MEETING
WESTERN NORTH AMERICAN DEFOLIATOR WORKING GROUP

OCTOBER 31- NOVEMBER 2, 2000

USDA FOREST SERVICE
PACIFIC NORTHWEST REGION REGIONAL OFFICE
333 SW FIRST AVENUE
ROOM “6 WEST A”
PORTLAND, OREGON

MEETING NOTES

Participants: David Beckman (ID-Dept. Lands), Dayle Bennett (R4-Boise), Dave Bridgwater (R6-Portland)), Sally Campbell (PNW-Portland), Gary Daterman (PNW-Corvallis), Tom Gregg (R6-Portland), Bruce Hostetler (R6-Sandy), Mike Johnson (Yakima Nation), Barbara Kukan (PFC-Victoria), Ladd Livingston (ID-Dept. Lands), Roy Mask (R2-Gunnison), Imre Otvos (PFC-Victoria), Dave Overhulser (ODF-Salem), Robert Progar (R4-Boise), Iral Ragenovich (R6-Portland), Carol Randall (R1-Coeur d’Alene), Karen Ripley (WA-Dept. Natural Resources), Terry Rogers (R3-Albuquerque), Roger Sandquist (R6-Portland), Don Scott (R6-LaGrande), Katharine Sheehan (R6-Portland), Ken Snell (R6-Portland), Jack Stein (FHTET-Morgantown), John Wenz (R5-Sonora, Chair), Beth Willhite (R6-Sandy).

Meeting Summary- Action Items for 2001

1) Coordinate with PNW-Forest Health Monitoring to help standardize defoliator/ damage codes for forest inventories (Sheehan).
2) Review the 1994 “Strategic/ Tactical Plan for the Management of Western Defoliators” and recommend alternative actions (Randall, Willhite, Rogers).
3) Prepare publication on the efficacy and use of the DFTM Early warning System since 1979- Draft for review in 2001 (Daterman, Wenz, Sheehan).
4) Write letter to Director, FHP-WO and R6 concerning the need to conduct sound post-treatment monitoring on 2000-2001 DFTM suppression projects (Wenz).
5) Write letter to Director, FHP-WO recommending that annual regional/ state insect and disease conditions reports be produced (Wenz).
6) Write letter to commend R6 on the 2000 DFTM suppression project (Wenz).
7) Write letter to the National Fire Implementation Team suggesting consideration of insects (defoliators in particular) and diseases in project planning, implementation and monitoring (Wenz).
8) Write letter of support to Otvos for development of DFTM virus detection kit (Wenz).
9) Regional FHP groups consider working with Otvos to submit development of DFTM virus detection kit as a STDP in 2001 (Regions).

Next Meeting**:** November 5-7, 2001, Portland, OR. Wenz, Chair.

Business (Meeting Opened, 0804, October 31, 2000)

1) Purpose of Working Group (Wenz)

A) Discuss current issues, concerns and opportunities.
B) Provide technology development needs and priorities annually to the Forest Health Technology Enterprise Team (FHTET) Special technology development Program (STDP) Insect Management Technical Committee (IMTC).
C) Communicate needs, issues of concerns and recommendations to appropriate entities.

2) Action Items from March, 1998 Meeting

A) Prepare letter to Forest Health Protection (FHP) Washington Office (WO) requesting that Regional Forest Pest Conditions Reports be continued (Ragenovich).

Action: See Conditions Report discussion below.

B) Prepare letter to FHTET recommending development of a better DFTM model (Sheehan).

Action: The proposed letter was not written because there are several options for incorporating DFTM effects into the FVS modeling system, and (in my recollection) the defoliator group had not reached a consensus on the relative merits of each option. Neither the current mid-crown branch DFTM model nor the Budworm Damage Model performed well when tested against data from the 1974 Blue Mountains outbreak (Sheehan and others 1994). Possible options for modeling DFTM effects include: (1) develop a multi-crown population dynamics model (using the BudLite framework), (2) revise the Damage Model so that it performs better at the heavier defoliation levels that are more common for DFTM than budworm, and (3) use mortality keywords based on the Blue Mountains outbreak (or any other available data) and general estimates of outbreak frequency to simulate the net effects of outbreaks. These options are listed in order of both costliness and probable accuracy – that is, option 1 would probably be the most expensive yet most accurate approach.

C) Check cost of getting the DFGTM mating disruption pheromone registered (Reardon).

Action: See DFTM mating disruption discussion below.

D) Prepare letter of support to Imre Otvos for development of a DFTM virus detection kit (Meeting attendees).

Action: Letter sent June 16, 1998 from R6, ODF and WA-DNR.

E) Prepare publication on the efficacy and use of the DFTM Early warning System since 1979 (Daterman, Wenz, Sheehan).

Action: Publication in preparation; target review draft in 2001.

F) Bioassy three wild DFTM populations in 1998-99 (Otvos and field representatives)

Action: Completed.

G) Test NOVO-038 carrier for Bt (Ripley).

Action: No tests completed with Bt. However, operational problems with Gypcheck, including settling in mixing tanks and clogging of spray nozzles, were corrected in 1999-2000 and the carrier was used with apparent success operationally with TM-BioControl-1 in eastern Oregon and Washington by R6 in 2000.

3) New Business

A) Sally Campbell, plant pathologist with PNW and Forest Health Monitoring Coordinator for FHP, Portland, requested assistance from the WNADWG to help her group standardize defoliating agent and severity coding for forest inventories across the west and possibly nation-wide. The issue is to resolve differences between various inventory systems. Discussion ensued.

Action: Sheehan agreed to serve as the WNADWG liaison with Campbell and her group. It is understood that members of the WNADWG will provide assistance as appropriate.

B) Wenz brought to the attention of the WNADWG the "Strategic/ Tactical Plan for Management of Western Defoliators" last modified in 1994. After discussion, it was decided that it would be beneficial to have a sub-group review the 1994 Plan and report back to the WNADWG at the next meeting (or before, as appropriate).

Action: Randall, Willhite and Rogers volunteered to review the 1994 Plan and work with Wenz to develop alternatives for consideration by the WNADWG.

Conditions Reports 2000- DFTM

R1 (Randall): Early warning pheromone traps began to detect an increase in Douglas-fir tussock moth populations in the late 1990's in western Montana and northern Idaho. In 2000 defoliation was visible on a small area (less than 50 acres) on the Flathead National Forest, and on over 50,000 acres (mostly state and private lands) in Latah and Benewah Counties in northern Idaho. Ground surveys in the tussock moth defoliated area in Idaho found the hemlock looper caused some of the defoliation. The State of Idaho is considering treatment of tussock moth impacted areas on state and private lands.

Idaho (Livingston/ Beckman)

R2/ Colorado (Mask): Douglas-fir tussock moth is a chronic defoliator of blue spruce in urban settings. In the general forest, in the summer of 2000, approximately 1000 ac. Of white fir were defoliated on private property in extreme southern Colorado (east of Trinidad). No control efforts were initiated.

With respect to the early warning system, at least nine sites have been trapped each year since 1995 using systems protocols. Two moths were caught in 1995 and one in 2000. "high dose" baits were used elsewhere in 1998 and 1999, yielding catches of 1 to 8 moths/ trap. Is there a need to refine the system for use in R2?

R3/ New Mexico/ Arizona (Rogers): After remaining at undetectable levels for more than 20 years, Douglas-fir tussock moth caterpillars were observed in considerable numbers during the summer of 2000 migrating and pupating under tables, tent pads, and on various structures at the Dayle Resler Boy Scout Camp on the Lincoln National Forest near Cloudcroft, New Mexico. Pheromone trapping and cocoon/egg mass surveys conducted at several sites in the Sacramento Mountains indicated that populations were at sub-outbreak levels and that defoliation of Douglas-fir and white fir by the Douglas-fir tussock moth in the survey area will be minor in 2001. Douglas-fir tussock moth pheromone trap catches from nine sites on the Sacramento Ranger District, Lincoln National Forest averaged 0 to 6.0 moths per trap. On the adjacent Mescalero Apache tribal lands moth catches averaged 1.4 and 1.2 moths per trap at the two sites surveyed. Pheromone trapping results at three sites in the Sandia Mountains east of Albuquerque, NM had trap averages of 20.5 moths at one site, 8.4 at the second site, and 0 at the third site. No visible defoliation or cocoon/ egg masses were detected.

No DFTM activity was reported from Arizona.

R4/ Utah (Progar): In Utah and Nevada 17 sites in 7 Districts are monitored for DFTM. In the early 1990's populations of DFTM were present in Utah/ Nevada. All but one of these were caught in northern Nevada at the Humbolt NF on the Mountain City District at the Fawn Creek and Merrit Mountain trap sites. These same two sites were the areas where DFTM turned up in 1988. As of October 30, 2000 trap counts are in for the Ely Rd. site in the Humbolt NF where 5 moths have been found. Aerial survey indicated approximately 100 acres of defoliation on the Fishlake NF in central Utah in 1999.

R5/ California (Wenz): The 5,800 acre 1997-99 outbreak in the Sequoia/ Kings Canyon National Parks and the Hume Lake District (Sequoia National Forest) collapsed due to a combination of natural factors in 1999. Follow-up cocoon, egg-mass, and larval sampling has confirmed the collapse.

The 2,220 acre DFTM outbreak, detected during 1999 on the Big Valley District, Modoc NF, and on adjoining private lands, declined due to natural controls. Follow-up egg mass surveys in late fall (1999) and larval surveys conducted in the spring of 2000, indicated that the populations had collapsed.

Year 2000 early warning system pheromone trap results are not yet available, but no DFTM defoliation has been reported in California in 2000.

R6 (Ragenovich): There were about 21,000 acres of defoliation by Douglas-fir tussock moth in northeastern Oregon on the Wallowa-Whitman National Forest in 1999. Year 2000 defoliation is expected to be around 170,000 acres. 39,600 acres were treated with NPV in northeastern Oregon and southeastern Washington. Ground sampling indicates increasing populations and a potential project in north central Washington near the Methow Valley on the Okanogan National Forest.

Oregon (Overhulser)

Washington (Ripley):

Olympia**:** Two Douglas-fir trees and several ornamental pear trees were completely defoliated by an unknown species of tussock moth in 2000.

Palouse**:** Some light defoliation was noted at Kamiak Butte County Park, north of Pullman (about 5 miles east of the Idaho border, so is likely affiliated with the Idaho activity north of Moscow).

Blue Mtns**:** (see R6 discussion, above)

North Central WA, Methow Valley**:** Low levels of defoliation was observed from the ground in the vicinity of Early Winters Creek in 1999. A small area around a hotel, the Freestone Inn, was sprayed (unknown product) in spring, 2000. Larval sampling and cocoon sampling indicate that outbreak populations will be present in 2001. Work continues to delimit those areas and submit egg masses to Imre Otvos for virus level analysis.

DFTM Early Warning Pheromone System

Summary of Results: 1980 to Present : Performance of Early-Warning System for Predicting Douglas-fir Tussock Moth Outbreaks: (Daterman)

Calibrated pheromone-baited traps have been in operational use from 1979-2000 in the western U.S. for monitoring Douglas-fir tussock moth (DFTM) populations. An annual minimum of 750 trapping plots have been deployed in the interior Douglas-fir host type, principally in the States of Oregon, Washington, Idaho, and California. Populations of DFTM have the capacity to change abruptly from endemic to epidemic status, and the objective of the monitoring traps is to provide an early-warning of 1-2 years for such a population change. The use of standard pheromone lures, traps, and plot design and maintenance has been followed each year as described in the 1979 recommendations. A summary and analysis of trapping results is being prepared for publication by Kathy Sheehan, John Wenz, and Gary Daterman.

The early-warning system has been effective in providing an early-warning of most of the outbreaks that have occurred during the 20-year span of time, but apparently ineffective or only marginally successful in other cases. It has become evident that the area of susceptible forest represented by a trapping site, and the distribution of trapping plots across a forest landscape, influence the chances for successful predictions. The density of trapping sites and their locations on the forest landscape are determined by the specialists implementing the method in their respective locations. Consequently, the densities and patterns of spatial distribution of sites have varied greatly. In areas where outbreaks have occurred during the past 20-years, trap density has varied from less than 1000-acres to over 40,000-acres represented per trapping site. Outbreaks of DFTM were successfully predicted one to two years prior to the occurrence of visible defoliation where each trapping site represented 12,500 acres **or less**.

At this point in the 20-year data analysis, the following conclusions and recommendations have emerged:

Geographic sub-regions exhibit similar patterns of population cycling.
Not all population increases lead to outbreaks that cause visible defoliation.
Susceptible forest type should be monitored by **at least** one trapping site per 12,500-Ac.
Trapping should take place annually and follow standard procedures.
Increase trap site density around areas of high value or concern.
The addition of supplementary plots is not recommended once trap catches increase.
Be timely and thorough in follow-up ground sampling once trap catches increase.

Discussion: Discussion focused on the above key conclusions as well as the need to be sure that pheromone plots are distributed as well as possible throughout the susceptible host type. This does not mean that additional plots should not be installed in high priority areas but that the host type should be adequately covered too. While an outbreak has been predicted with a plot density of one plot per 12,500 acres, it may be better to have plot densities as low as one plot per 5,000 acres. Data analysis is continuing. The importance of conducting appropriate follow-up ground sampling was emphasized.

Artificial Shelters (Wenz)

The use of artificial (cryptic) shelters as a method to sample Douglas-fir tussock moth (DFTM) cocoons and egg masses was developed in the late-1970's as part of an effort to monitor low-level DFTM populations {Dahlsten, D.L., D.L. Rowney, W.A. Copper and J.M. Wenz 1992. Comparison of Artificial Shelters and Other Monitoring Methods for Endemic Populations of Douglas-fir Tussock Moth, *Orgyia pseudotsugata*, (McDunnough) (Lepidoptera: Lymantriidae) Can. Ent. 124:359-369}. Since then, artificial shelters have been used in California and other locations within the range of DFTM in western North America.

Artificial shelters are 9cm X 10cm X 3.5cm wooden blocks with two, 2.5 cm diameter holes, about 2.75cm to 3.0cm in depth, drilled in the front of the block on opposite corners (diagonally from each other) and one hole of similar dimensions drilled on each side of the block. Two shelters are attached to the bole (one each on opposing sides- aspect is not important) of 10, well distributed host trees, per plot. Plots should be located in areas of host type susceptible to DFTM. Plot locations can also be determined by resource management priority; that is artificial shelter plots can be established in areas where a DFTM outbreak would likely result in unacceptable impacts to resources and where direct control would be a realistic, viable, management alternative. These same criteria are used to locate early warning pheromone plots and both monitoring techniques can be implemented in the same area.

Tussock moth larvae migrate to, and pupate in, the holes drilled in the shelters. The artificial shelters can provide information on cocoon and egg mass densities, pupal sex ratios, condition, including levels of natural mortality factors and egg viability. Preliminary (continuing) evaluation of data from California suggest that the shelters may be reasonable predictors of increasing DFTM populations and potential outbreaks. Information from artificial shelters can be used in conjunction with pheromone plot data to assess and monitor DFTM population trends and help predict a potential outbreak. The shelters are not intended to replace more extensive cocoon/ egg mass and/or larval sampling that should be conducted when it is determined that DFTM populations may be increasing to outbreak levels.

FY2000 DFTM Suppression

FY2000 Project Results- Idaho (Livingston/ Beckman)

FY2000 Project Results- Oregon/ Washington (Ragenovich/ Bridgewater)

Note: Since the 10/31-11/2, 2000 meeting, the final project report (*Douglas-fir Tussock Moth Project Final Report 2000*, USDA-Forest Service, Pacific Northwest Region, Umatilla NF, Wallowa-Whitman NF, Report No. BMPMSC-01-04, December 2000, Project Manager- Nick Greear) has beeen completed and is available from R6. A brief project summary is included here, followed by points of discussion :

Following increasing early warning system pheromone trap catches in 1997, 1998 and 1999 and about 21,000 acres of DFTM defoliation in 1999, the Pacific Northwest Region conducted an Environmental Analysis in 1999-2000 and published an Environmental Impact Statement. The Record of Decision was signed on May 26, 2000. The Regional goal for the affected national Forests was to maintain existing desired vegetative conditions in Areas of Concern that were at risk to DFTM defoliation within the next two to five years. Following are the project objectives for areas of the Umatilla (Walla Walla and Pomeroy Districts) and Wallowa-Whitman (Pine District and Hells Canyon NRA) National Forests:

- Protect riparian habitat where defoliation would cause unacceptable degradation of occupied habitat, especially critical spawning or rearing habitat for salmon, steelhead, and bull trout.
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- Protect designated old growth and late/old structure stands where defoliation would substantially degrade habitat values.
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- Protect residential and administrative sites where defoliation and the presence of large numbers of larvae would adversely affect people living or working there.
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- Protect high use recreation sites where defoliation and the presence of large numbers of larvae would adversely affect forest visitors.
- Protect municipal watersheds where existing formal agreement is in place and where 100% defoliation would have unacceptable impacts on water quantity or quality.
- Protect designated foreground scenic Areas of Concern where defoliation would have a substantial impact on scenery.
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- Protect seed orchards and plantations of genetically superior trees where defoliation would result in a considerable loss of investment and a reduction of seed needed of future seedling demand.
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- Protect areas where investments have already been made to protect Douglas-fir or other firs from bark beetles.

The overall project area included seven analysis areas in the Blue Mountains of northeast Oregon and southeast Washington covering 99,308 acres. A total of 39,602 acres were sprayed with TM-BioControl0-1. Direct project field costs, including the spray contract, were approximately $2, 659,000 ($67/acre). Total costs including preparation of the EIS and (future) monitoring are estimated to be $3,242,000.

Initial entomological analysis indicates how well the following objectives were achieved: 1) Identification of treatable DFTM populations was met; 2) The timing of virus application was met with a high degree of confidence; 3) The estimation of population densities (pre and post spray) was accomplished; 4) Initial estimates indicate that treatment objectives for foliage protection were met. Success in interrupting the population cycle of the insect can only be determined in one to two years. A Project Critique and Recommendations for Improvement are included in the final project report.

Discussion: The group concurred that Region 6 had acted appropriately on the best available information (DFTM activity in Region 5 in 1997-99, early warning pheromone plot data, 1999 defoliation and population data) to conduct an EIS in a timely manner to allow treatment of many areas prior to the occurrence of substantial tree damage. Treating before considerable damage has occurred in the “peak” phase of an outbreak has been a problem with past tussock outbreaks due primarily to late detection. The group also felt that the EIS moved in an appropriate direction by requiring the identification of specific “areas of concern” for treatment with relatively specific protection objectives as opposed to larger, more general treatment areas.

There was some discussion as to how much monitoring was needed. The working group felt very strongly that quantitative treatment efficacy monitoring be conducted, including the effects of the project on a) DFTM populations, including incidence of virus; b) damage (defoliation, mortality, top-kill) and c) the prevention and/or mitigation of unacceptable resource impacts. Such large-scale projects tend to be of considerable public interest and strong, defensible, monitoring data may be very important, not only for the current project, but for future projects. Funding for monitoring should be part of the projects costs and we should look at innovative ways to more effectively involve the resource areas benefiting from the project.

FY2000 Project Results- Oregon/ Washington: Virus and Parasite Monitoring (Scott)

A discussion of virus and parasite monitoring is included in the final project report referenced above; a summary is provided as follows:

The TM-BioControl-1 treatments dramatically increased the larval mortality rates over natural virus mortality rates throughout the treatment areas. Treatment applications clearly induced an NPV epizootic and enhanced the spread of natural virus in the population. Although natural virus was present prior to treating, there is nothing in our results to suggest that this level of virus alone would have spread as rapidly in th epopulation this year without the inoculative treatments with TM-BioControl-1. In that regard, a widespread epizootic from natural virus would probably not have occurred until next year (2001)- the anticipated year of collapse of this tussock moth outbreak cycle. Hence, we were successful in causing the epizootic to occur a year earlier than it would have under natural conditions and we have clearly demonstrated that TM-BioControl-1 is efficacious when applied under difficult operational conditions.

While foliage protection was one of the primary objectives for treatment, it won’t be until next year, when defoliation plot trees are re-sampled for defoliation, top-kill and mortality, that the success of that objective can be fully evaluated. Additional monitoring of the populations in 2001 will also be important to substantiate the continuing decline and collapse of populations that has resulted from virus treatments, as well as to follow the course of other natural mortality factors in helping terminate the current outbreak. We believe the strategy to suppress DFTM populations to protect foliage for the benefit of “resources of concern” has been accomplished but the real measure of success will be next year when it is determined the extent to which trees on treated areas have retained foliage, produce new foliage, have been top-killed or are killed by defoliation or secondary bark beetle attack, relative to untreated areas. It is essential that all of this follow-up monitoring be conducted in 2001 to bring proper closure to the 2000 DFTM Suppression Project in the blue Mountains.

Virus: TM-BioControl-1

Current Status of Shelf Life Bioassays (Kukan)

Background

Ten lots of TM BioControl-1 were produced between 1985-1995. The product was stored in seventeen different package sizes and four different processors were involved in the production. Our group at Pacific Forestry Centre is involved in a collaborative project with the US Forest Service to test the shelf life of the stored TM BioControl-1. More specifically, we are testing the effects on efficacy of strain (Douglas-fir tussock moth (DFTM) from different regions), package size, time in storage and processing by different companies.

Outline of Experimental Procedures for Activity Standardization

We were sent 47 20g samples for testing. Our bioassays are activity standardization bioassays to determine the current activity titre (amount of activity / unit wt.). These are conducted using the Goose Lake colony of insects which has been maintained at PFC since Mar. 1996.

Larvae are reared on artificial diet and newly molted 3rd instar larvae tested. The diet plug inoculation technique is used to administer the virus. One ul of virus is placed on a small diet plug in well dish. One larva is added and left 24 hr. Those larvae that eat the entire diet plug are put in individual cups and mortality checked daily for 21 days. For our bioassays, distilled water is used as a negative control and a fresh virus preparation as a positive control. Data is analyzed using POLO PC and SAS PROC PROBIT. Estimates of LD50 (lethal dose that kills 50% of the larvae) are calculated.

Strain of DFTM

During Year 1 and 2 of the study, different strains of DFTM were used in bioassays. We compared the efficacy of a fresh sample of OpNPV against four different field strains of DFTM (California, B.C., Idaho, Oregon) and 1 laboratory strain (Goose Lake). Results indicated that there is some variation in LD50 values with different strains of DFTM.

Three field strains from the US (CAL, IDA, OR) have similar, relatively low LD50 values while the BC strain has about a 3-fold higher LD50. The 3 US strains would be more susceptible to TM BioControl-1 than the BC strain.

Package Size, Time in storage, Processing**.**

Because strain makes a difference in LD values, it is necessary to use one strain to compare all TM BioControl-1 samples to assess lot, package size and processing differences.

We are doing this by using the Goose Lake colony in all future experiments. We chose the Goose Lake strain because egg masses are more reliably and readily available from laboratory rearing than from field collection (no egg parasitism or naturally occurring virus in the laboratory colony). The Goose Lake strain can be produced "year round" in the laboratory with the appropriate cold storage to break diapause. Thus, the laboratory strain provides a more "flexible" hatching schedule than with field collected egg masses so more bioassays can be done. The original efficacy data used for registration was also done on the Goose Lake strain.

Thirty-nine TM BioControl-1 samples have been tested with the Goose Lake strain, at least two from each package size. The last experiment in this series was completed last week so results are not available. We will have to spend the next couple of months analyzing this data before we know if there is any variation in LD values with package size, time in storage or due to processing.

DNA Analysis for Potential Genetic Variation (Kukan)

There is some concern about the composition of the different TM BioControl-1 samples and whether there has been any deterioration of the DNA with storage. We will assess the composition by testing the DNA of seventeen samples – one from each package size.

DNA will be isolated, purified, digested with restriction enzymes, separated on agarose gels, and Southern blots done. Results will be obtained by direct comparisons of the restriction fragment length polymorphism profiles (RFLP). A Scientist has been hired and plans for the DNA analysis of the TM BioControl-1 lots started. Protocols have been submitted for review by our collaborators.

Testing Anti-feedant Properties of the Carrier 038 (Kukan)

Last year before the spray project in Oregon - Idaho, we were asked to conduct an experiment to investigate the potential anti-feedant properties of the carrier 038. Carrier 038 was to be used to deliver TM BioControl-1 to target DFTM populations in the suppression project. O38 had not been used before with TM BioControl-1.

Larvae from Douglas-fir tussock moth egg masses, collected in Oregon in the fall 1999 were tested in this experiment. TM BioControl sample 9 (1840 g/pkg) from Lot 4 was selected for testing since it had the lowest potency and consequently requires the highest g/acre dose treatment of the samples tested so far from Lots 2-6.

Generally more feeding occurred in the controls than in treatments with the virus. The number of actively feeding larvae seemed to be higher in the controls including those feeding on the 038 treated foliage. There was less feeding observed by the larvae treated with TM BioControl.

More feeding was observed in virus with 038 treatment than in the dishes with virus treatment with distilled water. These results suggest that the TM BioControl may have some anti-feedant properties like other viruses. Carrier 038 did not appear to have any anti-feedant properties.
The highest mortality 15 days after infection was recorded in larvae treated with TM BioControl on artificial diet (100%). Mortality in larvae given the equivalent of 5.1 g virus/acre with the carrier 038 (96%) was higher than in larvae given the same dose of virus in distilled water (88%).

This suggests that enhanced feeding had taken place with the 038 present resulting in a higher infection rate. Larvae treated with a lower dose of TM BioControl (2.97 g/acre equivalent) also experienced high mortality (86%).

In summary, our results suggested that carrier 038 did not have any anti-feedant properties and may even be a feeding stimulant when combined with virus.

Comparison of Response of 2^{ND} and 3^{RD} Instars to TM BioControl-1 (Kukan)

Original activity standardization bioassays done on advance samples from the processor were done using the diet surface contamination technique and 2^{nd} instars. In our bioassays we use the diet plug inoculation technique and 3^{rd} instars. Diet plug bioassay is superior to diet surface contamination because it eliminates any variation in the distribution of PIBs on the diet surface and negates differences in larval feeding rates. In order to assist forest managers in acre-dose determinations, we undertook experiments to compare the response of 2^{nd} instar and 3^{rd} instar DFTM to TM BioControl-1. It may not always be possible to run the additional bioassays with the target field population of DFTM necessary for an accurate acre-dose determination. Data from our comparison experiments may be useful in calculating acre-dose values.

In this series of experiments we used 2^{nd} instar larvae and administered the virus by A) the diet plug method of inoculation and B) the diet surface contamination method. In addition, a comparison was made to 3^{rd} instar larvae from the same generation inoculated by the diet plug method with the same TM BioControl-1 samples.

LD50 values of the L3 diet plug experiments were 3.6 to 4.9 times higher than LD50 values of the L2 diet plug experiments. This means it takes 4 to 5 times more virus to kill 50% of the 3^{rd} instars compared to 2^{nd} instars. LC50 values of the L2 diet surface experiments were 1.4 to 2.9 times higher than the LD50 values of the L2 diet plug experiments. Therefore, it takes 1.5 to 3 times more virus to kill 50% with the diet surface method. LD50 values of the L3 diet plug experiments were 1.2 to 3.0 times higher than LC50 values of the L2 diet surface experiments.

Comparing the LC50 value of the original diet surface contamination bioassay, done when the TM BioControl was first produced, to the results from the diet surface contamination bioassay we just did, we find that the LC50 values now are higher so the numbers are less than 1. Lot 3 and lot 7 had a ratio of LC50 values equal to 0.7. This suggests that the potency is 70% of what it was when the TM BioControl was first produced.

Information Obtained by Rearing Douglas-fir Tussock Moth Egg Masses from California, Oregon and Idaho (Otvos)

It is highly desirable to rear Douglas-fir tussock moth (DFTM) egg masses collected from infested stands considered for treatment prior to actual treatment. Rearing these egg masses can reveal information about the health of the population that is useful to Forest Managers contemplating direct control of this insect. Rearing egg masses can provide information on larval hatch, egg parasitism, and the level of natural viral infection. Lower hatch and higher percent egg parasitism and viral infection usually indicates older outbreaks that may not require treatment because they are likely to collapse on their own.

This can be illustrated by the results of the rearing of DFTM egg masses collected in California in the fall of 1998. Of the 245 egg masses reared in Victoria, British Columbia, in the winter, 71 (24%) were sterile and no larvae emerged from them (Table 1). Overall larval hatch was low, only about 41%, and viral infection relatively high

(Table 1), with 22% of the larvae dying from NPV (Table 2). No egg parasitoids emerged from any of the egg masses reared from the five sites, which was surprising. These data indicated that the outbreak was old and likely to collapse in 1999. No control action was taken, and the outbreak did collapse on its own that year.

Dead and inactive larvae were collected from seven locations in the DFTM outbreak area in California during the summer of 1999. The larvae did not exhibit the usual characteristic of hanging down from the twigs and branches but rather were very sluggish and inactive and did not appear to be feeding. Diagnosis of these cadavers showed increasing levels of viral infection over time in the summer (Table 3). However, only moderate levels of NPV were detected in the larval smears, suggesting that other factors may have also contributed to the collapse of the outbreak in California.

In the fall of 1999, 65 new DFTM egg masses were collected in Oregon and 81 in Idaho. Rearings of these egg masses by the Canadian Forest Service in Victoria revealed that egg parasitism and levels of virus infection were low, and levels of larval hatch were high in both States.

Oregon – all 65 new egg masses collected in the fall of 1999 were reared. Egg parasitism was very low. The egg parasitoid *Trichogramma* spp., probably *minutum*, emerged from only two eggs (one of which was being reared for obtaining the level of viral infection), both eggs came from the same egg mass. The other egg parasitoid, *Telenomus* spp., was not recovered. Larval emergence was high (81.3%), and only 1% of the 1,508 larvae reared were killed by NPV (Table 4). These results indicated a healthy DFTM population and, without treatment, the outbreak was likely to increase in size. Therefore, treatment with TM-BioControl-1® was justified in the summer of 2000.

Idaho – 50 of 81 new egg masses collected in the fall of 1999 were reared. Egg parasitism was very low, only two eggs were parasitized by *Trichogramma* spp. (probably *minutum*) in one of the egg masses reared. No *Telenomus* spp. were recovered from these egg masses either. Larval emergence was very high (89%) and no viral infection was detected in any of the 1,203 larvae reared (Table 5), indicating the Idaho population is young and is likely to increase in 2001.

Table 1: Viability of egg masses used for determining the natural occurrence of virus collected in the Sequoia King's Canyon National Park, 1998/1999.

	No. new (1998) egg masses	No. egg masses with no emergence	**No. egg masses 25+ larvae[a]**	No. eggs reared	% larval hatch
Site 1	50	14 (28.0%)	30 (60.0%)	2000	42.8
Site 2	47	22 (46.8%)	15 (31.9%)	1880	28.6
Site 3	49	12 (24.5%)	31 (63.3%)	1960	44.7
Site 4	50	14 (28.0%)	29 (58.0%)	2000	42.2
Site 5	49	9 (18.4%)	30 (61.2%)	1960	44.7
Totals(x)	245	71 (29.0%)	135 (55.1%)	9800	40.7

[a] a maximum of 25 larvae from each egg mass were used for determining the natural occurrence of NPV.

Table 2: Natural occurrence of virus in egg masses collected in the Sequoia King's Canyon National Park, California, 1998/1999.

	No. new egg masses reared	No. eggs reared [a]	No. larvae emerged (%)	No. larvae reared for virus determination[b]	No. dead larvae	% dead larvae smeared	No. smears with NPV	Est. % larvae infected by NPV
Site 1	50	2000	42.8	791	260 (32.7)	50.0	68 (52.3)	17.1
Site 2	47	1880	28.6	492	191 (38.7)	43.5	39 (47.0)	18.2
Site 3	49	1960	44.7	843	355 (41.9)	40.6	56 (38.9)	16.3
Site 4	50	2000	42.2	784	455 (57.8)	35.8	64 (39.3)	22.7
Site 5	49	1960	44.7	807	458 (56.5)	36.2	98 (59.0)	33.3
Totals(x)	245	9800	40.7	**3717**	1719 (46.0)	39.9	325 (47.4)	21.8

[a] 40 eggs from each egg mass were used for virus determination rearings, the remainder were decontaminated and reared to establish a colony for virus assaying.
[b] a maximum of 25 larvae from each egg mass were used for determining the natural occurrence of NPV.

Table 3: Occurrence of virus over time in DFTM larvae collected in the Sequoia King's Canyon National Park, 1999.

	% larvae infected by NPV[a]				
Location/Date Collected	15/vii	20.vii	**11/viii**	24/viii	Avg.[b]
A – Grant Grove Stables	0.0 [10]	0.0 [11]	40.0 [10]	40.0 [10]	19.5 (25.8)
B – Crystal Springs Campgr.	0.0 [10]	10.0 [10]	0.0 [10]	0.0 [1]	3.2 (4.8)
C – Quait Flat	0.0 [10]	10.0 [10]	22.2 [9]	0.0 [6]	8.6 (12.0)
D – Sunset Campgr.	0.0 [10]	0.0 [10]	50.0 [10]	62.5 [8]	26.3 (35.7)
E – Dorset Campgr.	0.0 [10]	-	100.0 [2]	-	13.6 (25.0)
F – Beetle Rock	0.0 [10]	0.0 [10]	10.0 [10]	0.0 [8]	2.6 (3.6)
G – Swale .	-	66.7 [3]	-	-	66.7 (66.7)
Average	0.0	**7.**8	**27.5**	**27.**3	13.5 (18.9)

[a] Number of larvae examined for NPV given in square brackets.
[b] Percentages in brackets calculated without first collection.

Table 4: Natural occurrence of virus in egg masses collected in Oregon, 1999/2000.

Collection location	No. new egg masses reared	No. eggs reared	No. larvae emerged (%)	No. larvae reared for virus determination[a]	No. dead larvae[b]	No. dead larvae with NPV	Est. % larvae infected by NPV
OR1 Fish Creek	36	1443	1147 (79.5)	854	46 (5.4)	12 (26.1)[c]	1.4
OR2 Pine Rd. East	18	722	639 (88.5)	429	32 (7.5)	1 (3.1)	0.2
OR3 Pine Rd.	3	120	106 (88.3)	75	1 (1.4)	0 (0.0)	0.0
OR4 W.W. Nat. For.	8	320	227 (70.9)	150	11 (7.4)	1 (9.1)	0.7
Totals(x)	65	2605	2119 (81.3)	1508	90 (6.0)	14 (15.6)	0.9

[a] a maximum of 25 larvae from each egg mass were used for determining the natural occurrence of NPV.
[b] all dead larvae were examined.
[c] 11 of the 12 larvae that died emerged from the same egg mass collected at for site OR1.

Table 5: Natural occurrence of virus in egg masses collected in Idaho, 1999/2000.

Collection location	No. new egg masses reared	No. eggs reared	No. larvae emerged (%)	No. larvae reared for virus determination[a]	No. dead larvae[b]	No. dead larvae with NPV	Est. % NPV in pop. in 2000
ID-9	15	600	511 (85.2)	351	20 (5.8)	0 (0.0)	0.0
ID-12	15	603	550 (91.2)	377	15 (4.0)	0 (0.0)	0.0
ID-117	10	404	350 (86.6)	225	7 (3.2)	0 (0.0)	0.0
ID-216	10	401	376 (93.8)	250	12 (4.8)	0 (0.0)	0.0
Totals(x)	50	2008	1787 (89.0)	1203	54 (4.6)	**0 (0.0)**	**0.0**

[a] a maximum of 25 larvae from each egg mass were used for determining the natural occurrence of NPV.
[b] all dead larvae were examined.

Virus Detection Kit (Otvos)

Small amounts of TM-BioControl-1 were made into solution and injected into mice. Six antigens were found in the mouse's blood, of which three reacted with DFTM virus. The most sensitive of these monoclonal anti-bodies was tested against the NPVs of six insects. It reacted slightly to five of these, but was highly reactive to DFTM NPV, as we have hoped. The experiment is being repeated to confirm these promising results, and the gypsy moth NPV will be included in the sensitivity test with the other viruses.

Discussion: The group felt that the development of this virus detection kit should be considered as a priority for funding through the STDP Program in 2001. The group urged that one or several of the Region's consider working with Otvos to develop an STDP Project Proposal for 2001.

Status and Future Needs of TM-BioControl-1: (Wenz)

A conference call was held on September 6, 2000 to discuss the status and future needs for TM-BioControl-1. Participants were: Allan Bullard (FHTET), Jim Byler (R1), Jesus Cota (WO-FHP), Gary Daterman (PNW), Barbara Kukan (CFS-PFC), Iral Ragenovich (R6), Dick Reardon (FHTET), Don Scott (R6), and John Wenz (R5).

Major conclusions were that : 1) There appears to be sufficient material to meet current needs; 2) There will probably be material available at the start of the next outbreak but there may or may not be enough to meet all needs for the entire outbreak; 3) There will be a continuing/ increasing demand for material in the future; and 4) It is likely that additional material will be needed by 2007.

Discussion resulted in the following three recommendations: 1) A group be chartered to develop options for production of a new supply of TM-BioControl-1; 2) Work be continued on evaluating mating disruption as another management tool for DFTM (see Mating Disruption discussion, below); and 3) Address the need for continuing maintenance of the Goose Lake strain of DFTM beyond Spring, 2001. The issue of TM-BioControl-1 registration in California was also discussed (see Registration-California discussion, below) and, depending on the results of current registration efforts, it was recognized that there may be a need to determine the necessity of conducting any needed additional studies and associated costs etc. The results of the conference call were sent to the Director, FHP-WO, on September 25, 2000.

Registration of TM BioControl-1 in California: (Wenz)

TM BioControl-1 is not registered in California. A registration package was submitted to the California State Department of Pesticide Registration (CA-DPR) on December 20, 1999. On November 15, 2000, CA-DPR notified the Forest Service of a "Proposed Denial of Application for Registration of TM-BioControl, EPA Reg No. 27586-1", based on "deficiencies in the data supporting application". The deficiencies were detailed in Medical Technology, Worker Health and Safety, Efficacy, Chemistry and Microbiology Evaluation Reports.
It will therefore be necessary to determine the costs and consequences of whether to pursue registration of TM-BioControl-1 in California.

Discussion: The group discussed the need to develop the means to have field collected DFTM (egg masses/ larvae) analyzed for incidence of virus. This will be a periodic, recurring need, as reliable knowledge of virus levels in DFTM populations is critical to making informed management decisions. Otvos volunteered to perform this service at cost for the next 1 to 2 years, but a long-term solution to this issue is needed. It was suggested that the group chartered to deal with other TM-BioControl-1 issues (see above) also take on this issue.

Mating Disruption

Current Status/ 2001 Plans (Ragenovich)

Plans were made to continue development of the Douglas-fir tussock moth pheromone for mating disruption. Research over the last 15 years has demonstrated that mating disruption could be used to effectively manage DFTM populations. However, an effective formulation or carrier needs to be identified. Previous formulations used in experimental plots, such as Conrail fibers, are no longer available. Plans were made to test the Hercon flake – which is the formulation used for Disparlure for gypsy moth. Over 90,000 acres were treated with Disparlure in the East this past year. DFTM pheromone was purchased and sent to Hercon to be incorporated into flakes. They have done some preliminary testing to determine whether the DFTM pheromone, which is a 21 carbon chain will elute from the flake.
In addition, we have sent some pheromone to 3M to incorporate into their microcapsule bead. The bead can be applied through a standard spray equipment nozzle. Field-testing to determine release rates under field conditions was planned for this past summer, but was put on hold until final costs for the DFTM suppression project were in. Lab tests and field release rate tests will be conducted this winter and/or spring (2001). Release rates will be done in an area with comparable weather conditions to those that would occur in the Blue Mountains in August. Field efficacy tests are planned for the summer of 2001 in Oregon, Washington and/or Idaho.

Conditions Reports 2000- Western Budworms and Other Defoliators:

R1/ Montana/ Idaho (Randall): The amount of defoliator activity in Region 1 has been at fairly low levels for the past few years as determined through annual aerial detection flights. From 1996- 1999 the most frequently encountered defoliation in the region was from hardwood defoliators, such as the forest tent caterpillar, western tent caterpillar, satin moth, and fall webworm, along riparian zones. Western Montana and northern Idaho also experienced unusually high levels of larch casebearer defoliation that, in some spots, resulted in significant foliage loss, but rarely caused enough defoliation to be visible in aerial surveys.

The western spruce budworm, which has been fairly inactive in the Region since the early 1990's, defoliated some small (20-50 acre) areas in western Montana on the Helena and Gallatin National Forests in 1999 and 2000, and on the Beaverhead National Forest in 2000.

R2/ Colorado: (Mask): Western Spruce Budworm- This was the second consecutive year of defoliation in northern Colorado. Defoliation in portions of southern Colorado continued. Many locations have received some level of defoliation in white fir and Douglas-fir for at least a decade.

Ponderosa Pine Needle Miner- Approximately 3,500 ac. of ponderosa pine defoliation occurred in the Black Forest near Franktown with scattered occurrences elsewhere in the Front Range of Colorado.

Large Aspen Tortrix- In 2000, approximately 1,000 ac. of defoliation in aspen occurred in the south San Juan Mountains of Colorado. This is a significant decrease from activity noted in 1999.

Gypsy Moth- Three individual moths were caught in three separate locations in the Black Hills, south Dakota. The 60-trap delimitation grid in the Rocky Mountain national Park yielded one moth.

Very little defoliation was reported in South Dakota and Wyoming.

R3/ Arizona/ New Mexico: (Rogers): Defoliators have become a significant issue in Arizona in the last 5 years. Extensive defoliation by spruce aphid caused tree mortality during an outbreak 1995-1997 in the White Mountains. Spruce mortality on impact plots, established by Ann Lynch of RMRS, varied from 0 to 100% averaging 6% overall. Spruce aphid is again in outbreak in 2000 in the White Mountains, and has spread to the Pinalenos and the San Francisco Peaks. A total of 138,870 acres were recorded during the aerial detection survey in 2000, after 1999 when no spruce aphid acres had been recorded.

Western Spruce Budworm defoliation more than doubled in 2000. In 1999 only 10,455 acres were recorded compared with 26,316 acres in 2000. Ponderosa Pine Needleminer declined slightly in 2000 while White Fir Needleminer, not seen in 1999 was present on 135 acres. Prescott Scale defoliation increased significantly this year from 25 acres in 1999 to 21,503 acres in 2000. Pinyon sawfly defoliation continues to decline from 145 acres in 1999 to 35 acres in 2000. While the populations of the defoliator of spruce and fir, *Nepytia janetae,* have declined in the White and Pinaleno Mountains, tree recovery has been slow. Plots established for this insect are showing tree mortality due to secondary infestation by bark beetles and mortality that appears associated with multiple years of severe defoliation.

Aspen defoliation declined in 2000 from 171,000 in 1999 to 37,226 in 2000. Much of the 1999 Aspen defoliation was attributed to a late season frost. We have seen other hardwood defoliators as well, although nothing else of significance was recorded during the aerial detection survey. A complex of a yet unidentified caterpillar and a chrysomelid have been defoliating willow in western Arizona and sycamore bagworm and white marked tussock moth have been seen defoliating sycamore, willow and ash in Oak Creek Canyon.

Following is a brief summary of the insect defoliation activity occurring on forested lands in New Mexico during FY 2000:

Western spruce budworm defoliation decreased from 293,000 acres in 1999 to 165,100 acres in 2000. Defoliation occurred on the Carson (79,165 cares), Santa Fe (21,920 acres), Cibola (2,965 acres), Lincoln (1,075 acres), and Gila 2,310 acres) National Forests; Jicarilla Apache (3,925 acres), Mescalero Apache (165 acres), Taos (3,560 acres), and Santa Clara Pueblo (90 acres) tribal lands; and 49,925 acres of state and private lands.

Aspen defoliation decreased nearly seven-fold from 171,000 acres in 1999 to 25,050 acres in 2000. Defoliation in New Mexico was detected on Carson (4,475acres), Santa Fe (6,970 acres), Cibola (760 acres), Lincoln (560 acres), Gila (630 acres) National Forests; Jicarilla Apache (260 acres) Mescalero Apache (315 acres), and Taos Pueblo (25 acres) tribal lands; and 11,060 acres of state and private lands. This defoliation was caused by one or a combination of western tent caterpillar, large aspen tortrix, marssonina leaf spot disease, and/or abiotic factors (hale damage, etc.).

Ponderosa pine needle miner discoloration in New Mexico increased over 17-fold from 1,600 acres in 1999 to 27,210 acres in 2000. Needle miner infected ponderosa pines were observed on the Santa Fe (505 acres) and Gila (14,200 acres) National Forests and 12,505 acres of state and private lands in northern New Mexico. Needles infected with needle miners are eventually killed and cast from the tree.

Pinyon pine needle scale-caused discoloration was detected on 4,495 acres of host type. Defoliation is expected to occur on 325 acres of the Gila and 4,170 acres of the Lincoln National Forests.

R4/ Utah (Progar) Gypsy Moth; For the second time, a gypsy moth population has been eradicated in the State of Utah. The Gypsy Moth was first detected in Utah in 1988. At that time, the numbers of acres infested was unknown but egg mass counts were as high as 4,000/ acre. The decision was made to enter into an eradication program. After treating over 70,000 acres with the biological insecticide, *Bacillus thuringiensis,* the infestation was considered eradicated in 1993.

In 1997, the Gypsy Moth was reintroduced. Trapping was increased to delineate the population and 916 acres were treated in 1998. Because of poor product performance, a retreatment of 764 acres was necessary in 1999. Extensive post-treatment monitoring established that the new population was indeed a reintroduction and in 2000, only one moth was caught statewide.

The Gypsy Moth program managers attributed the success of the program to the following: 1) An excellent detection program in very difficult terrain. The crews sometimes climbed over 4,000 ft in steep terrain in a day; 2) Excellent support from the public and the environmental community; 3) Excellent inter-agency cooperation.

Western Spruce Budworm: On the Dixie NF in southern Utah, defoliation decreased from 19,500 acres in 1998 to 900 acres in 1999. In Idaho, approximately 2,500 acres of mostly light defoliation were mapped on the Targhee NF. This is the first western spruce budworm defoliation observed since 1988 in Idaho. Defolaition was again noted during aerial detection surveys in 2000 on portions of the Dixie and Targhee NF's. In addition, light defoliation was observed during ground surveys on portions of the Bosie and Sawtooth NF's in southern Idaho. Acreage estimated of defoliation have not yet been determined for 2000.

R5/ California (Wenz with input from Laura Merrill, Dave Schultz and Sheri Smith):

Fruittree Leafroller: The San Bernardino Mountain population of the fruittree leafroller, *Archips argyrosila* (Walker) (Lepidoptera: Tortricidae) was at it's highest level in 2000 since the early 1980's and possibly since the early 1950's. The primary host tree in the southern California mountains, *Quercus kelloggii*, was completely defoliated in some areas. Southern California is in the third year of a drought, thus the trees are also water stressed. Some trees did not refoliate and some individuals were observed which produced a small amount of foliage but a very large acorn crop. Defoliation was also high in 1999 covering about 14,000 acres. Ground surveys documenting occurrence and intensity of defoliation is being conducted through the known range of the leafroller in the san Bernardino and eastern end of the San Gabriel Mountains. Defoliation is expected to be much higher in 2000. Defoliation was observed for the first time at Barton Flats, possibly because early spring and bud expansion on the host black oaks permitted survival of the first instar larvae. Resident sin the affected areas complained about frass and the large amount of webbing which made it unpleasant to be outdoors.

White Fir Sawfly: Increasing defoliation involving the white fir sawfly was reported from several locations in central and northeastern California. Areas include about 900 acres on the Sierraville District and 50 acres on the Downieville District, Tahoe NF, several hundred acres on the Feather River District and about 160 acres on the Mt. Hough District, Plumas NF and heavy defoliation in much of the area defoliated in 1999 by the DFTM on the Big Valley District, Modoc NF. Historical information suggests that mortality from white fir sawfly outbreaks is generally less that 1% and most common in intermediate and suppressed host trees. Bark and/or engraver beetle activity has not been a problem following white fir sawfly outbreaks in California.

Modoc Budworm: Modoc budworm (*Choristoneura retiniana retiniana)* damage was not detected by aerial surveys in 2000 in the Warner Mountains following patchy activity in 1998 and 1999. Budworm activity was noted on the Big Valley District (Modoc NF) near Manzanita Mountain, Calpines, Deer Springs and the Rush Creek drainage in generally the same areas affected by DFTM feeding in 1999. The budworm defoliation was primarily on the current years growth and heavirest in the upper 2/3rds of the white fir crown. Mortality is npot expected but there may be some growth loss associated with the combined effects of DFTM, budworm and sawfly over a two year period.

Trinity Lake Budworm: The TrinityLake budworm (*C. carnana californica*) has once again defoliated about 5,000 acres of Douglas-fir around Trinity Lake in northern California. The defoliation is very light and not visible from the air.

Pine Needle Sheathminer: The pine needle sheathminer (*Zelleria haimbachi*) defoliated several hundred acres of plantation ponderosa pine near Deer Mountain on the Goosenest District on the Klamath NF. Part of this infestation is a "War Memorial Plantation" as well as the site of the only restroom for miles on State Highway 97.

Several acres were also affected in a 20- year old pondereosa pine plantation near Fender Flat in the northern warner Mountains east of Goose Lake on the Modoc NF. Moderate sheathminer activity was also observed near Pondosa on the Shasta-Trinity NF and west of Bordertown on the Truckee District (Tahoe NF) and the Humbolt-Toiyabe NF (R4).

Satin Moth: A three-year satin moth (*Leucoma salicis*) infestation on aspen on the Goosenest District (Klamath NF) collapsed in 2000. A 5-10 acre spot of overstory aspen is declining and dying; there are considerable numbers of aspen sprouts.

Fall Webworm: The fall webworm (Hyphantria cunea) has been at high levels since 1998 in the California Coast Range from about Clear Lake in the south to southern Oregon. In the Trinity and Klamath River drainages, defoliated madrone have been detected by the aerial survey; mature madrones have been defoliated 100% and are covered with webbing. Other trees affected include Oregon ash, apples and black walnut.

Oak Ribbed Case Maker: Black oak leaves have been skeletonized over several hunded acres in Lassen and Plumas Counties by the oak ribbed case maker, *Bucculatrix albertiella*. Larval damage consisted of lower leaf surface consumption resulting in a brownish, skeletonized, appearance. In some areas, heavy infestations resulted in almost total defoliation as the skeletonized leaves dropped off.

R6 (Ragenovich)

A number of defoliators were active, at least to some degree Washington and Oregon. Western Spruce Budworm outbreak in south central Washington, on the Yakima Indian Reservation, Gifford Pinchot National Forest and adjacent State and private lands continues to increase with approximately 384,750 acres defoliated.

A small intense spot of 500 acres of hemlock looper defoliation was found in northern Washington.

Other incidences of defoliation from sawflies were reported in southwestern Oregon on 55 acres.

A continuing ground survey identified new locations of balsam woolly adelgid in northeastern Oregon and coastal southwestern Oregon.

Gypsy moth projects were conducted by State Department of Agriculture folks in Washington in the Seattle area, and a small project in southwesten Oregon near Ashland, OR. Year 2000 traps caught very few moths in OR; however, additional finds outside of the Ashland treatment area will require additional treatment in 2001. One Asian gypsy moth was trapped in Forest Park in Portland. One find of AGM usually triggers an eradication project. In WA, a new infestation was found near Vader in southwest WA.

Pine needle sheath miner caused defoliation was reported from many localities in both eastern Washington and Oregon.

Fall webworm was active in many areas in both Oregon and Washington.

Washington (Ripley)

Western spruce budworm**:** Continues to defoliate several hundred thousand acres in the vicinity of Mt. Adams. Acreage increased and damage intensified from that observed in 1999. State, private, NFS, and Yakama Indian Nation lands are involved. Approximately 8,000 acres on state and private land north of Glenwood and approximately 4,000 acres of Yakama Indian Nation land were treated with *B.t.* in 2000. Pheromone trap catches continue to be high in the general outbreak area.

On the northern edge of this outbreak, trap catches in the Ahtanum state forest are the highest recorded in four years of monitoring. Portions of the area averaged from over forty to over 70 moths per trap in 2000. A suppression project on DNR land in the Ahtanum is anticipated for 2001, if funding is received.

Western oak looper**:** Causing severe defoliation on a fairly small area of state, NPS, and private land on San Juan Island.

Western hemlock looper**:** Causing defoliation on a few hundred acres in the North Cascades south of Baker Lake. This area was mapped in the aerial survey.

Pine needle sheathminer: Causing light defoliation in young ponderosa pine throughout Washington.

Gypsy moth: North American gypsy moth from recent introductions are frequently captured in discrete areas in Washington. If two or more life stages are detected, then eradication treatment is applied. Every capture site continues to be intensively trapped until no moths are caught for 2 years. Gypsy moth as not successfully become established in Washington; all catch site populations have died out naturally, been eradicated, or are still being monitored. In 2000, at least one site was sufficiently delimited to result in a small, ground based suppression proposal for 2001. At this time, no Asian gypsy moths have been identified from the moths caught in 2000.

Fall webworm: Very high levels along the Columbia gorge west of Hood River, Oregon. Populations in South Puget Sound have declined to low levels.

Birch sawfly: Birch on several hundred acres of forest and agricultural windbreaks near Lynden (Whatcom County) had extensive leaf mining by sawfly.

FY2000 Western Budworms Suppression and Special Projects

FY2000- Washington (Ripley)

A cooperative western spruce budworm suppression project was implemented on about 8,000 acres of state (DNR) and private (IP Pacific Timberlands, Boise Cascade) forest land in 2000. Habitat protection for the Northern Spotted Owl was an objective on DNR land. Timber resource protection was also important on private lands, particularly for stands which had received previous improvement treatments such as thinning.

Foray 48B was applied by helicopter "neat" at ½ gallon per acre to areas with a pre-spray population of at least 4.0 larvae per 45 cm midcrown branch. The average population throughout the project was 20 larvae per 45 cm midcrown branch.

The goal was to reduce the population (14 day post-spray, lower crown beating) to less than 1 larvae per branch. Two of three analysis units met this target with 0.87 and 0.39 larvae. The third unit had 2.07 larvae per branch. It had a highly diverse canopy with multiple layers and was nearly 100% host trees. Larval populations on much of the project area will be re-sampled in 2001.

The project was complicated somewhat by general, but not immediate, proximity to known sites where Mardon Skipper, a Washington State "Endangered" species has historically been observed. The treatment window to target western spruce budworm coincides with the time mardon skipper larvae are present. Surveys of the proposed spray area for mardon skipper did not occur. Washington Dept of Fish and Wildlife (WDFW) employees provided consultation and review as part of the Forest Practices Permit process for all landowners. They also provided input to DNR's proposed treatment areas during the planning stages in order to devise project boundaries that would best protect potentially high value skipper habitat in the area.

During this project, Beth Willhite, USFS, conducted a pilot test which examined use of 1) a ground cover and 2) sprinkling water to prevent deposition of *B.t.* on grasses which are mardon skipper host plants. Her study also provided insight into drift which occurred during the project (see discussion, below).

B.t. is an important tool in management of forest defoliators. Its impacts to non-target Lepidoptera are a growing concern. It is important to maintain a positive relationship with regulators and provide them with appropriate information about *B.t.* application scenarios and likely effects.

Mardon Skipper Habitat Spray Migration Study (Willhite)

A field study was conducted near Glenwood, Washington, during late June, 2000, to assess the potential of two methods to mitigate deposition of aerially-applied B.t.k. on Idaho fescue, which is the host plant of the mardon skipper, a Washington State endangered butterfly. The first method tested was a physical barrier approach designed to prevent B.t.k. spray deposition on host plants by using a lightweight, non-porous, aluminized plastic film ground cover. The second method tested the use of water applied with overhead sprinklers to wash spray deposition from the foliage of host plants. Both treatments were applied within spray blocks during operational spray application and for at least two hours following the completion of spraying. A wash solution from fescue grass blade samples collected in control and treatment plots before and after spraying was prepared and cultured for presence and relative abundance of B.t. Other data collected included maximum/minimum temperatures for ground cover treatments, photo records of vegetation response to ground cover treatments immediately following cover removal and 24-hours later, and amount of water applied by the sprinkler system.

Preliminary results indicate that the ground cover treatment is an effective means of preventing spray deposition. There was a marked and significant difference between the extremely low amounts of B.t. cultured from covered plot samples vs. very high amounts of B.t. cultured from control (uncovered) plot samples. In addition, it appears unlikely that the material used in the cover study would negatively affect mardon skippers trapped beneath because temperature records showed the material served to moderate temperature extremes beneath the cover in comparison to adjacent uncovered plots, even during sunny midday conditions. Most of the forbs in the covered plots were of medium to short height and showed no deleterious effect from the treatment. Neither did the tall grass seed heads, which seemed to recover their height within 24 hours after cover removal. On one covered plot, however, one very tall yarrow plant was bent over parallel to the ground and did not recover its original height by 24 hours following treatment.

The sprinkler method was promising, but was generally less successful than the cover method in mitigating B.t.k. deposition. Although a large and statistically significant difference in the amount of B.t. cultured was observed between the sprinkled and unsprinkled samples (absolute difference in sample means was a magnitude of 6), considerably more B.t. remained on the foliage following the sprinkler treatment than remained following the cover treatment. This was probably due to the sprinkler system used for the study. The study sprinkler configuration produced large volumes of water shooting out to 30 feet in a narrow stream, likely causing a backsplash of B.t.k. contaminated soil onto the fescue clumps. A sprinkler system using misting emitters to apply water less forcefully is likely to be more successful at mitigating spray deposition. Testing such a system is the next logical step toward further developing this application.

Discussion: The importance of B.t.k. as an effective management tool with relatively few unwanted side effects if applied properly with appropriate mitigations was stressed. Some voiced the opinion that forest entomologists should be more active in promoting/defending it as a viable defoliator management alternative and be more proactive in helping to better define the risks/ consequences/ “pros and cons” associated with various management alternatives, particularly the “no action” option.

Final Business

Meeting Critique: Comments positive. Consider expanding length of meeting to allow for more complete discussion of conditions and issues of interest associated with “minor” defoliators. Suggestion to consider including a field trip as part of meeting (before, during or after).

Next Meeting: November 5-7, 2001 in Portland, OR. Suggestion to allow for change in location pending defoliator activity in 2001. Wenz to remain Chair for 2001.

Adjourn: 1200, November 2, 2000