

## **Spruce Budworm**

*Choristoneura fumiferana* (Clemens)

Lepidoptera: Tortricidae

Lynch A. M.; Fowler, G.W.; Simmons, G. A. 1990. Sequential sampling plans for spruce budworm (Lepidoptera: Tortricidae) egg mass density using Monte Carlo simulation. *Journal of Economic Entomology* 83: 1479-1484.

**Objective:** To develop and contrast three sequential sampling plans to estimate the egg mass density of *C. fumiferana*.

**Abstract:** The spruce budworm is the most destructive defoliator of balsam fir, *Abies balsamea* (L.) Mill., and white spruce, *Picea glauca* (Moench) Voss, in eastern North America. The last three larval instars cause most of the defoliation. Periodic outbreaks occur every 30 years and epidemics can last 5-10 years.

Three sequential sampling plans based on the negative binomial distribution were developed for estimating *C. fumiferana* egg mass densities in Michigan's Upper Peninsula. Each plan classified egg mass populations as either low or high based on whole branch samples of balsam fir. Wald's approximation, Monte Carlo estimates of actual values, and Monte Carlo estimates of final values were used to predict operational characteristics and average sample numbers for each of three plans. Each model had the flexibility to include economic constraints, time or labor constraints, regional *C. fumiferana* population levels, and hazard levels.

The number of samples required in Plan I < II < III. The time and labor costs required for Plan I < II < III. Plan II classified stands as having high egg mass densities more often than Plans I or III. Therefore, the practicality of each plan is dependent upon the management objectives, available resources, and forest values.

**Sampling Procedure:** Sampling methodologies were described previously by Fowler and Simmons (1982). Count all *C. fumiferana* egg masses on a whole branch taken from the mid-crown of each balsam fir tree sampled. Determine the foliated area, and then divide the number of egg masses found by the branch area to estimate egg mass density (number of egg masses per 10 m<sup>2</sup> of foliage). The number of egg masses needed for classifying *C. fumiferana* populations as low or high approximately doubles from Plan III to II and from Plan II to I. For each plan, Wald's approximate procedure, Monte Carlo estimates of actual values, and Monte Carlo estimates for the final test are estimated.

**Reference:**

- \*Fowler, G. W.; Simmons, G. A. 1982. Spruce budworm egg mass density on balsam fir: low to extreme population levels (Lepidoptera: Tortricidae). *Great Lakes Entomology* 15: 277-286.