Douglas-Fir Tussock Moth

Orgyia pseudotsugata (McDonnough)
Lepidoptera: Lymantriidae

Mason, R. R.; Overton, W. S. 1983. Predicting size and change in nonoutbreak populations of the Douglas-fir tussock moth (Lepidoptera: Lymantriidae). Environmental Entomology 12: 799-803.

Objective: To predict future population trends of *O. pseudotsugata* populations from larval densities currently in a nonoutbreak phase.

Abstract: Douglas-fir tussock moth, *Orgyia pseudotsugata* (McDonnough), is a periodic defoliator of Douglas-fir, *Pseudotsuga menziesii* (Mirb.), and true firs, *Abies* spp., in western North America. Outbreaks occur quite unexpectedly every 7–10 years and usually persist for 3–4 years. Large numbers of trees are often defoliated before direct control measures can be applied. Defoliation by *O. pseudotsugata* can be severe and cause tree mortality during the first year of an outbreak, and surviving trees often exhibit growth loss and top kill.

Data collected from 11 generations of *O. pseudotsugata* from four widely separated populations in western USA were used to develop equations for predicting changes in nonoutbreak populations. The density of larvae surviving to late instars (X) in a given generation was a good predictor of the early larval density in the subsequent generation (Y), expressed as $\log Y = 0.950 + 0.963 \log X$ ($r^2 = 0.85$). Furthermore, densities of early and late instars can be used to detect increasing population densities in advance of an actual outbreak. High densities of surviving larvae are necessary for population increase in *O. pseudotsugata*, but population decline may be related to mortality in a different life stage than larvae. Overall, these procedures provide valuable information needed for management decisions with time to plan control operations in advance.

Sampling Procedure: Initiate sampling of early larvae (instars 1 and 2) when the density *O. pseudotsugata* appears to be approaching an outbreak phase but still fewer than 20 early larvae are present per 0.65 m^2 of branch foliage. Sample larvae in midcrown foliage using the methods of Mason (1970, 1977, 1979). Express larval densities as the mean number of larvae per 0.65 m^2 of branch foliage. Sample lower crown foliage if densities are below 1 larva per 0.65 m^2 of branch foliage. Return to plots and sample late larvae (instars 5 and 6) when present.

Use the following equation to predict the general population density of early instars in the subsequent generation:

$$\log Y = 0.950 + 0.963 \log X$$

where Y = the density of early instars in a given generation and X = the density of late instars in the previous generation.

Use the following equation to predict changes in the size of the subsequent generation:

$$Y = -0.214 + 13.825X$$

where Y = the trend index (I) and X = larval survival (S), or the proportion of larvae in a single generation surviving to late instars. The trend index, I, is the ratio of early instar densities in two successive generations ($I = N_{t+1}/N_t$ where N_t = the density of early instars in a given generation and N_{t+1} = the density of surviving late instars in the following generation). Populations are classified as increasing when I >1.0, but this regression model does not adequately represent declining populations where I <1.0.

Larval survival (S) is defined as $S = N_s/ N_t$, where N_s = the density of surviving late instars in the same generation as N_t. Larval survival can be used to detect declining or static populations not represented by the trend index in the above model. A larval survival rate of >0.2 generally signals a rapidly increasing population whereas a rate of <0.2 indicates that the population will remain static or decline.

Notes: These procedures were developed from data collected from low-density populations of *O. pseudotsugata* that had not erupted into an outbreak recently or were only in the very beginning of an outbreak phase. The equations may not be valid for larval densities during an outbreak or in a post-outbreak decline.

References:

* Mason, R. R. 1970. Development of sampling methods for the Douglas-fir tussock moth, *Hemerocampa pseudotsugata* (Lepidoptera: Lymantriidae). Canadian Entomologist 102: 836-845.

* Mason, R. R. 1977. Sampling low-density populations of the Douglas-fir tussock moth by frequency of occurrence in the lower tree crown. Res. Pap. PNW-216. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station; 8 p.

* Mason, R. R. 1979. How to sample Douglas-fir tussock moth larvae. Agric. Handb. 547. Washington, D.C.: U.S. Department of Agriculture, Forest Service; 15 p.