Two-year-cycle Spruce Budworm

Choristoneura biennis Freeman
Lepidoptera: Tortricidae

Nealis, V. G.; Turnquist, R. 2003. Predicting defoliation by *Choristoneura biennis* (Lepidoptera: Tortricidae). Canadian Entomologist 135: 903-907.

Objective: To predict defoliation within stands by *C. biennis* in its second year based on feeding damage observed during its first year.

Abstract: Two-year-cycle spruce budworm, *Choristoneura biennis* Freeman, occurs exclusively in high elevation stands of subalpine fir, *Abies lasiocarpa* Hook., and white spruce, *Picea glauca* (Moench) Voss, in British Columbia. During the first year, the insect develops to the fourth instar and overwinters. In the second year, the fourth instars resume feeding, pupate, emerge as adults, and lay eggs. Their progeny develop until the second instar and then overwinter, completing the 2-year life cycle. The last three instars of *C. biennis* (i.e., fourth, fifth, and sixth instars) produce most of the defoliation of subalpine fir and white spruce. Periodic outbreaks occur every 30 years and can last 5–10 years.

Most surveys for *C. biennis* rely on direct sampling of egg masses or larvae, but egg mass density is a weak predictor of larval density or defoliation. Historical and contemporary survey data were used to develop a method of estimating the defoliation within stands expected the second year of the *C. biennis* life cycle, based on feeding damage observed during the first year. A strong linear relationship exists between the percentage of shoots damaged by first-year larvae and the percentage of defoliation produced by larvae in their second year (r^2 = 0.78; P < 0.001). This relationship is expressed by the equation d = -4.24 + 1.053x, where d = the percentage of defoliation expected in the second year, x = the percentage of shoots damaged in the first year of feeding, and both d and x are arcsine-transformed values.

Feeding damage is relatively easy to assess using the method of Fettes (1950) and is not subject to the sampling bias of observers who may fail to find all *C. biennis* larvae in a branch sample. Land managers can use the predicted defoliation levels to judge whether control measures are necessary in the upcoming year.

Sampling Procedure: Establish 50 x 50 m plots at least 50 m inside the forest boundary. Each corner of the plots should have clusters of codominant white spruce and subalpine fir. Sample plots only after first-year larvae have finished feeding. Randomly select 10 mature trees of both white spruce and subalpine fir within the four corner clusters (10 trees per species/plot). Randomly cut 1 or 2 45-cm branch tips from each tree using pole pruners. Bag and return branches to the laboratory. Visually estimate the percentage of defoliation (needles removed) on current-year shoots of each branch using the illustration in Figure 6 from Fettes (1950).

Convert the defoliation class values to percentage shoots damaged using the mid-point of the defoliation class as the mean. Calculate the percentage of shoots damaged within the stand by pooling all branch data for both white spruce and subalpine fir.

Use the following equation to estimate defoliation in the subsequent year:

$$d = -4.24 + 1.053x$$

where d = the percentage of defoliation expected in the second year, x = the percentage of shoots damaged in the first year of feeding, and both d and x are arcsine-transformed values.

Reference:

Fettes, J. J. 1950. Investigations of sampling techniques for population studies of the spruce budworm on balsam fir in Ontario. Annual Rep. 1949. Sault Ste. Marie: Canadian Forest Service, Forest Insect Lab; 11 p.

Figure

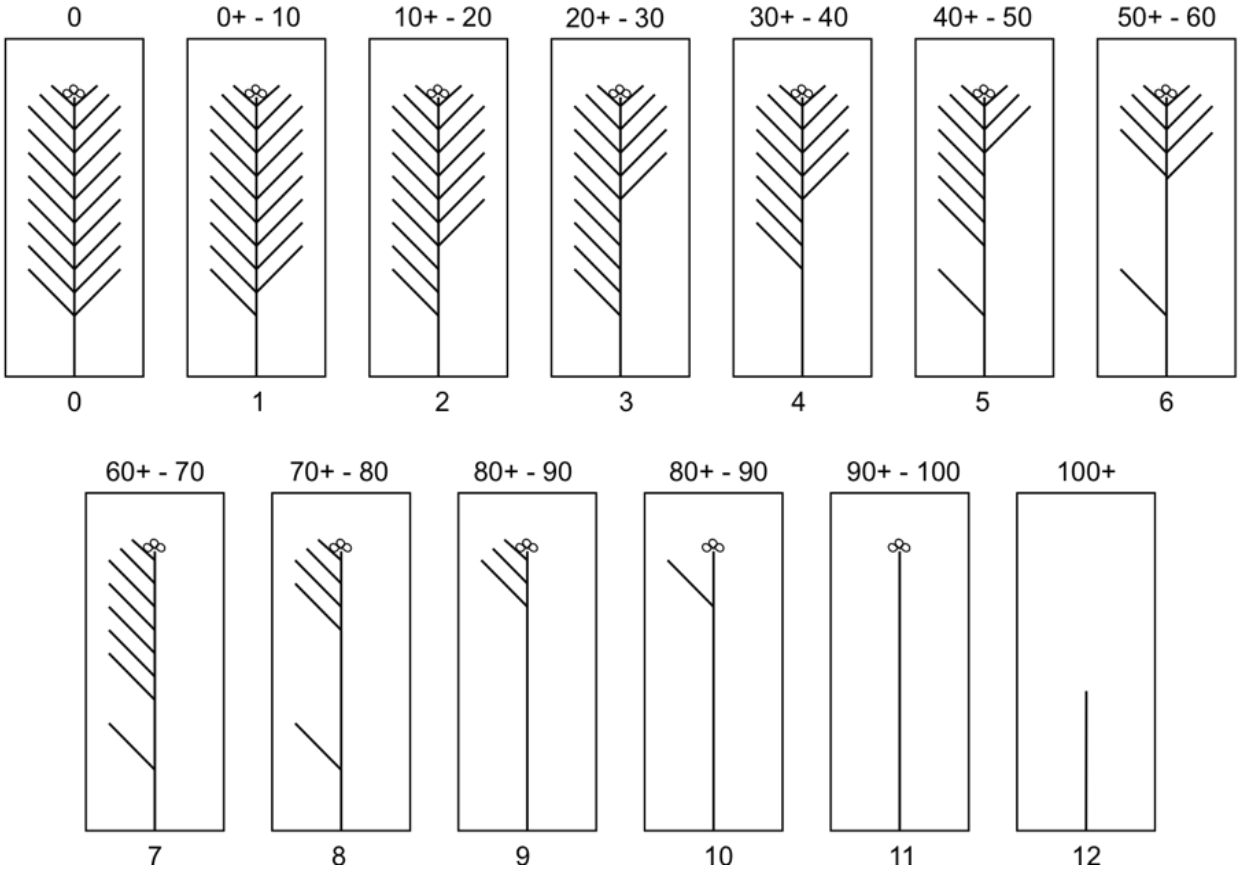

Fig. 6. Fettes method of estimating defoliation.

Figure 6 taken from:

Montgomery, B. A.; Simmons, G. A.; Witter, J. A.; Flexner, J. L. 1982. The spruce budworm handbook: a management guide for spruce-fir stands in the Lake States. Handb. 82-7. Ann Arbor, MI: Michigan Cooperative Forest Pest Management Program; 35 p.