Special Technology Development Program

New Project Proposal

PROJECT NUMBER: NA-2002-03

PROJECT TITLE: Developing habitat-type-based gypsy moth silvicultural guidelines for Wisconsin forests

PROJECT STATUS: New

EXPECTED PROJECT DURATION: 3 years

EXPECTED COMPLETION DATE OF THE PROJECT: FY2004 for installation. Monitoring would continue using state dollars and NE research dollars for an indefinite period of time.

SUBJECT:

1. Suppression/Prevention Technology	%		3. Assessment Technology	%	
c. Genetic, Cultural, and Silvicultural Innovations For Controlling Pest Species			d. Decision Support % Risk and Hazard %	**30**	**%**
iii. Thinning/Regeneration Techniques and other Silvicultural Guidelines %	**60**	**%**	5. Technology Transfer Innovations	**10**	**%**

STATUS OF SUBJECT SPECIES: non-native invasive

PROJECT OBJECTIVES:

1) Test the effectiveness of silvicultural treatments in reducing gypsy moth impacts.
2) Test the effectiveness of habitat types in predicting both the response of silvicultural treatment effectiveness (Objective 1) and gypsy moth impacts on forested ecosystems.
3) Modify existing silvicultural guidelines based on the results of Objectives 1 and 2.
4) Demonstrate the value and effectiveness of silvicultural treatments for gypsy moth to various forest landowners and publics.

BRIEF DESCRIPTION OF PROJECT: The project will use the existing habitat typing system in Wisconsin as the basis for selecting stands to be treated silviculturally using existing guidelines. A paired stand approach will be used with one stand of each pair receiving a silvicultural treatment and one stand remaining untreated. Stand pairs will be replicated both within and across the habitat types in the oak, maple-basswood, and aspen forest types across Wisconsin. The untreated stand will serve two objectives, allowing us to evaluate the effectiveness of silvicultural treatments and serving as impact plots to evaluate the effectiveness habitat typing to predict gypsy moth impacts. Stand selection and treatment implementation will be completed within the three years of this proposal.

FHP LEAD CONTACT:

Name	Affiliation (Office or Dept.)	Phone, E-mail, Fax
Dr. Steven Katovich	NA-FHP, St. Paul, MN	(651) 649-5264 skatovich@fs.fed.us (651) 649-5238

FHP LEAD INVOLVEMENT:

Role	Time Commitment
Project coordination, technology transfer	5%

PRINCIPAL INVESTIGATOR(S):

Name	Affiliation (Office or Dept.)	Phone, E-mail, Fax
Dr. Kurt Gottschalk	NE-4557, Morgantown, WV	(304) 285-1598 kgottschalk@fs.fed.us (304) 285-1505
Dr. Craig Lorimer	Univ. of Wisconsin-Madison, Madison, WI	(608) 262-6187 clorimer@facstaff.wisc.edu
Dr. Ken Raffa	Univ. of Wisconsin-Madison, Madison, WI	(608) 262-1125 raffa@entomology.wisc.edu

Dr. Andrea Diss	Wisconsin DNR, Madison, WI	(608) 264-9247 dissa@mail01.dnr.state.wi.us (608) 266-8576
Eunice Padley	Wisconsin DNR, Madison, WI	(608) 261-6459 padlee@dnr.state.wi.us

PRINCIPAL INVESTIGATOR(S) INVOLVEMENT:

Name	Role	Time Commitment
Dr. Kurt Gottschalk	Project design and analysis, training, QA/QC, technology transfer	5%
Dr. Craig Lorimer	Data management and analysis, training, QA/QC, technology transfer	5%
Dr. Ken Raffa	Data management and analysis, training, QA/QC, technology transfer	5%
Dr. Andrea Diss	Project management, technology transfer, gypsy moth population and defoliation levels	10%
Eunice Padley	Project implementation, technology transfer, provide land and implement treatments	10%

COOPERATORS:

Name	Affiliation (Office or Dept.)	Phone, E-mail, Fax
Dan Pubanz	Menominee Tribal Enterprises, Keshena, WI	(714) 799-3896 (714) 799-4323
Mark Theisen	Chequamegon-Nicolet NF, Park Falls, WI	(715) 762-2461 mtheisen@fs.fed.us (715) 762-5179

COOPERATOR INVOLVEMENT:

Name	Role	Time Commitment
Dan Pubanz	Provide land and implement treatments	5%
Mark Theisen	Provide land and implement treatments	5%

JUSTIFICATION: The work proposed is the first combination of habitat typing and silvicultural treatment response. Both of these technologies are well developed independently but have not been tested in a combined fashion. Success in the combination will allow FHP to provide GIS-based hazard-rating using habitat types and to recommend locations where silvicultural treatments will be the most effective alternative under an IPM management approach.

URGENCY: Silviculture is by nature long-term in its approach. However, the eastern counties in Wisconsin had approximately 700 acres of detectable defoliation in 2000, the first somewhat extensive gypsy moth defoliation reported in the state. Much more extensive defoliation is expected in eastern Wisconsin in 2001 and defoliation in the central portions of Wisconsin are likely within 2-3 years. The opportunity to establish various silvicultural treatments just prior to extensive defoliation in the state does make this proposal urgent.

NATIONAL FHP TECHNOLOGY DEVELOPMENT PRIORITY:

Priority 1: __ Priority 2: _X_ Priority 3: _X_ Priority 4: __

Existing silvicultural guidelines for the gypsy moth were developed largely from data collected in the eastern U.S. Wisconsin has large areas of oak-dominated forests that are found on extensive outwash sands and are dominated by pin oak types. This may make them react somewhat differently than oak stands found further east in the U.S. Further, Wisconsin has extensive stands of aspen and basswood is a common component in many northern hardwood stands. Both aspen and basswood are considered highly preferred food sources for gypsy moth. The existing silvicultural guidelines are targeted at oak-dominated stands and do not include options for aspen or basswood stands. Brooks and Hall (1997) adapted Gottschalk's guidelines to Wisconsin using habitat typing as a basis for developing modifications but no tests of this approach have been done.

Part of this project will quantify the impact gypsy moth has on oak, aspen, and basswood forests in the Great Lakes region. It will look at the interaction gypsy moth has with harvesting activities, a common forest disturbance. This information can be used to develop local risk or hazard-rating systems.

TECHNICAL COMMITTEE DEVELOPMENT PRIORITY:

Priority 1: __ Priority 2: __ Priority 3: __ Priority 4: _X_

Priority 5: _X_ Priority 6: __ Priority 7: __ Priority 8: __

Existing risk and hazard-rating systems were developed from data in the eastern U.S. and may not apply to forest types found in the Lake States, especially aspen and basswood stands. The impact data that will come from the untreated control stands included in this study will provide data on the impacts on forest ecosystem structure and function for these new types. The use of existing habitat typing as a basis for the plot selection will allow the development of risk and hazard models that fit well with existing succession models, we will be able to validate the effects of gypsy moth defoliation on the accuracy of those models and be able to rapidly provide risk and hazard by habitat type.

SCOPE OF APPLICATION: The results of this study should be directly applicable to the neighboring states of Minnesota, Michigan, northern Illinois and Iowa. Forest types are very similar. Large areas of aspen and basswood forest are present in Minnesota and Michigan's Upper Peninsula. Michigan is completing a habitat type guide similar to the system developed by the state of Wisconsin. Several industrial forests in Minnesota have developed systems based on Wisconsin's habitat type approach. The Minnesota DNR is developing a product that is very similar though it relies more heavily on detailed soil information. The results are applicable to gypsy moth but data on silvicultural response of stands is applicable to other spring defoliating insects.

RESEARCH BASIS: Wisconsin has a well-defined ecological classification system that utilizes habitat typing (Kotar and others 1988, Kotar and Burger 1996). This system has been widely used and accepted in the Wisconsin forestry community. The habitat type system is based on both the forest vegetation communities present and on sites. Communities are classified on a two-way gradient of soil moisture regime and soil nutrient regime. Each of these gradients is divided into 5 classes: very dry, dry, dry-mesic, mesic, and wet-mesic for soil moisture regime and very poor, poor, medium, rich, and very rich for soil nutrient regimes resulting in a continuum of soil moisture-soil nutrient combinations. In addition, each community is classified based on the potential climax community for that combination of soil moisture and soil nutrient regime. Disturbance-mediated seral communities are identified and the successional pathways between them and the climax community are detailed. The most recent FIA forest inventory in the state typed each of the FIA plots. The habitat type system provides a powerful management tool that can tie directly to various silvicultural options. Research was started 6 years ago on the Monongahela NF in WV to evaluate the impacts of gypsy moth by ELTs (Ecological Land Types). However, lack of defoliation due to low populations has precluded any results. Prediction of gypsy moth impacts has been difficult due to high variability in response across the landscape (Gansner 1987, Gansner and Herrick 1984, Gansner et al. 1987, Herrick and Gansner 1987, Houston and Valentine 1985). We believe that using ecological classification as the basis for hazard and risk rating systems will greatly reduce the variability and improve our ability to make predictions. The effectiveness of silvicultural treatments and prioritization of stands for treatment may be increased as well by using habitat types. Wisconsin has extensive forest types that can be considered at risk for defoliation by gypsy moth. The 1996 FIA inventory lists the following types and acreages in Wisconsin: oak-hickory 2.9 million acres, maple-basswood 5.3 million acres, and aspen 2.9 million acres. In the maple-basswood type, basswood is considered a highly preferred gypsy moth host, as is aspen. Data on impacts in aspen and basswood forests is generally not available from the eastern U.S. data sets and these plots would help to fill that gap.

Silviculture can play a significant role in increasing or decreasing stand susceptibility and vulnerability to defoliators such as gypsy moth (Gottschalk 1993). Guidelines have been developed specifically for the oak forest types with the ability to extend those concepts to other forest types (Gottschalk 1993). Research plots in WV have shown a significant reduction in mortality (30-50%) by using presalvage thinnings (Gottschalk In Preparation). Other research-demonstration plots are in place awaiting gypsy moth defoliation as it expands it territory. Brooks and Hall (1997) adapted Gottschalk's guidelines to Wisconsin using habitat typing as a basis for developing modifications but no tests of this approach have been done. Similarly, little information on silvicultural treatments for gypsy moth is available for Lake States forest types. These plots would expand the network of research-demonstration areas to include the Lake States.

The present status of gypsy moth in Wisconsin provides a unique opportunity to investigate the relationship between silvicultural manipulations and the resulting growth loss and mortality that follows an initial wave of gypsy moth defoliation. Currently, 24 eastern counties in Wisconsin are within the Federal quarantine zone for gypsy moth. Visible defoliation in these counties is just beginning with approximately 4,000 acres being reported in 2001. The Slow-the-Spread Action Zone extends through central Wisconsin with scattered, low-level populations in that area. Western Wisconsin is still considered relatively uninfested. A variety of

population levels exist in the state thus providing opportunities to try various silvicultural scenarios under different gypsy moth population levels. Wisconsin's gypsy moth monitoring program is very extensive utilizing over 33,000 pheromone-baited traps in 2001. The information from this intensive trapping program along with Wisconsin's Forest Health Monitoring off-plot survey activities will provide an excellent record of gypsy moth population and defoliation levels in Wisconsin.

METHODS: Silviculture is by nature long-term in its approach. As such, the conclusion of this project is a number of years in the future. This 3-year proposal will allow us to select the paired stands by habitat type, forest type, and Wisconsin region, assign silvicultural treatments to the pairs based on their stand and gypsy moth population conditions, and implement the treatments. A paired stand approach will be used with one stand of each pair receiving a silvicultural treatment and one stand remaining untreated. Stand pairs will be replicated both within and across the habitat types in the oak, maple-basswood, and aspen forest types across Wisconsin.

Northern WI habitat types show that oak types are spread across the moisture nutrient gradient. At the low end of the gradient (dry soil moisture-poor soil nutrient), oak types are the climax association present. As the soil moisture and soil nutrient status increase, oaks become a pioneer to mid-successional stage under medium conditions. At the high end of soil moisture-soil nutrient status, oaks are present as mid-successional and a disturbance maintained component of maple-basswood types. The species of oaks change as the continuum resources increase in abundance. Pin and white oak occur in the low to middle portion of the continuum and northern red oak occurs in the middle to upper portion. Basswood occurs only in the upper half of the soil moisture-soil nutrient continuum and similar to oak is mid-successional and maintained by disturbances. Aspen occurs as an earlier successional community across all but the very driest and nutrient poor habitats but is most successful on the upper half of the soil moisture-soil nutrient continuum. Central and Southern WI habitat types show a similar relationship for oak types but with a broader variety of species. Black, white, and pin oak occur in the lower range of soil moisture-soil nutrients, bur oak occurs across the entire range as does white oak but white oak reaches its peak in the middle portion of the range and is rare in the upper portion. Northern red oak occurs in the middle to upper portions of the continuum. Basswood occurs in the upper portions of the continuum as it does in the northern habitats. Aspen is more rare in the Central and Southern habitats and tends to occur on the poor to middle portion of the continuum. Most aspen plots will be in northern WI.

While the evaluation of the defoliation and subsequent treatment effectiveness will depend on the rate of gypsy moth spread, the utility of the paired stands for educating the public can start as soon as stand treatments are implemented. A combination of permanent or temporary plots (depending on land ownership desires and restrictions) will be set up in each stand to measure the vegetation and provide the baseline data for evaluation of impacts and treatment effectiveness. Nested plots for overstory (0.1 acre), understory (0.01 acre), and regeneration/herbaceous flora (0.001 acre) will be used. There will be ten sets of nested plots per stand up to 20 acres in size and an additional plot for every 5 acres above 20 acres in total stand size. The plots will be arranged in a systematic grid throughout the stand. An inventory of all trees greater than 4.5 inches dbh will be done on the overstory plot and will include species, dbh, crown class, and crown vigor. Marking dbh measurement points and numbers on the trees will allow us to measure the growth response to defoliation in addition to the mortality that occurs. The understory plot will inventory all trees less than 4.5 inches dbh and greater than 0.5 inches dbh and will include species, dbh, crown class, and crown vigor. The regeneration/herbaceous flora plot will include species and count data by size class for all trees and woody shrubs taller than 2 inches and less than 0.5 inches dbh and will also include percent coverage data for all herbaceous species. There will be two regeneration/herbaceous plots for every understory plot. The WI-DNR personnel and summer interns (or NF or MTE personnel on their lands) will collect the data with training and QA/QC provided by NE and University of WI-Madison personnel. Data will be collected pre-treatment and again post-treatment to give us information on the silviculturally treated stands and the type of treatment that was implemented. When gypsy moth reaches the stands and defoliates them, the plots will be remeasured two to three years post defoliation to obtain growth data and mortality due to defoliation. Once the treatment stands are identified and pre-treatment plots installed, the areas would be available for compatible studies that examined other aspects of gypsy moth population dynamics, impacts and silvicultural treatments.

The hypothesis that we are testing in Objective 1 is that silvicultural treatments will have no effect on the defoliation levels and on the growth and mortality of trees following gypsy moth defoliation. The testing of defoliation, growth, and mortality rates between treated and untreated plots will allow us to evaluate Objective 1 using analysis of variance and various tests for differences between means. The hypothesis that we are testing

in Objective 2 is that habitat types will have no effect on the defoliation levels and on the growth and mortality of trees following gypsy moth defoliation and no effect on the successional patterns resulting from the disturbance. The testing of defoliation, growth, and mortality rates between habitat types will allow us to evaluate Objective 2 using analysis of variance and various tests for differences between means. A novel hypothesis that can be tested from this design is that the interaction between habitat types and silvicultural treatments is not significant. If this interaction is not significant then the silvicultural treatment effectiveness is consistent (or universal) across all or most habitat types. If the interaction is significant, then it suggests that silvicultural effectiveness varies between habitat types. This result would mean that there could little or no benefit from silvicultural treatments for gypsy moth in some habitat types but large benefits in other habitat types. This would require that we modify existing guidelines to take habitat type and forest type into consideration (Objective 3). The effect of disturbance from gypsy moth on successional patterns will allow us to confirm that the habitat type successional pathways are the same as for other types of disturbance.

MEASURES OF SUCCESS:

Standard of Success: The success will be determined by a statistically significant difference in defoliation or mortality between treated and untreated stands and significant differences between habitat types.

Expected Outcomes: We expect to see significant reductions in mortality with silvicultural treatments as has been shown in WV. We also expect to see differences in mortality with habitat types as we have seen with site index, topography, aspect and other factors in the east. We do not know if the interaction between silviculture and habitat types will be significant, but are hypothesizing that it is not.

Implementation of Products/methods: This work will highlight the utility of using silvicultural treatments and accelerate their implementation by forest managers and landowners through the 'seeing is believing' model of technology transfer via adoption by local leaders approach. It will also highlight the utility of habitat typing as a predictive tool for risk and hazard rating and hasten the implementation of that technology.

PRODUCTS AND DUE DATES: Oct 1, 2004 – plot establishment and treatment implementation complete, implementation report done.

PUBLICATIONS: We anticipate producing a journal article on the effectiveness of silvicultural practices and station or state papers revising the silvicultural guidelines once results are in. A journal or station paper on impacts in new forest types and one on risk and hazard-rating will be prepared once the results are in. Within the duration of this project, an implementation report on the establishment of the plots and treatments will be prepared.

TECHNOLOGY TRANSFER: The location of stand pairs across the state enhances their utility as learning tools. Field tours and programs conducted by the WI DNR, University of Wisconsin Extension Service and the Wisconsin Woodland Owners Association, along with word-of-mouth dissemination from forest managers and landowners visiting these sites, will educate forester managers, landowners, and the public on the utility of forest management in reducing pest impacts. This effort will fulfill Objective 4.

PRODUCT LEVERAGING: This project is a compliment to several research and demonstration projects for gypsy moth silviculture in place around the eastern U.S. A NA Focus Funding project setup about 15 demonstration stands around West Virginia. An AIPM/FHTET project setup 30 research-demonstration stands on the Jefferson NF in Virginia. A NE project setup two research-demonstration stands on a State Forest in Ohio. All of these projects build on a research study on the West Virginia University Forest that examines the effectiveness of silvicultural treatments. In addition, future research-demonstration areas are under consideration in Kentucky, Missouri, and Indiana. NA Focus Funding projects provided a significant portion of the funding that developed the WI habitat typing system. As such, extension of the system to other uses leverages the investment that the Forest Service has already made.

LONG-TERM BUDGET REQUEST:

	Item	Requested FHP STDP Funding	Other-Source Funding	Source
FY 2002				
Administration	Salary	$17,000	$49,000	WI DNR, NF, NE, MTE, UW-M,
	Overhead	$ 900	$ 7,000	UW-M, NF, MTE
	Travel	$18,100	$ 6,000	WI-DNR, NF, MTE
Procurements	Contracting			
	Equipment			
	Supplies	$ 4,000	$ 5,000	WI-DNR
YEAR TOTALS		$40,000	$67,000	

FY 2003				
Administration	Salary	$17,000	$49,000	WI DNR, NF, NE, MTE, UW-M,
	Overhead	$ 900	$ 7,000	UWM, NF, MTE
	Travel	$18,100	$ 6,000	WI-DNR, NF, MTE
Procurements	Contracting			
	Equipment			
	Supplies	$ 4,000	$ 5,000	WI-DNR
YEAR TOTALS		$40,000	$67,000	

FY 2004				
Administration	Salary	$17,000	$49,000	WI DNR, NF, NE, MTE, UW-M,
	Overhead	$ 900	$ 7,000	UWM, NF, MTE
	Travel	$18,100	$ 6,000	WI-DNR, NF, MTE
Procurements	Contracting			
	Equipment			
	Supplies	$ 4,000	$ 5,000	WI-DNR
YEAR TOTALS		$40,000	$67,000	

LONG-TERM BUDGET REQUEST EXPLANATION: Annual budget breakdown by receiving unit is $20,000 to Wisconsin Department of Natural Resources (WI DNR), $15,000 to University of Wisconsin-Madison (UW-M), and $5,000 to NE-4557 (NE). Other source funding is in-kind contributions of $40,000 from WI-DNR, $16,000 from UW-M, $5,000 from NE, $3,000 from Chequamegon-Nicolet National Forest (NF), and $3,000 from Menominee Tribal Enterprises (MTE). Salary costs requested are for summer interns to help collect data and for personnel to enter and maintain the data into a spreadsheet or database. Overhead costs requested are for NE's standard 18.1% rate on the funding portion going to NE. Travel costs requested cover the costs for the PIs to travel for planning meetings, conducting training, QA/QC, and technology transfer and for interns and state employees to collect the plot data. Supplies requested are for the materials needed to mark the temporary and permanent plots and for materials used for data collection and data entry.

BENEFITS: Gypsy moth defoliation results in millions of dollars in impacts per year (Leuschner et al. 1996). Silvicultural treatments can reduce morality by 30 to 50 percent in treated stands versus untreated stands (Gottschalk In Preparation). This results in a benefit on the order of hundreds of dollars per acre, so the net benefits would be the total acreage treated times $/acre or a savings of potentially tens of thousands to millions of dollars depending on the acreage treated. While these values are timber values, non-timber resource values may be positively affected by thinning as well (for example, aesthetics Hollenhorst et al. 1993) further

increasing the benefits of using silviculture. Using habitat types for risk and hazard rating would save thousands of dollars per year in reduced management costs due to using existing GIS layers for habitat types to conduct the ratings.

LITERATURE, CITATIONS, ATTACHMENTS, etc.:

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