CHARACTERISTICS OF A BOTTOMLAND HARDWOOD FOREST UNDER GREENTREE RESERVOIR MANAGEMENT IN EAST CENTRAL ARKANSAS

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Abstract—Greentree reservoirs are a viable option for creating habitat and hunting opportunities for migrating waterfowl. Unfortunately, the prolonged annual flooding often associated with greentree reservoir management can be highly detrimental to many of the desirable tree species in these stands. In the summer of 2004, a total of 327 plot centers were established in a greentree reservoir under an annual flooding regime. At each plot center, a nested plot design was used to establish a 1/5-acre overstory plot, a 1/40-acre midstory plot, and a 1/100-acre understory plot. Our objective was to characterize the vegetative composition and abundance in a bottomland hardwood stand which had been under an annual flooding regime for over 50 years. Results indicate that overcup oak is dominant in all three vertical layers while the more desirable willow oak is common only in the overstory.

INTRODUCTION

Bottomland hardwood forests of the Southeast historically provided ample habitat for numerous wildlife species. As the region was settled, millions of acres of bottomland hardwood forests were cleared for timber and agriculture. Karr and others (1990) reported a loss of 20,000 acres of bottomland hardwood forest per year as late as 1960 through 1975. In the 1930s, as the loss of bottomland hardwood forests became more obvious and waterfowl hunting increased in popularity, landowners around Stuttgart, AR, initiated the creation of greentree reservoirs by constructing a system of levees around and through a bottomland hardwood stand so that water could be impounded (Young and others 1995). Since that time, the typical management practice applied to most greentree reservoirs has consisted of flooding the stand every year. Flooding usually begins mid- to late fall and ends after the close of waterfowl hunting season. While this practice may be beneficial to waterfowl, prolonged annual flooding can be detrimental to many of the tree species considered desirable for both timber production and waterfowl management. In our study area, the primary desirable species was willow oak. Wigley and Filer (1989) stated that the two most common problems reported by greentree reservoir managers are the lack of desirable regeneration and the loss of mature trees.

STUDY SITE

The study site is located in Arkansas County approximately 5 miles south of Stuttgart, AR. This particular greentree reservoir is approximately 650 acres in size and is part of the Monsanto Farm and Wildlife Management Center. The stand was converted to greentree reservoir use around 1950 and has been managed to provide opportunities for hunting migrating waterfowl. Annual flooding of the entire stand is typical of greentree reservoir management in this area. Flooding begins each year around the middle of October, but the exact date varies from year to year depending on climatic factors. During years of excessive rain, flooding can be delayed. However, flooding may be initiated earlier during dry years because it takes longer to saturate the soil. It should be noted that most trees in the study area have not gone dormant when flooding is started. Water gates are typically opened to release flood waters 2 to 3 weeks after the end of waterfowl hunting season, usually around the middle of February. However, with late winter and early spring typically being the wettest time of the year in this area, the site can remain flooded well into the beginning of the growing season.

MATERIALS AND METHODS

During the summer of 2004, a total of 327 plot centers were established on a 4 by 5 chain grid system. All plot centers were marked with a Magellan® global positioning system. At each plot center, a nested plot design was used to establish three circular plots: a 1/5-acre overstory plot, a 1/40-acre midstory plot, and a 1/100-acre regeneration plot. In each overstory plot, all overstory trees were identified to species, and diameter at breast height (d.b.h.) was measured and recorded. In the midstory plots, all midstory trees were identified to species. D.b.h. and total height, in 10-foot height classes, were also recorded for all midstory trees. Midstory vegetation was defined as all woody stems > 5 feet tall to the base of the overstory canopy. In each regeneration plot, all woody stems < 5 feet tall were tallied by species and height class. Regeneration height classes were: < 1 foot, 1 to 3 feet, and 3 to 5 feet.

RESULTS

Overstory Vegetation

A total of 20 tree species were recorded in the overstory. Table 1 contains a list of species codes and their corresponding common and scientific names. Overcup oak (*Quercus lyrata* Walt.) and willow oak (*Quercus phellos* L.) were the most common species and comprised 40 percent and 33 percent, respectively, of the total overstory stems per acre. Basal area calculations for each species again show that overcup oak and willow oak are the dominant species in the stand. However, in terms of basal area, their positions reverse, with willow oak comprising 39.47 square feet of basal area per acre while overcup oak comprised 33.08 square feet of basal area per acre.

Table 2 shows the average number of trees per acre and average basal area per acre for the eight most common species. Trees per acre and basal area for the remaining species are not reported because they occur infrequently throughout the stand.

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Citation for proceedings: Connor, Kristina F., ed. 2006. Proceedings of the 13th biennial southern silvicultural research conference. Gen. Tech. Rep. SRS–92. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 640 p.

Table 1—Species codes with common and scientific names

Code	Common name	Scientific name
CBO	Cherrybark oak	*Quercus pagoda* Raf.
DSH	Deciduous holly	*Ilex decidua* Walt.
GRA	Green ash	*Fraxinus pennsylvanica* Marsh.
HNL	Honey locust	*Gleditsia triacanthos* L.
NTO	Nuttall oak	*Quercus nuttallii* Palmer
OCO	Overcup oak	*Quercus lyrata* Walt.
PER	Persimmon	*Diospyros virginiana* L.
POO	Post oak	*Quercus stellata* Wang.
REM	Red maple	*Acer rubrum* L.
WAE	Water elm	*Planera aquatica* J. F. Gmel.
WAH	Water hickory	*Carya aquatica* Michx. f.
WLO	Willow oak	*Quercus phellos* L.

Table 2—Overstory trees per acre and basal area per acre

Species	Trees/acre	Basal area/acre
OCO	19.22	33.08
WLO	16.27	39.47
GRA	4.39	4016
NTO	2.65	5.95
WAH	2.11	2.36
POO	0.86	1.22
REM	0.86	1.41
CBO	0.46	1.13

Midstory Vegetation

A total of 20 species were recorded in the midstory. Overcup oak was the most common midstory species, with an average of 67.77 stems per acre. The majority of overcup oak stems occurred in the 10- and 20-foot height classes. Four other species had > 50 stems per acre. However, willow oak averaged only 6.73 trees per acre, with most stems in the 40-foot height class. Average number of stems per acre by height class for the eight most common midstory species is found in table 3. Trees per acre for the remaining species are not reported because they occur infrequently throughout the stand.

Woody Regeneration

Twenty-two species were recorded in the regeneration layer. With an average of 3,341 stems per acre, overcup oak was the most common woody species in this layer. The majority of these stems (1,564.53 per acre) were < 1 foot tall. However, overcup oak was dominant in all three regeneration height classes. Willow oak averaged 152 stems per acre with most stems in the < 1 and 1 to 3 foot classes. There were virtually no willow oaks in the 3 to 5 foot height class. Average number of stems per acre by height class for each of the eight most common understory species is found in table 4. Trees per acre for the remaining species are not reported because they occur infrequently throughout the stand.

Table 3—Midstory trees per acre by height class

	Height class			
Species	10 foot	20 foot	30 foot	40 foot
OCO	42.2	12.97	6.97	5.63
DSH	57.37	0.73	0.12	0
GRA	23.24	18.96	11.5	3.67
PER	41.71	11.13	1.83	0
WAH	42.81	6.85	1.96	1.71
REM	18.35	15.9	5.5	1.22
WAE	10.89	10.03	4.04	1.71
WLO	1.22	1.22	1.59	2.69

Table 4—Regeneration trees per acre by height class

	Height class		
Species	< 1 foot	1 - 3 feet	3 - 5 feet
OCO	1,564.53	1,302.75	473.7
WAE	1,242.2	125.38	8.56
REM	228.44	40.67	6.73
PER	92.36	143.43	27.52
HNL	66.06	125.38	25.69
GRA	60.25	106.73	25.69
WAH	33.03	84.1	42.51
WLO	81.96	62.39	7.65

DISCUSSION AND CONCLUSIONS

Overcup oak is a relatively flood- and shade-tolerant oak species. Due to its typically undesirable form, overcup oak is not considered a good timber producing species. The large encased acorns are of little value to waterfowl. Willow oak is far less tolerant of both flooding and shade (McKnight and others 1980). However, it is generally considered a good timber-producing species, and the acorns are preferred food for waterfowl (Allen 1980, Barras and others 1996). Tables 2, 3, and 4 demonstrate that overcup oak is abundant in all vertical layers in this greentree reservoir, but willow oak is abundant only in the overstory. The fact the willow oak has fewer stems per acre on average but more basal area per acre implies that the willow oaks in the overstory are considerably larger than the overcup oaks. The smaller diameters of the overcup oaks lead us to theorize that although overcup oaks have a slower growth rate, many of these trees may be younger trees that have only recently achieved a position in the overstory. This theory is supported by the fact that overcup oak is relatively common in all four midstory height classes. Willow oak, although it occurs in all four midstory height classes, occurs much less frequently. This indicates that very few willow oaks are progressing from the regeneration layer to the midstory and later into the overstory. Overcup oak is regenerating profusely and is extremely abundant in all three regeneration height classes (table 4). This same table shows that while willow oak is regenerating, very few trees are surviving to reach the upper height classes. All these facts imply that overcup oak is able to successfully regenerate in annually flooded greentree reservoirs, grow into the midstory, and eventually claim a place in the overstory. Conversely, willow oak was part of the overstory when greentree reservoir management was initiated, but it is now regenerating at a far lower rate with

very few trees surviving long enough to move into the midstory. The lack of smaller willow oaks in the overstory shows that very few are ever achieving this crown position. Data from all layers indicate that prolonged annual flooding practices (flooding before the onset of dormancy, and inadvertently allowing the stand to remain flooded into the next growing season) is shifting the species composition toward a more flood tolerant and less desirable species association. In order to maintain the willow oak currently in this stand and promote successful regeneration of willow oak, it may be necessary to alter the flooding regime of this stand.

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