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Seedling Survival and Natural Regeneration For a Bottomland Hardwood Planting on Sites Differing in Site Preparation

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SEEDLING SURVIVAL AND NATURAL REGENERATION FOR A BOTTOMLAND HARDWOOD PLANTING ON 'SITES DIFFERING IN SITE PREPARATION'

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Abstract-In January 1998, three tracts in Hardin County, TX, were hand-planted with seven species of 1-0 bareroot bottomland hardwood seedlings. The tracts, managed by The Nature Conservancy of Texas, were previously 20-year-old pine plantations. The tracts are located within the floodplain of Village Creek. An objective for this conversion is the restoration of a bottomland hardwood wetland in order to meet Clean Water Act requirements. A pre-harvest plant inventory was conducted for each tract. The tracts were clearcut during the Winter and Spring of 1997. Following harvest, each tract was subjected to a different site preparation technique. One tract was burned. Another tract was treated with herbicide to control Chinese tallow. The third tract was sheared, piled, burned and ripped. Planted seedling survival was greatest (72 percent) on the tract that was sheared, piled, burned and ripped. Hardwood natural regeneration was proportionally higher on the tract prepared by burning only. However, this tract appeared to have a greater potential for hardwood root collar sprouting following harvest of the pine overstory. Chinese tallow was a large portion of all natural woody regeneration on each tract.

INTRODUCTION

This paper presents first-year results of planted seedling survival and natural vegetation regeneration following the conversion of a pine plantation to a bottomland hardwood (BLH) forest. This conversion was implemented as wetland mitigation for pipeline construction as required by the Clean Water Act. For this project, successful mitigation requires establishment of at least 200 desirable seedlings per acre after 2 years. Restoration of structure and species richness to BLH forest is an additional long-term goal. A pm-harvest inventory was conducted to determine if an existing BLH seed source or advanced reproduction was sufficient to reforest the tracts. In the conversion process the three tracts were unexpectedly subjected to different site preparation techniques. Variation in site preparation afforded the opportunity to examine survival and recruitment with regard to site preparation technique. Of-site, existing BLH communities were inventoried to aid selection of species to be planted. Post-planting inventories were conducted to assess natural regeneration and to monitor seedling survival.

METHODS

Slte Characteristics

Conversion was performed on three tracts of 48, 14, and 8 acres in size which lie in the first-bottom of Village Creek on the Roy E. Larson Sandylands Preserve, Hardin County, Texas. Previously commercial ioblolly and slash pine plantations, these tracts are now managed by The Nature Conservancy of Texas. The tracts are positioned on flats with sloughs occurring throughout. Soils on site are of the Mollville and Manco soils series. Manco soils are deep, somewhat poorly drained, and moderately permeable. The water table is typically within 2 feet of the surface for 1 to 3 months during the winter. Flooding typically occurs during the winter and spring. Mollville soils are deep, poorly drained, and slowly permeable. Mollvilie soils are typically ponded during the winter and spring and a perched water table may be present very near the surface for long periods. Observations of sediment deposits on leaves at 6 feet in height suggests all tracts are periodically inundated by floodwaters from Village Creek.

On all tracts, a pre-harvest inventory was conducted during the Summer and Fall, 1996. An objective of this inventory was to determine if portions of the tracts contained desirable BLH trees as a seed source or advanced reproduction that could be incorporated into the converted forest. Vegetation was inventoried using nested plots. Tenth acre plots were used to determine species composition of stems greater than 20 feet in height. Hundredth acre plots were used to determine composition of stems ranging from 3 to 20 feet. Lobloily or slash pine had the greatest pre-harvest basal area on each tract and were trailed by sweetgum. water oak, and other trees (scientific names appear in Appendix 1). Dominant trees, reported as relative density (stems/acre) are presented in Tables l-3. The midstory on each tract was dominated by American hornbeam, sweetgum, American holly, and other understory species. No significant herbaceous layer existed on any tract prior to harvest.

Site Preparation

Commercial clearcuts were performed during Winter and Spring, 1997 on all tracts. Streamside Management Zones (SMZ's) of 50 to 75 feet were left intact, reducing planted acreage to 40 acres, 8 acres, and 3 acres respectively. Site preparation on the 48 acre tract included shearing, raking, piling, burning, and ripping. An unsuccessful attempt was made to bum logging debris on the 14 acre tract. The 14 acre tract was broadcast sprayed in August 1997 with a tank mix containing 18 ounces Arsenal ™ (imazapyr) to 1 quart of Accord ™ (glyphosphate) per acre to control competition from Chinese tallow. The 8 acre tract was successfully burned and had no other site preparation. In SMZs, attempts were made to control the Chinese tallow trees, using Pathway" (2,4 D/picloram) and Garlon 4 ™ (triclopyr) by injection and Garlon 4 ™ as an 11 percent basal spray. Post-planting spot control of Chinese tallow seedlings was attempted with Roundup ™ (giyphosphate) or Garlon 4 ™ applied with a backpack sprayer.

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Table l-Dominant pre- and post-harvest woody vegetation48 acre tract

Condition	Species	Relative density
		Percent
Pre-harvest	Loblolly pine	53
	Sweetgum	23.5
	Water oak	12
Post-harvest	Chinese tallow	85
	Sweetgum	8
	Planted seedlings	2.5

Relative density as stems per acre pre-harvest, woody stems per transect post-harvest.

Table P-Dominant pre- and post-harvest woody vegetation-14 acre tract

Condition	Species	Relative density
		Percent
Pre-harvest	Sweetgum	33.5
	Water oak	27.5
	Chinese tallow	17
	Slash pine	12
Post-harvest	Chinese tallow	80
	Yaupon	6
	Water oak	3.5

Relative density as stems per acre pre-harvest, woody stems per transect post-harvest.

Table 3—Dominant pre- and post-harvest woody vegetation-8 acre tract

Condition	Species	Relative density
		Percent
Pre-harvest	Water oak	44.5
	Slash pine	28.5
	Sweetgum	14.7
Post-harvest	Chinese tallow	41.5
	Sweetgum	17
	Water oak	17

Relative density as stems per acre pre-harvest, woody stems per transect post-harvest.

Planting

Two recently undisturbed BLH sites adjacent to Village Creek were selected as reference stands and inventoried using tenth acre plots. Based on these inventories and regulatory guidance, species selected for planting and the relative amounts planted included: willow oak (21.6 percent), cherrybark oak (19.8 percent), swamp chestnut oak (19.4 percent), common persimmon (13.2 percent), water oak (12.8 percent), green ash (6.6 percent), and bald cypress (6.6 percent). Sweetgum was an important component in the reference stands but was not planted as sufficient seed source existed in stands adjacent to the tracts. Bareroot seedlings (1-O) were obtained from a commercial forest tree nursery and planted by a contract planting crew in January 1998. Seedlings were hand-planted on an 8 X 12 feet spacing (450 trees per acre). Some seedlings, notably persimmon, had larger roots which necessitated pruning to facilitate planting. Site conditions were moist, and temperature was mild. Seedlings were randomly mixed, placed in planting bags and given to the planters. On the ripped site, seedlings were planted adjacent to the rip.

Post-Harvest Inventory

Seedling density and survival were monitored using randomly located tenth acre plots. Fifteen tenth acre plots were established on the 48 acre tract, and two tenth acre plots per tract were established on both the 14 and 8 acre tracts. initial density was recorded, and survival was recorded once per month, through October 1998. Initial density and final survival appear in Table 4. Pin flags were placed near each seedling to facilitate locating the seedlings. Seedling mortality was noted as lack of above ground green tissue or leaves. Some seedlings died back but later resprouted. Seedling mortality due to herbivory was not apparent.

Woody recruitment was sampled using a point-intercept method. On each tract, four transects were established from the edge to the interior on cardinal directions. Transects were positioned such that they did not overlap, and edge was minimized. Woody vegetation in contact with the transects was counted. Along the same transects, beginning with the edge, and at one chain or one-half chain intervals, 1 meter square sub-plots were established to measure

Table 4-Planted seedling density and first year survival

	Stems/acre		
Tract	Initial	Final	Survival
Acres			*Percent*
48	480	350	72.9
14	360	220	61.1
8	430	170	40.0

Table 5—Post-planting percent cover woody and herbaceous vegetation, all tracts

Species	Relative percent cover
Eupatorium	31.1
Openflower rosettegrass	10.8
Chinese tallow	10.2

Percent cover sampled 1 meter square subplots along transects.

species composition and percent area cover of species within the herbaceous layer. Percent bare ground and percent debris were also noted. Two or three 1 meter square sub-plots were' measured at each station along the transect. If little variation in species or percent cover was found, only two sub-plots were used. If cover or species composition varied, three sub-plots were used. Both woody and herbaceous vegetation were recorded and identified to the species level when possible. This data appears in Table 5.

RESULTS AND DISCUSSION

In 1998, yearly precipitation was average. Precipitation for March through June was **12.78** inches below average, with only 10.7 inches of rain falling over these four months. Initial planted seedling density and survival differed by tract (table 4). The 48 acre tract had the highest initial density and highest survival. We believe site preparation may be the major factor differentiating tracts. More intensive site preparation on the 48 acre tract may have led to high densities and high survival. Ripping probably contributed to the quality of the planting. Soil around the rip was loosened, easing the effort of planting, lessening j-rooting, and allowing proper hole closure. Low densities on the 14 acre tract might be due to the difficulty of planting in logging debris. Seedling density on the 8 acre tract was good, possibly due to the absence of logging debris. However, seedling survival was low on the 8 acre tract, eventually falling below mitigation goals.

Recruitment of vegetation onto the site was rapid. After 1 year, more than 68 species had been identified within the three tracts. Shannon's diversity index, calculated using means from the 1 meter square sub-plot data, was similar among tracts, and had values ranging from 2.7 to 2.6. More than 50 percent of the post-harvest vegetation was represented by three genera: Eupatorium, openflower rosettegrass, and Chinese tallow (table 5). Most of the vegetation recruitment was herbaceous. Woody recruitment was dominated by water oak, sweetgum, and Chinese tallow. Winged elm, American holly, yaupon, and black gum, while present, represented less than 5 percent of woody recruitment on any tract. Chinese tallow recruitment represented the majority of woody recruitment, and will likely be a component of the mature forest, unless controlled (Bruce, Cameron, and Harcombe 1995).

Chinese tallow was a minor component of each tract prior to harvest. After harvest, Chinese tallow appears to have become the dominant woody plant on all three tracts (tables l-3). We believe this dominance may be due to existing seeds in the seed bed. Ten to fifty percent of Chinese tallow seeds remain viable after one ydar and viability for up to seven years has been reported (Bruce, Cameron, Harcombe, and Jubinsky 1997). Alternatively, Chinese tallow seeds float, and may have been carried in from off site during flood events (Jubinsky 1994). Chinese tallow may be sensitive to fire; low density of Chinese tallow on the 8 acre tract may be due to the site preparation fire (Robinson 1995). Natural regeneration of sweetgum and water oak, primarily coppice, was occurring on the 8 acre tract. This regeneration likely represents the future forest on the 8 acre. Herbicide injection or basal spray of mature trees seemed an effective method of Chinese tallow control in SMZs. Roundup ™ did not have an appreciable impact on young tallow, while Garlon 4 TM appeared effective.

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APPENDIX I

Common and Sclentiflc Names

Bald cypress	*Taxodium distichum* L.(Rich.)
Common persimmon	*Diospyros virginiana* L.
Green ash	*Fmxinus pannsylvanica* Marsh.
Cherrybark oak	Quercus pagoda Raf.
Swampchestnut oak	*Quercus michauxii* Nutt.
Water oak	*Quercus nigra* L.
Willow oak	*Quercus phellos* L.
Sweetgum	Liquidamber *styraciflua* L.
Chinese tallow	*Sapium sebiferum* (L.) Roxb.
Loblolly pine	*Pinus taeda* L.
Slash pine	*Pinus elliottii* Englem.
Yaupon	*Ilex vomitoria* Ait.
Eupatorium	*Eupatorium serotinum* Mich.
Eupatorium	*Eupatorium capillifolium* (Lam.) Small
Openflower rosettegrass	Dichanthelium *laxiflorum* (L.) Gould
Blackgum	Nyssa *sylvatica* Marsh.
American holly	*Ilex opaca* Aiton
Winged elm	*Ulmus alata* Mich.
American hornbeam	*Carpinus caroliniana* Walt.

REFERENCES

Bruce, K.A.; Cameron, G.N.; Harcombe, P.A. 1995. Initiation of a new woodland type on the Texas Coastal Prairie by the Chinese tallow tree (*Sapium sebiferum* (L.) Roxb.). Bulletin of the Torrey Botanical Club. 122: 215-225.

Bruce, K.A.; Cameron, G.N.; Harcombe, P.A.; Jubinsky, 0.1997. Introduction, impact on native habitats, and management of a woody invader, the Chines&tallow tree *Sapium sebiferum* (L.) Roxb. Natural Areas Journal. 17: 255-260.

Jubinsky, G. 1994. A review of literature: Chinese tallow (*Sapium sebiferum*). Tallahassee, FL: Florida Department of Environmental Protection, Bureau of Aquatic Plant Management, Technical Services Section.,

Robinson, C. 1995. A review of the literature: control methods for Chinese tallow *Sapium sebiferum* (L.) Roxb. San Antonio, TX: The Nature Conservancy of Texas.