Gap Analysis and Identification of Key Biodiversity Areas in Mexico

Multi-institutional Project Coordinated by CONABIO & CONANP
Introduction

It crucial to carry out an evaluation of the protected areas (PA) capacity to represent Mexico’s vast biodiversity.

The first necessary step towards this evaluation is to identify priority sites for conservation.

**Previous conservation exercises:**
- World-wide Hotspots
- Terrestrial and Hydrological Priority Regions
- Alliance for Zero Extinction

However, the large extension of most of these previously identified priority regions stresses the need of identifying precise priority sites for conservation.
Goal 1.1
Create and reinforce national & regional PA systems integrated in a global net

Mexico decided to expand the scope of the national GAP analysis

215 experts participated in the PA GAP analysis

Environmental government sector + International and national NGO’s + Scientists

biodiversity’s complete assessment
Goals

Conduct several gap analyses to identify in situ conservation priorities

Five-step conceptual model:

1) Determine critical ecoregions for conservation
2) Identify terrestrial, fresh water and marine priority sites for conservation
3) Integrate results of terrestrial, fresh water and marine environments and generate a National Agenda towards the protection of priority sites.
4) Protect the most important gaps according to the National Agenda, favoring connectivity and ecological resilience
5) Continue the analyses of other conservation targets at finer scales to identify important areas for connectivity and ecological resilience (considering climate change)
GIS input material generated for gap analyses

Terrestrial ecoregions map (level 4; 1:1,000,000)

Protected areas
Species potential distribution maps:

Amphibians
Reptiles
Birds
Mammals
Plants (Mexican Red list, NOM-059-2001)

SNIB biological database
Gap analyses of biodiversity areas

Ecological environments by altitude

Primary vegetation

Ecoregions
Nature reserves vs. elevation levels

Percentage of Mexico's area

Elevation level (200 m)

Percentage of Nature Reserve's area

200 – 2400 m

12% (mean national protected surface)
Primary vegetation types

- Deserts and shrublands with higher representation in existing PA system
- Tropical dry forests highly under-represented

Dark green areas are ecoregions with the highest primary vegetation coverage
Three indexes were developed at the ecoregional level:

- Biodiversity Threats Index (IRE) (47 variables), Biodiversity Threats Index (IRE) (18 variables), Management and Responses (9 variables).
11 of 96 Ecoregions with no formal protection
Marine priority sites for biodiversity conservation

105 priority sites
79 coastal and oceanic sites
26 deep sea sites

National Survey: 67 of 239 priority sites; 22 are unprotected

Until 2006, 63 AZE sites in Mexico, 14 are islands (birds and mammals): 40% unprotected
### Coincidence of Marine Priority Sites and Marine Priority Regions

<table>
<thead>
<tr>
<th>Sites</th>
<th>Total area (ha)</th>
<th>No. of sites</th>
<th>% Overlapped area</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCMC + SMP</td>
<td>34 230 504.84</td>
<td>105</td>
<td>70</td>
</tr>
<tr>
<td>RMP</td>
<td>137 862 023.82</td>
<td>70</td>
<td>17</td>
</tr>
</tbody>
</table>

SMP = Deep see priority sites  
SCMC = Coastal priority sites  

- **105 priority sites**  
- **79 coastal and oceanic sites**  
- **26 deep sea sites**
### Marine priority sites by ecoregion

Coasts, islands and oceans

<table>
<thead>
<tr>
<th>Marine Ecoregions</th>
<th>no. SCMC+SMP</th>
<th>% de no. SCMC+SMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Gulf of Mexico</td>
<td>2</td>
<td>1.90</td>
</tr>
<tr>
<td>Centroamerican Pacific</td>
<td>5</td>
<td>4.76</td>
</tr>
<tr>
<td>Mexican Pacific Transition</td>
<td>19</td>
<td>16.19</td>
</tr>
<tr>
<td>Caribbean Sea</td>
<td>15</td>
<td>14.29</td>
</tr>
<tr>
<td>Southern Gulf of Mexico</td>
<td>21</td>
<td>20.00</td>
</tr>
<tr>
<td>Gulf of California</td>
<td>30</td>
<td>28.57</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>105</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
Coastal and marine gap analysis
Coastal and marine gap analysis

Classification of marine priority sites

<table>
<thead>
<tr>
<th>Sites</th>
<th>Important</th>
<th>Very important</th>
<th>Extremely important</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>no. of sites</td>
<td>% sites</td>
<td>no. of sites</td>
</tr>
<tr>
<td>Coastal</td>
<td>36</td>
<td>46</td>
<td>27</td>
</tr>
<tr>
<td>Deep Sea</td>
<td>5</td>
<td>19</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>39</td>
<td>33</td>
</tr>
</tbody>
</table>

Low representativity levels of priority sites in the protected area system (18.33%) 78 priority sites are represented with less than 20% of their area in the PA system.

All deep marine priority sites are without protection.
Comprises a unique portion of the country’s biodiversity: 1365 insular elements (1218 islands, 75 reefs and shoal, 31 islotes, 17 cays, 12 rocks, 8 bar, 3 morros, 1 bank)

2450 marine and 1937 terrestrial species in 151 insular bodies

Geomorphologic, physical, biological characteristics and human impacts

Highly vulnerable ecosystems; since 1600, 75% of the extinct species lived in islands
Terrestrial gap

Five expert workshops were carried out to identify and define:

Biodiversity key features and surrogates (used in analyses 1450)
Criteria for biodiversity targets (targets ranged 5-99%)
Major threats to biodiversity (19 layers)
Priorization software (MARXAN)
Size of planning units (256 km², 100 km²)
Criteria to assign biodiversity targets

Criteria for key species:

<table>
<thead>
<tr>
<th>Group</th>
<th>Endemism</th>
<th>Restricted distribution (rarity)</th>
<th>Mexican red list</th>
<th>IUCN</th>
<th>CITES</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes/No</td>
<td>IV Quartile divided in 4 (4, 3, 2 y 1)</td>
<td>E, P, A, Pr</td>
<td>Cr/En/Vu</td>
<td>I/II</td>
<td></td>
</tr>
<tr>
<td>Species 1</td>
<td>20</td>
<td>20/16/13/10</td>
<td>25/25/15/-</td>
<td>15/10/5</td>
<td>10/5</td>
<td>81</td>
</tr>
<tr>
<td>Species 2</td>
<td></td>
<td>10</td>
<td>15</td>
<td>5</td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>

Sum range Target (% of geographic range size within country)

<table>
<thead>
<tr>
<th>Sum range</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>85 – 64</td>
<td>40</td>
</tr>
<tr>
<td>63 – 42</td>
<td>30</td>
</tr>
<tr>
<td>41 – 22</td>
<td>10</td>
</tr>
<tr>
<td>&lt; 21</td>
<td>5</td>
</tr>
</tbody>
</table>

% Target:
Species 1: 40 %
Species 2: 10 %
Criteria to assign costs

Threat and pressure factors were:

- compiled
- ranked
- costs assigned based on agreed biodiversity impacts

### Example:

<table>
<thead>
<tr>
<th>Threat layer</th>
<th>Cost Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Land use change:</strong></td>
<td></td>
</tr>
<tr>
<td>Rate of primary vegetation loss</td>
<td>10 000</td>
</tr>
<tr>
<td>Fragmentation (area-perimeter index)</td>
<td>8300</td>
</tr>
<tr>
<td>Secondary vegetation, shrubs</td>
<td>100</td>
</tr>
<tr>
<td>Secondary vegetation, herbaceous</td>
<td>200</td>
</tr>
<tr>
<td><strong>Heat points from satellite images</strong></td>
<td>7500</td>
</tr>
<tr>
<td><strong>Cattle ranching:</strong></td>
<td></td>
</tr>
<tr>
<td>High impact cattle (goats and lambs)</td>
<td>6700</td>
</tr>
<tr>
<td>Low impact cattle (bovine and equine)</td>
<td>6100</td>
</tr>
<tr>
<td>Non-natural grasslands</td>
<td>6000</td>
</tr>
<tr>
<td><strong>Agriculture:</strong></td>
<td></td>
</tr>
<tr>
<td>Irrigation agriculture</td>
<td>5800</td>
</tr>
<tr>
<td>Seasonal agriculture</td>
<td>4000</td>
</tr>
<tr>
<td><strong>Human infrastructure:</strong></td>
<td></td>
</tr>
<tr>
<td>Road density (paved roads)</td>
<td>3000</td>
</tr>
<tr>
<td>Road density (unpaved roads)</td>
<td>2000</td>
</tr>
<tr>
<td><strong>Human population centers:</strong></td>
<td></td>
</tr>
<tr>
<td>New localities</td>
<td>1000</td>
</tr>
<tr>
<td>Localities &lt;1000 inhabitants</td>
<td>10</td>
</tr>
<tr>
<td>Localities 1000-10,000 inhabitants</td>
<td>20</td>
</tr>
<tr>
<td>Localities 10,000-100,000 inhabitants</td>
<td>30</td>
</tr>
<tr>
<td>Localities 100,000-200,000 inhabitants</td>
<td>40</td>
</tr>
<tr>
<td>Localities &gt; 200,000</td>
<td>50</td>
</tr>
<tr>
<td>Population growth (1990-2005)</td>
<td>900</td>
</tr>
</tbody>
</table>
Summary of actual and potential threats, weighted considering negative effects on biodiversity.

Summary of conservation targets for key species and surrogates
Results

VACÍOS Y OMISIONES EN CONSERVACIÓN DE LA BIODIVERSIDAD TERRESTRE DE MÉXICO

espacios y especies
Terrestrial priority sites for conservation and their coincidence with protected areas (PA), terrestrial priority sites (RTP) and areas of importance for bird conservation (IBA)

<table>
<thead>
<tr>
<th>Priority sites</th>
<th>area (km²)</th>
<th>% of Mexico’s continental area</th>
<th>Goals* (%)</th>
<th>PA</th>
<th>RTP</th>
<th>IBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme priority (SE)</td>
<td>42 725</td>
<td>2.18</td>
<td>34.9</td>
<td>18.19</td>
<td>49.52</td>
<td>30.70</td>
</tr>
<tr>
<td>High priority (SA)</td>
<td>283 092</td>
<td>14.45</td>
<td>81.2**</td>
<td>15.59</td>
<td>39.29</td>
<td>24.72</td>
</tr>
<tr>
<td>Medium priority (SM)</td>
<td>269 077</td>
<td>13.73</td>
<td>90.5**</td>
<td>9.23</td>
<td>29.80</td>
<td>20.42</td>
</tr>
<tr>
<td>SE + SA + SM</td>
<td>594 894</td>
<td>30.36</td>
<td>100</td>
<td>12.90</td>
<td>35.74</td>
<td>23.21</td>
</tr>
<tr>
<td>Best solution***</td>
<td>848 881</td>
<td>43.32</td>
<td></td>
<td>12.44</td>
<td>32.98</td>
<td>20.28</td>
</tr>
</tbody>
</table>

*Acumulated value
Gap Analyses by taxonomic group

Amphibians

Reptiles
Birds

Mammals
Effectiveness of protected areas to conserve primary vegetation (1993-2002)
Fresh water gap first approach: the Panuco hydrological region

Working on Regional analysis throughout the country

- Organisms with aquatic affinity
- Ecosystem layers
- Major threats

100 km² analysis units
Gap website same engineering as the Wikipedia / discussion / peer review
Mexico’s gap assessment: next steps

- Analyses at different scales
- Carry out a revision and validation process
- Integration of gap results of different environments and taxonomic groups with a quantitative and qualitative approach
- Inclusion of priority sites for migratory species & areas
  – stopovers, nesting beaches, etc.
- Development of models to estimate viability and to define required redundancy and resilience.
- Define different categories to analyze and represent the gaps (Representativity, management, etc).
- Analyze the tendencies of pressure factors, such as deforestation and climate change.
- Incorporate new elements and knowledge to update Gap analyses in the future
Conservation recommendations

• Given Mexico’s exceptional high biodiversity, it will be necessary to implement diverse strategies, such as the establishment of new protected areas, social and private reserves and integral management programmes.

• The participation of the society as a whole will be a key factor towards the conservation of our natural capital

• It will be crucial to identify the factors of success and failure of different instruments and areas, taking into account socioeconomic aspects
Executive Group
(all past and present members)

Gerardo Bocco  
TNC
Juan Bezaury  
TNC
Ernesto Enkerlin  
CONANP
Rocio Esquivel  
CONANP
Aurea Estrada  
CONANP
María Pia Gallina Tessaro  
CONANP
Patricia Koleff  
CONABIO
Flavio Cházaro  
CONANP
Martín Gutiérrez  
PRONATURA
Andrés Lira-Noriega  
CONABIO
Vanesa Pérez Cirera  
WWF
Rosario Álvarez  
TNC
Susana Rojas González  
PRONATURA
Lorenzo Rosenzweig  
FMCN
Jorge Soberón  
CONABIO / KU
Exequiel Ezcurra  
INE / SD
Marcia Tambutti  
CONABIO
Rosa María Vidal  
Pronatura
Carlos Galindo  
WWF
Arturo Peña  
CONANP
Francisco Takaki  
INEGI
Terrestrial gap team

Gloria Portales - INE
Jorge Carranza - CONANP
Juan Bezaury - TNC
Juan Francisco Torres - Pronatura
Mariana Munguía – Pronatura
Norma Moreno - CONABIO
Pedro Díaz - CONABIO
Raúl Jímenez - CONABIO
Susana Rojas - Pronatura
Townsend Peterson - KU
Jordan Glolubov – UAM-X
David Gutiérrez – CONANP
Jesus Alarcón - CONABIO
Elizabeth Moreno – CONABIO
Raul Ulloa - Consultor

Coordinator group:
Patricia Koleff – CONABIO
Rocio Esquivel – CONANP
Ignacio March – TNC
Marcia Tambutti – CONABIO
Andrés Lira Noriega – CONABIO
Melanie Kolb – CONABIO
Tania Urquiza – CONABIO

Jorge Soberón - KU
César Cantú – UANL
Ernesto Enkerlin - CONANP
Adolfo Navarro - FC-UNAM
Enrique Martínez Meyer - IB-UNAM
Exequiel Ezcurra - SD
Gerardo Ceballos- UNAM
Humberto Berlanga - CONABIO
Leticia Ochoa Ochoa - UNAM
Óscar Flores - FC- UNAM
Segundo Blanco IB-UNAM
Miguel Murguía – FES-I, UNAM
Víctor Sánchez Cordero - IB-UNAM
Fernanda Figueroa - IB-UNAM
Patricia Illoldi - IB-UNAM
Daniel Ocaña - CONABIO
Enrique Muñoz - CONABIO
Francisco Padrón - FMCN
Gabriela García – Pronatura
Javier Colín - CONABIO

Terrestrial Gap Analysis - Mexico
Marine gap team

Alfonso Aguirre, GECI, A.C.
Porfirio Álvarez Torres, DGPAIRS, SEMARNAT
Virgilio Arenas, Centro de Ecología y Pesquerías, UV
Sophie Ávila Foucat, Universidad de York, UK
Juan Carlos Barrera, Pronatura Noroeste
Humberto Berlanga, NABCI-Conabio
Alejandro Cabello Pasini, IIO, UABC
Rafael Calderón, TNC
Carlos Candelaria Silva, FC, UNAM,
Arturo Carranza, ICMyl, UNAM
Ma. de los Angeles Carvajal, CI-Golfo de California
Francisco Contreras, UAM - Iztapalapa
Ana Córdova y Vázquez, INE-Ordenamiento
Antonio Díaz de León Corral, DGPAIRS, Semarnat
Kurt Dreckmann, UAM - Iztapalapa
Elva Escobar, ICMyl, UNAM
Héctor Espinosa, IBUNAM
Aurea Estrada, DUMAC
Francisco Flores, ICMyl, UNAM, Mazatlán
César Flores Coto, ICMyl, UNAM
Margarita Gallegos, UAM - Iztapalapa
Juan Manuel García Caudillo, Terra Peninsular, Ensenada
Jaime González Cano, CONANP
David Gutiérrez, CONANP
Jorge Herrera Silveira, CINVESTAV-Mérida
Gerardo E. Leyte Morales, Udel Mar, Puerto Ángel
Sergio Licea, ICMyl, UNAM
Luis Medrano, FC, UNAM
Sandra Mora Corro, INEGI
Elisa Péresbarbosa, Pronatura - Veracruz
Enrique Portilla, UV
Óscar Ramírez Flores, DGVS, Semarnat
Héctor Reyes Bonilla, Fac. Biología, UABCS, La Paz
Lorenzo Rojas, INE
Olivia Salmerón, IG, UnAM
Laura Sarti, CONANP
Juan Jacobo Schmitter Soto, ECOSUR - Chetumal
Francisco Solís, ICMyl, UNAM
Vivianne Solís, ICMyl, UNAM
Ana María Torres Huerta, U del Mar, Puerto Ángel
Raúl Ulloa, INP, Guaymas
Alfonso Vázquez Botello, ICMyl, UNAM
Alfredo Zavala, CONANP
Jorge Zavala, Ciencias de la Atmósfera, UNAM
José Zertuche, IIO, UABC, Ensenada
et al.

Gap crew
Patricia Koleff, Rocío Esquivel, Ignacio March, Verónica Aguilar,
Diana Hernández, Melanie Kolb, Marcia Tambutti, Gabriela
García, José Manuel Espinoza, Jorge Carranza, Juan Bezaury,
Juan Francisco Torres, Mariana Munguía, Sergio Cedeira, Susana
Rojas, Vladimir Cachón, Andrés Lira-Noriega, Romeo López
Thank you!

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Presented by Patricia Koleff

pkoleff@conabio.gob.mx