United States
Department of
Agriculture

Forest Service

Forest Pest
Management

Davis, CA

FIFTH REPORT

National Steering Committee for Management of Western Defoliators

FPM 93-1
October 1, 1992

Pesticides used improperly can be injurious to human beings, animals, and plants. Follow the directions and heed all precautions on labels. Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides where there is danger of drift when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment, if specified on the label.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U.S Environmental Protection Agency, consult your local forest pathologist, county agriculture agent, or State extension specialist to be sure the intended use is still registered.

FPM 93-1
October 1, 1992

FIFTH REPORT

NATIONAL STEERING COMMITTEE FOR MANAGEMENT OF WESTERN DEFOLIATORS

Prepared by:

John W. Barry
Chairperson

USDA Forest Service
Forest Pest Management
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FIFTH REPORT

National Steering Committee for
Management of
Western Defoliators

October 1, 1992

USDA Forest Service
Washington Office/Forest Pest Management
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A. Committee Member's Reports

B. Draft - Strategic Plan for the Management of Western Defoliators

C. Letter 3400 dated September 2, 1992 - Technology Development Needs (Western Defoliators)

D. Letter 3400 dated November 16, 1992 - DFTM Pheromone Registration

I. INTRODUCTION

The fifth meeting of the National Steering Committee for Management of Western Defoliators met at Albuquerque, New Mexico, August 20-21, 1992. The primary purpose of the meeting was to identify national needs for managing western defoliators.

A. Attendees

Dayle Bennett	R-3/FPM (Albuquerque, NM)
Jesus Cota	WO/FPM (Washington, DC)
Dave Grimble	PNW/FIDR (Corvallis, OR)
Tom Hofacker	WO/FPM (Washington, DC)
Bruce Hostetler	R-6(RO)FPM (Portland, OR)
Dave Rising	MTDC (Missoula, MT)
Larry Stipe	R-1(RO)TM (Missoula, MT)
Julie Weatherby	R-4(BFO)FPM (Boise, ID)
John Wenz	R-5(SSSSA)FPM (Sonora, CA)
Sheri Smith	R-5(SSSSA)FPM (Sonora, CA)
Jack Barry (Chairperson)	WO/FPM (Davis, CA)

B. Committee Purpose

The purpose of this committee is to identify national needs for managing defoliators of western forests. Management, within the context of the committee, includes activities of direct control with biological and chemical insecticides, cultural control, population monitoring, survey methodology, risk/hazard rating, and damage/impact assessment. Identified needs were ranked in order of priority as voted by the committee members. A separate category that covers administrative issues is included in this report. The report is submitted to the Director, Forest Pest Management, Washington, DC.

With the expanded scope of the committee, subcommittees are needed to develop recommendations on certain needs and issues. Four subcommittees as listed in paragraph II, C were appointed at the 1991 Corvallis meeting. A letter of instruction to each subcommittee Chairperson delineates its charge and product delivery schedule.

The majority of needs identified by this committee are candidates for WO/FPM technology development funding. Other sources of funding, to

include NAPIAP, operating and suppression funds, should be pursued as appropriate to address needs identified by this committee. The call letter for technology development proposals was sent to FPM field offices by Director, Forest Pest Management on September 21, 1992 with responding proposals due by November 16, 1992.

C. **Reports to the Committee**

The following members submitted written reports that are enclosed in the Appendix A:

Dayle Bennett	R-3
Dave Grimble	PNW
Bruce Hostetler	R-6
Larry Stipe	R-1
Julie Weatherby	R-4
John Wenz	R-5

D. **Subcommittee Reports**

1. Subcommittee for Registered Pesticides for Western Defoliators

Chairperson - Julie Weatherby
Members - Sheri Smith

This subcommittee did not meet. Sheri Smith will assist Julie and pursue identifying and listing registered pesticides and report to the committee at the next meeting.

2. Subcommittee for Impact of Biological Insecticides on Non-target Organisms

Chairperson - Steve Munson
Members - Dayle Bennett

This subcommittee conducted a literature search and is coordinating with colleagues in the East who are conducting non-target studies.

3. Subcommittee for developing a 5-year plan that sets a path and identifies major needs that are to be accomplished progressively to improve FS ability to manage the western spruce budworm and Douglas-fir tussock moth.

Chairperson - John Wenz
Members -

This subcommittee is dissolved and its activities combined with subcommittee for Strategic Plan for Management of Western Defoliators.

4. Subcommittee for Strategic Plan for Management of Western Defoliators

Chairperson - John Wenz
Members - Bruce Hostetler
Ladd Livingston

John Wenz drafted a document titled Strategic Plan for the Management of Western Defoliators (Appendix B). The plan included in Appendix B is an updated version of the one discussed at the Albuquerque meeting. This committee and others are invited to review and provide comments to John. The subcommittee will refine the plan and report back to the committee on or before the 1993 meeting.

II. CURRENT NATIONAL NEEDS & ISSUES

A. National Needs

Priority 1

Conduct studies to address data gaps on impact of Bacillus thuringiensis insecticides on non-target organisms in the West.

Priority 2

Conduct field tests of TM Biocontrol-1 to evaluate formulation carrier(s), application rates, volumes, and efficacy.

B. Issues

1. Need to continue FPM permanent plot evaluation program beyond the initial 5-years.

2. Need to proceed with developing and coordinating the Strategic Plan for Western Defoliators.

3. Need to continue long-term monitoring impact and population studies as these are critical to managing western defoliators within the context of ecosystem management.

4. Need to proceed with registration of NOMATE pheromone for DFTM disrupture.

5. Concern that forest insect and disease research are under represented in FIDR and station ecosystem management planning and reorganizations; and reported elimination of microbial research in the West.

6. What is future of TM-Biocontrol production, storage, and use? Product Manager (PM) was assigned but no report provided to the committee.

7. What is future of long-term impact studies of DFTM and WSBW being conducted by PNW?

8. Need National coordination of studies on impact of pesticides on non-target organisms.

9. Need to proceed with registration of DFTM pheromone. As follow-up to this issue, the committee chairperson sent a letter to Director, FPM recommending initiation of the process to obtain registration. The letter with supporting enclosure is included as Appendix D.

III. STATUS OF OTHER ACTIVITIES

A. Continuing Biological Field and Laboratory Activities

1. Investigate new Bacillus thuringiensis (Bt) strains.

   PNW has nearly completed bioassay laboratory testing of Mycogen and Bac-Tec Bt strains. So far, none of these strains has shown to be as effective as the currently-used kurstaki strains. A report will be prepared on this work by year-end, but at present, no new Bt strains can be recommended.

2. Develop a plan to obtain data on impact of Bt on non-target organisms.

   A 3-year effort, funded by FPM-NAPIAP program, has been started by D.G. Grimble and R.C. Beckwith to evaluate the unintended impacts of Bt application on non-target lepidoptera. Plots were established during spring 1992 on the Umatilla and Wallowa-Whitman National Forests. ULV light traps have been operated on these plots weekly since May; foliage of plot trees and shrubs have been sampled and all lepidopterous larvae found were reared to pupal or adult stage. A lepidopterist is now identifying adult specimens. Overall plan is to obtain background data during 1992 on lepidoptera species diversity and abundance on the plots, repeat the sampling and spray some of the plots in 1993 with Bt to estimate the impacts on non-target lepidoptera present, and continue sampling in 1994 to evaluate possible recovery of species impacted by sprays during 1993.

3. Develop, identify, and evaluate improved carriers for TM Biocontrol-1.

   No activities reported to committee. John Cunningham FPMI will propose a cooperative project to Max Ollieu (R-6) to develop a carrier for TM Biocontrol-1.

4. Determine evaporation rates and physical properties of microbial tank mixes.

MTDC has contracted Southwest Research Institute to evaluate Thuricide 48LV, Foray 48B, and Dipel 6AF. Dave Rising is MTDC point of contact.

5. Study of pheromone traps to predict defoliation.

Chris Niwa, PNW, is continuing the effort to use pheromone traps to predict subsequent defoliation by WSBW. In 1991, nine areas were trapped in WA, OR, AZ, and NM; defoliation estimates are now being taken for these areas. During 1992, 18 areas were trapped in WA, OR, AZ, NM, MT, and CO. Data from these two years will strengthen and supplement the data base begun by Charlie Sartwell, before his retirement. There is also a minor effort to pheromone-trap in sprayed areas to evaluate spray efficacy (in OR and WA). Chris is also coordinating with Nancy Campbell (R-1) to have pheromone trapping used as a monitoring tool in the forest health monitoring program. Trapping would give an estimate of defoliation needed to run the WSBW model, and would add to the data base for GIS-Geostatistics work to improve our predictive capabilities.

6. Field test TM Biocontrol-1 including lower doses, and with improved carriers as they become available. Priority is given to testing methods of controlling Douglas-fir tussock moth (DFTM) as the insect is in current outbreak.

PNW Corvallis is still investigating the reasons for the reduced efficacy of DFTM virus during the 1991 field test in Idaho--testing the virus formulation against other "wild" DFTM populations, as well as the Goose Lake strain. A report will be prepared this fall. Also, soil samples have been taken from the Idaho plots to evaluate the quantity of virus "stored" in the soil; preliminary results indicate that virus is present in nearly all plots. Again, a report will be available later this year.

B. **Other Biological Activities at PNW.**

1. Rick Kelsey has begun to examine the production of non-terpene volatiles in western conifers which might be used by defoliators as chemical signals for primary attraction or to identify trees under stress. Current studies are focused on tree physiology but the results could have significance to defoliator biology, perhaps by a connection between these compounds and the behavior of the defoliators.

2. Skeeter Werner has been using pheromone-baited traps in an effort to monitor Choristoneura fumiferana in interior Alaska. The most

important defoliator problems in Alaska are C. fumiferana and C. orea in the interior, with 25,000-30,000 acres infested since 1989. Trees heavily infested are showing signs of top-kill and subsequent infestation by Ips perturbatus.

Also, a lepidopterous blotch miner has defoliated 500,000 acres of willow in the interior and south-central AK for the third year. The depletion of foliage could reduce nutrients in the stems and twigs, which would lead to inferior moose browse for the winter of 1992-1993. Reduced carbohydrate reserves in the roots could result in decreased biomass production and regeneration in the spring of 1993.

3. R.R. Mason, T.R. Torgersen and B. Wickman (LaGrande) are continuing with their long-term studies related to:

   Population dynamics studies of western defoliators (DFTM, WSBW, lodgepole needle miner); including population predictive methods, determining population survivorship in the Blue Mountains, and comparing population trends in sprayed and unsprayed areas.

   Investigating predator-prey systems for stabilizing pests at low densities; involves forest fertilization, and consideration of the effects of dead woody materials to selected predator species. A new development is the extension of some of these investigations to west-side Cascades forests, in a comparison to those of eastern OR.

   Prevention and control of forest pests by silvicultural practices; fertilization, and conservation of dead woody materials.

   Long-term population sampling/monitoring studies, for forecasting trends of DFTM and WSBW populations.

   A major cooperative dendrochronology study in which defoliator outbreaks in the Blue Mountains have been dated back 200+ years.

4. Roy Beckwith's Microbial Insecticide Development Team (PNW-Corvallis) is being dissolved at the beginning of FY 93. Reductions in appropriated funds for on-going efforts and redirected PNW programs, so as to be more responsive to expressed client needs, are the reported reasons for necessary shifts in program priorities.

C. **Reports Related to Direct Control of Western Defoliators**

The following reports related to direct control of western defoliators have been prepared and distributed:

1. Shea, P.J. and J.W. Barry. 1992. Guidelines for Field Experiments and Pilot Projects - Aerial Application of Pesticides. FPM Report 92-5, USDA Forest Service, Davis, CA.

2. Skyler, P.J., J. Roberts, J. Weatherby, and J.W. Barry. 1990. Aerial insecticide projects for suppression of western defoliators 1970 - 1989. (Updated through 1991). FPM Report 90-11, USDA Forest Service, Davis, CA.

3. Grim, B., J. Rafferty, G. Sutton, and T. Clark. 1992. Deposition of Bacillus thuringiensis into Gambel oak canopies. FPM Report 92-9, USDA Forest Service, Davis, CA.

4. Barry, J.W., M.E. Teske, J.A. Rafferty, B.S. Grim, and P.J. Skyler. 1992. Predicting spray drift in complex terrain. ASAE Paper 921085. St. Joseph, MI:ASAE.

5. Curbishley, T.B. 1992. 1991 CASPR spray aircraft efficiency model - validation study. FPM 92-8 (C.D.I. Technical Note No. 91-10). Prepared under Contract No. 53-0343-1-00153 by Continuum Dynamics, Inc. for USDA Forest Service, Forest Pest Management, Davis, CA.

6. Barry, J.W. 1992. Third Report - National spray model advisory committee - Notes of the Charlotte, NC meeting, June 23, 1992. FPM 92-10. USDA Forest Service, Forest Pest Management, Davis, CA.

7. Sower, L.L., J.M. Wenz, D.L. Dahlsten, and G.E. Daterman. 1990. Field testing of pheromone disruption on pre-outbreak populations of Douglas-fir tussock moth (Lepidoptera:Lymantriidae). J. Econ. Entomol. 83:1487-1491.

8. Sower, L.L., G.E. Daterman, W. Funkhouser, and C. Sartwell. 1983. Pheromone disruption controls Douglas-fir tussock moth (Lepidoptera:Lymantriidae) reproduction at high insect densities. Can. Ent. 115:965-969.

IV. SUMMARY

The National Steering Committee for Management of Western Defoliators met at Albuquerque, New Mexico, August 20-21, 1992. The primary purpose of the meeting was to identify national needs for managing western defoliators and to report these needs to the Director, Forest Pest Management. Two needs were identified and submitted to WO for funding considerations under the FPM Technology Development Program. The committee withheld identifying and submitting other national needs pending review and implementation of the Strategic Plan for Management of Western Defoliators.

The committee voted to meet at New Orleans, Louisiana September 16-17, 1993 to overlap with the gypsy moth committee that plans to meet in New Orleans, Louisiana September 14-15, 1993. New Orleans is subject to approval of WO.

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COMMITTEE MEMBER REPORTS

Dayle Bennett (R-3)
Dave Grimble (PNW)
Bruce Hostetler (R-6)
Julie Weatherby (R-4)
Larry Stipe (R-1)
John Wenz (R-5)

R-3 REPORT TO THE WESTERN DEFOLIATOR STEERING COMMITTEE
August 20, 1992
Dayle Bennett

Status of Defoliators--Western spruce budworm (WSB) populations have declined to very low levels in 1992. Current aerial detection surveys have detected only a few thousand acres of WSB-caused defoliation in the Region. Egg mass densities from 1991 surveys on portions of the Carson NF indicated a large decline in the population from 1990, and for the first time since before 1974, no defoliation was evident from aerial surveys conducted over the Carson NF. We anticipate WSB populations will remain low in 1993, precluding the need for suppression projects and negating the opportunity to conduct WSB suppression-related studies in the southwest.

Aspen defoliation, caused by western tent caterpillar or large aspen tortrix, is increasing. This is causing some concern in regards to visual quality (fall color gazing) and recreational experience (campground nuisance), but will not likely result in any suppression action.

Douglas-fir tussock moth (DFTM) activity appears to be increasing on NF lands in central Arizona where a few thousand acres of fir have been lightly to moderately defoliated. Again, no suppression action is anticipated, at least in 1993.

Status of Projects/Reports

Nontarget Moth Study (Flammulated Owl Food Base)--In 1991, we initiated a multiyear study to monitor the effects of Bt on nontarget moths (the primary food base of the flammulated owl--a state listed sensitive species) in an area on the Carson NF where a potential WSB suppression project was being proposed for 1992. Objectives of the study were 1) to determine species diversity and the relative abundance of moths within and adjacent to the proposed Bt application area; 2) to monitor the effects of Bt on nontarget moth populations during the year of application; and 3) to monitor the longterm effects of Bt on nontarget moth populations. However, since 1991 the WSB populations have declined, the proposed suppression project was canceled, and any additional trapping in the area has been indefinitely postponed. We are still sorting, counting, and pinning the hundreds of moths that we collected in 1991 (via 8 light traps operated twice weeking over a five-week period in June and July). We have sorted, counted, and pinned approximately 75 percent of the collected moths. We are "rough" sorting by gross morphological similarities, but still need to have representatives of each "group" identified to genus and species, if possible. (Any ideas on who and how to get this accomplished?) We plan to conduct a statistical analysis to determine if any differences exist between the eight sampled locations and will summarize this information in a report.

Nontarget Sensitive Butterfly Survey--In 1991, we contracted with Dr. Wayne Whaley, Enviro West Consulting, to survey for habitat and/or colonies of a NM state listed sensitive butterfly species. Colonies of this butterfly, the blue-black silverspot fritillary (Speyeria nokomis nigrocaerulea), have been reported in close proximity to a proposed 1992 WSB suppression project area. Results of Dr. Whaley's survey showed two large colonies located within two and one-half to five miles of the proposed spray areas. No colonies or individuals were found within the proposed treatment areas eventhough some "marginial" habitat was noted.

WSB-Caused Damage Survey(s)--Two WSB-caused damage surveys (1984 and 1991) were conducted over approximately 35,000 acres of mixed conifer forests in Red River Canyon, Carson NF, NM. The primary objectives of these surveys were to determine statistically meaningful estimates of both type and amount of damage (topkill and mortality) to host species and to map the distribution and intensity of the damage using double sampling techniques (aerial photos and ground sampling). Overall damage was light thoughout 25,700 acres of the surveyed area where WSB defoliation resulted in mortality to less than 3.5 percent of the total basal area. However, on the remaining 9300 acres, average WSB-caused mortality was in excess of 40 percent of the basal area, and in some individual stands, said mortality exceeded 75 percent of the total basal area. A final combined report of these two surveys will be completed this fall. Each of the 41 sample sites in this surveyed area has been permanently marked on aerial photos and on the ground, and can be readily relocated for future measurement and monitoring of longterm changes.

WSB Permanent Plots--We are currently establishing a series of permanent plots (stands) throughout the Region that will be used to gather longterm information for model validation, evaluation of silvicultural treatment effects, and refinement of risk/hazard rating systems. We plan to establish 25 of these plots in 1992 and an additional 25 plots in 1993. While special funds have been appropriated for plot establishment, we are concerned that annual base funds may not be sufficient to resample these plots in future years. Therefore, we recommend this committee discuss and develop a strategy to obtain funds necessary for continued monitoring of these plots---perhaps encouraging a link to the forest health monitoring effort.

WSB Pheromone Traps--During 1991 and 1992, we have been assisting Chris Niwa, PNW, in assessing the effectiveness of WSB pheromone traps. Three areas were trapped in 1991 and again in 1992. Defoliation levels were recorded at the trapping sites in 1992 and will be compared with 1991 moth catches to determine the level of correlation between moth catches and following year's defoliation.

DFTM Pheromone Traps--We have deployed DFTM pheromone traps in three areas of central Arizona during 1992 and plan to continue trapping again in 1993. We also plan to conduct lower crown beating to sample early instar larval populations in 1993.

Tree-ring Study--Dr. Tom Swetnam of the University of Arizona Tree-ring Laboratory has recently completed a R-3 contracted study of WSB outbreak history and radial growth impact of WSB outbreaks in the Sacramento Mountains of central New Mexico. A final report on the study is due this fall.

Dave Grimble (PNW)

Meeting: National Steering Committee for
Management of Western Defoliators

Albuquerque, New Mexico
August 20-21,1992

Report: D.G.Grimble, PNW Station

1. Progress on Recommendations from July 1991 Meeting in Corvallis:

A. Obtain data on impacts of Bt on nontarget lepidoptera ...

A 3-year effort, funded by FPM-NAPIAP Program, has been started by D.G.Grimble and R.C.Beckwith to evaluate the unintended impacts of Bt application on nontarget lepidoptera . Plots were established during spring 1992 on the Umatilla and Wallowa-Whitman National Forests. ULV light traps have been operated on these plots weekly since May; foliage of plot trees and shrubs have been sampled and all lepidopterous larvae found were reared to pupal or adult stage. A lepidopterist is now identifying adult specimens. Overall plan is to obtain background data during 1992 on lepidoptera species diversity and abundance on the plots, repeat the sampling and spray some of the plots in 1993 with Bt to estimate the impacts on nontarget lepidoptera present, and contiue sampling in 1994 to evaluate possible recovery of species impacted by sprays during 1993.

B. Evaluate pheromone disruption against WSB ...

No progress on this item because of reduced funding.

C. Develop pheromone monitoring system for WSBW ...

Chris Niwa, PNW, is continuing the effort to use pheromone traps to predict subsequent defoliation by WSBW. In 1991, nine areas were trapped in WA, OR, AZ, and NM; defoliation estimates are now being taken for these areas. During 1992, 18 areas were trapped in WA, OR, AZ, NM, MT, and CO. Data from these two years will strenghthen and supplement the data base begun by Charlie Sartwell, before his retirement. There is also a minor effort to pheromone-trap in sprayed areas to evaluate spray efficacy (in OR and WA). Chris is also coordinating with Nancy Campbell (R-1) to have pheromone trapping used as a monitoring tool in the forest health monitoring program. Trapping would give an estimate of defoliation needed to run the WSBW model, and would add to the data base for GIS-Geostatistics work to improve our predictive capabilities.

2. Status of previous recommendations

A. Pursue laboratory testing of new Bacillus thuringiensis (Bt) strains ...

We have nearly completed bioassay laboratory testing of Mycogen and Bac-Tec Bt strains. So far, none of these strains have proven to be as effective as the currently-used kurstaki strains. A report will be prepared on this work by year-end, but at present, no new Bt strains can be recommended.

B. Field test of DFTM virus for possible dosage adjustment ...

We are still investigating the reasons for the reduced efficacy of DFTM virus during the 1991 field test in Idaho-- testing the virus formulation against other "wild" DFTM populations, as well as the Goose Lake strain. A report will be prepared this fall. Also, soil samples have been taken from the Idaho plots to evaluate the quantity of virus "stored" in the soil; preliminary results indicate that virus is present in nearly all plots. Again, a report will be available later this year.

3. Other related 1992 activities or developments at PNW ...

A. Rick Kelsey has begun to examine the production of non-terpene volatiles in western conifers which might be used by defoliators as chemical signals for primary attraction or to identify trees under stress. Current studies are focused on tree physiology, but the results could have significance to defoliator biology, perhaps by a connection between these compounds and the behavior of the defoliators.

B. Skeeter Werner has been using pheromone-baited traps in an effort to monitor C.fumiferana in interior Alaska. The most important defoliator problems in Alaska are C. fumiferana and C. orea in the interior, with 25-30,000 acres infested since 1989. Trees heavily infested are showing signs of top-kill and subsequent infestation by Ips perturbatus.

Also, a lepidopterous blotch miner has defoliated 500,000 acres of willow in the interior and south-central AK for the third year. The depletion of foliage could reduce nutrients in the stems and twigs, which would lead to inferior moose browse for the winter of 1992-1993. Reduced carbohydrate reserves in the roots could result in decreased biomass production and regeneration in the spring of 1993.

C. R.R.Mason, T.R.Torgersen and B.Wickman (LaGrande) are continuing with their long-term studies related to:

-population dynamics studies of western defoliators (DFTM, WSBW, lodgepole needle miner); including population predictive methods, determining population survivorship in the Blue Mountains, and comparing population trends in sprayed and unsprayed areas.

-investigating predator-prey systems for stabilizing pests at low densities; involves forest fertilization, and consideration of the effects of dead woody materials to selected predator species. A new development is the extension of some of these investigations to west-side Cascades forests, in a comparison to those of eastern OR.

-prevention and control of forest pests by silvicultural practices; fertilization, and conservation of dead woody materials.

-long-term population sampling/monitoring studies, for forecasting trends of DFTM and WSBW populations.

-a major cooperative dendrochronology study in which defoliator outbreaks in the Blue Mountains have been dated back 200+ years.

D. Roy Beckwith's Microbial Insecticide Development Team (Corvallis) is being dissolved at the beginning of FY 93. Reductions in appropriated funds for on-going efforts and redirected PNW programs, so as to be more responsive to expressed client needs, were the basic causes for necessary shifts in program priorities.

Subject: Commercially available traps for Douglas-Fir Tussock Moth Early Warning System

In 1990 & 91 we (PNW) did a project comparing the standard FS Douglas-fir tussock moth early warning trap (baits produced here in corvallis, traps by MAG) to some commercially available alternatives. The objective was to provide alternatives to FS produced materials. Specifically, PVC and polyurethane baits provided by Pherotech Inc. were compared to our PVC baits in MAG traps and also in the common orange "Gypsy Moth" type of trap produced by Scentry Inc. Traps were deployed in 4 randomized blocks (one of each type per block) in homogenious type within a 3 sq mile area at each location. Generally, all types of trap and bait were about equivalent.

Results indicate that Pherotech's polyurethane bait is satisfactory for use in the MAG type trap. Pherotech prefers polyurethane to PVC on account of safety in manufacturing.

Three Pherotech bait equivalents can also be used in the orange "Gypsy Moth" type trap if the ends are left wide open. If trap ends are folded closed, as for gypsy moths, then very few tussock moths will enter the trap. For this test we used 3 bait pellets on one pin as bait but 1- 0.003% Pherotech urethane bait should yield the same result as 3- 0.001% baits. If used, the "Gypsy Moth" trap should be interpreted differently: Just assume that average captures of over about 30 males per trap indicate a need for ground survey follow-up. The change in interpretation relates to the "Gypsy moth" trap becoming saturated with males at about 40 per trap whereas the MAG traps, with a much thicker sticker layer, will hold about 80 males.

This summer we are doing a follow up that tests the standard trap and bait directly against orange Gypsy moth traps with open ends and baited with either 1 or 3 standard pvc pellet baits.

For the trap part of the DFTM early warning surveys we have, or will soon have, data that allow use of entirely commercial traps and baits. Commercial traps could either be used exclusively or used for supplimentary or backup. Desirability of converting the early warning system, in whole or part, to commercial material should be discussed. I myself would recommend phasing in the commercial material over a 3 - 4 year period rather than an abrupt switch.

Lonne Sower, PNW Corvallis.

FPM TECHNOLOGY DEVELOPMENT PROGRESS REPORT
Draft Copy 8/6/92: Not for citation and subject to change.

PROJECT NUMBER: R4-91-100

PROJECT TITLE: Cooperative Pilot Test Using Synthetic Pheromone to Disrupt Mating of Douglas-fir Tussock Moth, Orgyia pseudotsugata.

PROJECT STATUS: Planned work was completed on schedule. Some discretionary follow up, further consideration of data, and publication of results will finish the project. No additional funds are requested.

SUBJECT: Douglas-fir tussock moth

RESPONSIBLE REGION: R-4

FPM PERSON LEADING THE PROJECT: Julie Weatherby, State and Private Forestry USDA-FS, Boise Field Office, 1750 Front st., Boise, ID 83702.

DATE OF THIS REPORT: Aug., 1992.

PROJECT OBJECTIVES: To demonstrate the feasibility of using the mating disruption technique to control Douglas-fir tussock moth. Also, to determine the effect, if any, on selected non-target arthropods.

RESPONSIBLE PARTIES: Overall coordinator- Julie Weatherby. Planning and data management- Lonne Sower, PNW Station USDA-FS, 3200 Jefferson Way, Corvallis OR, 97331. Materials and application equipment- Iain Weatherston, Scentry Inc., Billings MT and Charles Doan, Scentry, Inc., Buckeye, AZ. Land managers- Michael Stayton and Sue Stafford. Weiser Ranger District, Payette National Forest, Weiser ID.

FIRST YEAR FUNDED: FY91
YEAR SCHEDULED TO END: FY93
ACTUAL YEAR TO END: FY93

FUNDS OBLIGATED: Funds obligated from beginning of project through end of FY92: Approximate $44,000 was spent during FY91. Approximately $6,000 was spent during FY92.

PRODUCTS AND DUE DATES IDENTIFIED IN THE ORIGINAL PROPOSAL: Final report, due December 20, 1992.

STATUS OF PRODUCTS: On schedule

BRIEF DESCRIPTION OF PROJECT: Six, 200-acre plots were established in the Hitt mountains, Weiser RD, Payette National Forest. No-Mate® DFTM pheromone loaded in center sealed fibers and mixed with a sticker was applied via helicopter to 3 plots in August, 1991. Dose was 10g/acre of Z-6-heneicosen-11-one, the synthetic DFTM pheromone, with 90g/acre of inert material. Pre-treatment larval populations were sampled in July, 1991 by lower crown beating of 40 trees per plot. A post-treatment sample was taken in June 1992. Counts of selected non-target arthropods were taken with the larval

samples. Cocoons and egg masses were collected from branches in October 1991 to determine oviposition rates of females.

The treated population had the following known characteristics: Host trees were true firs, douglas firs, and occasional engleman spruce. Before the start of tests the tussock moth larval population averaged 35 larvae/m sq of foliage. These larvae were mostly 2nd or 3rd instar at the time of sampling. Samples of cocoons from the treated generation indicated 19% of females emerged as adults, 48% were killed by parasitic insects, and 33% died of indeterminate causes. Wild tussock moth virus was present in the population and 13% of larvae emerging from the eggs collected in fall 1991 were infected.

BRIEF DESCRIPTION OF ACCOMPLISHMENTS AND RESULTS: Applications were completed in mid Aug. 1991. Coverage appeared good and timely (Table 1). Materials performed adequately with considerable pheromone material remaining in releasors at the end of the season. This was expected, but indicates that the formulation has potential for improved efficiency. Application equipment is non-standard and applicators will require technical assistance to install and use it the first time.

Treatment reduced the next years larvae population by about 81% in treated vs check plots (Table 2) and in treated plots only 16% of emerged females produced fertile eggs vs 72% in untreated plots (Table 3). Results are statistically significant and consistent with those of previous tests.

Treatment had no measurable effect on carpenter ants (Camponotus spp.), western spruce budworms (Choristoneura occidentalis), or spiders (Table 2). DFTM eggs collected from some locations in both treated and check plots harbored significant numbers of a beneficial parasite, Trichogramma sp. probably minutum. Interestingly, sterile egg masses produced about as many Trichogramma as fertile masses. Previous tests showed no adverse impact on populations of another DFTM egg parasite, Telenomus californicus.

In sum, mating disruption treatment has substantial impact on Douglas-fir tussock moth populations and is unlikely to effect non-traget arthropods. Preservation of beneficial insects should result in further pressure on the tussock moth population in the next year. Efficacy is arguably as good, or better, than for most of the alternatives such as B.t., or conventional pesticides, but probably lower than that of the DFTM virus at high population densities where virus is likely most effective.

VARIANCES FROM ORIGINAL PROTOCOLS: Work was completed on time and as planned with these exceptions. Plots were 200 acres not 330 acres. Cocoon samples were taken from 15 rather than 20 trees in each plot. 6 marked larvae sampling trees (of 40) in treated plot 1 were lost to logging.

ATTACHMENTS: Three data tables and a copy of those portions of the original work plan dealing with protocols are attached.

Table 1: Distribution of male flight and residual pheromone in fibers through 1991 season. 5 sets of 5 traps with 0.1% baits were placed in the general study area, but away from treated plots, and tended weekly beginning 8/14/91. 9,264 moths were caught total. Traps were replaced if several moths were present. Releasors were located in treated plot 1, they were found on fir foliage following treatment and marked with flagging. Each week, 4 releasors were gathered and sent to the lab for residue analysis.

Week	0	1	2	3	4	5	6	7	8	9	10
% Catch	0	1.8	9.5	14	29	26	13	3,8	2,3	0.3	0.3
% Residual pheromone*	100	59	67	99	59	42	42	37	56		

*Average from 4 fibers each date, 293 microgram/fiber=100%.

Table 2. Efficacy of Douglas-fir tussock moth disruption as indicated by lower crown beating samples: Beating counts for DFTM larvae and other insects as obtained from Hitt mtn. plots before treatment in July, 1991 and after treatment in June 1992. Samples were taken from 3 branches from each of 40 trees per plot and the same trees were sampled both years. Each branch sampled had about 1/3 m sq of foliage.

		Items per meter square of foliage			
Plot		DFTM larvae	Carpenter ants	Spiders (any)	Budworm larvae
Check 2	1991	13.7	0.09	4.41	36.4
	1992	13.4	0.63	1.65	48.9
Check 5	1991	45.3	3.00	2.19	8.5
	1992	44.4	3.24	4.35	29.2
Check 6	1991	16.4	0.99	2.49	16.8
	1992	14.5	2.55	2.94	40.2
Mean	1991	25.1	1.36	3.03	20.6
	1992	24.1	2.14	2.98	39.4
Treat 1	1991	45.3	0.36	4.77	69.0
	1992	2.1	1.86	2.73	31.2
Treat 4	1991	44.1	0.30	2.10	24.6
	1992	4.6	2.19	2.73	34.7
Treat 8	1991	46.9	0.60	1.14	18.9
	1992	18.8	2.10	2.94	79.4
Mean	1991	45.4	0.42	2.67	37.5
	1992	8.5	2.05	2.80	48.4

Efficacy = [1 - (8.5/45.4)/(24.1/25.1)]100= 81%.

As determined by analysis of covariance (1991 items vs 1992 items in checks vs treated plots) the effect of treatment on DFTM larvae was significant with F = 24 at 1/3 df and P = 0.02. Treatment had no statistically significant effect on budworms, carpenter ants, or spiders. Eight sampled trees from plot 8 may have been just outside of the treated area but were included. Deletion of those trees would increase the efficacy estimate slightly.

Table 3: Efficacy of Douglas-fir tussock moth disruption as indicated by egg Mass survey: Collected November 1991. Corrected for sterile egg masses (= no emergence after diapause). Six branches (1.5-2 m long) per tree and 15 trees per plot were sampled for cocoons. Total Cocoons are what we found from all branches in each plot, these include male cocoons and dead cocoons. Emerged Females = those cocoons from which a female emerged based on presence of eggs, or on dissection of the cocoon and examination of pupal exuva to determine sex and successful emergence. sterile Eggs = number of egg masses, including "spews" of just a few eggs, producing no larvae after holding through a diapause period (5 months at 0 deg C). Fertile Eggs = egg masses producing larvae after holding through diapause. % females reproducing = no of fertile egg masses divided by number of emerged females times 100.

Plot	Total Cocoons	Emerged Females	sterile Eggs	Fertile Eggs	% females reproducing
Check 2	15	8	1	5	63%
Check 5	205	26	3	19	73%
Check 6	83	16	1	13	81%
				Mean =	72.3%
Treat 1	52	8	4	0	0%
Treat 4	105	23	13	6	26%
Treat 8	180	62	31	15	23%
				Mean =	16.3%

Efficacy = [1- (16.3/72.3)]100 = 77%.

Females in check vs treated plots produced significantly different percentages of fertile eggs ($F = 33.2$, $P = <0.01$, $DF = 1/4$. For 72.3% in check SD = 9.0%. For 16.3% in treated SD = 14.2%).

Note: sterile egg masses are characteristic of pheromone treated plots. Some of these sterile egg masses can be identified by small size and rough appearance, particularly those very small masses we call "spews" which are found almost exclusively in pheromone treated areas. Identification of sterile masses by appearance alone however is not completely reliable. The best check for fertility is to hold all egg masses through diapause and then see whether larvae emerge.

Region 6 Report to National Steering Committee for
Management of Western Defoliators

August 18, 1992

Western Spruce Budworm

Budworm defoliation was detected on 4.8 million acres in Oregon and Washington during the 1991 aerial detection survey.

Two suppression projects were conducted in 1992, one on the Wallowa-Whitman National Forest (two analysis units, headquarters in Enterprise, Oregon), and one on areas of both the Wallowa-Whitman and Umatilla National Forests (five analysis units, headquarters in La Grande, Oregon). Both projects used a combination of fixed-wing aircraft and helicopters which applied Thuricide 48LV undiluted at 0.5 gallons per acre (24 BIU per acre). Acreages treated in the two projects were 70,222 (Enterprise) and 116,344 (La Grande) at estimated costs of $1,980,000 and $1,210,000, respectively.

Temperatures during late winter and spring were unusually warm. Insect development was two or three weeks ahead of normal and budworm instar distribution did not seem to follow normal patterns. Insecticide application on the Enterprise project began on June 4 and was completed on June 22, and on the La Grande project began on May 30 and was completed on June 18.

Pre-treatment budworm populations for the seven analysis units ranged from 7.6 to 18.6 larvae per 45-cm midcrown branch, and post-treatment populations ranged from 0.8 to 3.4 larvae. Population reductions, as determined by pre- and post-treatment larval sampling, were less than 90% (uncorrected for natural mortality) in all analysis units. This did not reach the projects' objectives of reducing the budworm populations by at least 90%.

The budworm situation is being analyzed for potential management actions in 1993 over about 750,000 acres on or adjacent to seven National Forests and one Indian Reservation in Oregon and Washington. These analyses are scheduled to be completed by December.

Douglas-fir Tussock Moth

No defoliation detected during the 1991 annual aerial detection survey was attributed to the tussock moth. In areas in which there was tussock moth defoliaton visible from the ground, it was mixed with budworm defoliation and was not possible to distinguish between the two types of defoliation from the air.

Samples were collected one year after treatment in the three treated and one untreated units of the 1991 Douglas-fir tussock moth project on the Wallowa-Whitman National Forest. The 1991 pre- and post-treatment larval population densities and the 1992 post-treatment densities (larvae per 1000 square inches of midcrown foliage) for all units are shown in the table that follows.

Unit	Pre91	Post91	Post92
Pine	16.0	0.9	1.0
Catherine	6.4	1.0	0.0
Hells Canyon	6.9	0.4	0.7
Untreated	33.6	4.9	5.2

There was a substantial decrease in tussock moth densities in both the treated and untreated units between the 1991 pre- and post-treatment density samples. The 1992 density samples, collected at approximately the same stage of larval development as the 1991 pre-treatment samples, indicate that the populations are at much lower levels than in 1991.

Tussock moth defoliation has been observed from the ground on two different areas on the Malheur National Forest and on one area of privately owned land in southern Oregon. Results of larval sampling and aerial surveys are not yet available.

Other Defoliators

Defoliation of ponderosa pine and some lodgepole on the Sisters Ranger District, Deschutes National Forest, increased from 27,000 acres in 1990 to approximately 60,000 acres in 1992.

Defoliation caused by the western hemlock looper has been reported for several hundred acres on the Darrington Ranger District, Mt. Baker-Snoqualmie National Forest.

WESTERN DEFOLIATOR STEERING COMMITTEE MEETING
REPORT FROM REGION 4

Julie Weatherby

The big story in R4 is Douglas-fir tussock moth. Outbreaks have occurred in 6 areas across the Region. Largest area of contiguous defoliation is in the Boise River Drainages on the Boise and Sawtooth National Forests (~ 250,000 ac). Defoliation is typically on dry Douglas-fir sites. Two other similar infestations are located in the Owyhee Mountains and in stringers around Hailey, Bellevue, and Ketchum, Idaho (~ 24,000 ac). In the Weiser RD on the Payette NF we have detected ~18,000 ac of defoliation caused by western spruce budworm and Douglas-fir tussock moth. Defoliation is typically on drier grand fir sites. Near Sagehen reservoir on the Boise NF there is ~22,000 ac of defoliation predominately on grand fir sites. And finally on the Wasatch Cache NF there is an outbreak in subalpine fir at an elevation of 8,000 ft.

It appears that impacts are heaviest on climax species in all of the infestations.

None of these outbreaks were anticipated because trap catches in both 1988 and 1989 were low. The first defoliation was detected in 1990 during out annual aerial detection surveys. Approximately 40,000 ac were mapped. In 1991 more than 300,000 ac of defoliation was detected. This year a few new satellite areas along with some fringe areas have been defoliated so that the total area of defoliation may be similar or somewhat larger than last year. Most populations appear to be collapsing. Areas heavily defoliated in 1991 were redefoliated in 1992 by early instars but few later instars or pupae were found.

A biological evaluation completed in 1991 showed that up to trees per acre had been 90 - 100 % defoliated in areas of heaviest defoliation. At that time it was estimated that trees per acre would be lost. After rereading these impact plots in 1992, approximately 47% of the Douglas-fir, 16 % of the grand fir and 33 % of the alpine fir had died.

Most districts with severe defoliation have instigated salvage programs. Salvage of dead and dying trees has been emphasized. Land managers are finding it difficult to predict which trees will live and which will die. Salvage is doing nothing to reduce susceptibility.

In 1991, 2 special projects for suppression of DFTM were conducted in the Region. An aerial virus project headed by Roy Beckwith and Dave Grimble was conducted outside of Featherville, ID. The results indicate that rates higher than the current labeled rate may be necessary to successfully suppress DFTM populations. A second project was completed on the Weiser RD. This project utilized a mating disruption strategy to suppress DFTM populations. This project successfully reduced populations by approximately 80%. Results are summarized in an accompanying report.

Larry Stipe (R-1)

REPORT TO: Western Defoliators Sterring Committee
20-21 August 1992
Albuquerque, NM
L.E.Stipe, R1

Western Spruce Budworm

Through 1991 western spruce budworm caused defoliation has continued to increase following a major decline caused by severe winter damage in 1989. Although our 1992 aerial survey is not complete, we expect 1992 defoliation to be near the pre 1989 level. See enclosed figures.

This year we expanded our pheromone trapping effort to include most of our budworm permanent plot locations. By summers end we will have four years of data at three locations and one years data at another eight sites. Data includes larval density, percent defoliation, egg mass density, and moth counts per trap.

Douglas-fir Tussock Moth

Our trap counts for 1991 increased a small amount, but still remain well below the 25 moths per trap target level. See enclosed figures. No visible defoliation was reported in our forested areas this year, but we have received several reports of ornamental spruce trees being defoliated in both Montana and Northern Idaho.

Gypsy Moth

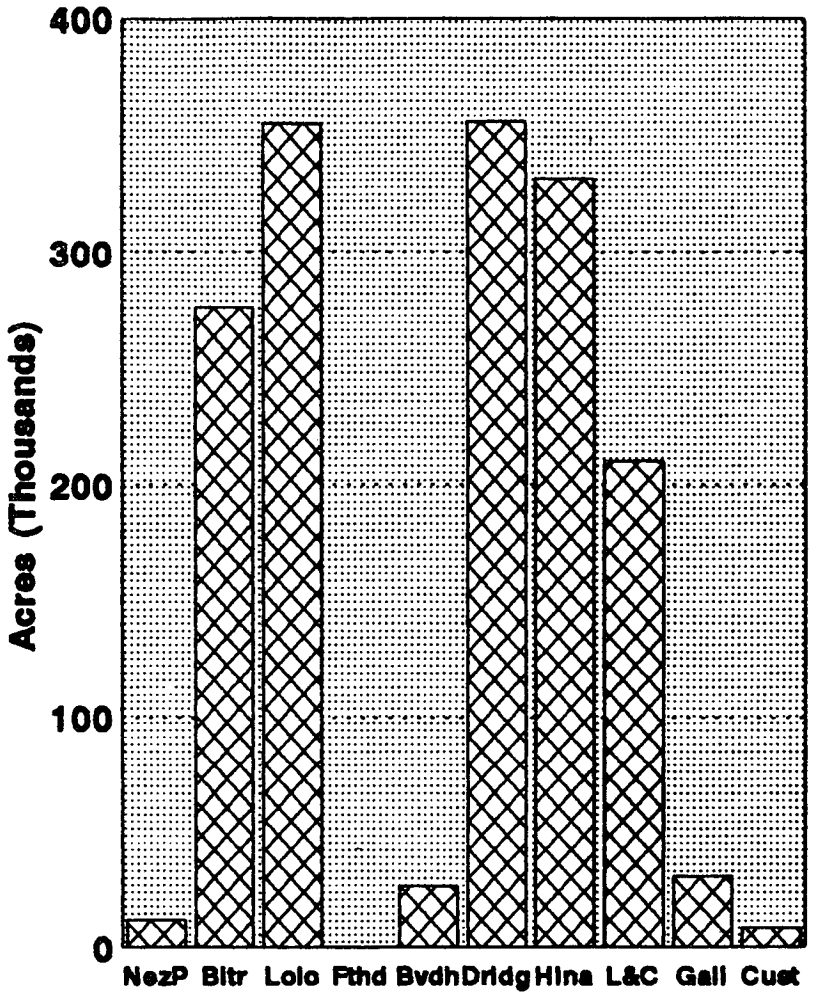
Through several cooperative agreements, land managers in R1 deployed over 8,000 trap in Montana and Northern Idaho. Traps were concentrated in high-use recreation areas, along major travel routes, and in many urban areas. During 1991, three moths were caught in Montana, and six in Idaho. No counts so far this year.

Projects

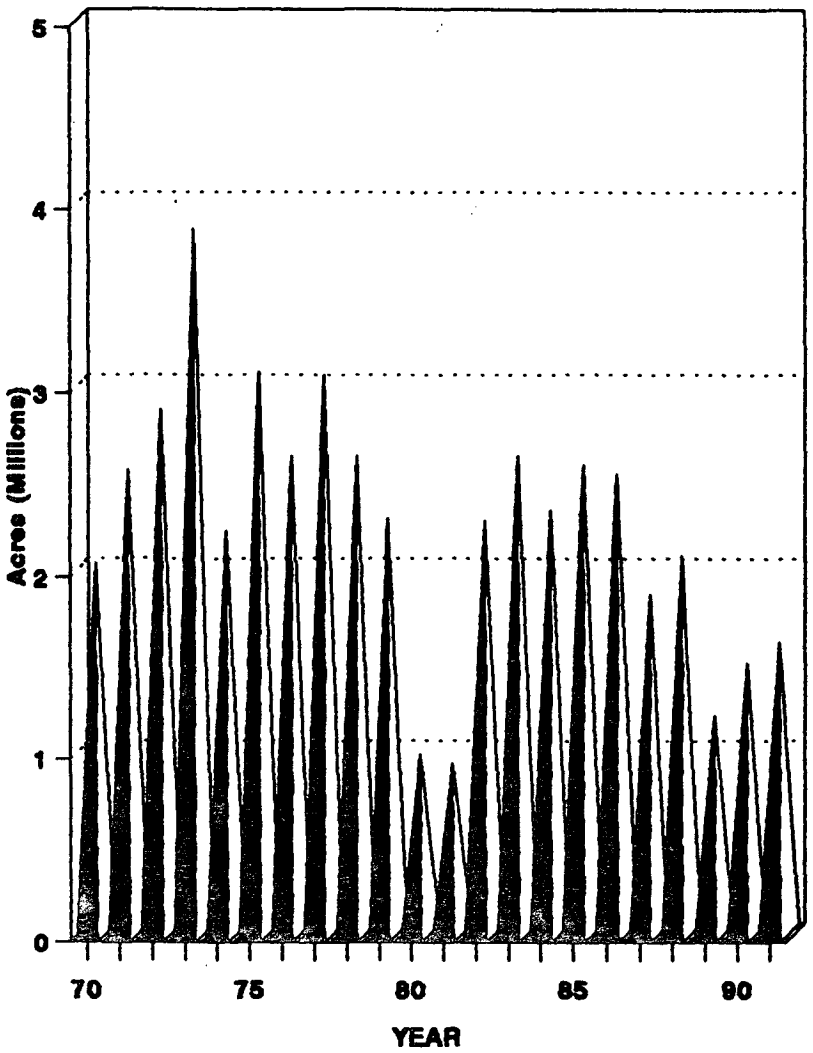
No current projects work in 1992 with no current plans for any in 1993.

SBW INFESTATIONS

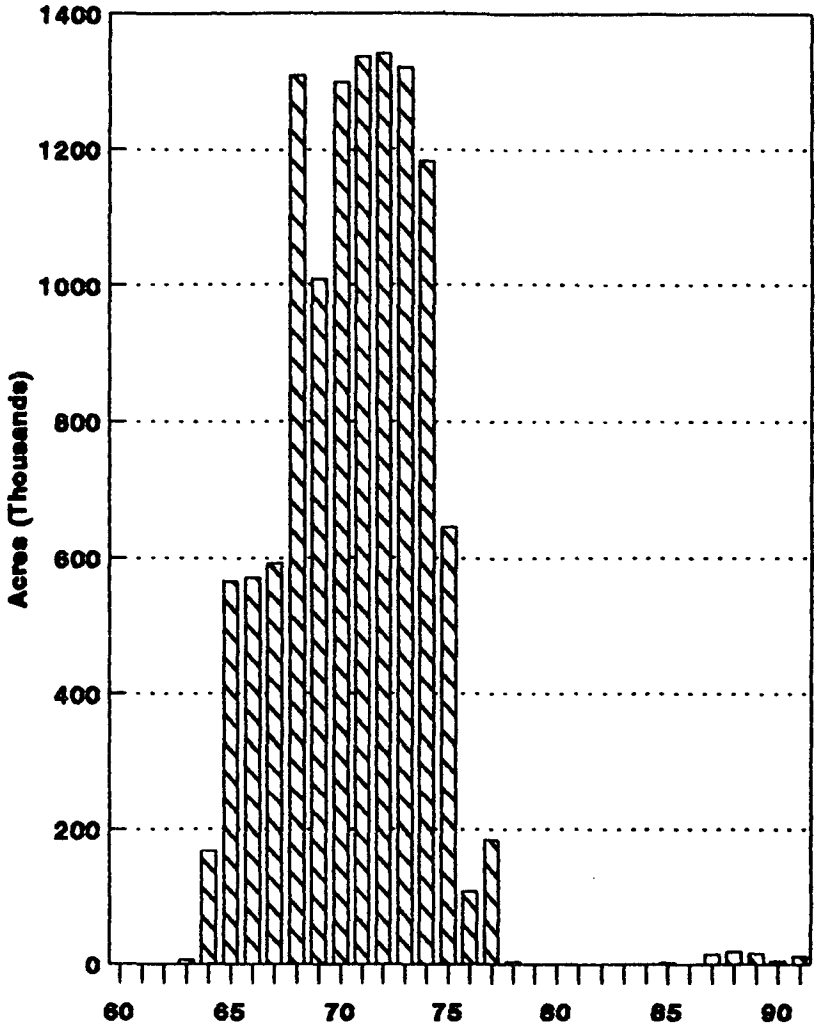
Northern Region 1991



WESTERN SPRUCE BUDWORM INFESTATIONS
MONTANA 1970-1991

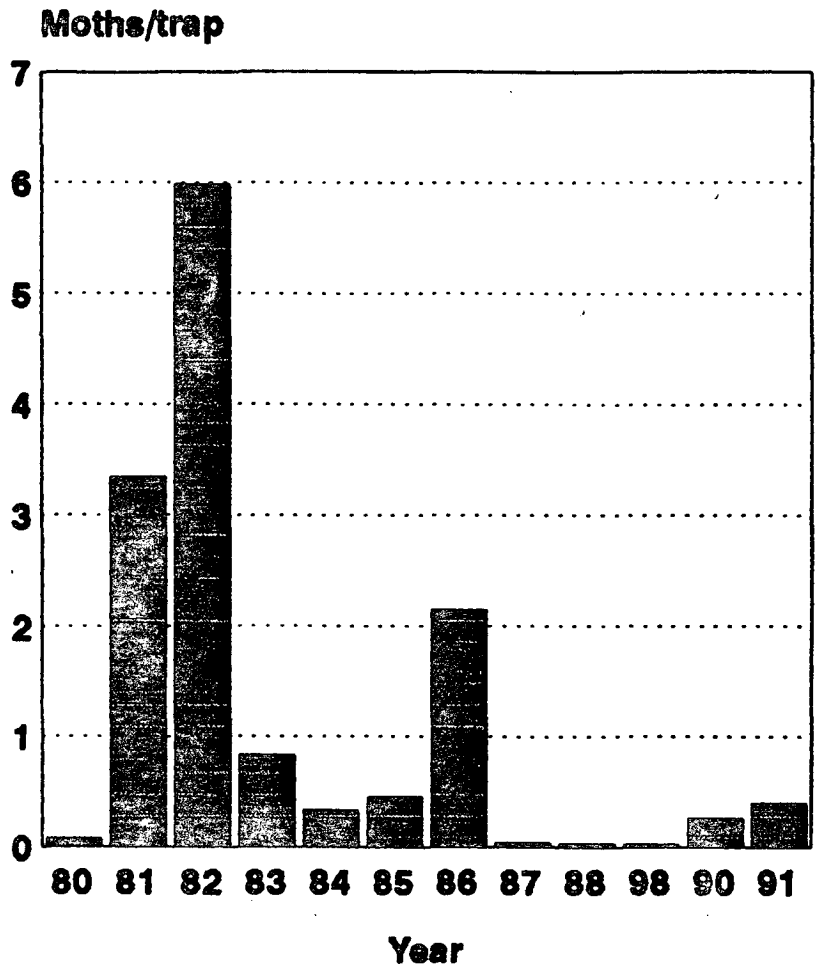


WESTERN SPRUCE BUDWORM DEFOLIATION
Nez Perce National Forest



DFTM TRAP DATA

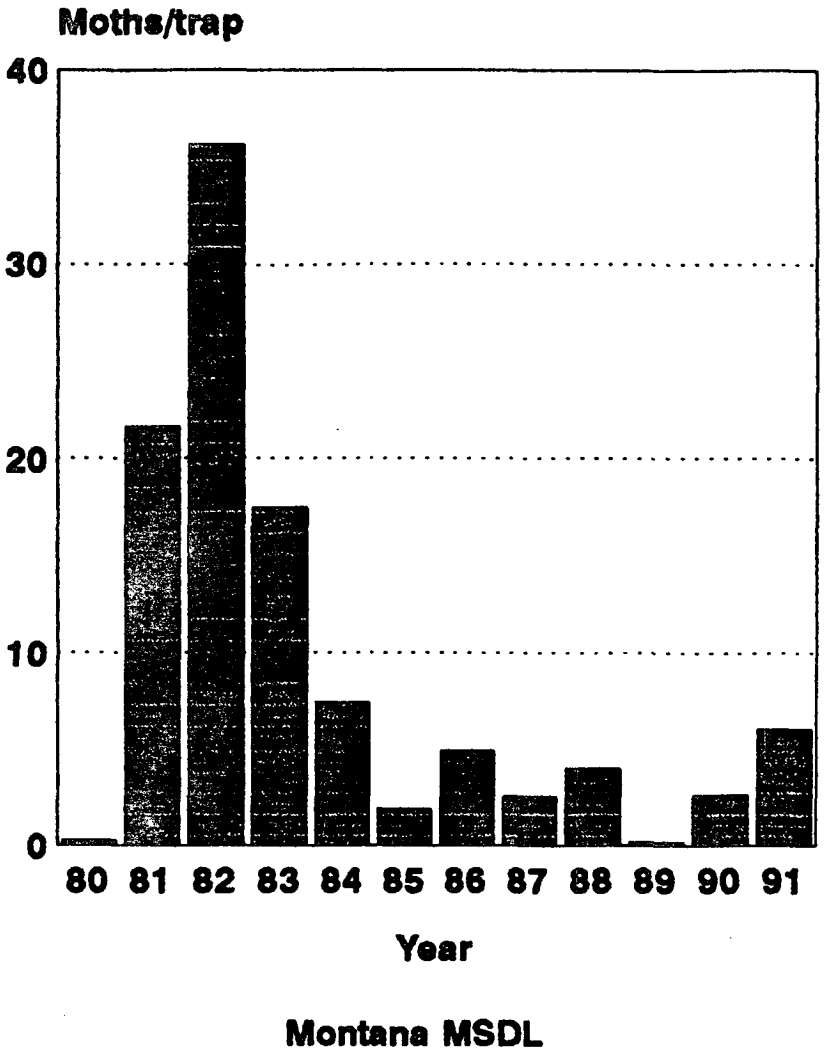
Northern Idaho



Region 1 FPM

DFTM TRAP DATA

Western Montana



Montana MSDL

NATIONAL STEERING COMMITTEE
FOR
MANAGEMENT OF WESTERN DEFOLIATORS

R5-Pacific Southwest Region Report
August 20-21, 1992

John M. Wenz

Current Status

1) Modoc budworm. Defoliation of true fir (white fir, Abies concolor, and red fir, A. magnifica) by the Modoc budworm, Choristoneura viridis (?), was detected in June 1992, over approximately 105,000 acres on the Modoc National Forest in northeastern California. High population levels and heavy defoliation have been observed in the Mill Creek, Benton Meadows, and Halls Meadow areas in the north Warner Mountains and in the Dry Creek-Deep Creek area in the south Warners. Low populations were found over about 50,000 acres, medium populations over 30,000 acres, and high populations on 25,000 acres. High activity levels are confined to overstocked, multi-storied, true fir stands at higher elevations. Defoliation in these stands is evident on trees at all canopy levels, dominant to understory. In lower elevation mixed conifer stands (white fir, Jeffrey pine, Pinus jeffreyi, and ponderosa pine, P. ponderosa), defoliation is minimal and concentrated on understory fir up to 20 feet in height. In intermediate elevation mixed conifer stands composed of true fir and lodgepole pine (P. lambertiana), the sugar pine tortrix, Choristoneura lambertiana, is defoliating the lodgepole pine. Sugar pine tortrix activity is particularly evident over about 20,000 acres in the Lassen Creek-Benton Meadows area. Budworm defoliation in these stands is generaly confined to understory, suppressed, fir. The Modoc National Forest is currently analyzing the situation and has expressed interest in silvicultural treatment alternatives.

2) Gypsy Moth. As of July 27, 1992, seven gypsy moths had been trapped in California. Single catches have been reported by the following Counties (Cities): Los Angeles (Lancaster), Sacramento, San Diego (Carlsbad), San Francisco, San Bernardino (Yucaipa), Santa Barbara (Lompoc), and Stanislaus (Turlock).

all single catches

3) Other Defoliators: Scattered defoliation of oaks by the fruit tree leafroller, Archips argyrospilus, was reported from several locations in the San Bernardino Mountains (San Bernardino National Forest) in southern California. Moderate to heavy feeding by the black pineleaf scale, Nuculaspis californica, on ponderosa and sugar pine was reported from several locations in central and northern California. There is particular concern that black pineleaf scale feeding damage, in conjunction with extended drought stress, will predispose white pine blister rust resistant, and resistant-candidate (untested) sugar pines, to bark beetle attack. In

addition, defoliation by the white fir sawfly, Neodiprion sp., was noted in several areas in central and northeastern California. The heaviest sawfly defoliation is to understory fir in mid- to low-elevation mixed conifer stands.

Suppression and Eradication

With the exception of an individual tree treatment for black pineleaf scale, there were no forest defoliator suppression or eradication projects in R5 in 1992. One rust resistant sugar pine was sprayed with carbaryl to control the black pineleaf scale on the Pacific District, Eldorado National Forest. Post-treatment evaluation indicates good control in terms of scale mortality and at last check, the sugar pine was still extant.

DRAFT

Strategic Plan for Management of Western Defoliators

United States
Department of
Agriculture

Forest
Service

Stanislaus National Forest
19777 Greenley Road
Sonora, CA 95370-5909

Reply To: 3400

Date: 5 November 1992

Subject: National Steering Committee for the Management of Western Defoliators- Strategic Plan

To: John W. Barry, Chairperson

At the August 20-21, 1992 meeting of the National Steering Committee for the Management of Western Defoliators, a draft Strategic Plan for the Committee was submitted for review and comment. Subsequently, John Wenz discussed the draft with Tom Hoffacker, Nancy Lorimer and Gene Lessard (WO-FPM) and John Neisess (R5-FPM Program Leader). The enclosed draft of the Plan reflects consideration of the comments and input received during and after the meeting in August.

Implementation of this Strategic Plan should provide the basis for a more integrated assessment of defoliator management needs and inclusion in emerging Forest Health and Ecosystem Management efforts. Implementation also has the potential to change the way the steering committee functions and what it is expected to do. The key to implementation in FY93 is the establishment of small working groups to initiate evaluation and consolidation of available information, element by element, for each designated western defoliator. This could have a significant impact on workloads.

It is therefore suggested that the draft Strategic Plan be presented and discussed at the FY93 FPM Staff Director/Program Leader Meeting to determine the appropriate action.

John M. Wenz
Entomologist,
R5-FPM/SSSSA

Enclosure
cc: J.Neisess- R5/FPM
T.Hoffacker- WO/FPM
G.Lessard-WO/FPM
N.Lorimer-WO/FPM
J.Wenz

NATIONAL STEERING COMMITTEE FOR WESTERN DEFOLIATORS

Strategic Plan for the Management of Western Defoliators

DRAFT
5 November 1992

Assumptions: This Strategic Plan was developed under the following assumptions:

(1) The primary objective of the Strategic Plan is to provide guidance in identifying and prioritizing needs for managing defoliators of western hardwood and coniferous forests. The Strategic Plan is intended to provide a framework for identifying critical issues and technology or information needs that should be filled or addressed to implement more effective management of western defoliators.

(2) The basic objectives of western defoliator management are to (a) maintain negative defoliator resource impacts at acceptable levels within the context of clearly defined management goals, objectives and the ecosystem "desired future condition", and (b) maintain, not interfere with, and/or enhance, positive resource/ecosystem interactions and impacts.

(3) While this Plan focuses on defoliators, it is recognized that evaluation of defoliator impacts and implementation of management strategies includes consideration of interactions with other biotic and abiotic factors including insects, diseases, and relevant site and stand factors.

(4) Utilization of the basic issues and elements outlined below as a framework for identifying defoliator management needs provides a strong basis for integrating defoliator (pest management) considerations with emerging Forest Health and Ecosystem Management efforts.

Basic Issues: The following basic issues must be considered to identify national western defoliator management needs:

(1) When and where unacceptable defoliator impacts are going to occur.

(2) Identification, analysis, understanding and prediction of defoliator impacts on diverse resource management goals and objectives, forest health, and the implementation of ecosystem management.

(3) Strategies, technologies and methodologies needed to implement effective management of western defoliators.

Elements: The following elements are intended to focus on these basic issues and help facilitate identification of information and technology needs.

Element 1. Functions/Interactions of Defoliators in Western Forest Ecosystem Dynamics.

A) Damage/Impact Assessment. There is a need to measure damage (mortality, top-kill, loss of foliage, growth loss) and analyse, evaluate and understand the positive and negative impacts on diverse resource management goals and objectives (desired future condition).

1) Impact assessment should include determining and evaluating the roles, functions, and interrelationships of western defoliators in forest ecosystem dynamics.

2) Consider short- and long-term time frames.

3) Evaluate and monitor both untreated and treated situations to determine treatment efficacy relative to diverse resource management goals and objectives.

B) Damage/Impact Prediction. There is a need to develop and test models that predict defoliator damage (impacts).

1) Ideally, these models should account for other pests (multi-pest models) and stress agents (e.g. drought) and consider a full range of damage/impacts.

C) Hazard/Risk Rating. There is a need to develop hazard/risk rating systems for use in predictive damage/impact modelling and focusing detection efforts.

Element 2. Population Dynamics

A) Survey/Detection. There is a need to develop new and improve existing survey and detection systems to predict when and where populations will reach levels that might cause unacceptable resource impacts.

B) Population Assessment. There is a need to develop valid, functional, population sampling/monitoring methodologies.

1) Low-level populations (survey/detection/prediction).

2) Relationships between defoliator population levels and consequent damage/impact on diverse resources.

Element 3. Management. There is a need to develop/implement biologically effective, environmentally sensitive, economically defensible, defoliator management strategies to maintain defoliator impacts at acceptable levels.

A) Silvicultural

1) Define/develop strategies. Define specific defoliator treatment objectives within the context of resource management objectives and opportunities (e.g., old growth areas, wildlife habitat, streamside management/riparian areas, wilderness areas).

2) Evaluate short- and long-term efficacy for a range of resource management opportunities/objectives.

B) Chemical Insecticides

1) Define/develop strategies. Define specific treatment objectives within the context of diverse resource management opportunities and objectives.

2) Evaluate short- and long-term efficacy for a range of resource management opportunities/objectives.

3) Develop/test new materials/formulations/application and assessment technology.

4) Evaluate environmental impacts (including non-targets).

5) Registration Issues

C) Biological Insecticides (Microbials, Growth Regulators)

see Element 3 (B) 1-5.

4) Semiochemicals

see Element 3 (B) 1-5.

5) Biological Control (Classical, Conservation, Augmentation)

1) Evaluate opportunities/define strategies. Define specific treatment objectives within the context of diverse resource management opportunities and objectives.

2) Evaluate short- and long-term efficacy for a range of resource management opportunities/objectives.

Element 4. Technology Transfer. Work with cooperators (NFS, Research, States, Private Industry, Special Interest Groups)to effectively implement and demonstrate effective defoliator integrated pest management. Coordinate with various Resource Managers to effectively link defoliator management strategies with new resource management approaches, e.g., ecosystem management.

Implementation: Within the context of the above assumptions, issues and elements, the following actions are proposed for the Western Defoliator Steering Committee in FY93:

(1) Considerable information on components of the above elements is already available and additional work is currently in progress. Small, functional, working groups will be designated to initiate consolidation, evaluation and summarization of available information and identification of work currently in progress for specified western defoliators (e.g., western spruce budworm, Douglas-fir tussock moth, others as appropriate).

(2) Each working group will develop a 5-year, defoliator specific, plan that includes identification of management information/technology development needs with timeframes to obtain the information and/or conduct the necessary development.

(3) Each working group will have the responsibility to work with the Steering Committee to prioritize needs.

Appendix C

United States Department of Agriculture | Forest Service | Washington Office | 2121 C Second Street Davis, CA 95616

Reply To: 3400

Date: September 2, 1992

Subject: Technology Development Needs (Western Defoliators)

To: Director, FPM
Thru: Assistant Director, PUM&C

The National Steering Committee for Management of Western Defoliators met in Albuquerque, NM, August 20-21 to identify technology development needs. The forthcoming report of the meeting will identify several needs and issues, report on progress of needs previously identified, and set forth a strategic plan for managing western defoliators. The objective of the strategic plan is to provide a planned and coordinated approach to managing western defoliators. Pending review and finalization of the plan, the committee decided to defer listing new technology development needs, other than those listed below, until the 1993 meeting. The two needs that require immediate attention are as follows:

Priority 1

Conduct studies to address data gaps on impact of Bacillus thuringiensis insecticides on non-target organisms in the West.

Priority 2

Conduct field tests of TM Biocontrol-1 to evaluate formulation carrier(s), application rates, volumes, and efficacy.

John W. Barry

JOHN W. BARRY
Chairperson

cc: Steering Committee
Mel Weiss, WO/FPM

United States
Department of
Agriculture

Forest
Service

Stanislaus National Forest
19777 Greenley Road
Sonora, CA 95370-5909

Reply To: 3400

Date: 3 November 1992

Subject: National Steering Committee for the Management of Western Defoliators- Douglas-fir Tussock Moth Pheromone Registration

To: John W. Barry, Chairperson

During the August 20-21, 1992 meeting of the National Steering Committee for the Management of Western Defoliators, the subject of mating disruption using the Douglas-fir tussock moth (DFTM) pheromone was briefly covered. I have subsequently discussed the issue with Lonne Sower (PNW) and we feel it is now appropriate for the Forest Service to take the lead in pursuing registration of the DFTM pheromone.

Following is a summary of the current status of work with the DFTM pheromone:

1) Reasonable efficacy of the pheromne used as a mating disruptant has been demonstrated in appropriately sized field tests in R4, R5 and British Columbia, Canada (see abstracts, enclosed). Results have been consistent between tests and have averaged between 70%-80% reduction in larval populations the following year. No further field tests are needed.

2) Treatments have not been shown to adversely affect DFTM parasitoids and other non-target arthropods, including carpenter ants and spiders.

3) The mating disruption strategy can be used either by itself or in combination with other suppression methods.

4) There is an existing technology transfer agreement between the Forest Service and Scentry Incorporated, the company that developed the formulation used in the mating disruption applications (Technology Transfer Agreement PNW 89-640, 16 August 1989). Scentry can be expected to support part of the registration effort.

The Forest Service (FPM and FIDR) has invested considerable time and effort to develop and field test the DFTM mating disruption technique and it would be very beneficial to have it available as a viable management alternative for the DFTM. Because of economic problems associated with "minor-use" products, it is very unlikely that Scentry will pursue registration unilaterally. We suggest that the Steering Committee recommend that the Forest Service take the lead, beginning in FY93, in coordinating registration of the DFTM pheromone. John Wenz (FPM-R5) and Lonne Sower (PNW- Corvallis) volunteer to initiate the effort.

/s/ John M. Wenz
FPM- R5

/s/ Lonne L. Sower
PNW-Corvallis

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Reply To: 3400

Date: November 16, 1992

Subject: DFTM Pheromone Registration

To: Jim Space, Director
Forest Pest Management

The National Steering Committee for Management of Western Defoliators recommends initiating registration of the Douglas-fir tussock moth pheromone. The rationale for this recommendation is contained in the enclosed memorandum from John Wenz and Lonnie Sower. John and Lonnie have volunteered to provide assistance.

JOHN W. BARRY
Chairperson

Enclosures

cc: J. Cota, WO/FPM w/enclosure
T. Hofacker, WO/FPM w/enclosure
L. Sower, PNW
J. Wenz, FPM/Stanislaus NF

Enclosure

Abstracted from FPM Technology Development progress report (Weatherby and Sower 1992):

Six, 200-acre plots were established in the Hitt mountains, Weiser RD, Payette National Forest. DFTM pheromone loaded in center sealed fibers and mixed with a sticker was applied via helicopter to 3 plots in August, 1991. Dose was 10g/acre of Z-6-heneicosen-11-one, the synthetic DFTM pheromone. Application equipment is non-standard and applicators will require technical assistance to install and use it the first time. Treatment reduced the next years DFTM larvae population by 81% in treated vs check plots. Treatment had no measurable effect on carpenter ants (Camponotus spp.), western spruce budworms (Choristoneura occidentalis), or spiders. DFTM eggs collected from some locations in both treated and check plots harbored significant numbers of a beneficial parasite, Trichogramma sp. probably minutum. In sum, mating disruption treatment has substantial impact on Douglas-fir tussock moth populations and is unlikely to effect non-target arthropods.

Abstracted from Sower and Wenz et al. J.E.E. 1990:

ABSTRACT Synthetic sex pheromone of Douglas-fir tussock moth, Orgyia pseudotsugata (McDunnough), was applied at 25 g/ha in hollow fibers to four plots of 16 ha each with preoutbreak level populations in north-central California. Treatment reduced the population level of the next generation by 74% and 68%, respectively, for egg mass and larval samples relative to controls. A key egg parasite, Telenomus californicus Ashmead, was not adversely affected by the treatment.

Abstracted from Sower and Daterman et al. J.E.E. 1983:

Hollow fibers containing synthetic pheromone (Z-6-heneicosen-11-one) were applied by helicopter to six plots of about 8 ha each. Douglas-fir tussock moth, Orgyia pseudotsugata (McDunnough), had reached such high population levels on the plots that trees in some areas were completely defoliated. Reproduction of the moths was reduced 71-81% [sic. based on production of fertile eggs], respectively, at dosages of 8 and 25 g of pheromone/ha relative to untreated control plots.