

Pupae

None of the northeastern states responding to our request for information reported doing routine pupal surveys. Techniques, similar to those used in large larval sampling, are reviewed by Sanders (1980) and Montgomery *et al* (1982). For the sake of completeness, a brief summary is given here.

- Objective:**
1. Provide an index to the moth population.
 2. Indicate the efficacy of large-scale treatments or operational spraying.
 3. Assess survival over a specified period of the insect's life cycle.
- Time of Year:** Pupal sampling can occur any time after the 6th instar and up through the adult stage (eg., late June to late July, depending on location). The earlier surveys are made, the better, since empty pupal cases are apt to be easily dislodged.
- Equipment Needed:** Extension pole pruners with basket attachment, tape measure, data sheets.
- Procedure:**
1. For extensive surveys, sample units are 45 cm branch tips. Whole-branch samples are used for intensive sampling.
 2. Estimate foliage area. Branches (L x W) are measured (see options for determining area of foliage under egg survey section, page 21). Branch measurements should be recorded on data sheets.
 3. Examine all foliage for budworm pupae. Larvae may pupate anywhere on the branch, often moving away from their feeding site to nearer the bole.
- Interpretation:** A simple two-way classification into low or high density populations by sequential sampling is given in Table 16.
- Data Sheets:** Sample data sheets are provided on page 56.

Table 16. Sequential sampling of spruce budworm pupae developed in New Brunswick. Sample unit is two 45 cm tips per tree from balsam fir, and four from red spruce. [From Prebble (1975) as presented by Sanders (1980)].

No. of Sample Units	Balsam Fir Population Category		Red Spruce Population Category	
	Low (Cumulative # of pupae)	High (Cumulative # of pupae)	Low (Cumulative # of pupae)	High (Cumulative # of pupae)
1	-	33 or more	-	9 or more
2	1 or less	50	1 or less	12
3	5	66	4	15
4	10	83	8	19
5	14	100	11	23

Comments:

1. Pupae are not dislodged as easily as larvae during the collection of samples, but sufficient numbers are dislodged to warrant the use of baskets.
2. The drum technique (described for large instar larvae) has been considered adequate for extracting pupae for extensive population estimates in Quebec (Sanders, 1980). However, it is not suitable if insects are required for rearing because insects are damaged in the process.
3. Pupal cases remain on the foliage following adult emergence, the time depending on the severity of the weather. Therefore, allowing for the weather, sampling may be conducted for some time following adult emergence.

SPRUCE BUDWORM SURVEY

FIR SPRUCE MAP AREA _____
POINT NO. _____

Collectors: _____

Date: _____ Year: _____ Town: _____

Location: _____

Stage: Early larval ___ Late larval ___ Pupal ___ Egg ___ Overwintering larval ___ Adult ___

PRE-SPRAY _____ POST-SPRAY _____ DEVELOPMENT _____ PARASITE _____

No. Units Searched _____ Total No. of Egg Masses or Larvae _____

EGG MASS OR OVERWINTERING LARVAL SURVEY

Branch #	Length	Width	Sq. Ft.	#Larvae or Egg Masses	#/Sq. Foot	#/100 Sq. Ft.

Egg Mass No. Old _____ Par. _____ D.O.C. _____