Native Riparian Species Seeding Demonstration Project In the Colorado River Delta

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January 29, 2013
Project Objectives:

- Research the seeding methodology developed by the US Bureau of Reclamation for native riparian species by implementing a demonstration project in a 5-acre revegetation site
- Enhance the capabilities of the LCR MSCP to restore cottonwood-willow and other habitat types while potentially reducing the costs of planting
- Increase genetic diversity of riparian tree species in restoration sites
Project Implementation

1. Site Identification
2. Hydraulic analysis and Irrigation Design
3. Site Preparation
4. Fremont Cottonwood and Gooding’s Willow seed collection and preparation
5. Seed design and application
6. Vegetation monitoring
Fremont cottonwood and Gooding’s willow seed collection and preparation

<table>
<thead>
<tr>
<th>Seed Type</th>
<th>Collection Year</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goodding's willow seed</td>
<td>2010</td>
<td>3,114,386</td>
</tr>
<tr>
<td>Goodding's willow seed</td>
<td>2011</td>
<td>6,291,464</td>
</tr>
<tr>
<td><strong>Total Goodding’s willow seed</strong></td>
<td></td>
<td><strong>9,405,850</strong></td>
</tr>
<tr>
<td>Fremont cottonwood seed</td>
<td>2010</td>
<td>1,832,202</td>
</tr>
<tr>
<td>Fremont cottonwood seed</td>
<td>2011</td>
<td>929,315</td>
</tr>
<tr>
<td><strong>Total Fremont cottonwood seed</strong></td>
<td></td>
<td><strong>2,761,517</strong></td>
</tr>
<tr>
<td><strong>Total seed collected in 2010 and 2011</strong></td>
<td></td>
<td><strong>12,167,367</strong></td>
</tr>
</tbody>
</table>
Seed design and application

- Desired tree density: 1 tree per 5 square feet or 2 trees per square meter (~8700 trees per acre)

- Species layout: Gooding’s willow nearest to irrigation canal; Fremont cottonwood furthest from canal; mixed cottonwood and willow in area between

- Used tree establishment rate of 1% and 10% respectively for Gooding’s willow and Fremont cottonwood (GSA 2008, 2009) to determine seeding rate
Plot 1: 1.3 acres
Plot 2: 3.7 acres
Monitoring and Results

1. Vegetation monitoring:
   - Vegetation quadrat surveys (1x per month)
   - Photo monitoring (1 x per month)
   - DBH, height and condition, herbaceous, shrub, and ground cover (2x per year)
   - Cover point transects (1x per year)
   - Aerial photo monitoring (2-3 times per year)

2. Depth to groundwater monitoring (1x per week)

3. Water quality of irrigation source (1x per year)
### Average density, Plants per square meter

<table>
<thead>
<tr>
<th>Species</th>
<th>Plot 1</th>
<th></th>
<th>Plot 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>September-11</td>
<td>March-12</td>
<td>October-12</td>
<td>October-12</td>
</tr>
<tr>
<td>Fremont cottonwood</td>
<td>0.58</td>
<td>0.59</td>
<td>0.65</td>
<td>0.45</td>
</tr>
<tr>
<td>Gooding's willow</td>
<td>0.29</td>
<td>0.21</td>
<td>0.23</td>
<td>7.06</td>
</tr>
<tr>
<td>Salt cedar</td>
<td>1.45</td>
<td>0.59</td>
<td>0.76</td>
<td>5.72</td>
</tr>
<tr>
<td>Arrowweed</td>
<td>0.19</td>
<td>0.14</td>
<td>0.33</td>
<td>0.07</td>
</tr>
<tr>
<td>Other species</td>
<td>0.78</td>
<td>5.22</td>
<td>3.58</td>
<td>41.4</td>
</tr>
</tbody>
</table>

### "Other species" composition
(arranged highest to lowest # of plants/m²)

<table>
<thead>
<tr>
<th>Plot 1</th>
<th>Plot 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 2011</td>
<td>October 2012</td>
</tr>
<tr>
<td>Fleabane</td>
<td>Cattail</td>
</tr>
<tr>
<td>Sow thistle</td>
<td>Grass</td>
</tr>
<tr>
<td>Salt heliotrope</td>
<td>Purslane</td>
</tr>
<tr>
<td>Lamb's quarter</td>
<td>Nutsedge</td>
</tr>
<tr>
<td>Palm</td>
<td>Salt heliotrope</td>
</tr>
<tr>
<td>Grass</td>
<td>Sow thistle</td>
</tr>
<tr>
<td>Purslane</td>
<td>Lamb's quarter</td>
</tr>
</tbody>
</table>
Crown Cover in Plot 2

- **Cottonwood**
- **Willow**
- **Screwbean mesquite**
- **Salt cedar**
- **Arrowweed**

**Axes:**
- **Y-axis:** Crown Cover (0% to 70%)
- **X-axis:** Date (4/1/12 to 10/1/12)
Average Height of Target Species in Plot 1 and 2

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fremont cottonwood</td>
<td>1.5</td>
<td>4.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Goodding's willow</td>
<td>1.5</td>
<td>3.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Average</td>
<td>1.5</td>
<td>3.75</td>
<td>1.75</td>
</tr>
</tbody>
</table>

Average Height (meters)
Photographic Monitoring

Plot 1: Photo point 1-6

Above: After 1 growing season

Right: After 2 growing seasons
Photographic Monitoring

Plot 1: Photo point 1-8

Above: After 1 growing season

Right: After 2 growing seasons
Photographic Monitoring

Plot 2: Photo point 2B-16

Above: 3 weeks after planting

Right: After 1 growing season
Photographic Monitoring

Plot 2: Photo point 2B-22

Above: 3 weeks after planting

Right: After 1 growing season
Lessons Learned

- Seed should be stored within 2 weeks after it is collected to maintain viability.

- Remove seed pods from branches to dry before storage; this reduces mold and speeds up drying process.

- Time the seeding application with the natural seed dispersal of surrounding riparian trees if possible.

- Seeded sites need to be weeded twice during the first growing season.

- If using a small hydroseeder, use a water truck for refilling and hose extensions to make moving from site to site easier.
Next Steps

- Fill in gaps of the 5-acre seeded area with other native species such as salt heliotrope and saltbush.
- Continue monitoring efforts to see how species composition and density changes over time in Plot 1 and 2.
- Initiate wildlife monitoring program with focus on bird species. Conduct habitat assessment for riparian bird species.
- Compare 1-acre hydroseeding site with 1-acre control to assess potential of passive restoration.
- Scale up the demonstration plot to look at feasibility of hydroseeding for large restoration projects.
Acknowledgments

- The Bureau of Reclamation
- Comisión International de Limites y Agua (International Boundaries and Water Commission)
- Programa de Empleo Temporal (Temporary Employment Program - SEMARNAT)
- Matt Grabau, GeoSystems Analysis, Inc.
- Francisco Zamora, Tomás Rivas, and field crew of Sonoran Institute
Thank you!