

**TITLE:** Interactions Among Prescribed Fire, Mechanical Treatments, Insect Pests and Pathogens in Red Pine

**LOCATION:** Muskrat Lakes area (Michigan DNR land), Luce County, Michigan

**DURATION:** Year 2 of 3-year project

**FUNDING SOURCE:** Fire Plan

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**COOPERATORS:**

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Additional collaborators include Deborah McCullough, Associate Professor, Depts. of Entomology & Dept. of Forestry, Michigan State University and Donald Dickmann, Department of Forestry, Michigan State University.

**PROJECT OBJECTIVES:**

- 1) Determine the effects of fire and mechanical treatments, alone and in combination, on incidence and impact of forest insect pests and pathogens in mature red pine stands in the Lake States.
- 2) Document the effects of these treatments on forest vegetation and litter parameters, and relate these effects to the biology of forest pests.

We hypothesize that prescribed burning will decrease the incidence and impact of shoot blight pathogens and shoot and cone infesting beetles. However, mechanical treatments, alone or with fire, may increase the abundance and impact of scolytids, wood-borers, and root disease pathogens. Understanding the response of insects, pathogens and vegetation to fire and mechanical treatments is essential to the management of these organisms in red pine forests in which fire and mechanical tools are used to attain silvicultural and restoration goals.

**JUSTIFICATION:**

There is an overall decline in the red pine forest type of 50% across northern Michigan, with just 0.2% of the original circa 1800 dry-mesic forest type intact today (Bielecki et al. 2004). The fire regimes that produced and maintained great red and white pine stands in xeric and dry-mesic habitats in the Lake States typically involved frequent (20-40 yr interval) low to moderate intensity fires, with less frequent (100-300+ yr interval) high intensity stand replacing fires. However, since implementation of coordinated fire prevention and suppression activities in the 1920s, the pine-fire cycle has largely been broken. Prescribed fire or fire surrogate treatments (such as thinning) have been proposed to help restore red pine to a “healthier” condition. On National Forests and state-owned lands in Michigan, prescribed fires in mature red pine are increasingly being used for fuels reduction and vegetation manipulation. However, there is very little information on how this change in management will affect populations and impacts of insect pests and pathogens.

FHM offplot survey data reported in the annual Forest Health Highlights has shown an increase in the frequency and intensity of damage to red pine by shoot blight pathogens, particularly *Sphaeropsis sapinea*. Cone and shoot damage to red pine by cone beetles has also been

identified as an emerging problem. European pine shoot beetle has also recently become established in Michigan and much of the northeastern region, and the potential of fire to reduce population levels is unknown. The benefits of prescribed fire to managing these pests, however, could be offset by increased vulnerability of residual trees to bark beetles, wood-borers or root-feeding weevils. (A more thorough discussion of the potential affects of fire on pests is included in our original proposal).

Clearly there is a need for more information on how fire and pests interact in the Lake States. Item Ci in the National Fire Plan identified the knowledge gap regarding interactions of fire, pathogens and insect pests, and invasive species. However, of the 63 projects that the NFP funded at \$26 million in 2001, none are addressing the ecological impact/role of fire in pine ecosystems in the Lake States or the interaction of fire, pests, and invasive species. In addition the USDA/USDI Joint Fire Science Program's Fire/Fire Surrogate study network does not have any sites in pine ecosystems of the North Central or Northeastern US. This project addresses several aspects of the fire plan issues within "rehabilitation and restoration" and "hazardous fuel reduction" categories, including ecological impacts of prescribed fire when used for fuels reduction, interaction of fire with pests and invasive species, restoration of fire-damaged ecosystems and use of fire to restore ecosystems.

**DESCRIPTION:**

**a. Background:**

The current FHM-EM (fire) project was funded in 2004, and treatment installation was initiated on state-owned lands at Muskrat Lakes, Luce County, MI. The continued work proposed will complete treatment installation and initiate post treatment data collection for a fire and mechanical treatment. In addition, further data collection will occur at a field site in Munising, MI established in 1997 in a 400 acre red pine stand on the Hiawatha National Forest, which was partially prescribed burned in 1998 and 2000.

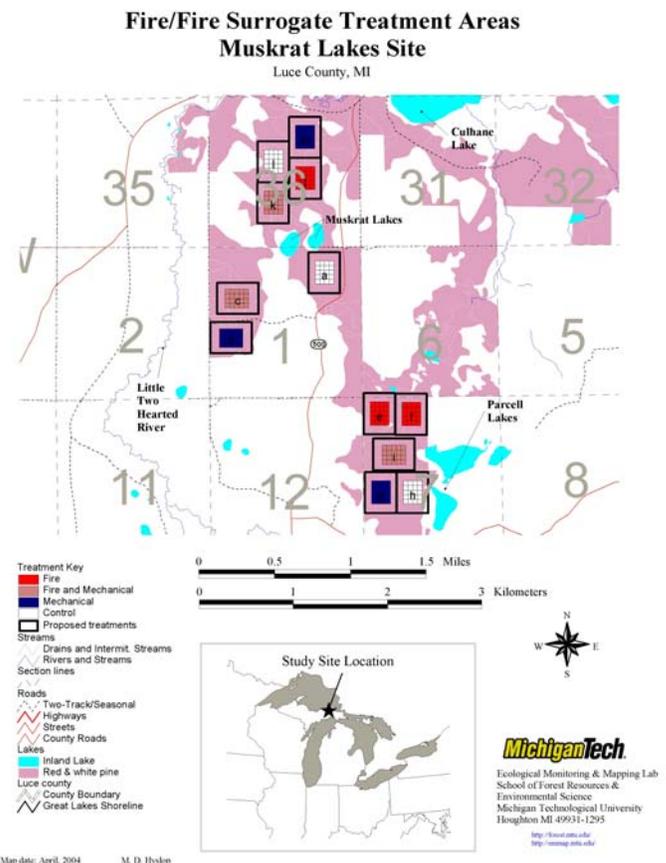
**b. Methods:**

**Study site and treatments:** Twelve treatment areas of approximately 17 hectares (see map) each have been divided into 3 blocks based upon predominant species composition. The treatments to be applied in Fall 2004 through Summer 2005 are:

1. Untreated control - No cutting or burning will take place in these blocks.
2. Prescribed fire only - No trees will be harvested in these blocks. A spring/summer burn will be prescribed to coincide with treatments described below.
3. Thin the stand to reduce canopy closure using a cut to length system.
4. Thin the stand to reduce canopy closure using a cut to length system followed by prescribed fire.

The USDA Forest Service will collaborate with the Michigan Department of Natural Resources in the fire treatments as part of prescribed fire training programs.

**Data collection:** Data collection for 2005 will build on the substantial pretreatment dataset



collected in 2004 (see progress in Section e below). Prior to burning, fuels will be assessed using triangles of transects within the treatment areas. After the burns we will determine the short term responses to the fire treatments and harvesting treatments by revisiting all plot centers and collecting overstory and understory vegetation data, post burn fuels data, and forest health (shoot blights, cone beetles, bark beetles) data. Spore traps (Vaseline-coated slides) will be installed throughout the field season to assess levels of spores of the major shoot pathogens. This data collection will enable us to accurately describe the effects of our treatments, and form the baseline for longer term monitoring of the stands. All trees in each treatment area will be assessed for beetle activity by conducting 360 degree scans from each plot center and recording trees with discolored crowns or thin crowns. Trees exhibiting these symptoms will be visited to determine the cause of decline. We will continue to utilize FFS methodology where appropriate in order to increase opportunities to compare this study with FFS studies in other parts of the country.

**Data analysis:** The significance of the treatments will be tested using parametric and nonparametric statistics. Linear, multiple and logistic regression and multivariate analyses will be used to evaluate relationships among vegetation, insect and pathogen variables.

**c. Products:** Results will be incorporated into recommendations that enable managers to make more informed decisions about how prescribed fire may alleviate or exacerbate specific pest problems. We will provide this information to end-users in leaflets, extension bulletins and web sites (e.g. USFS FHP web site in St. Paul). We will make our raw data available after publication of our results so that groups conducting meta-analyses of data from these types of studies can utilize it. We are registering the web domain muskratlakes.org for this purpose. Our results and recommendations will be presented at state and regional meetings of federal, state and private forest managers and landowners, and presented at FHM working group meetings. We will also document results in technical reports and scientific publications.

**d. Schedule of Activities:**

2004	Finalize study plan, collect baseline data, mark mechanical treatments, test sampling methods. Initiate mechanical treatments. Poster at FHM working group meeting.
2005	Collect pre- and post-burning fuels data. Apply prescribed burn treatments in spring/summer. Re-assess vegetation and forest health post treatment. Poster at FHM working group meeting. Presentation at NCFPW.
2006	Continue post treatment data collection. Data analysis. Publish results; develop and report management information, FHM report, and FHM fact sheet.

**e. Progress/Accomplishments:**

**Muskrat Lakes:** In 2004, a field crew of two visited all 240 plot centers across the 12 treatment areas three times during the 2004 field season, and data were collected on each occasion, timing the collection of each dataset for an optimal period during the growing season. The species, dbh, total height, height to complete live crown and height to any live crown was measured for all trees in the plots, and all within plot trees were marked with numbered aluminum tags. A total of 5352 trees (mean 22.3 per plot) were measured. Of these 54.2% were red pine, 16.0% were white pine, 11.3% jack pine and 8.9% red oak. Other species each made up less than 5% of the stems over 3 inch DBH. For red pine, the mean DBH was 11.3 inches, mean height was 49 feet, height to continuous live crown 35 feet and height to first live crown was 22 feet. On a second visit to plot centers, understory vegetation was assessed, and densiometer measurements estimated canopy cover. Percent cover of each vegetation type was assessed in 10% categories in all 1/10 acre plots. In all plots, four randomly placed 1m quadrats had percent cover by species and number of individuals recorded. On the third visit, tree health was assessed for all trees in the plot. In addition, spore traps (four per treatment area) and pitfall traps (ten per treatment area) were operated in all treatment areas for one week out of every four for a total of four rounds of data collection. In the

June round of spore trapping, a mean of 1.8 *Sirococcus* spores were found on each slide, and in the July round, 5.3 spores of this species were found per slide. The number of *Sphaeropsis* spores per slide was below one for each sampling period. The second two sets of samples (Late July and August) are still to be processed. Data entry into excel spreadsheets is ongoing, and will be summarized for the Forest Health Monitoring Working Group meeting. The treatment area perimeters have been marked in preparation for the thinning operation in fall 2004 and spring 2005. Timelines for treatment installation beginning in Fall 2004 have been worked out with MI DNR personnel.

The Fire Learning Network held a meeting in Marquette, MI and included a field trip to the Muskrat Lakes site with presentations by Andrew Storer, and Les Homan of the Michigan DNR.

**Munising Site:** Fourteen permanent plots were established in a mature red pine stand in September 1997. Four plots were prescribed-burned in spring 1998, an additional 5 plots were burned in spring 2000, and 5 plots remained unburned. In June 2004 we located and re-marked all 14 plots and re-measured plot data (including crown density and understory vegetation) and tree data (including diameter and height to live crown). This set of plots provides an interesting comparison to the Muskrat Lakes site by representing a longer study period, a different habitat type, and a different season of burn. It also has provided an opportunity to test and refine various sampling methods.

**COSTS:**

The 2005 funding request is \$35,406. Total project funding request for 3 years is approximately \$105,000.

	Item	2004			2005			2006		
		FHM EM-Fire Funding	Other- Source Funding	Source	Requested FHM EM-Fire Funding	Requested Other- Source Funding	Source	Projected FHM EM-Fire Funding	Projected Other- Source Funding	Source
<b>Administration</b>	Salary MTU	19,218	7,506	MTU	20,179	7,881	MTU	21,189	8,276	MTU
	Salary FS	4,000	4,000	FS	3,000	2,000	FS	3,000	2,000	FS
	Overhead (MTU, 15%)	3,933	9,438	MTU	3,927	9,424	MTU	3,778	9,068	MTU
	Travel MTU	5,000			5000			3500		
	Travel FS	1,000			2000			1400		
<b>Procurements</b>	Contracting									
	Equipment									
	Supplies MTU	2,000			1000			500		
	Supplies (FS)	1,000			300			200		
	<b>Total</b>	<b>\$36,151</b>	20,944		35,406	19,305		33,567	19,344	

**Appendix 1:  
Literature Cited in Proposal  
and other supporting references**

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