Conserved Forest Ecosystems: Outreach and Research Cooperative (CFEOR)

Developing Adaptive Management Strategies for Ecosystems in Transition:
Year 2 Project Report
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Overview of Project Proposal

Introduction
Management of conserved forests must consider the sustainability of a variety of ecosystem products and values. Increasingly, uneven-aged forest management is considered an ideal strategy for maintaining ecosystem function and structure to ensure the sustained production of both commodity products and other ecosystems services including wildlife habitat, carbon sequestration, and recreational value. In forest ecosystems of the Southeast, in particular the longleaf pine dominant ecosystems, uneven-aged management is also considered to mimic natural disturbance processes (Brockway et al., 2006; Jose et al., 2006). For example, the group selection and the single-tree selection methods simulate mortality caused by lightning strikes or small insect outbreaks. The irregular shelter wood method represents circumstances where a partial stand is left following a catastrophic event, such as a hurricane. Despite the increased

desire to incorporate uneven-aged management on conserved forests, uneven-aged methods such as selection system have received much less scrutiny than even-aged methods, in general, because of their perceived lack of operational efficiency and, in southern forest types, because of a perceived inability of shade-intolerant species to regenerate under a partial overstory. Currently, a large proportion of conserved forests in the Southeast have an even-aged structure either due to historic fire suppression or due to conversion to plantations. In addition to research opportunities related to the proper restoration and management of uneven-aged longleaf pine ecosystems, there has also been growing interest in managing sites better-suited for slash pine using uneven-aged methods.

Purpose

To examine a range of uneven-aged reproduction methods with two different fire frequencies (reproduction matrix) in order to achieve a sustainable multifunctional ecosystem that can provide a number of commodity (timber production and carbon sequestration) and non-commodity (biodiversity enhancement and wildlife habitat quality, and recreational value) services.

Research Objectives

- Objective 1: Can the proposed uneven-aged management strategies (reproduction methods and fire regimes) lead to long-term sustainable longleaf/slash pine ecosystems in terms of species composition (both overstory and understory), structure and productivity (timber yield and carbon sequestration potential)?
- Objective 2: Can the proposed uneven-aged management strategies lead to long-term sustainable non-commodity benefits such as habitat value for RCW, and enhanced recreational opportunities?
- Objective 3: What would be the market and non-market value of commodities and services derived from multifunctional uneven-aged long leaf slash pine ecosystems?

Experimental Design

The principal site selected for this operational-scale research-demonstration study is Tate's Hell State Forest (THSF) located in Franklin County, FL, between the Apalachicola and Ochlockonee Rivers ($29^0$51'N, $84^0$51'W). This area was once a swampy mosaic of wet prairies, cypress sloughs, Atlantic White Cedar forests and other wetland and pine flatwoods communities. Near the coast, habitats also include fresh and saltwater marshes and sand pine scrub. Large-scale silvicultural operations and hydrological manipulations during 1960s through 1980s converted extensive areas of native habitats to slash pine plantation. The research stands for the present study at Tate's Hell State Forest (THSF) are embedded within three of these unthinned, intensively managed 32-33 year old slash pine plantation (Figure 1).

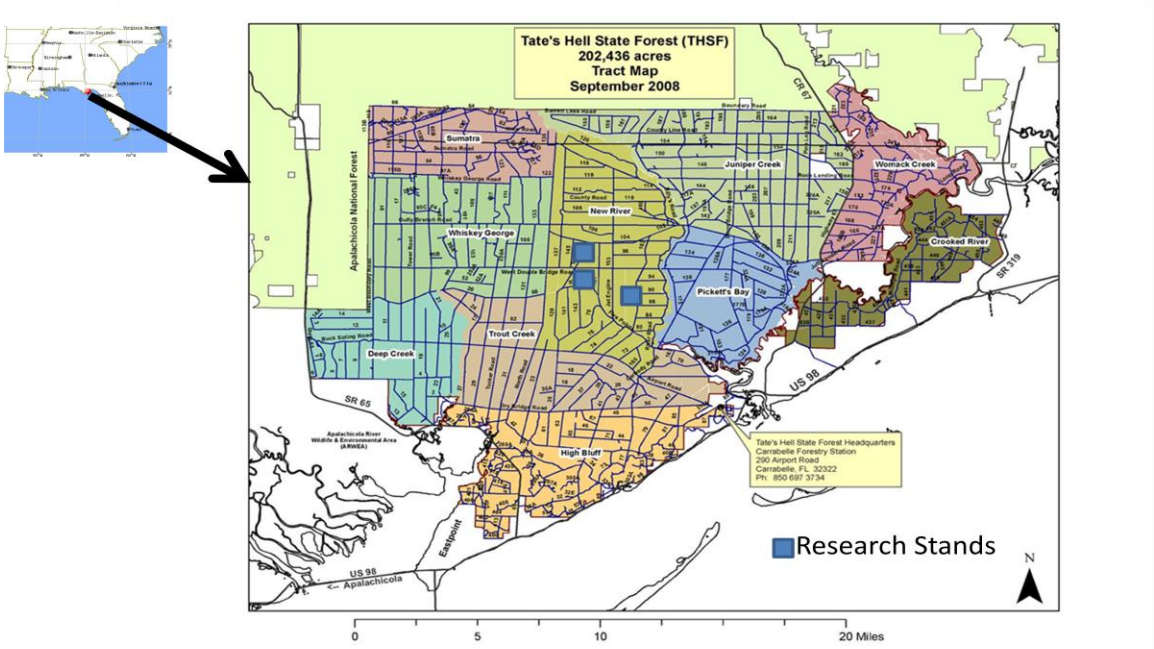

Figure 1. Location of the study site in Florida and the specific stand locations used for the 3 replications of each treatment within Tate's Hell State Forest.

The following six stand conversion options will be applied at each of the study sites.

(1) "Stutter-step" or Staggered row thinning; target residual basal area of 50 ft^2/ac in matrix
(2) Group selection: 0.25 to 2 acre gap openings; target residual basal area of 50 ft^2/ac in matrix
(3) Irregular shelterwood; target residual basal area of 30-40 ft^2/ac
(4) Leave 3 rows cut 2 rows; removes 40% of the basal area
(5) Third row thinning; removes 33% of the basal area
(6) Control-no tree harvest (prescribed fire only)

The study has been installed as a randomized complete block design. The 6 treatments (conversion felling methods and control) have been replicated 3 times n each block blocks for a total of 18 treatment plots. The treatment plots are of sufficient dimensions to qualify as true operational-scale applications (15.44 acre per plot). In each treatment plot, an internal grid network of 50 x 50 m spacing has been created and five subplots (25m x25m or 625 sq m) have been randomly established within each treatment plot, using the grid intersection points as geographic references. These subplots, called observation plots, serve as the principal areas for data collection.

The six treatments represent a range of traditional even-aged and uneven-aged silvicultural treatments which can be used to convert a stand from a plantation to an uneven-aged condition over time (and over several cutting cycles). Some treatments were modified from the original

proposal design to facilitate logging operations in these high density stands on wet, hydric soils. The stutter-step thinning replaced a traditional single-tree selection method of the proposal and will result in a checker-board removal of trees across the treatment plot. Additionally, the group selection treatment will create the traditional large gap openings, but thinning within the remainder matrix of the forest will begin with 3rd row thinning to facilitate the movement of logging equipment towards the designated gap locations. The irregular shelterwood method is a conversion process in which the residual seed tree overstory is never harvested, resulting at first in the development of a two-aged structure. This treatment is sometimes alternatively called "shelterwood with reserves".

Data Collection: Vegetation Sampling and Microenvironment
The forest vegetation variables that will be periodically measured and calculated are divided into overstory, midstory and understory layers. Pretreatment measurements are undertaken prior to applying the experimental treatments (i.e., initial overstory harvest) and post-treatment measurements will be taken each growing season following harvesting for up to 5 years.

Microenvironemntal variables will be measured on an hourly basis by installing weather stations equipped with PAR sensors, temperature and RH sensors, and soil moisture and soil temperature sensors in the experimental plots. The observations will be made for the duration of the study. Hemispherical photography will be employed to monitor canopy dynamics pre and post harvest treatments and its effect on light regimes in the experimental plots. The hemispherical photography will be conducted once in three years post harvesting.

An additional research study will also be embedded within the treatment plots to determine the site's suitability for either longleaf pine and/or slash pine regeneration. Longleaf pine seedlings will be planted within the gaps of the treatment plots and monitored along with slash pine regeneration. This study will be installed in winter 2010.

Project Activities- Year 1 (2008-2009) Summary
Three replicate study sites were identified at THSF, and locations and borders for six treatment plots were installed at each site. Using GPS mapping technologies a grid (50 x 50m spacing) was laid over each treatment plot and the locations of five observation plots were randomly selected at grid intersections. The observation plots are 25 x 25m in size and oriented in a north-south direction. Locations for the different sized gap openings in the group selection plots were randomly selected and recorded using GPS.

Starting in Spring 2009, collected baseline data on the observation plots to characterize pre-harvest stand conditions, including tree dbh and height as well as percent cover of ground vegetation and shrubs. Vegetation sampling and microenvironment data continued through June 2009.

CFEOR hosted a workshop on June 25, 2009 at THSF on Uneven-aged Management and the Proportional-B Method for Implementing Selection Silviculture, presented by Dr. Dale G. Brockway, Southern Research Station, USDA Forest Service and Edward F. Loewenstein, School of Forestry and Wildlife Sciences, Auburn University. The Pro-B method has already been implemented at Blackwater River and Goethe State Forests and could be used at Tate's Hell State Forest in future harvesting treatments. The workshop concluded with a discussion about considerations needed when converting intensively managed forests, and the THSF research sites were used as part of the workshop field demonstrations. There were approximately 23 people in attendance; most were land managers from the various state agencies in Florida.

Project Activities-Year 2

Final pre-treatment data collection of overstory and understory vegetation concluded in late Summer 2009, and pre-harvest density and basal area were calculated. These values were used to determine parameters for some of the "marking guides" for timber marking, including minimum diameters of trees to keep in the irregular shelterwood. Tree marking was completed by members of the CFEOR project as well as by DOF foresters at Tate's Hell (Figure 2), and paint was provided by DOF. Leave trees were only marked in the irregular shelterwood and at the boundary of the stutterstep treatment. It was agreed that tree marking for group selection would occur after thinning of the tree matrix in these treatment plots is complete.

Figure 2. Left- Ajay Sharma marks boundary trees in orange. Right- "leave" trees in the irregular shelterwood are marked in blue.

A timber contract for the sale of Gator Timber Stands (CFEOR project stands) in Tate's Hell State Forest was put up for bid by DOF in July-August 2009. Prime Energy Group was successful in buying the Gator Timber Sale in September 2010. Prime Energy is a reputed organization with skilled and experienced workers and has handled projects of similar nature in the past. It is highly motivated, supportive and enthusiastic about the CFEOR's signature project. The harvest was planned to start as soon as the bid was successful but wet conditions during the fall and winter presented some logistical issues that has delayed the beginning of harvest. DOF strictly enforces silvicultural Best Management Practices and the wet soil conditions could have resulted in severe rutting from logging equipment as well as possible water quality concerns.

Conditions have become more conducive for harvest operations lately as the moisture levels have fallen steadily over past few dry weeks. Dr. Kimberly Bohn, CFEOR coordinator Melissa Kreye, and doctoral student Ajay Sharma met with DOF and Prime Energy representatives in Carrabelle, FL, on May 26, 2010 for pre-harvest meeting and to assess the stand conditions for harvest operations. Prime Energy group plans to move forward with harvesting this summer of 2010. The research stands will be harvested first and harvesting should be completed by Fall 2010, contingent upon appropriate weather conditions.

Following harvesting, the gap planting of longleaf pine and slash pine seedlings will be carried out in the dormant planting season to determine the site's suitability for either longleaf pine and/or slash pine regeneration. The weather stations equipped with PAR sensors, temperature and RH sensors, and soil moisture and soil temperature sensors will be installed in the treatment plots to record environmental variables on hourly basis. The observations will be made for the duration of the study. The overall effects of different harvest methods on microclimate will then be assessed by comparing post harvest with control plot data. All these variables will be correlated with the growth and survival of slash pine and longleaf pine seedlings. If harvesting is completed by late June/early July, then immediate understory responses of groundcover will be measured in early Fall. Measurements of residual tree growth will begin in Summer 2011.

The delay in the harvest operations after the completion of pre-harvest data collection in August 2010 provided an opportunity for additional research studies in Tate's Hell State Forest as well as in Blackwater River Sate Forest and Goethe State Forest where projects of similar nature had been implemented in past. We studied canopy characteristics and understory light availability in research plots at THSF by the use of Digital Hemispherical Photography (Figure 3).

Figure 3. Left- Ajay Sharma takes a photograph of canopy conditions in the pre-harvest plots at Tate's Hell State Forest. Right- Example photograph used in the canopy light analysis.

The pre-harvest canopy has been characterized in term of Gap fraction, cover fraction, Leaf Area Index, Fraction of Absorbed Photosynthetically Active Radiation (fAPAR) as a function of stand parameters. These observations will be repeated at regular intervals (3 months) after the harvest to study the dynamics of stand canopy characteristics. The findings will have huge implications for developing uneven aged management strategies for the ecosystems in transition. The component studies at Blackwater River State Forest and Goethe State Forest were carried out in

research plots originally established by Dr Dale Brockway, USDA Forest Service. These plots are being managed under uneven-aged systems including Group Selection, Single Tree selection, Uniform Shelterwood, and Irregular Shelterwood systems. We studied how these different uneven aged management strategies affect understory light regimes in these ecosystems. The study revealed canopy light transmittance and understory light availability differs with respect to species, management system and practices, as well as proportional species composition in mixed stands. The findings have important implications for management of these ecosystems which are being managed using basal area regulation approach. The study suggests basal area-based management approaches need to account for light transmittance behavior of the constituent species so that optimum understory light regime could be created.

Results obtained and knowledge gained through various research activities funded by CFEOR were disseminated to wider audience through CFEOR newsletters and professional presentations at scientific meetings including National Conference on Ecosystem Restoration (NCER) in Los Angeles, CA on July 20-24, 2009, Society of American foresters (SAF) National Convention 2009 in Orlando, FL on September 30-October 4, 2009, SAF-SFRC Spring Symposium in Gainesville, Fl on June 2-3, 2010. An additional presentation will be made at Ecological Society of America (ESA) Annual Meeting 2010 in Pittsburg, PA on August1-5, 2010.

References

Brockway, D. G., Outcalt, K. W. and Boyer, William D., 2006. Chapter 4 Longleaf Pine Regeneration Ecology and Methods. The Longleaf Pine Ecosystem, 95-133.

Jose, S., Jokela, E.J., and Miller, D. L. 2006. The longleaf pine ecosystem: Ecology, Silviculture and Restoration. Springer Science, New York. 438 p.