EFFECTIVENESS OF SHELTERWOOD AND STRIP CLEARCUTS FOR REGENERATING BOTTOMLAND OAKS IN NORTHEAST TEXAS

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ABSTRACT

Oaks (*Quercus* spp.) are frequently the most valuable bottomland species, but are often hard to regenerate. In northeastern Texas, operational shelterwoods and strip clearcuts were established in 2014 to test their effectiveness for establishing oak regeneration. Measured in 2022, basal area of the shelterwood areas recovered to 96.2 square feet per acre and the sapling size class [diameter at breast height (d.b.h.) <2 inches] increased from an initial 270 trees per acre (TPA) to 580 TPA with 26 percent oaks. The seedling layer increased to 7,371 TPA with 67 percent willow oak (*Q. phellos*), 10 percent overcup oak (*Q. lyrata*), and 9 percent water oak (*Q. nigra*). In the strip clearcuts, no seedlings occurred in the sampling plots. However, there were 961 TPA in the small sapling size class (<2 inches d.b.h.) with 62 percent *Quercus* spp. These results indicate that both techniques successfully enhanced oak regeneration. However, additional treatments are likely needed to ensure recruitment of oaks into the overstory.

INTRODUCTION

Oaks (*Quercus* spp.) are among the most valuable bottomland species but are often difficult to regenerate. The typical regeneration prescription for oaks is a shelterwood, which partially opens the canopy to provide intermediate light conditions. However, planning and implementation of shelterwoods can be challenging; other practices such as strip clearcuts may provide a simpler alternative. The goal of this study was to compare the effectiveness of operational strip shelterwoods and strip clearcuts for establishing oak regeneration in a bottomland area of northeastern Texas.

METHODS

The study was located near Daingerfield, TX (32°58'40" N, 94°48'23" W). Average annual precipitation was 46.8 inches per year and mean annual air temperature was 64.4 °F. The soils were mostly Estes series (Fine, smectitic, thermic, Aeric Dystraquerts) which are very deep, somewhat poorly drained floodplain soils with clay/clay loam texture. The site typically floods between 2 and 60 days per year during the dormant season.

In 2014, alternating areas of strip clearcuts and strip shelterwoods (three each) were installed. Sizes ranged from 80 to 100 m wide by 400 to 800 m long. In the shelterwood strips, the establishment cut reduced basal area from 94 square feet per acre to between 50 and 60 square

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feet per acre. Five or six sampling plots were established in each cutting unit. Preharvest data were collected in the summer of 2014. Posttreatment data were collected in October 2022. For preharvest data and shelterwood posttreatment data, stems >2 inches d.b.h. (overstory and midstory) were sampled within 0.1-acre plots, stems <2 inches d.b.h. (small saplings) were sampled in 0.01-acre plots nested within the larger plot, and seedlings (<4.5 feet) were sampled from five 0.001-acre subplots. Subplots were located at plot center and 10 feet in each cardinal direction from plot center. Because of a general lack of overstory within the strip clearcut units, all stems taller than 4.5 feet were sampled within 0.01-acre plots and five 0.001-acre subplots were used to sample seedlings. Diameters, heights, and species were measured for the overstory and sapling layers. The heights of all seedlings were measured. Plot-level data within a given cutting unit were averaged before analysis, such that the cutting unit served as the experimental unit (n = 3).

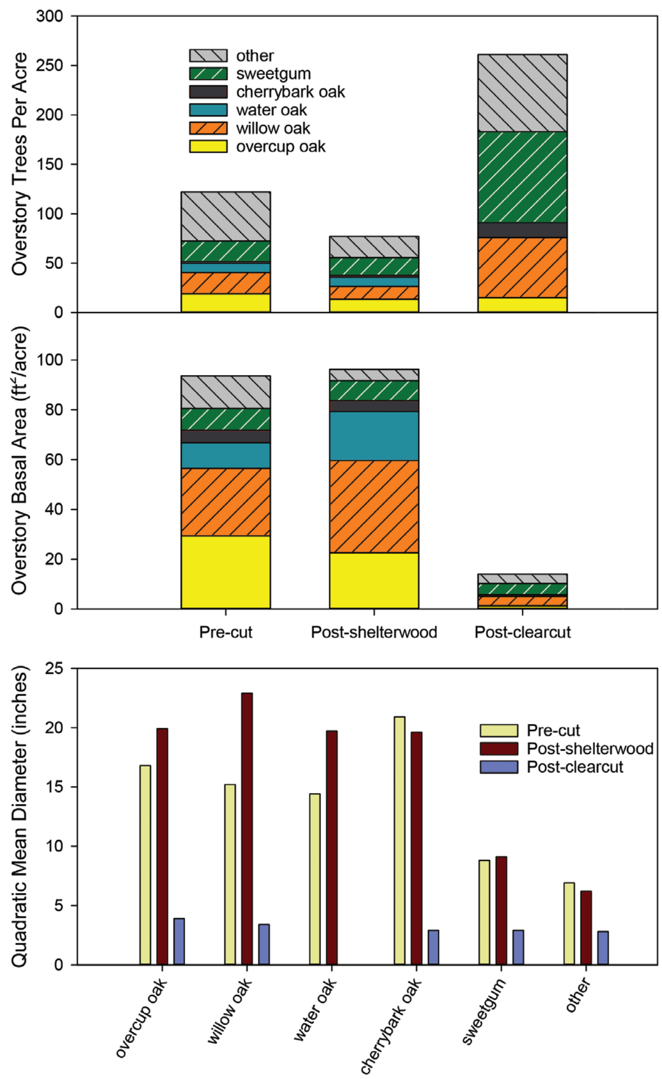

Figure 1—Overstory and midstory trees (>2 inches d.b.h.) measured in 2014 (precut) and in 2022; (top) trees per acre, (middle) basal area, and (bottom) quadratic mean diameter.

RESULTS

In 2014, the initial unmanaged stand had 93.6 square feet per acre basal area (BA) and 122 TPA. The basal area of the overstory and midstory was composed of 31 percent overcup oak (*Quercus lyrata*), 29 percent willow oak (*Q. phellos*), 11 percent water oak (*Q. nigra*), 9 percent sweetgum (*Liquidambar styraciflua*), 5 percent cherrybark oak (*Q. pagoda*), and 14 percent other species. Quadratic mean diameter of trees >2 inches was 11.9 inches with the mean for oak species exceeding 14 inches (fig. 1). The small sapling layer consisted of 270 TPA. Possumhaw (*Ilex decidua*) was most abundant (29 percent), and oaks composed only 6 percent (fig. 2). Before treatment, there were 1,965 seedlings per acre with willow oak most abundant (38 percent). Other common species were hophornbeam (*Ostrya virginiana*) (11 percent), *Ulmus* spp. (9 percent), hornbeam (*Carpinus caroliniana*) (6 percent), overcup oak (6 percent), *Celtis* spp. (5 percent), water oak (3 percent), green ash (*Fraxinus pennsylvanica*) (3 percent), and sweetgum (2 percent) (fig. 2).

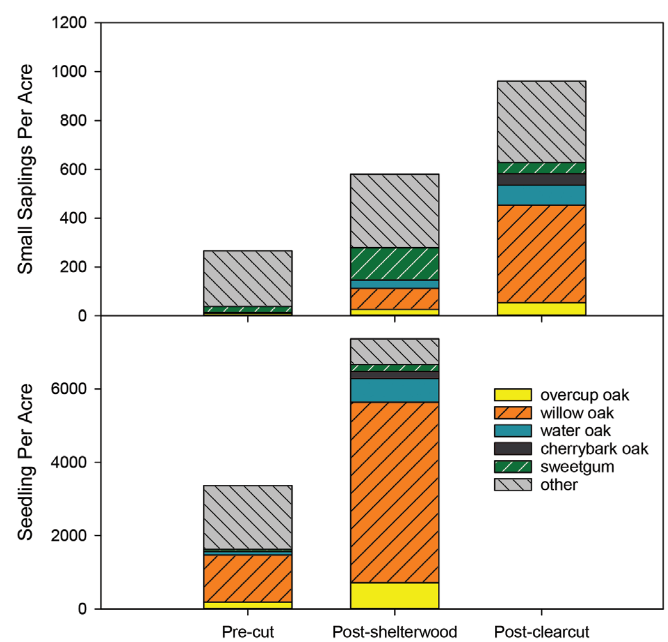

Figure 2—(top) Small saplings (<2 inches d.b.h) and (bottom) seedlings (shorter than 4.5 feet) measured in 2014 (precut) and in 2022.

Measured in 2022, BA of the shelterwood areas recovered to 96.2 square feet per acre in the overstory and midstory and was composed of 38 percent willow oak, 24 percent overcup oak, 20 percent water oak, 8 percent sweetgum, 5 percent cherrybark oak, and 5 percent other species. The TPA was 77. Quadratic mean diameter had increased to 15.1 inches and the mean of the oak species exceeded 19 inches (fig. 1). BA of the sapling layer was 2.73 square feet per acre consisting of 580 TPA. Of the trees, there were 23 percent sweetgum, 18 percent *Ulmus* spp., 17 percent *Cornus* spp., 15 percent willow oak, 9 percent possumhaw, 6 percent water oak, 5 percent overcup oak, and 7 percent other species. The seedling layer increased to 7,371 seedlings per acre and consisted of 67 percent willow oak (9.4 inches average height), 10 percent overcup oak (10 inches average height), 9 percent water oak (10 inches average height), 5 percent *Ulmus* spp. (13.2 inches average height), 3 percent cherrybark oak (9.7 inches average height), 3 percent sweetgum (17 inches average height).

For the strip clearcut areas measured in 2022, the overstory and midstory had BA of 15.4 square feet per acre, TPA of 261, and quadratic mean diameter of 3.3 inches. Of the TPA, there were 35 percent sweetgum, 24 percent willow oak, 21 percent black willow (*Salix nigra*), 6 percent cherrybark oak, 6 percent overcup oak, and 6 percent *Ulmus* spp. Basal area of sapling layer was 6.6 square feet per acre with 961 TPA. Of the trees, there were 41 percent willow oak (16 feet average height), 11 percent *Ulmus* spp. (13 feet average height), 10 percent water oak (17 feet average height), 6 percent overcup oak (18 feet average height), 5 percent cherrybark oak (9 feet average height), 5 percent sweetgum (10 feet average height), 5 percent green ash (11 feet average height), and 17 percent other. No seedlings were observed. The understory was composed of abundant herbaceous plants.

DISCUSSION

Given the shade intolerance of willow oak (Schlaegel 1990), water oak (Vozzo 1990), and cherrybark oak (Krinard 1990) and intermediate shade tolerance of overcup oak (Soloman 1990), very few oaks initially occurred in the sapling or seedling layers, indicating the need for increasing light availability to facilitate natural oak regeneration. Following the reduction in BA to 50–60 square feet per acre, the shelterwood establishment cut increased oak saplings from 16 per acre to 150 per acre. Seedlings increased 3.75 times, from 1,570 per acre to 6,484 per acre. However, the majority of the seedlings were short; 64 percent were less than 10 inches tall. In addition, growth of residual overstory trees was rapid and BA exceeded precut levels within 8 years. Because shade intolerant bottomland oaks, such as cherrybark oak, need 50 percent full sun for optimal growth (Gardiner and Hodges 1998), a second shelterwood establishment cut is probably necessary for continued development of the current sapling and seedling cohorts. Alternatively, a removal cut could be considered with reliance on existing oak saplings, release of current oak seedlings, and stump sprouts to provide adequate regeneration. Targeted herbicide application to control species such as sweetgum, possumhaw and *Cornus* spp. will help recruitment of oak into the sapling and midstory layers.

The strip clearcut produced about 600 oaks per acre in the sapling layer (between 0.1 and 2 inches d.b.h.) that likely will contribute to the next stand. This should be sufficient given a goal of 100–200 TPA of a mature overstory. Given the general lack of oaks in the sapling layer precut (<20 per acre), the oak saplings came from the release of seedlings or stump sprouts. Aggressive herbaceous growth following the clearcut resulted in a lack of seedlings and increased the reliance of the future stand on the current sapling layer. Therefore, targeted control of less desirable species, such as *Ulmus* spp., green ash, sweetgum, and black willow, is of particular importance to facilitate oak establishment.

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