Douglas-fir Tussock Moth Meeting Notes

OSU Learning Center
Portland, Oregon
March 10-11, 1998

Background

Fifteen representatives from the western USA and Canada met to exchange information on the status of Douglas-fir tussock moth (DFTM) in their respective regions, to discuss topics relating to DFTM monitoring and suppression, and to make decisions concerning the need for a new Early Warning System (EWS) data form, the direction of TM-Biocontrol testing, and whether to continue the Western Defoliator Steering Committee. A list of attendees is included at the end of these meeting notes. The previous Westwide DFTM meeting was held on February 15-16, 1995, at the USFS Lakewood office in Denver, Colorado.

Meeting Results

Decisions

Decisions made on decision items are listed below:

- Development of a new EWS data form is not necessary.
- Pursue TM-Biocontrol testing on wild populations (see *Action Items*).
- Continue the Western Defoliator Steering Committee as an informal working group on western defoliators. John Wenz and Nancy Sturdevant agreed to co-lead the group, renamed the Western North American Defoliator Working Group.

Action Items

In addition, the following Action Items were identified in the course of discussions, along with the individual(s) responsible for completion of each task. See Discussion Notes for details:

1. Prepare a letter to the USDA Forest Service, Forest Health Protection, Washington Office, requesting that Regional Forest Conditions Reports be continued. This action item was prompted by a concern that detailed, useful historical information was no longer published as Regions were opting to prepare sleeker, issue-focused reports on Forest Health Monitoring, in lieu of the traditional Regional Forest Conditions Reports. *Individual responsible: Iral Ragenovich.*
2. Prepare a letter to the Forest Health Technology Enterprise Team recommending development of a better DFTM model. *Individual responsible: Kathy Sheehan.*
3. Check the cost of getting the DFTM mating disruption pheromone registered. *Individual responsible: Dick Reardon.*

4. Prepare letters of support to Imre Otvos for development of a virus detection kit. *Individuals responsible: Meeting attendees who support this endeavor.*
5. Coordinate input to a document on DFTM activity and monitoring since 1979. *Individuals responsible: John Wenz and Kathy Sheehan.*
6. Bioassay three wild DFTM populations this year. *Individuals responsible: Imre Otvos will conduct the bioassays, egg masses from the wild populations will be supplied by Don Scott, Julie Weatherby, and Ladd Livingston.*
7. Test NOVO-038 carrier for B.t. this year. *Individual responsible: Karen Ripley*

Discussion Notes

Review of EWS trapping results and status of DFTM population levels in the West

State of Idaho - Ladd Livingston

Few moths have been caught at State and Private pheromone trapping sites in Idaho and Montana during the past several years. There was a small rise in trap catches in 1997, but it was not very significant. Ladd has maintained traps at the same sites for 20 years. Idaho State personnel (Ladd and David Beckman) place almost all of the traps for all ownerships; a few traps are put out by Potlatch Ranger District personnel.

At one time Ladd worked with Mike Marsden to evaluate the EWS data, and results indicated that the data was primarily useful to indicate general trends in DFTM population levels. Historically, trap catches have increased periodically, correlating with a 10 year cycle, but no one knows why there have been no associated outbreaks in some areas. Since 1947, outbreaks have occurred in basically the same locations. Perhaps forest management activities have impacted the area and depressed DFTM populations. The forest type in northern Idaho since the turn of the century has changed; it used to be predominantly western white pine, but has been converted to grand fir and Douglas-fir, which is a more favorable situation for DFTM. However, these forested areas are significantly fragmented, due to harvesting by a wide array of landowners; perhaps this fragmentation has reduced the potential for DFTM to reach outbreak levels. But a State park which has not been harvested, located in the middle of the fragmented forest type, has also been devoid of outbreaks, so perhaps the fragmentation theory is not adequate to explain the outbreak pattern.

Larry Stipe was monitoring some sites for virus in the past -- don't know what the status of the virus is now. The last big DFTM outbreak in northern Idaho occurred in the 1970's. It was treated with DDT.

Region 1 - Nancy Sturdevant

EWS plots on Forest Service land in Montana and Idaho, have not been monitored since 1986 due to low catch numbers. In Idaho, most federal trap sites were duplicates of the

State's trap sites. Region 1 plans to trap again in 1998-2001, which will give them a 20 year data trend, then will look at the efficacy of the trapping program.

Forest Health Protection (FHP) personnel employ the traps on Forest Service land. They have 27-30 plots. The DFTM database for all land ownerships in Idaho and Montana is on paper. Nancy Campbell maintains the federal lands database, Ladd Livingston keeps the database for the State of Idaho, and Steve Kohler maintains the DFTM data base for Montana State and Private lands.

Region 2 - Bill Schaupp

Wildland outbreaks of DFTM occurred in Colorado in 1937, 1947 (treated with DDT), 1984, and 1993. Historically, outbreaks have occurred on a particular soil type (Pikes Peak granite) that has a low moisture holding capacity. The EWS was initiated in Region 2 in 1984. Sixty pheromone trap sites were monitored from 1984 to 1990. During that time, they never caught more than 44 moths at any one site. Region 2 currently has 12 pheromone trap sites which are maintained by FHP personnel. Bill would like to know other streamlined ways of doing the trap monitoring.

In 1993, DFTM defoliation was inadvertently detected from the ground during a drive-through in Colorado. The outbreak collapsed in 1995. 18,000 acres out of 60,000 were defoliated, and within the defoliated areas, there occurred unexpected high mortality. Bill was able to watch individual trees, and found that much of the mortality was caused by the Douglas-fir beetle (DFB). Trees were defoliated one year, and DFB attacked the next. . No moths have been caught at the trap sites since 1995. Are the pheromones working the way they should?

DFTM is a chronic problem on urban blue spruce, but doesn't kill the trees. *Ips hunteri* is currently killing some of the defoliated blue spruce trees. Something seems to have changed in the wildland forest to make it more susceptible to outbreaks. DFTM is affecting blue spruce in some areas but not adjacent Douglas-fir.

Region 2 wants to develop a history of the Region's pheromone trapping and relate outbreaks with soils. Jose Negron, Ann Lynch, and Bill Schaupp are trying to do a retrospective look at the last (1993-1995) outbreak to find site factors that could be used for outbreak prediction. Theories include: 1) blue spruce acts as refugia for DFTM, and 2) air pollution has weakened the trees, making them more susceptible to DFTM outbreaks. Bill plans to use high dose trapping to delineate the distribution of DFTM. Ladd Livingston noted that a publication exists that reported high-dose trapping in urban areas across the west in the early to mid-1970's. DFTM moths were caught in almost every place traps were set out. Several people noted that the rusty tussock moth comes to DFTM pheromone traps easily. In Canada, Gerhart, Gries, and Schlesser(?) have identified a second component of the DFTM pheromone that may help to make it more specific, but the compound is not very stable. Gary Daterman does not recommend incorporating this compound into the current formulation.

On the subject of risk rating for DFTM: John Wenz pointed out that we have many susceptible stands, but relatively few historical outbreak areas. Many areas are "susceptible" that don't get outbreaks. Because there is so much host type, Region 5 puts traps out only where outbreaks have occurred in the past, but the last two outbreaks in Region 5 occurred in areas with no previous outbreak history.

Region 3- Jill Wilson

In Arizona, pheromone trapping has been conducted using the Early Warning detection protocols since 1992. They are currently maintaining 55 traps on 11 sites in 5 different areas. Traps have been placed in areas where DFTM outbreaks have occurred in the past as well as in areas where there is host type but no recorded outbreak history. Sites have been added when DFTM defoliation has been observed in an area where previously it was not recorded. This level of trapping has proved to be relatively inexpensive to maintain and yet provides an indication of potential change in population status. In New Mexico, DFTM seems to be primarily an urban problem, and no trapping has been conducted there in recent years.

In 1997, trap catches at all Arizona sites averaged less than 40 moths per trap. Populations are rising in the Pinal Mountains, and may also be rising in the nearby Sierra Ancha Mountains. Both are historical outbreak areas. Population levels are declining in the Pinaleno mountains. This area does not have a history of outbreaks, but trapping sites were added in 1995 after defoliation was discovered there in 1994. DFTM populations in Arizona appear to be rising and falling in unison within each mountain range, but between mountain ranges changes seem to occur independently of one another. In New Mexico, 1997 defoliation was observed in and around a number of urban areas.

Region 4 - Julie Weatherby

Southern Idaho experienced a large (400,000 acres) DFTM outbreak from 1990-1992. The outbreak was more widespread than the original trapping area, and 78 trap sites were added to the original 20 from 1991-1995. The additional trap sites covered the portion of the outbreak area that did not have a history of outbreaks, and included some subalpine fir habitat types.

DFB killed lots of extra trees following defoliation. DFB had a circular expanding pattern of mortality. Bark beetles were found in trees that were moderately defoliated. Totally defoliated trees did not appear to be attractive to the DFB. The DFB outbreak started subsiding significantly in 1996. Gary Daterman warned that one must be careful ascribing cause and effect with DFTM defoliation and bark beetle attack. Bark beetle populations have been high and mortality would have occurred anyway. The defoliation is, however, related to coalescence of the larger spots of bark beetle mortality.

The Dewey Peak site in the Owyhee Mountains had defoliation that was visible only from the ground in 1997, and has had high trap catches for the past 3 years. There also have been increased catches on the Payette National Forest on the western edge of southern Idaho.

Utah put out about 90 traps -- haven't heard anything about them. Julie's hazard rating for DFTM is in the 1996 Steele et al. publication.

Region 5 - John Wenz

Region 5 has monitored 120 EWS plots annually since 1980. The Regional EWS database was in Lotus 1,2,3 but may be in Excel now. They plan to convert the database to Oracle. Most plots are maintained by various cooperators, Bureau of Land Management, State, and Forest Service Districts. They have been looking at the database for effectiveness in predicting outbreaks.

Some DFTM populations cycle in California but never reach outbreak levels on a large scale. In 1971, several areas in the southern Sierras reported small spots of defoliation (several hundred acres each) lasting 1 year. There have been no other reports of tussock moth from this area, and no past outbreak history. There was an outbreak in 1987-1989 in northern California on a Forest that was not participating in the Early Warning System. Trap catches increased in the regularly monitored areas 2 years prior to aerially visible defoliation in the outbreak area. The outbreak was followed by an 8-10 year interval of low trap catches. Trap catches increased again in 1995 and 1996, then declined in 1997. Currently there is a pending outbreak in the Sequoia/Kings Canyon area which was detected from the ground in 1997. Like the 1987-1989 outbreak area, this area is outside of the regularly trapped area, but because of the overall EWS trap catch increase, John put out an alert and field staff noticed the defoliation. These populations may be in the pre-release phase in some areas, if so, they may reach outbreak levels in 1998-2000.

Region 6 - Don Scott

The last DFTM outbreak in Oregon occurred in the Blue Mountains during 1989-94. Several areas in the Blue Mountains were affected, including portions of the Pine Ranger District on the Wallowa Whitman National Forest, and the Bear Valley and Burns Ranger Districts on the Malheur National Forest.

The 1989-91 outbreak on the Pine Ranger District was treated with B.t. in 1991. Budworm was also present and causing defoliation at the same locations as DFTM during this period. EWS trap catches in this area were very low from 1992-95, but showed an increasing trend in 1996-97. Trap catches on the nearby Payette National Forest followed this same chronological pattern. We may see some defoliation this year. Don is planning to do lower crown sampling on the Pine District this summer, and Torgy Torgerson plans to sample Dick Mason's lower crown beating permanent plots.

Outbreaks occurring on the Bear Valley and Burns Ranger Districts in 1989-94 were not treated to suppress population levels. The locations of Bear Valley Ranger District EWS plots with higher trap catches in 1996-97 coincided with the area of the 1989-91 outbreak. On the Burns Ranger District, trap catch increases during the last outbreak cycle lagged a year or two behind the Pine and Bear Valley Ranger Districts. The outbreak on the Burns District occurred from 1991-94. John Wenz also noticed some asynchrony in the last northern California outbreaks, some occurred during 1986-88, others occurred during 1987-89.

The Burns Ranger District areas of increasing trap catches are the same as the areas of major outbreak in 1963 and 1964 (King Mountain and Gold Hill) that were treated with DDT. The Burns Ranger District added a lot of extra plots (larval beating and pheromone?) during the 1991-94 outbreak.

Pheromone trap catches dropped as the outbreak progressed. Although larval beating counts remained high, trap catches went down. The reason for this was due to high numbers of DFTM females emitting pheromone during the outbreak. We cannot outcompete the females with our synthetic pheromone. The synthetic pheromone used in the EWS traps has a low volatility, which gives it greater persistence, but it is not as strong as the pheromone emitted by the females. After mating, DFTM females stop producing pheromone, but a residual amount remains. Female DFTM sometimes mate more than once and remain attractive for a while after mating. In high density populations, traps are less effective due to the number of female tussock moths present on or near the pheromone trapping plots; the end result is a drop in the trap catches. Trap catches on the Burns Ranger District were low in 1997.

Mares Egg Spring is a site in Oregon that has chronic high DFTM trap catches.

The DFTM database for all ownerships in Washington and Oregon is maintained by R6 Regional Office personnel. Each State also keeps track of it's own data. The Regional Office database is in Paradox and Excel. Traps are employed by various federal, state, and private cooperators.

State of Washington - WDNR - Karen Ripley

A core set of plots have been monitored since 1981. Numerous plot additions and subtractions outside of the core set have occurred during that time. Champion International is a cooperator south of Mt. Adams. Hot spots include the Yacht Club plot at Lake Chelan, which averaged 43 moths this year, and Grayback Mountain, which averaged 22 moths/trap. The State hires a trapper to hang all of their traps each summer. Red McComb has done this in previous years, this year Bob Backman will be doing the trapping.

State of Oregon, Oregon Department of Forestry - Dave Overhulser

The State of Oregon has 53 active plots in the East Central Oregon, Klamath Lake, and Northeastern Oregon Areas. The last couple of years they have had reports from landowners (ranchers in northeast Oregon) of DFTM in blue spruce. Trap catches have been low the past two years. Private landowners are practicing active silviculture, resulting in mass conversion of their lands from fir to pine type. This may be affecting trap catches.

Canada - Imre Otvos

After the 1984 DFTM outbreak, the Provinces took over responsibility for forest insect and disease surveys; these surveys previously were conducted by the federal government. The transition has been somewhat uneven , and little reporting has been done since the 1984 outbreak. A DFTM outbreak occurred in British Columbia from 1990-1993. There appears to be a 9-13 year interval between outbreaks.

Since 1990, they have used Roy Shepherd's system of monitoring: after 3 consecutive years of higher moth catches in pheromone traps, additional traps are put out. Traps are employed on a one kilometer grid design, but this ideal is not always attained. Expected damage is predicted using sequential sampling of egg masses. If low to moderate damage is predicted, they apply the virus as an aerial spray. The virus was applied in 1990-1993. Some areas with DFTM populations missed inclusion in the trapping grid and were not treated. These areas experienced moderate defoliation, which seemed to confirm the efficacy of the treatment program. Some areas had high trap catches for 3 years but no outbreak developed. They are not sure what is happening there. Perhaps those stands can withstand higher levels of defoliation.

Imre is hoping to develop a virus detection kit that will work in 2 stages. 1) General - indicate whether any insect has NPV (non-species specific). 2) Species specific - indicate whether a specific insect, e.g. DFTM, has it's species specific NPV. Do we (meeting attendees) feel this would be a useful thing to have?
ACTION ITEM: Send a letter of support to Imre, for the granting agency wants to know of support before proceeding with financial approval.

Graduate student work on the correlation between parasitism and age of outbreak found no positive correlation. Imre still feels that the virus is the most important factor ending outbreaks. Dick Reardon noted that it was difficult to find gypsy moth (GM) without virus. This doesn't seem to be the case with the DFTM. Some outbreaks have collapsed with no sign of the virus. There is a remarkable difference in potency between GM and DFTM virus. The DFTM virus is more virulent. There are areas with no apparent DFTM virus. The virus must be present at a certain level to cause outbreak collapse. Two cycles of the virus can occur in one generation of DFTM due to the long larval feeding period.

Gary Daterman described the trap pheromone strength differences between the U.S. and Canada. Roy Shephard uses a magnitude of one stronger pheromone in Canada. Pherotech is now providing 0.001% by wt DFTM pheromone for US, and 0.01% by wt DFTM pheromone for Canada. British Columbia is the northern limit of the DFTM host range. The host foliage complement in British Columbia is more sparse, and a lower population of DFTM may cause more damage. Canada has 3 years of higher trap catches before an outbreak occurs, but they use a stronger lure. The US has 2 years warning.

Canadians used pest occurrence overlays and geoclimatic zones to decide where to put their traps They trap only in stands where outbreaks have occurred in the past. They are concentrating on a smaller geographic area than R6.

Report on status of R6 EWS evaluation - Kathy Sheehan, Region 6

Region 6 experienced difficulty in cleaning up and preparing the 1980's DFTM EWS database for analysis using current software programs. In a preliminary analysis of the data, Kathy divided Oregon and Washington into 8 "ecological subdivisions" (Bailey's ecoregions might be another possible way to subdivide the region). She looked for patterns and relationships between number of plots each year, the number of plots with one or more moths per trap, and the percentage of plots with one or more moths per trap.

The average catch by "ecological subdivision" rarely reached 25 moths per trap, and the number of plots trapped each year varied widely. We probably should not lump data across such a large area. Data analysis is complicated by the DFTM monitoring strategy of adding traps to areas with high trap catches during population level trend increase. Other confounding factors are concurrent budworm activity (perhaps budworm, by feeding earlier, removes some of the food critical to DFTM) and possibly budworm treatment areas. We need to analyze the data for smaller areas and overlay DFTM history. We also could randomly subsample the database using the computer to see if 1, 2, 3, or 4 traps per plot would give us the same information as 5 traps per plot.

John Wenz: The reason for the variability of trap catches between plots is not known. We need to be able to distinguish plot location differences to explain variation and whether it is relevant or not.
Gary Daterman: His group did a plot location design study one season, looking at number of traps per plot. Evaluation of the SE about the mean suggested that 21 or 22 traps at each location were necessary to get 80% precision. Five through 18 traps per plot had approximately the same variation, so they chose to go with 5 traps per plot. Precision with 5 traps per plot is down to around 33%.

Don Scott: How do we advise cooperators on relocating plots? How far does a plot have to be moved before it is considered "new"?
Gary Daterman: The traps attract males 3' to 6' away. Male moths move around, so you are sampling a greater radius than that, perhaps 1/2 mile. The traps are good for 1/4 to

1/2 mile. Relocate plots to nearby areas with similar site and stand characteristics. Discontinue the old plot name and number and treat as a new plot if the new location is more than 1/2 mile from the original location.

Review of EWS

The original purpose of the EWS was to provide an alert for increasing DFTM population levels. Trap catch thresholds were established to serve as triggers for additional, more intensive sampling that more accurately describe the spatial distribution of outbreaking populations.

Question: Does the EWS work, and is it being used effectively?

John Wenz (California): Yes. During the last outbreak, 1987-89, the EWS was applied and used effectively in Region 5. He sees 2 years of elevated pheromone trap numbers before an outbreak.

Ladd Livingston (Idaho): Yes. The EWS provided the advance warning needed in northern Idaho during the last outbreak.

Don Scott (Oregon): Yes. He agreed that EWS is working the way it's supposed to -- high trap catches are followed by lower crown beating, pupal sampling in the fall or the next spring, then treatment, if desired.

Bruce Hostetler (Oregon): Yes. EWS works for it's intended purpose. In 1990, fall pupal sampling was done in response to high pheromone trap catches on the Pine Ranger District, Wallowa Whitman National Forest. The pupal sampling covered a huge area; plot density was about one per mile. Bruce threw out 55,000 acres from proposed treatment areas in the spring of 1991 (the year of treatment with B.t.). The population collapsed in unsprayed areas as well as in the treated areas. A better approach would be to get from the Forest where the key host and areas to protect are located, and to concentrate the sampling there.

Julie Weatherby (southern Idaho and Utah): Maybe. She's not sure that it is working as an early warning. Her report of the 1990-92 DFTM outbreak in Idaho (p.4) shows that the pheromone traps tracked defoliation, but did not provide advance warning of defoliation. This is not happening in other regions, however. Did the bait change during those years?

Gary Daterman: Treatment of lures affects the effectiveness of traps. Shipping and handling may affect effectiveness. Timing is also important -- when the traps are first put out, baits are hot, and you may get an unusually high catch. You can get a "flash" response if adult flight is already in progress when the traps are put out. In the USA, the development of the EWS pheromone bait strength and capture was done in California,

Oregon, and Idaho. But this work was not done simultaneously in exactly the same way as Shepherd's work.

DFTM Sampling

Sampling Methods

The meaning of trap catches

Pheromone trap information appears to be most meaningful in terms of indicating trends. Absolute numbers and thresholds are not as meaningful as the proportion of traps that change from year to year. Gary Daterman suggested that we may want to adjust the trap catch action thresholds by area. The Early Warning System first selected 25 moths per trap as the threshold for more intensive sampling, then later increased it to 40 moths per trap. It is important to note that the traps become saturated once you catch more than 50 moths per trap

Alternative trap array

John Wenz, Lonnie Sower, and Julie Weatherby have experimented in Idaho and California with setting out lines of plots containing a single trap per plot as compared to the standard cluster of 5 traps per plot. Single traps were placed every 1/4 mile for 2 miles, resulting in lines of 15 traps repeated at 2 mile intervals. This design may allow you to cover a larger area with smaller numbers of traps, but we don't really know how it compares to the standard clustered trap array. We still don't understand the reasons for the geographic variation in trap catches, e.g. Colorado. Pherotech now produces our DFTM pheromone trap lures.

Cryptic shelters

Cryptic shelter data and lower crown beating data have been consistent with trap catches in northern California on plots where both methods were employed. On each EWS plot, John Wenz employs a series of cryptic shelters and does lower crown beating in addition to the pheromone traps.

In Idaho, Ladd Livingston also has plots with lower crown beating, pupal surveys, and cryptic shelter information. He found that lower crown beating data were correlated with pheromone trap catches. He had zero catch in the cryptic shelters.

We get information on parasitization rates from egg mass sampling. With lower crown beating, we get defoliation prediction and larval survival. With cryptic shelters, we get pupal densities and parasitism rates, followed by egg mass densities for following year.

Cryptic shelters are not a substitute for EWS pheromone trapping.

Sampling to predict population distribution and density

John Wenz: The current pending outbreak in northern California could affect 20,000-25000 acres. He asked the Forests to identify key areas to protect (e.g. high use administrative areas, wildlife areas such as California spotted owl nesting sites (58 areas). He then sampled only those key areas for egg masses, using Roy Shepherd's sequential egg mass sampling scheme (developed for Canada), and the standard foliage based (1000 m^2) egg mass sampling design. This year, John will follow through with egg mass sampling, and plans also to do larval sampling. Sampling is a problem area, though. Shepherd's sequential egg mass sampling scheme needs to be calibrated for other forest types and methodology needs to be developed for sampling on a larger land base than where the traps are set (landscape or larger land areas). There is also the issue of egg mass distribution, especially through the progression of an outbreak. We still don't have predictive techniques for outbreaks.

Bruce Hostetler, Dick Mason, and Don Scott developed a cocoon sampling strategy during the last (1989-91) outbreak in northeastern Oregon. The pattern of egg mass distribution is unclear -- it varies throughout the outbreak and we don't know what it means. A park in northeastern Oregon is considering spraying individual trees from the ground with B.t. to protect them from DFTM defoliation. People on the ground are noticing DFTM in places where traps are not located.

There remains some question about how much warning time we have between trap catch increases and defoliation, is it 1 year or 2 years?

Egg mass sampling is so variable, it's difficult to do accurate, statistically valid work -- it's quite expensive and time consuming. Early on, we compared results from Dick Mason's larval beating plots to pheromone trap plots, and found a high correlation between the two. We were not able to predict an outbreak though. There is a far greater sampling error associated with larval sampling than with pheromone traps. Region 6 plans to look again at the correlation between the EWS plots and Dick Mason's larval beating plots.

It's a good idea to document the impacts of DFTM outbreaks on non-treated areas. Such documentation will be useful for future evaluation of potential effects of DFTM outbreaks.

Other data collected on Early Warning System plots.

Nancy Sturdevant (Montana and northern Idaho) has been tracking western spruce budworm using WSB pheromone traps on DFTM plots for several years. Bill Schaupp (Region 2) collected some site and stand information on EWS plots in 1994 during the last Colorado outbreak.

Forest Health Monitoring (FHM) and DFTM - *Is there a link between Forest Health Monitoring (the program) and DFTM monitoring?*

Karen Ripley: the Washington Department of Natural Resources is spending FHM off-plot money to do DFTM EWS trapping this year. Co-locating EWS trapping onto FHM plots is not recommended, because of the potential for trampling on the FHM plots. If we can find efficiencies in reporting though, that would be desirable, such as including DFTM analyses in the FHM reporting system. It may be more important for FHM to track DFTM defoliation and impact, than to use EWS information. We could do post-outbreak retrospective analyses, ie. get stand information and backdate. We might actually show an improvement in forest conditions following DFTM outbreaks. A possible effect of global warming may be that DFTM outbreaks will occur in areas different than where they previously occurred. DFTM monitoring can be used to test the sensitivity of the FHM plots.

Bill Schaupp: Do we get outbreaks along the Colorado Front Range now because of air quality problems? As it stands right now, EWS has a place in FHM off-plot monitoring.

Ladd Livingston expressed an insect and disease reporting concern. In Idaho, the Forest Health Monitoring Report has replaced the Regional Annual Conditions report, and much of the detailed, historically-reported information has been omitted or lost in the sleeker summary format of the FHM publication. So much emphasis is put on on-plot conditions, that other historically reported I&D incidences are not being included.
ACTION ITEM - request that the Regional Annual Conditions reports be continued.

Report on the DFTM model - Kathy Sheehan, Region 6

The DFTM model evaluation compared FVS stand growth simulations run with and without defoliation models. Two defoliation models were used: 1) the DFTM defoliation model and 2) a DFTM adaptation of the WSB defoliation model, in which the WSB defoliation model was used to simulate DFTM defoliation by using a "converted" version of Boyd Wickman's DFTM defoliation dataset. Neither defoliation model worked satisfactorily. The DFTM model did a good job predicting populations on a midcrown branch, but had a poor linkage to the rest of the tree and the stand. The WSB model under-predicted mortality. The WSB model was developed at the end of an outbreak, and most of the growth and mortality data came from low and moderately defoliated areas. The next step is to either use Boyd's data to develop linkages that will improve the performance of the WSB model, or to translate Boyd's data into mortality keywords for FVS. A big pay-off is possible with little effort.
ACTION ITEM Kathy Sheehan will draft a letter recommending development of a better DFTM model to the FHTET director.

DFTM virus

There are two known strains of the naturally occurring, native DFTM virus: single (SV) and multiple (MV) occluded strains. The single occluded strain is found in the more southerly areas, and the multiple occluded strain is more virulent.

The virus should be applied to second instar larvae. You can get some defoliation in the year of application, especially if population levels are such that defoliation is predicted to be moderate to severe. No one yet has managed to detect DFTM populations at low levels and treat with the virus. The year to apply the virus would be the year that defoliation would first occur. The ideal scenario would be to spray the virus on an area with high population levels in a pre-release year, then follow up in the fall with mating disruption.

Imre Otvos: The non-diapausing Goose Lake strain (lab-reared DFTM population used to make TM-Biocontrol) is in the 33rd generation. Four companies produced 10 lots of TM-Biocontrol over a period of 11 years, and presumably the lots were all stored under the same conditions. This is a good time to look at the efficacy of TM-Biocontrol. Is each company's product consistent? We need to check efficacy against wild strains. What is the PIBS/hectare effective dose? *Note*: the lab non-diapausing strain appears to be far more susceptible to TM-Biocontrol than wild populations. We need to bioassay lots by company and also to bioassay wild populations. Send Imre several lots of egg masses to test. If one egg mass contains about 150 eggs, he'll need 10 egg masses, minimum. ACTION ITEM: Imre will test TM-Biocontrol efficacy on the Goose Lake strain, and on wild strains from British Columbia, Region 1, Region 4, and Region 6.

TM-Biocontrol is stored in Corvallis, Oregon, in a walk-in freezer. The virus has been freeze-dried and placed in vacuum-sealed packets in 200-acre doses. The physical plant person has the key; currently there is no virologist or technician overseeing the supply. Region 6 pays the annual $2,500 storage bill. The only recent withdrawal was by Sandy Kegley (Region 1 entomologist) who used it successfully to treat spruce trees in a Forest Service nursery near Coeur d'Alene, Idaho.

A field trial of TM-Biocontrol conducted by Roy Beckwith and Milt Steltzer in Idaho in 1991 failed to show any treatment effects.

Jack Stein is handling the reregistration of TM-Biocontrol and Gypcheck, and has been working on drafts of the labels. He plans to submit the labels for reregistration in June, 1998. The EPA wants toxicology studies, because registration requirements have changed since the last registration They will accept toxicology data from either Gypcheck or TM-Biocontrol. The studies will be paid for by FHTET. The cost of TM-Biocontrol is the same as B.t., around $5 per acre. Gypcheck is around $10 per acre. If homeowners want to spray TM-Biocontrol in British Columbia, the Province provides the material and the homeowners pay for the helicopter. VIRTUS is the Canadian version of TM-Biocontrol. It is produced using lab populations of the white-marked tussock moth. NOVO Labs has

produced a commercial Gypcheck carrier mix of molasses, sticker, and sunscreen. Some doubt that molasses will work in the arid mountainous west. Abbott Labs offers a product called NOVO-038 carrier. FHTET has tried NOVO-038 in both humid and arid (New Mexico) areas.

Given that Imre's bioassays of TM-Biocontrol show good efficacy in wild populations, where and when can we field test? Possibilities may exist in California and Idaho in 1999. It would be best to also have population and defoliation estimates.

It would also be good to further test the NOVO-038 carrier. Dick Reardon can provide the material and protocol for a field trial.
ACTION ITEM: Karen Ripley will talk to Champion International about conducting a field trial for NOVO-038 carrier in Washington during their western spruce budworm spray project this year.

Mating Disruption

Several studies on the efficacy of using a formulation of the pheromone for mating disruption have been done in Canada. Mike Hulme et al. are doing work on mating disruption and recently conducted a successful field trial. The problem is that the pheromone is not registered yet. What is the priority for getting it registered? The timing is good now for registering the mating disruption pheromone with EPA. Meeting attendees showed interest in getting it registered.
ACTION ITEM Dick Reardon will ask EPA what would be involved in getting the technical product registered, and will check out how much it will cost.

Mating disruption is more efficacious at lower DFTM population densities, but there is at least one test where it worked well at high population densities.. We don't know whether it will work alone or must be combined with other treatments such as the virus.

Western Defoliator Steering Committee discussion

The Western Defoliator Steering Committee was originally set up as an aerial spray working group. It then became chartered to give input to Special Technical Development Program (STDP) project proposal rankings. Jack Barry led the committee until Sherry Smith and Julie Weatherby became the co-chairs. The recent reorganization of the STDP process at the national level did away with the chartered steering committees and their input into the proposal selection process. Julie Weatherby wanted to know whether the Western Defoliator Steering Committee should disband. If there was reason to continue, then she felt it was time for someone else to chair the committee. Most of those present felt that it was important to maintain an interest group for defoliators in the West, and that the attendees at this meeting (as well as others who were unable to attend or who had an interest) formed the core membership of an ad hoc western defoliator group. We decided

to continue meeting periodically, as well as on an as-needed basis. We also decided to change the name “Western Defoliator Steering Committee” to “Western North American Defoliator Working Group”. John Wenz and Nancy Sturdevant agreed to co-chair the group.

LIST OF ATTENDEES

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