STDP New Project Proposal

Project Number: R8-2001-005

Project Title: Development of trap-out methods for southern pine beetles from individual trees or small infestations

Project Status: New

Expected Project Duration: 3 years

Expected Completion Date of the Project: FY 2004

Subject: Biological control, semiochemicals, *Dendroctonus frontalis* Zimmermann, the southern pine beetle (SPB)

Status of Subject Species: Native.

Project Objectives: Develop techniques to trap emerging bark beetles from individual infested pines, preventing loss of additional trees, leading to a reduction in area-wide impacts and preservation of natural enemy populations. Develop alternative tactic to protect high-value, individual pines at risk of attack from southern pine beetles.

Brief Description of Project: Baited Lindgren funnel traps will be hung on infested, individual pines to collect SPB emerging or reemerging from the tree. Small emergence traps on the tree will be used to calculate the percentage of emerging SPB collected. Additional funnel traps will be hung at ca. 12 m from the infested tree to capture dispersing beetles and determine if beetles are eluding the traps on the trees. The goal is to reduce area-wide SPB populations and/or prevent infestation of at-risk pines in the vicinity of infested trees, without the need for felling and removal.

Year 1: Test the efficacy of the method and the efficiency of the traps for the collection of the emerging beetles. Test two trap heights.

Year 2: Refine technique based on year one results, e.g. increase number of traps, change trap height.

Year 3: Continue technique refinement if necessary. If technique has proven successful on individual trees infested by SPB, check expanding its applicability to small SPB infestations ($\leq$5 infested trees) or to *Ips* bark beetle infestations.

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Cooperator Involvement:

Cooperator	Role	Time Commitment
FHP technicians	Assist in treatment application, monitoring. Help count beetles collected in traps.	30 person-days annually
Southern Research Sta.	Assist in treatment application, monitoring in Louisiana	20 person-days annually
Texas Forest Service	Assist in treatment application, monitoring in Texas	20 person-days annually
National Forests	Provide field sites, report individual infested trees	Incorporated in SPB suppression and prevention activities

Justification: It has often been suggested that removing individual pines infested by SPB in the fall, winter, and early spring could greatly reduce impacts in the following late spring and summer (see Research Basis below). With the loss of area salvage sales in the south, there is currently no economic or practical method to remove these trees. Felling individual pines also may result in damage to the residual trees. In addition, a trap tree study has been designed and implemented to reduce area-wide impacts of SPB. A trap-out method that collects the beetles emerging from these individual, infested trees would provide an easy and practical alternative to removal. This technique also has potential application in urban situations. SPB infestations in urban areas often move from pine to pine, with only one pine infested at a time. Removal of infested trees in a timely manner is often not feasible, and chemical sprays to prevent attacks on uninfested pines are expensive and not environmentally desirable in public areas. This technique could provide homeowners with a method to prevent infestation of high-value pines. A similar situation exists in RCW clusters. Individual trees may be infested, putting nearby cavity trees at risk. Removal of the infested tree is often difficult and may damage the residual cluster trees, so this technique would provide a simple solution. Salvage of infested trees also removes beneficial insects. Trapping the emerging SPB and leaving the tree in place will protect important predators, such as the clerid *Thanasimus dubius,* which often emerges later than SPB.

Urgency: Texas and Louisiana are currently experiencing endemic levels of SPB activity. It is expected that an SPB epidemic may occur in the near future, given that the last epidemic ended in 1994. This situation provides a unique opportunity to test the trap-out method for the reduction of area-wide SPB impacts, plus it melds well with the trap-tree study mentioned above. There is also an urgent need for tactics to protect high-value trees. Emerging bark beetles from single-tree infestations often attack and kill nearby pines, particularly in high-value areas such as urban settings or RCW clusters. Options for preventing attacks on the residual trees are limited, as few insecticides are registered for this use, and they are expensive to apply. Infochemical-based prevention has not proven successful to date. Homeowners and wildlife biologists need new options for protecting these valuable trees.

National FHP Technology Development Priority: This project addresses national program priorities numbers 1 and 2. The project will develop pheromone-based, biocontrol methods for the southern pine beetle. The project also will develop guidelines for the implementation of these methods to reduce adverse impacts of SPB in the southern United States, particularly in areas with high-value pines.

Technical Committee Development Priority: Priority 2: Develop management strategies for hazard trees.

Scope of application: This technique could be used throughout the range of SPB. It would be primarily utilized from the fall through early spring, and during endemic periods of SPB activity through the onset of epidemics.

Research Basis: The southern pine beetle, *Dendroctonus frontalis* Zimmermann, exhibits two types of population behavior. In the summer, the beetles are aggregated in expanding infestations, and most control efforts are implemented at this time to stop these expanding spots (Billings 1980). The lack of aggregation foci in the period from late fall-early spring results in a more dispersed population (Johnson & Coster 1980), and infestations are often limited to individual trees. Though emergence during this time period is periodic and dispersal losses are generally high (McClelland & Hain 1979), the population growth rate is at its peak (Miller & Parresol 1992). It has been suggested that a reduction of SPB populations in the fall and winter would have a great impact in reducing area-wide impacts of SPB the following summer (Thatcher & Pickard 1967, Franklin 1970, Miller & Parresol 1992). Control of winter populations of SPB is dependent on locating the scattered infested trees. One method currently under investigation to simplify this process is to create trap trees in the fall. Once the currently-infested trees are located, the only control option generally available is cut-and-remove, as cut-and-leave is not recommended during this time period (USDA 1987). Cut-and-remove of single trees is often difficult. The economics of harvesting single trees make sales almost impossible, particularly with the loss of area salvage on the National Forests in the South. Ground conditions in the fall and winter are often not conducive for tree removal. The salvage of infested trees also destroys the natural enemies of SPB within the tree, such as the predator *Thanasimus dubius*. This clerid may play an important role in regulating SPB populations (Reeve 1997, Turchin et al. 1999). A control method is needed which reduces the SPB population while protecting the predators, and trapping-out the emerging SPB may be effective.

A mixture of frontalin and host tree volatiles has been shown to attract SPB (Payne et al. 1978). This combination is currently used in Lindgren funnel traps to monitor dispersing populations of SPB in the spring in the southeast United States (Billings 1988). The use of traps to capture SPB and control expanding spots has not been tested, as mass trapping for SPB has been considered problematic (Vité 1971). Vité and Baader (1990) suggest that mass trapping is of little use when there is an abundance of suitable host material. However, this project will not attempt to mass-trap in active, expanding SPB infestations, but will concentrate on single infested trees. From late fall-early spring there is an absence of aggregation foci. Therefore it should be possible to capture the beetles that periodically emerge by providing an attraction source at the point of emergence. Gara (1967) found that emerging SPB remain near the brood trees when a source of attraction is available. In the winter, emerging beetles often infest the lower basal area or upper crown area of the same tree from which they emerged (Thatcher 1967). Gara et al. (1965) and Coster & Gara (1968) indicate that when SPB populations are low, landing and attack are restricted to the original attraction centers and it could be possible to concentrate populations in pre-selected areas. The behavior of SPB from late fall-early spring suggests that baited traps hung on infested trees would be very efficient in capturing emerging beetles, given the lack of other available sources of attraction.

Methods: In the late fall-early spring, individual trees infested by SPB will be located (from reports by National Forest personnel) or, if necessary, created by baiting trees with aggregation pheromones. To collect the reemerging and emerging beetles, two to four

baited Lindgren funnel traps will be suspended from shelf supports screwed into the trees. The baits used will be the standard SPB lures manufactured by Phero Tech Inc. The number of traps per tree will be based on tree diameter. Initially, two heights will be tested: 1) collection cups at 1.5 m for easy checking, and 2) the cups at 3 m, which puts the trap at 3-4 m, the height of greatest trap catch of SPB (Coster et al. 1977). If no significant differences in number of beetles collected are observed, the lower height will be used in subsequent years. Predator excluders will also be tested in the traps to determine if they prevent the capture of *T. dubius* without affecting SPB catch. As *T. dubius* often has a life cycle much longer than SPB (Reeve et al. 1996), we also expect the traps to be removed before the bulk of *T. dubius* emergence from the trap-out tree. Checks will consist of individual infested trees with unbaited funnel traps. Cups will be checked daily to weekly, dependent on emergence numbers, and the collected beetles counted.

The working hypotheses are that trap-out can significantly reduce the number of SPB dispersing from an infested tree, and can prevent the infestation of nearby, at-risk pines. To determine treatment success, two baited funnel traps will also be hung at a distance of ca. 12 m (in opposing directions) from check and treated trees to collect dispersing beetles. These traps will not be hung near living host trees to prevent the potential of unwanted attacks. If trap-out results in significant reductions in trap catch of SPB in the distant traps, then infestation prevention will be tested. When the situation warrants, trap trees will be established at ca. 15 m from the study trees. Trap trees will be created by baiting with SPB aggregation pheromone or by an infusion of MS-DMSO, causing the tree to become susceptible to bark beetle attack. Infestation rates of trap trees near trap-out and check trees will be compared.

We will also estimate the efficiency of the traps suspended from the infested trees in collecting emerging beetles. Small emergence traps will be placed on the bole above the traps, and the number of beetles emerging from the tree estimated based on the infested surface area of the tree. This estimate will be compared to the number of beetles collected in the traps on the tree.

For quality control, we plan to work with the SRS and mark emerging SPB on some trap-out trees. The numbers of marked beetles captured will be compared for traps on the trees and traps at a distance. In addition, we will examine the sex ratio of beetles collected in the traps to determine if trap catches are sex-biased.

Simple, standard tests for significance will be used to confirm treatment differences. The appropriate test will be selected in concert with a statistician before treatment implementation.

Measure of Success: Treatments will be judged as successful if significantly fewer numbers of SPB are collected in nearby traps, and if the infestation rate of nearby trap trees is near zero. We expect to develop an efficacious technique to trap SPB emerging from single-tree infestations. We also plan to develop recommendations on treatment application, such as number of traps per tree, time of year treatment is applicable,

frequency of trap inspection, etc. If successful, this technique will be incorporated into the SPB IPM program. We will train potential users in the proper application procedures.

Products and Due Dates: The final products will be an efficacious technique to trap-out emerging SPB from single-tree infestations and recommendations on its applications. These products will be delivered at the close of the project in FY 2004.

Publications: The results will be published in a refereed journal such as the Southern Journal of Applied Forestry.

Technology Transfer: A guide to treatment application will be developed and posted on the Forest Health Protection website. It will also be incorporated into the SPB IPM program on the SPB Internet Control Center. We will also discuss the technique at FHP-sponsored SPB training sessions. We also plan to test expanding its applicability to other bark beetle species or for multi-tree infestations.

LONG-TERM BUDGET REQUEST: (estimates by fiscal year and funding, both monetary and in-kind, excluding FHP base funding) (extend table as necessary)**:**

	Item	**Requested FHP STDP Funding**	**Other-Source Funding**	**Source**
EACH YEAR				
Administration	Salary		4000	FHP
	Salary		3000	SRS
	Salary		3000	TFS
	Overhead			
	Travel	2500		
Procurements	Contracting			
	Equipment			
	Supplies	6000		
Year Totals		8500	10000	

PROJECT TOTALS		25500	30000	

Production Function

Project Number: R8-2001-

Project Cost:

Year	2001	2002	2003	Total
STDP	8,500	8,500	8,500	25,500
Other	10,000	10,000	10,000	30,000
Total	18,500	18,500	18,500	55,500

Project Objectives: This project will develop techniques to trap emerging southern pine beetles (SPB) from infested, individual pines. These trees would otherwise be 1) cut-and-removed, removing both the SPB brood and their natural enemies; or 2) left untreated, producing adults which could initiate or contribute to infestations. This technique would also provide an option for the protection of high-value trees at risk to SPB attack from nearby infested pines. The emerging beetles could be trapped and killed when removal of the infested tree was either not possible or delayed. The benefits of the project are 1) a reduction in area-wide impacts of SPB, resulting in reduced levels of damage; 2) a reduction in pest suppression costs for expanding SPB spots; and 3) preservation of some SPB natural enemies, resulting in shorter length of SPB epidemics. Benefits 1 and 3 equate to a reduction in tree loss and increase in trees at harvest. Other benefits not quantified include the visual and wildlife value of pines protected from the reduction of SPB impacts. This technique will also have benefit as an alternative or additive treatment for the protection of high-value pines. As it is difficult to assign value to these trees and to predict the extent of the use of this technique for this purpose, this benefit was also not quantified in the analyses.

Assumptions:

Benefits will only be calculated for Texas, as the data were readily available. The B/C ratio should be similar throughout the range of SPB.

Benefits will accrue through the time span of a typical SPB epidemic.

Trap-out technique will be used in a 2-year period leading into an epidemic.

250 trees individual infested trees will be treated by trap-out in Texas each year. These are trees that cannot be felled and removed, so there are no treatment costs without the project.

The use of trap-out technique will conservatively yield a 1% savings in SPB suppression costs and a 1% decrease in economic losses.

Trees protected will be harvested in an average of 20 years.

Traps will be reused in year 2.

Background:

Estimated value of damage caused by SPB during epidemic (1991-1993) in Texas: $37,000,000 (Price et al. 1998)

Suppression project costs during epidemic: $5,500,000 (Clarke 1992, Clarke et al. 1993, Texas Forest service data)

Treatment supply cost per tree: 3 traps - $140
3 lures - $25 (Phero Tech Inc. Product Catalog)

Treatment application and monitoring costs per tree: 4 hours x $15/hour.

Treatment costs:
Year 0: Traps $140 x 250 trees = $35,000; lures $25 x 250 trees = $6,250;
Application 4 hrs x $15/hr x 250 trees = $15,000
Total $ 35,000 + $6,250 + $15,000 = $56,250
Year 1: Lures $6,250 + application $15,000 = $21,250 discounted to $20,433
Total: $20,433 + $56,250 = $76,683

Economic value of protected trees increases 3-fold in 20 years. (TSPIRS B/C analyses)

Expenditure and Output Values (EOV) without Project:

Economic damage $37,000,000 + Suppression costs $5,500,000 = $ 42,500,000

Expenditure and Output Values (EOV) with Project:

1% savings x Economic damage $37,000,000 = $370,000 prevention of loss
$37,000,000 - $370,000 = $ 36,630,000 value lost

$370,000 value saved X 3-fold increase = $1,110,000 discounted over 20 years = $506,593

1% reduction X suppression costs $5,500,000 = $55,000 savings
$5,500,000 - $55,000 = $5,445,000 suppression costs

$36,630,000 + $5,445,000 - $506,593 = $41,568,407

Benefit (Change in EOV) Attributable to Project:
$42,500,000 - $41,568,407= $931,593

Benefit/Cost Ratio:
$931,593/(76,683 + $53,393) = 7.16

Benefit Attributable to STDP Funds:
7.16 x $24,532 = $175,696

PNV of Project:
$931,593 **-** (76,683 + $53,393) = $801,517

PNV of STDP:
$175,696 - $24,532 = $151,164

Year	PV Factor	STDP	Other	Disc. STDP	Disc. Other	Total Disc.
0	1.0000	8,500	10,000	8,500	10,000	18,500
1	0.96154	8,500	10,000	8,173	9,615	17,788
2	0.92456	8,500	10,000	7,859	9,246	17,105
		25,500	30,000	24,532	28,861	53,393

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