Report of the 1993 National Bark Beetle Steering Committee Meeting

October 12-13, 1993
Albuquerque, NM

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The National Bark Beetle Steering Committee met in Albuquerque with the following objectives:

1. Report on the results of all bark beetle related activities over the past year,
2. Identify and prioritize potential TDP projects
3. Review 5-year Strategic Plan

Members reported on all activities, identifying cooperators and sources of funding for each project. A summary of these projects and accomplishments are attached.

Dave Thomas reported on the status of MCH registration. The draft registration package has been put together, including the six additional studies that had been required by EPA. The entire package was submitted in April. EPA has not been particularly responsive with regard to the registration, however, Dave feels with the change in the Administration and the elevated emphasis on alternative uses to pesticides that there is more opportunitiy for a response from EPA. Currently we are operating under an Experimental Use Permit. An extension to the EUP for the use of bubble caps was approved. He was still waiting for a response regarding the extension for the beads.

There was discussion about the various delivery devices. The bead formulations do not seem to work for verbenone, and release rates appear to be dependant on temperature. Lonnie tested the release of MCH from beads over time in Santiam Pass, and determined that, under those conditions, most MCH was essentially gone in 30 days. Beads with MCH apparently did not work in Alaska. This may be because the soil in Alaska was too cold and the MCH did not release. The Committee recommended that we do not use the beads until a data base for elution rates under various conditions is established. It was suggested that Hercon strips might be able to control the release rates better than beads. PheroTech bubble capsules seem to be working consistently now. Based on this discussion and the results of several projects the Committee felt it was important to establish a data base of elution rates of the different devices (bubble caps, beads, Hercon strips, etc.) under various conditions and temperature regimes.

Lonnie reported on the results of distribution of pheromone within the crowns. Generally, vertical distribution within a stand is covered by 50 meters downwind. This means that the protective pheromone zone is not necessarily where the pheromone is placed. This should be taken into consideration when designing a pheromone related test.

There was some discussion regarding the Western Bark Beetle Model. Following the User's Meeting last May, many of the Steering Committee members were concerned with the results of the model, the approach that was used, and the direction the model was taking. Some of the concern centered around the utility of large, broad models versus narrowly focused models for specific applications. Many of the members felt there had not been enough participation from committee members in the discussions and development of the model. It was agreed that the Committee concerns would be forwarded to WO-MAG.

Copies of the draft 5-Year Strategic Plan were reviewed. Comments and suggestions are to be provided so a final Plan can be devloped.

The next National Bark Beetle Steering Committee meeting will be held in Whitefish, Montana on October 4-6, 1994.

Reports were presented on 47 bark beetle related projects; in addition there was discussion on the westwide bark beetle model and the status of research on *Tomicus* and *Ips typographus*. Of the 47 projects, 12 (27%) were funded all or in part with Technology Development Project funds.

Based on the results from projects conducted this year, projects were identified and prioritized for FY'94 Technology Development Funding. These were:

PRIORITY NEEDS

1 Develop a Data Base for elution rates of semiochemicals for various devices (beads, bubble caps, Hercon strips) under various environmental conditions.

2 Determine the optimal dosage of MCH bubble caps for protecting Douglas-fir from attack by Douglas-fir beetle.

3 Use of MCH bubble caps for protecting different species of spruce from attack by spruce beetles in various geographic locations.

4 Antiaggregation pheromone combinations for preventing *Ips paraconfusus* and *Ips pini* in dispersed and piled ponderosa pine slash in California.

5 Douglas-fir beetle hazard rating system.

6 Antiaggregation pheromones for preventing *Ips pini* in slash in Idaho/Montana.

7 Flight periodicity and antiaggregation of roundheaded pine beetle.

8 Roundheaded pine beetle hazard rating system.

9 Effects of spruce beetle on plant diversity and wildlife habitat. *

10 Calibration and determination of effective distance of trap recovery for use of pheromone traps as a survey tool.

11 Use of methyl chavicol for antiaggregation of mountain pine beetle in ponderosa pine.*

* These projects were identified as possibly also being appropriate projects for funding through the National Forest Health Center.

Summary of 1993 Bark Beetle Projects

Mountain Pine Beetle

In general, mountain pine beetle emergence was late because of the weather. This would be good for testing the accuaracy of the mpb phenology model.

Project: Use of verbenone for antiaggregation of mpb in lodgepole pine.
Cooperators: Ken Gibson R1 and Pat Shea PSW
Funding: TDP
Summary: The objective was to keep beetles out of a stand using verbenone; also wanted to determine the period of time verbenone was eluted from beads. Verbenone in bead formulation was applied aerially. One application rate (4 lbs/acre) was tested, but two different beads were used - the standard "525" bead and a new "Dow" bead. Verbenone used is the enantiomer, 86/14 (-86%/+14%). Results were similar with both beads. Preliminary results indicate no treatment effect when comparing new attacks in treated and untreated plots. The problems seem to be with keeping verbenone in the bead.
Future Action/Recommendation: Recommend that we do not do any more aerial applications until we have an improved bead formulation or delivery syetem. Need to determine how pheromone bead releases under various environmental conditions, and establish a data base for all pheromone release devices.

Project: MPB attacks following fire in Yellowstone.
Cooperators: Jesse Logan, Lynn Rassmussan, INT
Funding: FIDR
Summary: Continued to sample residual bark beetle populations following the 1988 Yellowstone fires. Mortality was about 18%. This will be the last year of this study.
Future Action/Recommendation: None

Project: Use of pheromones to protect fire-injured lodgepole from mpb.
Cooperators: Steve Munson, R4 and Lynn Rassmussan, INT
Funding: TDP
Summary: The objective of this project was to determine the attractiveness of fire damaged lodgepole to mpb and determine effectiveness of verbenone to keep mpb out of the stands. Simulated fire conditions were used in the Sawtooth National Recreation Area to determine attractiveness. There were more mass attacked trees in the fire area than in the untreated stands.
Future Actions/Recomendations: None

Project: Use of pheromones in push/pull strategy to manage mpb populations in lodgeploe pine forests.
Cooperators: Steve Munson,R4 and Lynn Rassmussan, INT
Funding: TDP
Summary: Objective was to determine if we could manipulate mpb populations within a stand. Our goal was to "push" beetles out of previously infested areas of the stand with verbenone (an antiaggregating pheromone), into a "pull" area of the stand baited with mpb aggregating pheromone. The intent is to consolidate attacked trees into a concentrated area where infested trees are easily identified and removed by land managers before the current mpb brood is released. The use of mpb baits was highly effective in grouping attacks.

However, the verbenone "push" plots were not significantly different from the control plots. We next propose utilizing bait plots to infest stands of dwarf mistletoe infected trees. Goals will be to manipulate beetle populations out of helathy stands and into managed stands, improve health of diseased stands by removing infected trees , and provide an easily managed area for fuelwood harvest.
Future Actions/Recommendations: We need to have some ability to measure the effect of removing beetles from the area. What are we preventing? How do we determine the effectiveness of concentrating beetles into stands where they can easliy be removed.

Project: Evaluate response differences in old and new populations.
Cooperators: Lynn Rassmussan, INT
Funding: FIDR
Summary: Objective of this study was to determine if there were any differences in response to aggregating compounds between old and new mpb infestations. Results indicate there were no striking differences .
Future Action/Recommendations: None

Project: Determine if methy chavicol has antiaggregating effect on western pine beetle and mountain pine beetle.
Cooperators: Jesse Logan, INT
Funding: FIDR
Summary: Methyl chavicol is a host response material. The methyl chavicol decreases as the tree is stressed so the lack of repellent when the tree is stressed may be what the beetles are responding to. Methyl chavicol was used in traps with a lure and by itself. It appears to have repellent effects with western pine beetle and less so with mountain pine beetle in lodgepole pine.
Future Actions/Recommendations: Prehaps can augment with verbenone. Also look at the response of mpb in ponderosa pine.

Project: Bait and dissipate studies
Cooperators: Jesse Logan, INT
Funding: FIDR
Summary: Objective was to manipulate endemic mpb populations in high hazard/risk stands. Placed bait in an area outside of hazard stands in an attempt to dissipate beetles. Had some unanticipated tree mortality.
Future Action/Recommendations: None

Project: Evaluate hazard/risk rating schemes
Cooperators: Jesse Logan, INT
Funding: FIDR
Summary: General hazard/risk rating schemes do not seem to be useful. Population dynamics are missing. Need to accomodate regional differences in the hazard/risk system.
Future Action/Recommendations: Need to look at the Beetle Pressure Index used by BC Forestry.

Project: MPB/WPB flight periodicity and response to compounds in an eastside ponderosa pine site.
Cooperators: Pat Shea and George Ferrell, PSW
Funding: FIDR

Summary: Objective was to determine flight periodicity and responses to compounds in drought stressed trees. Beetles are in the air flying over a 5 month period. The two species appear to be sympatric or share compounds: found wpb in mpb traps, but rarely mpb in wpb traps. Wpb appears to be responding to a variety of things.
Future Actions/Recommendations: Use phenology model to determine if there are multiple generations.

Western Pine Beetle

Because of the late season, there was a delay in beetle flight and are still collecting data so do not have complete results to report.

Project: Antiaggregation effects of verbenone plus ipsdienol.
Cooperators: Pat Shea, PSW and John Wenz, R5
Funding: FIDR
Summary: Combinations of verbenone plus ipsdienol were used to determine antiaggrigation effects on wpb. Data is still being collected and summarized. Four of the five controls sampled have attacks inside the plots.
Future Action/Recommendations: None

Project: WPB flight periodicity studies.
Cooperators: Pat Shea,PSW
Funding: FIDR
Summary: Continued statewide flight periodicity studies in California. This was the fourth year of the study. Do not yet have data summarized but results will be different this year because of weather effects.
Future Actions/Recommendations: None

Project: Flight periodicity by elevational gradient.
Cooperators: Pat Shea, PSW and John Wenz, R5
Funding: FIDR
Summary: A transect of traps was placed along the elevational gradient throughout the conifer type. Traps were monitored to determine flight periodicity of wpb, mpb, *Ips pini* and *Ips paraconfusus*. Are finding that wpb are flying all the time with peak flights occuring at various times.
Future Action/Recommendation: Need a pheromone (releasor) that will last throughout the whole summer.

Project: Wpb attack of baited scorched ponderosa pine
Cooperators: Ralph Thier, R4
Funding: S&TA
Summary: Objective was to see if beetles could be effectivly manipulated into scorched trees that were planned for salvage. Baited trees were randomly selected. Number of attacks on specified surface areas on the trees were counted. Baited trees received 10x as many attacks as unbaited scorched trees.
Future Action/Recommendations: None

Roundheaded Pine Beetle

Project: Flight periodicity of roundheaded pine beetle and inhibition of roundheaded pine beetle using various enantiomeric blends of verbenone.
Cooperators: Dayle Bennett and Jill Wilson, R3 and Pat Shea, PSW
Funding: TDP
Summary: Study has identified an attractant for roundheaded pine beetle. Were surprised to find small peak summer flights occurred in addition to the expected large fall flight. Determined that most verbenone blends were effective in shutting down the attractive response to the baits.
Future Action/Recommendations: Test blends of verbenone for area-wide effectiveness.

Jeffrey Pine Beetle

Project: Identify jeffrey pine beetle pheromone complex.
Cooperators: Pat Shea, PSW; Tim Paine and Jocelyn Millar, University of California,Riverside
Funding: FIDR
Summary: Have identified heptinol, which is a host compound unique to jeffrey pine, and heptane as attractants. Attractants have a male bias. Also have developed the best combination of heptinol and heptane. Are now trying to identify the male compound.
Future Action/Recommendations: Plans are to expand study statewide and to identify the male compound.

Southern Pine Beetle

Project: Use of novel host compounds (methyl chavicol) to prevent southern pine beetle attack.
Cooperators: Jane Hayes, SO; FPM R8; Kisatchie NF
Funding: National Center for Forest Health
Summary: Lab assays of individual beetles and field population assays using baited pheromone traps indicate the consistent repellent properties of this coumpound throughout the year. Repellency was at least equivalent to verbenone. Successful protective treatment demonstrations have been established in red cockheaded woodpecker colonies.
Future Action/Recommendations: Continue ongoing evaluations and conduct a large-scale evaluation of the effectiveness of this technology for protection of red cockheaded woodpecker cavity trees.

Project: Thinning in old growth stands to reduce impacts of spb.
Cooperators: FPM R8
Funding: TDP
Summary: This study is part of the TDP Southern Pine Beetle Demonstration Area project. There is very little work with managing longer rotations of southern pines and this was set up to demonstrate thinning and managing pines to reduce susceptibility to spb while managing on a longer rotation.
Future Action/Recommendations: Continue to follow study.

Project: Effects of thinning on southern pine beetle risk to old-growth stands.
Cooperators: Peter Turchin, SO
Funding: FIDR
Summary: There is increased public interest in longer than traditional rotations of pines. However, old growth stands are susceptible to attack by spb. This project will determine whether spb risk in old-growth pine stands can be minimized by thinning, and how spb risk is affected by the presence of hardwoods. Spb populations are being introduced into the experimental stands to determine the rate of growth of the resulting infestations.
Future Action/Recommendations: Continue study.

Project: Combination of verbenone and buffer to stop spb spots.
Cooperators: R8, FPM; Texas Forest Service; University of Georgia; Virginia Polytechnic Institute
Funding: TDP
Summary: Project has demonstrated that you can shut down an active southern pine beetle spot by putting verbenone as a buffer around the active head of the spot and felling the trees behind the buffer. This was a very dry summer in Texas. There were also problems with the lures because the polymer for the release device was too thick.
Future Action/Recommendations: Continue to evaluate the operational effects of verbenone.

Project: Determine the energy reserves of individual southern pine beetles.
Cooperators: Don Kinn, SO
Funding: FIDR
Summary: A clinical chemistry method for determining cholesterol levels has been adapted for use in determining total lipid content of individual southern pine beetles. The percentage of lipid based upon dry weigth is significantly greater in females than males. In lab flight mill tests, flight duration and distances are significantly greater for females. Based on flight mill studies the average flight velocity of the southern pine beetle is 19 meters/minute and the average distance flown is 3000 meters. Results suggest that beetles are capable of much wider distribution.
Future Action/Recommendations: None

Project: Pathogenicity to loblolly pine of fungi recovered from trees attacked by spb.
Cooperators: Thelma Perry, SO; FPM R8
Funding: FIDR
Summary: Root pathogens associated with trees attacked by southern pine beetle are being isolated and identified to species. Forty one different species of fungi have been isolated and identified. Eighty two percent of the trees in spb infested plots were infected with one or more strains of fungi, while 35 percent of the trees in the control plots were infected. Variables such as soil type, hazard rating for annosum root disease, and stand density are being analyzed to determine if there is a relationship among the variables and the presence of the fungi.
Future Action/Recommendations: None

Project: Spatial dynamics of bark beetle/natural enemy interactions.
Cooperators: Peter Turchin, SO
Funding: FIDR
Summary: This study measures the aggregating response of natural enemies to local infestations of bark beetles and will determine whether the ratio of natural enemies to bark beetle densitities determines whether an outbreak will arise in one location and not another. The approach will be used on two different systems: the spb in the US, and a bark beetle (*Orthotomicus erosus*) in Isreal.
Future Actions/Recommendations: None

Project: Water deficits in loblolly pine lead to increased secondary metabloism and enhanced resistance to the spb.
Cooperators: Matthew Ayers and Peter Lorio, SO
Funding: FIDR, Southern Global Change Program
Summary: Effects of water regimes on mature loblolly pines using rain shelters, natural precipitation, and irrigation were evaluated. Treatments were successful in manipulating soil water and impacting tree water potentials. Tree growth increased dramatically with increasing water availability, but photosynthesis was unaffected until the second year when it declined somewhat in sheltered trees. Apparently due to these differential effects on growth and photosynthesis, oleoresin flow in response to wounding increased sharply in sheltered trees. High resin flow impeded beetle gallery construction so that those attacking sheltered ("stressed") trees produced only 17-68% as many progeny as those attacking irrigated trees. They are also exploring the consequences of climate change for tree-beetle interactions, and evaluating the potential for amelioation through silvicultural practices.
Future Action/Recommendations: Pursuant projects will extend the physiologically-based models to forest and ecosystem level processes.

Project: Impact of *Thanasimus dubius* on spb.
Cooperators: John Reeve, SO
Funding: FIDR
Summary: This study is to measure the effect of the predator, *T. dubius*, on adult spb during the attack process. Bolts with spb were exposed to clerid predation for 24 hours. At densities typical of those found in the field, clerids caused significant mortality of spb. This suggests that invertebrate predation during mass attack may be an important source of spb mortality.
Future Action/Recommendations: None

Spruce Beetle

Project: Use of MCH beads alone and in combination with ipsdienol and endo:exo brevicomin to deter spruce beetle attack in felled spruce
Cooperators: Skeeter Werner, PSW; Ed Holsten, R10; Pat Shea, PSW
Funding: FIDR (1993); TDP previous years
Summary: Two rates of beads containing MCH plus ipsdienol and endo:exo brevicomin mix were applied to felled trees in a right-of-way. There was no difference between the treatments and the control. Do not think that the MCH was eluting from the beads because the beads are formulated to release at 22 degrees C and the ground temperature never exceeded 16 degrees C; as a result the MCH did not elute.

Future Action/Recommendations: No future efficacy work with MCH beads until we establish a data base on elution rates at various temperatures.

Project: Use of MCH beads to protect standing spruce trees.
Cooperators: Skeeter Werner, PNW; Ed Holsten, R10: Pat Shea, PSW
Funding: FIDR (1993)
Summary: MCH beads were applied in standing green trees to prevent spruce beetle attack. There was no difference between treated and untreated plots. As in the previous study, there is doubt the MCH was eluting from the beads.
Future Action/Recommendations: No future efficacy work with MCH beads until we establish data base on elution rates at various temperatures.

Project: Use of MCH bubble caps to protect standing spruce trees.
Cooperators: Skeeter Werner, PNW; Ed Holsten, R10; Pat Shea, PSW
Funding: FIDR
Summary: Bubble caps containing MCH were placed on trees throughout susceptable stands at various rates per acre. MCH bubble caps were dispersed at 32 and 50 caps per acre; the 50 cap rate significantly reduced attack levels of spruce beetles when compared to 32 caps/acre and control stands.
Future Actions/Recommendations: Bubble caps at 50/acre appear to be effective for preventing attacks on standing trees. Need to evaluate in 1994 for operational use over larger areas.

Project: Dispersal of spruce beetle.
Cooperators: Skeeter Werner, PNW
Funding: FIDR
Summary: Beetle flight was monitored from a group of infested spruce trees along eight transects at distances of 100, 300, 500, 100, and 1,500 feet. Beetles were caught at the greatest distance from the the point of dispersal; however, most beetles were caught within 300 feet from the release point.
Future Actions/Recommendations: Three year study completed.

Project: Spruce beetle trapout
Cooperators: Skeeter Werner, PNW; Ed Holsten, R10; Roger Burnside, AK DOF.
Funding: FIDR
Summary: Groups of 5 funnel traps were baited with high concentrations of alpha pinene + frontalin + MCOL were placed in openings around stands of spruce with low populations of spruce beetles. Trees within plots were monitored for beetle activity before and after treatment. Trap out did not reduce the number of newly infested trees from attack by 1-year-cycle beetles, but did reduce 2-year-cycle beetle attacks during the second year of the study.
Future Action/Recommendations: Expand study to include various configurations of traps and trap placement.

Project: Host resistance in spruce to spruce bark beetles
Cooperators: Skeeter Werner, PNW; Barbara Illman, FPL; Erkki Annila and Pekka Niemela, Finnish Forest Research Institute.
Funding: FIDR

Summary: There are indications that stilbene-like compounds are prevalent in stressed spruce trees, especially around reaction zones of new beetle attacks. These compounds are phenolic in origin and have been found in Lutz, Sitka, white, and Norway spruce. Fertilization studies are underway in Alaska and Norway using N, K, and NPK in order to promote increased levels of the phenolic compounds, and therefore, host resistence.
Future Action/Recommendations: Continue study; include cooperation with scientists from Norway; possibly get a grant from OIGC.

Project: Pyrethrin insecticide to prevent spruce beetle attack.
Cooperators: Steve Munson, R4 and Utah State University
Funding: TDP
Summary: Sevimol is the standard insecticide used to protect trees from attack by spruce beetle. It is possible that Sevimol may not be available next year. Other formulations of sevin such as wettable powders will be, but wettable powders are not as effective. Three formualtions, Sevimol, Asana, and Tempo-2 were tested. Treatments were applied this year, and study will continue into next year. Company that makes Asana is moving to get conifer tree protection on the label. Tempo producers have not yet made a decision to go for a label.
Future Action/Recommendations: Continue study.

Project: Use of data visualization for decision making
Cooperators: Steve Munson, R4; MAG; University of Illinoise
Funding: TDP
Summary: Project has been completed. Data visualization was very effective in communicating with the public to show them the projected effects of spruce beetle over time. Project report has been published.
Future Action/Recommendations: None

Douglas-fir Beetle

Project: Use of aerially applied MCH beads to protect standing green trees from attack by dfb.
Cooperators: Dave Bridgwater, R6; Ken Gibson, R1; Ralph Thier, R4; Lonnie Sower, PNW Station; Ladd Livingston, IDL.
Funding: TDP
Summary: Objective was to protect standing green Douglas-fir from attack by dfb. Treatments were 0, 10, 30, and 100 grams of MCH impregnated into ploymer beads. The 30 gram treatment was approximately equivalent to the standard 4 pounds per acre. Treatments were replicated four times. Application was with an aerial seeder/spreader slung beneath the helicopter. Material was applied in April and the plots were evaluated in September. Because of extremely poor and/or extended beetle flight, results were inconclusive; there were not enough attacks in any block to determine treatment effect.
Future Actions/Recommendations: Still believe the method may be promising, however, should be tested in a time/place where treatment can be assessed. Also need to evaluate the perfomance of the release devices (beads) under various conditions.

Project: Douglas-fir beetle response to mass trapping and ground applications of an antaggregating pheromone (MCH).
Cooperators: Gary Daterman, PNW; Darrell Ross, OSU
Funding: FIDR

Summary: The objective of this study was to develop a treatment to minimize Douglas-fir beetle-caused mortality in high-valued stands using aggregation and antiaggregation pheromones. In 1992, a combined treatment of MCH bubble capsules and attractant-baited Lindgren funnel traps was compared to an untreated check. The mean percentage of host trees (approx. 20 cm dbh) that were mass attacked was significantly lower on the treated plots (1.7%) compared to the check plots (8.7%). In 1993, MCH bubble capsules alone (i.e., without the suppression traps) were tested at a rate of 150 capsules per hectare. The mean percentage of host trees that were mass attacked was again significantly lower on the treated plots (0.2%) compared to the check plots (8.5%).
Future Actions/Recommendations: These results demonstrate that MCH bubble capsules alone, or in combination with attractant-baited Lindgren funnel traps can effectively reduce the infestation of live trees in high risk stands. The final step in developing this technology for operational use is to determine the minimum effective dose of MCH. Registration of MCH by EPA should be facilitated as much as possible.

Project: Development of area-wide trap-out strategy for managing the Douglas-fir beetle
Cooperators: Gary Daterman, PNW; Darrell Ross, OSU
Funding: FIDR
Summary: The objective of this study is to develop strategies for reducing Douglas-fir beetle impact over large areas with attractant-baited traps. Three replications were installed in 1992 on the Wallowa-Whitman NF. Each replication consists of a pair of adjacent sections (1 sq. mile); one treated and one untreated. The sections were selected based on the presence of host type and evidence of recent beetle activitiy. Twelve to fourteens clusters of three baited Lindgren funnel traps placed throughout the treated sections. The trap clusters were located as far from host trees as possible. Similar locations were identified in the untreated sections, but traps were not placed there. Traps were left in the field troughout the summer of 1992, and were reinstalled in the spring of 1993. During both years, traps were emptied and maintained at 1-3 week intervals. More than 1.5 million Douglas-fir beetles have been trapped in the treated sections. Various approaches have been used to evaluate the effect of the trapping on the Douglas-fir beetle population. Samples are still being processed and results are not yet available.
Future Action/Recommendation: Future actions are dependant upon the results of the project, which will be summarized by the spring of 1994.

Project: DFB and associated preditor response to pheromone components.
Cooperators: Darrell Ross, OSU and Gary Daterman, PNW
Funding: OSU General Research Fund
Summary: The objective of this study was to determine the relative attractiveness of various mixtures of the dfb pheromone components to the beetle itself and its associated predators. The intent was to identify a mixture that was highly attractive to the dfb, but weakly attractive to the predators. A factorial design was used to compare frontalin alone to all possible combinations of frontalin and three alcohols (seudenol, MCOL, and ethhanol). Among the alcohols, seudenol was the most attractive to dfb followed by ethanol and MCOL. There was no evidence of synergism among the alcohols. Seudenol significantly increased the percentage of male dfb caught, while ethanol had the opposite effect. MCOL had no effect on the sex ratio of beetles caught. Seudenol also significantly increased the catch of clerids. The other alcohols had no significant effect on clerid catch.

Future Action/Recommendation: Based on these results the most effective bait for trapping the dfb is a combination of frontalin, seudenol, and ethanol. Although excluding seudenol from the mixture will significantly reduce the number of clerids and the percentage of male dfb caught, it will also significantly reduce the total catch of dfb. Methods of physically excluding clerids from baited traps should be studied.

Project: Optimal dosage of MCH bubble capsules for preventing the infestation of downed logs by dfb.
Cooperators: Lonnie Sower, PNW; Dave Overhulser, ODF; Darrell Ross, OSU
Funding: FIDR, OSU
Summary: The objective of this study was to compare three doses of MCH bubble capsules for preventing the infestation of downed logs by the dfb. Ten replications of four treatments were installed in the spring of 1993. Five replications were in natural blowdown on the Tillamook State Forest near Jewell, OR and five were installed in felled trees on the Paul M. Dunn State Forest near Corvallis, OR. Treatments included no bubble capsules and bubble capsules spaced at 2, 5, and 10 meter intervals along the tree boles. The five replications near Corvallis were discarded because the beetle activity was too low (i.e. almost no attacks on treated or untreated logs). All three MCH doses in the Jewell replications significantly reduced the number of dfb attacks compared to the untreated check. Although there was a slight dose effect, there was no significant differences among the three MCH doses tested.
Future Action/Recommendation: The study should be repeated where conditions are appropriate to add to to the limited amount of data collected in this study.

Project: Pathogenicity of dfb associated blue-stain fungi (*Ophiostoma pseudotsugae* and *Leptographium abietinum*) to Douglas-fir
Cooperators: Darrell Ross, OSU; Halvor Solheim, Norwegian Forest Research Institute.
Funding: OSU
Summary: The objective of this study is to determine the pathogenicity of *Ophiostoma pseudotsugae* and *Leptographium abietinum* to Douglas-fir. In spring 1993, eight trees were inoculated with each of the fungi at three different densities (200, 300, or 800 sites per mq. meter) for a total of 48 trees. The methods were similar to those used in other studies in Norway with related fungi. The trees were harvested on Nov. 4-5, 1993 and samples are currently being processed.
Future Action/Recommendations: Future action will be dependant on results to be summarized by spring of 1994.

Fir Engraver

Project: Identify fir engraver pheromone
Cooperators: Pat Shea, PSW Station
Funding: FIDR
Summary: The initial step is to identify the pheromone(s) for fir engraver. There is a student in Canada currently trying to identify this compound.
Future Action/Recommendation: Continue work to identify the compound.

Errata

Report of the 1993 National Bark Beetle Steering Committee Meeting
(Replaces summary "Brood productivity in slash" on bottom of page 13)

Project: Effects of overstory density on Ips pini brood production in ponderosa pine slash in northern Arizona
Cooperators: Jill Wilson, R3; and Mike Wagner and Jaime Villa-Castillo, Northern Arizona University
Funding: Northern Arizona University and FPM S&TA
Summary: The purpose of the projects is to evaluate effect of overstory density on Ips pini population dynamics in ponderosa pine slash. The effects of four thinning intensities were examined. Measurements were taken on both physical and insect attributes: heat flux density, light intensity, log moisture (top and bottom), Ips attack and egg gallery density, Ips egg and larval gallery lengths, and Ips productivity (ratio of brood emergence and attacks). All the Ips variables were measured on both the top and bottom of the logs.
Future Action/Recommendations: Study continuing.

Project: Effects of slash management practices on Ips spp. brood production in ponderosa pine
Cooperators: Jill Wilson, R3; and Mike Wagner and Victoria Wesley, Northern Arizona University
Funding: Northern Arizona University and FPM S&TA
Summary: This study is evaluating the effects of slash piece size, both diameter and length, on Ips pini and Ips lecontei population dynamics at two locations in southeastern Arizona. Log bolts of two different diameters (4 and 8 inches) were cut into three different lengths (2,4, and 8 feet) in order to test the hypothesis that slash piece size affects Ips brood production. Seasonal production of Ips is measured by the ratio of brood production (emergence) to attack rates.
Future Actions/Recommendations: Study continuing.

Arizona 5-spined Ips

Project: Identification of the Arizona 5-spined Ips pheromone complex.
Cooperators: Pat Shea, PSW; Steve Seybold, Univ. of Reno; Jill Wilson, R3.
Funding: FIDR
Summary: Have identified a pheromone; but are not convinced that we have the entire complex of pheromones.
Future Action/Recommendations: Continue to evaluate complex.

California 5-spined Ips

Project: Compound to prevent *Ips paraconfusus* buildup in slash.
Cooperators: Pat Shea, PSW and John Wenz, R5
Funding: TDP
Summary: Evaluated population buildups in both piled and dispersed slash. Piles were more attractive to ips than dispersed slash. If there is a choice, they will go to piled slash. Last year looked at doses and combinations of ipsdienol and verbenone. Were successful with keeping *I. paraconfusus* out of slash, but slash filled up with *I. pini*. Next used combinations of verbenone plus ipsdienol and a slow release of ipsenol to keep both out. There was also a geopgraphical variation to response.
Future Action/Recommendations: none

Ips pini

Project: Compounds to keep *I. pini* out of slash in northern Idaho and Montana.
Cooperators: Ken Gibson, R1 and Ladd Livingston, Idaho Dept. of Lands
Funding: TDP
Summary: This study was similar to to the paraconfusus/pini study in California. Study was to keep *I. pini* from infesting slash through the use of verbenone and ipsenol bubble caps (86/14 and 50/50, respectively). There were four treatments - 0, 5, 10, and 15 "pairs " of bubble caps, replicated four times. Applied in April and evaluated in June. No strong treatment effect was observed, but flights extended over a longer-than-normal period because of cool, wet weather. A similar combination of pheromones in bead formulation was hand-applied over broadcast slash in 1991; results were poor. In 1992, pheromones in funnel traps had been used to mask the attractant pheromone with good success.
Future Actions/Recommendations: Repeat project in 1994 with more accurate monitoring of beetle flight.

Project: Brood productivity in slash
Cooperators: Jill Wilson, R3 and University of Arizona
Funding: Univ. of AZ and FPM S&TA
Summary: This study was conducted to determine how *I. pini* brood production was affected by slash diameter and length.
Future Action/Recommendations: Study continuing

Ips perturbatus

Project: Field test ipsenol and methyl butenol in a bubblecap formulation to prevent infestations of *Ips perturbatus* populations in white spruce stands in interior Alaska.
Cooperators: Skeeter Werner, PNW; Ed Holsten R10.
Funding: TDP
Summary: Evaluated the efficacy of individual tree and stand treatment with slow-release bubblecap formulations of ipsenol and methyl butenal to protect stands of white spruce in interior Alaska from infestation by *I. perturbatus*. Methyl butenol plots with 50 caps/acre provided the best protection of white spruce stands with only 13% new attacks, compared to 19% for 32 caps/acre and 32% for untreated control plots. Ipsenol plots with 50 caps/acre had 21% infestation compared to 26% for plots with 32 caps/acre and 32% for untreated controls. Methyl butenol at 50 caps/acre, therefore, provided the best protection of spruce stands in this study. Treatment of plots with methyl butenol at 50 caps/acre cost approximately $90/acre; wheras the use of ipsenol would cost $275/acre.
Future Action/Recommendations: Project will be continued in 1994 using more bubble caps per acre and larger areas. Interior Alaska experienced the fourth year of continued defoliation from the eastern spruce budworm and some trees are under attack by *I. perturbatus*. Bubble caps will be used operationally in 1994 to protect high-value spruce stands.

Western Balsam Bark Beetle

Project: Flight dispersal at various elevations
Cooperators: Steve Munson, R4; Ken Gibson R1
Funding: S&TA
Summary: Study was to determine flight dispersal at various elevations. In Utah, four elevations were sampled; in Montana, flight periodicity was sampled at a single elevation. Intent of study was to determine when beetles were most active, and if there was more than one peak flight. Endobrevicomin and exobrevicomin were used. Eighty-five percent fewer beetles were caught when endobrevicomin was added.
Future Actions/Recommendations: Continue study for another year.

Larger Pine Shoot Beetle (*Tomicus piniperda*) and *Ips typographus*

Bob Lawrence summarized the status of *Tomicus* and *Ips typographus* in the Lake States. The larger pine shoot borer has been introduced, and was discovered in six states in 1992. The insect overwinters as an adult, emerges and flies around February or March, colonizes recently cut pine stumps or weakened trees, and creates egg galleries under the bark. Lavae feed under the bark, pupate, and emerge as adults in May and June. New adults emerge and fly to crowns of healthy pines where they feed inside the lateral shoots. During this feeding the adults may destroy 1-6 shoots by hollowing out the shoots. Adults exit the twigs after the first frost and enter the thick bark at the base of the trees where they overwinter. Most potential economic damage is to such products as Christmas trees.
Current research objectives for *Tomicus* includes:
(Work funded by FIDR and TDP)

North Central Station - Bob Haack and Rob Lawrence
1. Determine the life history in the Lake States, including overwintering behavior, flight activity/periodicity, reproduction, brood development, fungal associates, internal pathogens, native predators and parasites, interactions with native pine bark beetles, and genetic similarity among major populations.

2. Develop survey/trapping methodologies using alpha-pinene baited traps as a monitoring tool for spring flight, and most effective release of alpha-pinene.

3. Evaluate ability to reproduce and shoot-feed in native conifers including jack, red, eastern white, western white, limber, and ponderosa pines. It has been shown to do quite well in ponderosa pine.

4. Develop pest management tactics such as effectiveness of insecticides on stumps, chipping infested logs, and window of opportunity for shipping uninfested pine logs from regulated to unregulated areas.

Southern Station and PSW Station - Jane Hayes, Jacqueline Robertson, Lula Greene
- Determine degree of genetic similarity of major U.S. populations

APHIS - Vic Mastro, Bill Kauffman, Win McLane
1. Develop inspection certification schemes for nursery stock and Christmas trees.
2. Develop risk assessment data for cut, balled, and burlapped trees as a source of spreading *Tomicus*.
3. Develop survey tools by evaluating various lures and trap designs.
4. Develop regulatory treatments such as dips and fumigations.
5. Determine host orientation of adults.

Michigan State University - Deb McCullough, Dave Smitley
1. Determine effectiveness of various systemic insecticides to control shoot feeding.
2. Determine within tree colonization pattern during shoot feeding.

Ohio State University - Dave Nielsen
1. Seasonal development in Ohio
2. Determine effectiveness of selected pesticides at various attack opportunities.
3. Test lures and trap designs for collecting adults

Purdue University - Cliff Sadof
1. For Christmas tree plantations and nurseries, examine relationships of insect with tree species composition, plantation acreage, sanitation practices, pest control practices, and presence of other pests.
2. Document the infestation that is occurring in "natural" stands of mature eastern pines.
3. Determine seasonal development in Indiana.

Syracuse - Stephen Teale
1. Determine activity of monoterpenes to *Tomicus*.
2. Determine if a pheromone exists and identify it.

University of Georgia - Wayne Berisford, Tom Eager
1. Determine if *Tomicus* can reproduce and shoot feed in southern pines.
2. Determine if *Tomicus* can successfully overwinter in Georgia and document seasonal life history under Georgia conditions.

University of Wisconson - Gene Smalley
- Determine species of blue stain associated with beetle.
Internationl Cooperators - Yuri Baranchikov (Russia), Mercedes Fernandez (Spain), Bo Langstrom (Sweden), and Francois Lieutier (France).
-Each has shown an interest in screening various NA conifers that are growing in Europe and Russia for susceptibility to *Tomicus*.

Results to date show that *Tomicus* can utilize all tested pine species for shoot feeding and reproduction. It shows a low preference for white pine and a high preference for ponderosa pine. It was not successful on non-pine species.

To date, they have not been able to identify a pheromone; although beetle behavior suggests that there is one. Current surveys are made by looking for shoot damage. May be able to use traps baited with alpha-pinene.

Potential management tactics include trap logs, disposing of, or removing potential breeding sites before emergence, chipping infested logs, and insecticide treatments.