

# **Methow Valley Ranger District Douglas-fir Tussock Moth Suppression Project, 2010 Final Report of 2011 Followup Monitoring**

The Douglas-fir tussock moth (*Orgyia pseudotsugata*) is a major defoliator of Douglas-fir and true firs. Its populations are cyclic, and during its periodic outbreaks it can cause substantial damage. In 2010 the Methow Valley Ranger District controlled a building outbreak by aerially spraying high-value infested sites with the biological insecticide TM-BioControl1, a naturally-occurring virus of the tussock moth. This report documents monitoring of that control effort.

## *Population Viability Determination*

Extensive cocoon and egg mass sampling was conducted in October, 2009 to predict 2010 DFTM larval densities. Sampling was conducted in areas of concern identified in the Douglas-fir Tussock Moth Final Environmental Impact Statement (2000). The blocks that were treated for DFTM control in 2001 were used to identify sampling areas. Fortunately, shapefiles for the 2001 treatment blocks were still available on the Forest. Additional sampling was conducted outside EIS areas of concern to identify sites that could be used to compare the effects of treatment with non-treatment.

A total of 288 blocks were surveyed, of which 104 had sufficient numbers of cocoons and egg masses to indicate suboutbreak or outbreak populations of DFTM. Sampling protocol can be found in the Project Entomology Plan. Based on fall cocoon and egg mass samples, sub-outbreak populations were predicted in five Analysis Units (AUs): Mazama, Lucky Jim, Eightmile, Cub Creek, and portions of Twisp River. Mazama, Lucky Jim, Eightmile and Twisp River were identified as areas of concern in the EIS. Cub Creek was not an area of concern, but was used as a control area for monitoring.

Egg masses were collected from sampled areas so the natural level of virus and parasitism could be determined. A natural virus level greater than 25% indicates a population that is already about to collapse from an epizootic, so direct control is not necessary (DFTM Handbook 548). A total of 67 egg masses were collected, from which 2,807 eggs were extracted for rearing. Egg extraction was done by Roy Magelssen at the Wenatchee Forestry Sciences Lab in Wenatchee. Rearing was done at the Washington State Department of Natural Resources (WA DNR) facility in Olympia with the help of WA DNR entomologist Glenn Kohler. The assay was completed in late March, 2010. Percent hatch averaged 82%, and virus level averaged 0.5%. Parasitism was about 1%. Overall the populations appeared healthy, and direct control for foliage protection was indicated.

## *Methods*

In order to compare the effects of treatment with no treatment, evaluation plots were established in both treatment and control blocks. Every block that contained an evaluation plots initially qualified as "suboutbreak", with a calculated larval density between two and 20 per 1,000 square inches of midcrown foliage. Each evaluation plot consisted of 20 trees. The first five trees were sampled for larval population. All 20 trees were observed for defoliation and placed in one of seven defoliation categories ranging from "no visible defoliation" to ">90% defoliated". These plots were sampled immediately before treatment. They will be sampled again 20 to 23 days after treatment, again 34 to 36 days after treatment, and again in June of 2011, to

determine if the spray had the desired long-term effect. In the case of control blocks, the first sample was taken at the time when spraying would have occurred.

Twenty-six evaluation plots were established in treatment blocks: 16 in Mazama, three in Eightmile, two in Lucky Jim, and five in Twisp River. Twenty-six evaluation plots were established in control blocks: eight in Lost River, six in Cub Creek, 11 in Twisp River, and one near Lucky Jim on land managed by Washington State Department of Natural Resources. All of these blocks had larval densities at suboutbreak or greater according to larval density plot averages, but nine individual evaluation plots had calculated densities below suboutbreak. Three evaluation plots had calculated densities at outbreak level.

Walking routes to the evaluation plots were clearly flagged. These routes were used by ground observers to access treatment blocks for weather observation during spray days. In the future, entomology crews should flag walking routes into every treatment block, whether or not an evaluation plot is established, to facilitate access for ground observers.

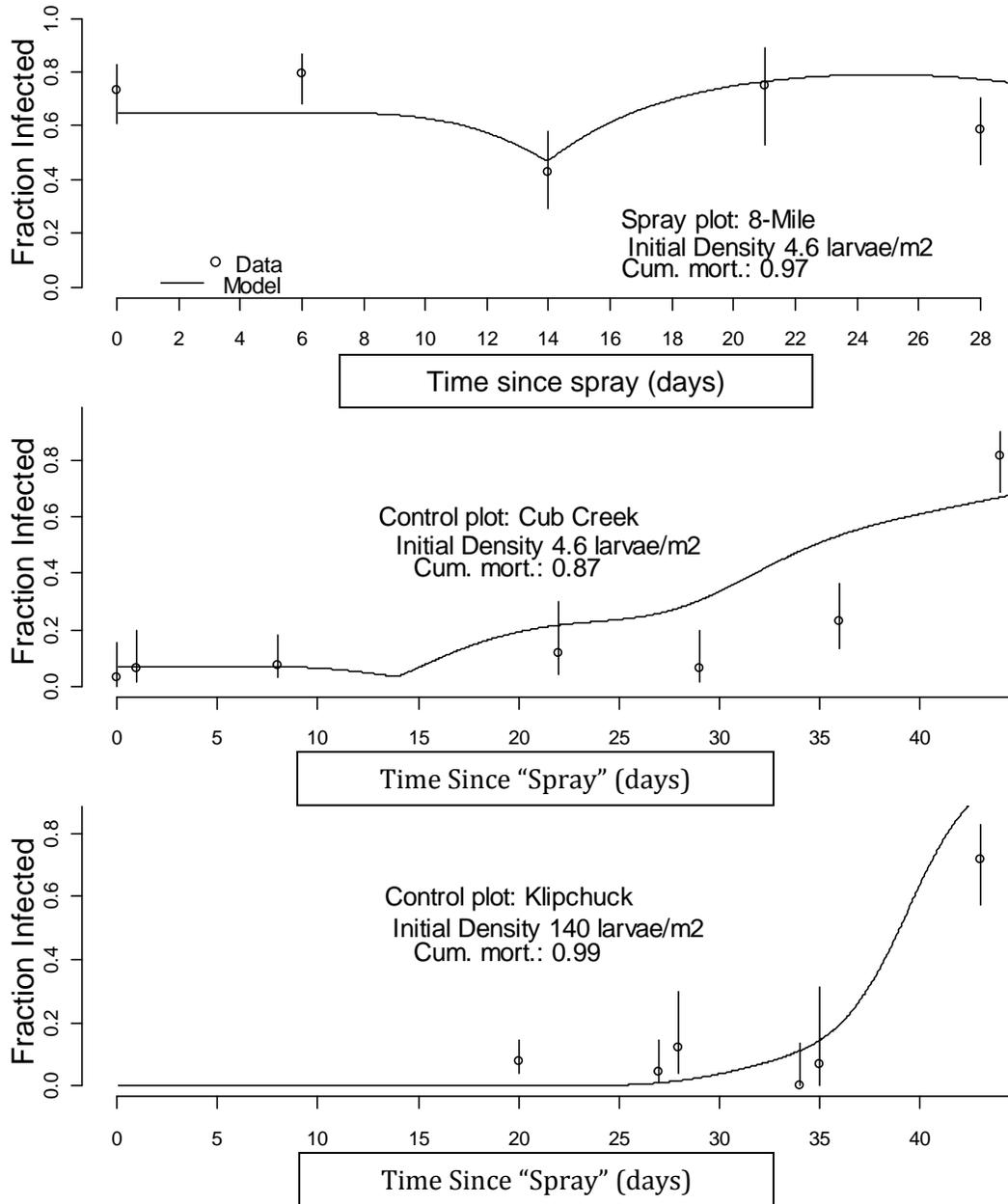
#### *Field Sampling Preliminary Results (2010)*

Three weeks after initial sampling, each evaluation plot was revisited to calculate larval density and estimate defoliation. By this time, DFTM populations appeared greatly reduced in both control and treated plots. Four of the control plots and one of the treated plots still had suboutbreak populations. All of the rest were low. Defoliation of 10 to 20 percent was noted in four of the control plots and four of the treated plots. Most defoliation was caused by western spruce budworm, which has been present at outbreak level on the District since 2004.

#### *Laboratory Rearing (2010)*

Approximately 30 DFTM larvae were collected from one treatment block (Eightmile), and 30 from each of two control blocks (Cub Creek and Klipchuck), beginning the day after treatment in Eightmile, the day that treatment would have occurred in Cub Creek, and 20 days after spray would have occurred in Klipchuck. Follow-up collections were made at one-week intervals: five in Eightmile, five in Cub Creek and four in Klipchuck, for a total of 150 larvae from Eightmile, 150 from Cub Creek, and 120 from Klipchuck. The larvae were reared at the Forestry Sciences Laboratory in Wenatchee, Washington until they either died or pupated. Dates of pupation or death were recorded. Cause of death and instar at the time of death were documented.

Larvae from Eightmile had a high initial rate of virus infection (65%). By day 28 field collections in Eightmile were no longer practical because live larvae had become scarce. Larvae from Cub Creek had an initial virus rate of 7%. Klipchuck larvae had about 10% at the time of first collection. Larvae from Cub Creek and Klipchuck continued to show low levels of virus infection until about day 40, when a virus epizootic was detected in the field collected populations. Cumulative mortality predictions for all three areas were 95%, 87% and 99%, respectively (Figure 1). Cumulative mortality was similar in all areas because the spray in Eightmile killed most larvae early, when larvae were smaller, whereas in the controls, a slower increase in infection led to high infection among large later instars, leading to very high infection near the end of the larval season.



**Figure 1.** Graph shows the fit of a mechanistic model of nucleopolyhedrovirus spread in DFTM (Elkinton et al 1995) to data from 2010. The good fit of the model to the data suggests that differences in initial infection rates and initial densities are sufficient to explain the differences in the mortality between plots. Initial virus infection, whether spray or natural, occurs shortly after hatch, so the later dip in infection rate occurs because, after the initially infected larvae die of the virus, it takes some time before additional infections occur. “Cum. mort.” is the model prediction of cumulative mortality over the whole season. The model suggests that cumulative mortality was similar in control plots and spray plots, and the good fit of the model to the data lends credence to this prediction.

## *Final Results (2011)*

All evaluation plots were revisited in July 2011. DFTM larval density and defoliation were recorded using the same protocol used in 2010. Because western spruce budworm larvae have caused measurable defoliation on most evaluation plots, these larvae were also recorded.

Ten control blocks and 18 treatment blocks had little or no defoliation visible. Fifteen control blocks and six treatment blocks had 10 to 20 percent defoliation recorded. One control block (Cub Creek 10) and one treatment block (Eightmile 16) had 25 to 45 percent defoliation. Most of the defoliation was caused by western spruce budworm. The only place where DFTM larvae were observed was in Little Bridge Creek, where a total of two caterpillars were recorded during larval sampling.

## *Discussion*

The 2010 DFTM spray project on the Methow Valley Ranger District met the objective of preventing DFTM defoliation in treated areas. Larvae collected from the Eightmile treatment area showed 65% virus infection 24 hours after spray. Few larvae reached the 4<sup>th</sup> instar and very few reached the 5<sup>th</sup>, the stage in which they cause the most damage. The DFTM population collapsed in all treatment areas, and no larvae were found in treatment areas during surveys in 2011.

Larvae in untreated areas were evident through the 4<sup>th</sup> instar. However, a virus epizootic caused the population to collapse as they reached the 5<sup>th</sup> instar. Defoliation was light in untreated areas, and larvae were very scarce during surveys in 2011.

Results of the 2010 spray project suggest two questions that need further investigation:

1. It appears that the virus level of 0.5% observed in laboratory-reared eggs was sufficient to cause an epizootic that resulted in population collapse. What is the initial infection rate that can produce a natural epizootic in the current year?
2. Prior to spray, most blocks had calculated larval densities of two to 20 per 1,000 square inches of mid-crown foliage. These numbers did not cause damaging defoliation in any block. What larval density would justify a spray project in order to prevent damaging defoliation in the current year?

## *References*

Elkinton, J.S., Dwyer, G., Sharov, A. 1995. Modeling the epizootiology of gypsy moth nuclear polyhedrosis virus. *Computers and Electronics in Agriculture*. 13:91-102.