2004

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Abstract

Oak (*Quercus* spp.) savanna, characterized by widely scattered oaks with an understory of prairie and other specialized species, is one of the most endangered native ecosystems in North America (Nuzzo 1986, Packard and Mutel 1997). The absence of grazing and burning along with the introduction of tillage agriculture are key factors for the loss of this ecosystem. Our objective was to determine the effectiveness of rotational grazing to reduce the shrub layer in degraded oak savannas. This study took place at three sites in southwestern Wisconsin. In this paper, we report on the results of the savanna grazing on the cattle. For two summers, cow/calf pairs or yearling Scottish Highland cattle (*Bos taurus* spp.) were placed on 1-acre (0.4-ha) treatment sites for two to three days per month with a rest on grass pasture for one day between replicates. Animal weight gain was satisfactory. During the study, cattle generally gained better in 2002 due to adjusted stocking densities from 2001. Cows that calved prior to the study typically maintained body weight similar to controls, while late-calving cows in both groups lost some weight. Dry cows, steers, and nursing calves also performed similar to the controls. Body condition scores (BCS) for all classes of cattle were similar between the treatment and control groups over the season, hovering around 5 and 6. Managed grazing with five to seven cow/calf pairs or 12 yearlings per acre, for two to three days per month two to four times per season reduced the shrub layer in oak savanna, while permitting adequate weight gains in the cattle.

Keywords: Oak savanna, managed grazing, Scottish Highland cattle, *Bos taurus* spp.

Introduction

Oak savanna, characterized by scattered open-grown oak trees, and a groundcover composed of grasses, sedges, wildflowers, and occasionally brush, is the most endangered native ecosystem in North America (Nuzzo 1986, Packard and Mutel 1997). Grassland ecologists attribute the lack of grazing and burning along with the introduction of agriculture as key factors explaining the disappearance of this ecosystem. Restoring oak savanna structure to the remaining fragments of this ecosystem begins with increasing light penetration to the herbaceous groundlayer. The overall objective of this study was to determine the effectiveness of rotational cattle grazing to reduce the shrub layer in degraded oak savannas. In this paper, we focus on the effect grazing oak savanna has on the livestock themselves. Shrub forage nutritional value and cattle observation data can be found in a complementary paper by Hedtcke and her colleagues (in press). Information on the impact of grazing on the vegetation is presented in a companion paper (Harrington and Kathol in press).

Study Area

The pre-settlement landscape of southwestern Wisconsin was a mosaic of vegetation types that ranged from prairie to forest. Tallgrass prairie had few-to-no trees and depended on frequent fires to maintain a grassy landscape. Next was oak savanna, which had scattered open-grown trees but also prairie underneath. Then there was oak woodland, which had more trees, but less than 80% canopy cover. And finally, the mixed hardwood forest itself, with little direct sunlight penetration beneath the tree canopy. Grazing was critical to maintaining the ecologies of the former two community types.

This study took place at three sites in southern Wisconsin: Yellowstone Lake Wildlife Area (YLWA) in Lafayette County, which is owned and managed by the Wisconsin Department of Natural Resources (WDNR); Prairie Oaks Farm (hereafter referred to as Farm 1), also in Lafayette County; and Creag-Is-Daru Farm (hereafter referred to as Farm 2), in Iowa County. Current conditions at the three sites reflect primarily soil and slope differences. Farm 1 is a shrub-infested oak woodland, dominated by bur oak (*Quercus macrocarpa*) and/or white oak (*Q. alba*). Yellowstone Lake Wildlife Area was a savanna that has been highly degraded by encroaching shrubs and invasive species. The Dubuque silt loam soils at YLWA and Farm 1 are well drained and high in organic matter. Farm 2 is the least degraded of all sites with significant oak savanna components present. Its soil (Northfield sandy loam on a greater than 12% slope) is well

drained, shallow, and sandy. Each site had remnant prairie patches with species common to historic tallgrass prairie and oak savanna regions of southern Wisconsin. The soil test values for each site are reported in Table 1. Farm 1 and YLWA, which are on fertile soils, were not brought under the plow primarily due to the steep slopes. At Farm 2, the steep, shallow, acidic, less fertile soils are not conducive to row-crop agriculture.

Figure 1. View of grazing plots looking upslope into the woods.

Table 1. Baseline routine soil tests to 6-inch (15-cm) depth from the three study sites.

Site	Soil Test P (ppm)	Soil Test K (ppm)	Organic matter %	pH
Farm 1	33	153	7.6	6.8
Farm 2	29	71	2.8	4.9
YLWA	20	141	6.0	7.0

Table 2. Cattle rotation schedule at the three sites.

Site	2001	2002
Farm 1	June 1–June 25	June 1–June 25
	June 26–July 20	Aug 20–Sept 13
	Sept 17–Oct 10	
Farm 2	June 1–June 25	June 1–June 25
	July 1–July 25	Aug 26–Sept 19
	Sept 15–Oct 8	
YLWA	June 1–June 25	June 1–June 25
	June 26–July 20	June 26–July 20
	July 21–Aug 14	July 21–Aug 17
	Aug 18 –Sept 11	

The study was done using a Scottish Highland breed of cattle (*Bos taurus* spp.) of which there are currently about 20,000 registered animals plus an unrecorded number of unregistered animals raised for beef in the United States (American Highland Cattle Association pers. comm. 2002). This breed has a shorter stature than typical beef breeds, but they have similar body weights. They are good browsing animals, and they possess large horns that they frequently use to knock over small trees and brush. Several local grazers considered these traits and their reported ability to thrive in less than ideal pasture circumstances on the Scottish moors as advantages for grazing in overgrown oak savannas.

Treatments and Design

At all three sites, the cattle grazed in the oak savanna for about 25 days/month during the summer and were compared to animals grazing only in grass/legume pastures. The design was a randomized complete block design with five replicates at each site. Three-strand high tensile wire fencing was installed around each 1-acre (0.4-ha) plot in the spring of 2001 at all three sites. Each plot had an open, grassy area at the bottom of the slope with increasingly dense understory beneath the tree canopy upslope (Figure 1).

Grazing occurred during the summers of 2001 and 2002. Cattle were weighed just prior to entering plots in late May and again at the end of the grazing season. Cattle were weighed one at a time using a gated chute set up around a weighing platform under which was a Tru-Test™ load-bar scale with digital readout. Cows and steers were also scored for body condition in 2002 at the beginning and end of the season using a visual BCS system with a scale from 1 to 9, with 1 representing emaciated and 9 meaning obese condition (Whitman 1975). The same trained cattle handler scored each animal at the time of the weighing.

Cattle grazed the savanna plots in each replicate for four days and were then placed in a pasture area for one day between replicates. At the end of the 25 days, the cattle were returned where they started in the first replicate (Table 2). At YLWA, the animals were grazed all summer (four cycles in 2001, three cycles in 2002) while on-farm, there were only two grazing cycles each year (Table 2). The July and August cycles of grazing were eliminated due to dry summer weather. In both years, June rainfall stopped

Table 3. Stocking densities in lbs/acre (number of animals in parenthesis) at the three sites.

	2001	2002
Farm 1	6,717 (6 cow/calf pairs)	7,256 (6 cow/calf pairs)
Farm 2	8,840 (6 cow/calf pairs + 3 dry cows)	5,802 (4 cow/calf pairs + 2 dry cows)
YLWA	8,685 (18 yearling steers)[1]	5,064 (12 yearling steers)

[1] Stocking density was reduced to six steers after first grazing cycle.

Table 4. Cattle weight gain or loss on treatment and control plots.

Site Class of cattle	Treatment (Degraded savanna)		Control (Grass/legume pasture)
	2001	2002	2-yr average
On-farm			
Lactating cows		lbs/head	
Calved early	–18 (n=9)	50 (n=7)	65 (n=8)
Calved late	–91 (n=3)	–92 (n=3)	–40 (n=7)
Baby calves	174 (n=11)	151 (n=7)	170 (n=14)
Dry cows	91 (n=3)	153 (n=2)	112 (n=8)
YLWA			
Yearling steers	76 (n=6)[1]	108 (n=12)	127 (n=4)

[1] Initially there were 18 animals on the plots. This was reduced to six steers in mid-summer.

by mid-month, and July rainfall was less than half of the 30-year average.

Stocking rates, expressed as AU/acre (1 AU = Animal Units of 1,000 lbs live cattle weight or 455 kg) were based on our evaluation of existing forage in late May (Table 3). On-farm, cow/calf pairs and dry cows (about 1,000 lbs each) were used while 450-lb (205-kg) steers were used at YLWA. At the same time that the grazing animals were selected, we identified a paired control group on grass/legume pasture as a reference for weight and body condition each summer. As summarized in Table 3, on Farm 1, six cow/calf pairs were rotated through the plots in both years. Based on experience we lowered the stocking rates at the other two sites in the second year. On Farm 2, six cow/calf pairs and three dry cows were used in 2001, and four cow/calf pairs and two dry cows were used in 2002. At YLWA, overstocking occurred for cycle 1 of the first year, where we started with 18 steers. Twelve animals were used for the entire 2002 season at YLWA. Our impression is that the 2002 stocking rates (5–7 AU/a) were sustainable and permitted good animal weight gains (Table 4) as well as partial clearing of the shrub layer.

Results and Discussion

Animal Performance

Cow/Calf Pairs

Under good grazing conditions, pregnant beef cows generally lose about 100–150 pounds (45–68 kg) during the first few weeks after calving due to heavy energy demands from peak milk production (National Research Council 1996). During our study, the treatment cows that calved late or during the study lost on average 92 lbs (42 kg) due to calving and peak lactation compared to a 40-lb (18 kg) loss in the control group (Table 4). Cows that calved prior to the study essentially maintained body weight and condition, similar to controls. Initial BCS were slightly higher in the control group (6.2) than the treatment group (5.2) but both groups maintained their condition at the end of the season.

Weight gains of nursing calves were similar between treatment and control groups (Table 4), with both groups doubling or tripling their birth weight by the end of the season. Most of their nutrition was from milk but some foraging of shrubs and forbs was observed as well.

Dry Cows and Steers

During the two seasons, dry cows gained a similar amount of weight on both the oak savanna plots and the control plots. As with the pregnant cows, body scores were similar between the animals grazing in the oak savanna and those on pasture all summer. Final BCS was also similar between groups of 6.6 for the controls and 6.0 for the treatment group. At YLWA, the 12 steers gained weight as well as the controls in 2002 and final BCS was acceptable at 5.3, but the control group gained more condition over the season increasing from 5.0 to 6.5. However, in the first season, due to overstocking and overgrazing on cycle 1, the six steers that remained on the plots only gained 60% of that by the controls (Table 4).

Conclusions

Our results indicate that grazing with Scottish Highland cattle has the potential to reduce the shrub layer and begin the process of restoring an oak savanna structure. We found that using five to seven cow/calf pairs or 12 yearlings per acre, rotated through the paddocks for two to three days per month two to four times a year resulted in measurable shrub removal. Generally, the weight gains and condition scores of cattle on treatment plots were adequate and similar to that on the control plots. Due to the heterogeneity of forage production within oak savannas and variability in summer rainfall, managers are advised to carefully monitor the vegetation and livestock as actual stocking rates and duration in the savanna will vary. We recommend further evaluation of this system on larger paddocks with more animals and for several years before promoting its use as a habitat management option.

Acknowledgments

The authors would like to thank the other collaborators on the oak savanna project without whose time and expertise we would not have gotten the project running: The cattle owner/land managers, Ron and Sally Niemann of Prairie Oaks Farm, Peter and Mary Rathbun of Creig-is-Daru farm, Bruce Folley and Jackie Curry of YLWA; John Harrington, Emily Kathol, and Devin Biggs at UW–Madison; Peggy Compton at UW–Extension; Tom Hunt and Marlene Sorenson at UW–Platteville; Jerry Bartelt and Dick Bautz at the Wisconsin Department of Natural Restources; and Martha Rosemeyer at Evergreen State College. Funding sources were EQIP, UW Consortium, and the WDNR's Partnerships for Wildlife Program.

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