Nantucket Pine Tip Moth

Rhyacionia frustrana (Comstock)
Lepidoptera: Tortricidae

Gargiullo, P. M.; Berisford, C. W.; Pienaar, L. V. 1983. Two-stage cluster sampling for pine tip moths. *Environmental Entomology* 12: 81-90.

Objective: To develop a sampling scheme for *R. frustrana* for a known SE.

Abstract: The Nantucket pine tip moth, *Rhyacionia frustrana* (Comstock), is a serious pine regeneration pest. Larvae feed within newly developing shoots causing flagging, tree deformity and reductions in growth. In the Georgia piedmont, there are three generations per year with the pupa of the third generation overwintering inside the shoots. A sampling scheme was described for the immature stages of *R. frustrana*, on 3-year-old loblolly pine, *Pinus taeda* L., in the Georgia Piedmont.

Sampling involved a two-stage process whereby trees were selected randomly (stage 1) and then the crown stratified into two levels, with shoots being sampled in each level (stage 2). Depending on the desired standard error (SE), from 2 (50% SE) to 454 (5% SE) trees are sampled. On these trees, as few as 2 or as many as 5 shoots were sampled per level. The time required to complete a sample was inversely related to desired SE.

Sampling Procedure: Select the desired SE (Table 1). Sample the number of trees indicated in Table 1 randomly throughout the area of concern. On all sample trees less than 0.5 m tall, treat the entire live crown as level 1 and sample according to desired SE (i.e., if SE was 10%, then 2 shoots would be sampled) (Table 1). On trees greater than 0.5 m tall, divide the live crown into two strata. Sample each level according to the desired SE. All samples, regardless of location within the crown, should be chosen to include nearly equal amounts of foliage. Thus, shoots should be non-overlapping and account for all foliage within a level. Shoots are numbered, clipped, placed into bags, and then put in a cooler.

In the lab, examine shoots for the life stages of *R. frustrana.* Counts are recorded according to shoot, level, and tree. A FORTRAN program along with documentation has been written to compute the necessary statistics presented in this article as well as procedures used to handle trees up to 2.5 m tall (Gargiullo and Berisford 1981).

Note: Do not confuse the larvae of *R. rigidana* with those of *R. frustrana*. The relative positions of the three prespiracular setae are used to distinguish between the two species (Miller and Wilson 1964).

References:

*Gargiullo, P. M.; Berisford, C. W. 1981. Sampling for pine tip moths—a procedural guide. Res. Bull. 272. Athens: *The University of Georgia*. 25 p.

Miller, W. E.; Wilson, L. F. 1964. Composition and diagnosis of pine tip moth infestations in the southeast. *Journal of Economic Entomology* 57: 722-726.

Table:

Table 1. Optimum numbers of trees and shoots to sample to obtain various desired precisions for minimized costs.

Desired SE (%)[b]	No. of trees	No. of shoots in stratum 1	No. of shoots in stratum 2	Total cost of sample (human-h)
5	454	2	2	781.1
10	114	2	2	197.0
15	51	2	2	88.5
20	29	2	2	50.5
25	18	2	2	31.5
30	8	3	4	22.4
35	9	2	2	15.9
40	6	2	3	12.4
45	3	3	5	9.4
50	2	4	5	7.2

Computed for the overall density of R. frustrana immature stages, based on pilot sample number 19097.

[b] SE (%) = (variance of the unbiased mean per tree estimate)$_{1/2}$ ÷ unbiased mean per tree estimate.