ECOLOGICAL RESTORATION Vol. 24, No. 2, pp. 114-115 June 2006
Published by the University of Wisconsin Press, in association with the Society for Ecological Restoration

Tree Plantings in Depression Wetland Restorations Show Mixed Success (South Carolina)

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Studies of bottomland forest restoration in the southeastern United States indicate that success can be improved by protecting planted tree seedlings from herbivores and selectively controlling competing vegetation, although such measures may be costly (Allen and others 2001). These studies are primarily from river floodplains, where flooding usually occurs during the dormant season and seedlings are susceptible to damage by river animals such as beaver and nutria. Reforesting "isolated" depressional wetlands may present different challenges, such as growing-season ponding that exposes seedlings to flooding stress. Although isolation from river systems might lessen the risk of herbivory, controlling competition may be undesirable because herbaceous cover is often a goal when restoring these wetlands.

We tested several approaches for restoring degraded Coastal Plain depression wetlands, including the use of passive methods for establishing emergent wetland vegetation (Barton and others 2004, De Steven and others 2006). We studied sixteen 1- to 5-acre (0.5- to 2-ha) ditched and disturbed depressions in which we 1) cleared successional vegetation to stimulate germination of wetland plants from the seed banks and 2) plugged the ditches to restore water levels. In eight of these wetlands, we also tested a low-effort approach for restoring wetland tree species.

We chose two species that are characteristic in depressions — swamp tupelo (*Nyssa biflora*) and baldcypress (*Taxodium distichum*). Although pond cypress (*T. ascendens*) is more typical of these wetlands, it was less available commercially than baldcypress. We tried to obtain nursery-grown bare-root seedlings that were tall enough to exceed predicted restored water depths of 19–38 inches (50–100 cm). Heights of the available stock averaged 41 inches (103 cm) for baldcypress and 22 inches (56 cm) for tupelo. A contracted crew used dibble bars to hand-plant the seedlings during the dormant season in February 2001, after depressions were cleared and before ditches were plugged. They planted seedlings across each wetland on a grid at a 15-ft (4.5-m) spacing, with each species in alternating rows. The larger cypress seedlings were root-pruned to facilitate transplanting. Seedlings were not protected from herbivores and were subject to competition from the developing wetland vegetation.

Following leaf-out in May 2001, we marked and measured a sample of up to 100 seedlings per species in each wetland. We censused the seedlings at the end of the first growing season (September 2001) and then annually each spring through 2005 (Table 1).

Table 1. Average (SE) survival and growth of planted tree seedlings in eight depressional wetlands.

	% surviving		Height (cm)	
Census date	Cypress	Tupelo	Cypress	Tupelo
May 2001	100	100	103 (1)	56 (1)
Sept 2001	91 (3)	80 (3)	106 (1)	55 (1)
May 2002	88 (4)	63 (5)	–	–
May 2003	82 (5)	26 (8)	131 (2)	63 (2)
May 2004	81 (5)	25 (8)	152 (2)	94 (3)
May 2005	79 (5)	23 (8)	196 (3)	124 (4)

We expected that restored water levels would influence seedling success, but ponding conditions fluctuated unpredictably. The wetlands were dry at the surface or starting to pond water at the time of planting, after which water levels rose to spring maxima of 2–31 inches (5–80 cm). Newly-planted seedlings, particularly the shorter tupelo, may have been submerged during the early 2001 growing season. A regional drought caused all wetlands to dry down by mid- to late 2001, and nearly all remained dry for most of 2002. Normal rainfall in 2003 returned water levels to 28–43 inches (70–110 cm).

After four years, survival averaged 79 percent for baldcypress, but only 23 percent for tupelo. Most tupelos died during the first two years. Although we could not identify specific causes of mortality, it was likely a combination of flooding followed by drought stress, and possibly some competition from well-developed emergent vegetation. We could not determine if there was deer herbivory, but many plants showed evidence of die-back and resprouting. After four years, average height of baldcypress was 55–98 inches (140–250 cm), while tupelo averaged 28–70 inches (70–170 cm).

We encountered some complications. First, the planting crew did not always follow the desired specifications for seedling numbers and array, indicating a need for closer supervision and more detailed planting layouts. Second, as the tupelo seedlings grew, we discovered that the original planting stock included water tupelo (*Nyssa aquatica*), which occurs with swamp

tupelo in river swamps. When congener species look similar and have confusing common names, nurseries may inadvertently supply mixed materials. It is uncertain if this affected our results substantially, as published studies have reported similar survival rates for both tupelo species.

We successfully established baldcypress with little effort, perhaps because seedlings were more tolerant of drought and larger than the tupelo, which appeared more sensitive to ponding conditions. Existing guidelines for bottomland forest restoration recommend a minimum tree seedling height of 18 inches (46 cm). However, when working in depressions that are ponded during the growing season, using taller seedlings or preferentially planting into shallow-water zones may improve survival. Competition control may be less important, because the presence of some emergent vegetative cover might shelter planted seedlings from unpredictable drought stress.

ACKNOWLEDGMENTS

The USDA Forest Service and U.S. Department of Energy, Savannah River Site, supported this research (Agreements 01-CA-11330135-457, 03-CS-11083600-002, and DOE Contract DE-FC09-96SR18546 with the University of Georgia). A. Harrison, J. Mulhouse and P. Stankus assisted with fieldwork.

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