

Spruce Budworm

Choristoneura fumiferana (Clemens)

Lepidoptera: Tortricidae

Morris, R. F. 1954. A sequential sampling technique for spruce budworm egg surveys. Canadian Journal of Zoology 32: 302-313.

Objective: To develop a sequential sampling plan for *C. fumiferana* egg mass surveys.

Abstract: Spruce budworm, *Choristoneura fumiferana* (Clemens), 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, while epidemics can last 5-10 years.

A sequential sampling plan was developed for *C. fumiferana* egg mass surveys in eastern Canada based on whether pole pruners can be used to sample the mid-crown of balsam fir, *Abies balsamea* (L.) Mill., within a stand. Trees selected for sampling are felled if the overall stand height is too tall for sampling the mid-crown with pole pruners (Method I). Fewer trees are needed to classify the egg mass density within a stand using Method I than if mid-crown branches are sampled using pole pruners (Method II), but felling trees requires more effort. A maximum of 10 or 15 trees are sampled with Methods I and II, respectively. With Method II, as few as 1 or 2 branches need be sampled per plot when *C. fumiferana* populations are extremely low or high (Table III). Field sampling parties preferred Method II due to ease of making collections without sacrificing accuracy.

Egg mass density is estimated by sampling multiple branches sampled from the crown divided into quarters with Method I, and by sampling one branch from the mid-crown with Method II. With both methods, egg mass density is expressed as the number of egg masses per 9.29 m². Light, moderate, and severe infestations are defined as <25, 50-100, and >200 egg masses per 9.29 m². If, after sampling the maximum number of branches per plot, the cumulative number of egg masses falls between the light and moderate bands, or between the moderate and severe bands, then infestation is classified as either light-moderate or moderate-severe, respectively.

Sampling Procedure: Begin sampling after the oviposition period has ended. Sampling can continue into egg hatch provided that workers can distinguish between old and new egg masses. Randomly select trees in each plot. If the trees in a stand are too tall to reach the mid-crown with pole pruners, then trees selected for sampling are felled (Method I). From each felled tree, sample a whole branch from both the apical and second quarters of the crown, and sample a half of a branch from the third and basal quarters of the crown. This division distributes sampling intensity throughout the tree, but pool branch samples to provide a single mean density for the tree. Discard the nonfoliated basal stem of each whole branch collected. If the mid-

crown of the selected trees can be reached using pole pruners, then sample a single whole branch from the mid-crown (Method II).

With whole branches collected with either method, measure the length of the foliated stem and the width at the midpoint of the stem. Multiply the two measurements to obtain a crude estimate of the foliated area of each branch. For half branches collected with Method I, divide each half branch longitudinally by removing all lateral branches along one side of the main stem. Count the number of healthy egg masses on each foliated branch half and express as the number of egg masses per 9.29 m² of foliage surface. Pool counts for branches collected with Method I to provide a single mean density for each tree.

Reference Table III for each pooled sample for a tree if using Method I or after processing each branch if using Method II. Continue sampling until the cumulative number of egg masses falls into one of the zones (i.e., light, moderate, or severe), then stop and classify the infestation level accordingly.

The general expected egg mass density found during light, moderate, and severe infestations are as defined below:

No. of egg masses per 9.29 m ²	Infestation
≤25	Light
50-100	Moderate
>200	Severe

If the cumulative count falls within either the light-moderate or the moderate-severe bands after sampling the maximum number of branches per plot, classify the infestation as either light-moderate or moderate-severe.

Notes: Workers should have experience in distinguishing between old and new egg masses and between healthy and parasitized or predated egg masses. Branches should be re-examined at least partially by a second worker to check that egg masses are counted correctly. Only one method should be used to classify the infestation level within a stand.

Table

Table III. Sequential table for use by field parties, read from the acceptance and rejection lines (Figs. 1 and 2, *in original publication*). (Sampling is continued until the cumulative result falls outside the bands into one of the zones.)

Tree	Cumulative No. of egg masses per 9.29 m ²					
	Light vs. moderate band			Moderate vs. severe		
<i>Sampling Method I</i>						
1	8	—	59	42	—	225
2	42	—	93	183	—	366
3	78	—	129	323	—	506
4	112	—	163	460	—	643
5	147	—	198	599	—	782
6	182	—	233	738	—	921
7	216	—	267	878	—	1061
8	251	—	302	1016	—	1199
9	286	—	337	1154	—	1337
10	320	—	371	1291	—	1474
<i>Sampling Method II</i>						
1	0	—	90	0	—	360
2	5	—	126	35	—	498
3	41	—	162	174	—	637
4	77	—	198	312	—	775
5	110	—	231	452	—	915
6	145	—	266	591	—	1054
7	179	—	300	728	—	1191
8	215	—	336	868	—	1331
9	249	—	370	1005	—	1468
10	284	—	405	1144	—	1607
11	318	—	439	1283	—	1746
12	355	—	476	1420	—	1883
13	389	—	510	1559	—	2022
14	422	—	543	1698	—	2161
15	457	—	578	1837	—	2300

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