Douglas-Fir Tussock Moth

Orgyia pseudotsugata (McDunnough)
Lepidoptera: Lymantriidae

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.

Objective: To develop a practical sampling plan for estimating very low densities of *O. pseudotsugata*.

Abstract: The Douglas-fir tussock moth is a major defoliator of Douglas-fir, *Pseudotsuga menziesii* (Mirb.) Franco, and true firs, *Abies* spp., in western North America. Outbreaks occur quite unexpectedly so that a large number of trees are often defoliated before direct control measures can be applied. Growth loss, top-kill and tree mortality are common during outbreaks. Conventional control methods of sampling larvae include examining and measuring branches removed from the mid-crown with a pole pruner (Mason 1969, 1970).

A new method is described for estimating larval density rapidly when populations are very low. This procedure is a large improvement over existing methods because observations are quickly and efficiently made in the lower crown without destructive sampling. Three branches are sampled using a beat cloth, and the presence or absence of larvae is recorded for each tree. Data are collected on the proportion of trees that contain larvae, which can be used to estimate the density in the lower and mid-crown.

Sampling Procedure: Select three branches randomly from the lower crown of Douglas-fir and beat over a portable drop cloth (61 by 123 cm), recording the presence or absence of larvae in each sample. The beat cloth should be placed within 56 cm of the branches. If a larva is found on the first branch, it is unnecessary to sample the remaining branches. The density of larvae in the lower crown can be estimated by substituting 2.0 for *R* in the equation:

$$L = -2R\ln(1 - P_x)$$

where, P_x is the estimated proportion of sample units in the lower crown containing larvae. Older larvae migrate toward the lower crown prior to pupation, and therefore *R* decreases through the season and affects the estimate of larval density. An *R* of 2.0 is recommended for sampling first and second instars, 1.5 for third and fourth instars, and 1.0 for fifth and sixth instars and pupae. Table 1 provides mid-crown larval density estimates for these three *R* values.

Notes: The sampling plan presented is for low density, sub-outbreak populations and should be applied to first and second instar larvae. The density equation assumes that the same frequency distribution of larvae in the lower crown applies to that of the mid-crown where data were collected originally. The distribution of larvae within each crown level, regardless of density, follows the same distribution.

References:

*Mason, R. R. 1969. Sequential sampling of Douglas-fir tussock moth populations. Res. Note PNW-102. Portland, OR: *U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station*; 11 p.

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

Table:

Table 1. Conversion of the proportion of infested lower crown samples (P_x) to density of larvae in the mid-crown ($\hat{M}$). Densities are calculated from ($\hat{M}$) = $-2R \ln(1 - p_x)$ for three values of R[1] and expressed as number of larvae per 0.645 m^2.

	$\hat{M}$				$\hat{M}$		
P_x	R = 1.0	R = 1.5	R = 2.0	P_x	R = 1.0	R = 1.0	R = 1.0
.001	.002	.003	.004	.31	.74	1.11	1.48
.002	.004	.006	.008	.32	.77	1.16	1.54
.003	.006	.009	.012	.33	.80	1.20	1.60
.004	.008	.012	.016	.34	.83	1.25	1.66
.005	.010	.015	.020	.35	.86	1.29	1.72
.006	.012	.018	.024	.36	.89	1.34	1.78
.007	.014	.021	.028	.37	.92	1.39	1.85
.008	.016	.024	.032	.38	.96	1.43	1.91
.009	.018	.027	.036	.39	.99	1.48	1.98
.01	.02	.03	.04	.40	1.02	1.53	2.04
.02	.04	.06	.08	.41	1.06	1.58	2.11
.03	.06	.09	.12	.42	1.09	1.63	2.18
.04	.08	.12	.16	.43	1.12	1.68	2.25
.05	.10	.15	.20	.44	1.16	1.74	2.32
.06	.12	.19	.25	.45	1.20	1.79	2.39
.07	.15	.22	.29	.46	1.23	1.85	2.46

.08	.17	.25	.33	.47	1.27	1.90	2.54
.09	.19	.28	.38	.48	1.31	1.96	2.62
.10	.21	.32	.42	.49	1.35	2.02	2.69
.11	.23	.35	.47	.50	1.39	2.08	2.77
.12	.26	.38	.51	.51	1.43	2.14	2.85
.13	.28	.42	.56	.52	1.47	2.20	2.94
.14	.30	.45	.60	.53	1.51	2.27	3.02
.15	.32	.49	.65	.54	1.55	2.33	3.11
.16	.35	.52	.70	.55	1.60	2.40	3.19
.17	.37	.56	.74	.56	1.64	2.46	3.28
.18	.40	.60	.79	.57	1.69	2.53	3.38
.19	.42	.63	.84	.58	1.74	2.60	3.47
.20	.45	.67	.89	.59	1.78	2.67	3.57
.21	.47	.71	.94	.60	1.83	2.75	3.67
.22	.50	.75	.99	.61	1.88	2.82	3.77
.23	.52	.78	1.04	.62	1.94	2.90	3.87
.24	.55	.82	1.10	.63	1.99	2.98	3.98
.25	.58	.86	1.15	.64	2.04	3.06	4.09
.26	.60	.90	1.20	.65	2.10	3.15	4.20
.27	.63	.94	1.26	.66	2.16	3.24	4.32
.28	.66	.99	1.31	.67	2.22	3.33	4.43
.29	.68	.102	1.37	.68	2.28	3.42	4.56
.30	.71	.107	1.43	.69	2.34	3.51	4.68
				.70	2.41	3.61	4.82

[1]*R* = 2.0 is recommended for sampling first and second instars (small larvae), R = 1.5 for third and fourth instars (medium larvae), and R = 1.0 for fifth and sixth instars (large larvae)