COLORADO RIVER DELTA RESTORATION PROJECT

SONORAN INSTITUTE
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Hydroseeding Native Tree Seeds

In 2010, the Sonoran Institute initiated a demonstration project with support from the U.S. Bureau of Reclamation to research the feasibility of hydroseeding native tree seeds as an alternative restoration technique. The first hydroseeding restoration project of its size, the 5-acre demonstration site is located along the lower Colorado River riparian corridor, where conditions for natural seeding of cottonwood and willow tree species are favorable. The project has been a great success, with high tree establishment and survivability rates.

What is Hydroseeding? Hydroseeding is a sowing technique in which a hydroseeder, a large tank with a sprayer attached, is used to spray a mixture of seeds, mulch, and water onto prepared soil. This technique is often used to seed plant species that have small seeds, such as grasses.

Hydroseeding for Restoration: While most riparian restoration projects use tree cuttings (or clones) to re-vegetate areas, hydroseeding is an alternative method that offers several advantages. By seeding restoration sites with locally harvested native tree seeds, the resulting tree population is more genetically diverse than if tree cuttings are used, creating a healthier and more robust forest ecosystem. Initial results of the Sonoran Institute's 5-acre hydroseeding demonstration project also show that the hydroseeding method is less time-consuming and more economical than planting tree cuttings.

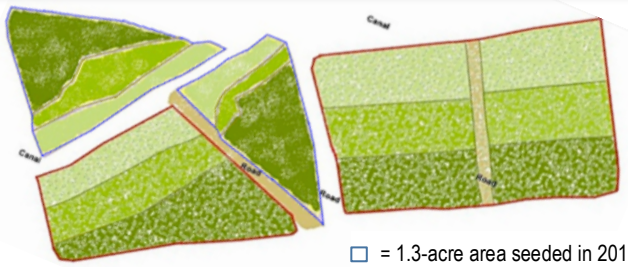
Above: Restoration Specialist hydroseeds restoration site in the Colorado River riparian corridor.

Left: Cottonwood seedling germinates after hydroseeding.

Left: Goodding's willow seedpods ready for seed collection.

The Hydroseeding Demonstration Site: In 2010, the Sonoran Institute, with support from GeoSystems Analysis (GSA), selected a 5-acre area for the hydroseeding demonstration site located within the lower Colorado River riparian corridor. The site was chosen for its favorable soil conditions and shallow proximity to groundwater, which are beneficial for the establishment of native tree species. In the spring of 2010 and 2011, workers collected seed from mature cottonwood and willow trees in the area and dried and cleaned the seed for storage until seeding.

According to the irrigation design and species requirements, the Sonoran Institute developed the seeding design and layout for the 5-acre demonstration site with support from GSA. The Institute successfully seeded 1.3 acres in 2011 and 3.7 acres in 2012 with cottonwood and willow seed using a 50-gallon hydroseeder.



5-acre Demonstration Site Layout

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Above: Photographic monitoring point 1-14 of the hydroseeding demonstration plot. Dates of photos from left to right: May 2011, Aug. 2011, Oct. 2011, Sept. 2012.

Ecological Monitoring: To assess the success of the hydroseeding demonstration project, the Sonoran Institute monitored the establishment, growth, and composition of vegetation in the demonstration site. By monitoring these and other ecological factors, we can determine the health and functionality of the habitat created at the restoration site.

Our goal is to use data from this project and other ongoing restoration projects to analyze the correlation between characteristics of restored habitat and the abundance and diversity of bird species. These results will ultimately influence our long-term restoration strategy, as we will adapt our current revegetation methods to attract wildlife and encourage their long-term presence in the area.

Ecological Monitoring Overview

The Sonoran Institute monitors the following:

- Surface and groundwater quality
- Depth–to–groundwater levels
- Height, condition, and diameter of target tree species
- Canopy cover and composition
- Ground cover composition
- Shrub and herbaceous species composition
- On-the-ground and aerial photography

Results: The two hydroseeding events in 2011 and 2012 were both highly successful, but produced very different results with regards to species composition and establishment in the 5-acre area. Plot 1, the 1.3-acre area seeded in 2011, is dominated primarily by cottonwood trees followed by willow and mesquite. Plot 2, the remaining 3.7-acre area seeded in 2012, is dominated instead by willow, followed by cottonwood. The high density of willow establishment in Plot 2 is primarily due to the significant volunteer establishment from on-site and adjacent willow trees dispersing seed in the spring. In addition, the soil type in the eastern portion of Plot 2 is more clay-like and retains moisture better than Plot 1. These conditions are more favorable for willow establishment than cottonwood.

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Results: Based on our monitoring data at the end of 2012, there are approximately 3,561 cottonwood and willow (CW) trees per acre established in Plot 1 and approximately 30,392 CW trees per acre in Plot 2. The average density in the entire 5-acre demonstration site is 23,416 CW trees per acre. The higher density of trees in Plot 2 is attributed to volunteer willow establishment and moist soil conditions.

It is important to note that although the density of salt cedar and other non-target species is frequently higher than the target species' densities (see figure 1), the target species are outcompeting the non-target species, as shown by crown cover percentages (see figure 2). Crown cover composition in Plot 1 after two growing seasons is dominated by Fremont cottonwood (67%), followed by Goodding's willow and mesquite (both providing around 15% cover). Native mesquite tree species in Plot 1 were established entirely by volunteer germination. Crown cover composition in Plot 2 after one growing season was dominated by Goodding's willow (63%) followed by Fremont cottonwood (18%) and salt cedar (14%).

After two growing seasons, the average CW tree height in Plot 1 was 4.16 meters, and the average height in Plot 2 after one growing season was 1.58 meters (see figure 3).

Figure 1.

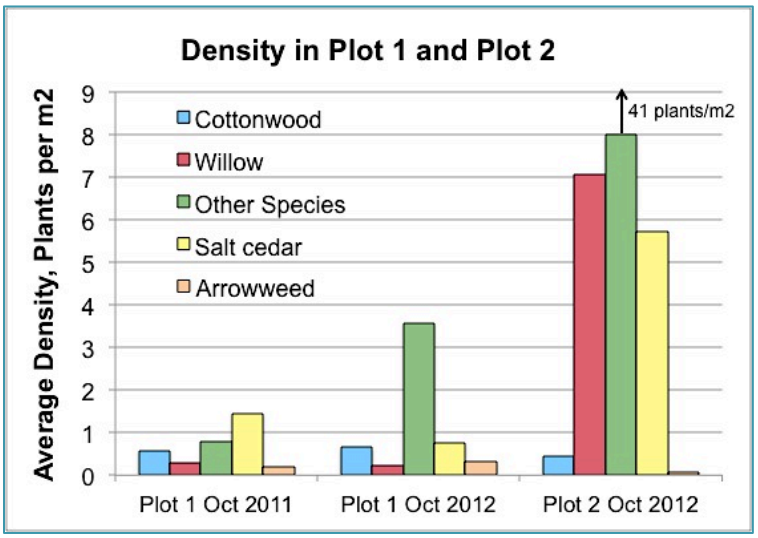


Figure 2.

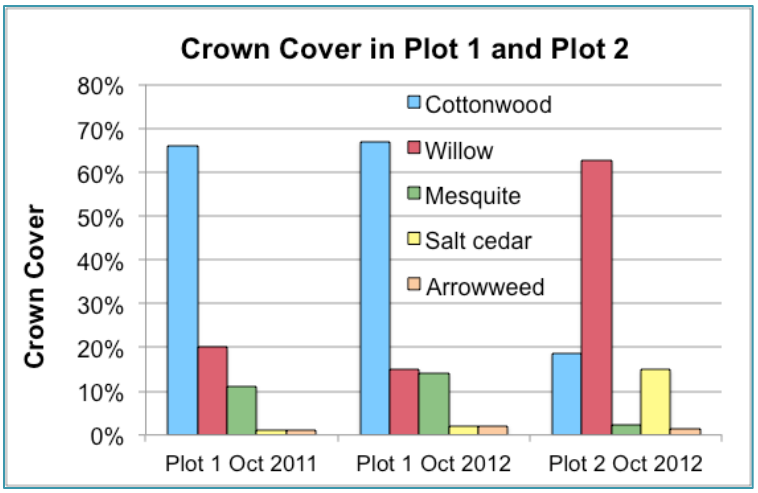
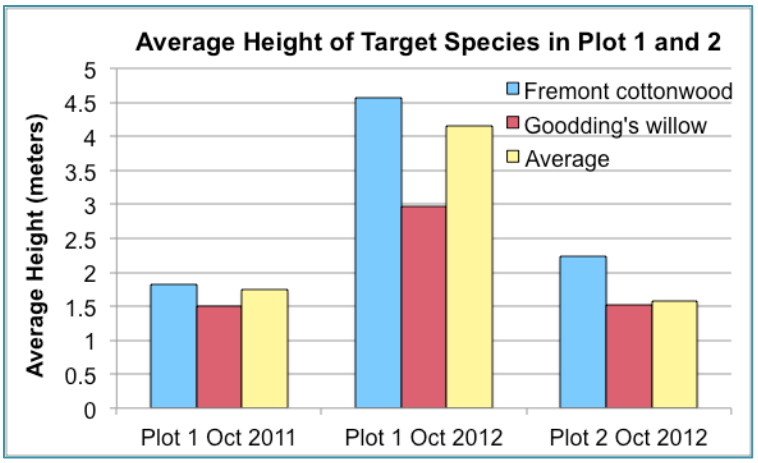


Figure 3.



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Lessons Learned: Based on our experiences with the 5-acre hydroseeding demonstration project, we developed several recommendations for future hydroseeding projects.

- Dry and store (refrigerate) the seed within 2 weeks after it is collected to maintain viability.
- Remove seedpods from branches to dry before storage. This reduces mold and speeds up the drying process.
- Time the seed application with the seasonal seed dispersal of nearby riparian trees to promote natural germination.
- Weed the seeded sites at least twice during the first growing season to promote target species growth.
- If using a smaller hydroseeder, use a water truck for refilling and hose extensions for ease in moving from site to site.

Workers weed undesirable plant species from the demonstration site.

The western screech owl (left), a resident bird species, and Wilson's warbler (right), a migratory bird species, perch among the willows at the riparian restoration site.

Next Steps: Based on the success of the 5-acre hydroseeding demonstration project, the Sonoran Institute plans to increase the seeding area to 30 acres or more in the next 2 years. This would allow the Institute to fully assess the costs and benefits of hydroseeding in large-scale riparian restoration projects. We also plan to continue monitoring the original 5-acre site to determine how species density and composition change over time, which could enhance the success of future hydroseeding projects.

In addition, the high establishment of willows in Plot 2 demonstrated that natural germination of native seed and passive restoration of riparian habitat are possible with the right conditions. We would like to further explore that finding by comparing a 1-acre hydroseeded plot with a non-hydroseeded 1-acre "control" plot to assess the viability of "passive germination" in sites with an established population of native riparian species. Lastly, we will experiment with the use of hydroseeding to increase germination of native tree species during pulse flow releases of the Colorado River in Mexico.

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