

Western Spruce Budworm

Choristoneura occidentalis Freeman

Lepidoptera: Tortricidae

Shore, T. L.; Alfaro, R. I. 1988. Predicting Douglas-fir defoliation from the percentage of buds infested by the western spruce budworm. *Journal of the Entomological Society of British Columbia* 85: 21-25.

Objective: To predict stand defoliation by *C. occidentalis* on Douglas-fir using logarithmic or linear regression models based on the percentage of infested flower and foliage buds.

Abstract: Western spruce budworm, *Choristoneura occidentalis* Freeman, is an important pest of Douglas-fir [*Pseudotsugae menziesii* (Mirb.) Franco], true firs (*Abies* spp.), Englemann spruce (*Picea englemannii* Parry ex. Englem.), and larch (*Larix occidentalis* Nutt.) in the western US and Canada. Infestations in mature stands result in growth loss, top kill, and occasional tree mortality.

The authors explored the relationship between the percentage of Douglas-fir buds infested by *C. occidentalis* and the resulting stand defoliation observed that summer. Buds from the mid-crown of three dominant or co-dominant trees were sampled for infestation and percentage infestation was calculated as an average of the three tree estimates. A total of 60 combined estimates of percentage bud infestation were made between 1977 and 1982 from 12 locations. When larval feeding had ended in late summer of the same year, percent defoliation was estimated from 10 randomly selected dominant or co-dominant trees at the same locations using binoculars. Defoliation estimates were made from the upper-, mid-, and lower-crowns of each tree. Total tree defoliation was calculated from the crown-level estimates of each tree and stand defoliation was calculated as the average of the 10 tree estimates.

A statistically significant relationship exists between the percentage of buds infested by *C. occidentalis* and the percent stand defoliation. The best regression model for this relationship is a logarithmic model:

$$\ln(\text{Defoliation} + 1) = -0.3491 + 1.2053 \ln(\text{Buds} + 1)$$

where \ln = natural logarithm, Defoliation = average tree defoliation (%) per location and Buds = % buds infested by WSB per location ($R^2 = 0.76$, $F = 136.8$, $MSE = 0.667$, $P < 0.01$, and $n = 46$). A simple linear model is also appropriate:

$$\text{Defoliation} = -0.3491 + 1.2053(\text{Buds})$$

where Defoliation = average tree defoliation (%) per location and Buds = % buds infested by WSB per location ($R^2 = 0.68$, $F = 94.4$, $MSE = 0.319$, $P < 0.01$, and $n = 46$). The linear model is easy to use and closely fits the model developed by Carolin and

Coulter (1972), therefore the authors recommend its use even though the logarithmic model was more precise.

Sampling Procedure: It is critical that Douglas-fir buds are sampled at the appropriate phenological stage, between the white scale stage and the brush stage as defined by Shepherd (1983, see publication for photographs of each stage of bud development). Larvae should be third and fourth instars during these stages.

Using pole pruners, sample mid-crown branch tips until 100 buds have been examined from each of three dominant or co-dominant trees (i.e., a total of 300 buds). Calculate the percentage of infested buds as an average of the three individual tree estimates. Use Table 1 to determine the expected defoliation associated with the percentage of infested buds as predicted by either the logarithmic or linear model. Defoliation classes are those used by the Canadian Forestry Service in British Columbia.

Notes: The model will overestimate stand defoliation if high larval mortality occurs after infested buds have been sampled. Sampling infested buds allows managers to define areas where sprays are not likely to be needed after winter mortality and check the effectiveness of earlier spray applications. However, sampling infested buds will not allow operation managers enough time to plan and execute spray operations to avoid defoliation by the current generation of larvae. Spray operations for current outbreaks of *C. occidentalis* larvae should be based on egg mass surveys or other sampling methods conducted in the fall.

References:

- * Carolin, V. M.; W. K. Coulter. 1972. Sampling populations of western spruce budworm and predicting defoliation on Douglas-fir in eastern Oregon. USDA For. Serv. Res. Pap. PNW-149; 38 pp.
- Shepherd, R. F. 1983. A technique to study phenological interactions between Douglas-fir buds and emerging second instar western spruce budworm. In R. L. Talerico and M. Montgomery (Eds.). Forest defoliator-host interactions: a comparison between gypsy moth and spruce budworms. Conference Proceedings. USDA For. Serv. Gen. Tech. Rpt. NE-85; 141 pp.

Table

Table 1. Percentage of buds infested by western spruce budworm and expected defoliation of Douglas-fir.

Buds infested (%)		Expected defoliation	
Linear	Logarithmic	Class	Percent
0	0	none	0
1-13	1-19	light	1-25
14-35	20-41	moderate	26-65
36-100	42-100	severe	66-100

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