Project Status: New, not previously funded

Project Number: R8-1998-04

Title: Enhancement of GypsES decision support model for use with other pest problems and port program to a Windows NT operating system

Subject: Bark Beetle, Gypsy Moth, Integrated Systems

Project Objectives: Port the GypsES program to a Windows NT operating system and expand decision support capabilities to include southern pine beetle (SPB) and other forest pests.

GypsES is a software program designed by the Forest Service to help resource managers deal with all facets of gypsy moth management. It contains a fully functional GIS system with on-screen digitizing capabilities. The program is organized into several work areas: FILES for basic file control work as well as importing and exporting to other GIS programs. EDIT for creating, viewing, or editing relational database files. WINDOWS for changing how information is displayed on the screen or printed. FOREST which contains the inputs for creating hazard and risk layers or predicting stand damage. SURVEY has two modes, one for suppression and one for eradication. Here egg mass or pheromone trap surveys are designed and managed. Data can then be used to develop defoliation predictions and propose treatment areas. TREATMENT provides export of treatment blocks and import of flight lines for all major DGPS aircraft guidance systems. Also included is a phenology model to assist in spray timing and a spray deposit model (FSCBG).

Project Leader - John Ghent, R8-FHP, Asheville Field Office

FH Sponsors: John Ghent, Bobbe Fitzgibbon, Dan Twardus

Justification: Since 1995, GypsES has demonstrated its acceptance as a technology transfer and application program for gypsy moth management. Currently, the GypsES Service Center is supporting approximately 50 systems used by a wide variety of Federal, State, County, and private users. Continued growth of the GypsES decision support system is limited by the program's Unix based operating system (OS). At the beginning of GypsES development, Unix was the only 32 bit OS available. However, this OS has not kept up with the rapid growth and enhancements of computer hardware. To meet future needs and expand its use, the program will be transfered to a Windows NT OS.

GypsES was developed primarily for State agencies and other federal cooperators that lack GIS support for program management. The ease of use and interaction with other pest management technologies has increased Forest Health Protection's leadership in the transfer of research technology to a user group

specialized in pest management. By providing the user with a method to view and manage spatial data, better pest management decisions are being made. The sharing of information between users (State to State, or State to FS or APHIS) has also been improved through the use of GypsES' import and export capabilities between systems and with other GIS programs such as ArcInfo.

Not all current users are involved with gypsy moth management. Some have adaped GypsES for use in other pest management programs (spruce budworm suppression, SPB aerial and ground surveys, aerial pesticide application, and urban forestry). Use in these and other pest programs provides a unique opportunity to place previously developed models into the hands of the user. This STDP proposes to incorporate spot growth models for SPB, as well as the Canadian Decision Support tool- BioSIM to deal with spruce budworm, hemlock looper, and jack pine budworm. A generic degree day model within BioSIM will allow users to adapt GypsES for use with additional pests.

Urgency: In Region 8, the Alabama Forestry Commission has contracted GIS support with a regional utility company to produce maps with SPB spot locations printed on USGS 7.5 quad maps. The ability to accurately plot spots increases the speed in which spots are located, ground checked, prioritized, and controlled. SPB activity increased rapidly across the South in 1997. More states are interested in developing similar techniques for SPB survey. GypsES currently has this capability, but hardware limitations have limited its widespread use. This STDP would eliminate that problem and increase the speed and efficacy of SPB control throughout the Southern Region. The inclusion of SPB spot growth models will allow for priortizing control operations. Additional benefits will occur with ability to track infestations, analysis of control data, preparation of inexpensive scalable USGS quad images, and notification of landowners. Use of this technology has application for survey and treatment of other insects or vegetation.

The demand for GypsES has exceeded the ability of the GypsES Service Center to deliver and support the product. The major limitation on growth is due to the specialized requirements for hardware drivers and components under the Unix OS. Porting to Windows NT will allow for increased growth and support for an increased user group, and better utilization of current personnel talents.

Failure to fund this request will delay implementation of a successful product to additional users. Delay in application will result in less effective pest management decision making, increased costs of pest management and control, and increase volume loss from delay in control.

Link to National FHP Technology Development Priorities:

National Steering Committees.
1. Modeling, Integrated Systems and Remote Sensing Steering Committee

selected: 'Adaptation of GypsES for Western States'. The inclusion of BioSIM will provide the ability to address western pest problems, some of which are already included in BioSIM.

2. Bark Beetle Steering Committee selected: 'Develop technologies that will aid in monitoring bark beetle populations and life histories, which will improve our ability to identify locations, trends, response, and recommendations for management options. This STDP would aid in monitoring, greatly improve identifying spot locations, predict spot trend through incorporation of spot growth models, and provide a basis for decision support prioritizing response activities.

Scope of Application: GypsES user base includes: USDA Forest Service (Asheville, Morgantown, Alexandria, Harrisonburg, and St. Paul); USDA APHIS (Georgia, Washington, Illinois, Minnesota, West Virginia, Indiana, and Missouri); federal agencies (NPS, ARS, and US Air Force), States (AR, TN, NC, VA, WV, OH, GA, and IN); VPI & SU; 6 counties in VA, and two companies in Canada (BioForest Technology and Forest Protection Limited). These users would receive immediate benefit from these requested enhancements.

Interest and/or requests for the program have been received from: USDA Forest Service Monongahela NF, Wayne NF, NFs in North Carolina, and International Forestry; USDI Fish and Wildlife Service; Ontario Ministry of Natural Resources; Manitoba Ministry of Natural Resources; Canadian Forest Service; North Carolina Forest Service; Societe de protection des forets contre, Quebec; USDI National Park Service, Big Bend National Preserve; Southeastern Boll Weevil Eradication Foundation; Florida Division of Forestry; Natural Resource Conservation Service; Michigan Department of Natural Resources; Lewanee County, MI; Fairfax County, VA; Indiana Department of Forestry; Union Camp Co.; Delaware Department of Agriculture; and Anhui Provance Forest Biological Control Center (China). These users would receive improved decision making capabilities and technology.

The GypsES Development Team is negotiating with the National Agricultural Aviation Association (NAAA) to license a subset of the GypsES program for distribution to NAAA members for use in aerial application world-wide. This product is dependent on porting the program to Windows NT.

Since the delivery of the first 9 beta versions in 1995, the user group has more than doubled every year. The GypsES Service Center provides programming, GIS and data support, and hardware setup to approximately 50 systems. The Center has produced a user manual and provided indepth training to over 80 users. The majority of funding needed to run the GypsES Service Center is provide through user support. This STDP would be used to enhance the GypsES product for use by a larger variety of users and application for additional forest and agricultural pests.

Research Basis:

SPBMODEL is a DOS-based model that enables foresters and forest pest managers to predict the growth of SPB infestations and corresponding tree mortality. The model was released by the Department of Entomology, University of Arkansas in 1995 (Lih, et al. 1995)

BioSIM is a software package that helps in the application of phenology and other seasonal forecasting simulation models for temperature-dependent processes to areas of ecological research and pest management. Besides elevation, BioSIM uses slope, aspect, and elevation to improve forecasing all gypsy moth life stages. In addition to gyspy moth this model simulates development in other forest pests (spruce budworm, jack pine budworm, and hemlock looper). For spruce budworm the interaction of ”Bacillus• ”thuringiensis• and deposition is also available. (Regniere and Cooke, 1997; Regniere et. al 1995; Regniere and Bolstad, 1994).

GypsES is a decision support system for gypsy moth management. It has been jointly developed by the USDA Forest Service, State and Private Forestry - Southern Region and Northeastern Area and Northeastern Forest Experiment Station. GypsES provides decision support to gyspy moth managers by: identifying areas of concern; recommending areas to monitor; recommending areas to treat using silvicultural alternatives, direct suppression for established populations, and eradication of localized spot infestations; giving treatment support options for modeling losses with and without treatment; uploading and downloading of spray block and spray line information through global positioning system (GPS) files; FSCBG spray deposit modeling. (Gottschalk et. al 1996; Ghent et. al 1996; Teske, M.E, et. al 1993)

Methods:

1. Port to Windows. One programmer will be assigned the task of converting Unix code to work under Windows. Approximate duration is anticipated to be 4 months.

2. Inclusion of BioSim. A preliminary meeting with Forest Canada indicates that the combining of the two models is desirable and practical. A design document showing links and data transfer between models would be developed. Programming of the models and testing is anticipated to be 4 months.
3. Improved SPB aerial and ground checking surveys. The Trimble Scoutmaster is an inexpensive handheld GPS unit, with the ability to record and store 250 locations. The system allows the user to name the location using a library editing feature to enter up to 14 characters for each location. Although not designed as such, the 14 characters can be utilized for data entry and be brought into GypsES and formated into data field defined by the user.

Currently this technique requires using another software product and these data are imported into GypsES via .DBF file formats. A seamless interface within GypsES which will allow the user to define fields for data importing and exporting to the Trimble Scoutmaster will increase the use of GypsES for other resource management programs. Programming the interface and field testing is anticipated to be 2 months.

4. Include ability for predicting and plotting SPB spot growth. The SPBMODEL would be included within GypsES. GypsES would be able to provide the geographic and ground check data sets to the model, the model would provide spot growth projection, and GypsES would generate reports, prioritize treatments, and display results using the programs GIS functions. Programming data entry screens, model linking, and display is anticipated to be 3 months. Field testing of results would take approximately 6 months.

Measure of Success: Success of any product is based on its acceptance and use by users. As stated above GypsES enjoys acceptance from a large and diverse user group. Enhancing GypsES to run on a Windows platform and include other pest management applications will increase its acceptance to a larger and more diverse user group. GypsES provides a vehicle to transfer previously unused or underused pest management models in an easy to use interface to an established user group.

Cooperators:
Jacques Regniere, Forest Canada, Entomologist, Population Dynamics. Developer of BioSIM. Consultation on GypsES/BioSIM interface. 1 month.

Fred Stephen, Univerity of Arkansas, Professor Forest Entomology. Developer of SPBModel. Consultation on GypsES/SPBModel interface. 1 month.

Richard Goyer, Louisiana State University, Professor Dept of Entomology. Project review and field evaluation. 3 months.

Terry Price, Georgia Forestry Commission, Pest Management Specialist, Project review and field evaluation. 3 months.

Coleman Doggett, North Carolina Forest Service, Pest Management Specialist, Project review and field evaluation. 3 months.

Roy Zipp, USDI NPS, Resource Manager Big Thicket National Preserve, Project review and field evaluation. 3 months.

Mark Twery, Northeastern Forest Experiment Station, Project Leader - Interdisciplinary approaches to managing northeastern forest ecosystems. Project review and interface consultation. 1 month.

Susan Thomas, Northeastern Forest Experiment Station, Lead Programmer GypsES project. Programmer, interface design and coordination. 3 months.

Products:
An enhanced program, running on a Windows NT operating system will be available for field testing as a beta version in the summer of 1998. The final product and associated documentation will be released in 1999.

Publications:
A user manual will be released with the final version. Tutorials and How to publications will be produced and available from the GypsES website.

Technology Transfer:
GypsES itself is also a technology transfer application. This project will take previously developed models, combine them to work together within a full functioning GIS system. GypsES is funded from its current user base, (APHIS, NPS, STS project, Forest Canada, State agencies). The proposed enhancements will broaden the softwares use and transfer additional technologies to pest and resource managers. Users will be supported by FHP staff specialists and the GypsES Service Center.

Project Duration: This project is projected to take two years to deliver a finished version.

Long term budget: 1998 - $46,000; 1999 - $25,000

FY 1998 BUDGET REQUEST

ITEM	FHP	Other Sources
Equipment to be Purchased		
Computer w/ Windows NT (2)	$ 6,000	$ 3,000*
Imagery (USGS 7.5)	$ 3,500	$ 2,000*
GPS Handheld (2)	$ 1,000	$ 1,000*
Salary		
Programer GS-12 (6 mon)	$ 30,000	$ 2,000*
Field Crews		$ 5,000*
Travel	$ 4,500	$ 3,000*
Other		
Aerial Survey		$ 4,000*
Total FY 1998	$ 45,000	$ 20,000*

* In kind services from State cooperators and Forest Canada
Literature Citations:

Ghent, J.H., D.B. Twardus, S.J. Thomas, M.E. Teske. 1996. GypsES: The Gypsy Moth Decision Support System. Presented at ASAE meeting, Paper No. AA96-005. NAAA/ASAE Joint Technical Session. Reno, NV.

Gottschalk, K.W., S.J. Thomas, D.B. Twardus, J.H. Ghent, J.J. Colbert, and M.E. Teske. 1996. GypsES: A Decision Suppoet System for Gyspy Moth Management, In Proceedings "Decision Support System for Forest Pest Management, Ed. T.L. Shore and D.A. MacLean. Victoria, BC Canada. FRDA Report No. 260.

Lih, M.P., F.M. Stephen, and K.J. Jeng. 1995. SPBMODEL A User's Guide. University of Arkansas, Fayetteville, AR.

Regniere, J. and P. Bolstad. 1994. Statistical Simulation of Daily Air Temperature Patterns in Eastern North America to Forecast Seasonal Events in Insect Pest Management. Environmental Entomology Vol. 23:1369-1380.

Regniere, J., B.J. Cooke, and V. Bergeron. 1995. BioSIM: A computer-based decision support tool for seasonal planning of pest management activities. User's Manual. Information Reprot LAU-X-116. Natural Resource Canada, Canadian Forest Service - Quebec.

Regniere, J. and B.J. Cooke. 1997. Validaiton of a Process-Oriented Model of Bacillus thuringiensis var. Kurstaki Efficacy againist the Spruce Budworm, Choristoneura fumiferana (Lepidopera: Tortricidae). In Press.

Teske, M.E., J.F. Bowers, J.E. Rafferty, and J.W. Berry. 1993. FSCBG: an aerial spray dispersion model for predicting the fate of released material behind aircraft. Environ. Toxicology and Chemistry 12(3): 453-464.

Williams, S.B., M.K. Thompson, and D.J. Roschke. 1997. Gypsy Moth Expert System (GypsES) Review. Forest Health Technology Enterpise Team. FHTET 96-24.
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STDP PRODUCTION FUNCTION

PROJECT NUMBER: R8-1998-xxx

Project Cost:

Year	0	1	Total
STDP request	$45,000	$20,000	$65,000

PROJECT OBJECTIVES:

1) Move the Decision Support Program - GypsES from a Unix based operating system to a Windows NT operating system in order to provide current technology to a larger user base; 2) expand the ability of the program to provide Decision Support for Southern Pine Beetle by incorporating SPBModel; 3) develop a seamless interface for handheld GPS receiver with the GypsES GIS to improve accuracy in plotting during aerial survey and locating infestations during ground checking; 4) incorporate the Canadian developed decision support tool BioSIM to improve survey and treatment for gypsy moth and to incorporated additional forest pest species.

Benefits:

Increase the availibility of the GypsES program for users. GypsES has demostrated in operational use that costs for gyspy moth treatment have been reduced by as much as 20 percent. Much of this saving is in reduced time in project planning, reduced costs in personnel needed to run the project, and reduced pesticide application. (AVOID PROPERTY DAMAGE through imporved spray timing and application; AVOID PEST SUPPRESSION COSTS through reduced time in project planning, reduced personnel cost, and reduced pesticide application costs; AVOID PESTICIDE-RELATED COST through improved application technology and
technology transfer of Forest Service developed spray deposit models.)

Improved accuracy and speed of SPB location, priortizing spot treatment for better control decision and salvage. (SALVAGE DEAD AND DYING TREES through more accurate and faster detection of spots, prioritizing treatments to those infestations with higher rates of growth, and improved ability to contact absentee landowners; AVOID PEST SUPPRESSION COST through the rapid salvage of infested timber which reduces damage and improves return on salvage lumber; ACCELERATE HARVEST TO CAPTURE GREEN VALUE though rapid response to fastest growing spots)

Improved forecasting of seasonal planning of pest management activities (survey and treatment). (AVOID PEST SUPRESSION COSTS through proper timing of

insecticide insecticide applicaiton to coincide with most susceptible life stage and aviod treatment of areas below an economic threashold; AVOID PESTICIDE-RELATED COSTS through better insecticide application, insuring proper dose, and evaluation of treatment performance.)

ASSUMPTIONS:

1) GypsES technology will reduce insecticide application by 5 percent in gypsy suppression. (Williams et. al 1997)

2) GypsES technology (on site digitizing, aircraft DGPS interface) has eliminated the need for personnel for marking treatment blocks with balloons. (Williams et. al 1997; VDACS; WVDA; NCDA personnel communication)

3) Improved speed for SPB survey and control will reduce tree mortality by 10 percent and reduce personnel costs required for ground checking infestations by 20 percent.

4) Improvment in aerial application technology through use of GPS guidance interface and FSCBG predictions will reduce retreatment of areas by 10 percent. (1% of total acreage or 8,820 acres)

BACKGROUND DATA:

1) Average acreage treated for gypsy moth per year (1990-1995) is 881,968 acres. (GM Digest Tracking Database), half of these would use GypsES or 440,000 acres.

2) Average cost of gypsy moth treatment per acre (1990-1995) is $10.94 (GM Digest Tracking Database).

3) On average, 10 percent of all treatment blocks are retreated the next year. (Historic data, VDACS 1986-1995, Asheville FO database).

4) Cost of labor for field work, $9.80/hr (GS-5, step 1).

5) Average volume for SPB controlled spot is 5 mbf.

6) Average value of salvage timber is $44/mbf.

7) Average value of green sawtimber is $88/mbf.

8) Length to harvest is 20 years.

QUANTITATIVE ANALYSIS

Expenditure & Output Values (EOV) Without Project

Gypsy Moth control

Labor cost for marking treatment areas:	
(projects in 1997 without GypsES) 6	
person/project 10 projects in 1997	
Avg. 14 days per project	$ 65,520
Per Diem ($75/day/person)	63,000
Insecticide application cost	
(average aircraft and insecticde)	
10.94/ac x 440,000 acres/yr.	
(GM Digest database 1990-1995)	$ 4,813,600

SPB ground check and marking

Labor cost for ground survey:	
2 persons/spot 2 spots/day	
Avg. 6000 spots per project (private lands)	
6000 man-days @ $78/day	
7 projects (1995 I&D Conditions Report)	$ 3,276,000
Timber lost to SPB:	
5 Mbf/spot x 6000 spot/project	
7 projects x $44/Mbf (salvage)	$ 9,240,000
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Total EOV Without Project	$17,458,120

Expenditures & Output Values (EOV) With Project

Gypsy Moth control

Labor cost for marking treatment areas:	
(projects currently without GypsES)	$ 0
Per diem	$ 0
Insecticide application cost	
(aircraft and insecticde)	
Reduce treatment cost 5%	
Reduce retreatment acres by 10%	
$10.39/ac x 440,000 acres/yr.	$ 4,571,600

SPB ground check and marking

Labor cost for ground survey:	
2 persons/spot 2.5 spots/day	
Avg. 6000 spots per project (state lands)	
4800 man-days @ $78/day	
7 projects (1995 I&D Conditions Report)	$ 2,620,800

Timber lost to SPB: 4.5 Mbf/spot x 6000 spot/project 7 projects x $44/Mfb (salvage)	$ 8,316,000
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Total EOV With Project	$15,508,400

BENEFIT ATTRIBUTABLE TO PROJECT

EOV without project - EOV with project $17,458,120 - $15,508,400	$1,949,720
Timber protected and later harvested .5 Mbf/spot X 6000 spots/project 7 projects x $88/Mbf Sawlogs harvested in 20 yrs ($1,848,000)	$ 843,408
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	$ 2,793,128

BENEFIT/COST RATIO

$3,599,359 /($45,000 + $20,000)	43.0

BENEFIT ATTRIBUTABLE TO STDP FUNDS

43.0 * $45,000	$1,935,000

PNV OF PROJECT

$1,935,000 -($45,000 + $20,000)	$1,870,000

PNV OF STDP

$1,870,000 - $45,000	$1,825,000