SHORTLEAF PINE NATURAL COMMUNITY RESTORATION ON PECK RANCH CONSERVATION AREA IN THE MISSOURI OZARKS

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ABSTRACT.—Oak decline has become a significantly increasing problem on Peck Ranch Conservation Area over the last several years. Most of the oak decline problems exist on past shortleaf pine sites. To address this issue, the area managers wrote a natural community restoration plan for 2,233 acres located on the Current-Eleven Point Oak-Pine Woodland Dissected Plain land type association. The goal of this plan is to restore the shortleaf pine-oak/vaccinium natural community on appropriate sites. Timber harvesting activities occurred between 1999 and 2003 on most of the restoration area. The silvicutural prescriptions used were a combination of pine seed tree and irregular shelterwood seed cuts. Three different treatments are being used to achieve the desired results. These treatments will be replicated on three different areas. A combination of artificial and natural tree regeneration along with mechanical thinning, herbicide release, and prescribed fire is being used to achieve the desired natural community. One additional area is a control that received the same type of harvests but will not be planted or receive any post harvest pine seedling releases. Most of the artificial tree regeneration occurred on the pine sites between 2004 and 2006. The entire project area is being monitored by the Resource Science Division to see which technique works best for restoring the appropriate natural community.

INTRODUCTION

This article explores the forest management activities taking place on Peck Ranch Conservation Area (CA). Through careful planning, Natural Community management is starting to enhance the forest community that was once dominant on the area. The shortleaf pine-oak/vaccinium dry ultic woodland natural community encompasses approximately 4,000 acres on the southern portion of Peck Ranch. The main objective for the area managers is to create the desired natural community and to determine the most efficient way of carrying out the management by taking into account time, money, and all the resources on site. The desired future condition 40 years from present is a sparsely stocked stand of mostly shortleaf pine (60 percent or greater), with scattered white and post oak trees and a diverse component of herbaceous/forbs in the understory. This project is being monitored for overstory, ground vegetation, and wildlife responses.

The current Peck Ranch CA forest is a result of actions that began around 1900, when most of the virgin pine forest was cut to provide lumber for a growing nation. This activity left few shortleaf pine trees on the southern portion of the Ranch, where the land is mostly flat with rolling hills.

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Around 1917, the Mid-Continent Iron Company began operation near Fremont, MO. The small town that sprang up was called Midco. To fuel the smelting furnaces each day, 180 cords of wood were required to produce 100 tons of pig iron. Most of the southern half of Peck Ranch was clearcut to provide wood for the iron company.

The Griffith Stave Company bought the remaining timber rights sometime after the end of Prohibition from George Peck, the previous owner. Most of the white oak trees that were big enough to make whiskey barrels were cut at this time.

In this era wildfires were frequent; many were to enhance grass for livestock grazing on open range. This burning often occurred during the driest time of the year, when trees were most susceptible to damage from fire. This burning caused oaks to re-sprout many times and the small pine seedlings simply did not have the resources to keep sprouting. These types of activities led to the present scarlet oak, black oak, and hickory forest located on past shortleaf pine growing sites.

The current condition of the forest is such that many acres of scarlet and black oak trees are declining in health, exhibiting symptoms caused mostly by age. Most of the problems occur in the southern portion of Peck Ranch primarily because of soil conditions. Where the former shortleaf pine forest existed, fragipan soils are typically found, leading to very dry conditions during droughts and

very wet conditions during periods of heavy rain. The recent drought years and soil conditions have proved to be very hard on the aging scarlet and black oak trees.

In 1999, the Peck Ranch Planning Team wrote an area plan that included Natural Community management. The Ecological Classification System was used to identify land type associations (LTA), ecological land types (ELTs), and each natural community represented on the area. In the plan, the team described natural community management groups, objectives, and strategies to achieve the structure and composition of the natural communities located on the area. In addition to the area plan, managers also wrote a restoration plan for 2,223 acres focused on restoring the shortleaf pine-oak/vaccinium natural community on appropriate sites.

The restoration plan focused on three management approaches. The first management emphasis identified was artificial/natural shortleaf pine regeneration accompanied by mechanical release on three management units. Mexel (1991) stated that mechanical control is not feasible from an economic standpoint. However, mechanical release is to be monitored to determine whether shortleaf pine seedlings can be released without damaging the herbaceous/forb component of the area.

The second management emphasis identified was artificial/natural shortleaf pine regeneration accompanied by prescribed fire on three management units. This combination of treatments will demonstrate whether prescribed fire can be used in conjunction with regenerating shortleaf pine trees while enhancing herbaceous diversity. In this treatment, two of the units will have fire withheld until the pine trees reach approximately 6 feet tall. Waiting for the trees to reach this height will prevent the terminal bud from being killed, which typically causes the trees to die. Shortleaf pine is unique in its ability to sprout prolifically when the crown is killed or badly damaged (Lawson 1990). The one remaining unit will be burned as needed to retard the oak sprouts and to enhance the herbaceous/forb component of the area.

Artificial/natural shortleaf pine regeneration accompanied with herbicide release was the third management emphasis involving three management units. The objective is to see whether herbicide can be used without damaging the herbaceous/forb component and the residual oak trees that were left scattered throughout the stands. Miller et al. (1999) found that after herbicide was used in site preparation in Georgia, the herbicide had little influence on total (herbaceous) species numbers or diversity 11 years after treatments. We hope to have the same results in species diversity and richness on our study site.

STUDY AREA

Peck Ranch Conservation Area is located in the northwest corner of Carter County, Missouri. The largest portion of Peck Ranch CA was purchased in 1945 by the Missouri Department of Conservation from George Peck. The area encompasses 23,048 acres and is about 95 percent forested.

This Conservation Area has four LTAs. The Current River Oak-Pine Woodland/Forest Hills is the largest LTA, comprising 47 percent of the area. The second largest is the Eminence Igneous Glade/Oak Forest Knobs (20 percent). Another 17 percent of the area is in the Current-Eleven Point Oak-Pine Woodland Dissected Plains, where the pine-oak/vaccinium community restoration work is taking place. The smallest LTA is the Current River Oak Forest Breaks, which makes up 14 percent of the area.

The study area is located on the southern portion of the Ranch. In 2004, area managers wrote a restoration plan for a portion of this area. This plan addressed different management ideas and concerns such as the lack of shortleaf pine on historical pine sites, the lack of good quality wildlife habitat, and the need to restore degraded natural communities. The Midco Pine Flats Restoration Area encompasses 2,223 acres of mostly high quality pine-oak/vaccinium restoration sites.

METHODS

The project is being conducted on Peck Ranch Management Compartments 10, 13, and 17. These three compartments have been further divided into 10 management units for planning and implementing monitoring activities. All 10 management units have had a salvage timber harvest carried out on them, leaving shortleaf pine for seed trees and about 20 feet2 of basal area per acre of white and post oak trees, when possible. The logging occurred between 1999 and 2003. Following logging, all stands were slashed to kill remaining suppressed oak and hickory trees. Since 2005, 568 acres (171,537 seedlings) have been planted to shortleaf pine on the study area. The next step is to control hardwood and herbaceous competition on the seedlings. Hardwood competition that is effectively managed can result in 40 percent volume increases on pine crop trees (Lowery 1986). Cain (1991) stated that even when an area has adequate numbers of pine seedlings, a rank ground cover of herbaceous species can reduce pine growth and may dictate the application of release treatments. The other nine management units were logged and artificial regeneration was used to supplement natural shortleaf pine regeneration. These latter nine units were subdivided into groups of three; one group received an additional treatment with prescribed fire, one group received herbicide release, and one group received mechanical release. One management unit was logged and follow-up slashing was conducted; the only shortleaf pine regeneration in this unit is that which occurs

naturally. Missouri Ozark Forest Ecosystem Project site number 8 is adjacent to the study area and is being used as a control; this area had previously been set aside as an unmanaged site.

In the herbicide release area a spot treatment method using Arsenal® AC and Escort® XP was used on 181 acres to release the shortleaf pine and preserve the herbaceous component. The application rate was 4 oz/100 gallons water for Escort® XP, and 1 oz /100 gallons of water for Arsenal® AC. All vegetation within a 6 foot radius of a shortleaf pine equal to or less than 4 inches diameter at breast height (DBH), was chemically treated. No chemical application was directly applied to any shortleaf pine trees or within the drip line of any residual tree equal to or greater than 10 inches DBH.

MONITORING AND EVALUATION

Vegetation

All 10 management units will be monitored to learn which technique works best and is the most cost effective. Our goal is to produce a pine stand with a diverse understory that will enhance wildlife habitats.

During the year following shortleaf pine seedling planting, a seedling survival inventory was implemented to determine how many planted seedlings survived after the initial planting. This inventory was conducted by establishing fixed 100th-acre plots throughout the area and counting the number of seedlings that survived within each plot.

To evaluate vegetative response, a fixed plot design is used for long-term data collection. In each of the 10 management units, three random points were placed within areas that were designated for restoration work. These points were used to establish 0.2-acre circular plots. Within each plot, all overstory trees are tagged and species and DBH are recorded.

Tenth-acre subplots consisting of the northeast and southwest plot quadrants are used for sampling pine seedlings and all saplings. For all non-pine species, we record species, height, and DBH. All pine saplings are tagged and the height and DBH are measured. For pine seedlings (< 4.5 ft height) we record height and basal diameter. Up to 60 seedlings are also tagged to track survival. Of the tagged seedlings, a sub-sample is selected to collect data on competition.

To track competition, a circular subplot of 3.5-foot radius is centered on a pine seedling. We then identify each woody plant to species and record the height. For dense shrub or vine species (*Rubus*, *Vaccinium*, *Vitis*, etc.) a stem count is recorded.

Twelve 1-m^2 quadrats are placed within the plot (three in each cardinal direction) to sample ground flora and ground cover. For ground cover, percent classes are used to measure the percent cover of bare ground, dead wood, litter, lichen, rock, and vegetation. Ground flora are identified to species and recorded in percent classes. For seedlings of any woody species, a stem count is also recorded.

Pretreatment data collection is under way and post-treatment data collection is scheduled to occur at 3-year intervals. In addition, we will continue to collect the same overstory, sapling, and ground flora data on 20 plots previously placed randomly according to the initial harvest areas.

Wildlife

The Peck Ranch Pine Management Zone Breeding Bird Survey (BBS) was patterned after the national BBS, but was modified to meet management objectives. The roadside survey has been conducted annually since 2000. The Pine Management BBS is conducted two to three times a year during the peak of nesting season, primarily in May and June. The route is 12 miles and encompasses all 10 management units. Twenty-five stops are located at 0.35- to 0.5-mile intervals along the route. Starting half an hour before sunrise, a five minute point count is conducted at each stop, during which the observer records all birds heard or seen. The objective of the Pine Management BBS is to monitor the composition and relative abundance of the songbird community within the management zone.

A northern bobwhite quail (*Colinus virginianus*) survey is also conducted within the management units. The roadside quail survey has been conducted since 2005 and is performed two to three times a year from June 15 to July 15. The quail survey consists of three routes, each of which is 7 miles long. Route 1 is located along the North Boundary Road and has 15 stopping points. Route 2 is located along Road 1 and has 14 stopping points. Route 3 is located along the South Boundary Road and has 13 stopping points. All stopping points are located at 0.35- to 0.5-mile intervals along each route. Starting half an hour before sunrise, a
5-minute point count is conducted at each stop, during which the observer records all quail heard or seen. The objective of the quail survey is to assess the relative abundance and spatial distribution of bobwhite quail.

RESULTS

Vegetation

During the summer of 2005, a pine survival survey was done on all areas that were planted on units 7-9. The pine seedlings that were planted on 12 x 12 foot spacing at a rate of 302 trees per acre averaged 40 percent survival overall (mean = 40, standard error ± 4.9). The lowest survival was on stand 27 on unit 8, which was only 23 percent. The highest survival was on stand 14 on unit 7, which was 60

percent survival. The expected survival rate before planting was 50 percent.

We are just now finishing data collection and data entry for the first season pre-treatment data on the treatment areas. So far it is too early to make any comparisons to show which treatment is working best.

Wildlife

The efforts to restore a unique natural community type have affected a suite of bird species. Over the past 6 years, the mean number of species detected on the route has increased from 30 birds to more than 40 birds, perhaps due to the influx of early-successional habitat species. Several early successional habitat species, such as the indigo bunting (*Passerina cyanea*), yellow-breasted chat (*Icteria virens*) and prairie warbler (*Dendroica discolor*), have shown evident increases (Fig. 1). The mean number of individuals per stop for the indigo bunting has increased from 1.24 in 2000 to 1.44 in 2006, while the yellow-breasted chat increased from 0.22 to 1.24 and the prairie warbler increased from 0.16 to 0.22. Mature-forest species, such as the eastern wood pewee (*Contopus virens*), which lives on ridge tops and has a moderate density, seem to have shown little population change, whereas the red-eyed vireo (*Vireo olivaceus*) has decreased in the mean number of individuals per stop from 1.38 to 0.92, perhaps due to the reduction in deciduous forest canopy. Target pine savanna species, such as the pine warbler (*Dendroica pinus*) and chipping sparrow (*Spizella passerine*), have also responded well to the management practices. The increase in the mean number of individuals per stop for each species from 2000 to 2006 is: pine warbler 0.78 to 1.08 and chipping sparrow 0.0 to 0.06. Other target species such as the yellow-throated warbler (*Dendroica dominica*) have kept a steady level with no significant increase or decrease.

We have only 2 years of data collection from the quail census. Although no quail have been recorded, it is too early to make any conclusions on abundance, spatial distribution, or to compare treatments.

DISCUSSION

The purpose of the study is to evaluate methods for restoring the shortleaf pine/oak/vaccinium natural community. In addition managers want to restore the forest communities that once existed on the site in order to enhance wildlife benefits and forest health. If oak is allowed to grow on historical pine sites, a manager can expect to have oak decline problems as the trees become older, particularly following droughts, and attacks by insects and pathogens.

Herbicide in combination with planting and natural tree regeneration is probably the best and most efficient way of regenerating trees. Success depends on the size of the area treated and type of application.

Prescribed fire accompanied with planting and natural tree regeneration is a technique that appears to work well for shortleaf pine as long as the trees reach a sufficient height before burning. Burning, however, may encourage a single-species stand of trees, which could create problems with insect infestation or disease outbreaks. Fire can enhance forbs and herbaceous vegetation, which in turn can lead to severe competition to the shortleaf pine seedlings.

Mechanical control in combination with planting and natural tree regeneration appears to be labor intensive. We located each tree and released a circle around it by cutting all the oak sprouts. Without herbicide, the oaks immediately sprouted back and within one growing season were again competing with the pine seedling. Managers have observed that in stands with many suppressed oak trees, delaying the slashing or cutting of these trees allows the pine seedlings time to get established. When pine seedlings were already established in the understory and the suppressed hardwood trees were cut, pine trees competed much better. In stands where very few pine seedlings were present and where the suppressed oak trees were immediately cut after logging, pine trees appeared to respond more slowly.

In the 10th unit the main factor affecting pine establishment is how much advance pine regeneration was present on the forest floor before logging took place. We have observed that where advance regeneration was located, pine trees are doing well. We have also observed that the herbaceous component is starting to diminish as the canopies start to close.

Many stands received a salvage harvest in which all shortleaf pine and 20 basal area of white and post oak trees were retained. We have observed an increase in many early successional species as a result of the sunlight reaching the forest floor. Quail, turkey, and many migratory birds use early successional grasses as nesting habitat, while forbs and legumes offer abundant food throughout the year. The variety of mature oaks provides mast crops to serve as high energy food for wild turkey, white-tailed deer, and squirrels. As some of these stands begin to have a more closed overstory, we are beginning to see a different suite of species favored, such as sedges, grasses, low shrubs, and wildflowers.

It is too early in the process to know which combinations of management techniques are going to work the best. Resource Science Division has only completed the initial layout of the plots and collected the baseline data. A literature review of published research suggests that, depending on the goal, each technique has its benefits and disadvantages. The role of the research is to determine the best technique to achieve our goal of restoring and managing the shortleaf pine-oak/vaccinium dry ultic woodland natural community.

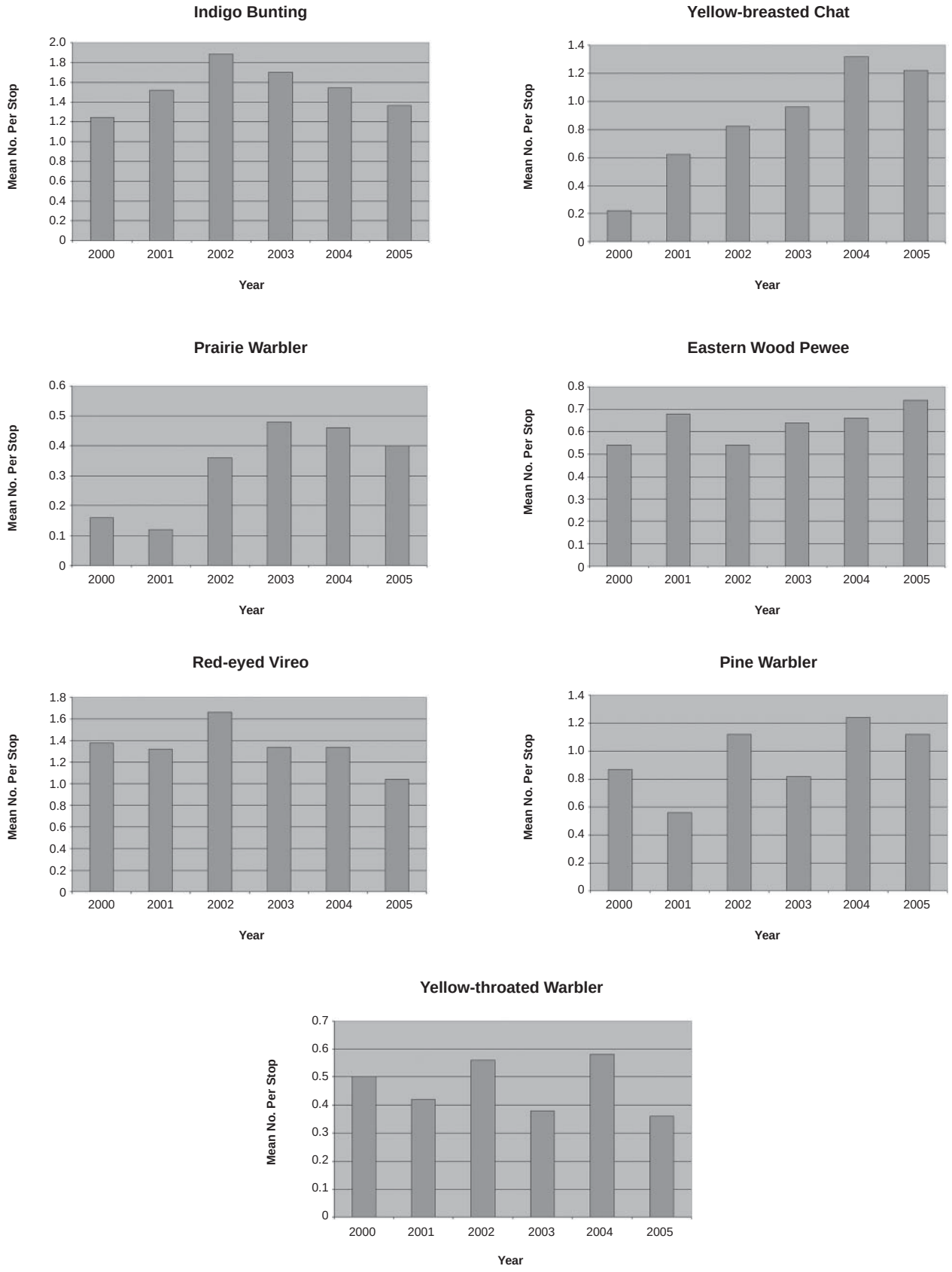

Figure 1.—Mean number of birds per stop from annual breeding bird surveys conducted in the restoration area.

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