

TITLE: Developing a damage threshold for dwarf mistletoe infested spruce stands

LOCATION: Northern Minnesota

DURATION: Year 1 of 2-year project **FUNDING SOURCE:** Base

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COOPERATORS:

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PROJECT OBJECTIVES: Using FIA and FHM plot information as a starting point, we will implement GPS-based surveys in infested stands. These data will then be used in a spatial model to project future disease losses. Projection results will be provided to forest managers and policy makers so they can make informed decisions about management in infested stands.

JUSTIFICATION: FIA and FHM data indicate the presence of dwarf mistletoe, but provide no information about future disease losses. Dwarf mistletoe affects a significant portion of black spruce stands in the Lake States, causing mortality and eliminating the spruce from sites where few other commercial forest species can grow. To fully understand dwarf mistletoe impacts, forest managers must be able to relate current infestations to losses that will occur at rotation age. This project will implement new survey and impact projection tools to provide information about this relationship to policy-makers, who can determine a threshold for implementing these surveys and/or disease management.

DESCRIPTION:

a. Background: The black spruce dwarf mistletoe *Arceuthobium pusillum* is the most important cause of mortality in black spruce stands. This parasite spreads laterally through stands at about 2.4 ft per year, killing trees in as little as 10 years. Using sequential aerial photography, mortality centers enlarged at almost twice that rate, 4.7 ft per year. In 1949 Anderson estimated 3-11% of the black spruce type in a sample in Koochiching County was out of production due to dwarf mistletoe infestation. Anderson was certain of dwarf mistletoe in 3%, considered another 16% as probably infested, and added half of the questionable area to his estimate. Elsewhere, however, he states that "in only a very few cases did the area fail to be infected when ground checked (Anderson 1949 p 19). Thus, his estimate could range as high as 18% of the area infested.

A 1976 survey of national forests in the Lake States found dwarf mistletoe on 15% of the area surveyed (Anderson and Mosher 1976). Anderson and Mosher (1977) reported that dwarf mistletoe was present on approximately 60% of the survey sample with spruce on six national forests. With 1.5 million acres of commercial black spruce forest in Minnesota, and 2.2 million acres in the Lake States, dwarf mistletoe is an important pest. Today we would expect at least as much, if not more of the black spruce type to be infested because dwarf mistletoe free stands are harvested preferentially to infested stands. FIA data show about 5% of the plots have dwarf

mistletoe on them, and 7% have brooms. In 1999 Forest Health Monitoring found the spruce/fir type had the third highest mortality rate (3.7%) behind only beeches and elms (<http://www.na.fs.fed.us/spfo/fhm/results/1999/nc/amsg.htm> viewed 9/11/03).

Most of the monitoring discussed so far has been done from aerial surveys. Mortality creates openings in the crown canopy, which are observed on the aerial photograph. Openings and changes in the texture of the crown canopy are often difficult to detect in stands younger than 60 years. Thus, we know very little about dwarf mistletoe in younger stands, and how it will affect stands in future years. In one stand 36 years after harvesting, dwarf mistletoe has increased from 16 trees per acre to 170 trees per acre, but is only now beginning to kill significant numbers of trees. Yet, when losses are projected to rotation, (Baker et al. 1980), at least 30% of the stand volume will be lost. This loss projection model model has recently been adapted for use in ArcView, and GPS-based survey techniques have been developed for sampling infested stands.

Dwarf mistletoe impacts are a function of the initial distribution of dwarf mistletoe-infected residuals, and the time to rotation. We propose to use GPS-based dwarf mistletoe surveys in infested stands with FIA and FHM plots, and project disease impacts with the ArcView model. We will focus on young and immature stands, stands < 70 years old, as it is in these stands that dwarf mistletoe will have its greatest impacts. Additional stands will be sampled to provide at least 10 stands in each 10 year age class. We emphasize that we will not develop an "action threshold." Rather, we will provide the disease impact information that managers and policy-makers would need as they consider alternatives.

b. Methods: Dwarf mistletoe infested stands will be identified from the FIA and FHM databases. Stands on state or federal land will be visited in July or August, or in December (stands < 30 years old) when snow will not hide infected trees. Older stands can be examined any time they can be accessed. Transect lines will be run 75 feet apart through the stands, recording (attributing) the presence or absence of dwarf mistletoe within 15 feet of the line on a gps unit. The stand boundary will be located with the gps unit, or we will use the shape file for the stand obtained from the MDNR. Age, site quality and stand density will be obtained from existing data sources (MDNR) or collected in the field. The dwarf mistletoe infestation and resulting yield losses will be projected to an appropriate rotation age. These data will be shared with appropriate policy makers.

Although we have validated the loss projection model, another way of examining model credibility would be to examine mortality rates of spruce on FIA plots, and compare them with model estimates.

c. Products: GPS - based survey protocols will be adapted for use in the Lake States Disease projection tool (in ArcView) will be modified and made available to cooperating agencies

The use of these tools will be evaluated by the agencies who might use them.

Should they be useful, users guides will be prepared for publication.

Results of the analysis of relationships between yield loss, stand conditions and current infestation will be published in appropriate scientific journals. Cooperators will work with their agencies to inform policy makers of significant results.

d. Schedule of Activities:

July 2004 Project Initiation; Identify infested stands from FIA and FHM databases;

Locate infested stands on state and public lands

Note: some of this work will begin when project is approved, before July.

mid- July - August Begin field work

Share survey and projection tools with cooperators for their evaluation

December- January Visit field sites with difficult access

September -May Collate simulations; preliminary data analysis; identify stands for survey in year 2; modify survey and projection tools

July-August 2005 Survey stands

December - January Visit field sites with difficult access

September - May Complete data analysis and modification of survey and projection tools.

June Prepare and submit final report and other manuscripts

e. Progress/Accomplishments: n/a**COSTS:**

| | Item | Requested FHM EM Funding | Other-Source Funding | Source |
|---------------|-----------------------|-------------------------------------|---------------------------------|---------------|
| YEAR 1 | | | | |
| | Administration | | | |
| | Salary & fringe | 21,294 | 8,460 | USU |
| | Overhead (39%) | 0 | 13,960 | USU |
| | Travel | 11,000 | | |
| | Procurements | | | |
| | Contracting | 1,500 | | |
| | Equipment | 2,000 | | |
| | Supplies | 0 | 500 | USU |
| TOTAL | | 35,794 | 22,920 | |
| Year 2 Budget | | 35,858 | | |

Budget explanation:

Salary for 2 student crew during summer and 4 weeks during winter (field work), and 150 hours during classes (data analysis, mapping plot locations, etc

Travel (per diem) for crew and PI from a central site in northern Minnesota, vehicle rental

Equipment: laptop computer for field use; gps units, chargers, cell phone, etc.