MEETING OF THE
WESTERN NORTH AMERICAN DEFOLIATOR WORKING GROUP
AND THE
HEMLOCK LOOPER COMMITTEE

NOVEMBER 5 - 6, 2002

HAWTHORN INN and SUITES
ARLINGTON, WASHINGTON

MEETING NOTES

Participants: Bob Backman (WA-Dept. Natural Resources, Olympia, WA), David Beckman (ID-Dept. Lands, Coeur d'Alene, ID), Beverly Bulaon (R1-Missoula, MT), Paul Flanagan (R6-Wenatchee, WA), Sandy Kegley (R1-Coeur d'Alene, ID), 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), Terry Rogers (R3-Albuquerque, NM), Karen Ripley (WA-Dept. Natural Resources, Olympia, WA), Roger Sandquist (R6-Portland, OR), Don Scott (R6-LaGrande, OR), Nancy Sturdevant (R1-Missoula, MT), John Wenz (R5-Sonora, CA), Beth Willhite (R6-Sandy, OR). (See attached list)

Guest Participant: John Keller (WA- Dept. Natural Resources, NW Region)

The annual Western North American Defoliator Working Group (DWG) Meeting for 2002 and he Hemlock Looper Committee Meeting were held jointly. The notes from the DWG meeting follow immediately below; the Hemlock Looper meeting notes are attached following the DWG notes.

WESTERN NORTH AMERICAN DEFOLIATOR WORKING GROUP (DWG)

November 6, 2002

DWG Meeting Summary

Action Items for 2002-2003

1) Continue consolidation of formal documentation of past defoliator committee meetings and convert into digital format (Hostetler, Sheehan).

2) Continue support of, and participation on, the TM BioControl-1 ad-hoc committee; communicate need to develop technology for early detection of NPV virus in increasing DFTM populations to STDP-Insect Management Technical Committee (Wenz). (see page 19)

3) Work with FHP-R6 to facilitate an update of the status and evaluation of all required monitoring following the 2000 and 2001 DFTM suppression projects using TM BioControl-1 in Washington and Oregon (Ragenovich, Wenz). (see page 19)

4) Form committee in 2003 to address issues associated with defoliator (specifically western budworm) effects assessment. (Bulaon, Progar, Willhite). (see page 20)

5) DWG will coordinate activities associated with testing potential improvements to the DFTM Early Warning System (Wenz, Ragenovich). (see page 20)

Other Decisions.

1) Re-confirmed DWG "Statement of Purpose", approved December, 2001 (see B, below).

2) Updating of the "Strategic/Tactical Plan for Management of Western Defoliators" will be conducted on an "as-needed" basis (see C, below).

Next Meeting: TBA.

DWG MEETING

BUSINESS

A) Status of Action Items from 2001 Meeting

1) Consolidate formal documentation of past defoliator committee meetings and convert into digital format (Hostetler/Sheehan/ Wenz). Continuing

2) Chair will develop a draft "Statement of Purpose" for the DWG and distribute to members for review and comment (Wenz). Completed 11/20/01 (see B, below).

3) DWG representatives will review "Action Items" in the 1994 Strategic Plan and report to Chair by January 15, 2002 (Working Group Representatives). Completed (see C, below).

4) A meeting of interested parties will be scheduled in early 2002 to discuss issues associated with western hemlock looper monitoring and management (Ragenovich). Completed 11/05/02 (see meeting notes, page 19).

5) A meeting of interested parties will be convened in early 2002 to discuss issues associated with sampling Douglas-fir tussock egg masses (Wenz). Completed 2/28/02.

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

7) 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). Completed 11/20/01 (see workshop summary D, below).

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

9) 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). Completed 1/23/02

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

The following "Statement of Purpose" was approved by the DWG in December, 2001 and re-confirmed at the 2002 meeting:

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

Specifically, the WNADWG provides a forum to:

1) Discuss current defoliator conditions in western North America;

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

3) Address 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.

The DWG reaffirmed that it was no longer necessary or efficient to formally conduct an annual review and update of the "Strategic/Tactical Plan for Management of Western Defoliators" to meet the current purpose and need of the DWG. The plan will continue to be a reference document for the DWG and updates or modifications will be conducted on an "as needed" basis.

D) Workshop Summary: Status and Impacts of Balsam Woolly Adelgid in the West

Workshop Moderator: Karen Ripley, Forest Entomologist, Washington Department of Natural Resources.

This workshop was developed due to input from the Western North American Defoliator Working Group meeting in Moscow, Idaho in November, 2001. Participants were interested in improving their general understanding of balsam woolly adelgid (BWA), monitoring activities, possible interactions between BWA and defoliators, and management recommendations. Following presentations by Russel Mitchell, Peter Hall, Ladd Livingston and Elizabeth Willhite,

summarized in the WFIWC Proceedings, brief discussion occurred. The main conclusions from this workshop include:

- BWA has had significant impact on various *Abies* species in Washington, Oregon, Idaho, and British Columbia. Significant impacts continue, even though direct mortality has subsided, sometimes due to host depletion. There is high likelihood of increased damage as BWA moves east into the Rocky Mountains, and, if regional climates warm, throughout previously infested areas.
- Some effort is being made to accurately survey the extent and presence of BWA in infested states.
- In British Columbia, efforts are being made to slow the spread from infested coastal areas to the important commercial *Abies*. No similar efforts are being made in the United States, partly related to the lack of commercial importance of *Abies* forests in the Rocky Mountains.
- Baseline information regarding the presence/absence of BWA and impact to *Abies* upon its arrival in not-currently-known-to-be-infested-areas would enhance our understanding of this insect and its effects.

DEFOLIATOR CONDITIONS REPORTS- 2002

Region 1: North Idaho (Kegley)

Hemlock Looper: Nez Perce National Forest (NPNF) had about 30,000 acres of defoliation mostly impacting true fir and spruce. Defoliation was most pronounced on understory trees, most overstory trees were less than 25 % defoliated. Overstory tree defoliation was patchy, not contiguous. Some patches of defoliation 50+ acres in size. Spruce and grand fir regeneration were most commonly impacted, though where subalpine fir regeneration was present it suffered the heaviest defoliation.

From discussions with field personnel on the NPNF, hemlock looper caterpillars were obvious in 2001, but 2002 was the first year of visible defoliation.

While touring defoliated areas on the NPNF we were able to collect lichen and observe current eggs. Based on visual estimates, we expect defoliation to continue into 2003 on the NPNF. We could easily see more than 4 healthy, bronze colored eggs on the lichen we collected at a site (less than 100 grams). We did not systematically collect lichen samples throughout the area, and while the NPNF is interested in knowing what the looper is likely to do, it is not interested in pursuing a control program.

The Clearwater National Forest (CNF) also experienced defoliation in 2002. Unlike the NPNF there was visible defoliation on the CNF in 2001, and in 2000 moths were extremely abundant, though defoliation was not widely reported. In 2001 hemlock looper defoliation was reported over a considerable area of the CNF, including the northernmost Palouse Ranger District (where looper defoliation was mixed with Douglas-fir tussock moth defoliation) as well as the Pierce Ranger District, where defoliation was noted in 2002. Defoliation estimates in 2002 are not

precise. The FHP aerial survey program on the CNF covers much of the impacted area, but flights occurred too early in the season to detect the defoliation. Estimates by Idaho Department of Lands personnel are "miles"- but because the impacted area was not in IDL surveyed areas, no polygons were drawn on a map. CNF personnel felt that the area had diminished from 2001 to 2002, however the IDL surveyor (David Beckman) felt this was not so. While hemlock looper defoliation was not evident in the northern districts of the CNF in 2002, David felt that the area impacted in the central portion of the CNF had expanded.

Tree species impacted on the CNF included hemlock and true firs. The defoliation was again most severe on regeneration, though defoliated regeneration on the CNF was not as widespread as on the NPNF (based on limited ground surveillance). Defoliation was patchy in nature, based upon ground surveillance, aerial surveyors indicated it did not appear too patchy from the air. Spruce did not seem to be impacted on the CNF. Also of note- lichen was not overly abundant in the area toured on the CNF making egg surveys difficult if not impossible.

Historically, hemlock looper outbreaks were reported in the Northern Region from 1937-39 and 1972-73.

Western Spruce Budworm**.** IPNF had about 9,000 acres of light and moderate defoliation near Priest Lake and Sandpoint. Hemlock mainly affected but also GF, SAF, and WP.Last recorded outbreak on the IPNF was in 1922 on hemlock

Carol and/ or Beverly plan to establish semi-permanent plots to characterize:

1. the duration (# of years) of defoliation
2. defoliation intensity (light, moderate, heavy)
3. impact of defoliation on overstory and understory trees
4. impact of defoliation on different tree species
5. population fluctuations of budworm in areas of concern

Douglas-fir Tussock Moth. Traps: 33 trap sites in 2002; 6 new; 27 traditional.

All traditional trap catches way down—highest average was 9 moths.
The 6 new trap sites were put in the outbreak area where there was defoliation
Ave. moths/trap ranged from 16-52
4/6 sites caught above 25-moth threshold

Semi- Permanent Plots- In 2001 we established 65 semi-permanent plots throughout the outbreak area. Defoliation in 2001 and 2002, egg mass counts 2001 and 2002, and larval counts 2002 were taken on many of these plots. 2001 results are summarized in a R1 biological evaluation, 2002 results are being analyzed. Larval count information has been difficult to interpret. All existing protocols deal with rising, pre-outbreak populations. We took larval counts in the middle of an outbreak and could not really say much with it. Based on peer-reviewed literature, larval counts should have indicated heavy defoliation, however, defoliation was moderate at worst and non-existent in many plots. Pheromone trap catches were still consistently above threshold, however, recently completed egg mass surveys on 25 of the semi-permanent plots in

outbreak areas on Forest Service Lands which experienced defoliation in 2001 and/ or 2002 found 2, very small 2002 egg masses.

Permanent Plots- 4 permanent plots were established in 1992 on the Palouse RD, Clearwater NF to measure growth loss, top kill, tree mortality, and to observe forest changes as a result of DFTM activity. These plots were only lightly defoliated during the most recent outbreak.

In 2001, we established 2 more plots in mod/heavy-defoliated areas—1 in a mature stand and 1 in a plantation. In the mature stand, defoliation ranged from 10-90% with the higher defoliation in the understory trees.
In the plantation, we tagged 40 DF and 61 GF in 7 fixed radius plots. The average height of the trees was 25 feet and average diameter 3.8 inches.
After 1 year of defoliation, 52% of GF and 73% of DF were >80% defoliated; 3% of GF were dead.

After 2 years of defoliation, 50% of GF and 53% of DF were >80% defoliated; 8% of GF and 20% of DF were dead.

California Tortoiseshell: This butterfly again defoliated patches of *Ceanothus* this year around Priest Lake, Idaho. The largest patch personally observed was 50 acres in size, and not a single leaf was visible on the plants in the center of the defoliated patch in September.

Region 1: Montana (Sturdevant)

Western Spruce Budworm**.** The insect that caused the majority of defoliation of conifers in the Northern Region was the western spruce budworm (*Choristoneura occidentalis* Freeman). On the Beaverhead NF, our aerial survey detected 29,600 acres of Douglas-fir defoliated by western spruce budworm. Light to heavy defoliation was recorded near Melrose and also in the Tobacco Root Mountains. We also recorded 5,760 acres of defoliation from western spruce budworm on the Deerlodge N.F. with heavy defoliation recorded in the High Ore drainage near Basin. Defoliation from budworm was also recorded both north and south of Helena and on the Gallatin N.F. on Elkhorn Ridge. We noted some defoliation on the Lewis and Clark N.F. outside of our normal aerial survey flight.

There was a significant increase in number of moths caught in pheromone traps at several trapping sites on the Deerlodge N.F. and a slight increase in moths caught at several of our other sites. Even a slight increase suggests that the population is beginning to increase in Montana. We have only begun to record defoliation from budworm over the past few years which was preceded by almost a decade of little budworm activity. We are also beginning to record moderate to high levels of defoliation from ground surveys. Some tree mortality resulting from heavy defoliation appears to have occurred in pole and sapling size trees over the last two years.

If weather conditions remain within the normal range or are warmer and drier during 2003, we can expect budworm populations to increase in historic budworm areas. We expect to see moderate to high populations and associated defoliation on parts of the Helena, Beaverhead,

Deerlodge and Gallatin N.F.s. We also expect to begin to see scattered defoliation on forests west of the divide.

During 2003, we will remeasure the budworm permanent plots that were installed in the early 1990s. The installation of these plots followed the budworm outbreak in the 1980s. We will remeasure tree heights, diameters and mortality on all plots. Most historic budworm areas are represented by a series of permanent plots. We hope that the information from the permanent plots can be useful in suppression or prevention projects. There are suppression techniques, such as spraying a biological insecticide, that are very effective in protecting green foliage throughout a budworm outbreak. In Montana, budworm outbreaks can last as long as 10 or so years. Suppressing budworm populations might be appropriate if the objective of the land manager is to protect certain values such as wildlife habitat or visuals.

Other Defoliators

2,720 acres of defoliation by the Western false hemlock looper was recorded on the Kootenai N.F and 2080 acres of defoliation by the pine tortix was recorded on the Gallatin N.F..

Idaho: Department of Lands (Beckman)

Douglas-fir Tussock Moth

In 2001 and 2002 The State of Idaho held a Spray project to control DFTM. In Fall of 2002 after the spray project, about 8000 acres of light defoliation was mapped in by aerial survey. All 8000 acres were mapped in on non-treated areas. Over 600 traps were put out at 122 sites, an average of 31 moths per trap were caught at all sites. That is down from an average of 71 moths per trap in the fall of 2001 trap catches, at the same sites.
In the fall of 2002, over 200 egg mass surveys plots were sampled. There were no new egg masses found, in or out of the treatment areas.

Western Spruce Budworm

No visible defoliation was mapped in on any state and private lands in North Idaho.
The USFS did map in 9,000 acres north and east of Priest Lake and Sandpoint, Idaho.

Hemlock Looper

There was only a small amount of light defoliation mapped in on state and private lands in the Clearwater reporting area, but there was over 25,000 acres of light to heavy defoliation on national forest lands ten to twelve miles east and south of Pierce, Idaho. An additional 30,000 acres of defoliation, mostly impacting true fir and spruce, was mapped in on the Nez Perce reporting area, in central Idaho north of Elk City, Idaho, on national forest lands. The defoliation was most severe on the regeneration.

In the areas of hemlock looper defoliation in northern Idaho reported in 2001 on the St. Joe reporting area, east of Coeur d'Alene, Idaho, there was no visible defoliation in 2002.

Gypsy Moth
No gypsy moths were trapped in Idaho in 2002.

R2: Colorado/Kansas/Nebraska/South Dakota/eastern Wyoming (Schaupp)
Colorado: State Forest Service (Leatherman)

In general, 2002 was not a big year for defoliators in the Rocky Mountain Region. Perhaps it was too dry or perhaps bark beetles have killed all the available trees…

COLORADO

Douglas-fir tussock moth

- The Hayman fire apparently dropped out of the tree crown and "sat down" when it reached the areas of Douglas-fir mortality caused by the 1993 – 1995 DFTM outbreak and subsequent Douglas-fir beetle episode.
- Douglas-fir tussock moth on white fir on Raton Mesa east of Trinidad is ongoing but small (200 – 500 ac). It was surveyed this year from the air.
- Douglas-fir tussock moth remains a chronic problem on ornamental blue spruce in Front Range communities. Attacks by *Ips hunteri* on defoliated blue spruce seem to be more common, perhaps as a result of the dry conditions.
- Early warning trapping system continued at 8 sites in Douglas-fir within the South Platte River drainage. For the second year consecutive year, 3 DFTM were caught. No moths are usually caught by this system, which began again in 1995. Therefore, consecutive year catches actually may be a harbinger of defoliation to come, given that high pheromone dose traps have caught only 0-5 DFTM. The Hayman fire consumed the ninth trap site. The forest near several other sites was significantly burned.

Western Spruce Budworm

- Moderate defoliation Douglas-fir, white fir and associated host conifers noted in the following areas of southern Colorado:
    - Rio Grande NF: large, chronically affected area with heavy mortality in the understory and mid-canopy; infestation now about 16 years old; Douglas-fir beetle has been killing defoliated trees for the past 3-4 years, although this is as yet not widespread
    - San Juan NF: about 5,000 ac of moderate defoliation
    - Uncompaghre Plateau and NF: chronic infestations since about 1994 in subalpine fir and spruce, killing understory; elevation is at least 9,000 feet
- Light defoliation noted along the Colorado Front Range; may be building

Gypsy Moth

- Surprisingly, no gypsy moths were caught.
    - Delimitation trapping negative near nursery in northern Denver metropolitan area, where we had positive catches in 2000 and 2001.

    - Delimitation trapping in Rocky Mountain National Park negative, second consecutive year.

Other defoliators

- Elm leaf beetle defoliation was heavy in places.
- Dramatic, landscape level discoloration and defoliation of ponderosa pine foliage has been occurring across the San Juan National Forest since 1999, caused by the needle-cast fungus *Davisomycella ponderosae*. Though not so bad this year, pine mortality due to western pine beetle has been noted in the same areas impacted by this fungus…. a relationship ?

KANSAS

No information

NEBRASKA

Gypsy Moth

- No gypsy moths were caught

Other defoliators

- A big year for defoliation statewide by bagworms
- European pine sawfly was prominent.
- Pine tip moths, fall webworm, and walnut caterpillar did their usual and significant feeding.

SOUTH DAKOTA

Gypsy Moth

- Four gypsy moths were caught at 4 separate places, all suspect hitch-hikers; 3 were caught in the Black Hills and the fourth in the south eastern part of the state.

Other defoliators

- The ashgrey blister beetle made the news, defoliating honeylocust and pea shrub near alfalfa fields; ingestion of even one of these beetles can be fatal to livestock, so hay contamination was the newsworthy aspect of this story.
- Elm sawfly and uglynest caterpillar in the northeast, pear sawfly in the east, bagworms and fall webworm earned minor mention.

WYOMING

Western Spruce Budworm

- 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

- Subalpine fir at the prairie/forest interface near Arlington in the Snowy Mountains had some defoliation for the first time
- State pest specialist continues to be interested in "minor" defoliators such as elm leaf beetle and not just budworm and tussock moth

Gypsy Moth

- One gypsy moth was caught in an RV park in Yellowstone NP
- Delimitation in Teton County near Jackson was negative for the second consecutive year

Other defoliators

- Lodgepole pine needle miner defoliated about 200 ac near Sinks Canyon outside Lander; species as yet undetermined

Region 3: Arizona/New Mexico (Rogers)

Western spruce budworm defoliation decreased Region-wide from 470,615 acres in 2001 to 210,335 in 2002. In Arizona, western spruce budworm defoliation was recorded on the Grand Canyon National Park (175 acres); and the Navajo Indian Reservation (11,255 acres). In New Mexico, western spruce budworm defoliation was detected on the Carson (114,680 acres), Cibola (1,695 acres), Gila (760 acres), Lincoln (130 acres), and Santa Fe (32,075 acres) National Forests; Valles Caldera National Preserve (440 acres); Jicarilla Apache (2,220 acres) and Taos Pueblo (8,265 acres) tribal lands and 38,640 acres of State and private lands.

New Mexico fir looper defoliation was detected on approximately 3,865 acres of the Sacramento Mountains in New Mexico.

In Arizona, spruce aphid was seen during ground surveys but defoliation was not observed during the aerial detection flights. No spruce aphid activity was observed in New Mexico.

Aspen defoliation, decline and morality, caused by one of, or sometimes an entire complex of insects, including the western tent caterpillar and the large aspen tortrix, root disease and abiotic factors, stayed about the same: at 49,990 acres in 2001 and 59,490 in 2002. In Arizona, aspen has been in decline throughout the northern-half of the state, since a frost event occurred in June of 1999 that was followed by several years of drought. Although the acreage did not change this year, the degree of damage did. Many areas experienced large-scale mortality rather than mere defoliation. In Arizona, aspen decline was recorded on the Apache-Sitgreaves (12,145 acres), Coconino (5,220 acres), Coronado (55 acres), Kaibab (16,370 acres), and Tonto (50 acres) National Forests; Grand Canyon National Park (4,220 acres); Fort Apache (3,155 acres) and Navajo (3,225 acres) Indian Reservations and 395 acres of State and private lands. In New Mexico, defoliation was detected on the Carson (2,645 acres), Cibola (1,045 acres), Gila (625 acres), Lincoln (395 acres), and Santa Fe (3,530 acres) National Forests; Valles Caldera National Preserve (1,575 acres); Mescalero Apache (60 acres) and Santa Clara Pueblo (440 acres) tribal lands and 4,340 acres of State and private holdings.

Region 4: South Idaho (Progar):

Douglas-fir Tussock Moth (*Orgyia pseudotsugata)*. Trap catches from 2002 averaged less than 5 moths per trap. One trap line at Sharps Canyon near Bell Mountain east of Bellvue, ID had an average of 50 moths per trap. We made one site visit in September at the request of the Burley/Twin Falls Ranger District to evaluate defoliation along the northern front of the Albion Mountains southeast of Oakley, ID. Observable levels of defoliation to the top of firs and in the understory were found. There were no viable pupae or new egg masses found. We observed several cadavers showing symptoms of viral mortality. The population apparently collapsed or is collapsing as a result of a viral epizootic.

Western Spruce Budworm (*Choristoneura occidentalis*). Western sprucve budworm populations are on the increase. Defoliation was mapped on the Boise Natioal Forest (Lowman and Idaho City Districts) and across the Targhee Natioanl Forest. Estimated total defoliation ranged from 5-10,000 acres.

California Tortoiseshell (*Nymphalis californiaca*). For the second year there are recordings of large outbreaks of the California tortoriseshell feeding on *Ceanothus*. Large patches of *Ceanothus* have been reported to be entirely defoliated.

Region 4: Utah, Nevada, & Western Wyoming (Pederson/Dymerski)

Douglas-fir Tussock Moth (*Orgyia pseudotsugata*)

Utah. In 2000 and 2001, over 4,000 acres of predominantly true fir had been heavily defoliated by a building population of Douglas-fir tussock moth in northeastern Nevada on the Jarbidge RD, Humboldt-Toiyabe NF. No new signs of defoliation were observed in the area this year, so it is assumed the population has collapsed due to a viral epizootic.

Nevada. No notable Douglas-fir tussock moth defoliation reported.

Western Wyoming. No notable Douglas-fir tussock moth defoliation reported.

Western Spruce Budworm (*Choristoneura occidentalis*)

Utah. The Escalante and Teasdale RD's on the Dixie NF had 8,000 acres of light to heavy defoliation mapped in for 2002, which was an increase from 3,000 acres in 2001. The Escalante RD took top defoliation honors, with 6,000 acres occurring in the areas of Bear and Cyclone Lakes, Roger Peak, Sand Creek Drainage, Mud Spring, and Price and Blue Spring Mountains. The Teasdale RD claimed 2,000 acres of budworm damage which mainly occurred around the Jim Larsen Reservoir, just southwest of the town of Teasdale. The Fishlake NF was observed to have 1,200 acres of light to heavy defoliation occurring on the southern end of the Beaver RD.

On the Manti-La Sal NF, small, scattered polygons of light defoliation were mapped across the west side of the Price RD. In all preceding descriptions, subalpine fir was the primary affected host.

Nevada. No notable western spruce budworm defoliation reported.

Western Wyoming**.** No notable western spruce budworm defoliation reported.

Gypsy Moth (*Lymantria dispar*)

Utah**.** A total of 3,812 gypsy moth traps were placed statewide by state and federal crews for 2002. Trapping efforts produced one male gypsy moth capture from Hill Air Force Base, which is located several miles south of Ogden. The trap was situated near Air Force personnel living quarters. A delimitation survey will be conducted in this area for 2003-2004. The delimitation survey in Rock Creek Canyon located in the Upper Stillwater campground, Ashley NF, was completed in 2002 with negative captures. A second-year delimitation survey will occur at Lake Fork Guard Station, adjacent to Moon Lake campground, Ashley NF, in 2003.

Nevada**.** Negative captures.

Western Wyoming**.** Negative captures.

Forest Tent Caterpillar (*Malacosoma spp*.)

Utah**.** Nearly 1,000 acres of light to heavy defoliation were observed in aspen stands scattered across the Wasatch-Cache, Uinta, and Ashley NF's.

Nevada**.** Light to heavy defoliation occurred on over 2,000 acres of aspen along the Santa Rosa Mountain Range on the Santa Rosa RD, Humboldt-Toiyabe NF, in northwestern Nevada.

Western Wyoming**.** No notable forest tent caterpillar defoliation reported.

Region 5: California (Wenz)

Contributors: Brian Mattos (Yosemite NP), Laura Merrill (FHP), Dave Schultz (FHP), Sheri Smith (FHP), John Dale (FHP), John Wenz (FHP).

Douglas-fir Tussock Moth, *Orgyia psedotdugata.* Douglas-fir tussock moth activity remained at low, non-damaging levels, throughout California. Mean trap catches from the 2002 DFTM Early Warning System showed decreases for most plots with 96% of the 168 plots averaging less than 25 moths/trap.

Pandora Moth, *Coloradia Pandora.* An incipient pandora moth outbreak was detected in June, 2002, on the Mammoth and Mono Lake Districts, Inyo National Forest (M261E). Light to moderate defoliation in the upper half of the crowns of Jeffrey and lodgepole pines was observed over about 5,200 acres. Feeding injury was restricted to the older foliage. Locations involved include an area south of the Crestview Roadside Rest west of Highway 395, south and east of Lookout Mountain, south and east of Dry Creek and east of Highway 395 from Wilson Butte north of the Bald Mountain road. Pandora moth outbreaks usually last for 3 to 4 generations and increased defoliation is expected over the next 4 to 6 years.

Lodgepole Needleminer, *Coleotechnites milleri*. The increasing trend in lodgepole needleminer populations in Yosemite National Park that started in 1992-94 generation continued in 2002 (M261E). Population increases were seen at 22 of 28 monitoring plots. Numerous adult moths were noted flying in the vicinity of Tuolumne Meadows. Four plots that had decreasing densities were so severely defoliated that larval populations were limited by available host foliage. Aerial surveys (August, 2002) showed approximately 51,684 acres of lodgepole needleminer defoliation. Severe weather (hailstorms) during the pupal stage at Tuolumne Meadows in 2001 and increased levels of parasitism noted in some plots has not resulted in a widespread population decrease. The increased population densities will likely result in severe defoliation over an area extending from Tenaya Lake nearly to Tuolumne Meadows with moderate to high mortality of host trees expected. Populations south and east of Tuolumne Meadows showing an increasing trend but densities are expected to remain below the threshold for visible defoliation. North of Tuolumne Meadows, moderate defoliation is expected in the Dog Lake, Delaney Creek and Dingley Creek Basins. Complete defoliation and high levels of mortality are expected in the vicinity of Sunrise High Sierra Camp.

Lodgepole needleminer larvae were found feeding in western white pine foliage at Cathedral Lake. Larvae have been reported feeding on other tree species during periods of high population levels when lodgepole pine foliage is seriously reduced.

Jeffrey Pine Needleminer, *Coloetechnites* sp. Nr. *milleri*. High populations of the Jeffrey pine needleminer were observed from areas in the San Bernardino Mountains known to have been infested in the past, particularly along Highway 18 in the vicinity of Snow Valley and on the south side of Big Bear lake.

Budworms. Budworm populations and associated defoliation remained generally low in 2002.

White Fir Sawfly, *Neodiprion* sp. *abietis* (?) and Pine Sawfly, *Neodiprion* sp. *fulviceps* (?). Sawfly defoliation and populations continued at low levels in 2002.

Pine Needlesheath Miner, *Zelleria haimnachi*. Pine needlesheath miner feeding on ponderosa pine east of Pondosa in Siskiyou County has been reported from this vicinity since 1997. No activity was reported in 2002.

Leafbeetles, *Chrysomela* sp. Moderate to heavy feeding on willows was reported in riparian areas south of the Tioga Pass Entrance Station to Yosemite National Park. The defoliation was caused by high populations of a chrysomelid beetle, *Chrysomela* prob. interrupta.

Fruittree Leafroller, *Archips argyrospila*. The fruittree leafroller outbreak in the San Bernardino Mountian of southern California continued into it's fourth year in 2002 affecting an estimated 25,000 to 30,000 acres of California black oak. Defoliation levels were similar to those observed in 2001. Egg masss sampling suggests similar population levels may be expected in 2003. Characteristic fruitrtee leafroller damage and egg masses were observed in the Castaic Mountains which may represent the first report of fruitrtee leafroller activity from that area. Many oaks in the San Bernardino Mountains outside the area of infestation had such poor leaf production due to extended drought conditions that at a distance they resembled trees defoliated by the fruittree leafroller.

Spruce Aphid, *Elatobium abietinum.* Chronic spruce aphid infestations continued in 2002 on planted Sitka spruce in Humboldt County in northwestern California. Over the past couple of years, damaging infestations have been reported from native stands. Affected areas have been noted from Ferndale north to Stone lagoon.

Fall Webworm, *Hyphantria cunea*. Light to moderate defoliation to madrone by fall webworm continued in 2002 in localized areas in the Klamath and Trinity River drainages and in El Dorado, Amador and Calaveras Counties.

Gypsy Moth, *Lymantria dispar*. Four male gypsy moths have been trapped by Pest Detection, California Department of Food and Agriculture by September 24, 2002; one each in Fresno and Santa Cruz Counties and two in Los Angeles County. No egg masses have been found.

R6: Oregon/Washington
Washington: Department of Natural Resources (Ripley)

Douglas-fir tussock moth outbreaks at Tekoa Mountain, the Blue Mountains and the Methow Valley have declined. Traps collected thus far indicate that populations of this defoliator should be low statewide for 2003. The only traps that have caught a significant number of moths were in the Tekoa Mountain area.

Hemlock looper and phantom hemlock looper activity was mapped on about 40,000 acres in 2002. Activity in the Arlington and Lake Chaplain area is in decline, but defoliation may continue in the Baker Lake area for one more year. Black-headed budworm activity was observed in the Wenatchee National Forest, in the vicinity of Mission Ridge ski area.

A persistent western spruce budworm outbreak in the vicinity of Mt. Adams has declined in the Glenwood area, but remains strong on its northern front, south of Mt. Rainier National Park in the vicinity of Rimrock Lake and Reynolds Creek. 56,000 acres were mapped in the 2002 aerial survey, down from 236,000 acres mapped in 2001. Balsam woolly adelgid activity has been high in defoliated areas and has likely contributed to the impacts of this outbreak including tree mortality and crown cover reduction, which has reduced habitat for Northern spotted owl. The Douglas-fir beetle is causing high levels of damage in areas that were previously defoliated.

Tent caterpillar activity was high in the central Puget Sound, expanding from southern Whidbey Island and Kingston to Vashon Island. Although the northern portion of this outbreak has been defoliated for several years and natural controls are developing, the outbreak is expected to continue and expand in the south. Red alder, willow and cottonwood are the major hosts, but a variety of fruit and ornamental species are being defoliated.

Only 17 gypsy moths were caught in about 19,000 traps in Washington in 2002. This is the lowest number of moths caught since 1979. Catches were spread across seven counties. The highest catch area was near the Port of Bellingham (4 moths). Other catches were single moths per site. All moths were North American.

Washington had an extremely dry winter 2000-01 and has had extended summer droughts in 1998 and 2002. October 2002 was the driest or second driest on record for many locations in the state. In fact, the July through October period was also one of the driest on record. The percent of normal precipitation ranged from 15 to 30 percent for western Washington and 7 to 15 percent for eastern Washington. The Palouse and Blue Mountains were the wettest area of the state with 48 percent of normal July through October precipitation. Autumn rains, usually expected in mid-October, did not arrive until November 6, 2002. Recharge of soil water is expected to take weeks. The impact of these dry conditions on tree vigor and defoliator populations remains to be seen.

Oregon: Department of Forestry (Overhulser)

Douglas-fir Tussock Moth – Tussock moth defoliation of Douglas-fir in Wheeler Co. declined from 29,149 acres in 2001 to 9,392 acres in 2002. This should be the last year of visible defoliation from a collapsing outbreak. Tussock moth early warning trap catches in Oregon are down from 2001 at all sites on federal and private lands.

Pandora Moth – A new pandora moth outbreak was detected in northern Klamath Co. along the Highway 97 corridor. Defoliation is concentrated in lodgepole pine and involves some 24,365 acres. In some areas lodgepole pine is almost stripped of old foliage and little new foliage was produced this year.

Western Tent Caterpillar – Extensive defoliation of red alder has occurred near the town of Elsie in Clatsop Co. Defoliation increased from 1,034 acres in 2001 to 3,683 acres in 2002, much of it visible from Highway 26, the main route to the coast from Portland.

Western Spruce Budworm – Light defoliation of grand fir/white fir occurred on 1,896 acres in Grant Co.

Balsam Woolly Adelgid – Acreage detected by aerial survey increased from 16,689 acres in 2001 to 35,252 acres in 2002. Infested acreage detected in Oregon has decreased dramatically since 2000 when surveyors started to use lichen visibility in the crowns of sub alpine fir as a signature for balsam woolly adelgid.

Larch Casebearer – Only 249 acres were detected by aerial survey although several

DISCUSSION TOPICS

Douglas-fir Tussock Moth

A) **Status of DFTM Mating Disruption Project – 2002 (Ragenovich)**

In the spring of 2001, card and needle elution studies for two slow-release formulations of Douglas –fir tussock moth pheromone were done under controlled greenhouse conditions and in the field. These formulations were the Hercon laminated flake – DFTM Disrupt and the 3M Canada microencapsulated bead. During the summer of 2001, a field efficacy study using aerial application of 5 and 10 gm a.i. of the Hercon flake was done on 50 acre plots in the vicinity of Potlach in north Idaho. Treatment effectiveness was monitored through male moth catches in traps baited with super-strength pheromones, viable egg masses, and larval populations the following summer. Data have not been analyzed, however, trap results indicate that there will be no differences between the two treatments, but that there will be differences between the treatments and the controls in numbers of male moths trapped. Virus caused the populations in the South plots to collapse, although the plots were sampled, no egg masses or larvae were collected. Egg masses were collected from the North plots and data have yet to be evaluated. Larvae were also collected in the summer of 2002, however, two of the North plots were completely or partially treated during a 2002 DFTM project conducted by the State of Idaho in 2002.

In late fall of 2002, additional elution studies were done. Greenhouse studies were done at APHIS PPQ at Otis ANGB, MA and field elution studies were done in Tucson, AZ. IN this study, four slow-release formulations were tested, the Hercon flake, the 3M mircrobead, a hollow fiber produced by Scentry, Inc., and a polymer formulation made by Shin-etsu. In addition, a second Scentry fiber and a second active ingredient rate in both fibers were also tested in the greenhouse. Formulations were placed on canvas cards, cards made of 105 mesh steel bolt cloth, and on Douglas-fir needles. Samples are collected approximately weekly for 60 days and gas chromatograph analyses will be done to determine elution rates.

B) **Evaluation of the 2000 DFTM Suppression Project, Eastern Oregon/ Washington (Scott/Spiegel)**

One and Two Year Follow-up Evaluation of TM BioControl-1 Treatments to Suppress Douglas-fir Tussock Moth in the Blue Mountains of Northeastern Oregon and Southeastern Washington

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Wallowa-Whitman National Forest
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Report No. BMPMSC-02-02

(Following is an Executive Summary of this report. A copy of the complete report is available on the R6 FHP website: http://www.fs.fed.us/r6/nr/fid/)

Treatment of Douglas-fir tussock moth populations on 39,602 acres of the Pine, Walla Walla, and Pomeroy Ranger Districts in 2000 represented the first large-scale, operational use of the viral insecticide, TM BioControl-1, to suppress a tussock moth outbreak in the United States. This fact, and the widespread national and international interest in application of insect viruses to control forest defoliators, compelled the need to closely monitor treatment effects on populations, as well as subsequent damage to host trees. Accordingly, we re-sampled larval populations in 2001 and tree defoliation and mortality in 2001 and 2002 in treated and untreated areas. This provides information beyond the initial year of treatment on the effectiveness of the treatment in reducing defoliation, top-kill, and tree mortality resulting from defoliation or subsequent bark beetles.

Tussock moth populations were so low in 2001 that it was difficult to find larvae to sample. Midcrown densities in 2001 were less than 2 larvae per 1000 in^2 of foliated midcrown branch on all analysis units, with the exception of one untreated analysis unit on the Pomeroy Ranger District that had an average of 2.3 larvae per 1000 in^2. All densities represented a substantial decline in populations from the previous year. This decline is attributed to virus-caused mortality. The average virus infection rate of young larvae from all treated analysis units in 2001 was 34.1% compared to a rate of 29.9% on untreated control units. The low population and the similar virus infection rates indicate that applied virus did not influence larval infection rates any differently than natural virus levels one year after initial treatment.

The amount of defoliation that occurred in 2001 and 2002 was negligible due to the low numbers of larvae. Only the Duck analysis unit on the Pine Ranger District had measurable defoliation in 2001. This amounted to only 5 of 498 trees with defoliation that was 10% or greater by the end of the season in 2001. Only two trees had measurable defoliation in 2002.

While cumulative top-kill and tree mortality were similarly low on all units, there were significant differences between treated and untreated areas. All treated units on the Wallowa-Whitman had significantly less top-kill than untreated units ($p<0.025$). Differences on the Umatilla were not significant. Two of the three treated units on the Wallowa-Whitman had significantly more mortality than untreated units ($p<0.05$). All other differences in mortality were not significant.

These plot locations were chosen randomly to represent the overall conditions likely to be found in the defoliated areas. Due to the patchy nature of tussock moth defoliation and damage, it is very likely that more severe conditions can be found over the larger landscape of the entire defoliated area. Tussock moth damage tends to appear in the forest as spots of heavy defoliation grading out to no defoliation with every variation of defoliation intensity between these

extremes. While approximately 220,000 acres were mapped with defoliation during the 2000 aerial survey, those acres exhibit the complete spectrum of defoliation. The results of this follow-up study indicate that less than 1% of the trees in this 220,000 acres area are dead from the defoliation, with about 3% of trees suffering top-kill.

The suppression project had mixed success. The overarching goal was to protect foliage in high value areas such as sensitive species habitat and high value recreation areas. Post-treatment monitoring in 2000 clearly showed an increase in virus infection rates accompanied by a decrease in larval populations and defoliation in treated areas compared to larvae from untreated areas. However, the appearance of naturally occurring virus in all units obscures the overall results. By 2001 there was no difference in virus infection rates nor in measured defoliation in treated and untreated areas. The lower number of top-killed trees in treated areas indicates a lasting positive effect from spraying. The higher mortality in some treated areas needs further investigation.

The current Forest Service stocks of TM BioControl-1 are limited, and it would not be easy to produce additional quantities, nor could it be done quickly or inexpensively. Hence, application of the virus must be done with care to avoid wasting the biological insecticide by treating areas where treatment may not be required due to an abundance of naturally occurring virus in populations. Moreover, it would be helpful to know well in advance of treatment both if natural virus were present and the extent to which such occurrence might influence ultimate collapse of the population. Clearly, there is need for more research to provide information that would facilitate suppression project decisions that are timely, accurate, and cost effective.

C) **DFTM Project Efficacy Monitoring**

The issue of project efficacy monitoring following the 2000 and 2001 DFTM suppression projects in Washington and Oregon was discussed. The DWG is on record (3400 memo from the DWG to the Director, FHP-WO, February 6, 2001) as supporting the importance of, and funding for, quantitative monitoring to document treatment efficacy in terms of meeting specified project objectives. Specific "items" to be monitored are listed in the Records of Decision. Some of the monitoring results are already available (see B immediately above). The DWG decided to request information on the status of all monitoring efforts from FHP R6 as an action item (see 2002-2003 Action Item #3, above). The intent is for the DWG to work with R6 to determine what monitoring has been accomplished, what, if any, is ongoing, evaluate results of the monitoring, assess what worked and didn't work and provide suggestions for improvements to make future monitoring efforts more effective. Iral Ragenovich and John Wenz are to coordinate this Action Item.

D) **TM-BioControl-1 (Wenz)**

The DWG confirmed the importance of maintaining the availability of TM-BioControl-1 for suppression of DFTM. The DWG supports, and recommends giving priority to, the efforts of the ad-hoc committee headed by Allan Bullard (FHTET, Morgantown, WV) to address the several

issues associated with maintaining TM-BioControl-1. Members of the DWG are currently participating on the ad-hoc committee and the DWG is available to provide whatever assistance is needed. In addition, the DWG identified the need to develop technologies that would allow early detection of the NPV virus in increasing DFTM field populations so that predictions of the effects of the virus on DFTM populations would be available for timely, effective use, by decision-makers evaluating DFTM management alternatives. This technology development need will be brought to the attention of the ad-ho committee and the STDP Insect Management Technical Committee. (See Action Item #2).

E) **Early Warning Pheromone System**

A new plastic device developed by Phero-tech designed to clamp to the trap and hold/protect the pheromone bait was discussed. Limited testing in Washington in 2002 suggested that it had promise and there may be further testing in 2003. In addition, a trap (also from Phero-tech) using a potentially improved system for distributing the adhesive material on the traps has become available (the adhesive material used in this trap is different from the stickem currently used in the operational traps). There are plans for initial, limited, testing of these traps in R5 and 6 in 2003.

It is appropriate to consider improvements to the DFTM early warning system. However, any changes to the current system must be tested over adequate time frames and geographical areas using agreed upon standardized protocols before being considered for integration into the current operating system. The DWG is a logical entity to coordinate such activities and Iral Ragenovich and John Wenz have volunteered to coordinate (at least for 2003) any testing of potential improvements to the EWS (see Action Item #5).

Western Spruce Budworm

A) **Effects Assessment/ Monitoring**

Western Spruce Budworm activity and associated defoliation is continuing south of Mt. Rainer NP in Washington and in parts of Colorado and Wyoming. It is increasing in several areas throughout the west, including Montana, southern Idaho, and Utah, and may be increasing along the Colorado Front Range. There was considerable discussion of issues associated with budworm management. A basic concern involves the quantitative documentation of defoliator (western budworm in particular) effects (specifically non-commodity effects) and associated issues. These issues include the need for better coordination with wildlife biologists and other resource specialists and how to effectively implement and fund complex monitoring/assessment studies. It was decided to form a committee to look into these issues (see Action Item #4); Beverly Bulaon (R1), Rob Progar (R4) and Beth Willhite (R6) volunteered to initiate this action.

HEMLOCK LOOPER MEETING

November 5, 2002

Meeting Notes (Iral Ragenovich)

During the 2001 NADWG meeting in Moscow, ID a number of participants requested that a Hemlock Looper Meeting be held. The meeting was held the day prior to the 2002 NADWG meeting in Smokey Point, WA. A morning discussion on the status of Hemlock loopers, in the Northwest, current knowledge, impacts, predictive models and recommendations, was followed by an afternoon field trip to an outbreak area on the Mt. Baker Ranger District, and to and nearby private land, where some of the issues associated with old growth hemlock, hemlock looper, and marbled murrelet were discussed.

A good source of reference of hemlock looper related publications is:
"Annotated bibliography of the hemlock looper, *Lambdina fiscellaria* (Guen.) (Lepidoptera:Geometridae)" by A.G, Raske, I.S Otvos, and L.J. Jobin

Status
British Columbia: Hemlock looper feeds primarily on hemlock, but can spill over to other hosts. Populations have been increasing – next year will be the first year of moderate defoliation. The Current outbreak is in the SE part of the Province, north of Idaho. The Province is considering using Btk, which is registered for hemlock looper in eastern Canada. Treatment would be two applications of 30 BIU/acre, because the larvae hatch over an extended period.

Since 1994, they have monitored populations with pheromone traps, however, although counts in traps have been increasing, until the insect goes through an outbreak cycle, they will not know what these counts mean in terms of an impending outbreak. In addition, larval numbers have been increasing.

Idaho: More defoliation has been mapped in this year than has been seen in the last 25 years. In 2001, hemlock looper was first recorded as DFTM and was relatively light on 20,000 acres around Couer d' Alene. That population has declined; however, farther south in central Idaho hemlock looper and false hemlock looper defoliation was mapped in as 20,000 acres on the Clearwater National Forest (in hemlock and true-fir) and 30,000 acres on the Nez Pearce (in subalpine, spruce and grand fir). Defoliation is expected to continue. The last time hemlock looper was recorded in Idaho was 1972-73. Prior to that it had occurred in 1937-1939.

Washington: This state has a long history of hemlock looper outbreaks. The first recorded outbreak was 1889. Subsequent outbreaks have occurred in the mid to late 40's the early 50's, early and late 60's, early to mid-90's, and the current infestation which began in 2000. In 2001, 11,000 acres of moderate to heavy defoliation, primarily in Snohomish and Skagit counties occurred on state and private land. Defoliation occurred on the City of Everett watershed, which

represents atypical hemlock looper habitat – single layer, relatively young (60 yrs old) thinned stands. These stands had a significant amount of top kill, but little mortality. Heavy defoliation, resulting in more mortality, has occurred around Baker Lake for several years in classic hemlock looper habitat – old, multi-layer hemlock. See attached appendix for more detailed discussion of the history of hemlock looper outbreaks and control projects in Washington.

Oregon: In previous years – in the late 1880's, the early 1940's and the early 1960's significant hemlock looper outbreaks occurred in coastal Oregon, however, in recent years Oregon has experienced very little hemlock looper defoliation. A small spot has been recorded on the Mt. Hood National Forest. Of more significance is a closely related species – the oak looper. 13,000 acres of oak were defoliated in the Willamette Valley. Primary impacts from this insect are residential.

Detection and Sampling

Aerial detection: Hemlock looper defoliation is mapped in during the annual aerial detection survey. Typically this survey occurs in Western Washington around the first of August. Given the biology of the insect, most of the defoliation occurs in late August or early September. As a result, we may be underestimating the amount and intensity of hemlock defoliation.

Larval and Egg Sampling: Traditional methods of population sampling are: 1) egg sampling, which involves collecting and washing large amounts of moss, and 2) larval sampling, which involves beating the lower branches of sample trees. Both of these methods are fairly involved and time consuming.

Pheromone traps: Pheromone trapping is being evaluated in British Columbia. Traps have been placed since 1994, and larval sampling ahs been done each year in conjunction with the trapping in order to relate trap catches to numbers of larvae. However, what trap catches actually mean will not be known until they have trapped though an outbreak cycle. Pheromone traps will not be precise, but they may be able to indicate increasing populations, and give general estimates of population levels – high, moderate, or low, for example.

Impacts

In early years, the driving concern for hemlock looper was impacts on volume and economic. In more traditional stands the outbreaks usually last form 4-5 years. The issues now include:

-Management of old-growth stands and Late Successional Reserves – this becomes more important as we are deliberately trying to create "old-growth"; and the hemlock looper is traditionally considered to be associated with older stands

-Endangered species habitat – for instance habitat for the marbeled murrelet;

-One of the questions that entomologists are being asked, is "are the trees going to die"; whether a tree will die influece particular decisions.

-Impacts on individual trees as well as on stands

-Hazard trees

-In the Willamette Valley – the primary issue with oak looper is residential

-In some situations, treating with B.t. may be a needed option.

Predicitive Models

Management objectives for hemlock looper have changed over time. Defoliation and impact on volume are not the only focus. We need to look at the effects of a complex of interactions, such as hemlock looper, balsam wooley adelgid, and armellaria. Ways to predict impacts in a larger context are needed.

When managing old growth forests that are being defoliated by hemlock looper, managers are often faced with having to make a decision of whether a tree is going to die. In marbled murrelet habitat, a tree cannot be cut unless it is going to die – so the question becomes – how can you determine if a tree will die? Therefore, guidelines to predict if a tree will die following defoliations are needed.

Findings

1. Recommend that the aerial survey committee develop standards for a survey that may include hemlock looper; or some standard that would trigger a second flight for that insect. Surveys should coincide as much as possible with the timing of the most visable insect damage.

2. Pheromone trapping – need to develop a threshold level based on trap catches to predict an outbreak.

3. Need predictive models that can evaluate effects of the complex and interactions of armellaria, BWA, and environmental conditions, etc.

4. Need to determine the relationship of hemlock looper defoliation and impacts on resources – will a tree die? What is the combined impact of a number of insects and/or diseases? Etc.

Appendix: Hemlock Looper Meeting

Hemlock Looper – Historic and Current Activity in Washington
Karen Ripley, Washington Department of Natural Resources
November 5, 2002

Hemlock looper is the most important defoliator of western Washington.

Early history (1889-1963):

Early history is well described by Wickman, Torgersen and Furniss in the Fall, 2002 (Vol. 48, No. 3) American Entomologist. "The first known record of extensive tree killing by a forest defoliator in the western United States involved the western hemlock looper, *Lambdina fiscellaria lugubrosa*. This defoliator killed a vast amount of western hemlock, *Tsuga heterophylla* in Tillamook and Clatsop Counties, Oregon about 1889-1891. A subsequent outbreak killed 200 million board feet of hemlock in Pacific and Grays Harbor Counties, Washington, from 1929 to 1932. Losses in Pacific County were reduced in 1931 through the first airplane dusting experiment attempted against a forest defoliator in the western United States." Six thousand acres were treated with calcium arsenate at a cost of $2.71 per acre. Many photographs were taken of this suppression project.

Wickman *et. al*. continues, "In 1945, the hemlock looper again became destructive in Clatsop County, Oregon. Part of this infestation was dusted with DDT by airplane, marking the first such use of this insecticide in a west coast forest." The DDT treatment (2,300 acres) cost $2.35 per acre. The majority of the project (11,600 acres) used lead arsenate and cost $3.50 per acre.

In July 1963, 55,000 acres of a 70,000-acre hemlock looper infestation in southwest Washington were treated by helicopter with aerial applications of either Sevin (43,000 acres) or DDT (12,000 acres). Spraying was initiated when most larvae were in the 2nd instar. Spray coverage was good and mortality excellent (98%, 1 plot) in the DDT treated area. Spray coverage was variable and insect mortality (0 to 86%; average 20%) insufficient to prevent tree mortality in Sevin treated areas (18 plots). In pilot tests, 2,276 acres were treated with Phosphamidon and 325 acres were treated with B.t.

Conditions Reports and Aerial Survey Records.
Hemlock looper activity was recorded in Washington's insect and disease condition reports fairly frequently in recent decades:

1938	Mt. Baker, Day Lake, Skagit River Drainage
1943	Skagit River Drainage
1945-47	Olympic Peninsula
1947-48	Pacific and Clallam Counties
1949-52	Clallam County
1950	Olympic Peninsula
1952	Olympic Peninsula
1952-53	Wahkiakum County

1960-63 Pacific and Wahkiakum Counties
1967 Mt. Baker National Forest
1992-94 Mt.Baker/Snoqualmie National Forest and North Cascades NP
1994 Olympic Peninsula
1996 Mt. Baker/Snoqualmie National Forest and Olympic Peninsula
1996- Mt. Baker/Snoqualmie National Forest
2000-02 Mt. Baker/Snoqualmie National Forest

These records deserve more evaluation regarding the actual locations and acreage, as well as the survey methods used to detect and record them. In general, it is difficult to discern from this list how outbreaks were isolated or related to one another and the actual duration of specific outbreaks. Aerial surveys of western Washington generally occur too early in the summer to accurately detect and record hemlock looper defoliation episodes.

Moreover, some areas appear to be "hotspots" for the western hemlock looper, with defoliation occurring again and again. As forest stands have been converted to younger, simpler structures, the hemlock looper appears to have declined (Pacific County). Where forests are still structurally diverse and dominated by hemlock, the outbreaks have continued to occur (Bacon Creek, Mt. Baker National Forest).

Recent History.

There has been almost continuous hemlock looper activity in northwestern Washington through the 1990's. In 1967, an outbreak along Bacon Creek in the Mt. Baker National Forest had been treated with Zectran and stabilized pyrethrins. In the early 1990's the area again was defoliated for several years by hemlock looper. Damage was also observed 1992 and 1993 in Canyon Creek and Granite Falls area. In the late 1990's damage occurred in the vicinity of Baker Lake. In 2000 and 2001 defoliation was observed on 11,000 acres in the vicinity of Lake Chaplain (the City of Everett's watershed) and surrounding state and private forests. The phantom hemlock looper was also part of this defoliation.

These state and private forests are a fairly unique situation because of their young age and simple stand structure. All are hemlock-dominated forests, with some Douglas-fir and western redcedar, but they are not old forests. Much of this area was thoroughly logged following World War II. The stands are quite uniform, dense 60-year old trees. Some have been partially cut in the last 5-8 years ("late thinning") to maintain a fully stocked stand, yet allow high value growth on residual crop trees. Although Western Forest Insects states that outbreaks may occur in younger stands, the specifics of those comments are not known. In Canada, the activity in younger stands has been attributed to spillover from nearby older stands where the outbreaks originate (Otvos, personal communication).

In these young stands, damage has been variable. Hemlock mortality was limited and patchy, but topkill was fairly common and growth losses were ubiquitous. Douglas-fir

only suffered growth losses. Hemlock stands that had been thinned in the last decade suffered less damage than unthinned stands.

Lichen and moss collected in December, 2001 contained only approximately 5 healthy eggs per 100 grams of moss and lichen. The outbreak was not expected to expand. However, there was no information collected regarding the phantom hemlock looper. The egg evaluation method was very time consuming and difficult.

The Washington Department of Natural Resources is proceeding to salvage the most heavily damaged hemlock sites in the Granite Falls, Lake Chaplain area. Emergency Prevention and Suppression funds provided by the US Forest Service will support part of the restoration work.

In the Baker Lake area, the potential impact of hemlock looper activity on marbled murrelet habitat is unknown. Private landowners are required to protect murrelet habitat by leaving large diameter (>=32" DBH) living trees with platforms. Judging which large trees will stay alive, or conversely the likely imminent mortality due to defoliation and interacting drought effects and Armillaria root disease, can be very difficult.

Findings:

- Aerial survey does not consistently detect and record hemlock looper activity in western Washington.
- Predictive tools to determine the onset and duration of hemlock looper outbreaks are lacking.
- Tools to predict the impact of hemlock looper defoliation on trees and stands of different ages, particularly second growth stands, are lacking.
- The interactions and relationships of false hemlock looper, phantom hemlock looper, and western hemlock looper are poorly understood.
- Predictive tools and monitoring methods are not available for the false hemlock looper and phantom hemlock looper.

Western North American Defoliator Working Group

Participant List: 2002-2003

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