive landscape to the provision of adequate supplies of clean water to urban areas;
- Much valuable conservation experience has already been accumulated in the Yucatán, upon which to base future conservation activities;
- Institutions, public and private, exist in the Yucatán that have the capability to plan, implement, monitor and evaluate conservation activities to a high standard.

The following table indicates representative types of actions that USAID/Mexico could usefully finance to assist Mexico to conserve its biodiversity and tropical forests in the Yucatan Peninsula.

Table 2 Representative Conservation Actions for USAID/Mexico Financing in the Yucatán

Priority Conservation Actions	Representative Activities for USAID/Mexico Financing in the Yucatán
Group 1	
Action 6: Expand biological corridors	Conduct studies required to identify the most technically sound location of biological corridors through the Yucatan Peninsula; Determine the long-term feasibility of maintaining the biological corridors; Calculate the budget required to establish and maintain the biological corridors and compare it with the available funds; identify the priority sections of the corridor which could be established with the available funds; Identify the institutional responsibilities for establishing and maintaining the biological corridors; Design and implement a monitoring and evaluation process for the biological corridor(s).
Action 8: Align public policies with conservation priorities	Support the policy studies required to establish clear priorities for policies that support conservation in the Yucatan Peninsula; Publish policy studies and organize the meetings/workshops required to make them known as a means to establish a common understanding of how policies affect conservation in the Yucatan Peninsula among different levels and units of government, the private sector and NGOs; Establish monitoring and evaluation systems as the basis for evaluating the effectiveness of policy alignments for achieving conservation objectives in the Yucatan;
Action 7: Establish biological corridors	Identify additional biological corridors in the Yucatan Peninsula; Manage existing biological corridors; Use financial incentives to establish & manage corridors.
Action 8: Align public policies with conservation priorities	Support actions with state and municipal officials to improve the alignment of their policies with conservation priorities in the Yucatan Peninsula; Coordinate between national, state, municipal level policies to align them with conservation priorities.
Action 11: Implement technical training programs	Evaluate current training programs for conservation technicians in Yucatan; Design training programs for conservation technicians with focus on Yucatan; Identify potential institutional arrangements to provide technical training in conservation applicable to Yucatan.
Action 15: Expand conservation communication programs	Identify segments of the Yucatan public to be addressed by a conservation communications programs; Design content of communication programs for different audiences in the Yucatan; Finance the implementation of these communication programs; Design and implement the monitoring and evaluation of communication programs.
Action 17: Exchange knowledge of territorial planning	Finance meetings between territorial planners in Yucatan; Provide training for territorial planners in Yucatan; Finance territorial planning in Yucatan in coordination with the identification of biological corridors.
Action 20: Assist *ejidos* to conserve biodiversity & forests	Identify *ejidos* with interest in maintaining their forest management units; Identify ways to assist *ejidos* to manage their forests; Link *ejidos* with incentives and biological corridors.
Action 20: Exchange of knowledge of territorial planning	Evaluate current status of territorial planning in Yucatan; Finance workshops/training/ publications required to transfer knowledge of territorial planning methodologies between state and local government units in the Yucatan.
Action 22: Integrate land use planning & conflict management	Evaluate current status of the integration of land use planning & conflict management in Yucatan; Formulate recommendations for integrating land use planning & conflict management; Implement workshops/training/ technical advice required to implement the integration of land use planning & conflict management.
Group 2	
Action 1: Increase protected areas	Identify the need for more protected areas in Yucatan, based on data of species distribution, biological corridors and threats; Identify potential boundaries of new protected areas; Identify landownership in potential new protected areas; Identify and implement specific actions required to establish new protected areas.
Action 2: Prepare	Evaluate current status of management plans for protected areas in Yucatan &

Priority Conservation Actions	Representative Activities for USAID/Mexico Financing in the Yucatán
management plans for protected areas	determine needs for new management plans; Establish procedures for preparing new management plans that incorporate local governments and people; Prepare new management plans; Disseminate new management plans.
Action 4: Reconcile protected areas and human needs	Identify type, scale and source of conflicts between human needs and conservation in protected areas; Design measures to reconcile protected areas and human needs; Implement measures.
Action 13: Make conservation knowledge accessible to decision-makers	Organize training/workshops to transfer scientific/technological knowledge to state and local government officials.
Action 14: Improve conservation incentives	Evaluate effectiveness of existing conservation incentives in Yucatan; Determine priority focus in Yucatan for conservation incentives; Work with local and federal officials, private sector and NGOs to formulate an effective program of incentives for conservation in Yucatan.
Action 18: Complete territorial planning.	Evaluate present status of territorial planning in Yucatan; Finance program of completion of territorial planning; Disseminate results of territorial planning.

Cross-Cutting, Cross-Sectoral Linkages

The proposed activities in the draft Concept Paper for the USAID/Mexico country strategy 2013 to 2018 include: (1) reducing crime and violence; (2) improving criminal justices; and (3) reducing greenhouse gas emissions.

Technical training could contribute to turning young men who may be headed towards lives of violence and crime to law-abiding, productive occupations. No links between conservation and reforms to Mexico's system of criminal justice could be identified.

Many linkages, by contrast, exist between the actions required to reduce Mexico's emissions of greenhouse gases and those required to conserve its tropical forests and biodiversity. Managing natural forests is the prime example: By applying silvicultural techniques to forests, it is possible to improve the conditions they provide for a variety of species of plants and animals, increase their rates of sequestration of atmospheric carbon in commercially high value trees, increase regeneration of commercially valuable species of trees, reduce the rate of carbon emissions as a result of the changes in land use, maintain ecosystem functions such as water flows, and produce income to pay for the costs of protecting biodiversity and sequestering atmospheric carbon.

Negative Effects of Proposed Actions on Mexico's Biodiversity and Tropical Forests

No negative effects on Mexico's biodiversity and tropical forests from the actions proposed in USAID/Mexico's draft country development strategy for 2013 to 2018 were identified.

1. INTRODUCTION

1.1 Purpose of the Report

USAID/Mexico is preparing a new country development cooperation strategy for 2013 to 2018. Sections 118 and 119 of the Foreign Assistance Act (FAA) requires each country development strategy statement prepared by USAID to include analyses of: (1) the actions necessary in that country to achieve the conservation and sustainable management of tropical forests and the conservation of biological diversity; and (2) the extent to which the actions proposed for support by the Agency meet the needs thus identified. The purpose of this report is to provide USAID/Mexico with these required analyses and to recommend conservation actions for USAID/Mexico to include in its country development cooperation strategy for 2013 to 2018.

1.2 Sections of the Report

The report has six sections.

- Section 1, Introduction, reviews the purpose and methodology of the report and summarizes USAID/Mexico's draft Country Development Cooperation Strategy for the period from 2013 to 2018.

- Section 2, Geography of Mexico, summarizes the principal physical and social characteristics of Mexico which influence the character, location and management of its tropical forests and biological diversity.

- Section 3, Status of Tropical Forests and Biodiversity, summarizes the principal characteristics of Mexico's tropical forests and biodiversity at the ecosystem, species and genetic levels.

- Section 4, Threats to Tropical Forests and Biodiversity, analyzes the five categories of direct threats to Mexico's tropical forests and biodiversity, and the indirect sources of these threats.

- Section 5, Necessary Actions to Conserve Tropical Forests and Biodiversity, analyzes the actions necessary in Mexico to achieve the conservation and sustainable management of its tropical forests, and the conservation of its biodiversity.

- Section 6, Conclusions and Recommendations, analyzes the extent to which the actions proposed in the USAID/Mexico draft country development cooperation strategy for 2013 to 2018 meet Mexico's conservation needs and makes recommendations for incorporating the priority conservation actions into the USAID/Mexico Country Cooperation Development Strategy for 2013 to 2018.

1.3 Methodology

The team members first jointly reviewed and discussed the Terms of Reference in order to understand them thoroughly. Then the Team Leader prepared a draft outline of the report, which was discussed and revised by the team members. Responsibility for preparing drafts of report sections and chapters was assigned among team members from Sun Mountain and the Institute of Ecology of the Autonomous University of Mexico (UNAM).

The team members discussed among themselves, and with the relevant staff of USAID/Mexico, about the advantages of different possibilities for making field observations. Fields sites were selected in Oaxaca and Quintana Roo, and sites in Chiapas, Veracruz, Puebla, and Michoacán States were added during fieldwork to provide increased perspective and follow up on leads identified during the first part of the field work.

The team members agreed to organize the discussion in the report of the threats to Mexico's biodiversity and tropical forests based on the following five categories of threats: (1) loss and degradation of habitat; (2) over-exploitation of biodiversity and forests; (3) pollution of habitats; (4) spread of aggressive introduced species; and (5) climate change.

The team members also agreed to organize the discussion of the actions necessary to conserve and manage Mexico's biodiversity and tropical forests based on the 12 categories of conservation actions indicated in Figure 1.

Figure 1 Categories of Necessary Actions to Conserve Biodiversity and Tropical Forests

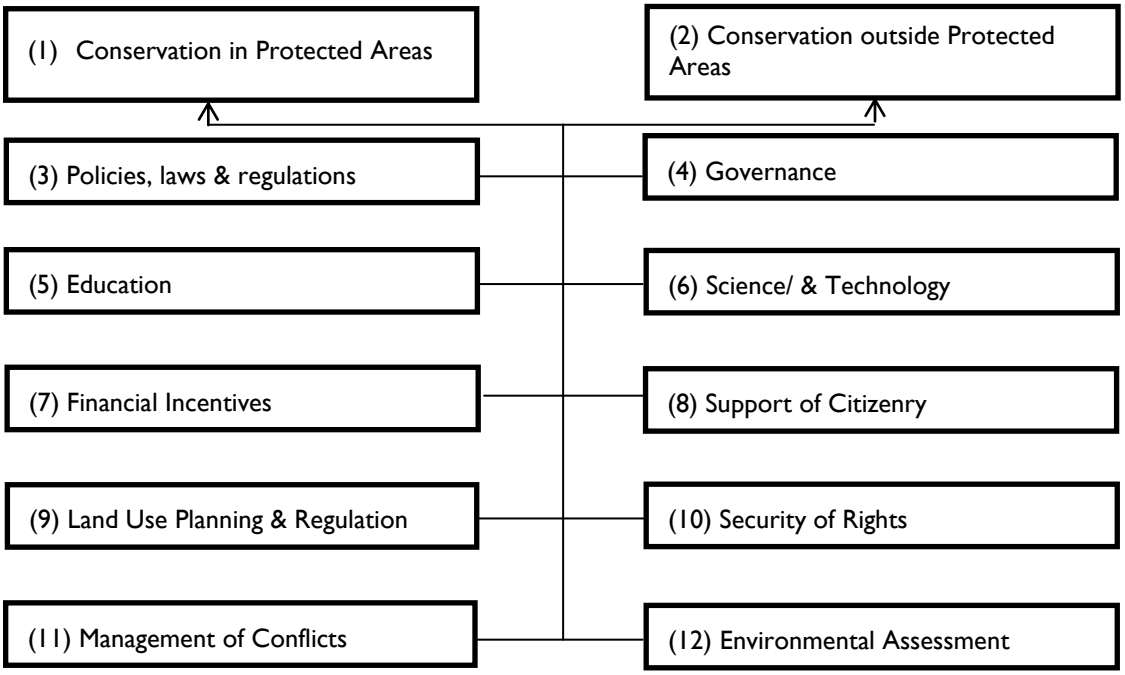


Figure 1 indicates that categories three to twelve contribute to achieving categories one and two. Although separated for analysis, the categories are in fact interrelated: the implementation of conservation actions in one the categories generally cannot be fully effective without the implementation of conservation actions in all the other categories.

For each of the categories of necessary conservation actions, the justification for the action was stated, and its current situation in Mexico of the action was described. The priority issues and actions related to that category were then identified based on the description of the situation.

The methodology provided for the preparation of two draft reports before the presentation of the final report to USAID/Mexico, thereby permitting the Mexican and international members of the team the opportunity to thoroughly review the report's findings, conclusions and recommendations. The first draft of the report was assembled from the contributions of the different members of the team. Once comments on that draft were received from USAID/Mexico, the members of the team revised the sections they had written and sections written by others, and sent their revisions to the team leader to prepare the second draft report and final report. A total of twenty-four priority necessary actions to conserve Mexico's biodiversity and tropical forests were identified through this process.

These priority conservation actions were then rated against USAID/Mexico's criteria, as stated in the Terms of Reference (TOR), for its selection of necessary conservation action using the following criteria: consistency, impact, comparative advantage, urgency and linkages. It was not possible to make a rating based on quantitative data, and so a qualitative scoring system was used. Zero indicated no adherence to the criteria; 3 indicated complete adherence; and 1 and 2 indicated intermediate adherence to the criteria. Based on these ratings, the priority necessary conservation actions were separated into three groups: those actions with a rating of 15; those actions with a rating from 10 to 14; and those actions with a rating of less than 10. This study also identified and recommended a geographic focus for potential USAID/Mexico efforts to implement the priority necessary conservation actions that were identified.

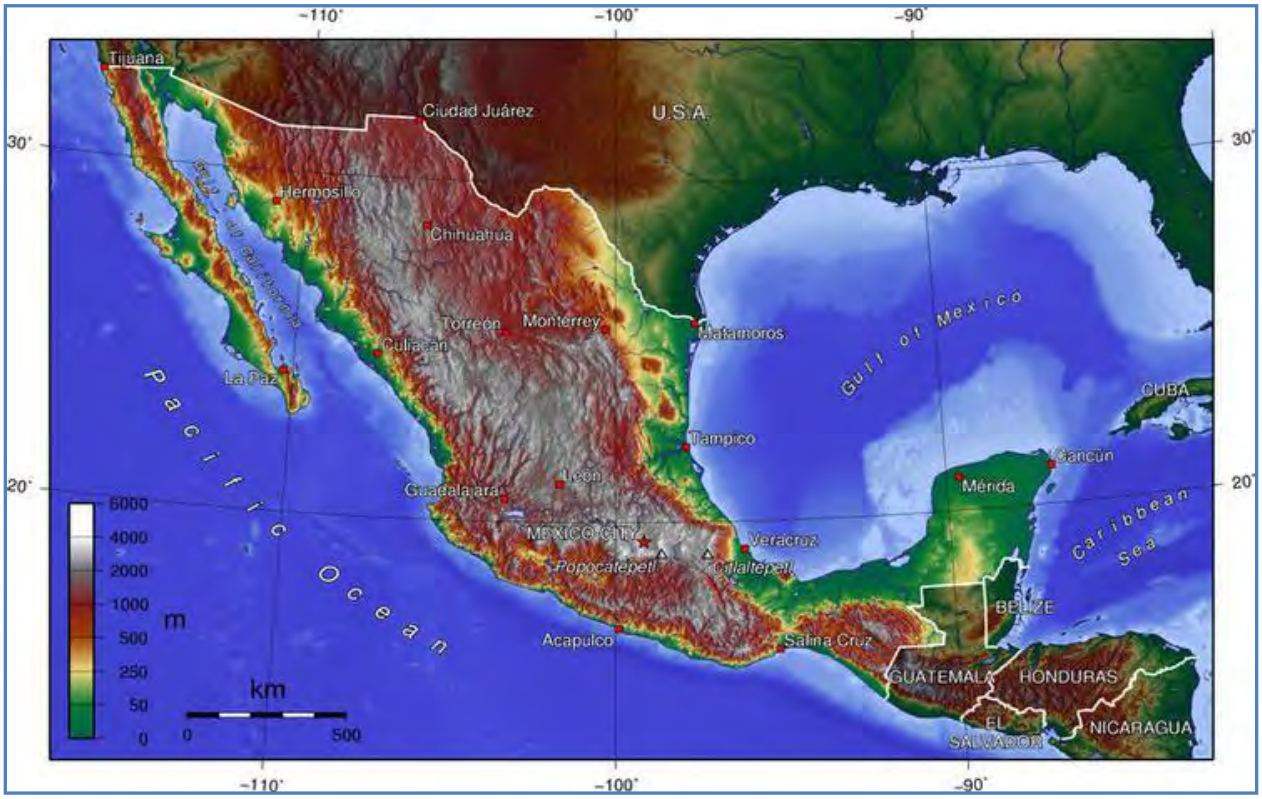
2 GEOGRAPHY OF MEXICO

2.1 Physical Geography

2.1.1 Location, Size and Topography

Mexico is the fourteenth largest country in the world, with a terrestrial area of 1,964,375 km^2, territorial waters of 231,813 km^2 and a maritime exclusive economic zone of 3,149,920 km^2. (Lara-Lara, J.R, et al., 2008; CIA, 2012). Map 1 indicates Mexico's location and topography.

Map 1 Location and Topography of Mexico



Source: Kemper, 2012

Mexico lies to the south of the United States and to the north and northwest of Belize and Guatemala. It is bordered by three water bodies: the Gulf of Mexico off its eastern coast, the Caribbean Sea off its southeast coast, and the Pacific Ocean off its western and southern coasts.

The *Sierra Madre Occidental* and *Sierra Madre Oriental* mountain ranges, both of which have an average elevation of about 2,250 meters, extend for 1,250 km and 1,350 km down western and eastern Mexico respectively. A high plateau lies between the two ranges. South of Mexico City, from the Pacific Coast to Toluca and ending in the State of Veracruz, numerous active and inactive volcanoes form the *Éje Neovolcánico*. The *Sierra Madre del Sur* is a shorter and lower coastal mountain range that joins with the *Éje Neovolcánico* and runs along the Pacific coast from Michoacán State in the west, to Guerrero State in the east. Further south is the mountainous

Isthmus of Tehuantepec, which separates the Pacific Ocean from the Gulf of Mexico. The flat, low-lying Yucatán Peninsula lies to its northeast (Deman, 1978).

Baja California, a long, narrow peninsula in northwest Mexico, has two mountain ranges – the Juarez and the San Pedro Martir ranges – which both run its length and which reach 1,800 and 3,100 meters above sea level, respectively. The Gulf of California, also called the Sea of Cortez, is located between Baja California and the Mexican mainland. There are 244 islands in Mexico, most of them in the Pacific Ocean and the Gulf of California. Tiburon Island, in the Gulf of California, and Maria Madre and Guadalupe Islands, in the Pacific Ocean, are the largest of these islands.

2.1.2 Hydrographic Basins and Water Bodies

Map 2 indicates the location of Mexico's 37 hydrological regions (shown with red boundary lines) in relation to its states (shown in different colors).

Map 2 Hydrological Regions of Mexico

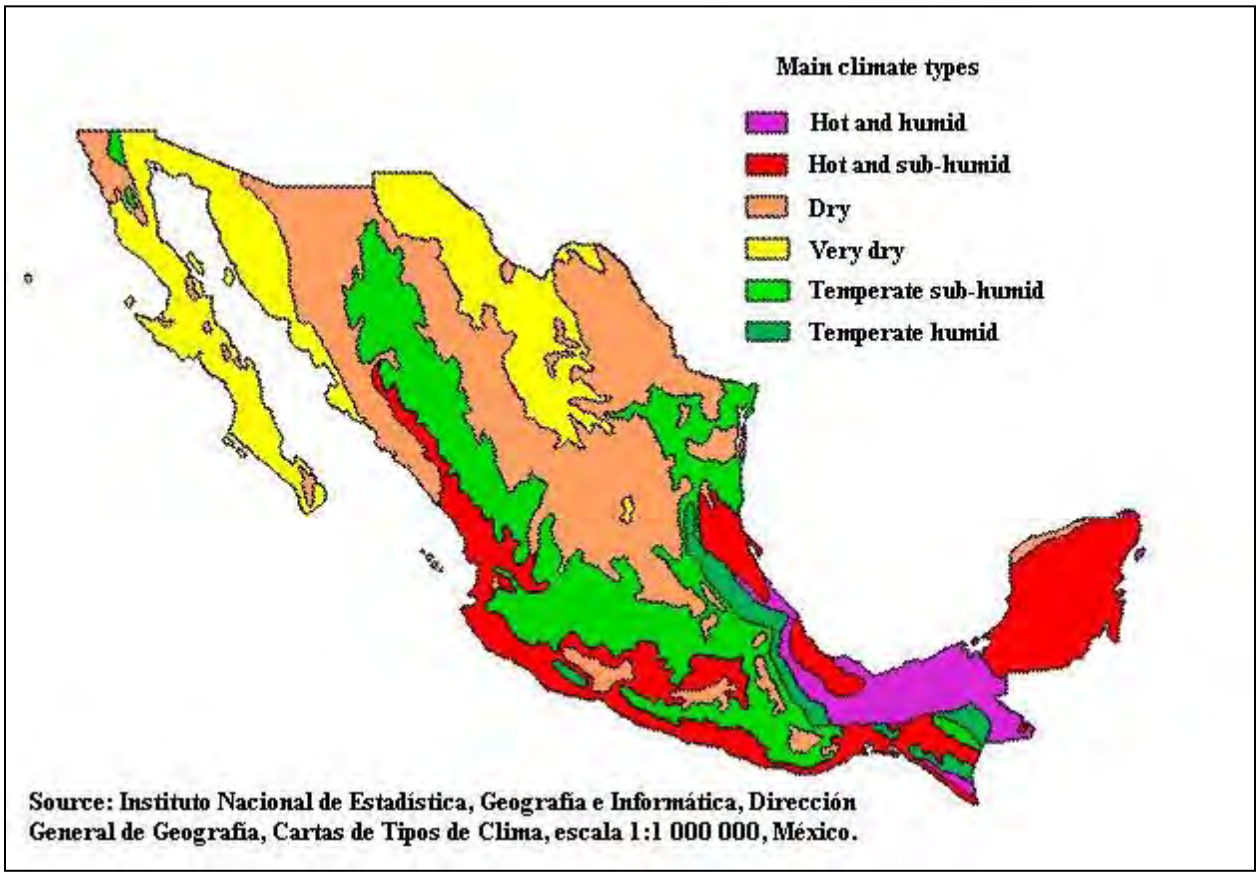
Source: CONAGUA, 2012

Mexico has 50 large rivers. The two largest rivers are the Usumacinta and Grijalva Rivers in southern Mexico. The two most important are the Lerma and Santiago Rivers, because they supply much of the water used in Mexico City. Other principal rivers are the Papaloapan, Coatzacoalcos, Balsas, Pánuco, Santiago and Tonalá. Mexico's three largest lakes are the Chapala, Cuitzeo, and Patzcuaro (CONAGUA, 2011).

2.1.3 Climate

Map 3 shows the locations of Mexico's six main types of climate.

Map 3 Location of Climatic Types of Mexico



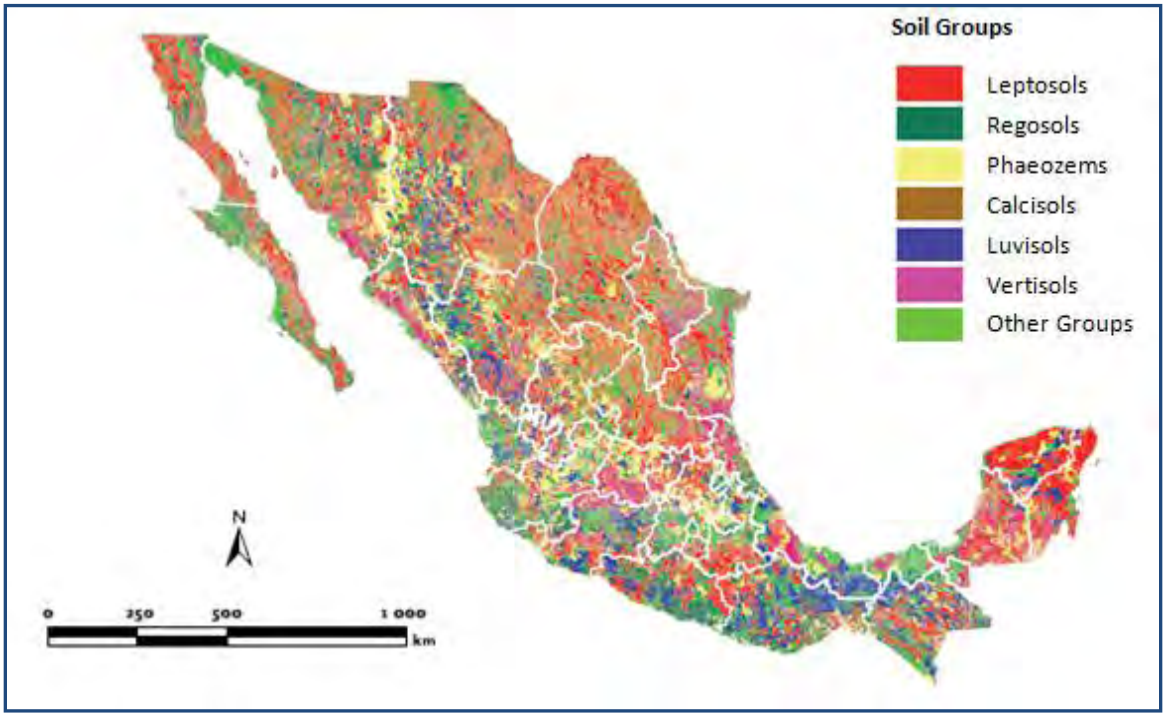
Source: INEGI, n.d.; in: *Amendola, Castillo, Martinez,* 2006.

Mexico's Hot and Humid and Hot and Sub-Humid climates have an average rainfall between 2,000 to 4,000 mm per year and average temperatures between 22°and 26°C. These climates occur on the Yucatan Peninsula, along the southern Pacific and Atlantic coasts, and to a small extent along the western foothills of the *Sierra Madre Occidental.* Dry and Very Dry climates have an average rainfall from less than 400 mm per year to 700 mm per year, and an average temperature ranging from 18° to 26°C. They occur over most of northern and central Mexico, except at higher elevations in the mountains. Temperate Sub-Humid and Temperate climates have an average rainfall of between 600 and 4,000 mm annually, and average annual temperatures ranging from 18° to 22°C; they occur at higher elevations of the mountains (SEMARNAT, 2012a). In most of Mexico, except in those areas where it rarely rains at all, the dry season occurs from December to June and the wet season between from July to November.

2.1.4 Soils

Map 4 shows the location of Mexico's six main soil types.

Map 4 Principal Soil Groups in Mexico



Source: INEGI 2007; in SEMARNAT 2009

The Leptosols (red) cover about 54.3 million ha; the Regosols (dark green) about 26.3 million ha.; and the Calcisols (brown) about 20 million ha. These soil types occur mostly in northern Mexico and are mostly shallow, and infertile. The Phaeozems (yellow) cover about 22.5 million ha; the Luvisols (dark blue) 17.3 million ha; and the Vertisols (purple) 16.5 million ha. They tend to be fertile and deep. A diversity of other soil types occurs on smaller areas throughout the country. About 45% of Mexico's soils are physically or chemically degraded (SEMARNAT, 2008).

2.2 Social Geography

2.2.1 Population

In December 2012, Mexico's population was approximately 117 million, and its rate of annual population growth was about 1.086% (CIA, 2013). In 2010, 78% of the population lived in cities, and 35% lived in cities of more than 1 million inhabitants. About 21 million people, a sixth of Mexico's population, lived in the Federal District of Mexico (Mexico D.F.) (INEGI, 2010). In 2011, Mexico's annual urban population growth rate was 1.56%, while the rural population was shrinking at an annual rate of -0.07% (World Bank, 2013). About half of Mexico's population is less than 24 years old (CIA, 2013). Although fewer Mexicans are migrating to other countries now than in 1999, when the number of migrants reached an all-time high of nearly 750,000, almost 500,000 Mexicans are likely to migrate in 2013, most of them to the United States (CONANPO, 2012).

About 14% of Mexicans, or approximately 16 million people, are indigenous (OECD, 2013). Nearly half of Mexico's indigenous peoples live in southern Mexico, in the states of Oaxaca, Chiapas, Veracruz, Puebla, Yucatán, Guerrero, and Hidalgo, and speak one of Mexico's 62 indigenous languages (Minority Rights Group International, 2008).

2.2.2 Economy

In 2012, Mexico's GDP was US$1.2 trillion, and its rate of economic growth was 4.2% (INEGI, 2012). Agriculture, livestock, forestry, fishing and hunting, in which about half of Mexico's indigenous peoples work, contributed 3.5% of GDP in 2011, while growing at an annual rate of 6.6% in 2012 (INEGI, 2012; CONABIO 2010). Renewable and non-renewable natural resources contributed US$76 billion to Mexico's GDP in 2012, approximately 7% of the total (World Bank, 2013). The World Bank classifies Mexico as an upper middle-income country, although in 2010 more than half of the population lived below the poverty line. Poverty was higher in rural areas (61%) than in cities (45%) (World Bank, 2013). In 2011, remittances from emigrants were US$22.8 billion- about double the income from agricultural exports ($10.3 billion) or tourism ($10.0 billion) (CONANPO, 2012).

2.3 Government

Map 5 shows the location and names of Mexico's states and the Mexico D.F.

Map 5 Location of the States of Mexico

Source: Whereig.com, 2011

Mexico has 31 states, a Federal District (D.F.) and 2.546 municipalities (CIA, 2013). Each state has its own constitution, as well as executive, legislative and judicial branches, and the right to

legislate and levy taxes. Despite its federal structure, the Mexico's government is highly centralized, and most state governments depend on the federal government for much of their revenue (Photius.com, 2013).

Mexico's federal government has executive, legislative and judicial branches. The president is elected for a six year term and was last elected on July 1, 2012. The National Congress has a Senate, with 128 seats and a Chamber of Deputies with 500 seats. The last elections for the legislature were held on July 1, 2012. The president appoints the members of the Supreme Court of Justice, with the consent of the Senate.

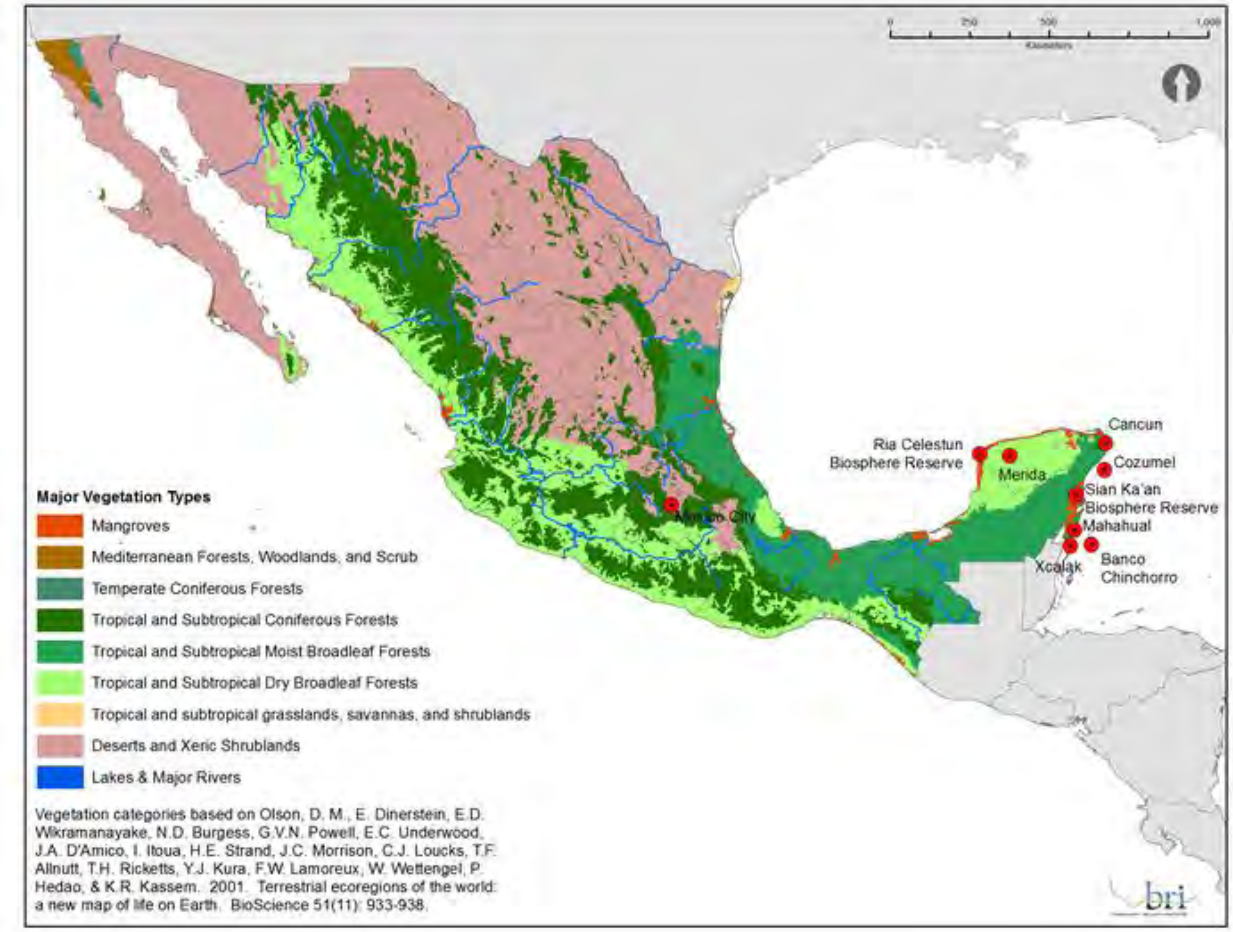
3 STATUS OF BIODIVERSITY AND TROPICAL FORESTS

3.1 Ecosystem Diversity

Terrestrial Ecosystems

The term terrestrial ecosystem, for the purposes of this report, is considered to be equivalent to vegetation types. Map 6 shows the location according to one classification of the major vegetation types of Mexico.

Map 6 Major Vegetation Types of Mexico



Source: Olson, D. et al, *2001*

Map 6 shows that mangroves (red) occur in patches along Mexico's Pacific, Caribbean and Gulf of Mexico coasts. Mediterranean Forests, Woodlands and Scrub (brown) and Temperate Coniferous Forest (moderate-green) occur in only in a small area of northern Baja California. Tropical and Subtropical Coniferous Forests (dark-green) cover large areas of the *Sierra Madre Occidental,* down to the border with Guatemala, and smaller areas in the *Sierra Madre Oriental* and E*je Neovolcánico* mountain ranges. Tropical and Subtropical Moist Broadleaf Forest (blue-

green) is located on the coast of the Gulf of Mexico, across most of the central part of the Isthmus of Tehuantepec, south to the border with the Petén of Guatemala, and east across the southern Yucatan Peninsula. Tropical and Subtropical Dry Broadleaf Forest (light green) occurs at lower elevations and valleys of the *Sierra Madre Occidental* along the Pacific Coast south to the border with Guatemala; north almost to the border with the United States; and in a small patch on the southern coast of the Gulf of Mexico and in the northern Yucatan Peninsula. Tropical and Subtropical Grasslands, Savannas and Shrublands (tan) occur only in a small area on Mexico's northeastern border with the United States. Deserts and Xeric Shrublands (pink) occur in a large area of northern Mexico, including Baja California and extend south to a small area in central Mexico.

Marine Ecosystems

As mentioned before, Mexico has three types of marine ecosystems: Coral Reefs, Coastal Waters and Open Ocean.

Map 7 shows the geographic distribution of Mexico's Coral Reef Ecosystem.

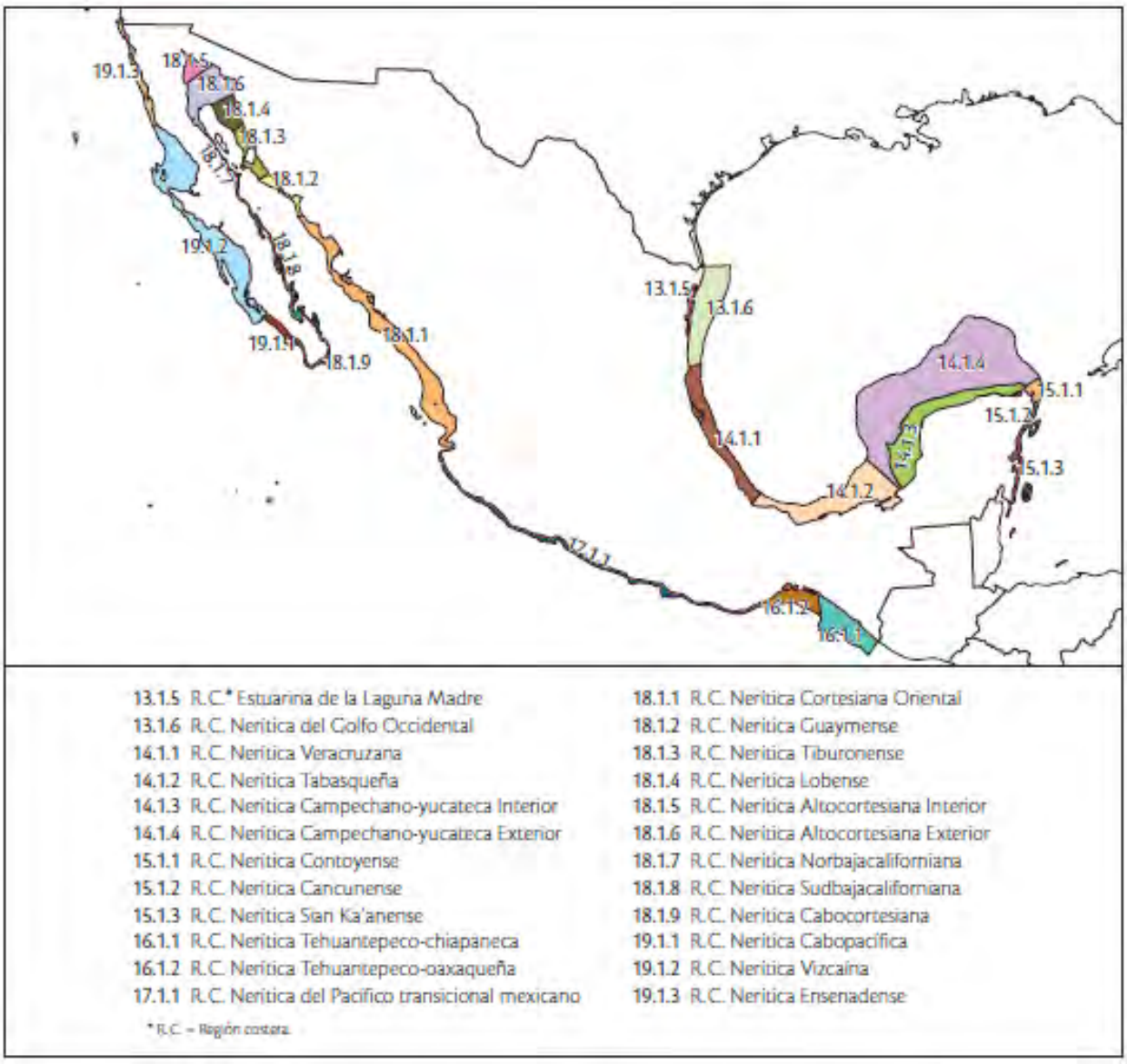
Map 7 Location of Mexico's Coral Reef Ecosystems

Source: Reefbase 2008

Map 7 indicates that Mexico's coral reefs occur in six locations: (1) a small area in the northern west coast and a larger area on the southern east coast of Baja California; (2) the Revillagigedo Archipelago between 500 and 1000 km off the mid-western coast; (3) the Marias Islands closer to the Pacific coast off of central Mexico; (4) off the Southern Pacific Coast; (5) off the Gulf Coast and Bank of Campeche State; and (6) off the eastern coast of the Yucatan Peninsula in the Caribbean Sea.

Map 8 indicates the location of Mexico's coastal ecosystems.

Map 8 Location of Mexico's coastal ecosystems

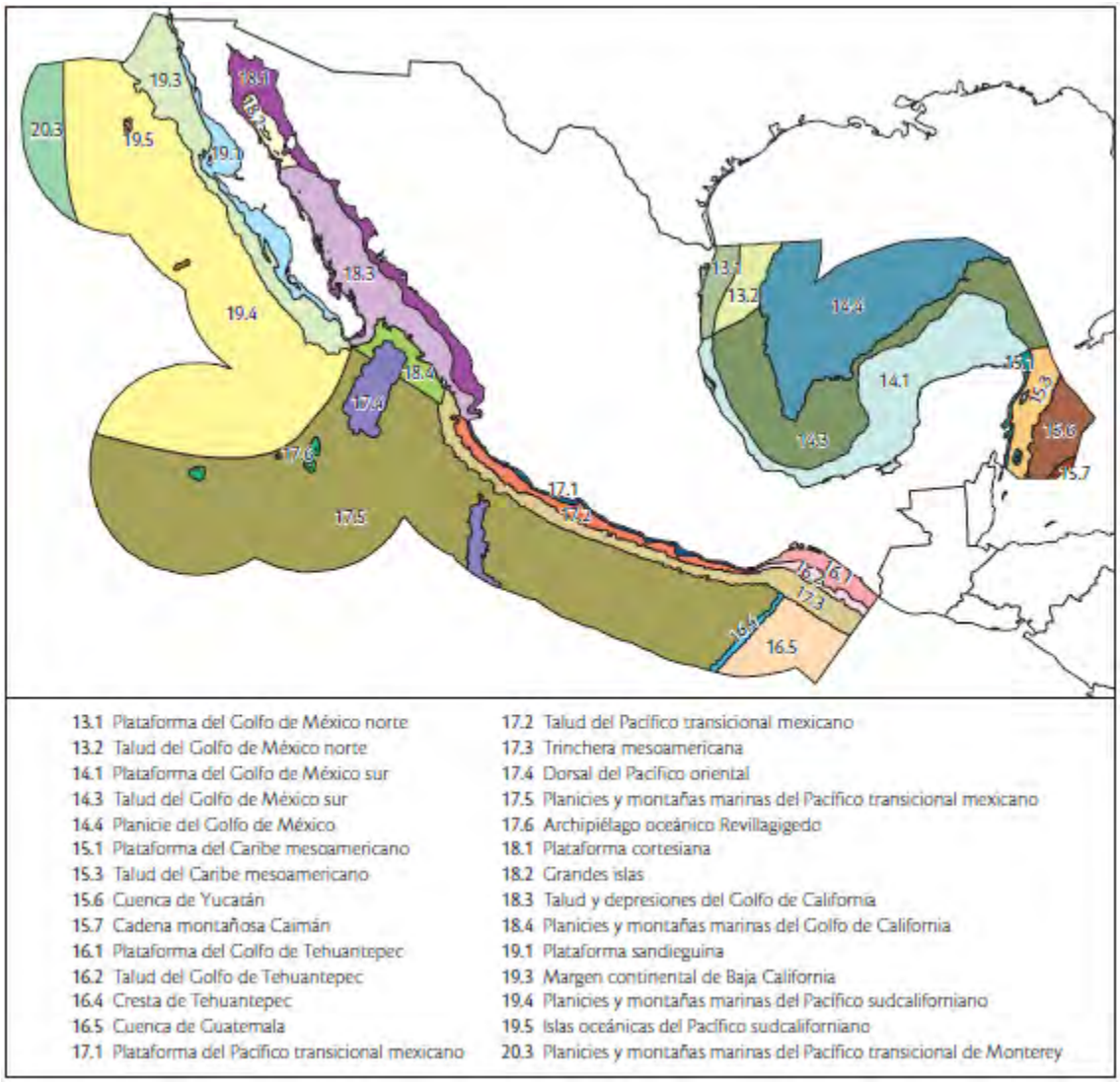


Source: Lara-Lara, J.R, et al.*, 2008*

Map 8 indicates that Mexico has 24 sub-categories of coastal ecosystems, a variety that results from the exposure of Mexico's extensive and varied coastline to a number of ocean currents (Lara-Lara, J.R, et al., 2008).

Map 9 indicates the distribution of Mexico's Open Ocean Ecosystems.

Map 9 Location of Mexico's Open Ocean Ecosystems



Source: Lara-Lara, J.R, et al.*, 2008*

Map 9 indicates the Mexico has 28 categories of Open Ocean Ecosystems. The variety of categories results from the diversity of the topography under Mexico's territorial waters, which includes continental slopes, trenches, ridges and subduction zones, hydrothermal vents, methane seepage areas and submarine canyons (Lara-Lara, J.R, et al., 2008).

3.2 Species Diversity

Terrestrial Species Diversity

Mexico covers only 1.4% of the globe's terrestrial surface but has the fourth largest species diversity in the world, harboring 10% to 12% of all the species known to science (CONABIO, 2010). In addition to its great species diversity, it also has high rates of endemism, due to its varied topography that creates the conditions for many microhabitats and its location where species from further north and further south mingle. Table 3 indicates by taxonomic group

Mexico's total number of known species, estimated total number of species, number of endemic species, and percentage of endemic species.

Table 3 Species Described and Estimated in Mexico

Taxonomic Group	Total number of species known in Mexico	Estimated Total number of species in Mexico	Number of species endemic to Mexico	Endemic Species as % of known species in Mexico
Fish	2,692	2,729	271	10
Amphibians	361	371	174	48
Reptiles	804	812	368	46
Birds	1,096	1,167	125	11
Mammals	535	600	161	30
Insects	47,835	100,000	No Data	No Data
Vascular Plants	25,000	27,000 - 30,000	12,500 – 15,000	50-60

Source: Sarukhan, J. et al, *2009; compilation Sun Mountain International, 2013*

Table 3 indicates that Mexico has 2,692 species of fish, of which 545 are freshwater species (Contreras, in press), 361 species of amphibians, 804 species of reptiles, 1,096 species of birds, 535 species of mammals, 47,835 species of insets and 25,000 species of vascular plants. About 100 species of fish, 10 species of amphibians, eight species of reptiles, 71 species of birds, 65 species of mammals and 52,165 species of insects remain to be described. There are approximately 271 species of endemic fish in Mexico, 174 species of endemic amphibians, 368 species of endemic reptiles, 125 species of endemic birds, 161 species of endemic mammals, and 12,500 to 15,000 species of endemic vascular plants. Ten percent of Mexico's fish, 48% of its amphibians, 46% of its reptiles, 11% of its birds, and 30% of its mammals are endemic. There are no data on how many of Mexican insects are endemic. About 50 to 60% of Mexican vascular plants are estimated to be endemic.

The highest levels of mammalian endemism are in the *Eje Neovolcanico* and the watershed of the Balsas River, a major river of south-central Mexico that flows through the states of Puebla, Morelos, Guerrero and Mexico, and empties itself into the Pacific Ocean at Mangrove Point, adjacent to the city of Lázaro Cárdenas in Michoacán State. Endemic bird species are concentrated at elevations of 2,000 meters in the *Sierra Madre Occidental*, *Eje Neovolcanico*, and *Sierra Madre del Sur* in pine, oak and mesophile mountain forests and in the Revillagigedo and Three Marias Islands. The highest concentration of reptile and amphibian endemism occurs in the *Eje Neovolcánico*, the *Sierra Madre del Sur*, and along the Pacific Coast (Koleff and Soberón, et al., 2008). The greatest mammalian diversity occurs in the states of Oaxaca, Veracruz, Chiapas and Tabasco, while the greatest bird diversity is found on the coastal plains of the Gulf of Mexico, the Yucatán Peninsula, the Tehuantepec Isthmus and the coast of Oaxaca. The greatest amphibian diversity is in the states of Oaxaca, Veracruz and Chiapas (Koleff and Soberón, et al., 2008). The highest diversity of angiosperm species is located in the states of Chiapas and the Neovolcanic Axis and in the *Sierra Madre Occidental Sierra* and *Sierra Madre Oriental* (Koleff and Soberón, et al., 2008). Overall, the mountains in the north of Chiapas and Oaxaca are the regions of Mexico with the greatest species diversity in the smallest area (Koleff and Soberón, et al., 2008).

Forty-nine species of Mexico's terrestrial flora and fauna are probably extinct, and another 475 species are at risk of extinction. There are 896 threatened animal species and 1,185 species that require special protection in order to survive. About 415 locations in Mexico have been identified as the last remaining sites where high concentrations of terrestrial threatened or endangered species of mammals, birds, reptiles, amphibians and freshwater fish remain. For mammals these sites are in the states of Chiapas, Oaxaca, Baja California and Baja California Sur. For birds, they are in the states of Chiapas, Oaxaca and Quintana Roo. For reptiles, they are in the states of Chiapas, Oaxaca, Baja California, Baja California Sur, Guerrero and Veracruz. For amphibians, they are in the states of Oaxaca, Guerrero and Veracruz, and for freshwater fish, they are in the states of Oaxaca, Chihuahua, Michoacán, Veracruz and Jalisco (Ceballos et al., 2009).

The biodiversity of the soils of Mexico has not been studied thoroughly, but Mexican soils are known to have a wide variety of microorganisms, invertebrates, vertebrates and fungi (Negrete Yankelevich and Barois Boullard, 2012).

Marine Species Diversity

Relatively little is known about Mexico's marine species diversity. There are at least 1,782 species of marine fish (Contreras, in press, in: Koleff and Soberón, et al., 2008). Coral reefs are the most biologically diverse marine ecosystems in Mexico and also provide important habitat for the reproduction and protection of fish and other aquatic fauna (Sarukhan, J., et al., 2009). There are between 63 and 81 species of coral in Mexican reefs, representing between 8 and 10 percent of all known coral species worldwide (Carricart-Ganivet and Horta-Puga, 1993; Spalding et al., 2001). The extensive fringing reef along the Yucatan Peninsula is connected to the barrier reef off Belize.

Many islands are important habitat for bird, seal, and sea turtle reproduction, particularly near Baja California and in the Gulf of California. Over 218 endemic plant and animal species and subspecies, including 81 reptiles, 45 birds and 92 mammals live on or around the islands, keys, banks and reeds in this region (Sarukhan, J., et al., 2009). Many of these species, especially those of birds, reptiles and cacti are endemic, although some of them are extinct due to competition from invasive species.

At least 349 species of echinoderms live in Mexico's deep waters (Francisco Solís Marín, n.d.). In the Gulf of Mexico, 227 species of animals have been identified (Briones, 2000). The *vaquita* porpoise (*Phocoena sinus*), for instance, lives only in the Gulf of California (Ceballos and García, in press). Hydrothermal vents create a particularly biodiverse habitat, where life forms occur that are unknown elsewhere on earth (Challenger, A. and J. Soberón, 2008)

3.3 Genetic Diversity

Terrestrial Genetic Diversity

Most of the genetic diversity that occurs in Mexico's wild and domesticated species has not been studied. Only 97 plant species, for example, have been studied at the genetic level, and they are mostly plants with economic value. Thirty-six of Mexico's mammal species, five of its

bird species, 27 of its reptile species, 16 of its fish species, and 27 of its insect species have been studied to some extent at their genetic level (CONABIO, 2010).

Genetic variation is known to be typically highest in the centers of origin of a species, and Mexico is a center of origin of about 10% of the 128 most economically valuable species of plants in the world, including corn, cotton and some of the micro-organisms that fix atmospheric nitrogen. Its reserves of genetic variation in both domestic and wild relatives of these species, therefore, are of global importance (CONABIO, 2010).

Marine Genetic Diversity

No data were available about Mexico's marine genetic diversity. Speculation suggests, however, that the high diversity level of its marine species may be matched by a high genetic diversity in some of those species.

4 THREATS TO BIODIVERSITY AND TROPICAL FORESTS

4.1 Loss and Degradation of Habitats

Loss of habitat refers to the complete elimination of natural vegetation on an area, while degradation of habitat means a change in species composition and structure of vegetation and fragmentation of contiguous vegetation into smaller, more isolated patches of vegetation.

No data were available for loss of habitat based on the vegetation types of Mexico shown on Map 6. Table 4, however, compares the area of Mexico's original vegetation, according to another similar classification, to the remaining area of these vegetation types.

Table 4 Original and Current Area of Vegetation Types in Mexico

Vegetation Type	Original Area of Natural Habitat (ha)	Remaining Area of Natural Habitat (ha)	Change in Area of Natural Habitat (ha)	Change in Percentage of Natural Habitat (ha)
Tropical rainforest	**25,480,042**	**15,151,162**	**10,328,880**	**41**
Tropical dry forest	25,857,995	16,435,731	9,422,264	36
Temperate forests	47,043,879	34,155,715	12,888,164	27
Total forest habitat	98,381,916	65,742,608	32,639,308	33
Scrublands	60,009,502	50,895,897	9,113,605	15
Grassland	16,279,081	10,315,933	5,963,148	37
Aquatic vegetation	3,380,776	2,436,607	944,169	28
Halophytic vegetation	4,947,186	4,638,338	308,848	6
Other vegetation	9,987,814	6,794,238	3,193,576	32
Riparian vegetation	189,465	164,458	25,007	13
Total	193,175,740	140,988,079	52,187,661	27

Source: Sánchez Colón et al. *2009.*

Table 4 indicates that the original extension of Mexico's natural vegetation was 193,175,740 ha, and that this area has been reduced to 140,988,079 ha at present, a decrease of 27%. Temperate forests have decreased the most in total area, from an original area of 47,043,879 ha to a current area of 34,155,715 ha, a decrease of 27%.

Temperate forests, however, have decreased less in percentage than several other types of Mexico's natural vegetation. Tropical rain forest has decreased the most in percentage; 41% has been eliminated, a decrease of 10,328,880 ha from its original area of 25,480,042 ha. Grasslands have decreased from 16,279,081 ha to 10,315,933 ha, a decrease of 37%. The tropical dry forest habitat has decreased by only a slightly smaller percentage; its original area was 25,857,995 ha and only 16,435,731ha are left, a decrease of 36%. Other vegetation types have decreased by the fourth largest percentage; their original area was 9,987,814 ha and 6,794,238 ha remain - a decrease of 32%. Scrublands had the largest original area of natural habitat in Mexico with 60,009,502 ha. It remains the largest area of natural habitat with 50,895,897 ha, but has decreased in area by 9,113,605 ha, or 15%. Halophytic and riparian vegetation have decreased by 6% and 13% respectively.

Table 4 indicates that the original combined area of tropical rainforest, tropical dry forest and temperate forest in Mexico was 98,381,916 ha. Of these hectares, 32,639,308 ha have been eliminated and 65,742,608 ha remain, so forest has been eliminated from 33% of its original area and remains, in some form at least, on 77% of its original area.

Until the mid-20th century, deforestation had affected mostly the temperate forests of the Central and Northern Plateau. In the decades of the 1950's, 60's and 70's, rapid deforestation nearly eliminated the tropical rainforests of the coastal plain of the Gulf of Mexico, the northern Yucatán Peninsula, and the tropical Pacific Coast from Jalisco south to Chiapas. Since the early 1980's, by contrast, deforestation has been occurring most rapidly in Mexico's tropical dry forests (Sarukhán, J., et al., 2009). The rate of deforestation, however, has slowed during recent years. Thus from 1973 to 1992 the rate of deforestation was about 406,000 ha/year (SEMARNAT, 2005), while between 1990 and 2000 the rate of deforestation decreased to 348,000 ha/year and between 2000 and 2010 it decreased further to 260,000 ha/year (SEMARNAT, 2010).

Although Table 4 indicates that 140,988,079 ha of natural habitat do remain in Mexico, most of it has been degraded. Degradation has occurred in part as a result of over-exploitation of the habitat. The dry tropical forests of Quintana Roo, for example, have been severely degraded through the extraction of their most commercially valuable trees without adequate regeneration of these trees (Kernan, pers. obs.; Merendez, pers. com). Pollution has degraded much of Mexico's wetland habitat, and much of its marine environment has been severely degraded by constant trawling for fish and shrimp; for example, each single square meter in the Gulf of California, is typically trawled 20 to 30 times every year, causing drastic changes in the ecosystem and to the absolute and relative numbers of species (Interviewee 1, 2013).

The statistics on loss of habitat given in Table 4 also fail to capture the extent to which fragmentation has degraded Mexico's natural habitats. Of Mexico's 15,151,162 ha of tropical rainforests, only 15% occur in an area of more than 20 contiguous hectares (CONABIO, 2010). Large contiguous areas of natural forest habitat remain only in the more remote regions of Mexico, including Chimalapas in Oaxaca, Lacandon in Chiapas, Calakmul in Campeche and the Sierra Madre Occidental in Durango and Chihuahua (Sanchez Colon et al., 2009). Likewise, only a fragment marshes in Central Mexico – 3,000 ha of the original 30,000 ha – now remain (Ceballos, pers. obs. 2013), The pine and oak forests of the states of Michoacán and Puebla occur in relatively small patches, generally adjacent to or interspersed with agricultural and pasture land (Kernan, pers. obs. 2013).

Wildfires, which burn thousands and sometimes hundreds of thousands of hectares of land in Mexico every year during the dry season, are a principal factor in the loss and degradation of its natural habitats and, therefore, of its biodiversity and forests. The temporal and spatial occurrence of such events varies, depending on the local and regional physical, demographic pressures, land use and the extent of management. Human-induced fires result mostly from traditional agricultural practices. Farmers use fire to burn crop residues, prepare fields for cultivation and renovate pastures, but they generally take no precautions to prevent the fires from spreading into neighboring areas of natural vegetation (G. Jimenez, pers. comm., 2013; Kernan, pers. obs. 2013). Fire is also used as a means to illegally expand the agricultural and

livestock frontier. Between 1991 and 1998, there was an average of 8,862 fires per year that affected an average of about 275,000 hectares per year (SEMARNAT, 1999). Some years, however, are particularly prone to large fires such as occurred in 1988 and 1989, when wildfires burned more than half a million hectares. About 90% of these wildfires, however, affect scrubland and grasslands rather than forests. As of April 2013, there had been more than 12,000 recorded wildfires in Mexico and they had affected more than 200,000 ha, with two month remaining in the dry season (CONABIO, 2013).

Social, political, and economic factors have driven habitat loss and degradation in Mexico. Economic and population growth have stimulated demand for infrastructure, such as dams, irrigation systems and buildings, whose construction indirectly and directly tend to cause irreversible loss and degradation of natural habitats. Over the last few decades, Mexico's primary, secondary and tertiary road system has been greatly expanded and improved, so that land uses in formerly relatively remote areas of the country are now being affected by national and even international markets for goods and services (Kernan, pers. obs., 2013). Poverty also remains a driver of habitat loss and degradation in Mexico. In spite of Mexico's recent rapid economic growth, 50 million Mexicans still live in poverty, and some of them survive by extracting products from natural habitats, such as timber, plants, and animals, using exploitation methods that cause the irreversible loss or degradation of these environmental products (Campos, Hernandez, Velazquez, Perez, Carrillo, pers. comm., 2013).

4.2 Pollution of Habitats

The accumulation of contaminating substances, such as metals, agrochemicals, or organisms such as bacteria, parasites, and viruses, causes pollution when it affects the relative abundance of different species or ecosystem functions in aquatic and terrestrial ecosystems.

Pollution of Aquatic Habitats

In Mexico, water quality is monitored at the 1,627 sampling sites that are part of the National Monitoring Network (SEMARNAT-CONAGUA, 2012). Monitoring stations are mostly located close to population centers and industrial areas, and some parts of Mexico have fewer sampling sites than others. Few data are available, for example, on the water quality in the states of Baja California, Yucatán, Guerrero, Oaxaca and Chiapas. Table 5 indicates the results of an analysis of water quality data from 725 sampling sites in Mexico in 2012.

Table 5 Pollution data of water in Mexico at 725 sampling sites.

Quality	Water Quality Indicator		
	BOD	COD	TSS
Heavily polluted (%)	3.8	5.6	0.6
Polluted (%)	7.5	20.4	2.5
Acceptable quality (%)	18.9	21.2	11.4
Good quality (%)	27.5	23.6	30.2
Excellent quality (%)	42.3	29.2	55.3

Source: SEMARNAT-CONAGUA, 2012.

Key: BOD = biochemical oxygen demand, COD = chemical oxygen demand and TSS = total amount of suspended solids

Table 5 indicates that, depending on which parameter is used, the water at 3.1% - 26.0% of the sampled sites was polluted, while the remaining sites had acceptable to excellent water quality (SEMARNAT-CONAGUA, 2012). The highest COD and BOD values occurred in the densely populated areas of central Mexico (SEMARNAT-CONAGUA, 2012). However, Mexican water bodies may actually be more polluted than is indicated by these monitoring data, as the data do not measure all physical, chemical and biological contaminants (Mazari-Hiriart, et al., 2010). Furthermore, the level of pollution is likely to rise in the future, together with increasing demand from water from industrial, agricultural and urban areas (Torregosa, et al., 2012).

Most water pollution in Mexico is caused by the discharge of untreated wastes into water bodies from industrial, household, agricultural and ranching operations, and the excessive sedimentation from agricultural practices. Less than 40% of Mexico's wastewater is treated, and many Mexican industries continue to discharge untreated waste directly into bodies of water. Fertilizer and pesticide runoff from agricultural fields contaminates water bodies to varying degrees, depending on the volume of water and the abundance of riparian vegetation (Jimenez, et al., 2010; Santo Domingo and Ashbolt 2008). Sometimes water contaminants are transported downstream and accumulate in water bodies, such as lakes, marshes, mangroves, and other freshwater and marine ecosystems (Cotler & González, 2010; Ruelas, et al., 2010).

Discharge of urban sewage and runoff from livestock production frequently introduces feces into aquatic environments, causing eutrophication. This reduces the availability of oxygen and thereby degrades aquatic habitats, killing or stunting aquatic species, increasing the persistence and survival of human and marine animal pathogens and exposing marine mammals to terrestrial pathogens such as toxoplasmosis (Santo Domingo and Ashbolt, 2008).

Pollution from pesticides and other chemical contaminants, can severely affect biodiversity. Pesticides, for example, can cause cancer, tumors and lesions, reproductive failure, suppression of immune systems, disruption of the hormonal system, cellular and DNA damage, terathogenic effects (physical deformities), and thinning of egg shells on aquatic and terrestrial organisms (Ongley, 1996). Naranjo and Dirzo (2009) found high concentrations of heavy metals in Mexican oysters, shrimp, shark, clams and fish.

In recent years, Mexican industry has increased the percentage of industrial waste that which is treated. Between 1999 and 2007, only 7% of total treated industrial water met government standards for water quality, while by 2008, 31% of industrial treatment plants treated water to Level I, 55% to level II, and 3% to Level III, the highest federal water quality standards in Mexico (Torregosa, et al., 2010; López Zavala & Flores Arriaga, 2010).

Pollution of Soil Habitats

Soil in many areas of Mexico is being polluted. Spills or discharges of hydrocarbons and derivatives, metalloids from mining, halogenated hydrocarbons from industrial processes and halogenated products such as trichloroethane and pesticides cause most contamination of soils (SEMARNAT, 2010).

Solid waste also contaminates soils, when it is thrown to the roadside or into ravines and rivers. In 2007, only 67% of Mexico's solid waste was disposed of in landfills (SEMARNAT,

2008). The cities of Aguascalientes, Nuevo León and Mexico D.F. were the only ones to disposed most of their solid waste in landfills in this year. When improperly disposed, solid waste can contaminate water which can the leach into and contaminate soil or, if discarded into a water body, can be carried downstream, polluting riparian and aquatic habitats.

Between 2004 and 2008, Mexico produced more than one million tons of hazardous waste. Around 31% of this hazardous waste is generated in the metropolitan area of Mexico City, and about 17% in the State of Chihuahua. Hazardous waste is mostly used oil, solids such as asbestos, heavy metals and derivatives from industrial management, and biological and infectious materials (SEMARNAT, 2008). Mexico is producing more solid waste every year, so the problem of it polluting natural habitats is increasing constantly and rapidly.

Salinization could be considered a type of soil pollution. It occurs principally in arid, closed basins and coastal areas as a result of poor irrigation practices. Salinization is occurring in the mostly in the states of Tamaulpas, San Luis Potosí, Chiapas, Nuevo León, Oaxaca, Veracruz and Zacatecas.

Soil pollution threatens biodiversity and forests when it damages or inhibits the growth of plants, animals and microorganisms, reduces soil fertility and modifies biological processes (Fernandez Linares, et al., 2006). Although some plants are able to survive soil pollution, they may take up contaminants through their roots that then stunt or alter the plant's growth and life cycle. If animals then eat the contaminated plants, their health and reproduction may be affected (EPA, No Date).

4.3 Over-exploitation of Plants and Animals

The exploitation of wild plants and animals in Mexico provides many products of economic value, such as pets, pelts, ornamental plants, drugs for medicine, food, honey, fruits, oils, wood, forage for domestic animals, and game. The sustainable use of wildlife can thus provide a financial incentive for the conservation of biological diversity and forests.

Over-exploitation, however, has severely affected the populations of some of Mexico's plant and animal species. Over-exploitation of a species can affect not only the species itself but also other species. When ecosystems lose most of their wildlife, for example, their structure and function are severely affected, which leads to a cascade of negative environmental impacts. (Wilkie et al., 2011). If a species plays an important role as a food source or in the regeneration of a species, a decline in its population may affect other species. A reduction in the population of a prey species, for example, generally causes a reduction in the population of its predators (Chavez et al., 2007). Reduced populations of organisms may also change the structure and functions within an ecosystem, causing it, for example, to exert less control over hydrological and nutrient cycles (Ceballos and Ehrlich, 2002). Over-exploitation of Mexican wildlife has been driven by three main factors: commercial trade, subsistence hunting and extermination campaigns against organisms considered to be pests.

Over-exploitation for Commerce

Commercial trade has caused the decline in population or extinction of a number of species of Mexican animals and plants. During the 1800's, for example, American, Russian and Japanese

companies hunted Mexico's populations of sea otters (*Ehydra lutris*) to extinction. Between 1969 and 1971 about 1,500 jaguar skins were legally exported from Mexico to the United States. A national census of jaguar populations indicated that there were then only about 4,000 jaguars left in Mexico in 2007 (Chavez, et al., 2007). Until 1994, thousands of nesting sea turtles could still be legally killed each year on Mexico's beaches. Banning commercial hunting of marine turtles has permitted the populations of five species of marine turtle that nest on the Caribbean, Pacific, and Gulf of Mexico coasts of Mexico to recover (IUCN, 2010).

Some commercially valuable marine species, including sharks, sea cucumbers, and tuna currently are being overexploited in Mexico's territorial waters (Sarukhan, et al., 2009). There has been a steep decline in the populations of tuna and sharks over the past few decades (Casey, et al., 1998), probably because foreign fishing ships regularly exceed their quotas for fishing within Mexican territorial water with impunity. This is in part because the Mexican Ministry of Agriculture and Fisheries lacks sufficient funds to take the measures that are required to enforce the quotas. The illegal trade of wild plants and animals such as orchids, cacti, bromeliads, reptiles, amphibians, fur animals, macaws, and song birds persists as these plants and animals continue to be collected or captured, mostly for export to markets in the United States and Europe.

Subsistence hunting

Subsistence hunting has caused a severe decline or extinction of some Mexican species. In the 1960's, for example, the imperial woodpecker (*Campephilus imperialis*) was hunted to extinction for food (Ceballos and Navarro, 1991). Subsistence hunting continues to occur throughout Mexico in most places where wild animals still occur in sufficient numbers to make hunting them worth the effort. It is most common in the tropical rainforests of the Yucatan Peninsula and Chiapas. Peasants probably kill thousands of deer, peccary, coati, spider monkey, white-lipped peccary, agouti, armadillo, wild turkeys, quails, doves, iguanas, and turtles there every year (Escamilla, et al., 2000). Some species of wildlife are more affected by subsistence hunting than others, because of their intrinsic vulnerability (Ceballos and Navarro, 1991). For example, subsistence hunting has endangered spider monkeys and white-lipped peccaries, while white tail deer, although hunted, still occur in many areas, and overall are not endangered (Escamilla, et al., 2000). In Mexico, as in other countries, subsistence hunting has created "empty forests", where although the forest remains, it has few or no animals left.

Extermination of species as pests

During the twentieth century, some Mexican animal species were considered pests and campaigns were undertaken to exterminate them. In the 1960's and 70's, for example, the United States financed a campaign to poison Mexican wolves (*Canis lupus baileyi*) and grizzly bears (*Ursus artos*) along the Mexico-United States border, considering them as predators of cattle. Currently, Mexico has no programs to eliminate animals. Many Mexican ranchers, however, continue to kill pumas (*Puma concolor*) and jaguars (*Panthere onca*) because they consider them a threat to livestock.

4.4 Introduction & Spread of Invasive Species

Exotic species that have been introduced, accidently or intentionally, into Mexico include at least 60 species of mammals, 30 species of birds, seven species of reptiles, and six species of amphibians. An unknown number of fishes and 220 species of plants also have become established in Mexico (Alvarez Icaza & Muñoz, 2008). Many of these species spread aggressively and affect the survival of native Mexican organisms.

Devilfish or plecostomus (*Hypostomus plecostomus*) and tilapia (*Oreochromis* spp), for example, are exotic species that cause a decline in the populations of native freshwater aquatic species. The introduced lionfish (*Pterois volitans*) in Mexico's Caribbean waters eats 34 species of native fish and 45 species of crustaceans (Valdez Moreno, et al. 2012).

One of the most harmful introduced exotic plants is buffelgrass (*Pennisetum ciliare*), which reduces the diversity and productivity of native plants. Even so, the Mexican government continues to promote it for pasture in dry areas (Franklin and Molina-Freaner, 2010; Morales-Romero and Molina-Freaner, 2008). Other examples of such harmful exotic plants include the Salt cedar, (*Tamarix ramossisima*), which spreads aggressively in dry areas of northern Mexico, suppressing the growth native vegetation; the Hydrila (*Hydrilla verticillata*), which has invaded bodies of fresh water bodies; and the Melaleuca (*Melaleuca quinquenervia*), which has spread across many terrestrial ecosystems (CONABIO, 2012).

House cats have also caused the local extinction of native animals, including endemic, small vertebrates (Vazquez-Dominiquez, et al. 2004). Other especially aggressive exotic invasive species in Mexico are cactus moths (*Cactoblastis cactorum*) and Barbary sheep (*Ammotragus lervia*).

4.5 Climate Change

Mexico's Fourth Report to the Convention on Biological Diversity predicts that climate change will become one of the main threats to Mexico's biodiversity.

Climate change could threaten Mexico's biodiversity and forests by causing shifts in the geographic distribution and/or the area of some ecosystems. Such shifts could change the total area and the location of the habitats available for some species of organisms. Research commissioned by the National Institute of Ecology in 2008, for example, found that "based on considerations of temperatures, humidity, altitude, type of vegetation and plagues … forests could be affected in up to 7% and 11% of their total surface area by temperature increases of 1°C and 2°C, respectively" (CIFOR, 2010).

The same study

> "…selected 12 forest species distributed in three climate zones and assessed the potential distribution of each species under the baseline and climate change scenarios" and " showed that "…the most severe impacts in temperate zones could be felt by *Pinus cembroides* and *Pinus pseudostrobus* as a consequence of an increase in the area with conditions not suitable for its growth. The north of the central part of the country would see an increase in the extension of the surface not suitable for temperate species; however, due to the particular conditions found in the center of the State of Chihuahua

some non-suitable areas for such species would become moderately and marginally suitable."

If climate change so affects the distribution of *Pinus cembroides* and *Pinus pseudostrobus,* it could similarly affect other organisms. If an organism is unable to adapt to the new habitat or shift its range to correspond to the new locations of the habitat it requires for successful reproduction, then its reproductive success may decline, perhaps to a level that is so low that it eventually becomes extinct in parts or all of Mexico. Species in isolated ecosystems with low species diversity, such as islands, are particularly vulnerable to climate change. Likewise, climate change threatens plants in mountain ecosystems because they cannot migrate upwards to cooler climates as the areas which they now inhabit become warmer. Endemic species, for example, are especially at risk of extinction in Mexico's high-elevation cloud and oak-pine forests (Carabias, et al. 2010).

Climate change may also affect Mexico's biodiversity more directly and quickly by changing the length, number and geographic extent of droughts. Fire already greatly influences the distribution and composition of vegetation in upland and lowland Mexico (Kernan, pers. obs., 2013). Longer and more severe droughts would be likely to increase the frequency, extent and severity of such fires and make them an even greater factor in the location and species composition of the vegetation and the animals which depend on the habitat that is burned. On the other hand, if climate change causes longer rainy seasons and more total precipitation in some parts of Mexico, then it would affect the distribution and composition of vegetation types and their associated organisms differently.

Climate change in Mexico could affect its biodiversity by raising the seal level. If the sea level were to rise by a meter, up to 9% of the states of Campeche, Nayarit, Quintana Roo, Sinaloa, Tabasco, Tamaulipas, Veracruz and Yucatán would be inundated, thereby changing the location, extent and structure of terrestrial and estuarine habitats, such as mangroves, and their associated organisms, as well as the marine species that spend part of their life cycle in such habitats (Gilman, 2008; NOAA, 2012).

A fourth effect of climate change in Mexico could be the result of increased number and intensity of hurricanes. Hurricanes greatly affect the species composition of the forests of the Yucatan Peninsula. Mahogany, for example, is a species that regenerates after hurricanes and fire, so its abundance could increase as a result of an increase in the number and severity of hurricanes.

Finally, climate change could magnify the effects of interactions between human activities and ecosystems on the abundance and variety of organism. For example, higher human populations will produce more contaminants that will be carried through ecosystems more rapidly and in greater volumes if climate change causes more frequent and more severe climate events such as hurricanes.

5 ACTIONS NEEDED TO CONSERVE MEXICO'S BIODIVERSITY AND TROPICAL FORESTS

5.1 Conservation within Protected Areas

5.1.1 Justification

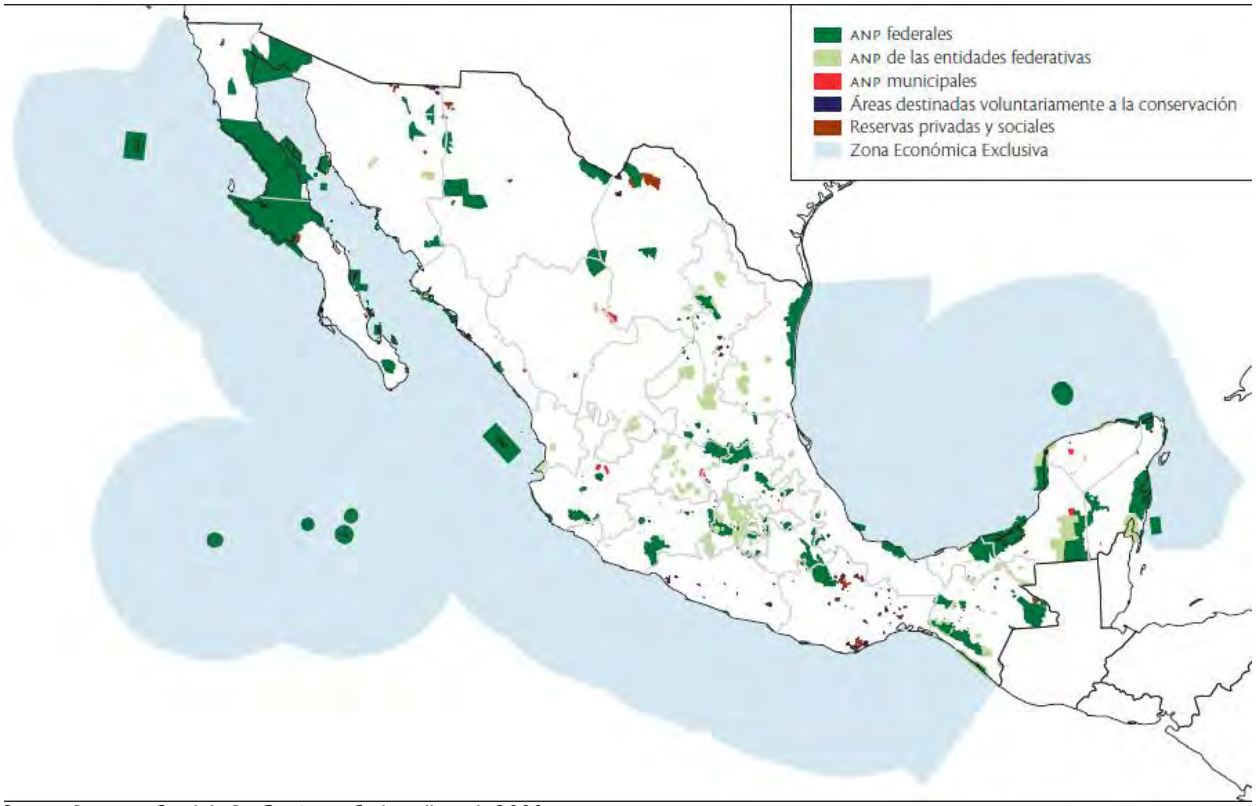
Protected areas, including botanical gardens, seed banks and zoos, provide areas whose main purpose is the permanent conservation of biodiversity and tropical forests.

5.1.2 Current Situation

Natural Protected Areas

Map 10 indicates the location of Mexico's legally declared Natural Protected Areas (ANPs). The map's legend indicates that Mexico's ANPs have been established by six types of entities: the federal government (dark green); state governments (light green) (referred to in the map's legend as "federated entities"); municipal governments (red); areas voluntarily dedicated to conservation (blue); and private and social entities (brown).

Map 10 Natural Protected Areas of Mexico



Source: Bezaury-Creel, J., D. Gutiérrez Carbonell et al. *2009*

The federal has established the greatest number and largest of Mexico's APNs. Particularly large federal APNs are in Baja California, northern Mexico and on the Yucatan Peninsula, while

smaller federal APNs are in central Mexico. States have established the next largest number and area of APNs. Municipal ANPs, areas dedicated voluntarily to conservation, and private and social ANPs are fewer in number and have smaller total areas. Of the marine ANPs, 37 were created by the federal government, and 27 were created by state governments (CONABIO, CONANP, TNC, Pronatura & FCF-UANL, 2007b).

Mexican ANPs occur in six categories: biosphere reserves; national parks; natural monuments; protected areas for natural resources; protected areas for flora and fauna; and sanctuaries. Table 6 indicates the number and total area for each of these categories.

Table 6 Management Categories, Numbers and Areas of Mexico's National Protected Areas in Mexico

Category of Protected Area	No	Area (Ha)
Biosphere Reserves	41	12,652,787
National Parks	67	1,445,301
Natural Monuments	5	16,268
Protected Areas for Natural Resources	8	4,440,078
Protected Areas for Flora and Fauna	37	6,687,284
Sanctuaries	18	146,254
Total	176	25,387,972

Source: CONANP, 2012

Table 6 indicates that the total area within Mexico's ANPs is 25,387,972 ha, about 1.3% of Mexico's total area. About half of this area, 12,652,787 ha, is within 41 biosphere reserves, where, except for their nuclear zones, rural communities are permitted to use natural resources, if they do so sustainably (CONANP, 2012). The next largest total area of ANPs, 6,687,284 ha, is within 37 protected areas for flora and fauna. There are eight protected areas for natural resources with a total area of 4,440,078 ha. Although there are 67 national parks, their combined area is only 1,445,301 ha. Five natural monuments and 18 sanctuaries have 16,268 ha and 146,254 ha respectively.

Map 10 indicates the location of the biosphere reserves (dark green), national parks (light blue), areas for the protection of flora and fauna (red), natural monuments (red), and protected areas for natural resources (yellow). It does not show the location of the sanctuaries or the protected areas for natural resources, but they may be included in other categories (light green) or decreed areas (gray).

Map 11 Categories of Natural Protected Areas in Mexico

Source: SEMARNAT, n.d.; in Verdebandera, 2013

Map 11 indicates that Mexico's biosphere reserves are located mostly in the northwest, the central highlands, Chiapas, the Yucatan Peninsula and in marine areas. In Baja California, northern Mexico and the coast of the Gulf of Mexico, there are large areas for the protection of flora and fauna. The larger national parks are located around Mexico City. .

Of Mexico's total of 176 ANPs, 58 are entirely or partially marine areas and they include over 12 million ha. Map 11 indicates that there are many marine protected areas with the Gulf of California and in the Pacific Ocean and fewer in the Gulf of Mexico and the Caribbean Sea. Thirteen of the marine ANPs occur in areas of coral reefs, nine in the Gulf of Mexico and four off of the Pacific coast (SEMARNAT, n.d.).

Botanical Gardens and Zoos

There are 51 officially registered botanical gardens in Mexico, although between 2000 and 2006 only 37 were active (Lascuráin, et al., 2009), and between them they have specimens of a little more than 10% of all the Mexican plant species.

Mexico's seed banks mostly store seed of commercially important crop species, although some banks also have the seed of medicinal plants. The International Center for the Improvement of Corn and Wheat has a seed bank with capacity for 450,000 seed samples, but its seeds are almost entirely of varieties of corn, wheat, barley, and rye. Other important seed banks include

the UNAM Iztacala bank and the National Bank of Plant Germoplasm of the Autonomous University of Chapingo.

Eighty-nine zoos are registered with the Directorate General for Wildlife of SEMARNAT. No information was available about their significance for the conservation of Mexico's fauna.

5.1.3 Priority Issues and Actions

(1) Increase Natural Protected Areas

Most of Mexico's ANPs were originally selected for their natural beauty rather than to conserve a representative sample of all of Mexico's habitats. As a result, although 25 of Mexico's 52 types of natural vegetation are well-represented in its ANPs, 27 of its vegetation types have less than 10% of their total area within ANPs and some of them have no representation in any ANP (Arriaga Cabrera, 2009). Although 96% of Mexico's threatened or endangered birds occur in Mexico's ANPs, only 82%, 61% and 38% of its threatened or endangered mammals, reptiles and amphibians, respectively, occur within an ANP (Ceballos, et al., 2009). Furthermore, only 49% of Mexico's endemic reptile species, 30% of its endemic amphibian species, 60% of its reptile species at risk of extinction and 30% of its amphibian species at risk of extinction occur with ANPs. These data indicate that Mexico's current number and extent of ANPs are insufficient to ensure the conservation of its biodiversity and tropical forests. The highest concentration of regions that require additional coverage in ANPs is in the states of Oaxaca and Quintana Roo (Arriaga Cabrera, et al., 2009), mostly in mountainous areas, where Mexico's natural habitat is best conserved (Arriaga Cabrera, et al., 2009). Consequently, CONANP has established a goal of protected at least 30% of Mexico's terrestrial and aquatic habitats within the next ten years (Ceballos and García, in press). A priority necessary action to protect Mexico's biodiversity, including its tropical forests, is therefore to ***increase the area, number and representatives of Mexico's ANPs***.

(2) Increase ex-situ conservation

Because Mexico has lost so much natural habitat, ex-situ conservation is the only way to conserve many of Mexico's threatened species. Yet Mexico's zoos have only 417 of the 1,588 vertebrate species that in 1998 the International Union for the Conservation of Nature (IUCN) listed as threatened in Mexico, and its botanical gardens have only 363 of the 9,801 plant species listed in the 2001 Mexican Red List as requiring ex-situ conservation to survive (SEMARNAT, 2002, in: Lascuráin, et al., 2009). Furthermore, Mexico's seed banks have mostly the seeds of economically important varieties. They do not include the majority of threatened wild and domesticated plant species. A priority conservation action, therefore, is to ***increase the ex-situ conservation of Mexico's threatened plants and animals.***

(3) Prepare management plans for ANPs

Management plans for ANPs provide essential guidance for their effective management to achieve permanent conservation of biodiversity and tropical forests, and Mexican law requires all protected areas to have a management plan. Yet many of Mexico's protected areas lack

[1] The Mexican Red List of Threatened Species (Norma Oficial Mexicana 059) has since been updated, but updated information on the number of listed species in botanical gardens was not identified.

technically-sound, up-to-date management plans, although the number could not be determined for this report. A priority action for the conservation of Mexico's biodiversity and forests, therefore, is to ***prepare technically sound, up-to-date management plans for all the ANPs.***

(4) Reconcile protected areas and human needs

Most of Mexico's ANPs were simply declared by the government without prior consultation or agreement with their numerous inhabitants. Moreover, rarely has the government paid the inhabitants any compensation for the restrictions on the use of their land that the creation of an ANP requires, much less purchased their land, as required by law. Some of the inhabitants of the ANP's thus feel that their rights to exploit the natural resources within the ANPs have been unfairly restricted or fear that their rights to the land itself has been placed at risk by the creation of the ANPs (A. Pacheco, pers. comm., 2013).

A human presence, however, is not always inimical to conservation within ANPs. Sometimes, in fact, ANPs may create sources of income for local people that would otherwise not be available, and therefore create an incentive for local people to conserve rather than destroy biodiversity and forests. In and around the Monarch Butterfly Reserve, for example, many people receive income from tourism, giving them a financial incentive to conserve rather than degrade this ANP (Kernan, pers. obs., 2013). In any case, it is improbable that the Mexican government will ever expropriate and purchase the land owned by the inhabitants of the ANPs. A priority necessary action to achieve the conservation of Mexico's biodiversity and tropical forests, therefore, is to ***reconcile the conservation objectives of the ANPs with the needs of their inhabitants.***

5.2 Conservation outside Protected Areas

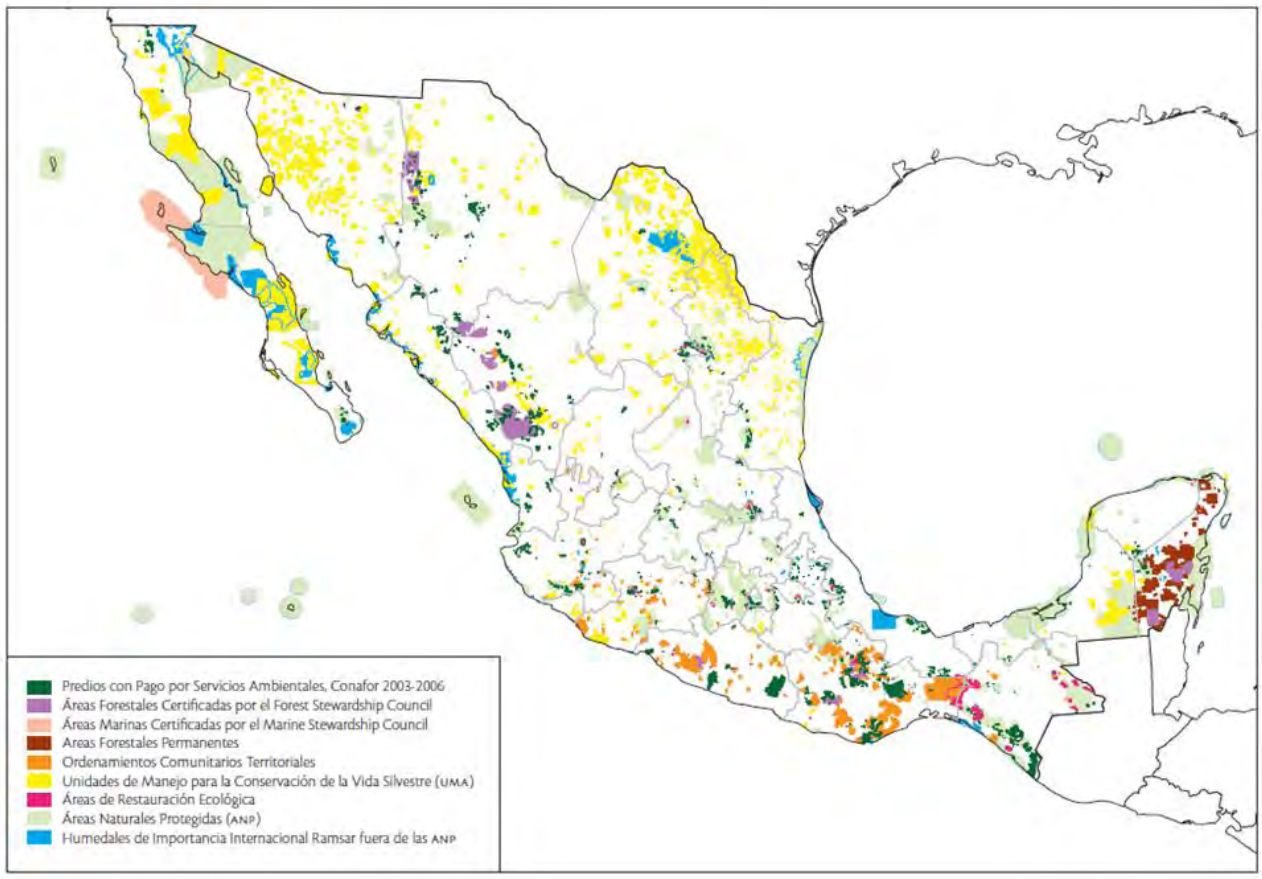
5.2.1 Justification

Conservation outside protected areas is necessary to produce sustainably the goods and services humans require, establish biological corridors between protected areas, conserve species of organisms that do not occur within protected areas and conserve, and restore ecosystem processes.

5.2.2 Current Situation

The legend of Map **12** lists nine types of conservation areas in Mexico. One, Natural Protected Areas (ANPs), was already discussed in Section 5.1. Anther, Properties with Payment for Environmental Services (dark green), is discussed in Section 5.7. The other type of areas shown in Map 12 are: Forest Areas Certified by the Forest Stewardship Council (purple); Marine Areas Certified by the Marine Stewardship Council (pink Permanent Forest Areas (brown);); Territories with Community Planning (orange); Wildlife Conservation Management Units) (yellow); Areas of Ecological Restoration (red); and Wetlands of International Importance (blue).

Map 12 Conservation Areas outside Natural Protected Areas



Source: Bezaury-Creel, J., D. Gutiérrez Carbonell et al. *2009*

Conservation practices also are taking place outside of ANPs on areas not shown on Map 12, including in Managed Watersheds, Biological Corridors, Marine Zone Management Areas, and Marine Turtle Beaches.

Areas Certified by the Forest Stewardship Council

Up to 2009, over 600,000 ha of forestland in Mexico had been certified according to the standards of the Forest Stewardship Council (FSC) as being managed in compliance with its technical standards for the management of permanent production forests. All of these hectares were on land that belongs to *ejidos.* The area of certified forest has not changed much since 2008, so the map is probably a fairly accurate representation of current extensions of certified forest (Bezaury-Creel, Gutiérrez Carbonell, et al., 2009).

The FSC has certified many private companies as certifiers of forest management. NGOs that are partners of FSC in Mexico, including WWF, TNC, Greenpeace, and the Mexican Council for Silviculture, but those with most activity in certification are Rainforest Alliance, through its Smartwood certifying arm, and Reforestamos Mexico. There is almost no domestic market for certified forest products and few possibilities for exporting certified wood either. Although the national government requires its entities to purchase certified wood, the poor control of the

supply chain has made this requirement largely ineffective. CONAFOR finances certification of forest properties (Madrid pers. comm., 2013)

Marine Areas Certified by the Marine Stewardship Council

By 2008, over 1,568,944 Ha. of marine area had been certified by Marine Stewardship Council (compilation: Bezaury-Creel, Gutiérrez Carbonell, et al., 2009). No further data were available about the effectiveness of marine areas certified by the Marine Stewardship Council.

Permanent Forest Areas

Map 12 indicates Permanent Forest Areas (APF) as occurring only in the eastern edge of the Yucatan Peninsula. The APFs are portions of the *ejidos*, communities or private properties that have been removed from any type of exploitation except for production of forest products and services by decision of the assembly of the agricultural unit. An APF is similar to a Community Planning Unit, but they are only for areas of forest rather than for the entire property. The first units of land to establish APFs were the *ejidos* associated with the Pilot Forestry Plan of Quintana Roo State in the 1980's. APFs have now been codified as part of the General Law for Sustainable Forest Development (Bezaury, pers. comm., 2013).

Territories with Community Planning

Map 12 indicates that Territories with Community Planning occur mostly in southeastern Mexico and that the cover rather large areas. No additional data were available about these areas.

Wildlife Conservation Management Units

Wildlife Conservation Management Units (UMA) were established as a unit of land management in 1995, when Mexico enacted a law that required private landowners to prepare a management plan for their land before they can legally use, capture or trade wildlife species commercially. The General Direction for Wildlife, part of SEMARNAT, must approve the management plan (INE, 2000; SEMARNAP 1997). As of December 2012, 11,655 UMAs had been established with a total area of 37,630,000 ha, which is about 19% of Mexico's total terrestrial area (OECD, 2013). In 2011, between them, the UMAs provided habitat for 1,130 vertebrate species, and subspecies, of which 805 were being intensively managed and 697 were being extensively managed (Ceballos & García, in press).

Almost 76% of the total area of the UMAs is in Mexico's six northern states. Many of the UMAs have become financially viable through sale of hunting rights, mostly to Americans. By contrast, southeastern Mexico does not attract hunters, so its *ejidos* have not earned much income from hunting (Gallina-Tessaro, 2009). Consequently, to attract more hunters, some of these UMAs are using practices that harm wildlife, such as fencing, cultivating exotic grasses and transporting wild animals between UMAs.

Areas of Ecological Restoration

Although Map 12 shows the location of a few areas of ecological restoration in southern Mexico, no data were found about them.

Wetlands of International Importance

Wetlands of international importance in Mexico are the 138 wetlands it has registered as Ramsar sites. The total area of these sites is 8,959,543 ha (CONANP, 2013). Of these sites, 63 are also ANPs. Although the remaining 75 Ramsar sites are not ANPs, CONANP is also responsible for their management. Map 12 shows the Ramsar sites that are not within an ANP, while Map 13 shows the location of all of Mexico's Ramsar sites.

Map 13 Location of Mexico's Ramsar Sites

Source : CONANP 2013

Map 13 indicates that Mexico's Ramsar sites occur mostly along its coasts, in its central valley, in Baja California and in Chiapas. No data were available on the condition of the Ramsar sites or on whether the designation of these sites as Ramsar sites has resulted in an increase in their conservation.

Managed Watersheds

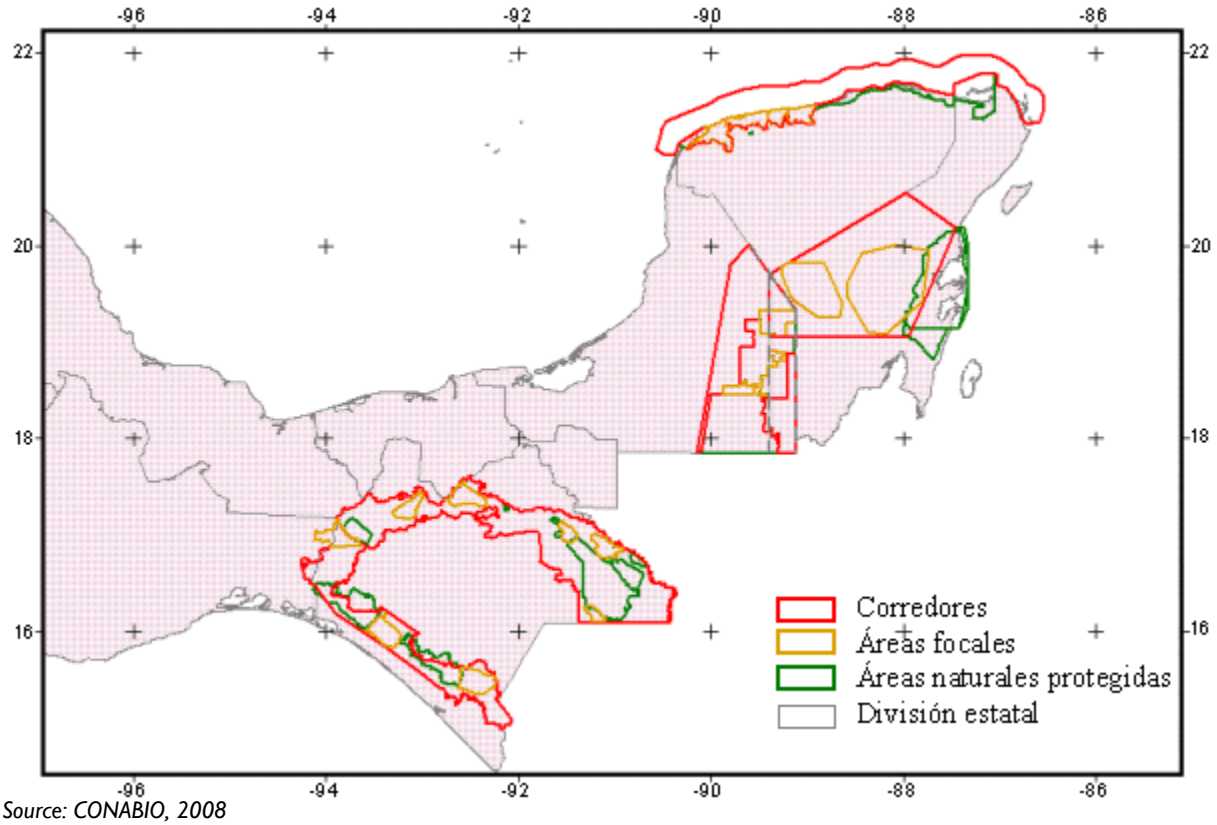
Water management in Mexico falls under the jurisdiction of the National Water Commission (CONAGUA), which is part of SEMARNAT. Map 2, in Section 2, shows the twenty-five hydrological administrative regions into CONAGUA has divided Mexico. As part of its Water Agenda for 2030, SEMARNAT has established river basin councils, commissions and committees in all of these administrative (OECD, 2013). No data were available on the effectiveness of watershed management activities by CONAGUA.

Biological Corridors

Biological corridors serve to maintain natural habitat between ANPs so that the separated populations of organisms do not become so isolated and small that the species cannot survive.

In 1997, Mexico joined the regional Mesoamerican Biological Corridor (CBM) Project. Map 14 shows the location of this corridor in Mexico. The corridor is outlined in red, the ANPs in green, the particularly important areas for conservation in orange, and the state boundaries in grey.

Map 14 The Mesoamerican Biological Corridor in Mexico



Source: CONABIO, 2008

CONABIO's principal activity in relation to the biological corridor is to promote and finance production by their inhabitants of such products as coffee, honey, wildlife, livestock and fish. No report was available that evaluates the effectiveness of this program in achieving more conservation of biological diversity and forests.

Currently, the CBM is the only biological corridor in Mexico, but the Mexican Law of Climate Change, enacted in 2012, identifies biological corridors as an effective measure to adapt to climate change, and SEMARNAT and CONABIO are planning to expand their number and area in other parts of Mexico.

Marine Zone Management Areas

Mexico has established Fishery and Aquatic Zones in parts of the Mexico territorial waters under federal jurisdiction. The National Council for Fisheries (CONANPESCA) manages fish stocks within these zones (SAGARPA, 2012).

Nesting Beaches for Marine Turtles

Map 15 shows the location of 29 key nesting beaches for marine turtles in Mexico and the location of 25 sea turtle camps that were managed by the General Wildlife Directorate until 2005. The map indicates that six species of marine turtles nest on Mexican beaches, and that some of them nest only on its Pacific beaches, some only on its Gulf of Mexico and Caribbean beaches and some on beaches on both sides of Mexico. Map 15 indicates a notable concentration of marine turtle nesting beaches down the eastern side of the Yucatan peninsula and a particular concentration on its northern eastern tip, where the city of Cancun and its tourism industry are located.

Turtle camps are seasonal encampments established for people to live while they protect the turtles as they nest, excavate the turtle eggs and transport them to special enclosures and release the newly hatched turtles to the sea. Map 15 indicates that until 2005 the General Directorate for Wildlife operated 16 turtle camps on the Pacific coast, seven turtle camps on the Gulf of Mexico coast and two turtle camps on the Caribbean coast.

Map 15 Location of Sea Turtle Nesting Beaches in Mexico 2008

Source: SEMARNAT, 2002; in SEMARNAT 2009.

Sea turtle camps have proven to be an effective way to protect and increase the populations of marine turtles. The turtle camp program has been continued under Mexico's current administration, and they are being managed by CONANP, state governments, NGOs, private

companies and research institutes, but no current data were available on their number or location.

5.2.3 5.2.3 Priority Issues and Actions

(5) Strengthen UMA regulations and incentives

UMAs have been an effective tool to promote sustainable use of biodiversity outside of protected areas. Yet the regulations that govern the establishment and management of UMAs are inadequate, especially because they provide for an insufficient level of financial incentives to landowners to conserve and manage biodiversity and forests on their land. It is unlikely, therefore, that under the current regulations the size and number of the UMAs will increase sufficiently to provide for sufficient conservation of Mexico's biodiversity and tropical forests. A priority necessary action to conserve Mexico's biodiversity and forests, therefore, is to ***strengthen UMA regulations.***

(6) Strengthen watershed commissions

Because the boundaries of watersheds cross the boundaries of states and municipalities, the successful implementation of watershed management requires effective coordination between state and municipal governments. The legal, administrative and technical basis for such collaboration, however, is inadequate. State and municipal governments lack incentives to collaborate with each other, and the watershed commissions lack regulatory authority or financial means to achieve such collaboration (Interviewee 11, pers. comm., 2013). Effective management of Mexico's watersheds could contribute greatly to conserving its biodiversity and forests. A priority necessary conservation action, therefore, is to ***strengthen the legal, administrative and technical basis for the functioning of the watershed commissions***.

(7) Expand biological corridors

The combination of fragmented habitats and rapid climate change make biological corridors a particularly important conservation tool in Mexico for conservation. Mexico's experience so far with its one biological corridor indicates that this tool could be used effectively, if the number, area and effectiveness of biological corridors were to be increased. A priority conservation action is to ***expand the planning and implementation of biological corridors.***

5.3 Policies, Laws & Regulations

5.3.1 Justification

Effective, comprehensive policies, laws and regulations are required to establish the legal and regulatory basis for actions to conserve tropical forests and biodiversity.

5.3.2 Current Situation

Table 7 indicates the most important Mexican laws related to the conservation of its biodiversity and tropical forests.

Table 7 Principal Mexican Laws Related to Conservation

Law	Content
General Law of Environmental Equilibrium and Protection	Framework law for environmental and natural resource management; defines the attributions of each level of government; defines environmental policy's principles and the instruments for environmental management.
Regulations of the General Law of Environmental Equilibrium and Protection in the Area of Natural Protected Areas	Regulates the establishment, administration and management of federal natural protected areas, environmental audits, environmental impact assessments, land use zoning, emissions,
Regulations of the General Law of Environmental Equilibrium and Protection in the Area of Emissions Registry and Pollutant Transfers (Third tier law)	Regulates the registry of emissions and discharges from selected sources to air, water, soil, subsoil, and through wastes.
General Law of Sustainable Fisheries and Aquaculture	General Law of Sustainable Fisheries and Aquaculture (Second tier law)
General Law of Wildlife	Regulate the conservation and sustainable use of wildlife and its habitat (excluding the use of timber and non-timber goods, marine species, and endangered or at risk species).
General Law for the Prevention and Integrated Determines the responsibilities for hazardous, special, and Management of Wastes	solid waste management for the Federal, State, and Municipal Governments, respectively
General Law of Sustainable Forest Development	Regulates the use and administration of forest resources; recognizes the environmental services provided by forests; aims to reduce poverty rates among forest dwellers
Law of National Waters	Regulates use and management of water; defines responsibilities of CNA and watershed organizations; mainstreams environment into water management.
Law of Biosafety of Genetically Modified Organisms	Regulates use, trade, and experimentation od genetically modified organisms
Law of Sustainable Rural Development (Second tier law)	Aims to improve welfare of rural communities; creates a program that provides resources to protect rural environment, enhance sustainability of rural development, and valuation of environmental services
Law of Planning	Mandates the incorporation of environmental criteria in the programs and actions of the Federal Government's administrative sector
National Endangered Species Act	Defines presence of priority species for conservation as a criterion for establishing protected areas.
General Law of Climate Change	Regulation of greenhouse gas emissions & promotion of carbon sequestration

Source: USAID 2009 with additions by assessment team

The General Law of Environmental Equilibrium and Protection (LGEEPA), although enacted in 1994, almost 20 years ago, remains Mexico's framework environmental and conservation law. Although Mexican states and municipalities are required by this law to pass legislation that is equivalent to that of the LGEEPA but applicable within their jurisdictions, as of 2009 not all of them had yet done so (Cortina-Segovia, 2009). The enactment in 2012 of the General Law of Climate Change, in addition to regulating emissions of greenhouse gases, also established an Inter-ministerial Commission for Climate Change (ICCC), whose chairman is Mexico's president. The ICCC has established climate change objectives for every ministry except for the Secretariat of Education.

The National Endangered Species Act (SEMARNAT, 2010) defines the presence of priority species in an area as a criterion for declaring it a protected area. The act lists 2,606 animal and 987 plant priority species. The list is being continuously updated (Ceballos and Garcia, in press). The act has made it possible to use recently available scientific knowledge about the conservation status of plants and animals in Mexico to identify the optimal areas for the establishment of additional protected areas.

As indicated in Table 7, Mexico is signatory to all of the principal international agreements that concern conservation and the environment, as well as many bi-lateral and tri-lateral agreements and treaties with conservation and environmental aspects.

Table 8 International Conservation and Environmental Treaties to which Mexico is Signatory

Convention	Description
Convention on Biological Diversity (CBD)	Aims to conserve biodiversity, foster sustainable use of its parts, and promote fair and equitable sharing of benefits arising from genetic resources.
Cartagena Protocol on Biosafety of the CBD	Focuses on the protection of biodiversity from potential risks posed by living modified organisms resulting from modern biotechnology.
Convention on the International Trade of Endangered Species of Wild Fauna and Flora (CITES)	Attempts to ensure that international trade in specimens of wild animals and plants does not threaten their survival and it accords varying degrees of protection to more than 30,000 species of flora and fauna.
Inter-American Convention for the Protection and Conservation of Sea Turtles	Sets standards for the conservation of sea turtles (which are endangered animals) and their habitats
International Whaling Commission (IWC)	Designed to provide for the proper conservation of whale stocks and thus make possible the orderly development of the whaling industry
Convention on Wetlands of International Importance, especially as Waterfowl Habitat (Ramsar)	Establishes a framework for conservation and sustainable use of wetlands.
United Nations Framework Convention on Climate Change (UNFCCC)	Defines the international framework for stabilization of greenhouse gas concentrations in the atmosphere; establishes differentiated responsibilities between developed and developing countries.
Kyoto Protocol of the UNFCCC	Establishes legally binding reductions of greenhouse gases for industrialized countries; defines the flexible mechanisms for emissions mitigations, including the Clean Development Mechanism (CDM). Mexico, as a developing country, did not commit to a quantified reduction target when it ratified the Protocol.
United Nations Convention to Combat Desertification (UNCCD)	Aims to combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification, particularly in Africa
Vienna Convention for the Protection of the Ozone Layer	Centers on the protection of human health and the environment from adverse effects resulting from human activities that modify the ozone layer
Montreal Protocol on Substances that Deplete the Ozone Layer (of the Vienna Convention)	Sets schedules to phase out the production and use of number of ozone depleting substances
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes	Aims to protect human health and the environment against the adverse effects resulting from the generation, management, transboundary movements and disposal of hazardous and other

Convention	Description
	wastes
Rotterdam Convention	Promotes open exchange of information and calls on exporters of hazardous chemicals to use proper labeling, include directions on safe handling, and inform purchasers of any known restrictions or bans
Stockholm Convention on Persistent Organic Pollutants (POPs)	Attempts to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically and accumulate in the fatty tissue of humans and wildlife.
North American Agreement on Environmental Cooperation	Declaration of principles, objectives and measures to further cooperation on conservation and protection of the environment among USA, Mexico and Canada; side agreement to NAFTA; created the Commission for Environmental Cooperation (CEC).

Source: USAID 2009

Mexico's obligation to comply with these international agreements has been a stimulus for it to establish methodologies for monitoring the status of its biodiversity and forests and to enact conservation policies, laws and regulations.

5.3.3 Issues and Actions

(8) Align public policies to favor conservation

Some Mexican laws have permitted and encouraged destruction rather than conservation of Mexican biodiversity and forests. The Agrarian Law, for example, was modified in 1994 to give land titles to the members of *ejidos*. As a result, parts of many *ejidos* have been subdivided and sold, causing some large areas of contiguous habitat to be fragmented and degraded. Likewise, the Mexican ministries responsible for agriculture, fisheries, mining, tourism commerce revenue and health have some legal mandates that run counter to conservation of biodiversity and forests. The PROCAMPO program, of the Ministry of Agriculture, for example, subsidizes the conversion of forestland to agricultural land. To achieve conservation of Mexico's biodiversity and forests requires that such contradictions be eliminated. A priority necessary conservation action, therefore, is to ***align the policies of public institutions to favor conservation***.

5.4 Governance

5.4.1 Justification

The conservation of biodiversity and forests requires effective governance institutions that that also inter-act effectively with other institutions.

5.4.2 Current Situation

Governance institutions for conservation in Mexico include public, private-non-profit and profit-making institutions at the national, regional, state, and local levels.

Public Institutions

Mexico has a federal government, in which the national, state and municipal governments each have specific competencies. Table 9 indicates the principal national level institutions that have responsibilities related to the conservation of Mexico's biodiversity and tropical forests.

Table 9 Principal Mexican National Level Institutions with Responsibilities for Conservation

Institution	Mandate
Ministry of Environment and Natural Resources (SEMARNAT)	Protection, restoration, and conservation of eco-systems, natural resources, and environmental goods and services; regulation and administration of federally-managed natural resources, except for oil, hydrogen carbides, and radioactive minerals.
Undersecretary of Planning and Environmental Policy of SEMARNAT	Environmental planning, definition of environmental policies, mainstreaming in other sectors of the federal government, compilation and analysis of environmental data
Undersecretary of Environmental Regulations of SEMARNAT	Elaboration of technical norms (NOMs), bills and regulations.
Undersecretary of Environmental Management of SEMARNAT	Issuance of permits and licenses, including those related to wildlife, forests, EIA, wastes and air emissions
National Commission of Natural Protected Areas (CONANP)	Manage natural protected areas and implement sustainable regional development programs in areas of high biodiversity
National Institute of Ecology (INE)	Conduct scientific and technical research to guide the design, implementation, and evaluation of environmental policies and programs
National Water Commission (CNA)	Manage and preserve national waters to achieve their sustainable use
Federal Attorney General for Environmental Protection (PROFEPA)	Enforce legal dispositions governing environmental pollution, restoration of natural resources, preservation and protection of forest resources, wildlife, endangered species, coastal zones, natural protected areas, EIA, and regional development plans
National Forestry Commission (CONAFOR)	Support productive, conservation, and restoration activities in the forestry sector; participate in the development and implementation of policies and plans for sustainable forestry development
Mexican Institute for Water Technology (IMTA)	Conduct research to improve water management and develop technologies to improve water allocation and enhance water use efficiency
National Commission for the Knowledge and Use of Biodiversity (CONABIO). Inter-agency commission chaired by the President and integrated by the 10 Ministries, including SEMARNAT. The Secretary of SEMARNAT is CONABIO's Technical Secretary and provides most of CONABIO's funding.	Integrate and update the National System on Biodiversity Information (SNIB); carry out research on knowledge and use of biodiversity; advise governmental agencies and other sector; help comply with international conventions (particularly CBD), and disseminate knowledge on biological wealth.

Source: USAID 2009

At the national level, the Ministry of the Environment (SEMARNAT) is Mexico's national public institution which has principal responsibility for conserving Mexico's tropical forests and biodiversity. Within SEMANAT are a number of divisions, such as the General Directorates of Wildlife, Soil Management and Environmental Impact and Risk, with specific roles and responsibilities for conserving Mexico's biodiversity and forests. SEMARNAT's Under Secretariat for Environmental Planning and Under Secretariat for Policy together with the National Institute of Ecology and Climate Change (INECC) have responsibility for defining and implementing policies and programs related to the mitigation of, and adaptation to, climate

change. Delegations represent the national government at the state and municipal levels and participate in planning local development activities (OECD, 2013).

The National Commission of Natural Protected Areas (CONANP) has the responsibility of managing national natural protected areas and implementing sustainable regional development programs in areas of high biodiversity. In 1997, a donation from the Global Environmental Facility (GEF) was used to establish the Mexican Fund for Natural Protected Areas (FANP). Its current value is now nearly US$ 76 million, and its income is used to pay the staff of 23 ANPs. The national government does not provide sufficient funds to ensure the adequate protection of the other ANPs, and in 2006 only half of the national ANPs had sufficient staff (OECD, 2013). More recent quantitative data about the status of the financing of the ANPs were unavailable for this assessment. Observations at the Monarch Butterfly Reserve, however, indicated that even this world-famous ANP lacks sufficient, trained staff (Kernan, pers. obs., 2013).

The National Commission for the Use and Knowledge of Biodiversity (CONABIO) was originally established as an inter-ministerial committee. Although little inter-ministerial coordination has actually occurred, SEMARNAT has provided CONABIO with sufficient funds and support, so it has been able to lead the development of conservation policies, based on the compilation of up-to-date scientific data about Mexico's biodiversity and forests.

The National Council for Water (CONAGUA) is the most powerful entity associated with SEMARNAT and receives about half of its annual budget. CONAGUA's principal objective, however, is to ensure an adequate and reliable supply of water for energy, irrigation, industry and households, so at times the projects it implements negatively affect Mexico's biodiversity and forests.

The National Council for Forestry (CONAFOR) has principal responsibility for managing and protecting Mexico's forests and for supervising the program of payment for environmental services, but, according to one informant, lacks sufficient administrative and technical capacity to achieve these objectives (Interviewee III, pers. comm., 2013).

The Office of the Federal Attorney General for Environmental Protection (PROFEPA) has principal responsibility in Mexico for enforcing environmental laws.

At the state level, the structure of environmental governance usually reflects its structure at the national level. For example, all but two states have ministries with environmental responsibilities. The effectiveness of state environmental ministries varies, but is usually higher in more prosperous states, whose budgets are larger (OECD, 2013).

At the municipal level, most municipalities have limited capacity to manage their responsibilities for conservation of biodiversity and forests. The budgets of municipalities in remote, rural areas where biodiversity and forests tend to occur are generally small in comparison to their needs, so conservation receives little municipal financial support. Furthermore, municipal mayors are elected to three year terms and cannot be reelected, which creates a lack of

continuity that weakens environmental planning and management (E. Monterrasa, per. com, 2013)

At the community level, local traditional authorities, both indigenous and non-indigenous, have played an important role in the management of tropical forests and biodiversity. Organized through local assemblies, many rural agricultural communities have managed to develop sustainable strategies to use their forest resources, taking care of both woody an non-woody products, ecotourism and conservation.

Successful conservation in Mexico requires effective coordination between the different levels of government, especially since ecological units, such as watersheds or protected areas, cross political boundaries, such as those of states and municipalities (OECD, 2013). For that reason, Mexico has established administrative entities, such as councils of water use, which integrate various states and municipalities. According to one informant, coordination generally works well, except where programs such as PROCAMPO and PROARBOL operate independently of national, state and municipal institutions (Interviewee IV, pers. comm., 2013).

Non-Governmental Organizations

The largest conservation NGOs in Mexico are WWF, Pronatura, Naturalia, Fondo Mexicano de Conservación de la Naturaleza (FMCN), and Greenpeace. These NGOs, and others, have played an important role in promoting sustainable management and protection of its biodiversity and forests. They have designed and implemented programs and projects ranging in scope from the national level to specific regions, communities, ecosystems, flora and fauna. The focus and approach of these projects varies from one NGO to another, but they have included some aspects of all the twelve categories of necessary conservation actions.

Some Mexican conservation NGOs have succeeded in achieving substantial conservation of biodiversity and forests. ProNatura, for example, has a large program in Chiapas that is managing two small reserves above the city of San Cristobal (B. Kernan, pers. obs., 2013) and is implementing a large conservation program in the state of Chiapas (E. Lopez, pers. comm., 2013). The NGO Uyoolchie Aie, in Quitana Roo, likewise, has had some success in persuading the *Ejido* Felipe Carrillo to conserve rather than completely degrade their forestlands (B. Kernan, pers. obs., 2013; J. Arrela P; O. Martinez C and C. Ku P, pers. comm. 2013). Amigos de Sian Khan, an NGO based in Cancun, has been one of the most successful of Mexico's conservation NGOs. It succeeded in persuading the Mexican national government to establish the Sian Khan biosphere reserve and continues to work well with the state and municipal governments of Quintana Roo on land use planning and control of water contamination (G. Meridez, pers. comm., 2013).

Private Sector Institutions

Private businesses working in agriculture, forestry, mining, and tourism range from small scale family farms to large agribusiness, plantations and mining operations. Some of these private businesses have operations in large areas of Mexico and affect its biodiversity and natural vegetation. No data were available on the role of private sector businesses in Mexico in conserving biodiversity and forests. Most assistance to private companies has been provided to improve the efficiency of their energy use (PROFEPA, 2013).

5.4.3 Priority Issues and Actions

(9) Strengthen inter-ministerial committees

Lack of coordination among the ministries of Mexico's federal government frequently negates the effectiveness of conservation activities. Although inter-ministerial committees have been established to improve coordination among government ministries have proven to be useful, they have not been fully effective. To make them more effective the inter-institutional committees must have an administrative status higher than their member ministries. Therefore, a priority necessary action to conserve Mexico's biodiversity and forests is to **strengthen the status and power of inter-ministerial conservation committees.**

(10) Reorganize SEMARNAT

Responsibility for setting conservation policies and implementing conservation measures are often split among several entities with SEMARNAT. Responsibility for wildlife management, for instance, is divided among the General Direction of Wildlife (DGVS), which oversees the issuance of hunting and research permits as part of Environmental Management Units (UMA), CONANP, which has responsibility for threatened and endangered species, and CONABIO, which is supposed to control invasive species. Such divisions of responsibilities make it difficult to establish effective, coordinated policies and programs that will be effective in conserving Mexico's biodiversity and forests. Therefore, a priority necessary action for conserving Mexico's biodiversity and tropical forests is to ***reorganize SEMARNAT to achieve more coordination among its entities.***

5.5 Education

5.5.1 Justification

Effective conservation of biodiversity and forests requires professional and technical capabilities achievable only through formal education programs.

5.5.2 Current Situation

The Secretariat of Public Education (SEP) and SEMARNAT have started a program for including conservation topics within all the levels of Mexico's education system from kindergarten to post-graduate programs (Gobierno de la República, 2007; SEP, 2011).

The Secretariat of Public Education (SEP)'s Technological High Schools, which its General Direction of Agricultural Technology Education (DGETA) administers, has 290 technical training programs (SEP, 2012).

At the undergraduate and postgraduate levels of education, Mexico has bachelor and postgraduate programs in biology and natural resources management. Except for the State University of Coahuila, all of Mexican's state universities have bachelor's programs in biology. Fourteen state universities offer a master's program on biological sciences, and 13 have doctorate programs in biological sciences. A few universities offer a bachelor's program in the

conservation and management of natural resources and the environment (ANUIES database). Many students who have graduated from biology programs work in government institutions, such as CONAGUA, CONABIO and CONANP, although there a fewer positions available in these institutions than there are graduates of the biology programs.

5.5.3 Priority Issues and Actions

(11) Implement technical training

Although Mexico has numerous technical training programs, few of them offer training in conservation fields such as forestry, ecotourism, soil conservation, fishery management or management of protected areas. Mexico, therefore, has an insufficient number of technicians available for the work that is required in these fields. A priority action to conserve Mexico's tropical forests and biodiversity is to ***implement technical training programs in conservation fields.***

5.6 Science and Technology for Conservation

5.6.1 Justification

Scientific research provides the understanding of biodiversity and tropical forests that is required to develop the technologies required to conserve them.

5.6.2 Current Situation

The National System of Biodiversity Information (SNIB), established in 1984, has accumulated a great deal of data about Mexico's forests and biodiversity (Escobar et al., 2009). The research institutions that contribute to collection of data that is useful for conservation include the National Council of Biology (CONABIO), the National System of Researchers (SNI), the National Autonomous University of Mexico (UNAM), the National Polytechnic Institute, The Autonomous Metropolitan University, the Autonomous University of Baja California, and the Veracruzana University. CONABIO, in particular, has sponsored a great deal of research related to the conservation of forests and biodiversity (Koleff, 2007; Arriaga Cabrera, et al., 2009).

Within UNAM, the Institute of Biology has collections of biological specimens, and its staff does research on Mexico's flora and fauna. UNAM's Institute of Sea Sciences and Limnology operates two marine research ships. The Institute of Ecology within UNAM does research on ecosystems, evolution and conservation and in 2012 founded the National Laboratory of Sustainability Sciences for the purpose of channeling the results of biological research into the process that public institutions, such as SEMARNAT, use to make decisions that affect Mexican forests and biodiversity. UNAM operates the Center for Research on Ecosystems (CIEco) in Michoacán, which does research related to the conservation of ecosystems, ecosystem restoration and territorial planning.

The Ministry of Public Education (SEP) and the National Council for Science and Technology (CONACYT) finance research at the Center for Biological Research in the Northeast, the Center for Scientific Research and Higher Education of Ensenada, the Center for Scientific

Research of Yucatán, the Institute of Ecology and the Potosino Institute for Scientific Research and Technology.

The National Institute of Ecology and Climate Change, which is part of the national government, the Institute of Ecology, which is part of UNAM, and the Institute of Ecology, which is part of the Secretariat of Education, are all commonly referred to as the Institute of Ecology.

The National System of Researchers has more than 18,000 researchers in its program, all of whom have a PhD degree or equivalent. Seventeen percent of them have degrees in biology or chemistry.

5.6.3 Priority Issues and Actions

(12) Increase federal budget for conservation research

Although CONABIO, UNAM, and other Mexican universities and institutes have done a great deal of research that is relevant for making decisions about how to conserve Mexico's tropical forests and biodiversity, much research remains to be done. Research, for example, is needed urgently on how to best restore degraded ecosystems, reestablish endangered species of plants and animals, manage wildlife for subsistence and sport hunting, and regenerate commercially valuable tree species, such as mahogany, through silvicultural practices. Mexico has sufficient trained scientists to do the required research, but is not providing sufficient financing to permit the required research to be implemented. The Mexican national government is the only potential source of funds in the amounts required to do the necessary research. A priority action for conserving Mexico's tropical forests and biodiversity, therefore, is to ***increase the federal budget for conservation research.***

(13) Make conservation knowledge accessible to decision-makers

For Mexico to conserve its biodiversity and tropical forests, its national, state and municipal public institutions must take policy and program decisions that will consistently favor conservation rather than destruction of biodiversity and forests. Mexican decision-makers, however, often take decisions that affect Mexican biodiversity and forests negatively rather than favorably. One reason they do so is that they frequently find it difficult to access, understand and use the knowledge that already exists in Mexico related to conservation. A priority action to conserve Mexico's biodiversity and tropical forest, therefore, is ***to make conservation knowledge accessible to decision-makers.***

5.7 Financial Incentives for Conservation

5.7.1 Justification

Financial incentives are a powerful tool for influencing people to implement actions to conserve and manage, rather than destroy and degrade, biodiversity and tropical forests.

5.7.2 Current situation

The Mexico federal government has several programs of financial incentives for conservation. It makes payments to landowners who enroll their land as an Environmental Management Unit (UMA), and UMAs currently cover approximately 19% of terrestrial Mexico. In another program, the federal government finances the preparation of forest management plans for privately-owned forests. Under the National Program for Hydrological Environmental Services (PSAH), which is financed by water user fees, the federal government pays owners of private land for protecting the hydrological functions of their land. Most recently, the Climate Change Law of 2012 established a new federal policy objective of using market instruments and incentives for activities that contribute to the mitigation of climate change.

The National Council for Forests (CONAFOR) is responsible for implementing Mexico's strategy for Reduced Emissions from Deforestation and Degradation (REDD+). Mexico's National REDD+ Strategy objectives include institutional strengthening and capacity building, improving the effectiveness existing programs and expanding payments for environmental services, promoting sustainable forest management, improving monitoring capabilities, and integrating new financing mechanisms for carbon and sustainable production commodities. Most of Mexico's REDD+ projects have been in the states of Jalisco, Chiapas and the Yucatán Peninsula (The REDD Desk, 2011).

5.7.3 Priority Issues and Actions

(14) Improve conservation incentives

Mexico's current financial incentives for conservation could be improved by increasing their overall funding to levels that could cover all areas of primary vegetation and by increasing the amounts of the payments per hectare, so that the conservation of natural habitat would become a competitive land use in comparison with changing the land use. Also, the period that a land owner can receive the financial incentive should be increased to more than the current five years, because once the financial incentive ends, the land owner may choose to change the land use - perhaps paying the costs of doing so with the funds from the financial incentive itself. Additionally, properties that are valuable for conservation should be assisted to develop multiple sources of income based on their biological resources, so as to increase the financial incentive for conservation. Finally, SEMARNAT and CONAFOR should have sufficient technical capacity to monitor and evaluate the effectiveness of the financial incentive programs. Therefore, a necessary action for conserving Mexico's biodiversity and tropical forests is to ***improve and expand the conservation incentive programs***.

5.8 Support of Citizenry for Conservation

5.8.1 Justification

Widespread understanding of and support for conservation measures among different segments of society is a prerequisite for the formulation and implementation of effective conservation policies and actions for conserving biodiversity and tropical forests.

5.8.2 Current situation

No survey of public opinion about conservation among different segments of Mexican society has been carried out, so quantitative data are unavailable about the degree of understanding and support in different segments of Mexican society for the conservation of Mexico's biodiversity and tropical forests. Recent actions by citizen groups, however, indicate not only concern among some segments of Mexican society about the loss and degradation of Mexico's biodiversity and forests, but also that at least some Mexicans are willing to take action in favor of conservation. Indigenous, rural citizens, NGOs, and students and professors, for example, recently forced the cancellation of a mining project near Wiricuta, a sacred site for the Huichol indigenous peoples and a proposal to develop tourism within the Cabo Pulmo National Park.

The Ministry of Environment (SEMARNAT) has a strategy called Environmental Education for Sustainability, whose objective is to promote sustainable use of biological diversity and to offer incentives for conservation and restoration (CONABIO, 2008). SEMARNAT, CONABIO, PROFEPA, CONAFOR and CONANP all provide financial support for environmental communication programs that use mass media to convey messages about Mexico's conservation issues and the importance of resolving them (CONABIO & SEMARNAT, 2009). There were not data available, however, about the content, timing and scope of these programs.

5.8.3 Priority Issues and Actions

(15) Expand conservation communication programs

Current public environmental communication programs reach only a small percentage of Mexicans and are not systematic or continuous. Mexico's numerous zoos, botanical gardens, protected areas and educational institutions are not being used to their capacity to convey conservation messages to segments of the Mexican society. There are little or no data on the attitudes of the different segments of Mexican society towards conservation issues. An effective conservation program, however, must reach a high percentage of Mexican citizens, be systematic and continuous, fully utilize Mexican institutions and be based on reliable data. A priority action, therefore, to achieve the conservation of Mexico's biodiversity and tropical forests is to ***expand and improve Mexico's conservation communication programs.***

5.9 Land use planning and regulation

5.9.1 Justification

Effective land use planning and regulation permits different protective and productive land uses to be compatible and complimentary across a landscape, a basic requirement for conserving tropical forests and biodiversity.

5.9.2 Current Situation

The General Law of Environmental Equilibrium and Protection (LGEEPA) established the legal basis in Mexico for Ecological Territorial Planning Programs (POET). It gives SEMARNAT, through the National Institute for Ecology and Climate Change (INECC), the legal mandate to implement the General National Ecological Territorial Planning Program (POEGT) at the

national level, including marine and insular areas. SEMARNAT, however, cannot legally prepare state and municipal POETs, although it can provide technical assistance for doing so upon request by a state or municipality. The first federal terrestrial POEGT was not official approved until 2012. Before that many states and municipalities had already prepared their own PEOTs, which may not be consistent with the new POEGT.

By 2008, only about 25% of Mexico was covered by POETs so many states and municipalities still lack POETs (Alvarez Icaza & Muñoz, 2008). Nonetheless, Mexico has amply experience upon which to prepare additional POETs. Whereas initially groups with powerful political and economic interests were formerly able to manipulate territorial planning for their own benefit, now SEMARNAT requires a more transparent, participatory planning process (Alvarez Icaza & Muñoz, 2008). A POEFT, moreover, is not legally binding, so its effectiveness depends on it being prepared with ample public participation.

5.9.3 Priority Issues and Actions

(16) Complete territorial planning

The planning in the federal, country-wide POEGT is based on environmental information at a geographic scale of 1:2,000,000 (SEMARNAT, 2012), a scale at which important conservation areas at the municipal and state level may be overlooked, thereby permitting land uses that negatively affect biodiversity and forests. If coordinated POETs were to be completed at different levels of government, they would provide an underlying, technical basis for ordering and reconciling land uses across different landscape scales, thereby making an important contribution to the conservation of Mexico's biodiversity and forests. Therefore, a priority necessary conservation action is to ***complete municipal and state PEOTs***.

(17) Exchange knowledge of territorial planning

SEMARNAT has prepared model terms of reference for local and regional PEOTs, but does not have the resources or the mandate to provide support to individual states and municipalities in their preparation (Interviewee II, com. pers., 2013). Yet those municipalities and states that have already completed PEOTs, could usefully share their experience with other states and municipalities. Such sharing would permit officials who are responsible for preparing PEOTs to share technical criteria and methodologies, which would increase the ability of officials to foment public participation in the planning process, which is essential for the plans not remain as paper exercises rather than being implemented. It would also enable networks to develop among state and local officials that would allow them to coordinate their planning across political jurisdictions. A priority necessary action to conserve Mexico's biodiversity and tropical forests, therefore, is to ***exchange knowledge of PEOT preparation between federal, state and municipal levels of government.***

(18) Integrate ecological territorial planning with and urban development

Mexican municipal governments are legally required to prepare urban development plans. These plans often conflict with the PEOTs. Such conflicts sometimes enable the manipulation of plans to favor vested financial interests, especially as PEOTs are not legally binding, to the detriment of Mexico's biodiversity and forests. A priority necessary conservation action in

Mexico, therefore, is to ***integrate ecological territorial planning with urban development plans***.

(19) Integrate municipal and marine territorial plans

Sound management of marine areas requires sound management of neighboring terrestrial areas. Marine areas, however, are under federal jurisdiction. SEMARNAT, therefore, is able to prepare marine area ecological territorial plans without ensuring the participation of municipalities and states. The ecological territorial plan for the Gulf of California, for example, does not include any obligatory requirements for coastal municipalities and states, and each of the municipalities and states along the coast must ratify legally its provisions for them to be effective. For this reason it is important to ***integrate municipal and marine territorial plans***.

5.10 Security of Rights to Land and Resources

5.10.1 Justification

Security of rights to land and its resources provides a powerful incentive for those who have these rights to conserve rather than degrade these resources, including biodiversity and forests.

5.10.2 Current Situation

Ejidos, land which is communally owned, predominantly by indigenous groups, occupy about 50% of Mexico's land (INEGI, 2012). About 38% of Mexico's land is in private, individual ownership (Secretaría de la Reforma Agraria, 2007). The federal government owns about 4% of Mexico's territory, of which 1.5 million hectares, less than 1% of the territory is included in national parks, although CONANP has legal authority to reserve federally owned land for national protected areas.

The issue of land security which most affects Mexico's biodiversity and tropical forests is the ownership of land within the ANPs. Government entities own only 20.4% of the land within Mexico's ANPs. Rural communities and *ejidos* own 60% of the land within ANPs. Twelve percent of the land within ANPs is privately owned. Data are unavailable for the ownership of the remaining 7.3% of the area within ANPs (CONABIO, 2010).

5.10.3 Priority Issues and Actions

(20) Assist ejidos to conserve biodiversity and forests

Originally, Mexico's constitution prohibited the subdivision or sale of land belonging to an e*jido* (Morett Sánchez, 1990). In 1992, however, the constitution was change to make it legal for *ejido* land to be subdivided and sold. The sale of *ejido* land to private owners is causing changes in land use that are severely affecting Mexico's biodiversity and tropical forests. In some cases, the members of *ejidos* now are living off the sale of *ejido* land, rather than on the sale of forest products. Consequently, the traditional attitude among the members of *ejidos* that land should be kept and conserved is yielding to a new attitude that land has little value and should be sold off to the highest bidder if possible (Ku Pacal, pers. comm., 2013). Although there is no possibility of reversing the trend of subdividing and selling *ejido* land (Meridez, per. comm.,

2013), a priority necessary conservation action is ***assist* ejidos *to conserve their biodiversity and forests.***

(21) Regularize ownership rights in protected areas

Many of Mexico's national parks were superimposed on land that was privately or communally owned, with expectation that the land would be expropriated and purchased from its owners. In fact, the federal government has expropriated and purchased almost none of the land within the protected areas it has declared. Thus the federal government does not own most land within protected areas, but rather only attempts to regulate its use to favor the conservation of its biodiversity and natural habitats. Attempts to enforce such regulations, however, frequently create conflicts with the landowners. A priority necessary conservation action, therefore, is to ***regularize ownership rights within national protected areas***.

5.11 Management of Conflicts over Natural Resources

5.11.1 Justification

Conflicts over the ownership and use of biodiversity and tropical forests often preclude their protection and management., so managing and, if possible, resolving, these conflicts is a prerequisite for the conservation of biodiversity and tropical forests.

5.11.2 Current Situation

The principal conflicts over natural resources in Mexico concern the harvesting of timber, development of tourist facilities, open pit mining operations, and the budgets for Environmental Management Units (UMAs). These conflicts frequently occur between one sector of Mexican society and a government agency. Recent conflicts over the use of natural resources include those over the construction of tourism facilities within Cabo Cortes, a protected area in Baja California, over a proposal to start an open-pit mine in San Luis Potosi on land that the Huichol, an indigenous group, consider sacred, and over a mining project in an area of cloud forest in Veracruz (Sanchez, 2012; Gayosso, 2012).

5.11.3 Priority Issues and Actions

(22) Integrate land use planning and conflict management

Some conflicts in Mexico over the ownership and use of renewable natural resources derive from inherent conflicts between different possible uses of land and its resources. Open pit mining, road construction, conversion of forestland to agriculture and pasture, for example, bring different land uses inevitably into conflict. Other conflicts derive more from poor technical practices and inadequate use of conflict avoidance and management techniques. Forest management, nature tourism, protection of biodiversity and ecosystem functions, given the application of effective technologies, can be compatible with conservation objectives. Land use zoning and territorial planning and regulation are useful for avoiding or managing conflicts of both types. Yet currently in Mexico land use zoning and regulation are rarely considered or used as a technique for avoiding or resolving conflicts over the use of land and natural resources. A necessary action, therefore, to conserve Mexico's biodiversity and tropical

forests is to ***integrate land use planning with management of conflicts over natural resources.***

5.12 Environmental Impact Assessment

5.12.1 Justification

Environmental impact assessment provides a systematic, legally enforceable way to identify the potential negative impacts of proposed development projects on tropical forests and biodiversity and formulate, implement, monitor and evaluate measures to avoid, mitigate or compensate for those impacts.

5.12.2 Background

The General Law of Environmental Equilibrium and Protection (LGEEPA) requires one of two types of Environmental Impact Assessments (EIA) to be prepared for all public and private projects of any type: an Environmental Impact Manifest (MIA) or a Preventive Report (IP). An MIA is required for large projects whose environmental effects are likely to be large-scale, irreversible and severe. It predicts the environmental impact of a proposed project, evaluates the feasibility of preventing, mitigating or compensating these impacts, and makes a determination as to whether a proposed activity should receive an environmental license or not. An IP is required for smaller projects whose environmental effects are likely to be small-scale, perhaps reversible and not severe (SEMARNAT, 2012; OECD, 2013).

Activities that require an MIA include logging operations that include exploitation of protected species, the exploitation of any timber or non-timber forest product within a tropical forest, any exploitation of species that do not easily regenerate, and any forestry exploitation within protected areas. It also includes industrial, mining, fishing and oil and gas activities and most activities within protected areas and wetlands (SEMARNAT, 2012).

The Mexican EIA process requires public consultations, which provide an opportunity for local people and environmental NGOs to express their concerns about the environmental and social effects of a proposed project. Public opposition expressed during the public consultation process has sometimes resulted in the denial of an environmental license for a project. For example, Cabo Cortez tourist resort in Baja California was denied an environmental license due to public opposition expressed during the EIA process (Johnson, 2012).

5.12.3 Priority Issues and Actions

(23) Revise MIA processes

Rather than a useful planning and decision making tool, the MIA is generally perceived as merely a paper formality that is carried out without high technical standards. The regulations themselves do not require high technical standards for MIAs. MIAs are usually prepared after the principal decisions about the project design have already been made. SEMARNAT lacks sufficient technically competent personnel to evaluate the thousands of MIA's it receives every year, much less to monitor compliance with the mitigation measures they establish. Project proponents are generally believed to bribe authorities in order to receive approval of their

MIAs quickly and without a rigorous technical review. The consulting companies that prepare MIAs tend to minimize the negative environmental effects of the proposed actions in order to assure themselves more work (Bojorquez, pers. comm., 2013; Interviewee II, pers. comm., 2013). A priority necessary action to conserve Mexico's biodiversity and forests, therefore, is to ***improve the technical and administrative process for the preparation of MIAs.***

(24) Increase participation in MIAs

Public consultations on the environmental aspects of development projects in Mexico take place after rather than during the preparation of an MIA, which makes it difficult to modify the design of a project design in response to public comments. Furthermore, little time is usually given for public comment. Therefore, although there are well-organized groups in Mexico who could make useful comments on proposed projects during the preparation of MIAs, they generally do so only for large, controversial projects. A necessary action, therefore, to conserve Mexico's biodiversity and tropical forests is to conduct public consultations earlier in the EIA process and provide a longer period for public comments and questions as part of consultation, and thereby ***increase public participation in the preparation of environmental assessments.***

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 USAID/Mexico Country Development Cooperation Strategy

At the time of the preparation of this report, USAID/Mexico had not yet prepared its country development strategy or defined the actions it will support, so it was not possible for this report to analyze the extent to which USAID-supported actions will help meet directly the needs for biodiversity and tropical forestry conservation in Mexico. Indeed, one of the purposes of this report is to identify actions which USAID/Mexico could usefully support as part of its country strategy that would effectively assist Mexico to conserve its biodiversity and tropical forests.

The team did have access, however, to a draft 2012 Concept Paper for USAID/Mexico's country development strategy. According to the draft Concept Paper, during the period of the new country strategy, USAID/Mexico intends to finance three categories of activities.

First, to reduce crime and violence, USAID/Mexico will

> "…support Mexico's efforts to develop and test models that mitigate the community-level impacts of crime and violence at the federal, state and local levels with public private sector and civil society institutions. It will finance activities to improve federal, state and local government capacity to safeguard citizen security, increase public and private sector financing for expanding socio-economic opportunities in areas most affected by crime, and increase the capacity of young people to stay in school, find work and integrate into society."

Second, to improve criminal justice, USAID/Mexico will

> "…help the Government of Mexico (GOM) to reform its criminal justice system, by moving from closed door, written procedures to public, oral trials, mostly at the state level; preparing new policies and legislation; strengthening the capacity of judicial institutions; and protecting human rights in general and journalists in particular. "

Third, USAID will support Mexico in

> "…reducing its emissions of greenhouse gases from energy and forestry through more effective policies, including the preparation of a national low emissions development strategy (LEDS), greater institutional and technical capacity and increased financing for mitigation measures. It will support Mexico's efforts to establish reliable systems for monitoring, reporting and verifying GHG emissions and to reduce GHG emissions from deforestation and forest degradation (REDD) and to create financial mechanisms for financing reductions in emissions from energy and forestry."

Furthermore, the concept paper says

> "… specific technical areas of focus are expected to include mitigating the effects of Global Climate Change, developing and testing models to reduce community level crime and violence, and supporting implementation of criminal justice reforms that protect human rights."

It also says that USAID/Mexico will program its funds

> "…based on U.S. and Mexico's mutual security interests and…shared commitment to mitigate the effects of global climate change" "…in specific technical areas that are high priorities for both the USG and the GOM."

6.2 Impacts on Biodiversity and Tropical Forests of USAID/Mexico Country Strategy

The proposed USAID/Mexico strategy and program, as described in the draft Concept Paper, would cause no negative impacts on Mexico's biodiversity and tropical forests.

6.3 Analysis of Necessary Actions

Table 10 presents an evaluation of the 24 necessary conservation actions. The first column of the table lists the 24 necessary conservation actions by category of action. Columns two through six are the abbreviated references to the five criteria that were defined by USAID/Mexico for evaluating the priority necessary conservation actions: Consistent; Impact; Advantage; Urgency and Linkages.

The team leader, based on his professional judgment, rated each of the 24 priority necessary conservation actions on a numerical scale of 0 to 3. A rating of 0 reflects the team leader's judgment that there is little or no correspondence between the necessary action and the criteria. A rating of 3 reflects his judgment that there is full or almost full correspondence between the action and the criteria. Ratings of 1 or 2 indicate the team leader's judgment that there is an intermediate degree of correspondence between the priority action and the criteria. All the priority actions were assigned a rating of 3, because they had already been selected as priority, or urgent, conservation actions.

The seventh column of Table 10 shows the total number of points that were assigned to each priority necessary conservation action. The last column places the 24 actions into one of three groups based on the number of points they the action received. Group 1 includes those actions that received 15 points. Group 2 includes those actions that received 10 to 14 points. Group 3 includes those actions that received less than 10 points.

Table 10 Rating of Priority Necessary Conservation Actions in Mexico by Category

Category/Priority Required Action	Selection Criteria						
	Consistency	Impact	Advantage	Urgency	Linkages	Total	Group
1 - Conservation within Protected Areas							
1) Increase ANPs	2	3	2	3	2	12	2
2) Increase ex-situ conservation	0	0	0	3	0	3	3
3) Prepare ANP management plans	2	1	3	3	2	11	2
4) Reconcile ANPs & human needs	3	2	1	3	1	10	2
2 - Conservation outside of Protected Areas							
5) Strengthen UMA's regulations	2	1	1	3	1	8	3
6) Strengthen watershed commissions	1	2	1	3	2	9	3
7) Establish biological corridors	3	3	3	3	3	15	1
3 - Policies, Laws & Regulations							
8) Align public policies with conservation priorities	3	3	3	3	3	15	1
4 - Governance for Conservation							
9) Strengthen inter-ministerial committees	2	2	1	3	1	9	3
10) Reorganize SEMARNAT	1	2	1	3	1	8	3
5 - Education for Conservation							
11) Implement technical training	3	3	3	3	3	15	1
6 - Science & Technology for Conservation							
12) Increase federal budget for conservation research	0	3	2	3	0	8	3
13) Make conservation knowledge accessible to decision-makers	2	2	2	3	2	11	2
7 - Financial Incentives for Conservation							
14) Improve conservation incentives	2	2	2	3	1	10	2
8 - Support of Citizenry for Conservation							
15) Expand conservation communication programs	3	3	3	3	3	15	1
9 - Land Use Planning & Regulation							
16) Complete territorial planning	2	3	3	3	3	14	2
17) Exchange knowledge of territorial planning	3	3	3	3	3	15	1
18) Integrate territorial & urban development plans	1	1	3	3	1	9	3
19) Integrate municipal & marine territorial plans	1	1	1	3	2	8	3
10 - Security of Rights to Natural Resources							
20) Assist *ejidos* to conserve biodiversity & forests	3	3	3	3	3	15	1

Category/Priority Required Action	Selection Criteria						
	Consistency	Impact	Advantage	Urgency	Linkages	Total	Group
21) Regularize ownership right in ANPs	1	3	1	3	1	9	3
11 - Management of Conflicts							
22) Integrate land use planning & conflict management	3	3	3	3	3	15	1
12 - Environmental Impact Assessment							
23) Revise MIA processes	0	2	2	3	1	8	3
24) Increase participation in MIAs	0	1	1	3	1	6	3

Table 11 shows the three groups of priority conservation actions based on the ratings they were given in Table 10.

Table 11 Groups of Priority Actions Based on USAID Criteria

Group 1 15 points	Group 2 10-15 points	Group 3 <10 points
Action 7: Expand biological corridors	Action 1: Increase ANPs	Action 2: Increase ex-situ conservation;
Action 8: Align public policies with conservation priorities	Action 3: Prepare ANP management plans	Action 5: Strengthen UMA's regulations:
Action 11: Implement technical training	Action 4: Reconcile protected and human needs	Action 6: Strengthen watershed commissions
Action 15: Expand conservation communication programs;	Action 13: Make conservation knowledge accessible to decision-makers	Action 9: Strengthen inter-ministerial committees
Action 17: Exchange knowledge of territorial planning	Action 14: Improve conservation incentives;	Action 10: Reorganize SEMARNAT
Action 20: Assist *ejidos* to conserve biodiversity & forests	Action 16: Complete territorial planning	Action 12: Increase federal budget for conservation research
Action 22: Integrate land use planning and conflict management.		Action 18: Integrate ecological territorial planning with urban development
		Action 19: Integrate municipal and marine territorial plans;
		Action 21: Regularize ownership rights in ANPs
		Action 23: Revise MIA processes
		Action 24: Increase participation in MIAs

6.4 Conservation Opportunities for USAID/Mexico

The TOR require this report to identify potential opportunities for USAID to contribute to biodiversity and forest conservation, consistent with Mission program goals and objectives, and make recommendations on how USAID can maximize impact by drawing on its comparative advantages and capabilities.

In this report, 24 actions that are necessary to conserve Mexico's biodiversity and tropical forests have been identified. USAID/Mexico could use an action-based approach to select the conservation interventions it will finance during the period of the new country strategy. For example, it might pick-out ***Action 6, Expand biological corridors*** or ***Action 8, Align public policies with conservation priorities***, or a combination of several priority conservation actions and finance them on a national scale through the appropriate federal ministry.

Another possibility would be for USAID/Mexico to use a geographic area approach to select its interventions. High levels of threatened biodiversity occur in many parts of Mexico. Oaxaca, for example, harbors the largest single fraction of the Mexico's biodiversity. We recommend, however, that if USAID/Mexico chooses to concentrate its assistance to Mexico for conservation in a geographic area it choose the Yucatán Peninsula (including the state of Chiapas) as its area of geographic focus. Our reasons for this recommendation are the following:

- Extensive areas of contiguous forest remain in the Yucatán Peninsula and harbor species that cannot survive in the fragments of forests that occur in other parts of Mexico;
- The wood in the remaining forest of the Yucatán contains high volumes of carbon; to the extent that if this forest is eliminated or degraded this sequestered carbon will be emitted into the atmosphere;
- The Yucatán forest contains high levels of biodiversity; the destruction or degradation of this forest will severely affect this biodiversity;
- The Yucatán forest is being degraded and eliminated at an accelerating rate, as *ejidos* are subdivided and sold to private owners;
- The Yucatán forest contains commercially valuable tree species, including mahogany and Spanish cedar. Silvicultural practices can increase the proportion and growth rates of these species of trees, thereby increasing the value of forest land, making it more competitive with other potential land uses;
- The application of silvicultural practices would also increase the rate of growth of commercially valuable trees in the forest, thereby increasing the rate of sequestration of atmospheric carbon and sequestering atmospheric carbon for a long period of time;
- A commercially more valuable forest can finance costs involved in its protection, whereas a protected area without commercial products requires constant financial subsidies, which frequently are not available;
- The Yucatán forest affects water flows from the Yucatán peninsula into the off-shore marine ecosystems, such as reefs, which also provide habitat for a large variety of living organisms, many of them threatened by extinction;
- The tourist industry of the Yucatán, which is extremely important to Mexico's economy in general, and to the economy of the Yucatán in particular, depends on the conservation of the Yucatán's natural environment in many ways, from the preservation of an attractive landscape to the provision of adequate supplies of clean water to urban areas;
- Much valuable conservation experience has already been accumulated in the Yucatán upon which to base future conservation activities;

- Institutions, public and private, exist in the Yucatán that have the capability to plan, implement, monitor and evaluate conservation activities to a high standard.

The Yucatán Peninsula, of course, is by no means the only part of Mexico where actions are required to conserve biodiversity and tropical forests. No other geographic area of Mexico, however, appears to offer the same opportunity as the Yucatán Peninsula for USAID/Mexico to finance actions that could quickly achieve large-scale, long-term sequestration of atmospheric carbon and conservation of biological diversity and tropical forests.

We recommend that if USAID/Mexico decides to focus its assistance geographically on the Yucatan Peninsula, it structure the program around the implementation the eight priority actions that were placed in Group 1. It could also finance the actions in Group 2 that fit well into the program. For example, in the Yucatan, it may be useful to finance the preparation of one or more ANP management plans, make conservation knowledge accessible to decision-makers, or complete territorial planning. Table 12 indicates some representative activities of the type that USAID/Mexico could finance in Yucatan to assist Mexico to conserve biodiversity and tropical forests and to mitigate and adapt to climate change.

Table 12 Representative Activities for a Conservation Program in Yucatan

Priority Conservation Actions	Representative Activities for USAID/Mexico Financing
Group 1	
Action 6: Expand biological corridors	Make the studies required to identify the most technically sound location of biological corridors through the Yucatan Peninsula; Determine the long-term feasibility of maintaining the biological corridors; Calculate the budget required to establish and maintain the biological corridors and compare it with the available funds; identify the priority sections of the corridor which could be established with the available funds; Identify the institutional responsibilities for establishing and maintaining the biological corridors; Design and implement a monitoring and evaluation process for the biological corridor(s).
Action 8: Align public policies with conservation priorities	Support the policy studies required to establish clear priorities for policies that support conservation in the Yucatan Peninsula; Publish policy studies and organize the meetings/workshops required to make them known as a means to establish a common understanding of how policies affect conservation in the Yucatan Peninsula among different levels and units of government, the private sector and NGOs; Establish monitoring and evaluation systems as the basis for evaluating the effectiveness of alignments of policies for achieving conservation objectives in the Yucatan;
Action 7: Establish biological corridors	Identify additional biological corridors in the Yucatan Peninsula; Manage existing biological corridors; Use financial incentives to establish & manage corridors.
Action 8: Align public policies with conservation priorities	Support actions with state and municipal officials to improve alignment of their policies with conservation priorities in the Yucatan Peninsula; Coordinate between national, state, municipal level policies to align them with conservation priorities.
Action 11: Implement technical training programs	Evaluate current training programs for conservation technicians in Yucatan; Design training programs for conservation technicians with focus on Yucatan; Identify potential institutional arrangements to provide technical training in conservation applicable to Yucatan.
Action 15: Expand conservation	Identify segments of the Yucatan public to be addressed by a conservation communications programs; Design content of communication programs for different

Priority Conservation Actions	Representative Activities for USAID/Mexico Financing
communication programs	audiences in the Yucatan; Finance implementation of communication program; Design and implement monitoring and evaluation of communication program.
Action 17: Exchange knowledge of territorial planning	Finance meetings between territorial planners in Yucatan; Provide training for territorial planners in Yucatan; Finance territorial planning in Yucatan in coordination with identification of biological corridors.
Action 20: Assist *ejidos* to conserve biodiversity & forests	Identify *ejidos* with interest in maintaining their forest management units; Identify ways to assist *ejidos* to manage their forests; Link *ejidos* with incentives and biological corridors.
Action 20: Exchange of knowledge of territorial planning	Evaluate current status of territorial planning in Yucatan; Finance workshops/training/ publications required to transfer knowledge of territorial planning methodologies between state and local government units in the Yucatan.
Action 22: Integrate land use planning & conflict management	Evaluate current status of the integration of land use planning & conflict management in Yucatan; Formulate recommendations for integrating land use planning & conflict management; Implement workshops/training/ technical advice required to implement the integration of land use planning & conflict management.
Group 2	
Action 1: Increase protected areas	Identify need for more protected areas in Yucatan based on data of species distribution, biological corridors, & threats; Identify potential boundaries of new protected areas; Identify landownership in potential new protected areas; Identify and implement specific actions required to establish new protected areas.
Action 2: Prepare management plans for protected areas	Evaluate current status of management plans for protected areas in Yucatan & determine needs for new management plans; Establish procedures for preparing new management plans that incorporate local governments and people; Prepare new management plan; Disseminate new management plans.
Action 4: Reconcile protected areas and human needs	Identify type, scale, source of conflicts between human needs and conservation in protected areas; Design measures to reconcile protected areas and human needs; Implement measures.
Action 13: Make conservation knowledge accessible to decision-makers	Organize training/workshops to transfer scientific/technological knowledge to state and local government officials.
Action 14: Improve conservation incentives	Evaluate effectiveness of existing conservation incentives in Yucatan; Determine priority focus in Yucatan for conservation incentives; Work with local and federal officials, private sector and NGOs to formulate an effective program of incentives for conservation in Yucatan.
Action 18: Complete territorial planning.	Evaluate present status of territorial planning in Yucatan; Finance program of completion of territorial planning; Disseminate results of territorial planning.

6.5 Cross-cutting, Cross-sectoral Linkages

The TOR for this report requires it to identify "opportunities for cross-cutting, cross-sectoral linkages with proposed activities, especially those that would be low cost and/or would enhance the effectiveness of the proposed activities."

The proposed activities in the draft Concept Paper, as noted above, are in three areas: (1) reducing crime and violence; (2) improving criminal justices; and (3) reducing greenhouse gas emissions.

There are few cross-cutting, cross-sectoral linkages between the actions necessary to conserve Mexico's biodiversity and tropical forests and those required to reduce crime and violence. In

general the types of activities required for these two components of the USAID/Mexico program are quite different. Yet two potential linkages are worth mentioning.

On the one hand, the programs under this component that are intended to "…increase the capacity of young people to stay in school and find work and integrate into society" could include education for young people, especially young males, to learn conservation skills. For example, there is a big deficit of field workers and technicians in technical areas of conservation such as forestry, soil conservation, conservation biology, coastal zone management and fisheries. If young men and women learn a specific skill that results in not only work but also earning respect, they are less likely to participate in criminal activity. In Panama, for example, an NGO trained young men with propensity for criminal activity to identify birds, converting them from actual or potential trouble-makers into experts in a difficult technical subject. Some of these young men were able to find work as bird-watching guides in the forests of Panama's Canal Zone, even to highly educated tourists. As a result, they became less likely to engage in criminal activities.

On the other hand, training in technical conservation fields for young men who are likely to turn to criminal and violent activities in part because they lack other skills could contribute to reducing crime and violence in Mexico. Young men who have no skills not only cannot find work but often lack normal self-esteem. Their feeling of failure sometimes expresses itself in violent and criminal behavior. Technical training might give some of these potential criminals greater self-esteem, especially if the training leads to securing a job, thereby reducing their probability of falling into a self-perpetuating pattern of criminal activity.

There are few if any links between conservation and USAID/Mexico's program to assist Mexico to improve its criminal justice system, because Mexico's environmental laws and regulations concern civil laws and regulations rather than criminal law.

To achieve USAID/Mexico's objective of reducing greenhouse gas emissions in Mexico requires many of the same actions as are necessary to conserve Mexico's tropical forests and biodiversity, in those aspects that have to do with reducing GHG emissions from deforestation in mitigating GHG through increased sequestration of atmospheric carbon. The threat to tropical forests and biodiversity from loss and degradation of habitat is equally a threat for increasing GHG emissions. So much carbon is stored in soils and vegetation that if vegetation is lost and degraded, and if such loss and degradation increases the rate of soil erosion, then GHG emissions will increase. Many of the actions necessary to reduce GHG emissions thus are largely identical to the actions necessary to conserve Mexico's biodiversity and tropical forests.

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Appendix A List of Persons Contacted

Name	Affiliation
Elva Escobar	Directora del Instituto de Ciencias del Mar y Limnología del UNAM
Paula Bauche	Directora del Programa de Pago por Servicios Ambientales (CONAFOR)
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Edward Peters	Instituto Nacional de Ecología,
Margarita Caso	Instituto Nacional de Ecología, Dir. De Biodiversidad
Sergio Madrid	Consejo Civil Mexicano para la Silvicultura, FSC.
Liliana García	Fomento Ecológico Banamex
Mariana Bellot	Comisión Nacional de Areas Naturales Protegidas
Ignacio March	The Nature Conservancy
Cesar Dominguez	Director del Instituto de Ecólogia de la UNAM
Coro Arizmendi	Facultad de Ciencias, Biología de la UNAM
Iris Jiménez	Subdirectora de Evaluación del Cambio Climático, SAGARPA
Celia Piguerón	Directora de Políticas y Estudios de Cambio Climático y Manejo Ecosistémico Subsecretaría de Planeación y Política Ambiental - Dirección General de Políticas de Cambio Climático SEMARNAT
Armando Pacheco Miranda	Guide at the Botanical Garden Heliia Bravo-Hollis
Romeo Montejo Hernandez; Oel Martinez Velasquez; Abelardo de la Cruz Perez	Ocote Natural Reserve
Park Guard, Name Unknown	Hitepec Natural Reserve
Eric Daniel Lopez	Villanueva- Specialist in Environmental Education, ProNatura
Joreg Uriel Suarez	Guide: Santecomapan Lagoon
Alvaro Compas	Researcher at the Biological Station of Los Tuztleas, Institute of Ecology, UNAM
Jose Chondal	Director Los Tuxlas Biosphere
Hugo Vallardi Perez	Civil Protección, Municipality of Serdán, Puebla State
Guillermo Jimenez	CONAFOR Department of Forest Fires
Elizabeth Monterrasa Trinidad	Director, Department of Civil Protection, Serdán
Jose Antonio Arrela Palacios	NGO Uyoolche Aie
Omar Martinez Castillo	NGO Uyoolche Aie
Felipe Carrillo Perto	Quintana Roo State
Alejando, Last Name Unknown	Forest guard, Ejido Felipe Carrillo Puerto
Clemintino Ku Pacal	President of Ejido Felipe Carrillo Puerto
Rosa Maria Trab	Treasurer Ejido
Gonzalo Meridez, Director	NGO Amigos de Sian Khan

Appendix B Scope of Work

SCOPE OF WORK FOR PREPARATION OF AN FAA SECTION 118/119 BIODIVERSITY AND TROPICAL FORESTRY ASSESSMENT FOR USAID/MEXICO

I. Purpose and Objective

The purpose of this short-term consultancy is to conduct an updated assessment of biodiversity conservation to comply with sections 118 and 119 of the Foreign Assistance Act of 1961, as amended, and country strategy guidelines under ADS 201.3.4.11 and ADS 204.5. The results from this assessment will inform the formulation of the Mission's new Country Development Cooperation Strategy 2013-2018, will define how the new strategy contributes to the country's conservation needs, as required by agency regulations, and will also serve as a planning tool to assist USAID/Mexico in better integrating environment concerns into its overall program.

II. Background

USAID/Mexico is currently in the process of formulating a new Country Development Cooperation Strategy 2013-2018. The U.S. Foreign Assistance Act of 1961, Sections 118 and 119, require USAID to analyze national needs for conserving tropical forests and biological diversity and potential USAID contributions to these needs in all country strategy plans. Specifically, the Foreign Assistance Act, Part I, Section 118(e) Country Analysis Requirements states that:

"Each country development strategy statement or other country plan prepared by the Agency for International Development shall include an analysis of: (1) The actions necessary in that country to achieve conservation and sustainable management of tropical forests, and (2) The extent to which the actions proposed for support by the Agency meet the needs thus identified."

Similarly, FAA Section 119(d), Country Analysis Requirements states that:

"Each country development strategy statement or other country plan prepared by the Agency for International Development shall include an analysis of: (1) the actions necessary in that country to conserve biological diversity, and (2) the extent to which the actions proposed for support by the Agency meet the needs thus identified."

To respond to these FAA requirements, USAID has developed more specific guidance for the conduct of such assessments, which is set forth in the document *Best Practices for Biodiversity and Tropical Forest Assessments* which is attached hereto.

II. a. Mexican Context

Mexico is home to some of the world's greatest biological riches. With a terrestrial surface of only the 1.5% of the global total, Mexico is one of the five countries in the world with the

highest variety of ecosystems, is home to about 10 to 12% of the world's known species, an ample proportion of which are unique to the country. Mexico is considered one of the world's 17 "megadiverse" countries.

This enormous biodiversity is being lost or is seriously threatened by human activities (such as land-use change, introduction of invasive species and diseases, overexploitation and illegal extraction, freshwater and aquifer depletion and contamination) and natural disasters, particularly forest fires and hurricanes. Over the last decades, Mexico has experienced significant loss of vegetation cover mainly as a result of land-use change particularly affecting tropical forests. By 2002, 27.5% of the country's territory had been converted into agricultural lands, pastures and rangelands, urban areas and other anthropic uses. Mexico's deforestation rate –estimated at some 348,000 ha/year during the 1990-2000 period- is one of the highest among countries with significant forest cover, although it has decreased recently. Almost every year, forest fires and hurricanes affect the terrestrial ecosystems of large parts of the country. In the period 1996-2004, an average of about 8,279 forest fires per year occurred, affecting nearly 268 thousand hectares per year; the impact of hurricanes and tropical storms on Mexico's ecosystems has not been adequately studied but is known to be considerable. A total of 338 high risk, high priority invasive species have been identified in Mexico, mostly affecting terrestrial ecosystems. Some 897 of the Mexican native species (100 species of mammals, 54 birds, 95 reptiles, 211 amphibians, 114 fish, 5 mollusks, 57 other invertebrates and 261 plants) are considered to be at risk of extinction (219 critically endangered, 297 endangered and 381 vulnerable).

Anthropogenic climate change is projected to have potentially enormous impacts on water resources, ecosystems, biodiversity, productive activities, infrastructure, public health and essentially all components of development. Despite its relatively minor contribution to the global climate change process, Mexico is highly vulnerable to its various impacts and consequences. Changing temperature and precipitation regimes and frequencies, including risks of more extreme weather events, as well as rising sea levels associated with global climate change will likely exacerbate or impose additional threats to Mexico's biodiversity, particularly for endemic species, tropical and temperate forests, natural grasslands, coral reefs and other coastal habitats, water resources and other ecosystem services. Changing climate and weather events may make forest ecosystems more vulnerable to pests and disease and potentially increase the risk of forest fires, drought and flooding during certain seasons. These changes will likely also adversely affect primary economic activities such as agriculture, cattle ranching and fisheries, thus exacerbating poverty. All sectors of the Mexican economy and all parts of its territory will likely be affected by climate change impacts, to varying degrees.

Mexico has dedicated significant efforts to the development of laws and programs that are working toward the overall conservation of biological resources. Examples include the establishment of the National Commission for the Knowledge and Use of Biological Diversity (CONABIO); the National Commission for Protected Areas (CONANP) and the National Forest Commission (CONAFOR), all established under the Ministry of the Environment (SEMARNAT). The Government of Mexico's National Development Plan 2007-2012 recognizes conservation of biodiversity and ecosystems as a subject of national interest, essential for alleviating poverty, achieving sustainable economic development, and enhancing the country's

competitiveness. Sustainable management of natural resources and the conservation of biodiversity and ecosystems are essential to the long-term provision of vital goods and services that underpin the economic growth and the national economy, support primary industries such as agriculture, forestry, aquaculture, and tourism and ensure the livelihoods of both urban and rural communities. In many areas of Mexico, biodiversity loss and the degradation of the natural resource base is directly linked to the lack of sustainable economic alternatives for local producers. In the international arena, Mexico is an active participant in the major multilateral environmental agreements, including the UN Conventions to Combat Desertification (UNCCD), to address Climate Change challenges (UNFCCC) and to conserve Biodiversity (CBD).

II. b. USAID/Mexico Environment Programs

USAID began its environmental activities in Mexico in 1989 as the first bilateral donor to support environmental conservation efforts in Mexico. In 1993, the natural resources portfolio was expanded to include the topics of renewable energy and energy efficiency. The increasing number of USAID/Mexico environmental activities led to an integrated program of work guided by the first Environment Strategy 1999-2003. The first strategy pursued two Strategic Objectives: "Critical ecosystems and biological resources conserved" and "Carbon dioxide emissions and pollution reduced." Activities carried out under both objectives strengthened Mexico's ability to reduce greenhouse gas emissions from the energy sector, forestry sector, and land-use change. USAID's activities have also helped Mexico address its vulnerability to climate change.

Environmental work continued under the USAID/Mexico Environment Program 2004 – 2008 which aimed for the improved management and conservation of critical watersheds. This program included two major activities: natural resource management in targeted watersheds, with a related regional fire management program and coastal resource management activities, and promotion of clean production and renewable energy technologies.

In an attempt to expand impacts and support Mexican-led initiatives to improve the country's competitiveness, USAID/Mexico launched a cross-cutting, policy-oriented program in October 2008. The USAID/Mexico Competitiveness Program 2008-2012 aimed to enhance competitiveness by promoting more effective policy design, implementation and evaluation across three governance areas: environmental management, small business promotion, and precursor and factor markets including financial services, renewable energy and water service. The Program built upon prior USAID efforts in Mexico to achieve sustainable reforms by improving transparency, strengthening civil society participation, and promoting accountability.

Building upon this rich experience, recognizing Global Climate Change as a policy priority for Mexico and the United States, and in fulfillment of the "fast start financing" commitments made by the United States under the Copenhagen Accord, in 2010 USAID/Mexico began the design of a new Global Climate Change Program.
USAID/Mexico conducted assessments and consultations with key representatives from the federal government, including the Ministries of the Environment and Agriculture, the National Forestry Commission and others; with academics, non-governmental organizations and private

sector entities in Mexico to identify the major climate change challenges in the country. The USAID Mexico Global Climate Change (GCC) Program was launched in September 2011 and will run through 2016 with an estimated total investment of $70 million (subject to appropriations). The USAID Mexico GCC Program pursues the overall strategic objective of supporting Mexico in achieving a low-carbon future, by focusing on mitigation efforts in both energy use and the forestry and land-use sectors, the latter focusing specifically on Reducing Emissions from Deforestation and Forest Degradation (REDD+).

The USAID Mexico GCC Program is being implemented through two main complementary mechanisms:

The Mexico Low Emissions Development Program (MLED) provides broad-based support to the GOM on the design and implementation of its Low Emissions Development Strategy (LEDS) and the strengthening of its monitoring, reporting, and verification (MRV) systems. MLED also has a sector-specific component aimed to enhance the promotion and adoption of clean energy, including renewable energy and energy efficient technologies. MLED supports on-going efforts by the Government of Mexico to achieve regulatory reforms that facilitate the adoption of clean energy technologies at the national, state and local levels. MLED also helps to strengthen the technical and institutional capacities of private and public entities to promote the adoption of renewable energy. Finally, MLED helps establish the financial architecture –based on public and private sources- necessary for the implementation of clean energy projects. MLED is being implemented by a consortium constituted by: Tetra-Tech ES, Inc., World Wildlife Fund, Center for Clean Air Policy, CySTE,S.A, Det Norske Veritas USA, Inc. and MGM Innova Consulting LLC.

The Mexico's Reduced Emissions from Deforestation and Degradation program (M-REDD) will assist Mexico in designing and establishing an operational REDD+ system. Working with SEMARNAT, CONAFOR and state and municipal governments, as well as with *ejidos* and Mexican and international non-government organizations, MREDD will support the country to take advantage of carbon markets, will continue identifying ways in which emissions reduction can become a community-level economic activity, and will work to strengthen forest carbon accounting systems, carbon inventories and to expand access to the international carbon market. M-REDD is being implemented by a consortium constituted by Mexican and international organizations: The Nature Conservancy, Rainforest Alliance, Fondo Mexicano para la Conservación de la Naturaleza, Woods Hole Research Center and the Carnegie Institution for Science.

Since 1989 USAID/Mexico has contributed over US$100 million to support Mexico's efforts to manage its natural resources sustainably, protect its rich biodiversity, reverse environmental degradation, and improve the well-being of its population. The assistance thus provided has led to significant results and has allowed for the development of strong relationships with the leading GOM environment and energy agencies and national/international conservation NGOs.

III. Statement of Work

Under the direction of a team leader, and following the guidelines stated in the USAID document *Tropical Forestry and Biodiversity (FAA 118 And 119) Analyses: Lessons Learned and Best Practices from Recent USAID Experience (http://transition.usaid.gov/our_work/environment/biodiversity/118_119_analyses.html)*, the assessment team shall evaluate biodiversity and tropical forest concerns in Mexico. The focus of all activities taken under this assignment is twofold:

1) To identify the actions necessary to conserve Mexico's biodiversity and to achieve conservation and sustainable management of its tropical forests, and

2) To analyze how and to what extent the actions proposed for support by USAID/Mexico meet, or would meet, the needs thus identified.

The "*Biodiversity and Tropical Forest Conservation, Protection and Management in Mexico: Assessments and Recommendations*" 2002 report, along with the "*Assessment of Tropical Forest and Biodiversity Conservation in Mexico*" 2009 report will serve as the base documents for this updated assessment and will be provided by the USAID Mission together with other relevant documents. Data that has already been produced by academic institutions, government agencies and conservation organizations in Mexico and from the work already accomplished by USAID and other donors in the country will also inform this updated assessment.

The study hereby requested will build on the foundation of these assessments to synthesize other updated information available on the biological and forest resources in Mexico, their current status, and the recognized pressures impacting them. It will include the actions and potential actions of the overall Mission program, not just environment. USAID/Mexico will provide a written description of the actions and potential actions of the mission program by the start of phase II (see below) to facilitate this analysis.

The Contractor shall perform the following activities:

A) Data collection.

1. Hold meetings with USAID/Mexico staff to obtain a solid understanding of the Mission's ongoing sectoral assessments, program goals and objectives under its proposed strategy. The Mission will also provide the team with advice and protocol on approaching USAID partners and host country organizations with respect to this assignment. The team shall be aware of sensitivities related to an assessment exercise (i.e., the potential for raising expectations, and the need to be clear about the purpose of the assessment) and respect Mission guidance and time constraints. The team will discuss organizations to be contacted and any planned site visits with the Mission and coordinate as required. USAID/Mexico staff will facilitate meetings with other areas at USAID to allow the team to gain a full understanding of the country program and strategy. USAID/Mexico staff will help facilitate interaction, information exchange and consultations with other USAID staff in Washington and other missions to gather information on regional programs and agency environmental regulations.

2. Gather, review and analyze existing information prepared by government agencies, bilateral donors, and national and international NGOs working in Mexico dealing with the country's natural resources, geographical, ecological and biological specificities, current status of the environment - in particular biodiversity and tropical forest conservation, organization of key conservation institutions at the entity and systemic level, key stakeholders and donors in environment and biodiversity, legislation related to the environment and biodiversity, and other relevant information required for the assessment.

3. As necessary, hold meetings with relevant ministries and agencies, donor organizations, NGOs, and other organizations involved in forest and biodiversity conservation, cross-cutting issues, or that are implementing noteworthy relevant projects in Mexico or relevant regional efforts.

4. Conduct no more than three priority site visits, which would supplement understanding of USAID's program, or of biodiversity issues that arise in interviews and literature or would confirm information in previous assessments. The sites for the field visits will be determined by the team during the assessment in consultation with USAID/Mexico.

B) Analysis:

Assess and summarize the status of biodiversity and tropical forests in Mexico including the state and issues concerning marine and coastal resources. Identify the key current, recent and potential, direct and indirect threats to Mexico's biodiversity and ecosystems. Global Climate Change issues (REDD, mitigation, adaption, clean energy) should be integrated into the analysis as they impact upon tropical forests and biological diversity (and vice versa). Identify the priority actions necessary to conserve and sustainably manage renewable natural resources, biodiversity and tropical forests in Mexico in the current context. Summarize and assess the social, economic, institutional, legal, and policy context for the use and conservation of biodiversity and tropical forests in Mexico, including actions currently being taken by government, USAID and other donors, NGOs, and the private sector.

C) Report:

Prepare a report on the status of biodiversity, tropical forestry and conservation efforts in Mexico and potential implications for USAID or other donor programming and environmental monitoring which shall define the actions necessary for conservation. This report shall clearly meet the legal requirement of FAA Sections 118 and 119 by answering the following:

(1) What are the significant threats to tropical forest sustainability and biological diversity conservation? and

(2) How can these threats be addressed and resolved via USAID involvement?

The report should be no more than 50 pages in length (excluding appendices), and shall include sections covering the following topics:

Title Page, including the date of completion of the analysis report

Table of Contents

A. *Introduction*, describing the purpose of the assessment and methods used in conducting it, including the timing of the analysis in relation to the timing of USAID strategy development.

B. An updated overview of the current *status of biodiversity in Mexico*, encompassing the various organization levels (i.e., ecosystems, species and genetic diversity) and origins (i.e., native, exotic, introduced, cultivated species) of biodiversity components. Freshwater, marine and coastal resources should also be included.

C. An updated overview of the current *status of Mexico's ecosystems*, with particular reference to tropical forests. The overview should include ecosystem diversity, values and economics of ecosystems and ecosystem services, vegetation cover and land use and recent trends in land use change. It will also summarize how current land tenure arrangements affect ecosystem conservation in Mexico.

D. An overview of the recent, current, and potential *threats to Mexico's biodiversity and ecosystems* (with particular reference to tropical forests), including direct and indirect threats and their drivers, the magnitude of both current and foreseen impacts, and their environmental, economic and social consequences. Global Climate Change issues (REDD, mitigation, adaption, clean energy) should be specifically addressed as they impact upon tropical forests and biological diversity (and vice versa) based on existing global climate change assessments for Mexico, information from the existing REDD project, and interviews.

E. An updated *overview of conservation efforts in Mexico, their scope and effectiveness*. This should emerge from:

a) A review and summary of recent, current, and planned activities by government, NGO, universities and other local organizations, private sector, and donor programs and activities that contribute to conservation and sustainable natural resources management in the country, as well as a general description of responsible government agencies.

b) A general assessment of the social, economic, and political context for sustainable natural resources management and the conservation of biodiversity and tropical forests in Mexico, encompassing national policy and regulatory framework, national programs and strategies, institutional capacity and arrangements, private sector involvement, participation in international treaties, and the role of civil society.

c) A general assessment of the effectiveness, strengths, and weaknesses of these policies, institutions, and activities to achieve biodiversity and forest sustainable management and conservation in Mexico. Priority conservation needs that lack donor or local support should be highlighted.

F. A review of the proposed USAID/Mexico strategy and program followed by an *analysis of the extent to which USAID-supported actions help meet the needs for biodiversity and tropical forestry conservation in Mexico*. This should identify potential opportunities for USAID to contribute to

biodiversity and forest conservation, consistent with Mission program goals and objectives, and make recommendations on how USAID can maximize impact by drawing on its comparative advantages and capabilities. These issues and recommendations should be prioritized to identify those requiring the most immediate attention. It should also identify opportunities for cross-cutting, cross-sectoral linkages with proposed activities, especially those that would be low cost and/or would enhance the effectiveness of the proposed activities. Also identify and analyze potential, direct or indirect impacts or threats to biodiversity and tropical forests from the proposed USAID/Mexico strategy and program, and make recommendations for how these might be mitigated or avoided.

G. *References* used and cited in the report should be listed; web URLs for information resources should also be provided.

H. *Appendices* to the report should contain, at minimum:

- The SOW for the analysis,
- Biographical sketches of analysis team members,
- A list of persons contacted and their institutional affiliation,
- Other background or supporting material as needed.

Appendix C Notes from Field Visits

Bruce Kernan, Notes, Field Trips in Mexico
January 13 – 19 (Puebla, Oaxaca, Chiapas, Tabasco, Veracruz States)
January 23 – 25, Quitana Roo State

Sunday, January 13
Botanical Garden Heliia Bravo-Hollis
Tehuacán Cuicatlán Biosphere Reserve
Puebla and Oaxaca States

Interviewee: Armando Pacheco Miranda
Guide at the Botanical Garden
Calzada Adolfo Lopez No 33,
Zapotitlan Salinas Puebla
C.P. 25870 Mexico
Tel 2381501407

We drove from Mexico D.F. to the botanical garden, arriving there in the early afternoon. The Botanical Garden Helia Bravo-Hollis is named for Mexican botanist who was associated with the Autonomous National University of Mexico (UNAM) and the Institute of Biology. She was a specialist in cacti and published more than 160 papers, describing 60 taxa.

The botanical garden is located in Zapotitlán Salinas in Oaxaca State and is one km2. The Tehuacán Cuicatlán Biosphere Reserve, declared in 1998, is about 9000 km 2 and is located in southern central Mexico in south-eastern Puebla and northern Oaxaca states in the upper Tehuacán Valley at from 600 to 2200 meters above sea level. It is administered by the "Comisariado de Bienes Comunales". The comisario is elected every three years and cannot be re-elected.

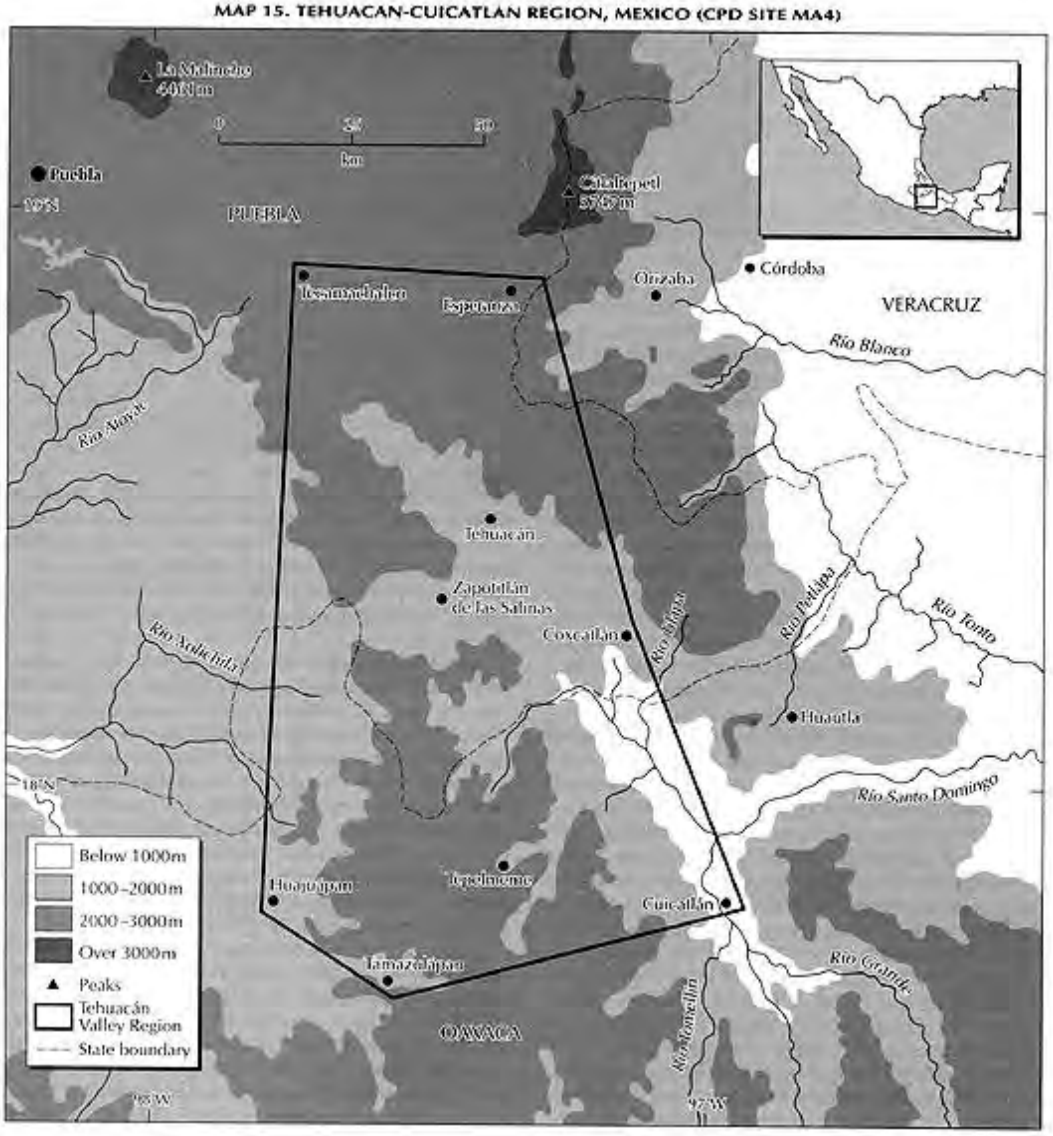
The reserve has several dry land scrub formations with succulent, spiny and thorny plants. It has about 2700 species of plants and 910 genera of seed plants of which about 30% are considered endangered. It is considered one of the most important reserves of dry vegetation in the world. The main threats to its vegetation are fire and grazing animals, especially goats. Southern central Mexico, south-east of Mexico City, Useful plants include ornamentals, such as the cacti, *Dasylirion*, *Nolina*, *Beaucarnea*, *Agave*, bromeliads), traditional medicines, food from cactus fruits, ceremonial uses and fuelwood. The main threats are agricultural and pastoral activities, soil salinization and hardpan formation (caliche), depletion of groundwater, overgrazing by goats; and road improvements.

According to Armando Pacheco, the reserve was established without consultation and against the wishes of the local people who own the land. The Botanical Garden was started in about 1998 with the assistance of Japanese botanists who were collecting cacti. Now according to Pacheco, about half the people support the reserve and the other half oppose it, mostly because they are concerned that it will infringe on their rights to the land.

Sources of conflict between the reserve and the local people concern land ownership and use of resources. The land of the reserve is owned by communities in 51 municipalities. A lot of people are worried that the existence of the reserve threatens their rights to land ownership and the use of the resources. People use the reserve land to cut fuel wood, graze goats, donkeys and some cattle. Formerly, cattle were driven through the reserve on their way to markets and they were given water by cutting down cactus. Now the cattle are transported by trucks so they are no longer such a problem to the natural vegetation.

The entrance fees for the botanical garden go to the community for the maintenance of the botanical garden. The botanical garden needs more investment especially in building paths from stone. It has some cabins for tourists to sleep in.

MAP 15. TEHUACAN-CUICATLAN REGION, MEXICO (CPD SITE MA4)



After seeing the botanical garden, we visited the salt works nearby. Salt is produced by evaporation in shallow pools. Pools are individually owned, and there are several dozen owners within an area of about 100 hectares or so.

We spent the night in Tehuacasn, Puebla State

Monday, January 14
Observations from Oaxaca to Gulf of Tehuantepec

During the five hours we spent driving from Oaxaca to Tehuantepec we saw mostly dry landscapes with cactus and dry forest. We went to the archeological site on an elevated site at the end of the Gulf of Tehuantepec, and I walked through the forest in the for an hour or so. It is a dry tropical forest with no commercial value at all. It looked very susceptible to fire. Where the road comes out of the mountains, at the end of the Bay of Tehuantepec there is a large area of forest, perhaps several thousand hectares in size, on the flat land just before the mountains start. In the middle of it there a large rectangular area has been cleared of trees, it looked as if by machinery. The purpose of the clearing was not evident. If that area is burned, however, the fire will almost certainly spread into the dry forest which surrounds it and a valuable area of habitat will be lost. The forest area is surrounded by a fence so it is probable that cattle and/or goats are grazed within the forest. The forest is so thick that it would be very difficult to walk through it.

A few kilometers before arriving at Tehuantepec we stopped at roadside stand. The local bishop was having a cold coco there so I talked with him for a few minutes. He said that the principal problem in the area is poverty and that the Catholic Church is more concerned about poverty of the people than any other social issue. I asked him if there is a connection between the degradation of the environment and poverty and whether the Catholic Church has a policy about environmental protection. He gave me no clear answer. The people he was sitting with were from Los Angeles and were just visiting their place of origin.

We spent the night in Salnia Cruz, to the north of Tehuantepec. It is a congested, dirty commercial center.

Tuesday, January 15
San Mateos del Agua
Oaxaca State
Observations but no interview

San Mateos del Agua is in Oaxaca State on a narrow spit of land along the northern side of the Golf of Tehuantepec. San Mateos is the largest town on the spit but there are several other smaller towns. The people living in these towns are generally referred to as "Huaves", but a book about these people that I consulted in the town library said that their name for themselves is "Mero Ikooc" which means "real people" and that "their traditions talked about a long voyage over the sea from the south towards the North made by that people after internal wars and fights with their neighbors obligated them to migrate". (Los Huaves by Daniel Zizumbo Villareal, Department of Rural Sociology, Autonomous University of Chapinzo).

According to Georgina Cepeda Santiago, the town librarian, Huave men live mostly from fishing, but another person told me that they also work for other people as day laborers. One activity of the women is weaving.

We walked out to the beach, seeing a few patches of mangroves on the way. The lagoon behind the beach was full of water birds. There were no buildings on the part of the beach we saw. The vegetation on the way was mostly scrub forest and brush that seemed to be used for pasture for goats and cattle.

The cities of Salinas and Tehuantepec are heavily built up in a disorganized way. We drove to the east from Tehuantepec along the coast. In the section called Los Ventos, there is a huge wind power farm. The wind mills are spread across a large area. Bejamin told me that he had participated in an environmental assessment of the wind farm and had concluded that the wind mills have been built in an important flyway for migrating birds and that they kill many birds. He said that he felt that his observations had been completely ignored by those responsible for constructing the windmills.

We drove to Tuxtla Gutierrez in Chiapas State and spent Tuesday night there.

Wednesday, January 16
Reserve Natural Ocote
Chiapas State

Romeo Montejo Hernandez, park guard
Oel Martinez Velasquez, park guard
Abelardo de la Cruz Perez, park guard

The reserve is a state reserve and is located to the south of Tuxtla Gutierrez. It is commonly referred to as the "Laguna Beligca", although there is no lake but only a depression with a wetland where a rare type of frog lives. The reserve is officially 50 ha but 7 more ha have been added informally where natural vegetation has taken over part of a property that borders on the reserve. The park guards just moved the fence that surrounds the reserve over to include these 7 additional hectares. There are about 8 adjoining properties. The reserve reverted to the State of Chiapas for some reason, which is why it is owned by the state government.

The State of Chiapas has declared about 22 reserves but only two or three are on land actually owned by the state itself. The rest of the reserves have been declared on what is actually privately owned land. Three of the state reserves have guards and there are four guards assigned to this reserve.

The threats to the reserve are collecting plants, cutting firewood and fire. People who sell plants in nearby cities came here to get plants. That threat has now gone down considerably because the guards have stopped people from collecting plants.

The principal threat to the reserve now is fire. Fires spread into the reserve when the owners of neighboring properties burn their pastures and agricultural fields to renovate the grass and

clear off scrub forest. There is more fuel on agricultural fields than in pastures so fires on agricultural fields are more dangerous. The guards have cleared a firebreak around the entire reserve. It is from 4 to 7 meters wide depending on the topography. It takes a month for the four guards to clear the firebreak and they estimate it is about 4000 meters long. The guards clear all the leaves and vegetation off the firebreak before the fire season starts in February. The guards have no firefighting tools. They have a rake without a handle and with bent teeth. I saw the area where in 2012 a fire spread into the park from a neighboring pasture because a large burning stump fell across or close to the boundary line. The guards said it took them two days and part of a night to put out the fire by beating it with branches. It also stopped because it met a trail through the reserve. The fire was evidently slow burning. The guards said it burned underground as well as on the surface.

The neighboring landowners collaborate with the reserve to the extent that they sometimes let the guards know when and where they are going to burn their pastures. The neighbors take no responsibility for the spread of fire into the reserve and do not help to fight a fire within the reserve. There are about

The reserve has a wooden hut as its headquarters. It had a better building but several years ago the building was torn down in order to replace it with a new building. The new building has never been finished. All that is there now is a deep hole in the ground with some rebar sticking out of it.

One of the guards has worked at the reserve for 27 years. The others have worked there for three and five years. They are graduates of high school. They have gone to a course about fighting fire. They have no equipment to take scientific measurements or observations. They have no binoculars, for example. The guards say that they make no regular observations about the rare frog that is in the reserve.

The reserve is visited by groups of school children. It has trails and there are numbered posts along the trails which once served as place to refer to an interpretative guide. The guards no longer have any of the guides left to distribute.

The most important thing the park needs is more equipment to fight forest fires and equipment to make observations and record data.

Interviewee: part guard, name unknown
The Hitepec Natural Reserve, whose official name is Lorenzo Gomez Jimenez, was established in 1986 as the first private reserve in Mexico by ten private individuals. It remains independent of government support, relying mostly on private contributions, although it receives some support from the federal government. It has an area of 135 ha and is located on the edge of a gorge that is part of the slope of the inactive volcanoe called Huitepec. It is operated by the NGO ProNatura. The vegetation of the reserve is almost entirely three species of oak grees and a bush called madron. The principal problems for conserving the forest are the stealing of bromeliads, the cutting of firewood that people need to make tortillas, and cutting of a plant called *norangillo*, which is used as a decoration on All Soul's Day. There is one park guard for this reserve. The trunks and branches of all the oak trees I saw had been cut, so the trees are

deformed and crooked. There was little understory vegetation. The degraded forest probably protects the slope from soil erosion to some extent. I myself saw little of interest in the forest that would make it worthwhile to visit. It is a terribly degraded forest, that requires silvicultural measures in order to obtain regeneration and create an understory of plants. No such silvicultural measures have been formulated much less implemented.

Interviewee: Eric Daniel Lopez, Villanueva- Specialist in Environmental Education, ProNatura
The Mashemequil Ecological Reserve is located on another slope above San Cristobal de las Casas. The reserve has 97 hectares and was donated and established in 1997 by people from the United States who were living in San Cristobal de las Casas. ProNatura Sur is responsible for its protection and management. The forest is considered to be important because it protects the sources of water for the wetlands at the bottom of the slope. It also is considered to serve as a refuge for some species of animals, particularly the 74 species of birds that have been recorded in the site. The principal problem the reserve has is the extraction of bromeliads and the throwing around of trash. Cutting firewood is not a big problem because people only take dead wood and by doing so they reduce the risk from fire, although so far fire has not affected the forest during the time it has been part of the reserve. The area is open to the public and many people from the five or six nearby communities walk through it on their way back and forth to their houses. ProNatura puts a lot of effort into using the area for environmental education programs, which involve about 1500 children a year from five schools. Through this program, ProNatura hopes that it is educating the next generation of inhabitants of San Cristobal de las Casas to protect the vegetation and forest around the city especially as a measure to protect its water supply. . The local municipal and community governments have shown no interest in the reserve and have not supported it in any way. The other forests around San Cristobal de las Casas belong to *ejidos*, but there are no relationships between those *ejidos* and the reserve. In the opinion of Eric Daniel Lopez there is room for much more coordination between the reserve and other organizations. No research is done at the reserve. I walked a short distance into the forest and observed that it is severely degraded. Eric Lopez said that an endangered species, the "chipa rosado" (Erigaticus versicolor), and endangered bird, lives in the forest. According to Eric Lopez an inventory of the forest is urgently needed upon which to base a management plan. ProNatura has 90 people working in Chiapas on projects that involve more efficient wood stoves and environmental education. It also gives training courses, including training for government employees.

Thursday, January 17

We drove from San Cristobal de las Casas north to Tabasco State and then west to Veracruz State. The landscape on the way is mostly pastures and fields with a few patches of forest left. We spent the night in Catemaco, next to Lake Catemaco.

Friday, January 18

Interviewee: Joreg Uriel Suarez, boatman and guide
We first went for a boat ride through the Santecomapan Lagoon next to the ocean below Catemaco. There were perhaps 30 or 40 fishing boats at the docks and we saw five or six fishermen out on the water, throwing nets and fishing with lines. Manatees once lived in the

lagoon but they were hunted so heavily that they are no longer seen. There is a lot of water hyacinth at times, but when the river into the lagoon (Rio Chueapa) many of these plants are washed away. There are four types of mangrove: red, yellow, white and black. There was no sign that the mangroves are being cut and some of them are as much as 30 cm in diameter although none are very tall. Crab are caught with a bait of sting ray meat.

Interviewee: Alvaro Compas, Researcher at the Biological Station of Los Tuztleas, Institute of Ecology, UNAM

Alvaro has spent 19 years at the research station. The principal purpose of the station is to catalogue the biodiversity of the area and to make ecological studies, particularly regarding natural regeneration of vegetation and methods of planting native vegetation. There is a 30 year record of publications based on research at the research station, so a lot is known about the vegetation and the animals. More than 1000 thesis projects have been carried out in Los Tuxles Biological Station over the last 40 years. The process for obtaining natural regeneration is now known. Still, there remains much to be studied. Under-graduate students find it more difficult to complete their research projects than graduate students because they do not receive any financing to do it as graduate students do. They have to pay for the costs of doing their research. Nonetheless, 85% of the undergraduate students have completed their theses. Foreigners do research here and some of them bring their students. However, there is little useful interchange of information between Mexican and foreign researches at Los Tuxles. The foreign researchers tend to come, obtain data and leave without leaving much for Mexican research. Some research has been done on the relationship between the people and the reserve, mostly about how much financial benefit the park has provided to local people.

Interviewee: Jose Chondal, Director Los Tuxlas Biosphere
The station has 640 hectares. They are within the 150,000 ha of the Los Tuxles Biosphere Reserve. The biosphere reserve was declared in 1998. It includes 8 municipalities. Local communities were not consulted before the area was made a biosphere reserve and it was not generally known that there were *ejidos* in the area. . All the area was covered by forest 19 years ago. The government expropriated the land of the indigenous people who lived there and paid them 2000 pesos per hectare. The people grow coffee and cattle. Now only small patches of forest remain. It was declared a biosphere reserve in 1998. The station is trying to promote ecotourism as a way to give the people an alternative to eliminating the remaining forest to create more pasture and farmland. In Alvaro's opinion some people are beginning to recognize that the remaining forest should not all be destroyed. The reserve belongs to the Federal government, but the work of extension with local people is not done by the federal government but by the research station. When the biosphere was established the idea was to buy the land from its owners, who were private and *ejideros*. The government never has provided sufficient funds to buy the land, so the owners remained on the land and continued to eliminate forest.

The GEF financed a project in the biosphere for 8 years that ended about two years ago. It was called the Integrated Management of Ecosystems and it included two other Mexican reserves as well. The project allowed the government officials to inter-act with the communities within the biosphere. The biosphere is applying for another GEF project.

Fire is a problem for the conservation of the reserve from January to March. People burn the pastures and the fire spreads into the forest, especially because winds can be quite strong. During the GEF project 50 Committees of Vigilance to fight the fires were created and they still exist. Regulations have been written related to the control of wild fires but they are not followed for the most part. Another effort of the GEF project was to protect marine turtles nesting sites along the biosphere's 60 km of coastline. Tourists come to see the turtles hatch. The biosphere is working with 15 ecotourism groups and some of them are certified. It is also doing reforestation of with mangrove species of trees. A groups of women is collecting forest tree seeds from the forest. The largest land use is for cattle. The biosphere staff visits the cattle ranches and tries to explain to the ranchers the advantages of maintain some tree cover on their ranches. The forest has 200 species of medicinal plants. The biosphere reserve has established a network of environmental education.

The biosphere reserve is underfinanced. It receives 7,000,000 pesos from CONAFOR and 1,000,000 from. At least 15 million pesos are required to manage the biosphere reserve properly. There are two park guards to patrol the park our of a total staff of seven people. They have 3 to 4 vehicles.

From drove from Catemaco to Oriizaba on Friday afternoon and night and slept in Orizaba. Veracruz State.

Saturday, January 19

Interviewee: Hugo Vallardi Perez
Civil Protección, Municipality of Serdán, Puebla State

Civil Protection in Sedan has a staff of 8 people and is the first line of defense against forest fires. It has no equipment for fighting forest fires that is in good condition. Fires are caused by the carelessness of people. CONAFOR has given us some training in fighting forest fires – one time a four day course. CONAF knows how to manage backfires. There was a forest fire here recently, but it was small and we could control it.

Guillermo Jimenez
CONAFOR
Department of Forest Fires

Puebla State is divided into five districts for the management of fires and he is in charge of the district of Sean, which includes 24 municipalities. There are about 400,000 ha of forest, mostly pine, oak, and fir. The fire season is from January to July when it doesn't rain. Fires are caused by "cleaning the agricultural fields". Fires escape and enter the forest, because the forest is interspersed among agricultural lands. All the forest has owners, mostly *ejidos*. The *ejidos* are divided, however into parcels owned by individuals. The *ejideros* use the forest to sell wood and distribute the proceeds among themselves. But the ejideros are farmers and they are not interested in the forest in spite of the money it gives them. Norma 015 permits them to use fire when the inform a government official who decides whether they can burn or not, but the

people burn whenever they decide to, not obeying a government official. Forums have been organized to educate the people about the damage fire does and how to manage fire but few people actually understand the concept of controlling or managing fire. The tradition of burning the fields)the "rastrajo") is very embedded in the culture of the people. We have programs in the schools to teach about fire control and management and we have observed that people do learn through their children. I have heard one say "My son told me…". There is a Forest Day in May in which we have events about forest fires.

We have become more effective than before. In 1990 it would take us two hours to respond to a forest fire whereas how we can usually respond within 15 minutes of being notified of a fire thanks to the communication equipment and satellite images we now have. Each municipal is supposed to have a fire brigade and CONAFOR has given those brigades training. They are supposed to control the smaller fires. People from the USFS have come down here to give us training in fighting forest fires. We continue to give training courses ourselves, such as those we give to the Mexican army. We have specialized fire-fighting equipment, but the municipal governments lack proper equipment. They only have boots that are adequate – the reset of their equipment is polyester which is inflammable. It costs about $800 to equip one person properly with firefighting equipment and we do not have the money to buy that amount of equipment.

So far in 2013, we have responded to 6 fires and in 2012 we responded to 28. Five were bigger than 10 ha and only one went out of control. People don't burn pasture anymore as they did in the 1980's. Global climate change is making it more difficult to control forest fires.

The most useful actions with regard to controlling forest fires would be to (1) educate people about forest fires; (2) increase the physical capacity of the people who fight the forest fires; (3) train people in the use of fire fighting tools. Municipalities should legislate about controlling forest fires. The Norma General gives responsibility to municipal governments to fight forest fires. They should have groups ready to fight forest fires. Municipal governments are central to controlling forest fires and thereby controlling soil erosion. But municipal governments are uninterested because their personnel want to build things i.e. "obras".

Elizabeth Monterrasa Trinidad
Director, Department of Civil Protection, Serdán

We must operate according to Law 015 which gave municipalities the responsibility for combating forest fires. But there is a problem. The law is very clear that the farmers have first responsibility for putting our forest fires, then the Civil Protection, then the state offices of CONAFOR and then the national office of CONAFOR. But the farmers are the people who start the fires in the first place. They want to burn "rastrojo" and those fires often get out of control and go onto neighboring land. If the fire does not affect them, they have no reason to combat it.

We in the municipality have very rustic, old tools to fight fires and only a few people. In 2011 the municipality received some tools from CONAFOR and gave them to the *ejidos*.

CONAFRO has equipment to fight forest fires but it does not get to the site before the fire is big. Four forest fires went out of control in 2012.

We had two fires yesterday at 5 AM and 3 PM. CONAFRO sent its people. People want to burn their crop residues ("rastrojo") rather than convert it into humus for the soil. They see forest fires as perfectly normal, as part of agriculture and are not interested in controlling them. They want chemical fertilizers.

Officials in the municipal government work only for three years and then are changed with the election of new government officials. On Feb 15, 2014 there will be a new municipal president and all the municipal officials will also change. The people who are in my department are very young which helps a lot to fight forest fires since they are physically strong and they are enthusiastic. They put out fires with branches.

From Sedan we drove to Mexico D.F., arriving there in the early evening.

Wednesday, January 22

Jose Antonio Arrela Palacios, forester, NGO Uyoolche Aie
Omar Martinez Castillo, Director, NGO Uyoolche Aie
Felipe Carrillo Perto, Quintana Roo State

The ONG Uyoolche Aie was founded in 1999 by a group of biologists. Its lines of action now are: (1) biosilvestre; (2) forest management; (3) climate change; (4) commercialization of community products. Biosilvestre, however, is not currently active because of legal obstacles to the sale of wild forest products. Many ONGs have said that prohibiting the commercialization of even endangered species is counterproductive and has not worked. The law was changed with the intention of stopping the destruction of mangroves by the tourist industry but that change also has not been effective. Communities were already selling parrots and could have earned income while taking care of wild parrots. SEMARNAT has another opinion and so does Greenpeace and the Ley de Vida Silvestre which have "No touch" policies. Mexican includes all parrots although not all parrots are endangered and some could be harvested without harming, and indeed causing more protection, of the species. Comercialization of parrots would have been an incentive to conserve their habitat.

The forest has many layers of value and all the layers should be used to increase the value of the forest and thereby increase its chance of not being eliminated. Forest management could improve the rate of sequestration of carbon in the forest. Carbon has been sold in Chiapas but not in Quitana Roo. The Community Forest Management Project in Felipe Carrillo Puerto involved improving the use of milpa, bee keeping and ecotourism and territorial planning. USAID financed part of the project The *ejido* of Felipe Corrillo Puerto had had a forest management plan for over 40 years but his project tried to add other economic activities to it. There was an audit of the carbon project in 2011 but the project was not improved because the data was not reliable enough. It said that more samples were needed in the field. It would cost $180,000 to collect the data that are required for the carbon project.

Certification of forest management has not involved financial analyses. The forest does not produce enough income to pay for the costs of certification of forest management. No *ejido* has become self sufficient in forest management i.e. the forest management plans are not business plans but just cutting plans. The forest management plans are not being applied well. The quality of the forest is declining not increasing. There are serious problems in obtaining regeneration. More opening of the forest is required to obtain regeneration. The forest has been over-exploited. An analysis of the species is needed from the silvical and silvicultural viewpoint. We are using data to prepare forest management plans that are 30 years old. Thirty years ago, under the Plan Piloto Forestal, we tried to establish permanent plots but they were all lost. Sylvia Porato with financing from the U.S at the University of Veracruz, has placed measuring tapes on some trees to try to determine growth rates and age. ECOSUR is studying the effects of hurricanes on species composition. SEMARNAT does not take action with regard to forestry or silvicultural problems. We have had no contact with the USFS. The *ejidos* were established under the Plan Piloto Forestal. The *ejidos* replaces the forestry concessions under which the *ejidos* received no financial benefits from the exploitation of timber from the forest. PPF changed the system and gave power to the *ejidos* to manage the forest. Almost all, but not all, the *ejidos* have a forest management plan. They work with CONAFOR. CONAFRO has all the data on the production of wood from the *ejidos*. It gives permission for logging in the *ejidos*. The Ley Agraria establishes that the natural resources belong to the communities. CONAFOR is asking each *ejido* to make a short Action Plan with a plan for financing development included. Until now the communities do not see that the forest management unit is a business unit; they have not reached that level of understanding. They are only interested in selling wood, not in forest management.

Alejandro
Forest guard, Ejido Felipe Carrillo Puerto
Field observation in the forest of the eljido

We have the problem that our forest is not large and we cut it over just 8 years ago. There is hardly any valuable wood left. The *ejido* has 4,600 ha of which only a part is in the forest management plan. People can buy land from the *ejido* and it cost $9000 per hectare. All the *ejidos* have titles but now there are no conflicts over land as there were 35 years ago. There is a lot of illegal hunting. Deer meat is sold but with permission of the *ejido*. Eleven people have a license to sell deer meat with a seal. Javali are a problem for farmers because they eat the camote and the yucca and almost everything else too. Groups of 30 or more can go through a corn field and eat everything. It is not a good idea to use poison because one farmer used it and killed all the animals and it did not seem fair to use so the *ejido* banned the use of poison. Our *ejido* still has not been divided into parcels legally. A study of land use has been made. The *ejido* has prohibited the clearing of high forest and there are punishments and regulations within the *ejido*. We are taking care of the forest now whereas before we just sold wood without a thought. We have a project of "mlpa mejorado" which would permit us to concentrate production on a smaller area, about 20 by 20 meters and use fertilizer and fumigate to control the insects and diseases and sow the plants more closely together. We have an area of timber to sell in 2013 and we will see if there are any buyers. The trees are marked to 500 meters Back from the road. There is a lot of destruction when a tree is cut down and dragged out. There a minimum diameters for the cut of different species of trees. Caoba has a taproot and if

it is broken the seedling will die. All the *commisarios* have wanted to do is to sell timber without any thought for regeneration of the species. The term "acauwales" means forest re-growth. The ejiderios want to sell off all the pole sized trees in the forest now that the timber has almost been entirely extracted.

Observations; there is some regeneration in the forest, even of mahogany. No silvicultural work other than that involved in a diameter limit logging operation, has been carried out and no thought has been given to doing it. The forest is generally in terrible condition – simply overcut so much that there are few seed trees left. The road has been destroyed by the logging operation. It has huge ruts and is now not passable by even a four wheel drive pickup truck.

Clemintino Ku Pacal, President of Ejido Felipe Carrillo Puerto
Rosa Maria Trab, Treasurer Ejido
Calle 54 No 56 clle Cecilia Chi, 77220

Many years ago we had a lot of valuable trees but now there are none. Logging is now minimal and we almost have nothing compared to 30 or 40 years ago. There were immense majogany trees then that 3 or 4 people together could not reach around. They were cut down with axes and it took a lot of time to cut the logs into boards.

We had a saw mill but it stopped working 10 years ago and is now obsolete. It was bought by a project. Now we just sell logs. We are trying to reforest in order to have wood again sometime.

Ranching has not been successful in this *ejido* because the soil is not good for that purpose. We reforested just the sides of the road.

About the road – we had no idea of fixing up the road. The reason they log in the wet season is that the government places time limits on when the logging can take place. If it does not take place in time, then the permission to log lapses and we would have to go through the process again of getting the permission to log. The *ejido*'s forest has not been certified although we are trying to get it certified.

Our principal source of financing is selling land of the *ejido* to private owners that are people from outside. We sell to whoever pays us the most. The people want to sell and not work in the forest in any way. They would have to be paid to work in the forest. A day of work cost $170. Our ejideros are accustomed to dividing up any income among themselves without investing anything in the *ejido* itself. They are worried that if they approve the use of funds for the *ejido* the leaders of the *ejido* will teal the funds. The assembly of the *ejido* is the maximum authority and we have to do what it tells us to do.

Now we have a problem because we have to prepare an environmental impact study in order to get our forest management plan approved and we do not have any money to prepare the EIA.

Friday, January 25
Gonzalo Meridez, Director, NGO Amigos de Sian Khan
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The Sian Khan Biosphere Reserve in Quitano Roo is a federal protected áreas. The NGO was started in 1986 in order to help overcome the deficits in capabilities that then existed in the government for the management of protected areas. The citizens of Quitano Roo promoted the establishment of the biosphere reserve. Now the NGO works more outside than inside the reserve; it has activities all over the state of Quintano Roo and the entire Yucatán Peninsula.

USAID helped us a lot through the Parks in Peril Program with TNC and the University of Rhode Island. PIP ended in 2007 and the NGO and the reserve are products of that program. It is the principal environmental NGO of Mexico. What interests us the most is the relationship between people and ecosystems.

There is a lot of subterranean water in the Yucatán and the nutrients in that water affect the reefs off the coast.

We have three main challenges. First, we have to maintain the continuity of forest cover. Now the *ejidos* can be split up and sold whereas before that was illegal. The *ejidos* are as big as 200,000 ha to as small as 2000 ha. They are selling land to the highest bidders. The management of the forest was complex before. Now public policies are complex too. There is no way to stop the breakup of the *ejidos*.

We are looking for ways to sell environmental services especially water to the city of Cancun. We are working with TNC on doing that through a trust fund mechanism. Water is a big issue in the Yucatán.

Most problems in Yucatán were on the coast before but now they are spreading inland with the breakup of the *ejidos*. This is a new problem for the tropical forest of Mexico. The cause was the change in the Constitution of 1992 that allowed the sale of *ejidos*. That was stimulated by the NAFTA. In theory forest lands are not supposed to be broken up but in fact they are being broken up.

Corruption is a major problem in making the environmental laws and regulations work effectively.

The Ordenamiento Ecologico is supposed to be done at the national, regional state and municipal levels. The NGO is a member of the committee for the territorial planning of Quitano Roos's 10 municipal governments. Agreements exist between the three levels of government. The plan for each level is approved by the executive of that level. The whole society does not participate in the land use planning but only part of the society. The plans are too complex to permit everybody and anyone to participate. Data are lacking – for example, there are no reliable data about the density of hotels in Cancun.

Ranching has failed in Quitana Roo so that is not a big threat. It is more common further south though nearer to Belize. The price of land is going up so now it is $200,000 /ha which is not much for somebody from the Mexico DF.

The NGO has studied the reef a lot along the Rivera Maya. Half the reef has died as a result of pollution of water, over fishing, scuba diving etc. There are protected areas of the reef and there is an attempt to plan the uses for different parts of the reef. There is a lot of work to do to treat residual waters. People have thought of water treatment for human health but not for ecosystem health. The hotels treat about 705 of the water they use. It is the city of Cancun that is the big problem. The karst topography makes water an extremely important issue in Quitano Roo.

95% of the people do not know much about conservation. A lot of them are migrants from other states. Nonetheless, Quitano Roo is the pioneer in Mexico for environmental issues, particularly marine issues. It has established environmental regulations that are ahead of other states. Cultural change is occurring rapidly in Quintano Roo and among the Maya. The pueblo Maya is changing quickly. The younger generation is losing its identification with Maya.

The NGO does environmental education with videos, films etc. USAID provided a lot of support for a long time for environmental education programs. People here are very aware of environmental issues. The newspapers always have articles about environmental issues. The IDB is financing ecotourism projects around the reserve. Costa Rica is an example for Quitano Roo since it is the same size but has over a billion dollars of revenue from ecotourism whereas Quitano Roo has almost zero.

Appendix D Qualifications of Team Members

Team Leader: Forestry and Climate Change Specialist: Bruce Kernan has a master's degree in Forest Science from Yale University, School of Forestry and Environmental Studies and a Masters of Professional Studies from Cornell University in natural resources management and policy, as well as a forestry technician's degree from the New York State Ranger School, College of Forestry and Environmental Science, State University of New York. He has lived in Ecuador since assigned there as a USAID Foreign Service Officer in 1983, when he was the Project Officer for the Forestry Sector Development Project and the Integrated Rural Development Project, and is intimately familiar with Andes and Amazonian culture and ecosystems. He was the USAID Regional Environmental Advisor for South America from 1994 to 1998. He has prepared numerous environmental assessments, project evaluations and project designs for USAID. He has repeatedly demonstrated his strong inter-personal skills by being a successful team leader for over 20 teams of consultants, including for the preparation of FAA 118 and 119 studies for USAID in Bolivia (2013, 2002) Panama (2010), Paraguay (2009), El Salvador (2009), Colombia (2008), Ecuador (2006) and Peru (2004). Mr. Kernan is a United States citizen and has been Sun Mountain's Senior Tropical Forestry and Climate Change Advisor since July 2011.

Conservation Ecologist and Institute of Ecology Team Leader: Dr. Gerardo Ceballos completed his BA in Biology at the UAM in Mexico City, a Masters in Ecology in the University of Wales, and his Ph.D. in Ecology at the University of Arizona. In 1996 and 2003 he spent his sabbatical leaves at Stanford University in collaboration with Dr. Paul R. Ehrlich. He is a researcher at the Institute of Ecology at UNAM. He has published 350 scientific papers and 40 books. He has been honored with several awards such as the Rolex Awards for Enterprise, the "Distinguished Service Award in Academy" of the Society for Conservation Biology, and the Whitley Award for Nature Conservation. Dr. Ceballos played an instrumental role in this assessment, bringing together environmental and natural resource management specialists from the UNAM Ecology Institute. Dr Ceballos also used his considerable professional network within Mexico to establish a number of the key interview and data sources needed to complete this biodiversity assessment. His extensive background and contacts have played a major role in the success of this assessment.

Economic Anthropologist and Environmental Assessment Specialist: Scott Solberg
Mr. Solberg holds two master's degrees, one in International Agricultural Development and the other in Community Development, from the University of California Davis, and is currently a PhD candidate at the Universidad Simon Bolivar (Ecuador) in Environmental Administration. Mr. Solberg is an environmental assessment and M&E specialist who has led or been a team member on over 40: initial environmental examinations (IEEs), environmental assessments, risk and vulnerability assessments, Pesticide Evaluation Reports and Safer Use Action Plans (PERSUAPs), biodiversity assessments and or rapid environmental assessments. Mr. Solberg also has extensive experience in environmental education, behavior change and institutional analysis and during the last 32 years, has designed, implemented, monitored and evaluated socio-economic and environmental projects in Latin America, Africa and Asia, including analysis of the administrative, structural and functional capacity of several development organizations.

He is currently Director of Sun Mountain International and one of three key personnel in the USAID Global Environmental Management Support contract under which this USAID Mexico biodiversity assessment was carried out.

Botanist and Environmental Communications Specialist: Dr. Clementina Equihua Z., is a botanist specializing in the ecology of tropical mosses and liverworts. C. Equihua completed her BA in biology at the Facultad de Ciencias, UNAM in Mexico city, a masters in botany at the Univertisy of Florida, USA, and a Doctorate in Sciences (Biology) at UNAM. Besides she has diplomas in science popularization, scientific journalism, editorial process and edition of digital publications. Equihua has worked for the Instituto de Ecologia, UNAM in several projects since 1995 as scientific advisor for the restoration of the Middle Ajusco, Mexico City, as a technician handling databases for CONABIO projects and designing and implementing a digital outreach program. She has also worked as consultant for biodiversity and sustainability projects for the Science Museum UNIVERSUM and the Museo Interactivo de Economía (MIDE). She has wide experience coordinating editorial projects for UNAM, the Sociedad Mexicana de Mastozoología and independent publications. Today she works for the Institute of Ecology at UNAM, and is in charge of science communication projects. She is a collaborator for the magazine ¿Cómo ves?, published by UNAM, and has several publications in Mexican newspapers and EFE verde from Spain. Also, she is currently teaching Popular Science Writing at the School of Biology at UNAM.

Social and Environmental Assessment Specialist: Daniel Griswold is Sun Mountain's Social and Environmental Assessment Coordinator. He has an honors degree in International Development from McGill University and lives and works in Ecuador. He has been team member or leader for more than 20 socioeconomic and environmental assessments in the Andes, Amazon, and internationally, including stakeholder identification and analysis, including a tropical forest and biodiversity assessment for USAID/Bolivia. He also participated in stakeholder workshops held with representatives of government, indigenous groups, NGOs and industry as part of the consultation for the Equitable Origin EO100 standard for certified responsible oil production.

USAID Regulation 216 and Environmental Management Specialist: Michael Seager is Sun Mountain's Technical Coordinator and has extensive experience carrying out Initial Environmental Examination (IEEs), developing Environmental Mitigation and Monitoring Plans (EMMPs) and Environmental Assessments (EAs) for USAID-funded international development programs. He graduated from Connecticut College with a BA in International Relations with a focus on International Environmental Policy and a minor in Latin American Studies. Mr. Seager has worked with the USAID/DCHA bureau to develop guidance on budgeting for environmental impact management components of Title II food assistance programs, and provided direct backstopping services to the USAID/DCHA Bureau Environmental Officer. He led a 2-year initiative to improve environmental management, and monitoring and evaluations systems for a multi-year USAID development program in Haiti and developed environmental management systems for four emergency response/recovery programs following the 2010 earthquake in Haiti.

Ecology and Mammal Conservation Specialist: Dr. Rodrigo A. Medellín has been a researcher at the Institute of Ecology at UNAM since 1993. Medellín completed a BA in Biology at the Facultad de Ciencias, UNAM, and a doctorate in Wildlife Ecology at the University of Florida, USA. His work has focused on the ecology and conservation of mammals, mainly on Mexican bats. Mr. Medellin has won several recognitions and awards for his research on bats, including the Mexican government award *Conservación de la Naturaleza 2004* and in 2004 and 2012 he won the Whitley Fund for Nature Prize given by HRH Princes Anne of England, the 2008 Rolex Award for Enterprise. . He has more than one hundred publications including his own books, articles in scientific journals, and chapters in books. He is part of the Mexican scientific advisory panel at CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) and regularly advices the Mexican government on wildlife and conservation issues.

Environmental Policy and Governance Specialist: Dr. Irene Pisanty Baruch is a biologist interested both in basic and applied research, and in the application of scientific knowledge to policy making. She has been working at the School of Science at UNAM for more than 30 years, specializing in ecology and environment at different levels, and participating in different academic-administrative activities. Between 1995 and 1998 she was the Project manager for Ecosystem Conservation at the Commission for Environmental Cooperation, which is part of the environmental agreement of NAFTA. From 2001 until 2007, she was the chief advisor in the National Institute of Ecology (SEMARNAT) where, among many other activities, she implemented the first Sectoral Fund for Environmental Research. There, she became interested in governmental structures and their interactions with non-governmental groups such as academic institutions, social and civil organizations.

Biology and Sustainable Development Specialist: Claudia Galicia graduated from UNAM with a degree in Biological Sciences with a specialty in social perceptions regarding the environment. In addition, Ms. Garcia holds an international Masters Degree in development, globalization and social exclusion. She has worked for the Ministry of Environment of Mexico City overseeing the City Program of payment for environmental services implemented in rural communities outside the city. Professionally, she has principally dedicated her efforts toward the implementation of sustainable development projects in rural communities.

Ecosystem Conservation and Governance Specialist: Eduardo Ponce Guevara studied Biology as an undergraduate at the Autonomous University of Querétaro and has focused his postgraduate research on mammal populations in northern Mexico. In particular, he is interested in the intersection between conservation biology and conservation governance. He is a graduate student at the Institute of Ecology, UNAM, where he has worked extensively on grassland restoration projects. As part of these projects he has worked closely with pastoral communities to harmonize conservation with local economic activities.