Special Technology Development Program
Progress Report

PROJECT NUMBER: R5-00-01

PROJECT TITLE: Improved Spread and Intensification of the Dwarf Mistletoe Impact Model, an extension of the Forest Vegetation Simulator (FVS)

PROJECT STATUS: Continuing

EXPECTED PROJECT DURATION (total years for project)**:** Two years

EXPECTED COMPLETION DATE OF THE PROJECT (fiscal year): End of FY2001

SUBJECT: Planning and Public Information, Disease Management, Modelling, dwarf mistletoe

STATUS OF SUBJECT SPECIES: native, noxious

PROJECT OBJECTIVES: Improve the capability of, even-aged and understory components, of the non-spatial spread and intensification module of the Dwarf Mistletoe Impact Model (DMIM) of the Forest Vegetation Simulator to accurately predict the spread and intensification of dwarf mistletoe for a variety of species.

BRIEF DESCRIPTION OF THE PROJECT:

The Dwarf Mistletoe Impact Model (Hawksworth and others 1995) used to project mistletoe spread and intensification for the Forest Vegetation Simulator will be repaired to describe mistletoe dynamics in various stand types. Model performance in terms of spread and intensification will be assessed by comparison to the behavior of these indicators observed in long-term field studies. Relationships will be developed and validated for true fir in California; ponderosa pine in Oregon, Colorado, and Arizona; lodgepole pine in Idaho, Wyoming and Colorado; and western larch in Montana (Hawksworth and Marsden 1990). A model form (Maffei and others 1999) will be used that accounts for differential rates of spread and intensification in trees of different sizes and stands of various vertical structures. Changes by size class in percent of trees infected and DMR (Hawksworth 1977) will be used to describe spread and intensification for each observation period of each field plot. (The number and length of periods vary by field study but most include at least several 5–10 year periods.) The final report will include sections describing observed mistletoe spread and intensification in the field studies (table, graphs, and summary equations) and analyzing model behavior in terms of sensitivity and goodness-of-fit (Chen and others 1993, Smith and Rose 1995).

Stage 1. Assemble data into a common format. Information from many different series of long-term, fixed area plots will be compiled into a common, documented database (FSVeg). Data will be provided by Region 1 (Taylor) for western larch, by Region 2 and RMRS (Geils) for lodgepole pine and ponderosa pine, from Region 3 (Fairweather) and RMRS (Geils) for ponderosa pine, from Region 4 (Hoffman) for lodgepole pine, from Region 5 (Frankel) for true fir, and from Region 6 (Goheen) for ponderosa pine.

FY2000:

Database construction and population was to be accomplished by FHTET (Adams) before January 31, 2000. Because of the complexity of the data and revision of the FSVeg structure, this activity became the primary activity accomplished by Geils from February to April, 2000. This work required assistance from all the cooperators and the WOD staff involved in FSVeg and FVS development. Programs to input and extract data from FSVeg were written by Glen Brink. These data were input into FSVeg and output as files which serve as input to FVS. We have, however, learned that several modifications would more completely and honestly represent the observations as data in FSVeg and better correspond with FVS model assumptions. Therefore, the FSVeg tables for these datasets should be re-generated (a minor exercise compared to that of developing the adaptive system we now have).

The available, historic data were collected for diverse purposes and using various methods, not necessarily those for which FSVeg was designed. Although FSVeg is sufficiently robust to accommodate these data, considerable familiarity was required with field procedures, the FSVeg structure, the FVS model, and modeling mistletoe spread and intensification. The basic issues were what population do the sampled trees represent and

what is the proper sampling weight for each tree (errors interpreting these seriously jeopardize the validity of using a dataset for the intended purpose). We found it was necessary to screen and re-structure data into a spreadsheet format; the number and design of individual spreadsheets varied by data source. These spreadsheets were a useful interface for describing how to interpret the original data into FSVeg tables and records which would correctly translate into FVS stand and tree variables. Although FSVeg, an Oracle database application, is a large and complex system, it provides an excellent tool for documenting, achieving, and sharing these data. For fitting relationships to model change in tree DMR over time, however, the FVS tree list file (and stand header file) provides the necessary information in a more efficient format for statistical analysis.

Stage 2. Prepare data summaries. Tables and graphs will be constructed for each plot describing host and mistletoe dynamics by species, size class, and observation period. Descriptors will include trees per acre, basal area per acre, percent infected, DMR, and other selected indicators. Although these tables will be directly computed from the observed data, the tables will be formatted to resemble output from the FVS/DMIM. Graphs will illustrate time trends of observed behavior and projections using the DMIM. These summaries will be used to determine how data are pooled and allocated for further analysis and subsequent validation.

FY2000:

Although the summaries were to have been prepared by Geils in February 2000 and soon afterwards reviewed by the cooperators, progress on this stage was delayed by the need to compile the data (see discussion for Stage 1.). Nonetheless, significant progress was achieved from March to April 2000 by Geils and David in designing filing structures, common definitions, and procedures for processing, summarizing, and distributing the FVS simulations and summaries. This work plan describes these structures, definitions, and procedures in detail.

Although we will need to modify these structures, definitions, and procedures as we proceed with preparation of the summaries, we have done some testing and feel confident the system will work. During that preliminary development, it was very helpful to be able to personally visit and interact with WOD staff, especially FHTET and its contractors (rather than rely on phone and email). The detail assignment for Geils provided a good opportunity to focus on this work; the downsides are added expense for temporary housing and need to twice move an office. One set of difficulties we encountered was related to the corporate computing environment, for example setting up an FTP-site for users with different servers. Hopefully, these administrative and technological barriers will lower as the USDA/FS network matures.

Stage 3. Characterize mistletoe spread and intensification. Statistical analysis will describe the change in DMR class distribution by decade for various initial conditions (DMR, tree size, and other significant factors). The strategy agreed to at the Tucson work meeting will be used (general approaches described by Geils and Mathiasen 1990 and by Maffei and others 1999). We will attempt to use a common regression model across studies so that species differences are reflected in model coefficients and can be compared. Where differences between species or regions are not epidemiologically important, data will be pooled. Analysis results including confidence estimates and residual analysis will be presented to the cooperators for review and comment before proceeding to the next stage.

FY2000:

Statistical analysis was to be conducted by Geils during March and presented to the cooperators at a workshop in April. The April workshop was cancelled, analysis was postponed because summaries were not complete and summaries were not complete because additional time was required to prepare the data.

Stage 4. Revise model code. A revision of the DMIM will be constructed in a manner similar to the Understory Spread and Intensification Enhancement but using the relationships derived in the previous stage. Work will be conducted by FHTET (Adams) and include testing for proper interface to FVS and required debugging.

FY2000:

Although no work on this stage was expected before completion of Stage 3, David did review the DMIM code and cleaned up several problems in spring 2000.

Stage 5. Validate revised DMIM. Comparisons of model output (changes in percent infected and average DMR by size class) will be prepared by Geils (April). In addition to the graphs similar to those prepared in the first stage, model performance will be evaluated with statistical techniques such as described by Smith and Rose (1995) and Frankel and others (1998). Cooperators will provide input as to the magnitude of difference between observation and prediction which is acceptable from a management perspective. Comparisons will be made for the model to reserved data (for statistical purposes) and for the model and each study (for evaluation purposes). If the revised DMIM is acceptable to the cooperators, it will replace the former version.

FY2000:

No activity planned for 2000.

Stage 6. Report results and make recommendations. Three reports will be prepared to document this project. FHTET (Adams) will write an amended users guide for the revised model; upon satisfactory review by the cooperators, it will be released in 2000 as an FHTET publication. Geils will lead drafting a General Technical Report with all the cooperators as co-authors; the GTR will contain detailed descriptions of source data, analysis, and validation results (to be published in 2001). Frankel, Geils, and Maffei will also prepare a journal article (suggested outlet Western Journal of Applied Forestry) that briefly describes the problem, approach, results, and significance to forest management.

FY2000:

No activity planned for 2000.

CHANGES TO ORIGINAL PROJECT SCOPE OR OBJECTIVES:

Although we intend to keep the original scope (regions, tree–mistletoe combinations, FVS variants, etc) and original objectives (improved DMIM), the continued addition of other new tasks outside this work means that the time-frame for this project will have to be extended.

ADDITIONS TO ORIGINAL PROJECT SCOPE OR OBJECTIVES:

Populate FSVeg with historic, long-term, repeat-measured mistletoe data. When we prepared the original proposal, we did not know when FSVeg would be available for use and other important details about its structure and use. Therefore, we proposed using a simpler application program (MS Access) which would provide a common data format and documentation but not the archive and distribution functions only available from a corporate database. Although this addition may have increased the time and difficulty of Stage 1, it will ultimately provide a better set of benchmark stands for validating this and later improvements to the DMIM.

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COOPERATOR INVOLVEMENT:

This information is included within BRIEF DESCRIPTION OF PROJECT text for the six Stages.

PRODUCTS AND DUE DATES:

A revised Dwarf Mistletoe Model Extension provided to FHTET and the FVS Forest Management Service Center for distribution with FVS variants over the world wide web.

An amendment to the Dwarf Mistletoe Model Users Guide to document model changes and their rationale. The changes would be included in the basic FVS training provided annually in each Western region.

The model validation results will be published as a scientific paper in the Western Journal of Applied Forestry.

STATUS OF PRODUCTS/PRESENTATIONS:

The time required for data preparation has delayed progress, but emphasis will be placed on accelerating this project during FY2001.

ACCOMPLISHMENTS TO DATE:

Products:

A detailed work plan which describes file structures, common definitions, and procedures to be used for compiling data and preparing stand summaries.

Data from the sources listed in Table 1 are entered into FSVeg (identified in FSVeg by a value of "DM" for field PURPOSE_CODE. Each stand and year combination is represented in FSVEG as a "setting" or set of tables describing location, sample design, tree, and damages).

Table 1. Data sources for modeling mistletoe spread and intensification.

Location	Project	Host	Mistletoe	Data From	Years	Stands
Northern Idaho	Flathead	WL	LDM	NR	1991–96	2
Northern Idaho	Colville	PP	WDM	PNW*	1982–87–92	7
Central Rockies	Manitou	PP	SWDM	RMRS	1972–84	2
Central Rockies	FrontRange	PP	SWDM	RMRS	1978–85–91–99	22
Central Rockies	NorthPark	LP	LPPDM	RMRS	1965–70–75–81–86–91	13
Central Rockies	GrandCanyon	PP	SWDM	RMRS	To be completed	
Tetons	Targhee	LP	LPPDM	INT	1983–88–93–98	5
Northern California	Klamath	WF	WFDM	PSW	1981–95	12
Northern California	RogueRiver	PP	WDM	PNW*	1982–87	4
SORNEC	LassenLatour	RF	RFDM	PSW	1981–95	11
SORNEC	SouthernOregon	PP	WDM	PNW*	1980–85–90	32
					1980–85–91	4
					1981–86–91	24
					1982–87–92	18
					1982–87	3
					1983–88–93	8
Westside Sierra	Sierra	RF	RFDM	PSW	1981–95	9
Eastside Cascades	Cascades	PP	WDM	PNW*	1982–87–92	4
					1981–86–92	3
Blue Mountains	BlueMts	PP	WDM	PNW*	1980–85–90	3
					1982–87–92	15
					1982–87	9
					1983–88–93	5

Table 1. Data sources for modeling mistletoe spread and intensification.

Location	Project	Host	Mistletoe	Data From	Years	Stands

Location identifies a geographic origin of data, grouping by FVS variants.
Host names are FVS species codes; mistletoe are common abbreviations.
Data from NR provided by Taylor; from RMRS by Geils; from INT by Hoffman; from PSW by Frankel: and from PNW by Goheen.
*Due to the complex re-measurement regime, original field data from the PNW are grouped by observation pattern (years) rather than by project for the purpose of loading data into FSVeg.

Publications: N/A

Technology Transfer: N/A

FIRST FISCAL YEAR FUNDED: FY2000.

FUNDS OBLIGATED FROM BEGINNING OF PROJECT THROUGH CURRENT FISCAL YEAR:

	Item	Requested Funding	Expended Funding	Unused Funding
FIRST YEAR				
Administration	Salary	$36,000	$36,000	
	Overhead	$ 4,500	$ 4,500	
	Travel	$ 4,500	$ 4,500	
Procurements	Contracting			
	Equipment			
	Supplies			
Year Totals		$45,000	$45,000	-0-
SECOND YEAR				
Administration	Salary			
	Overhead	$ 4,500		
	Travel	$ 4,500		
Procurements	Contracting	$36,000		
	Equipment			
	Supplies			
Year Totals				
CURRENT YEAR		**Requested FHP STDP Funding**	**Other Source Funding**	**Source**
Administration	Salary			
	Overhead	$ 4,500		
	Travel	$ 4,500		
Procurements	Contracting	$36,000		
	Equipment			
	Supplies			
Year Totals		$45,000		
PROJECT TOTALS		$45,000		

FUNDS NOT USED FROM PREVIOUS FISCAL YEAR: N/A

Fiscal Year	STDP Funding Allocated	Funds Obligated	Funds Unused

EXPECTED BUDGET FOR NEXT FISCAL YEAR : N/A

	Item	Requested FHP STDP Funding	Other-Source Funding	Source
Administration	Salary			
	Overhead			
	Travel			
Procurements	Contracting			
	Equipment			
	Supplies			
Totals				

DIFFERENCE BETWEEN ORIGINAL AND AMENDED REQUESTS AND JUSTIFICATION (the difference between originally requested funds and funds needed based on changes in the budget or scope of the project)**: N/A**

STDP FUNDING NEEDED:

Total estimated additional future funding needed beyond the current fiscal year: ***N/A***

Estimated STDP funding needed in remaining year(s) of the project by fiscal year. Show separately the funding to be requested/provided from other sources (extend the table as necessary). ***N/A***

Fiscal Year	STDP Funding	Other-Source Funding	Source