Spruce Budworm
Choristoneura fumiferana (Clemens)
Lepidoptera: Tortricidae

Objective: To determine the minimum sample size necessary for estimating the larval population density of *C. fumiferana* at various levels of precision.

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. A study was carried out in Newfoundland, Canada to determine the minimum sample size needed for accurate estimation of second, third, and fourth instar larval populations.

The observed variances for both whole branch and 45-cm tip samples did not differ significantly with those expected from a negative binomial distribution. Similar sample sizes were predicted for both the whole branch and 45-cm tip samples. Therefore, the 45-cm tip sample was recommended for sampling second to fourth instar *C. fumiferana* because it is the easiest and cheapest sample size for collecting larvae. This sampling method was feasible for estimating *C. fumiferana* populations exceeding one larva per 45-cm branch tip.

Sampling Procedure: Table 1 describes appropriate sample sizes based on larval density, confidence levels, and sampling precision. Select the required number of dominant and codominant balsam fir trees (one branch per tree) randomly throughout each area of concern. The sample should be carried out when the majority of the budworm population is predicted to be second, third and fourth instar. Cut one 45-cm branch tip from the mid-crown of each sample tree, and count the number of budworm either in the field or later in the laboratory. If samples are to be processed in the laboratory, then store them in a cooler or freezer to reduce the likelihood of larvae molting before the samples can be assessed.

Note: This sampling method depends on previous knowledge of the larval population density of *C. fumiferana* in order to determine the appropriate number of samples to collect.

Table:

Table 1. Required number of branch tip samples to estimate the population density of early instar (second to fourth instar) larvae of the spruce budworm.

	Confidence level (α)											
[1]Mean density	0.90				0.80				0.70			
	SE of mean				SE of mean				SE of mean			
Larvae/m^2	.10	.15	.20	.25	.10	.15	.20	.25	.10	.15	.20	.25
0.10	3683	1637	921	589	2131	947	533	341	1333	592	333	213
1	569	253	142	91	329	146	82	53	206	92	52	33
10	258	115	64	41	149	66	37	24	93	41	23	15
20	240	107	60	38	139	62	35	22	87	39	22	14
30	235	104	59	38	136	60	34	22	85	38	21	14
40	232	103	58	37	134	60	34	21	84	37	21	13

[1] First line of table (mean density = 0.01 larvae/m^2) deleted because sample sizes were too high for practical use.
Refer to the original publication for SEM = 0.30.

Table 1 reprinted with permission from the Canadian Entomologist, January 15, 2001.