MEETING
WESTERN NORTH AMERICAN DEFOLIATOR WORKING GROUP

NOVEMBER 6-8, 2001
BEST WESTERN UNIVERSITY INN
MOSCOW, IDAHO

MEETING NOTES

Participants: Debra Allen-Reid (R3- Albuquerque, NM), David Beckman (ID-Dept. Lands, Coeur d'Alene, ID), Dave Bridgwater (R6-Portland, OR), Gary Daterman (PNW-Corvallis, OR), Paul Flanagan (R6-Wenatchee, WA), Bruce Hostetler (R6-Sandy, OR), Mike Johnson (Private, Yakima, WA), Ladd Livingston (ID-Dept. Lands, Coeur d'Alene, ID), Steve Munson (R4-Ogden, UT), Imre Otvos (PFC-Victoria, BC, Canada), Dave Overhulser (OR Dept. Forestry, Salem,OR), Lee Pedersen (R4-Ogden, UT), Robert Progar (R4-Boise, ID), Iral Ragenovich (R6-Portland, OR), Carol Randall (R1-Coeur d'Alene, ID), Karen Ripley (WA-Dept. Natural Resources, Olympia, WA), Bill Schaupp (R2-Lakewood, CO), Don Scott (R6-LaGrande, OR), Lia Spiegel (R6-LaGrande, OR), Jack Stein (FHTET-Morgantown, WV), John Wenz (R5-Sonora, CA, Chair), Beth Willhite (R6-Sandy, OR), Doug Wulff (R1-Coeur d'Alene, ID) (see attached list).

Guest Participants: Jim Byler (Forest Service, Retired), Steve Cook (University of Idaho, Moscow, ID), Larry Ross (District Ranger, Palouse District, Potlach, ID), Don Patterson (Bennett Lumber Products Inc., Princeton, ID), Cliff Todd, (Forester, City of Troy, ID)

MEETING SUMMARY

Action Items for 2002

1) Meeting participants will provide the Defoliator Working Group (DWG) Chair with a narrative of presentations (preferably in digital format) for inclusion in meeting notes by December 10, 2001 (Working Group Participants).
Action:

2) Consolidate formal documentation of past defoliator committee meetings and convert into digital format (Hostetler/ Wenz).
Action:

3) Chair will develop a draft "Statement of Purpose" for the DWG and distribute to members for review and comment (Wenz).
Action: Completed 11/20/01- see discussion below.

4) DWG representatives will review "Action Items" in the 1994 Strategic Plan and report to Chair by January 15, 2002 (DWG Representatives- see discussion below).
Action:

5) A meeting of interested parties will be scheduled in early 2002 to discuss issues associated with western hemlock looper monitoring and management (Ragenovich).
Action:

6) A meeting of interested parties will be convened in early 2002 to discuss issues associated with operational scale, predictive sampling of Douglas-fir tussock pupae/egg masses (Wenz).
Action: Meeting set for 2/28/02, Portland, OR.

7) A questionnaire will be sent to DWG members concerning a virus detection kit for Douglas-fir tussock virus (Otvos).
Action: Completed 11/26/01

8) The DWG will contact the program committee for the 2002 Western Forest Insect Work Conference concerning the opportunity to hold a workshop on the balsam woolly adelgid (Ripley).
Action: Completed 11/20/01.

9) DWG will send a letter to appropriate entities expressing concern over continuing decline in forest entomological research in the west (Wenz).
Action: Completed 2/7/02

10) DWG will send a letter to Director, FHP, WO expressing support for, and need to expeditiously address, the TM-BioContro-1 issues and concerns raised in the March 26, 2001 conference call as summarized in the May 16, 2001 3400 memo from Allan Bullard (Wenz).
Action: Completed 1/23/02

Other Decisions

1) The DWG agreed that the current "Meeting Notes" format for documenting meeting results was effective and would continue to be standard format used in the future. It is understood that following each meeting by an agreed upon date, members will provide the DWG Chair with a digital version of any presentations/ comments made for accurate inclusion in the meeting notes.
2) It was also agreed that a summary of the meeting notes be included at the beginning of the meeting notes package. The summary will include the "Action Items" and other narrative as appropriate.
3) DWG participants are responsible for distributing the Meeting Notes to interested parties in their area.

Next Meeting: November 5-6, 2002, Portland, OR. Wenz, Chair.

TUESDAY, NOVEMBER 6

BUSINESS

A) Status of Action Items from 2001 Meeting

1) Coordinate with PNW-Forest Health Monitoring to help standardize defoliator/ damage codes for forest inventories (Sheehan).

Action: Completed; continuing on as-needed basis.

2) Review the 1994 "Strategic/ Tactical Plan for the Management of Western Defoliators" and recommend alternative actions (Randall, Willhite, Rogers).

Action: Completed/ continuing (see discussion below)

3) Prepare publication on the efficacy and use of the DFTM Early warning System since 1979- Draft for review in 2001 (Daterman, Wenz, Sheehan).

Action: Draft completed with internal review; submitted to journal for publication by early 2002.

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).

Action: Completed 2/2/2001

5) Write letter to Director, FHP-WO recommending that annual regional/ state insect and disease conditions reports be produced (Wenz).

Action: Completed 2/2/2001

6) Write letter to commend R6 on the 2000 DFTM suppression project (Wenz).

Action: Postponed pending further discussion.

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).

Action: Completed 2/2/2001

8) Write letter of support to Otvos for development of DFTM virus detection kit (Wenz).

Action: Continuing (see discussion below).

9) Regional FHP groups consider working with Otvos to submit development of DFTM virus detection kit as a STDP in 2001 (Regions).

Action: Completed/ continuing (see discussion below)

B) Purpose of the Western North American Defoliator Working Group (DWG)

The DWG has reviewed, and generally agreed on, the purpose of the group at each meeting. However, a formal "Statement of Purpose" has not been developed. It was decided that the Chair would prepare a draft "Statement of Purpose" and distribute it to the members for review (Action Item #3). The draft "Statement" was reviewed by the members in December, 2001. The members approved the "Statement" with a few minor revisions. Following is the revised "Statement of Purpose" for the DWG.

The purpose of the Western North American Defoliator Working Group (DWG) is to provide a means to address issues associated with western defoliator ecology and management. The DWG meets annually or more frequently as needed. The group is composed of professional forest pest management specialists, research scientists and resource management specialists representing federal, provincial, state and local governments, universities and private interests.

Specifically, the DWG provides a forum to:

1) Discuss current forest defoliator conditions in western North America;

2) Identify and discuss issues and concerns related to western forest defoliator ecology and management;

3) Consider short- and long- term research, technology development and management needs for western forest defoliators;

4) Communicate issues, concerns, recommendations, priorities and needs to appropriate entities.

C) Strategic Plan

At last years meeting, Randall, Rogers, Willhite agreed to work with Wenz to review the "Strategic/ Tactical Plan for Management of Western Defoliators" last modified September 7, 1994. Wilhite reported that the existing document was not really a "strategic" plan and that while it contained some potentially useful information, it did not seem pertinent at this point in time given the current purpose of the DWG. It was decide that members of the DWG (at least one from each Region and State) would review the 1994 Plan and determine which elements, if any, were currently useful/ relevant and communicate their findings to the Chair by January 15, 2002 (Action Item #4). These results will be consolidated and discussed at the 2002 meeting. The DWG felt that developing, and reviewing on an annual basis, a priority list of both "long- and short-term" management, technology development, information and research needs, might be effective. The entire topic will be discussed at the 2002 meeting.

D) Aircraft/Flight Restrictions

Debra Allen-Reid lead a short discussion on new FAA security requirements regarding spray aircraft and the potential impacts on aerial application projects. She reported that Dan Twardus (FHP-Northeastern Area) has drafted a list of project-related issues including tanker security during transport, on-site security of spray tanks and equipment, on-site security of spray aircraft, public awareness, and financial obligations if spray operations are suddenly suspended by the FAA. Also mentioned was the distribution by Jesus Cota (FHP-Washington Office) of recommendations by the National Agriculture Aviation Association regarding agricultural spray operations. Our discussion revealed that this information was not being shared with State Cooperators. Jack Stein agreed to inform Tim McConnell (FHTET-Ft. Collins) of the need for all States to be included in the information exchange.

CONDITIONS REPORTS 2001

Region 1: North Idaho/ Montana (Randall/Wulff/Sturdevant)

Douglas-fir Tussock Moth: In 2000 aerial surveyors noted approximately 54,000 acres of Douglas-fir tussock moth defoliation near Moscow, Idaho. The defoliation was largely confined to state and private lands in two areas: Moscow Mountain and Mary Minerva McCrosky Memorial State Park. In 2001 the Idaho Department of Lands conducted and aerial suppression project utilizing B.t. and Dimilin on approximately 75,000 acres. The US Forest Service, while recognizing that there would likely be visible defoliation on Clearwater National Forest lands, opted not to participate in the aerial spray project because ground surveys on affected NFS lands showed DFTM populations were at far lower levels than on state and private ground near Moscow Mountain and the state park. In 2001 NFS lands, particularly around Gold Hill and Crane Point, and in holdings in areas sprayed by the state, did experience defoliation. Subsequent egg mass surveys conducted in the fall of 2001 showed that new egg masses were present on affected Forest Service lands in similar numbers as in 2000, but again not at densities that would result in unacceptable levels of defoliation and tree mortality. Based on the information gathered by Forest Health Protection Personnel, and with recognition of the fact that defoliation in 2002 may be heavier than that in 2001, the Clearwater National Forest has decided not to proceed with planning a spray project in 2002. If unacceptable levels of tree damage are experienced, the Forest is prepared to respond with silvicultural treatments.

The Forest Service did participate in a pheromone mating disruption trial using 2 formulations of the Douglas-fir tussock moth sex pheromone. A more thorough description and preliminary results from that trial will be summarized elsewhere.

Gypsy Moth: Six hundred and eleven gypsy moth traps were sent to federal agencies in Montana, Idaho, Wyoming, and North Dakota. One gypsy moth was caught in a trap at the Swiftcurrent campground in Glacier National Park, MT, and one suspected gypsy moth was caught in a trap in Yellowstone National Park, WY. The suspect moth was sent to APHIS in Cheyenne, WY and we are waiting for a positive identification. The state of Idaho caught 2 moths, there have been no reported suspect moths in Montana besides the positive catch in

Glacier, N.P, no moths caught in the Dakotas, and 2 moths in Wilson, WY in addition to the one suspect in Yellowstone, N.P.

False Hemlock Looper: Aerial surveyors mapped approximately 1,500 acres of defoliation by the false hemlock looper on the east side of Flathead Lake, by Bigfork, MT.

Hemlock Looper: Aerial surveyors mapped small pockets of defoliation by the hemlock looper southeast of Missoula by Miller Creek Divide and over by Lincoln, MT in the Reservoir Lake area. In Idaho this is the second year aerial surveyors have mapped hemlock looper defoliation on the Clearwater National Forest.

Western Spruce Budworm: Aerial surveyors mapped small pockets of defoliation by the spruce budworm east of the Continental Divide. Because of the low population of budworm over the past few years, our annual pheromone-trapping program for budworm was limited in scope for 2001. There was a significant increase in number of moths caught at several trapping sites, while number of moths caught at other sites decreased slightly or remained relatively unchanged. In one stand on the B-D National Forest in Montana, we caught 133 moths in 10 traps. We do not expect to see high budworm populations across the region in 2002, but increases in localized populations in intensity and area of defoliation.

California Tortoise Shell: There have been a number of reports of this insect defoliating *Ceanothus* in North Idaho.

Idaho: Department of Lands (Livingston/ Beckman)

Hemlock Looper: Southeast of Pierce and also west of Clarkia; areas south of Kellogg and a number of smaller spots scattered throughout north Idaho.

Douglas-fir Tusscok Moth: Large areas of mostly light defoliation north and northeast of Moscow. Large areas west of Clarkia mixed with hemlock looper. Some small areas in southern Idaho.

Balsam Woolly Adelgid: Areas southeast of Lewiston, northeast of Headquarters and south of Pierce around Emida and Bovill.

Region 2: Colorado/Kansas/Nebraska/South Dakota/eastern Wyoming (Schaupp)
Colorado: State Forest Service (Leatherman)

KANSAS AND NEBRASKA

- Major problems continue with tip moths on pines
- A big year for hardwood defoliators such as walnut caterpillar and fall webworm
- No other information obtained

SOUTH DAKOTA

- Little defoliation reported in the Black Hills
- USFS caught no gypsy moths

WYOMING

- No large episodes of defoliation reported
- Western spruce budworm activity continued for a third year at low to moderate levels on the east and west slopes of the Snowy Mountains in south central Wyoming, including areas near Centennial and about 2,000 ac along the upper North Platte River valley that includes portions of the Savage Run Wilderness
- USFS caught no gypsy moths
- State pest specialist interested in "minor" defoliators such as elm leaf beetle and not just budworm and tussock moth

COLORADO

Douglas-fir tussock moth

- Aftermath from 1993 – 1995 outbreak in the South Platte River drainage (Pike NF and environs) --- no detectable tussock moth activity; Douglas-fir beetle outbreak weakening. Beetle-caused mortality has been quite extensive following the 1993 – 1995 outbreak.
- Douglas-fir tussock moth on white fir on Raton Mesa east of Trinidad is an unknown, since it was not surveyed this year from the ground or the air. It was intended to be flown on Sept 11 but a certain series of events kept the observers grounded. Estimated defoliation in 2000 was about 1,000 acres.
- Douglas-fir tussock moth remains a chronic problem on ornamental blue spruce in Front Range communities. Attacks by *Ips hunteri* on defoliated blue spruce have been reported, in some cases causing mortality.
- Early warning trapping system continues at 9 sites in Douglas-fir within the South Platte River drainage. Unlike most years since 1995 when this round of trapping began, some Douglas-fir tussock moths were actually caught. A total catch of 3 moths, however, may not be a harbinger of defoliation to come.

Western Spruce Budworm

- Extensive late frosts occurred across much of mountainous Colorado on May 20-21 and again on June 13-14. This affected both conifers and deciduous trees. We do not have data, but believe the frosts may have set back building WSBW populations in the Sangre de Cristos mountains by depriving larvae of sufficient new growth. It remains to be seen if this is a temporary setback or more significant. Does anyone else have experience with such a scenario?
- In some areas, enough budworms survived to cause moderate defoliation of Douglas-fir, white fir and associated host conifers. Moderate defoliation was noted in the following areas of southern Colorado:
    - Rio Grande NF…large, chronically affected area with top-kill and other impacts, infestation now 15 years old
    - San Juan NF…about 5,000 ac of moderate defoliation
    - Gunnison NF…less than 1,000 ac along Cochetopa Creek

    - Uncompaghre Plateau and NF… small infestations
- Suppression: One homeowner group in the area of Pass Creek between La Veta Pass and Gardner did hire an aerial contractor to spray their budworm with B.t. The results were reportedly successful.

Gypsy Moth

- We apparently have an established gypsy moth infestation in the northern Denver metropolitan area in western Arvada/nearby Jefferson. We had a positive catch in 2000, delimitation trapped at the rate of 25 traps/sq.mi. this year, and caught 4 moths. The four catches this year are all near one another and one of them was at a nursery. It is suspected to be part of the Michigan plant material widely distributed in spring 2000, which we didn't learn about until August 2000. We would like to hear the group's recommendations as to how we gain public acceptance for aerially spraying a multi-block area homes with a bacteria that starts out as a suspicious white powder!

Other defoliators

- *Neodiprion fulviceps* outbreak in the Black Forest along the Front Range apparently collapsed as expected after 2-3 years of heavy defoliation, which resulted in thin crowns but very little direct mortality.

- 2001 was an exceptional year for fall webworm in the riparian corridor from Salida to Canon City, Colorado. Narrow leaf cottonwoods were 100% stripped by mid-August, with Plains cottonwoods suffering much less. Boxelders growing nearby were essentially ignored. This heavy defoliation has occurred for the past few years, but one has to wonder how long the trees can sustain such massive populations. Perhaps they can do so for several years because they have their roots in the Arkansas River and the season of defoliation is late.

- Exceptional year for three non-tree leps in the Region: white-lined sphinx, variegated fritillary, and western painted lady butterfly. The latter two are reputed to migrate in from the southwest, but the populations we had this year were so large that immigration is hard to fathom for all of them. The painted lady larvae feed on thistle, so maybe they are more than an indicator of southwesterly winds. Maybe they are telling us we have a weed problem (which we know we do).

<u>Region 3: Arizona/New Mexico (Allen-Reid)</u>

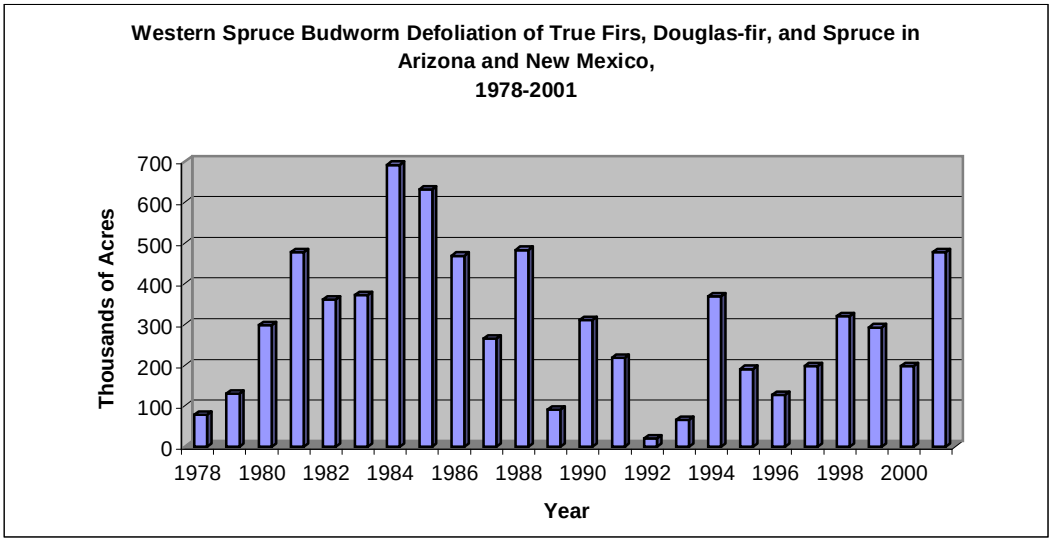
Douglas-fir Tussock Moth, *Orgyia pseudotsugata*
Hosts: White fir, Douglas-fir, Spruce

Outbreak activity appears to be limited to the Sacramento Mountains in New Mexico. High populations at a boy scout camp last year dwindled in 2001, but several other small areas of infestation showed up for the first time. Caterpillars collected this summer showed a significant incidence of parasitism by a tachnid fly—most likely the primary factor in the decline at the scout camp. A total of 830 acres of defoliation was mapped from aerial survey (813 acres on the

Sacramento RD of the Lincoln NF and 17 acres on Mescalero tribal land). Several small areas of moderate defoliation on private land were also observed from the ground. No high value areas are being affected so no treatment is being considered. Traps placed in the Sacramento Mountains show lower catches than last year. Traps in the Sandias revealed 2 out of five plots averaging 25 moths/trap, an increase over last year. Trapping results were not yet available from Arizona but no tussock moth defoliation was observed during aerial survey.

Western Spruce Budworm, *Choristoneura occidentalis*
Host: True firs, Douglas-fir, Spruce

In New Mexico, spruce budworm defoliation increased nearly three-fold from 2000 levels, with 456,450 acres detected during 2001 aerial surveys (12,490 acres on tribal lands, 74,830 acres on state and private lands, and 369,130 acres on NFS lands). In Arizona, defoliation levels decreased slightly from last year's report of 32,700 acres, to a preliminary estimate of 21,500 acres for 2001.



Aspen Defoliator Complex (Western Tent Caterpillar/Marssonina Leaf Spot/Large Aspen Tortrix)
Declined in New Mexico from 25,050 acres in 2000 to 10,800 acres in 2001.
Declined in Arizona from 65,649 acres in 2000 to 29,650 acres in 2001.

Ponderosa Pine Needle Cast, *Lophodermella cerina* and other species
Declined in New Mexico from 18,242 acres in 2000 to 4,904 acres in 2001.
Not reported in Arizona.

Ponderosa Pine Needle Miner, *Coleotechnites ponderosae*
Declined in New Mexico from 27,210 acres in 2000 to just 2,727 acres in 2001.
Not reported in Arizona.

Pinyon Needle Scale, *Matsucoccus acalyptus*
Little change in New Mexico with 5,750 acres reported in 2000 and 4,820 acres in 2001.
Not reported in Arizona.

Spruce Aphid, *Elatobium abietinum*
Arizona reported 138,870 acres of defoliation in 2000. In 2001, the activity is being mapped as mortality; however, no figures are yet available.
No spruce aphid activity was observed in New Mexico.

Drought-damaged Ponderosa Pine
For 2001, Arizona is reporting approximately 4,300 acres of ponderosa pine with drought-induced foliage desiccation, down from 124,450 acres reported last year.

Gypsy Moth Trapping
In 2001, two moths were collected in one trap at a private campground in Payson, AZ. The campground manager moved to the area from Maryland in July. Intensified grid trapping is planned for 2002. Traps on nearby private and federal lands were negative.
New Mexico had no positive traps.

Region 4: Utah, Nevada, & western Wyoming (Pedersen)

Edited and submitted by Lee Pederson; Information provided by "Aerial" Al Dymerski

Douglas-fir Tussock Moth (*Orgyia pseudotsugata*)

Total acreage defoliated in 2001 by Douglas-fir tussock moth in Region 4 was 15,600, resulting in a decrease from 18,620-acres detected in 2000. Most of this damage occurred on Bureau of Land Management, State of Idaho, and private Douglas-fir forests in the Owyhee Mountains of southwest Idaho. On the Humboldt National Forest in northern Nevada, 3,900 acres were found to be heavily defoliated on the Jarbidge Ranger District. This is a substantial increase from 50-acres of defoliation from the previous year.

Western spruce budworm (*Choristoneura occidentalis)*

Across the Intermountain Region, western spruce budworm decreased from 21,000-acres in 2000 to 13,200-acres in 2001. The Dixie National Forest in southern Utah showed a reduction of 14,000-acres in 2000, to 7,900-acres in 2001. On Utah's Fishlake National Forest, 1,500-acres of heavy defoliation were detected for this year. In southern Idaho, 3,800-acres of defoliation ranging from light to heavy was observed on the Boise and Targhee National Forests.

Forest Tent Caterpillar (*Malacosoma disstria)*

On the Salt Lake, Ogden, and Logan Ranger Districts of the Wasatch-Cache National Forest, over 1,000-acres of aspen were defoliated by forest tent caterpillar. In particular, heavy defoliation was detected in various aspen stands at and near the Park City ski area on the Salt

Lake Ranger District. No significant defoliation was detected on the Bridger-Teton National Forest in western Wyoming for 2001.

Gypsy Moth (*Lymantria dispar*)

Eradication efforts over the last two years proved successful in Salt Lake county, where seven gypsy moths had been caught in 1999. Trapping efforts for this year produced one male gypsy moth from the Lake Fork Guard Station, adjacent to Moon Lake campground on the Ashley National Forest in northeastern Utah. This will result in a delimitation survey to be conducted in this area. A second year delimitation survey will occur in Rock Creek Canyon at the Upper Stillwater campground, also on the Ashley National Forest. Two single male gypsy moths were trapped there in 2000. Placement of approximately 4,000 gypsy moth pheromone detection traps along the Wasatch Front is projected for 2002.

Region 5: California (Wenz)

Contributors: Jack Marshall (CDF), Brian Mattos (Yosemite NP), Laura Merrill (FHP), Don Owen (CDF), Dave Schultz (FHP), Sheri Smith (FHP), John Wenz (FHP).

Douglas-fir Tussock Moth, *Orgyia psedotdugata.* Douglas-fir tussock moth activity was at low, non damaging levels, throughout California. Light tussock moth defoliation was observed on one ridgetop on the Almanor Ranger District, Lassen NF, in the northeast Sierra Nevada.

Budworms. Budworm populations and associated defoliation were generally low in 2001. Very light feeding injury to Douglas-fir by the California budworm, *Choristonuera carnana californica*, was detected in a chronic budworm area on the east side of Trinity Lake in Trinity County (north-central California) and light defoliation of true fir by the modoc budworm, *Choristoneura retiniana*, was found west of Lily lake on the Warner Mountain RD, Modoc NF, in northeastern California.

Lodgepole Needleminer, *Coleotechnites milleri*. Lodgepole needleminer populations Have been increasing in Yosemite National Park since 1993-94. This trend continued in 2001 as population increases were seen at 20 of 28 monitoring plots. The largest increases were observed adjacent to existing high density populations near Tenaya Lake and Tenaya Gap. Extensive areas of defoliation are visible along Highway 120 and along all major trails leading north and south from Tuolumne Meadows. Aerial surveys conducted in October, 2001, showed about 15,000 acres of low-severity defoliation and approximately 25,000 acres of high-severity defoliation. Severe defoliation and tree mortality continued around May Lake. Heavy defoliation is also present around Tenaya Lake and over an extensive area from upper Budd Creek west to Sunrise High Sierra Camp Lodge and campground developments. Populations in the Tuolumne Meadows area are increasing but still below levels that cause visible defoliation while populations east of Tuolumne Meadows remain low.

Larvae of the alternate generation needleminer, maturing in 2002, were found at Tenaya Beach, Upper Tenaya and Cathedral Creek South. Unusually high levels of a parasitoid (*Copodosma*

sp.) were found in six of the monitoring plots and, coupled with severe weather in early July that knocked infested needles to the ground, may help reduce the 2001-2003 generation in some areas.

White Fir Sawfly, *Neodiprion* sp. *abietis* (?). The populations that caused defoliation in several areas of northeastern California in 2000 declined in 2001. Two areas of sawfly defoliation were detected in 2001. Widespread injury occurred throughout the Mineral Management Area on the Almanor RD, Lassen NF and defoliation was also detected throughout the Cascades area of the Beckworth RD, Plumas NF. About 200 acres of white fir were defoliated in the vicinity of Deer Mountain on the Goosenest RD, Shasta Trinity NF, in north-central California. Feeding injury by the white fir sawfly was also observed near Latour State Forest headquarters in Shasta County.

Pine Sawfly, *Neodiprion* sp. *fulviceps* (?). Approximately 1000 acres of plantation ponderosa pine exhibited varying degrees of defoliation by the pine sawfly in the Military Pass area north of Mt. Shasta, Shasta County. Some of these same plantations had been heavily defoliated by the pine needle sheathminer (see below) in 2000. Pine plantations on both the Klamath and Shasta Trinity NF's were also affected by pine sawfly feeding.

Pine Needle Sheathminer, *Zelleria haimnachi*. Damage from pine needle sheathminer feeding was again reported on ponderosa pine east of Pondosa in Siskiyou County. Pine needle sheathminer activity has been reported from this vicinity since 1997. Pine needle sheathminer feeding injury was also reported on ponderosa pine northeast of Susanville in Lassen County.

Fruittree Leafroller, *Archips argyrospila*. Fruittree leafroller populations continued at high levels in the San Bernardino Mountains of southern California 2001 although defoliation to California black oak was less widespread and less intense than in 2000. This is the third year of the outbreak. Approximately 25,600 acres had visible defoliation in 2001. Egg mass surveys indicate that populations and defoliation may be heavy in areas northwest of Lake Gregory and north of Lake Arrowhead in 2002.

Alder Flea Beetle, *Altica ambiens.* Heavy defoliation of alders by the alder flea beetle was reported from several areas in southern California including the San Gabriel Mountains, the San Bernardino Mountains, the San Jacinto Mountains and the community of Montclair in Los Angeles County.

Spruce Aphid, *Elatobium abietinum.* Moderate damage to sitka spruce from spruce aphid feeding was reported from the northwest coast in Mendocino, Humboldt and Del Norte Counties from about Fort Bragg north to the Oregon border. Spruce aphid damage and mortality has been reported from these areas for the past 10 years.

Fall Webworm, *Hyphantria cunea*. Defoliation to madrone by fall webworm declined slightly in 2001 compared to 2000 in interior Medocino County, southeastern Humboldt County and southwestern Trinity County. Defoliation was also reported east of Buckhorn Summit in Shasta County.

Western Tent Caterpillar, *Malacosoma californicum.* The western tent caterpillar defoliated about 20,000 acres of bitterbrush east of Truckee on the Truckee RD, Tahoe NF. Bitterbrush defoliation was also reported over extensive areas from Lee Vining south toward Mammoth Lakes and Crowley Lake in Mono County.

Gypsy Moth, *Lymantria dispar*. Six male gypsy moths have been trapped by Pest Detection, California Department of Food and Agriculture in 2001; one each in Alameda, Madera, Orange and Siskiyou Counties and two in San Diego County. No egg masses have been found.

Region 6: Oregon/ Washington (Ragenovich)
Washington: Department of Natural Resources (Ripley):

Western Spruce Budworm: Defoliation from this insect was primarily in south central Washington, on the Yakima Indian Reservation, Gifford Pinchot National Forest and adjacent State and private lands. There was a small amount (250 acres) on the Mt. Hood National Forest in Oregon. Approximately 236,720 acres were defoliated; this is a decrease from the 384,500 acres reported in 2000. About 5,000 acres were treated on the Yakima Indian Reservation with B.t. in 2000 and about 54,000 acres were treated in 2001. On State and private lands, approximately 20,000 acres were treated in 2001.

Douglas-fir tussock moth. Douglas-fir tussock moth defoliation occurred on 53,255 acres; this is a decrease from 220,000 acres reported in 2000. However, in 2000 almost all of the defoliation was on the Wallowa-Whitman National Forest. In 2001, 28,000 acres of defoliation occurred in Oregon, primarily on the Heppner District of the Umatilla National Forest and 24,000 acres of defoliation occurred in north central Washington. About 15,000 acres were treated with NPV on the Okanogan National Forest and adjacent private lands in Washington. One private owner treated approximately 20 acres in SE Washington with carbaryl. Private land at Tekoa Mountain, close to the Idaho border, may be treated in 2002.

Hemlock Looper: Defoliation from this insect increased from 3,000 acres in 2000 to over 17,000 acres in 2001. Defoliation is primarily in northern Washington. Defoliation is occurring both in old growth and second growth hemlock.

Balsam Woolly Adelgid: Acres infested with balsam woolly adelgid increased considerably from 6,200 acres in 2000 to over 50,000 acres in 2001. The Forest Health Monitoring evaluation survey was completed in Oregon: The survey on the remaining portions of Washington will be completed in 2002.

Gypsy Moth: European gypsy moth projects were conducted by State Department of Agriculture folks in Washington in an area near Vader, WA. Twenty-nine acres were treated on the ground around the introduction site in 2001. Ten moths were still trapped the following summer, so 560 acres will be treated from the air in 2002. Eight moths were also caught in 2001 at Crown Hill, a Seattle neighborhood. A 16.5-acre ground treatment is proposed for that area. Oregon Department of Agriculture conducted a project of 160 acres in southwesten Oregon near Ashland, OR. This is the second year that area has been treated. An Asian gypsy moth project

was also done in North West Portland. About 920 acres were treated in the Forest Park area. No treatments are planned for Oregon in 2002.

Limited acres of defoliation for other insects, such as larch case bearer (5,500 acres) and tent caterpillar (1,500 acres) were also noted.

Oregon: Department of Forestry (Overhulser):

Douglas-fir tussock moth- Total acres defoliated in 2001 dropped to 29,171 acres from 174,197 acres n 2000. Current defoliation is concentrated on the Heppner Ranger District of the Umatilla national Forest. Virtually no state or private land is involved in the outbreak.

Early Warning Trap Surveys in Lake and Klamath Counties indicate a potential for a tussock moth outbreak in the next two years. In 2001, trap catches on private lands exceeded the threshold for ground sampling from the town of Keno west of Klamath Falls to the Warner Mountains in the east. Most of the traps with high catches were just north of the California border.

Rusty Tussock Moth- A rusty tussock moth outbreak occurred in a Douglas-fir seed orchard near St.Paul, Oregon and was treated with an aerial application of Asana in 2001.

Western Spruce Budworm- The only budworm defoliation detected by the aerial survey was 246 acres on the Mt. Hood National Forest.

Western Tent Caterpillar- An outbreak of western tent caterpillar severely defoliated 1,034 acres of red alder in Clatsop county.

Larch Casebearer- Only 341 acres of larch casebearer defoliation was recorded n 2001.

British Columbia: Report from B.C. Ministry of Forests (Otvos)

Annual aerial overview surveys are now the responsibility of the B. C. Ministry of Forests. Upon completion of surveys and digitization of information, survey data and maps are accessible to those interested from the B. C. Ministry of Forests website. The following websites may be of interest:

1. General url relating to Aerial Overview Surveys:

   http://www.for.gov.bc.ca/hfp/FORSITE/overview/overview.htm

2. Specific Web-Map website which allows queries on maps and statistics of damaging agents (a link is also provided to this site in (1) above). This is updated when current overview surveys are completed and entered.
   http://142.36.218.240/health/maps/maps.html

3. 2000 aerial overview summary tables (link also provided in (1) above):

   http://www.for.gov.bc.ca/hfp/FORSITE/overview/2000table.htm

4. 2000 aerial overview summary maps (link also provided in (1) above):

   http://www.for.gov.bc.ca/hfp/FORSITE/overview/2000maps.htm

Survey information from 2001 aerial overview surveys will be posted on the above sites when available. The following partial information was provided by Regional Entomologists after a specific request for information for this working group. Information may change as final survey data becomes available.

DOUGLAS-FIR TUSSOCK MOTH

FY2000 DFTM Suppression Project, Eastern Oregon/ Washington (Scott/Spiegel)

Evaluation of TM BioControl-1 Treatments to Suppress Douglas-fir Tussock Moth in the Blue Mountains of Northeastern Oregon and Southeastern Washington One Year After Treatment; Donald W. Scott and Lia Spiegel, Blue, Mountains Pest Management Service Center, Wallowa-Whitman National Forest, La Grande, Oregon 97850; Report No. BMPMSC-02-02, November 15, 2001

The following was condensed from the above report by omitting the literature cited.

Introduction

An operational Douglas-fir tussock moth, *Orgyia pseudotsugata* (McDunnough), suppression project was conducted in the Blue Mountains of northeastern Oregon and southeastern Washington in 2000 using the nucleopolyhedrovirus (NPV) product, TM BioControl-1. The project treated a total of 39,602 acres. The Wallowa-Whitman NF treated 3 analysis units on the Pine RD consisting of 33,427 acres, and the Umatilla NF treated 6,175 acres on two analysis units: 3,912 acres on the Pomeroy RD and 2,263 acres on the Walla Walla RD. This was the first large-scale operational use of TM BioControl-1 for tussock moth suppression in the United States. During the spring and summer of 2001, we re-sampled Douglas-fir tussock moth on treated and untreated control analysis units from the 2000 Tussock Moth Suppression Project. The purpose of this tussock moth sampling was to provide follow-up monitoring information on treatment efficacy of the 2000 project, track the course of virus one year after treatment, and evaluate the effect of treatment in reducing defoliation, top-kill, and tree mortality, especially in light of a current and widespread Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins, outbreak in part of the project area.

Methods

To determine larval densities, we sampled early instar (L1-L3) tussock moth from June 25 to July 10, by using thelower crown beating method. The samples consisted of three 18-inch

branch tips from each of 5 haphazardly selected trees at all 219 plot locations accessible within one mile of the road selected from among the plots established for the 2000 suppression project. We followed this procedure to sample plots from each TM BioControl-1 treatment analysis unit (Eagle, Pine, Imnaha, Spangler, and Mill Creek) and untreated control analysis unit (Duck, Gold, and Pomeroy). The same plot locations were sampled about four weeks later from July 23 to August 7, 2001 for late instars (L4-L6) to determine changes in population density from the earlier sample. From August 15 to September 12, 2001 we revisited 175 of the 204 defoliation plots established during the 2000 suppression project to measure 2001 defoliation rates, top-kill, and determine causes of any observed host tree mortality. We used Wickman's defoliation estimation procedure to rate total crown defoliation.

We collected up to 15 larvae from each plot, during the early and late density sampling, for laboratory rearing to determine causes of mortality including nucleopolyhedrovirus. Larvae were collected and placed individually into small (50 x 9 mm) disposable plastic petri dishes with tight-fitting lids. A small piece of current year foliage was placed into each dish to provide the larvae with food while transporting them back to the laboratory for rearing. At the laboratory each larva was transferred to a new, 60 x 15 mm disposable plastic petri dish with loose-fitting lid. A small cube of artificial tussock moth diet, approximately 1-in x 1-in x ¼-in, was added to each petri dish. Larvae were re-supplied with fresh diet approximately once per week, depending on the condition of the diet. Larvae were reared until pupation or death. Upon death, larvae were microscopically examined by phase contrast microscopy to determine cause of death.

Results and Discussion

Population Densities

Larval counts determined by lower crown sampling had to be converted to mid-crown densities (expressed as larvae/1000 in^2 of foliage) for comparison with results from 2000. Early larval mid-crown densities on all units in 2001 were substantially lower than pre-treatment densities the year before. Early larval mid-crown densities from treated and untreated analysis units on both the Wallowa-Whitman and Umatilla National Forests were less than 2 larvae/1000 in^2 in nearly all cases, and were classified as "low" or "very low" populations. Only one analysis unit, the untreated Pomeroy control unit on the Umatilla NF, exceeded the threshold level for "sub-outbreaks" (i.e., $\geq$ 2 larvae/1000 in^2, but less than 21. With a mid-crown density of 2.34 larvae/1000 in^2, this unit was only slightly higher than those early larval populations on other analysis units with densities that classified as "low."

The tussock moth populations continued to decline through the 2001 season. When raw data from lower crown sampling were converted to mid-crown densities to account for age-related losses and redistribution of older larval populations within the tree crown, all analysis units showed substantial decline in mid-crown population density from the early instar to late instar sample periods.

Larval Mortality

Tussock moth populations in 2001 were clearly collapsing. High rates of mortality in 2000 from natural and treatment-induced exposure to virus and other causes resulted in relatively few egg

masses being produced at the end of last season. Lower populations produced substantially fewer larvae in 2001 than in the previous year. Low population densities this spring made it difficult to find adequate numbers of larvae to collect for rearing to monitor mortality. We collected a total of 219 larvae on all eight analysis units over both sampling periods.

The percent virus infection rate ranged from 25% to 39% in the early larval collections from treated analysis units, and from 20% to 38% on the untreated controls. We believe many larvae become infected during egg eclosion. Hatching larvae are believed to pick up virus from eggs that become contaminated as winter rains and melting snow leaches virus from larvae and cocoons containing pupae that had been killed by virus the previous summer. The spread of this virus to new egg masses, and over foliage is believed to greatly enhance the incidence of virus in the new generation of larvae. Virus spread by rainfall and snowmelt may help initiate the collapse of the outbreak by widely contaminating the environment of the insect with virus.

The percent virus infection rate for older larvae ranged from 0% to 33% in the treated analysis units, and from 22% to 42% in the untreated control units. Late instar virus infection rates did not appear to be different from early instar infection rates. Overall population abundance had declined last year to such levels that horizontal spread of the virus by contagion in 2001 was quite restricted. Contagion may be less important in the disease cycle at this phase when the virus is widespread in the environment of the insect, as previously indicated. Low numbers of insects clearly accounted for poor virus spread from early collections of larvae to later larval collections. Most virus-infected later-stage larvae had likely encountered the background level of virus that was now widely present throughout both treated and untreated areas since infection rates were virtually the same as early instar infection rates.

Even though the impact of all mortality factors was important in further reducing tussock moth numbers, in some cases to around zero, the survival rates of the very low numbers of larvae that were collected in all the lower crown samples at both sample timings provides a rather obscure, and somewhat misleading picture of current larval populations over these areas in 2001. For example, percent survival from the early sample to the late sample in 2001 on the treated analysis units was 0% on the Imnaha, 21.4% on Pine, 27.3% on Eagle, 37.5% on Spangler, and 88.9% on Mill Creek. The percent survival from early to late sample stages on the untreated control analysis units was 11.9% on Duck, 41.3% on Gold, and 33.3% on Pomeroy. Suffice it to say, that although these figures represent the residual population, the actual numbers of larvae that remained at the end of this season were few, and will probably be the stock that maintains the populations at typically unnoticeable, endemic levels year-to-year, until the next tussock moth outbreak several years from now.

Defoliation and Tree Mortality

Defoliation, top-kill, and tree mortality were nearly absent in 2001. The Duck control area was the only analysis unit to exhibit any defoliation. One percent of the trees in the Duck control area were 10% defoliated.

Heavy defoliation last year was expected to lead to top-kill and tree mortality this year. The Gold control area was the only analysis unit that had defoliation levels high enough in 2000 to expect appreciable levels of top-kill or mortality in 2001. Still, only 9% of the trees on the Gold

control had more than 50% of the crown defoliated in 2000. Less than 1% of the trees on each of the other units had more than 50% of the crown defoliated in 2000. The Gold control area had 2% of trees showing top-kill in 2001. Top-kill on all other analysis areas was negligible (less than 1%). There was no mortality on the Umatilla National Forest analysis units (Spangler, Mill Creek, and Pomeroy control). One tree died on the treated area of the western Wallowa-Whitman National Forest project area (Eagle). On the eastern Wallowa-Whitman project analysis units, the Imnaha had 1.6% mortality, the Pine had 1.5% mortality, and the Duck control had 0.2% mortality. All tree mortality recorded on defoliation plots was caused by a combination of defoliation and Douglas-fir or true fir bark beetles.

These figures for overall tree mortality and top-kill do not capture well the range of defoliation effects of this outbreak on the forest. These plot trees were chosen to represent the areas from which they came and in that sense probably do approximate the overall mortality in the respective locales of the defoliation plots. However, because of the patchy nature of Douglas-fir tussock moth epidemics, tree mortality generally occurs in patch mosaic patterns on the landscape, similar to fire-caused mortality. There are patches of 100% mortality where defoliation was 100%, ringed by patches of top-kill and lower mortality rates where defoliation was less uniform and less severe. Perhaps a more informative way to monitor Douglas-fir tussock moth impact would be to link larval density counts at specific sites with subsequent defoliation, top-kill, and tree mortality. We are not aware of any attempts at making this linkage for specific sites, although it has been demonstrated that acres of current defoliation can be estimated over large areas from the means and variances of larval density estimates obtained from a series of sample plots.

We expect to see some additional mortality over the next few years in areas that were heavily defoliated in 2000 as bark beetles continue to find and lethally attack these weakened trees. Peak Douglas-fir mortality generally occurs in the year immediately following cessation of defoliation, while true fir mortality peaks in the second year after defoliation ceases. We will revisit these tagged trees next year to document any further defoliation or mortality.

Decision Protocol and Criteria For Suppression of Tussock Moth Populations with TM BioControl-1

There are several factors to consider in deciding to apply TM BioControl-1. The first is the presence and magnitude of natural virus in the target population. Another factor is the density of the target tussock moth population. These factors are interwoven as virus incidence increases with larval density.

Two techniques have been developed to detect the natural level of NPV in the field. A soil-borne virus bioassay procedure can detect very low levels of virus persisting for 40 years or longer. An egg mass virus detection technique can determine levels of virus in newly hatched larvae. Use of the former technique is valuable in areas where the historical presence of NPV is unknown. The latter technique can be used to estimate virus incidence in current populations. In September 1998 60 egg masses were collected from a part of the proposed spray area. We found 6.7% of egg masses contaminated with virus and 0.9% of 1508 hatched larvae died from virus infection (personal communication from Dr. Imre Otvos, Canadian Forest Service, April 2000). Stelzer found that if 25% of larvae were contaminated with virus at egg hatch, the population

would collapse before unacceptable tree damage occurred. He noted that if initial (first instar) infection rates are low (below 15 percent) spread of virus disease during the first four or five instars is slow, but then dramatically increases as the larvae reach maturity and begin to pupate. Virus levels measured from our egg mass collection sites in 1998 were not expected to control this population prior to the occurrence of unacceptable levels of tree damage since natural control of the outbreak would occur too late to prevent severe tree damage and some mortality.

The density of tussock moth larvae also affects the decision to suppress a population. We decided Douglas-fir tussock moth larval densities must be above 10 larvae/1000 in^2 of foliage in the midcrown to proceed with suppression treatment. Populations lower than 2 larvae/1000 in^2 of foliage are considered low density and not expected to outbreak. Populations >2 but <21 are considered suboutbreak with little defoliation visible. Populations higher than 40 larvae/1000 in^2 foliage indicate a severe outbreak and it is expected some trees will be completely defoliated. 1999 cocoon sampling indicated early 2000 larval densities would average over 35 larvae/1000 in^2 foliage. At this density the population would be in outbreak and cause visible defoliation and other damage.

Our decision to proceed with suppression treatment in 2000 was based on the predicted high larval densities on the Pine Ranger District (Wallowa-Whitman NF) and the low natural virus levels in egg masses collected in fall 1998. These low virus levels were not expected to control the outbreak. Given these data, we anticipated tussock moth would cause unacceptable damage. We believed that natural virus would build slowly in this population, and natural virus prevalence rates would probably not prevent unacceptable tree damage. However, we did not make another collection of egg masses in 1999 to determine if natural egg mass virus levels had changed from the previous year. In retrospect, this was probably a mistake because tussock moth populations had increased to levels high enough during 1999 to cause more than 20,000 acres of light to moderate defoliation in this area. Larval populations high enough to cause this amount of defoliation would probably be accompanied by an increase in overwintering egg mass virus levels in 1999-2000. Therefore, we believe the unknown levels of 1999 naturally occurring egg mass virus were higher than anticipated. This inoculum source caused the natural virus to develop rapidly in the populations. This resulted in higher virus levels in 2000 in all analysis areas than were expected from the egg masses collected in 1998.

Conclusions

The purpose of treatment with TM BioControl-1 was to protect foliage of trees in areas of special concern such as riparian areas, late/old structure stands, and high use recreation sites. To determine effectiveness of treatment, larval mortality and tree defoliation and mortality were monitored. While there is no question that a widespread NP disease epizootic resulting in larval mortality in treated areas occurred immediately after treatment, the protection of foliage and reduction of tree mortality is less clear.

Post-treatment larval collections beginning about 10 days after treatment clearly showed a treatment-related response in virus prevalence rates compared to untreated areas. But a year later, by the end of the 2001 season, larval densities had declined to such low levels that there were no longer any real differences between treated and untreated areas. The overall low numbers of insects in 2001 makes interpretation of these data difficult. Our virus monitoring

results suggest that there was enough natural virus present in all areas for the virus to build up last year and initiate the collapse of tussock moth populations in 2001. Evidence from many sides suggests that when virus is present and increasing in a tussock moth outbreak, buildup of virus in the population may be rapid and strongly contribute to the collapse of the population.

Still, there remains the question of whether or not this project would have gone forward had we known the potential for natural virus in overwintering egg masses in 1999-2000 to initiate an NP epizootic in this population. These results point out the important fact that having this virus information in a timely manner is paramount to making the critical decision of whether or not to suppress tussock moth populations. Some bioassay tools are available to assist in generating information needed to make this decision in advance of a project. However, greater refinement and standard protocol may be needed to more accurately interpret and apply this information in any given pest management or pest suppression scenario in the future

FY2001 DFTM Suppression Project, Okanogan National Forest, Washington (Bridgwater)

Fall cocoon surveys in 2000 indicated that there were approximately 29,000 acres that would have outbreak or sub-outbreak populations in 2001, and qualified for treatment under the R-6 Douglas-fir Tussock Moth Environmental Impact Statement.

Egg masses were collected during the fall and sent to Imre Otvos for virus level determinations. Imre's results were that the virus level was an average of 14.7 percent, which was well below the 25 percent level he identified as causing population collapse that year.

Before spraying, treatment evaluation plots were established in both the areas to be treated and in control areas. Early instar larvae were monitored to determine population development for proper timing of treatment. During both the sampling establishment of evaluation plots and the population development plots, it was difficult to find larvae in many of the areas. Additional monitoring plots were established to better define the population levels. As a result, many areas were subsequently dropped from treatment.

A total of 16,906 acres were eventually treated. We had quite a number of frustrated project people, and application contractors. Fifty eight percent treatment of the anticipated acres resulted in the project ending early, and the contractor requesting reimbursement for those additional acres they were prepared to treat.

The 2002 pretreatment and post treatment population monitoring showed that in the treated areas there was an average of 10.8 larvae per 1000 sq. inches. The average for the controls was 3.6. The post treatment monitoring showed an average of 1.0 larvae per 1000 sq. inches and the control areas average was 1.1. This was 90% mortality for the treated with a corrected mortality figure of 69.3%. Overall, defoliation estimates in both the treated areas and the controls didn't exceed 10%. These areas will have population monitoring samples taken again during the summer of 2002 to see if there are any longer term effects of treatment.

Late in the project, it was discovered that the egg mass samples were not taken through out the proposed treatment area, but rather from only two locations where they could easily be gathered.

The information the cocoon sampling provided us was fair to poor. If we had high populations, and some areas did, the predictions were great. However, in very low level populations we felt that the cocoon surveys did not perform well. This is similar to the results from the 2000 project in the Blue mountains.

The only suitable thing that can be said for the egg mass survey is that since it was not conducted properly, it was of no value.

I think the cocoon sampling system in low to very low populations needs to be revisited to see if we can develop a better predictor of future populations.

DFTM Early Warning Pheromone System (Daterman)

Update on use of pheromone trapping (early warning system) for detecting potential outbreaks of Douglas-fir tussock moth.

This topic was presented as a synthesis of the major findings documented in a publication on the first 21-years of using the early warning system (EWS) to detect potential outbreaks of tussock moth (DFTM). Significant findings of the 21-year data analysis were presented in the form of recommendations for successful application of the EWS. During the 21-years of monitoring there were nine outbreaks in areas where traps were located in near enough proximity to allow evaluation of monitoring efficacy. Seven of the nine outbreaks were successfully detected by the EWS from 1-3 years prior to the occurrence of visible defoliation. Monitoring of the remaining two outbreak areas was unsuccessful because they were not monitored by an adequate density or distribution of trapping sites. Recommendations for successful EWS application included the following;

Annually maintain one EWS plot for every 3000-acres of susceptible forest.
Plots should be evenly distributed over the areas of concern.
High-value forest areas (such as campgrounds) may warrant an even higher plot density.
Temporary trapping plots should not be used to supplement permanent EWS plots.
Factors to consider when trap catches rise (exceed 25 moths per trap).

> Interval of time since last outbreak in area.
> Historic trends in that subregion.
> Distribution of plots with >25 moths per trap
> Value of resources at risk versus cost of ground sampling.

Initiate ground sampling for larvae and egg masses (where high trap counts are concentrated, and where resource values justify the costs).

> Ground sample in vicinity of EWS plots and extend for 1-km radius from plots.

Virus-TM BioControl-1 (Stein)

The following is the FHP budget commitment for TM Biocontrol-1 needs in FY2002:
1) $10,000 to maintain the Goose Lake strain at the Pacific Forestry Centre, Canada Forestry Service, B.C.
2) $3,000 to store the stockpile of TM Biocontrol-1 at PNW, Corvallis, OR.
3) $5,000 to cover expenses (of Imre Otvos) to determine virus from field samples to help decide whether treatment is necessary.
4) There is continued interest in registering TMB for use in the Sate of California. R5 and FHTET are cooperating in an effort to determine necessary guideline requirements and costs associated with this State registration.

DFTM Virus Detection Kit (Otvos)

The virus detection kit was originally conceived for detecting naturally occurring virus in Douglas-fir tussock moth larvae in the field. It was not intended for use to detect viruses in egg masses.

Background
Douglas-fir tussock moth (DFTM) outbreaks occur about once every decade. The use of a DFTM virus detection kit will be helpful and will very likely facilitate decision-making on whether to apply control measures or not against this insect. It is also highly likely that the kit could also be used for the detection of viruses in other tussock moths. There are four species of tussock moth in North America: Douglas-fir tussock moth (*Orgyia pseudotsugata*) in western North America, rusty tussock moth (*O. antiqua*) in southern Canada and the northern US, whitemarked tussock moth (*O. leucostigma*) in eastern North America, and definite-marked tussock moth (*O. definita*) in southern Ontario and the eastern US. Control measures have been conducted against the first three species. Besides the DFTM virus, to date only the whitemarked tussock moth virus has been tested in the laboratory, and our tests showed that the kit would detect viruses of both insects. There is no reason to suspect that our kit would not detect viruses in other tussock moths, including those elsewhere in the world or in those that have a world-wide distribution like *O. antiqua*. We hope/plan to test this with other *Orgyia* spp. from the UK, Finland, and China.

Virus Detection Kit
I believe that we are at the stage of building the prototype of the virus detection kit for field testing. The original concept/intention of the virus detection kit was for detecting DFTM virus in from 2nd instar to late instar DFTM larvae. Once the prototypes are built, the kit can be tested in the field to see if it can also detect DFTM virus in all life stages from egg to pupal stage. We feel that the kit will likely detect viruses from the 2nd instar to pupal stage – it may also detect NPV in the adult stage but may not detect NPV on the egg masses. Even if it did detect virus in a DFTM egg mass, converting the presence of virus in an egg mass (having between 150-250 eggs) to % infection among the larvae hatching from these 150-250 eggs may be difficult, if not impossible to do.

Regardless of what life stage the virus is detected in, the kit, like all new methods, has to be "calibrated". Calibration with respect to how it is used, and what the percent infection, calculated from the data obtained from the use of the kit, means in terms of the population dynamics of the host (i.e. will the DFTM or other tussock moth populations collapse on their own, or are control measures needed to suppress population to minimise damage?). A sampling method has to be devised for the virus detection kit similar to the approach currently used for determining level of viral infection from field collected egg masses. Currently, 25 larvae are reared from each egg mass for 2 weeks after hatching. Ideally, 50 egg masses are collected at each location or site and reared in this manner. This means rearing 50 x 25=1250 larvae for 2 weeks on artificial diet and determining the presence of virus in the dead larvae through microscopic examination of the cadavers. If the level of naturally occurring virus is between 20-30% among the dead larvae, such a "threshold" level indicates that the population in the area (represented by the 50 egg masses) is very likely to collapse.

Using the above method, the cost of determining level of viral infection, larval hatch and percent egg parasitism from up to 50 egg masses is $600 US per site.

Based on our rearing of DFTM larvae from almost 12,000 eggs from egg masses collected from 17 field "sites" over the last 3 years from the western US, the number of dead larvae varied between 20 and 460 cadavers per site. We examined all dead larvae up to 100, from each site, and between 35-45% of the cadavers after the first 100.

As a guide, until field-testing provides a better basis for developing guidelines, it is recommended to collect larvae from two branch tips from each of the 20 randomly selected trees that would represent an area. From each branch tip randomly select 10 larvae (20 larvae per tree) for a total of 400 larvae per site. The larvae should be tested for the presence of virus, as they are collected. Keep a running total of the level of infection, and if the level of infection reaches 20-30%, the current threshold, the DFTM population in that area is likely to collapse on its own without requiring control measures, but some damage may occur before the outbreak collapses. As a further guide, it is recommended that one should check the first 100 larvae, between 100 and 200 larvae should check 100 +10% of larvae over the first 100, between 200 and 300 check 100 + 15% of the larvae over the first 100, and between 300 and 600 larvae check 150 for the presence of the virus. I used these figures to "guess-timate" the number of virus kits to determine level of natural virus incidence in one location. This suggested guideline may change after field testing the virus detection kit.

At the present we have reached a "Catch 22" situation– in order to build the prototype we have to get the company to sign a non-disclosure agreement. Although the method is patentable, before a decision is made regarding the practicality of requesting a patent we have to "guess-timate" potential size of the market. A survey will be developed and sent to potential users to evaluate the potential market.

DFTM- 2001 Mating Disruption Field Test- North Idaho

Douglas-fir Tussock Moth Mating Disruption Project (Ragenovich)

Previous research has demonstrated that Douglas-fir tussock moth pheromone could successfully disrupt mating. Slow-release carriers used in those projects, primarily the Conrel fibre, are no longer available. Two potential slow-release carriers are the Hercon Disrupt DFTM flake, slightly modified from the flake used in gypsy moth mating disruption projects; and a 3M Microencapsulated DFTM bead.

Elution studies using canvas cards and potted Douglas-fir trees were done in the spring of 2001 in both a greenhouse, under controlled conditions, and in a weathering study in Flasgstaff Az. Flakes and drops were placed on canvas and wax paper cards, and Douglas-fir needles. At specified intervals over time – 3 days, 7 days, 14 days, etc. – three reps of each treatment were collected for gas chromatograph analysis. The objective of these studies was to determine the rate of release of the pheromone over time.

In early July, 12 plots were established on NFS, U of Idaho, and private forested lands in the vicinity of Potlach, Idaho. Plots were about 35 to 45 acres in size. As much as possible, plots were located with buffers between both the mating disruption plots and areas that were being treated operationally by the State of Idaho. Prior to treatment, mid-crown larval samples were taken from 10 trees in the center of each plot to verify that insect populations were present. Pretreatment samples ranged from an average of 34 to 328 larvae per 1000 sq. of foliage, with most having around 60 larvae per 1000 sq. inches of foliage. Sampling took place over a period of several weeks, therefore, differences between populations, may be due in part to natural mortality that occurred over time. However, all plots did have adequate tussock moth populations. Plots were treated on July 19 and 20. Originally, plans were to apply both the bead and the flake formulations at 10 grams active ingredient per acre. Due to last minute complications, we were not le to apply the bead formulation and the study was changed to test the Hercon flake applied at 5 and 10 grams active ingredient per acre or 30 and 60 grams formulated material per acre.

The elution study with canvas cards and potted Douglas-fir trees was also repeated simultaneously with this test in order to monitor elution under the exact same weather conditions as the operation project. The 3M beads were included in this elution portion of the test.

Effectiveness of treatment will be monitored in several was. Full strength DFTM baits in sticky traps were placed in the center of each plot and monitored at a minimum of weekly to count trapped moths. The ability of the treatments to shut-down trap catches would be one way to verify the ability of the treatment to prevent males from locating a pheromone source. Preliminary trapping results show a significant difference between trap catches in the treatment and the control plots.

Preliminary Results - Total Moths Trapped per Plot

10 g a.i./ acre		5 g a.i./acre		control	
#2	1	#4	2	#1	192
#3	0	#6	15	#5	3
#7	1	#10	0	#8	394
#9	9	#11	2	#12	275

Additional effectiveness measures include counting apparently fertile and infertile egg masses and collecting and rearing egg masses to verify infertility. These collections will be done this fall. Also, mid-crown larval sampling will be repeated in the early summer of 2001.

This was truly a cooperative project involving participation from FHP personnel in Region 1, 3, 5, and 6 and FHTET, PNW-Corvallis, Potlatch RD of the Clearwater National Forest, University of Idaho, Potlatch Corp., Animal and Plant Health Inspection Service – Otis Plant Protection Lab, and APHIS Air Operations in Mission, TX, ARS Chemical Ecology Lab in Beltsville, MD, Hercon Corp. and 3M Canada.

Planned future work:

- Develop elution curves for both the beads and the flakes at standard time and temperature settings.
- Conduct field evaluations of the 3M Canada product.

WEDNESDAY, NOVEMBER 7

DFTM 2001 SUPPRESSION- NORTH IDAHO

Idaho Department of Lands: Douglas-fir tussock moth: Results of 2001 Spray Project
Prepared by R. Ladd Livingston, Idaho Department of Lands, 20 November 2001

Treatments

Two pesticides were used

1. Foray 48B produced by Valent Bio. Sci.
   Applied at ½ g. / acre
   Bacillus thuringiensis var. *kurstaki* as the active ingredient
   Naturally occurring bacterium
   Only affects the caterpillar stage of moths and butterflies
   Has to be eaten to be effective, picked up as larvae consume foliage

2. Dimilin 4L produced by UniRoyal Chem. Co.
   Applied 2 oz active ingredient with 4 oz Insist (anti-evaporant) mixed with water to make 1 gal. / acre spray.

Diflubenzuron is the active ingredient. This is an insect growth regulator that disrupts the ability of immature insects to shed their skin. The insect cannot complete development and dies.

Acreage Treated

1. Foray 48B: 16,268 ac
2. Dimilin 4L: 60,224 ac

TOTAL 76,492 ac

Land Owner Participation

1. 1167 landowners were contacted within the proposed treatment area of Latah and Benewah Counties, Idaho. Landowners were given the opportunity to participate or not. They were also given the option to choose which pesticide would be used on their property. In a few cases, this decision was made by the state for increased efficiency of application.
2. 484 landowners decided to participate.

Contractor

Heli-Jet Corp. of Eugene, Oregon was the contractor.
They utilized six helicopters for the majority of the project, 4 medium-sized spray ships and two small, Hiller-sized ships. The small ships applied the Foray 48B and the medium ships applied the Dimilin 4L.

Spray ships were required to utilize Geographic Information System (GIS)/Global Positioning System (GPS) technology for guidance to the spray blocks and during the application. Without this technology, the project could not have been accomplished as designed with the many small, isolated blocks of different ownerships and treatments.

Application Parameters

The following parameters for application of the pesticides were used during the project to assure proper application and deposition.

1. Wind no greater than 8 mph.
2. Temperatures no higher than 70ºF and no lower than 35ºF.
3. Relative humidity no lower than 50%.
4. No predicted rain within 6 hours.
5. Foliage not dripping wet.

Cooperation

Numerous state and federal agencies participated in many ways:

1. Idaho Department of Lands
2. Idaho Department of Agriculture
3. Idaho Department of Fish and Game
4. USDA Forest Service
5. Local State Legislators

Cost

Cost figures are for purchase and application of the pesticide by the contractor and for overhead costs by the Idaho Department of Lands.

1. Foray 48B @ $22.00 / ac 16,268 ac = $357,896
2. Dimilin 4L @ $37.84 / ac 60,224 ac = $2,278,876
3. Overhead costs $263,000

TOTAL Project Costs: $2,900,000

Cost/Benefit of Treatment

Dr. Charley McKetta, University of Idaho Forest Resources Economist prepared an evaluation of economic considerations for control of the 2001 tussock moth outbreak. His estimated impacts for the infested area were as follows:

Estimated Growth Loss:	$2.5 million
Estimated loss due to mortality:	$45.4 million
Subtract Recovery through salvage	$25.2 million
Total Estimated Loss due to DFTM	$22.7 million

With project costs of $2.9 million, the benefit/cost ratio, based on Dr. McKetta's estimates, is 7.8: 1. For every dollar spent, we gained $7.80 of value.

Success of Treatment

Success of the treatment was evaluated is several ways including population reduction of caterpillars, estimates of defoliation caused by the feeding of the caterpillars, and counts of egg masses deposited by surviving moths. Analysis of all data has not been finalized but we have the following preliminary information:

1. **Reduction of numbers of caterpillars due to spray**:
   Foray 48B treatments: 90% population reduction
   Dimilin 4L treatments: 95% population reduction

   This is a very good percent control for a project of this size and complexity.

2. **Estimates Of Defoliation After The Project:**
   At least 87% of the Foray 48B treated trees in sample plots and 100% of the Dimilin 4L treated trees have 75% or more of their foliage left after the treatment. While these trees will undoubtedly experience some growth loss they are expected to survive. This compares with 33% of the trees in non-treated plots that have 75% of their foliage, 66% having lost more than 25%. These trees are expected to suffer top kill or whole tree mortality. Thus, both treatments did a very adequate job of protecting adequate foliage to keep the trees alive.

3. **Surveys For Fall 2001 Egg Masses.**
   Surveys were conducted in the project area, looking at each treatment separately including non-treated areas.
   Results are preliminary, but will be very similar to the following:

PERCENT OF PLOTS BY NUMBERS OF EGG MASSES FOUND

Number Egg Masses	Foray 48B	Dimilin 4L	Check (non-treated)
0	59%	87%	6%
1-5	29	9	53
6-10	0	1	14
>10	12	3	27

The egg masses that were found in the Foray and Dimilin treated areas were very small and unhealthy in appearance. Those in the untreated areas were basically healthy and with a full number of eggs. In general, the very low numbers of egg masses found in the treated areas demonstrate that the project was very successful in reducing the tussock moth population and protecting the trees from future defoliation.

Overall Evaluation of the 2001 Spray Project

Based on the population reduction of the caterpillars, the amount of foliage left after feeding by the caterpillars and the general lack of egg masses found in the treatment areas along with the reduced size and health of those that were found, I consider the treatment to have been generally very successful. Also, there are localized sites where the spray apparently did not reach the target and defoliation of the trees was severe. But they represent only a small percentage of the entire project area. Also, there are a few areas where we did not know the insect was present and did not include these in the treatments. In at least one of these, the defoliation was very severe. It was also very severe in on many of the properties where the landowner chose not to treat the infestation. As serious as this defoliation was, it presents a graphic representation of the damage that I anticipate would have occurred over many thousands of acres had we not gone ahead with the treatment. With the treatment the trees were protected and landowners provided time in which to pursue other management options in the future.

Considerations for Retreatment

There are a few areas within the 2001 treatment boundaries that will be considered for retreatment in 2002. This is based on the numbers of egg masses found in the fall 2001 surveys. However, as mentioned, these egg masses were small and unhealthy in appearance. Also, I anticipate an increase in the level of the naturally occurring virus over the entire area. If this does take place, it will likely eliminate the need for retreatment. Egg masses have been collected for this evaluation. The results will not be available until spring of 2002.

New Areas Needing Treatment

We are in the process of evaluating all areas to the east and north of the 2001 project area. We have found significant tussock moth populations in numerous locations. We are in the process of evaluating these for the need for treatment in 2002. While we do not yet have numbers of acres needing action, there are certain areas where numbers of egg masses are high enough to warrant the evaluation. A count of infested sections show at least 50 (32,000 ac) where further evaluation is needed. Estimates of actual acres that might qualify are premature at this time. As was done for the 2001 project, we would need to canvas all owners in the proposed areas to determine their desire to participate, do

a final analysis of the egg mass data, and, in the spring of 2002, obtain the final virus infection determination before we could finalize the acreage figures.

Forest Service: Clearwater National Forest, Palouse District, Larry W. Ross, District Ranger

Thank you for holding your annual meeting in Moscow. I have learned a lot about Tussock Moth and forest management issues that result from tussock moth outbreaks. Thanks too, for inviting me to participate. I plan to talk a little about our rationale for not participating in the spray project in 2001 and some lessons learned.

The Douglas-fir Tussock moth outbreak in the Palouse region in 2000 created the "normal" array of challenges associated with unexpected events, such as insect outbreaks as well as a special challenge or two.

Some of the normal challenges were:

Estimating the probable extent of the outbreak.
Determining what would be the appropriate management actions to take.
Coordinating with other partners and informing the public as the outbreak unfolded.
Determining what monitoring was needed to adequately track and measure the outbreak.

One special challenge was to:

Come to grips with and understand the role of native insects on public lands.

The first challenge, "*Estimating the probable extent of the outbreak*" went the smoothest of all challenges. The Forest Service has the advantage in Idaho of a good working relationship with the State of Idaho to monitor and track forest insect populations. The State of Idaho provided solid information on the intensity and extent of the population. Subsequent monitoring indicated that this information was pretty much on target. In addition, the Forest Health group (FHP) headquartered out of Coeur d'Alene, Idaho, was superb in educating the Palouse Office on Tussock Moth ecology, providing critical pieces of information, and monitoring the population. A particularly valuable role FHP played was to prepare a comprehensive biological evaluation (BE) of the outbreak. This BE provided critical information about the outbreak and was key in helping the Forest Service decide what action would be appropriate to take in calendar year 2001.

The second challenge "*Taking appropriate management actions*" and the special challenge "*Come to grips with and understand the role of native insects on public lands*" are intertwined and need to be discussed together. For me, these challenges were the most fascinating aspect, to date, of this outbreak.

Traditionally, the Forest Service would have likely jumped immediately into a control and treatment mindset and initiated actions to spray infested acres and harvest affected stands. However, in the last 10 years, there has been increased emphasis placed on understanding the

function and role of landscape processes such as insect outbreaks and disease and to take those processes into account in our decision making. Our management has shifted from one based on a traditional economic model to a non-traditional economic model that accounts for intrinsic values such as functioning streams, sustainable native populations, clean water and so on. In the case of this outbreak, our decision was to not actively control the tussock moth. Rationale for this decision was as follows:

Tussock Moth populations were observed to be low (few egg masses found) on NFS lands. Further, the infestation appeared to be of limited extent.

The Biological Evaluation estimated that the amount of defoliation on individual trees would likely be moderate with a few pockets of heavy (up to 100%) defoliation. The BE also estimated that the aerial extent of defoliation would be limited.

For all three areas on NFS lands experiencing tussock moth populations, the landscape conditions expected to result from this outbreak were deemed appropriate for the current condition and present management direction. No areas with special or high values appeared to be affected.

It was expected that some forest stands with commercial value would likely have individual trees or clumps of trees that experienced heavily defoliation. However, based on information in the BE and information from other tussock moth outbreaks, it appears that forest managers would have about a two to five year window to recover the timber value of heavily affected stands. A two to five year window gives us enough time to monitor these stands and prepare appropriate environmental assessments.

In brief: There were three areas affected by the moth. Browns Meadows, Gold Hill and Skyline Drive.

Affected stands in the Browns Meadow area have been managed and much of the area is in plantations comprised of non-host species. Losing precommercial sized grand fir and Douglas-fir trees to defoliation was determined to be a positive result. Loss of commercial sized grand fir and Douglas fir was expected to be minimal.

Affected stands in the Gold Hill area are comprised mainly of sixty to seventy year old Douglas-fir and grand fir. The under story is mainly grand fir. This current composition of species is clearly outside the range of historic conditions. Historically, these stands were comprised of white pine, ponderosa pine, larch, as well as Douglas-fir and grand fir and forest management in the area is aimed at restoring this historic composition. Plantations in this area are regenerated with non-host species. Death of minor amounts of mature grand fir and Douglas-fir individuals scattered throughout the area was determined to be an appropriate and acceptable outcome of this native insect outbreak. It was further determined that if the outbreak resulted in significant mortality within individual stands, that harvest could be initiated to recover the value of the merchantable timber.

Affected stands in the Skyline Drive area are also currently outside their historic range of variability. These areas historically experienced more-or-less regularly recurring, non-lethal fires that maintained the area in an uneven aged ponderosa pine cover type. Exclusion of fire has shifted the stand from open stands of large, mature ponderosa pine to a dense stand of grand fir and Douglas-fir. These stands have been managed to favor ponderosa pine and the Forest Service is actively under-burning these stands with low intensity fire to restore the historic forest cover type of unleavened Ponderosa Pine. As with the other two areas, the estimated level of mortality was deemed compatible with this management emphasis.

The last two challenges "*Coordinating with adjacent landowners and the State of Idaho as the outbreak unfolded" and "Conducting appropriate monitoring to track the outbreak"* were relatively easy to do because of the quality of the spray project put together by the State of Idaho, the expertise and knowledge of the State of Idaho and the FHP group in Coeur d'Alene. The willingness of the private, State and Federal partners to work together has made this part of the program go smoothly.

Results: Based on everything observed so far, impacts to the landscape are well within estimates predicted in the BE except more acres were affected than was originally predicted.

Forest Service foresters have visited all of the sites. So far, the effects of the outbreak have been well within the range estimated in the BE. Many small non-commercial sized grand fir and Douglas-fir in all three areas have been killed, much to the delight of the foresters. There is at least one plantation in the Gold Hill area that we do have concern about because of the amount of defoliation on an already thinned stand. This one plantation may experience a lower stocking rate than desired if the trees do not refoliate and recover. Observed mortality in the Sky Line Drive and Brown's Meadow area has been described as slightly desirable by those examining the sites. In the Browns Meadow area, subsequent mortality, if it should occur, will reduce the stocking levels, which currently are higher than desired. Further, precommercial-thinning activities would have favored other tree species over grand fir and Douglas-fir. In a sense, the outbreak may actually benefit us by reducing the amount of grand fir and Douglas-fir while reducing overall overstocking level.

In the Skyline Drive area, any mortality of individual grand fir and Douglas-fir trees that may occur will help us achieve the desired future condition of the stands in that area by removing the grand fir and Douglas-fir under story that is crowding into the under story of what historically was an uneven aged ponderosa pine cover type. An added bonus will be that dead, submerchantable trees would help carry the low intensity fires planned for the area.

In the Gold Hill area, affected stands have been inventoried and preliminary information has been gathered to begin planning a salvage sale if this years monitoring indicates that significant mortality will likely occur in the near future (2002 – 2005).

Conclusions and Lessons Learned

As costly and painful as emergency projects can be, they usually result in a lot of positive outcomes. The science is advanced. New generations of forest managers are educated and informed and equipped with knowledge that will allow them to better handle the next outbreak. The "bank" of information about the pathogen is increased to further advance the science. New relationships are forged and existing protocols are tested and improved.

Relationships are extremely important and need to be sustained. The partnership between the State of Idaho and the Forest Service works well and needs to continue.

The boundary less nature of these outbreaks affects many landowners and managing agencies. It reinforces the need to keep and maintain good working relationships at the local level.

Research and development has done a great job developing practical solutions that are effective and much more environmentally safe.

New technology, such as onboard satellite tracking systems, greatly increases the probability that predicted outcomes of spray projects will be achieved by providing a much greater degree of control over the application of materials. There is a need to keep abreast of the new technology.

The role these natural processes play in landscape ecology needs to be better understood. Public land managers need to be better able to predict probable results early in an outbreak to determine if the insect will get "out-of-bounds" and begin to significantly and adversely affect other resource values.

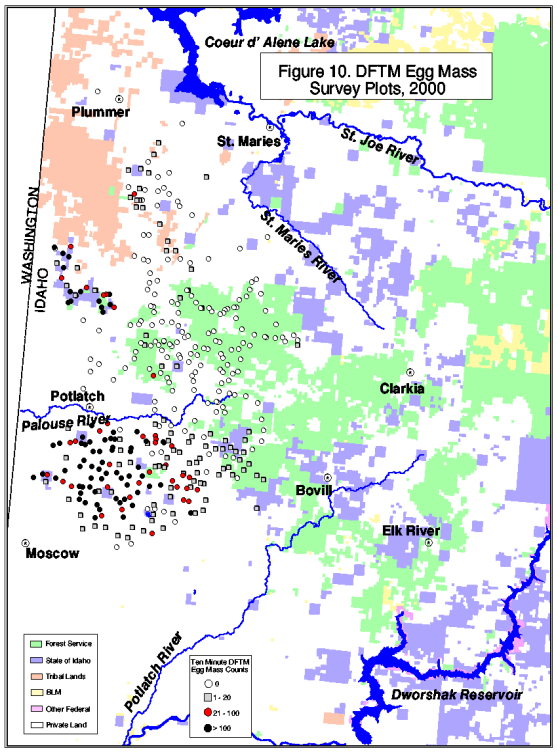
For federal lands, there is continued need to better understand landscape ecology and think and act on a landscape scale rather than a stand scale. There is a continued need to manage the landscape within an historic range of variability so that insect and disease episodes occur "normally" and more or less within acceptable limits and don't reach epidemic proportions. For example, from historic data we know that there is a lot more tussock moth host species present today than ever occurred naturally in the landscape. Tussock moth was probably always here and playing its role in the environment, but probably never to the degree we saw in 1973-74 or even the current outbreak.

There is a need to stay the course to restore the historic mix of tree species in the landscape. Forest stands supporting an historic compliment of western white pine, western larch, and ponderosa pine, as well as Douglas-fir, grand fir, cedar and lodgepole pine are much more resilient to outbreaks of tussock moth.

There is a need to standardize sampling methodologies used by all the partners in this area so that data can be shared and to make sure that information is formally entered into a "central data bank" for future reference and use.

Forest Service: Forest Health Protection, Douglas-fir Tussock Moth Monitoring on the Palouse Ranger District, Clearwater N.F. (Randall)

Introduction:



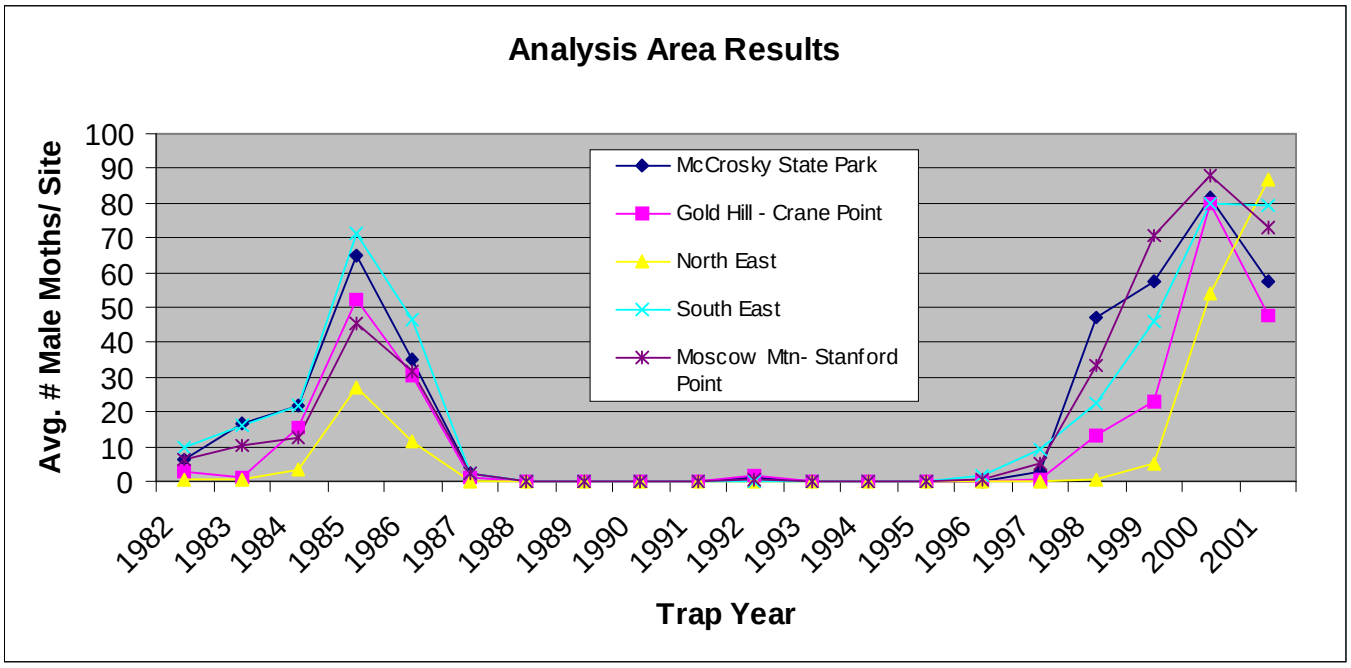
In the summer of 2000 approximately 54,000 acres of Douglas-fir tussock moth defoliation was mapped on predominantly state and private lands around Potlatch, ID. The Idaho Department of lands, with assistance from the USFS conducted extensive egg mass surveys in and around the defoliated areas (Figure 10) and found that egg masses seemed to be concentrated in two areas, around Moscow Mountain to the south and around Mary Minerva McCrosky State Park to the north. While there were some areas of fairly high egg mass densities on National Forest System (NFS) lands (21-100 egg masses found in a 10 minute timed search), when compared to the state and private lands around Moscow Mountain and the state park the NFS infestations were considered to be of fairly low intensity and not meriting suppression. In 2001 the Idaho Department of Lands conducted an aerial suppression project.

The NFS lands experienced defoliation, and the District requested that Forest Health Protection develop a monitoring strategy to 1) assess current tussock moth populations and identify areas on NFS lands that would likely experience heavy defoliation; 2) provide the District with information necessary to develop a strategy to respond to Douglas-fir tussock moth activity; and 3) document the current outbreak.

To adequately address the Districts objectives we developed a multifaceted monitoring strategy that incorporated existing pheromone early warning system sites, egg mass surveys, egg mass virus screening, larval sampling, over story and under story tree sampling, and photo points. We plan on maintaining a series of semi permanent plots through 2003. In addition Sandy Kegley and Nancy Sturdevant have re-measured existing and established new permanent plots to assess the long-term impacts of the current outbreak.

Pheromone Data:

The Idaho Department of Lands has maintained a series of early warning Douglas-fir tussock moth pheromone traps since the early 1980's. We divided the current outbreak area into five analysis units and summarized the average trap catch by unit (see graph below). In 2001 average moth catches decreased in all analysis units except for one (North East). While this information



may indicate that populations of tussock moth are declining, it is not certain. During outbreaks pheromone trap data is less reliable because of the large numbers of female moths making the traps less appealing to wandering males. In this situation, we also need to consider the large-scale suppression project conducted by the State, which may have resulted in lower trap catches. For this reason we supplemented pheromone trap catch data with ground surveys to determine tussock moth population trends on NFS lands.

Egg Mass Surveys/ Tree Data:

In the fall of 2001 a District crew established a number of short term (1-3 year) plots to measure egg mass densities and defoliation. Plots were established at a density of one plot per square mile on NFS lands in the analysis areas. At each plot we pruned three lower branches from 20 over-story trees (>4 inches d.b.h.) and counted the number of egg masses. We changed from the 10 minute timed survey used in 2000 because of concerns that it would be difficult for the crew to distinguish current year from older egg masses unless they could examine the masses at close range. Each of the 20 over-story trees, and an additional 20 under-story trees, was rated for defoliation using the Wickman 7 class system. We also collected two egg masses from each plot to be sent to Dr. Imre Otvos for virus incidence screening. We plan on returning to these plots in the early spring 2002 to collect more egg masses for virus screening, later in the spring 2002 to conduct early instar larval sampling, and again in the fall of 2002 to conduct egg mass sampling and defoliation measurements. This sampling schedule will be repeated in 2003 if populations remain high.

Photo Points:

Photo points were established to document the severity of visible defoliation in 2001. In the fall of 2001 photo points were established and new pictures will be taken at these sites annually for the next 3 to 5 years so that a time series of the visual impact of this outbreak can be created.

Results form monitoring efforts conducted in 2001 will be summarized in a Region 1 Forest Health Protection Technical Report. If there are any questions about this monitoring strategy, please feel free to contact Carol Randall (Crandall@fs.fed.us).

Private Industry: Bennett Lumber Products Inc. (Patterson)

City of Troy, ID (Todd)

University of Idaho : Evaluating the Use of MIMIC^{TM} 2LV (Tebufenozide) Against Douglas-fir Tussock Moth in Idaho, Stephen P. Cook, Department of Forest Resources, University of Idaho.

There is an ongoing outbreak of Douglas-fir tussock moth, *Orgyia pseudotsugata* (McDonnough) (DFTM), in Latah and Benewah Counties, Idaho. Direct suppression of DFTM population outbreaks frequently involves the use of aerially-applied insecticides, several of which have been tested and approved for use (McGrath 2001). Among the compounds registered for use against DFTM are two insect growth regulators (tebufenozide and diflubenzuron) and the microbial insecticide, *Bacillus thuringiensis*. The objective of the current study was to compare the effectiveness of tebufenozide, diflubenzuron and *B. thuringiensis* when applied to suppress an outbreak of this insect during the summer of 2001.

The evaluation was conducted in conjunction with the Idaho Department of Lands (please see description in this proceedings). The Idaho Department of Lands was using applications of diflubenzuron (Dimilin 4L ®) and *Bacillus thurengiensis* (*Bt*, FORAY 48B ®) in a DFTM moth suppression project. Treatments were applied at rates of 28 ml (active ingredient) of diflubenzuron with 56 ml of Insist® anti-evaporant in 9.5 liters of solution per hectare or 60 BIU of *B. thurengiensis* in 5.7 liters of solution per haectare using helicopters. Acceptable environmental conditions for application included no rain in the previous 6 hours, temperatures between 2 and 21^{o} C, relative humidity $\leq$ 50% and wind speed below 12.5 kilometers per hour. The tebufenozide (MIMIC^{TM} 2LV) was applied at a rate of 28 ml (active ingredient) in 9.5 liters of solution per hectare using the same application criteria. Treatments were applied between June 13-23, 2001. In addition to the treated plots, five control plots were established in infested areas that did not receive any suppression treatment.

The 20 sample plots were approximately 0.40 hectares in size and were embedded within the larger treatment blocks. DFTM caterpillars were collected before and after treatment application. The caterpillars collected before treatment were typically in the 2nd instar while those collected after treatment application were a combination of 2nd and 3rd instars. Twenty-five caterpillars per sample plot were collected from understory foliage and low branches during each of the two sample periods and placed in individual 30 ml containers approximately 25% filled with semi-synthetic diet. Caterpillars were maintained at approximately 24^{o} C in a 12: 12 hour (light: dark) regime and monitored for 14 days to determine mortality. The caterpillars collected before treatments were applied were collected within 10 days of treatment application. The post-treatment collection of caterpillars occurred 2-3 days following treatment. Larval mortality was adjusted (within a sample plot, pre-treatment mortality rates were subtracted from post-treatment mortality rates) and analysis of variance procedures were conducted to test for treatment differences.

While the mortality of field-*collected O. pseudotsugata* larvae was similar across sites prior to the treatment applications, there was a significant difference ($F = 4.85$; $df = 3, 16$; $[P > F] = 0.0138$) among treatments in larval mortality following treatment application. Larval mortality was significantly higher in all three of the insecticide treatments (tebufenozide = 56.8%, diflubenzuron = 42.4%, and *Bt* = 44.8%) compared with the control plots (11.2%), but the three treatments resulted in statistically similar larval mortality. The larval mortality measurements probably do not reflect the total impact of these treatments on the DFTM populations. Caterpillars were only collected from the lower canopy and understory vegetation and may not have been exposed to the same dose of the compounds as the individuals in the upper canopy. Further, the caterpillars were collected 2-3 days following application of the treatments and were then reared on untreated, semi-synthetic diet. The difference in larval mortality based upon the limited exposure period would probably be more dramatic in the two insect growth regulator treatments versus the *B t* treatment.

Residual activity of the two insect growth regulators was examined by collecting foliage (understory and lower branches) from 10 grand firs from each of three treatment plots (tebufenozide, diflubenzuron and control). Laboratory reared 2^{nd} instar caterpillars (n = 10 per tree, 100 per treatment) from egg masses collected within the outbreak boundaries, but prior to any treatment application were randomly assigned to treatments and placed on the foliage for two days. After two days on the foliage, caterpillars were transferred to individual 30 ml containers, approximately 25% filled with semi-synthetic diet, maintained under the temperature and light conditions described above and monitored for 14 days. Analysis of variance procedures were used to test for treatment differences.

The DFTM caterpillars fed foliage that had been treated with either of the insect growth regulators 3-weeks earlier suffered significantly higher mortality (tebufenozide = 55.0% and diflubenzuron = 40.0%) ($F = 8.81$; $df = 2, 27$; $[P > f] = 0.0011$) then did caterpillars fed foliage from untreated plots (11.0%). Indeed, the mortality of larvae fed the foliage three weeks following treatment was very similar to the mortality of the field-collected caterpillars 2-3 days following application for all three treatments (control, tebufenozide and diflubenzuron). The similarity in the mortality rates three weeks following treatment may indicate that application of the materials may not have to be timed as precisely as when using a biological pesticide such as *B. thuringiensis*. However, before earlier application of the materials are attempted, tests should be conducted to determine the impact of shoot elongation on the deposition and consumption of the material by early instar caterpillars.

The same 20, 0.40 ha plots that were used for the larval mortality tests were used to determine the degree of foliage protection achieved by applying the three materials. Overstory and understory host trees (grand fir and Douglas-fir) were examined. Trees were classified as overstory trees if the diameter at breast height (dbh) was > 10 cm. Trees that were over 1.5 m in height but with a diameter of less then 10 cm were used to determine understory defoliation levels. Defoliation of individual trees was categorized based upon the scale described by Wickman (1978). Defoliation of overstory and understory trees was examined separately. Analysis of Variance procedures were used to determine if there were significant differences among treatments in the percentage of host trees that sustained >25% defoliation in either the overstory or the understory of the treatment plots.

There was a significant difference in the distribution of defoliation intensity based upon treatment. There was a significant difference among treatments in the percentage of host trees that sustained $\leq$ 25% defoliation during the summer for both understory ($F = 2.80$; $df = 3, 16$; $[P > F] = 0.0737$) and overstory ($F = 8.35$; $df = 3, 16$; $[P > F] = 0.0014$) trees (Table 5). The difference in defoliation intensity was especially noticeable in the overstory trees where less then 20% of the host trees in the insecticide-treated plots experienced defoliation levels over 25% compared with nearly 50% of the host trees in the control plots that experienced this level of defoliation. Although there was a difference in the distribution of defoliation intensity among the three insecticide treatments, there was not a significant difference among the treatments in the percentage of host trees that experienced greater then 25% defoliation.

This article reports the results of research only. Mention of a proprietary product does not constitute an endorsement or recommendation for its use.

Literature Cited

McGrath, D. 2001. 2001 Pacific Northwest Insect Management Handbook. Oregon State University, Corvallis, OR.

Wickman, B. E. 1978. Tree mortality and top-kill related to defoliation by the Douglas fir tussock mothin the Blue Mountains outbreak. USDA For. Serv. Res. Pap. PNW-233.

Field Trip: A field trip was conducted Wednesday afternoon to look at areas involved in the north Idaho DFTM outbreak.

THURSDAY, NOVEMBER 8

Western Budworms

Budworm Impact Plots- PTIPS (Hostetler)

In 1986, permanent plots were established in 33 stands in northeastern Oregon to monitor effects of a western spruce budworm outbreak. These plots were established before funding of PTIPS (Pest Trend Impact Plot System), but were incorporated into the system in 1990, with partial PTIPS funding for several years to help cover the costs of field sampling. Included in these 33 stands were seven pairs of thinned vs. unthinned stands (i.e., 14 stands). Annual measurements of defoliation, topkill, and mortality were collected for 11 years (1996-1995, 1997), with the primary objective being to develop topkill equations for the budworm damage model which links to the Forest Vegetation Simulator (FVS, formerly known as PROGNOSIS). I am working with Tom Gregg, R6 biometrician, and Mike Marsden, contactor with FHTET, in developing tree mortality and topkill equations using logistic regression techniques. We are also working with

Kathy Sheehan, R6 entomologist/modeler, to incorporate these predictive equations into the budworm model. We hope to have results sometime during 2002.

Hazard Rating- Central Oregon-STDP Project R6-2001-02 (Hostetler)

The western spruce budworm hazard rating STDP is being conducted on the Deschutes National Forest by Helen Maffei. She has obtained data from about 900 stand exams. The stand exam data were collected after most of the damage had occurred, so they will be used to reconstruct the stands to estimate what the stand characteristics were before the outbreak. Then, she will test the currently available and new hazard rating systems against the pre- and post-outbreak stand and tree characteristics. Included in this test will be the Wulf/Carlson system for predicting stand susceptibility to budworm.

Question that Helen raises are "What is the definition of hazard?" What constitutes high, moderate, or low hazard? Is it only high hazard: if the effects of budworm will switch the seral state of a stand; if it loses a certain amount of canopy cover; if the basal area of host trees is reduced below some particular level? Some hazard rating systems do not adequately define the term "hazard", and, when definitions are given, they may vary greatly between systems.

Budworm 2001- Gifford Pinchot National Forest (Willhite)

The western spruce budworm outbreak in the Gotchen Late Successional Reserve (LSR), located in southcentral Washington on the Mt. Adams Ranger District, Gifford Pinchot National Forest, entered its seventh year in 2001. Although a budworm outbreak began in 1985 on lands farther east, budworm activity was not mapped in the Gotchen LSR during annual aerial detection surveys until 1994. Established thresholds for initiating treatment analysis were reached in 1998. Larval population sampling, tree inventory and impact sampling, and pheromone trapping have been conducted annually in the LSR since 1999. District efforts to conduct a spray project for a single aerial application of B.t.k. to three one-hundred acre owl habitat cores were unsuccessful in 2000, and again in 2001, due to a complex of environmental, regulatory, and political issues. The most significant issues include concerns of adjacent and nearby private industrial timberland owners over spread of the outbreak and/or associated catastrophic wildfire onto their uninfested/previously treated properties, and protection of the mardon skipper (a Washington state endangered butterfly with habitat interspersed throughout the LSR). The situation was brought to the attention of Washington State U.S. Senators in 1999, who responded with several inquiries, a staff field trip to the Forest, and earmarked appropriated dollars for "eradicating" the budworm problem.

PNW Research, Portland Forest Science Lab, initiated the "Gotchen Late Successional Reserve Study" in 1999. The team of scientists working on this project, led by Jamie Barbour, are looking at eastside LSR sustainability and management issues, and are involved in studies concerning identification of forest development patterns in the LSR, clarifying relations between current and late successional forest conditions, silvicultural management options, an evaluation of the net social benefit of management activities, and the relationship of budworm defoliation to fire hazard.

The District is currently preparing an EIS, due for completion in 2002, that addresses all potential management actions in the LSR. One of the proposed alternatives will include limited spraying for budworm suppression.

Budworm 2001-Yakima Nation (Flannigan)

Selective harvesting and fire exclusion converted many open ponderosa pine forests in the Inland West into dense forests of Douglas-fir, grand fir, and associated conifers. As a result of these structural and compositional changes, entire landscapes are increasingly at risk to insects, pathogens, and wildfire. While risks are shared across diverse owner ships, they particularly threaten Native American communities and forests, where ties to Tribal lands are strong, and economic dependence on a sustainable timber resource is great.
Forty percent of the standing timber volume administered by the USDI BIA Branch of Forestry is on the Yakima Reservation where an outbreak of western spruce budworm, first detected on the Yakima forest by aerial survey in 1983, is responsible for over a billion board feet of tree mortality. Yakima foresters are taking aggressive measures to restore forest health, including developing silvicultural guidelines that fragment and reduce budworm habitat, prioritizing "gray before green" harvest units, accelerating the pre-sale process, and harvesting >200 mbf per year. Restoring forest health to Tribal lands requires Yakima foresters to replace stand-based forest management practices and silvicultural objectives with an integrated, landscape scale approach.

Other Defoliators

Gypsy Moth (Munson): GypSeS West: Providing phenologically based decision support for timing effective management actions. Cooperators – Jesse Logan (RMRS), Steve Munson (FHP), Jacque Regniere and David Gray (Canadian Forest Service Research)

The project goal is to provide the most efficacious gypsy moth suppression/eradication program with the least possible non-target impacts. The models and decision support tools developed will be generally applicable to the western United States. There are three major objectives associated with this project:

(1) Validate improved egg hatch and larval phenology models
a. Compare the new phenology model to the existing model in GypSeS
b. Characterize model predictions for western regional climate with specific application in Utah
c. Use existing FHP field egg hatch data for model validation (Gray vs Sawyer model)
d. Conduct studies to collect data similar to existing FHP data (form SLC) in southern Utah

(2) Produce validated decision support tools for field application for western regional climates.
a. Interface new model with BioSIM
b. Design phenologically homogeneous spray blocks
c. Produce target event maps for effective timing of trap placement and removal
d. Provide real-time forecasts for effective spray applications based on modeled gypsy moth phenology

(3) Evaluate probability of establishment for Utah
a. Obtain maps of gypsy moth host species for Utah
b. Produce probability of establishment maps
c. Combine (a) and (b) to produce risk of establishment maps

2001 Accomplishments

- Incorporating the phenology modeling tools (MATLAB & BioSIM)
- Obtaining pertinent GIS data layers and interfacing them with BioSIM
- Obtaining the required weather data bases (Normals, Real-time & Historical)
- Installed 13 field sites with caged sterile egg masses and HOBO units that record ambient air temperature at 10-minute intervals. Sites varied from high elevation areas to lower elevation sites where snow cover is not a consideration. Sites chosen represented a wide latitudinal/elevation range to discriminate data outputs between the Sawyer and Gray models.
- Produced probability of establishment maps – will be refined after completion of Objective 1.

Final Business

Reviewed Priorities/ Recommendations
Reviewed Action Items

Next Meeting: November 5-6, 2002 in Portland, OR. Wenz to remain Chair. Location may change pending defoliator activity in 2002.

Western North American Defoliator Working Group

Membership List

* Participated in November 6-8, 2001 Meeting, Moscow, ID
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MEETING
WESTERN NORTH AMERICAN DEFOLIATOR WORKING GROUP

NOVEMBER 6-8, 2001

BEST WESTERN- UNIVERSITY OF INN
MOSCOW, IDAHO

AGENDA

TUESDAY, NOVEMBER 6

Introduction/ Business

0800-0830 Meeting Organization (Wenz)
Action Items from 2000 Meeting
New Business
Purpose of Working Group
Strategic Plan
Flight Restrictions- Potential Implications

Regional/ State Reports- Current Defoliator Conditions

0830-1000 R1/ Montana/ North Idaho (Sturdevant/ Randall)
Idaho IDL (Livingston/ Beckman)
R2/ Colorado (Schaupp)
R3/ New Mexico/ Arizona (Allen-Reid)
R4/ South Idaho (Progar)
R4/ Utah (Pederson)
R5/ California (Wenz)
R6/ Oregon/ Washington (Ragenovich/ Bridgwater)
Washington DNR (Ripley)
Oregon ODF (Overhulser)
British Columbia (Otvos)
R10/ Alaska

Break 1000-1015

Regional/ State Reports (Continued)

1015-1130

Lunch 1130-1230

DFTM- FY2000 Suppression Project, Eastern Oregon/ Washington

1230-1330 Project Results- Post-treatment Monitoring (Spiegel/ Scott)

DFTM- FY2001 Suppression Project, Winthrop, Washington

1330-1430 Project Results (Bridgwater)

DFTM Early Warning Pheromone System

1430-1500 Analysis of Data 1980 to Present- Status (Daterman))
Conclusions/ Recommendations

Break 1500-1515

Virus- TM BioControl-1

1515-1615 Discussion Topics:

Evaluation Committee Report- Current Status (Stein)
- Maintenance of Goose Lake Strain
- Production Alternatives- Future Needs
- CA Registration- Status
- Availability for Use by Different Agencies/ Organizations- Policy

Virus Detection Kit- Status
Bioassays of 2001-2002 Populations (Idaho, Washington, Oregon)

DFTM- 2001 Mating Disruption Field Test- North Idaho

1615-1700 Progress Report (Ragenovich)

Adjourn 1700

WEDNESDAY, NOVEMBER 7

DFTM- 2001 Suppression- North Idaho

0800-0915	Idaho Department of Lands (Livingston/ Beckman)
	Background/ History of Current Outbreak 2001 Suppression Project (Bt and Dimilin)- Results to Date Plans for 2002
0915-1000	Forest Service
	Potlach Ranger District (Ross) FHP (Randall)

Break 1000-1015

1015-1045	Private Industry
	Bennett Lumber Products Inc. (Patterson)
1045-1115	City of Troy (Todd)
1115-1200	University of Idaho (Cook)
	Mimic Field Test- Results/ Progress Report

Lunch 1200-1300

Field Trip 1300-1700

Adjourn 1700

THURSDAY, NOVEMBER 8

Strategic Plan

0800-0830 Purpose
Current Status
Needed Action

Western Budworms

0830-1000 Suppression Projects 2001
Budworm Impact Plots- PTIPS (Hostetler)
Budworm Management Strategies
Hazard Rating- Central Oregon-STDP Project R6-2001-02 (Hostetler)
Plans for 2002

Break 1000-1015

Other Defoliators

1015-1115 2001 Gypsy Moth in the West- Summary (Bridgwater)
Other Discussion

Final Business

1115-1200 Priorities/ Recommendations
Review Action Items
New Chairperson
Next Meeting
Date and Location

Adjourn 1200