Special Technology Development Program
New Project Proposal

PROJECT NUMBER: NA-2002-02_New_Proposal

PROJECT TITLE: Development of a Trapping and Monitoring Protocol for Early Detection of Exotic Bark Beetles Near Ports of Entry

PROJECT STATUS: New

EXPECTED PROJECT DURATION: 2 years

EXPECTED COMPLETION DATE OF THE PROJECT: FY03

SUBJECT: 2a Survey and Monitoring Technology; Advancements in Detection Technology: 100%

STATUS OF SUBJECT SPECIES: native/non-native/non-native invasive (All three categories but with an emphasis on "non-native species")

PROJECT OBJECTIVES: The goal of this project is to provide answers to the following 3 questions:

1. What is the optimum number of traps to deploy in a given area to obtain a good (>95%) representative sample of the scolytid species present in the area that are known to be attracted to a specific bait?
2. What types of urban habitats offer the most promise for collecting the widest diversity of bark beetle species?
3. Which lures are the most effective in collecting the widest diversity of bark beetle species?

BRIEF DESCRIPTION OF PROJECT: More than 400 species of exotic forest insects are known to be established in the United States (Mattson et al. 1994), of which at least 44 are exotic species of Scolytidae (Haack 2001). Several of these exotic scolytids were only recently detected in the US. For example, *Hylastes opacus* and *Pityogenes bidentatus* were first detected in 1989 (Hoebeke 1989, 1994), *Tomicus piniperda* in 1992 (Haack and Kucera 1993), *Hylurgus ligniperda* in 2000 (Hoebeke 2001), and *Hylurgops palliatus* in 2001 (Haack 2001). Of these four pine-infesting scolytids, *Hylurgops palliatus*, *Hylurgus ligniperda*, and *Tomicus piniperda* were first detected near major ports along the Great Lakes.

In 2001, USDA APHIS and USDA Forest Service conducted a pilot test along with several state and university cooperators to survey for exotic scolytids and lymantriids at nine US ports. Surveys were conducted at 3 southeastern ports (Alexandria, LA; Baton Rouge, LA; and Houston, TX), 3 northeastern ports (Erie, PA; Oswego, NY; and Toledo, OH), and 3 western ports (Oakland, CA; Portland, OR; and Seattle, WA). At each port city, three trapping sites were selected, such as within the port itself, a nearby urban park, a nearby forest, and/or a nearby wood recycling center. At each trapping site, three traps were deployed, each baited with a different bait (alpha-pinene, ethanol, and ipsdienol). It was recognized by the people involved in the pilot test (which included Robert Haack) that three traps per site, each baited with a different lure, was probably not adequate to collect a truly representative sample of the bark beetle fauna present. However, no studies were found that provided guidelines on what the minimum number of traps should be, nor were there studies that indicated how scolytid diversity changed with different lures. This study will provide data to fill each of these two data gaps.

Year 1. During the first year, we will determine the minimum number of traps that should be deployed in a single site, when using a standard bait (alpha-pinene + ethanol), to ensure that most of the species that could potentially respond are collected. We will target conifer-infesting bark beetles and ambrosia beetles. We will sample five habitat types in each of two port cities. The habitat types will include (1) the ports where cargo is off-loaded from the ships, (2) pallet recycling yards or pallet storage yards, (3) Christmas tree plantations, (4) urban neighborhoods; and (5) parks or wooded preserves. Each habitat type will be replicated 2 to 3 times in each port city. We have tentatively selected the port cities of Erie, PA, and Toledo, OH. Scolytid beetles have been regularly intercepted at both of these ports. For example, USDA APHIS made 287 scolytid interceptions, representing beetles in more than 15 genera, at the port of Toledo during 1985-2000 (Haack, unpublished data; see Appendix A).

Year 2. During the second year, we will determine which lures are the most effective in attracting the widest diversity of scolytid beetles. We will again target the conifer-infesting bark beetles and ambrosia beetles. We will

test a minimum of six different lures at each site. The trapping density at each site will be based on the results from Year 1. We will conduct the tests in each of the same sites that were used during Year 1.

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FHP LEAD INVOLVEMENT:

Name	Role	Time Commitment
Robert Acciavatti	May assist in trap deployment	2%

PRINCIPAL INVESTIGATORS:

Name	Affiliation (Office or Dept.)	Phone, E-mail, Fax
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PRINCIPAL INVESTIGATORS INVOLVEMENT:

Name	Role	Time Commitment
Robert Haack,	Study design, trapping, ID, report writing	10%
Therese Poland	Study design, trapping, ID, report writing	10%
Toby Petrice	Study design, trapping, ID, report writing	20%

COOPERATORS:

Name	Affiliation (Office or Dept.)	Phone, E-mail, Fax
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COOPERATOR INVOLVEMENT:

Name	Role	Time Commitment
E. Richard Hoebeke	Insect ID and confirmation	1%
JM Burch & G Clement	Provide approval & logistical guidance	1%
T Bunting & C Thompson	Logistical guidance on trapping	1%

JUSTIFICATION: There is growing interest in conducting proactive surveys for exotic forest insects in the United States given that, on average, at least one new exotic forest insect has been discovered annually in the US over the past decade. As mentioned above, a pilot test to develop survey techniques for exotic scolytids and lymantriids was initiated in 2001. This pilot study was directed by Dr. Mary Ellen Dix (FHP-WO) and included participants from FS-FHP, FS-Research, APHIS, and several state and university cooperators. In the case of the exotic scolytid survey, it was decided to place 3 traps at each trapping site, baiting the first trap with alpha-pinene, the second with ethanol, and the third with ipsdienol. More traps per site and a wider variety of lures per site was initially desired, but due mostly to budgetary constraints, a smaller scale project was performed in 2001. A survey of the literature in

2000 and 2001 found no published papers that provided guidelines on the minimal trapping density (number of traps per site) to ensure that the vast majority (say >95%) of scolytid species being targeted are collected during the trapping program. Similarly, no papers were found in the literature that described studies in which several different baits were compared as to their efficacy in catching the widest array of scolytid species, although there are several papers that provide details on the trap catch for single baits. The study proposed here will fill these data gaps. That is, results from this study will provide guidelines as to (a) the minimum number of traps to be deployed at any given site when surveying for scolytids, and (b) the best combination of lures to use depending whether a few specific scolytid species or a broad range of scolytids are being targeted. These results will strengthen the FHP program by providing a scientific foundation to its survey efforts. Results from this study will allow FHP to better plan future surveys so that the most appropriate number of traps and lures are used in the effort. This study directly addresses the high priority STDP objective to *"develop or improve detection, analysis, and management of pest species, especially technologies or methods that contribute to our ability to prevent introductions or to detect and eradicate new introductions."*

URGENCY: Information is urgently needed to develop a scientifically based trapping and monitoring protocol for the early detection of exotic bark beetles given that USDA APHIS and USDA Forest Service plan to develop a national survey for exotic scolytids at major ports of entry nationwide. If the national surveys were initiated without knowing the results of the proposed research, then the chances are good that the survey efforts will be inadequate to detect all the exotics that are present.

NATIONAL FHP TECHNOLOGY DEVELOPMENT PRIORITY:

Priority 1: __ Priority 2: __ Priority 3: __ Priority 4: **XX**

TECHNICAL COMMITTEE DEVELOPMENT PRIORITY:

Priority 1: __ Priority 2: __ Priority 3: __ Priority 4: **XX**

Priority 5: __ Priority 6: __ Priority 7: __ Priority 8: **XX**

SCOPE OF APPLICATION: This project will provide information that is applicable to the entire United States, given that exotic scolytids can enter all US states.

RESEARCH BASIS: Exotic forest insects are often transported in solid wood packing material (SWPM) including crating, pallets, and dunnage. During 1985 through 1998, USDA APHIS made nearly 7,000 interceptions of exotic insects on SWPM at nearly 100 US ports (Haack and Cavey 2000). Of these 7000 interceptions, more than 62% were scolytids (Haack and Cavey 2000), indicating that the risk of new introductions is high. As mentioned above, several exotic scolytids have been detected in the US during recent years. For example, *Tomicus piniperda* was first detected near Cleveland, OH, in 1992 (Haack and Kucera 1993); *Hylurgus ligniperda* near Rochester, NY, in 2000 (Hoebeke 2001); and *Hylurgops palliatus* near Erie, PA, in 2001 (Haack 2001).

A review of the scientific literature since 1972 found no published accounts where scolytid diversity was discussed in terms of trapping intensity (number of traps per unit area), nor were any papers found that compared scolytid diversity relative to several different lures. Nevertheless, there are several papers like those of Vite et al. (1972) and Atkinson et al. (1988) in which the diversity of scolytids responding to a single bait was reported. We are also aware of L.M. Humble's unpublished work in the area of Vancouver, BC, in which scolytid diversity was compared among nine different baits. But in Humble's study, only one trap per bait was used at each trapping site.

Since 1993, APHIS has sponsored surveys for various exotic conifer-infesting scolytids under the CAPS (Cooperative Agricultural Pest Survey) program (Cavey et al. 1994). In these surveys, each trap was typically baited with three distinct lures: Ipslure (which primarily targets *Ips typographus*), Chalcoprax (which primarily targets *Pityogenes chalcographus*), and alpha-pinene (which targets several species of *Hylurgops*, *Hylurgus*, and *Tomicus*). However, in these efforts, each trap is baited with all lures, and so it is not possible to compare which beetles are responding to which lures.

Given the above situation, it is clear that there is a need for detailed studies that evaluate scolytid diversity relative to the trapping intensity and the types of lures employed.

METHODS (project design, hypothesis, statistical approach, and QA/QC procedures): Trapping experiments will be conducted near two active US ports: Toledo, OH, and Erie, PA. These ports were selected because they regularly receive SWPM, they have a long history of scolytid interceptions, and exotic bark beetles are known to be established in the vicinity. We will sample five different habitat types in each port city. The habitat types will include (1) the ports where cargo is off-loaded from the ships, (2) pallet recycling yards or pallet storage yards, (3) nearby Christmas tree plantations, (4) urban neighborhoods; and (5) parks or wooded preserves. Contacts have already been made with APHIS personnel at each port and several sites have been tentatively selected. Each habitat type will be replicated 2-3 times in each port city. Trapping sites will generally be located within 10 km of the port. At each sampling site, 16 Lindgren funnel traps will be deployed in a 4 x 4 grid pattern with a minimum distance of 50 m between traps. Although 16 traps per site may still not be intense enough to collect extremely rare scolytids, we believe that this trapping intensity (a) is very adequate to collect the vast majority of the species present, and (b) represents a higher trapping intensity than will likely ever be used in a national program. A minimum of 320 traps will be used in this study: 2 ports x 5 habitats/port x 16 traps/site x 2 replicates = 320 traps). As a means to test the assumption that 16 traps is adequate, we will expand at least two of the grids from a 4 x 4 grid (16 traps) to a 8 x 8 grid (64 traps), and compare the species richness of each.

In Year 1 of the study, all traps will be baited with the same combination of alpha-pinene plus ethanol, which will collect a wide variety of native and exotic scolytids. Insects will be collected from traps every 1 to 2 weeks, placed in labeled zip-lock bags, and identified. The diversity of scolytids captured (numbers of species) will be compared among habitats types, as well as among traps within each trapping site. To determine the effect of trapping intensity, the number and diversity of scolytids captured will be compared when considering all traps or various sub-samples of the traps (e.g., every other trap, every 4th trap, etc.). In this way, species accumulation curves will be generated and compared among sites, habitat types, and port cities. Analyses will be performed using standard diversity index tests, e.g., species richness, Shannon, Margalef. The approximate number of traps needed per site to collect 50%, 90%, or 95% of all the species collected will be generated from the species accumulation curves for each habitat type and port city. A subsample of the scolytids will be sent to one or two outside identifiers as a check on our species identification.

In Year 2, we will compare the numbers and diversity of scolytid species collected in traps baited with a minimum of six different lures. Each trap will be baited with only one lure or a combination of lures. The trapping intensity for each type of bait will be based on the number of traps needed, using Year 1 data, to collect 95% of the scolytid species present. We anticipate that 5-8 traps per site per bait may be needed to collect 95% of the potentially responding scolytid species. In Year 2, we will trap the three habitat types that had the greatest scolytid diversity during Year 1. At each trapping site in Year 2, we set out clusters of traps, with no traps being any closer than 25 m. If, for example, 5 traps per site is found to be the "ideal" trapping intensity, then we will deploy 30 traps/site (6 baits/site x 5 traps/bait = 30 traps/site). Thus, we will deploy a minimum of 360 traps in Year 2 (2 ports x 3 habitats/port x 2 replicates x 30 traps/site =360). Results from Year 2 will be analyzed as in Year 1, however, the emphasis will be placed on the variation in scolytid species diversity as influenced by bait type. Lures will include such compounds as the 3-component Ipslure, alpha-pinene, beta-pinene, 3-component *Tomicus piniperda* lure, and ethanol. Other compounds may include attractants such as dipentene and methyl salicylate, as well as pheromones such as lineatin. A variety of these lures will be pilot tested in a separate study in 2001 to evaluate their potential.

MEASURES OF SUCCESS:

Standard of Success: This project will be considered successful if new knowledge is obtained that provides scientifically-based guidelines on (1) the proper trapping intensity to be used during standard survey efforts for exotic scolytids, and (2) how scolytid diversity is influenced by habitat type and the bait used.

Expected Outcomes: It is expected that state and federal agencies involved in survey efforts for exotic scolytids would adopt the findings of this project when developing their survey protocols. Moreover, if these findings are adopted, it is expected that new exotic scolytids will be detected more frequently and earlier, thus allowing the possibility for eradication of new introductions.

Implementation of Products/methods: Survey guidelines will be prepared at the end of the study and made available to state and federal agencies involved in plant pest protection. Information will also be made available on the Internet.

PRODUCTS AND DUE DATES:
PUBLICATIONS: A project report will be completed at the end of each year of funding, with final results being

published in scientific journals and on the Internet.

TECHNOLOGY TRANSFER: The products of this project will be transferred primarily to regulatory officials, forest entomologists, and forest health specialists. The information will be made available through publications, presentations, electronic mail, and posting of the results on the Internet.

PRODUCT LEVERAGING: In general, this project builds on past research in the areas of bark beetle chemical ecology and trapping methods. Although an independent effort, this study is linked to the exotic scolytid and lymantriid survey pilot test that was conducted at nine US ports in 2001.

LONG-TERM BUDGET REQUEST:

	Item	Requested FHP STDP Funding	Other-Source Funding	Source
FY 2002				
Administration	Salary	6,000	24,000	USFS-NC
	Overhead (ca. 17%)	6,000		
	Travel	6,000	3,000	USFS-NC
Procurements	Contracting			
	Equipment	16,000		
	Supplies	6,000		
YEAR TOTALS		**40,000**	27,000	

FY 2003				
Administration	Salary	6,000	24,000	USFS-NC
	Overhead (ca. 17%)	3,000		
	Travel	6,000	3,000	USFS-NC
Procurements	Contracting			
	Equipment			
	Supplies	6,000		
YEAR TOTALS		**21,000**	27,000	

LONG-TERM BUDGET REQUEST EXPLANATION: BUDGET REQUEST: Salary is requested for two student employees to work fulltime during the summer months and part time during the school year. Travel is requested for 6 round-trips to the field sites, with 4 employees travelling on the first and last trips, and 2 employees travelling during the other four visits. It is anticipated that each trip will require a full week of travel (MI to OH to PA to MI). This equates to approximately 80 travel days at $85 per diem, which is over $6000. We are requesting funds to purchase 400 Lindgren 12-unit funnel traps at approximately $40 each = $16,000. Supplies costs are primarily for the lures, which vary in cost between $6 to $12 each. We anticipate that some lures will have to be replaced during the course of the study. The expected overhead charged by the USFS North Central Research Station is about 17%. In-kind contributions will be made by USFS North Central Research Station in the areas of salary (for Haack, Poland, and Petrice) and travel (vehicle and mileage charges). In addition, other in-kind contributions may be made by FHP staff (Acciavatti), APHIS port personnel, and limited taxonomic services (species confirmations by Hoebeke). The USFS North Central Research Station will pay any consulting fees that are required to obtain taxonomic services.

BENEFITS: The main benefit from this project will be the development of scientifically-based guidelines for conducting exotic scolytid surveys. By using these guidelines, forest health specialists will (1) have greater confidence in the results of their survey efforts, especially when no exotics are detected, and (2) detect new exotics earlier when eradication is still an option. Moreover, the results from this project (i.e., the trapping inensity needed) will provide data that forest health specialists can use when requesting funds to conduct a survey.

LITERATURE, CITATIONS, ATTACHMENTS, etc.:

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Hoebeke ER. 1994. New records of immigrant bark beetles (Coleoptera: Scolytidae) in New York: attraction of conifer-feeding species to ethanol-baited trap logs. Entomological News 105: 267-276.

Hoebeke ER. 2001. *Hylurgus ligniperda*: a new exotic pine bark beetle in the United States. New records of immigrant bark beetles (Coleoptera: Scolytidae) in New York. Newsletter of the Michigan Entomological Society 46 (1-2): 1-2.

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Vite JP, Gara RI, Svihra P. 1972. Survey of the seasonal flight pattern of *Ips typographus* L. with an attractant trap in Slovakia. J. Applied Entomol. 72: 80-92.

Appendix. Number of scolytid interceptions on solid wood packing material during the period 1985-2000 at the port of Toledo, Ohio. Source USDA APHIS, Port Information Database, as compiled by RA Haack.

Port city	Scolytid genus	Number
TOLEDO	*Crypturgus*	1
	Dryocoetes	15
	Hylastes	13
	Hylesinus	4
	Hylurgops	44
	Hylurgus	4
	Ips	20
	Orthotomicus	9
	Pityogenes	28
	Pityophthorus	1
	Polygraphus	2
	Scolytidae Species	58
	Scolytus	25
	Taphrorychus	11
	Tomicus	51
	Trypodendron	1
Total		287