Ecological Restoration of Transportation Projects as a Successful Mitigation Measure

Sergio López Noriega, Biologist
CEO
sergio@selome.com.mx

Norma Fernández Buces, PhD Science
Scientific Director
norma@selome.com.mx

Grupo Selome S.A. de C.V
Louisiana 104 Col. Nápoles 03810
52 (55) 55 56 87 27 00
sergio@selome.com.mx
CASE 1
Tejocotal
CASE 2
Cuyutlán
Environmental Impact Assessment Study (EIS)

- Environment fragility
- Project impacts during construction and operation
- Proposal of mitigation measures

Mitigation

- Landscape connectivity
- Reduce habitat fragmentation
- Reduce ecosystem loss

Resolution conditions

Ecological Restoration programs

Environmental Authorization

Infrastructure Project (planning/design)
Design ecological restoration programs to mitigate environmental impacts from the construction of two transportation projects:

**A highway and a railway in Mexico**

Both case studies were successful restoration experiences. They represent two different approaches:

- **First case:** Nuevo Necaxa, was done within a government environmental protection area (ANP), and therefore it required a detailed long term restoration program.

- **Second case:** the Cuyutlán lagoon railroad restoration program had to be done in a fast and efficient way to cope with time requirements.
First case: Nuevo Necaxa highway

Mexico-Tuxpan highway

Length: 18 km

Cloud forest (2070-2138 masl)

Forest patches removed along 6 km (buffer zone of a environmental pa)

Development of an Ecological Restoration Program
1 Concentric circle method (20 sites):
• Species composition
• Community structure
• Vegetation communities
• Degree of human disturbance

2 Guild establishment

3 Edapho-ecological study:
• Soil properties
• Infiltration
• Texture
• Erosion

4 Polygons definition:
• Land use
• Vegetation
• Soil
• Slope
• Orientation

5 Restoration zones (12):
• Topography
• Remaining top horizon
• Nutrients
• Vegetation

6 Restoration priority zones
Section 1               Section 2
7 zones (9 km)    5 zones (9 km)

7 ER Scheme charts (1:400)
Law protected species

- **Cyathea fulva**
- **Carpinus caroliniana**
- **Podocarpus reichei**
- **Acer negundo**

**Results**

- **22 native species**
- **50 000 rescued plants (10-150 cm)**
- **120 000 total plants produced**
<table>
<thead>
<tr>
<th>ZONE</th>
<th>SITE CHARACTERISTICS AND SPECIES TO BE CONSIDERED FOR RESTORATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Soft topography, medium slope, high human perturbation (agriculture), scarce and isolated patches of secondary CF vegetation; mainly along streams and glens. Species: Crataegus pubescens, Buddleia cordata, Quercus spp, Alnus sp. and Archibaccaris sp (bush)</td>
</tr>
<tr>
<td>II</td>
<td>Steep slopes with high heterogeneity in soils and vegetation. Species: Quercus spp, Liquidambar styraciflua, Prunus serotina, Clethra sp., Carpinus caroliniana, Ocotea sp. and Podocarpus reichei</td>
</tr>
<tr>
<td>III</td>
<td>Open spaces with high human disturbance. Species: Clethra spp., Podocarpus reichei, Alnus spp. and Quercus spp.</td>
</tr>
<tr>
<td>IV</td>
<td>High topographic complexity and large patches of cloud forest vegetation. Species: Podocarpus reichei, Quercus spp and Pinus spp.</td>
</tr>
<tr>
<td>V</td>
<td>Small hills with deep glens. Vegetation remnants show different degrees of human disturbance. Species Quercus spp., Pinus patula, Podocarpus reichei and Liquidambar styraciflua.</td>
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<tr>
<td>Etc.</td>
<td>-</td>
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</table>
**Soil conservation techniques**

**Pits**
- Increase plant cover.
- Soil within the pit was enriched.
- Dike to contain water and soil.

**Furrows**
- Set up in slopes (4 to 19°).
- Perpendicular to terrain slope.
- Native seedlings were planted.

**Terraces**
- Set up in slopes (≥ 20°) with a length of 90 to 120 m.
- Reduce water runoff to allow infiltration.
- Plants were introduced 50 cm away from terrace.
- Edge, stakes and logs were used to increase stability.
Design of a plantation template that represented a non systematic pattern but could be systematically reproduced.
• Good plant survival and growth
• Restored plants were cared for during the first two years by the construction company
The railroad crosses through:

Well preserved tropical deciduous forest (2.82 ha)
&
Mangrove (0.47 ha)

Ecological Restoration Program
Germoplasm was recovered

Temporary in site nursery
- Species abundances
- Species tolerances to removal and transplant.

Mangrove trial plots
Native plants, fruits and seeds were rescued and taken to the nursery.

Rescued seed were classified, according to the species.

Mangrove replanting plots are being tested before restoration begins.

<table>
<thead>
<tr>
<th>TYPE OF PLANTS</th>
<th>TOTAL PLANTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rescued plants</td>
<td>12,423</td>
</tr>
<tr>
<td>Cactus and Bromelias</td>
<td>3,882</td>
</tr>
<tr>
<td>Plants produced from seeds (including mangroves)</td>
<td>92,244</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>108,549</strong></td>
</tr>
</tbody>
</table>

There are 79,034 additional plants being germinated nowadays. Successful ones will be added to the former for a maximum total of 187,583 available plants for restoration purposes.
Crushed residues of plant removal and workers meals were used to make a compost. A total of 656 m$^3$ of soil and 25 m$^3$ of litter were rescued. Piles or rescued organic soil horizon were covered with grass or plastic to conserve their humidity and increase o.m. descomposition.

Clearing residues were crushed. Crushed residues of plant removal and workers meals were used to make a compost. Residues from tree cutting were piled and transported to the nursery for further use.
• Best compliance is obtained when authorities, consulting companies, constructors and local people are working together to obtain good environmental results.

• Planning and good Ecological Restoration Programs applied to construction sites can adequately mitigate the negative impacts of clearing during construction.

• Adequate management of plants and the increase in native plant numbers within a nursery, based on communities studies, is needed for the ecological restoration of affected sites.

• Mangrove species being reproduced within the nursery are already being tested in plantation plots in order to optimize plant survival during restoration.

• Soil is being conserved and its nutrients and texture improved for future use during ecological restoration activities, that will begin by the end of this summer.
• SEMARNAT (Ministry of the environment)

• ICA Contractor (study case 1)

• TRADECO Contractor (study case 2)

• Outsourcing y Gestión Ambiental (study case 2)