## Gypsy Moth

*Lymantria dispar* (Linnaeus)
Lepidoptera: Lymantriidae

Fleischer, S. J.; Carter, J.; Reardon, R.; Ravlin, F. W. 1992. Sequential sampling plans for estimating gypsy moth egg mass density. NA-TP-07-92. Morgantown, WV: *U.S. Department of Agriculture, Forest Service, Northeastern Area*; 12 p.

**Objective:** To develop a sequential sampling plan for classifying egg mass density into three categories for two land classifications.

**Abstract:** The gypsy moth was introduced into Medford, Massachusetts in 1869, and is now a major defoliator of hardwoods throughout the northeastern USA and Canada. Defoliation reduces tree growth and vigor and in combination with other stress factors can cause excessive tree mortality. A sequential sampling plan was developed for estimating *L. dispar* egg mass density in forested and urban-suburban habitats. Sequential sampling decision plans for three egg density thresholds (250, 500, and 1000 eggs per acre) are presented and are based on a 100-$m^2$ sample plot.

**Sampling Procedure:**

Forested habitats: Take a minimum of 4 and maximum of 10 plots, in which you locate and record the number of egg masses found on all plants and rocks in the understory. Use binoculars to examine taller objects, if necessary. The sum of samples is compared to a range of values for the corresponding sample number in the table for each management threshold selected. Continue sampling until a decision is met for one of the three management thresholds (Table 2).

The plan gives the same pest management decision in 79-84% of the areas that were surveyed using current operational techniques. This rate of success is achieved with a labor savings of 40%. Only 2-3% of the areas were classified improperly.

Urban and suburban habitats: A suburban habitat is defined as an area with a minimum of one house per 4 hectares. In these environments, the influence of man-made objects causes egg mass distributions to be aggregated. The sequential sampling plan is presented in Table 3. Take a minimum of six 100-$m^2$ (1/40 acre) plots where you locate and record the number of egg masses found on all trees, rocks, and man-made objects. Use binoculars to examine taller objects, if necessary. The sum of samples is compared to a range of values for the corresponding sample number in the table for each management threshold selected. Continue sampling until a decision is met for one of the

three management thresholds. Appendix 1 provides the equations used to generate the sequential plan tables.

The plan gives the same pest management decision in 90-100% of the areas that were surveyed by using current operational techniques. This rate of success was achieved with a labor savings of 49%. Only 6% of the areas were classified improperly.

**Note:** The frequency distribution and damage thresholds must be known as the frequency distribution is used to estimate the probability of being above or below the threshold.

**Tables:**

**Table 2.—Sequential sampling decision charts for three management thresholds in continuously forested eastern hardwoods.**

| Threshold (Egg masses/ acre) | Sample Number (1/40 acre) | Stop Sampling (below threshold) | Continue Sampling | Stop Sampling (above threshold) |
|---|---|---|---|---|
| | | *.....Cumulative Egg Mass Count .....* | | |
| 250 | 4 | 0-6 | 7-42 | >42 |
| | 5 | 0-12 | 13-48 | >48 |
| | 6 | 0-18 | 19-54 | >54 |
| | 7 | 0-24 | 25-60 | >60 |
| | 8 | 0-30 | 31-66 | >66 |
| | 9 | 0-36 | 37-73 | >73 |
| 500 | 4 | 0-15 | 16-81 | >81 |
| | 5 | 0-27 | 28-94 | >94 |
| | 6 | 0-39 | 40-106 | >106 |
| | 7 | 0-52 | 53-118 | >118 |
| | 8 | 0-64 | 65-130 | >130 |
| | 9 | 0-76 | 77-143 | >143 |
| 1000 | 4 | 0-18 | 19-178 | >178 |
| | 5 | 0-43 | 44-202 | >202 |
| | 6 | 0-67 | 68-227 | >227 |
| | 7 | 0-92 | 93-252 | >252 |
| | 8 | 0-116 | 117-276 | >276 |
| | 9 | 0-141 | 142-301 | >301 |

**Table 3.—Sequential sampling decision charts for three management thresholds in urban/suburban habitats.**

| Threshold (Egg masses/ acre) | Sample Number (1/40 acre) | Stop Sampling (below threshold) | Continue Sampling | Stop Sampling (above threshold) |
|---|---|---|---|---|
| | | *.....Cumulative Egg Mass Count .....* | | |
| 250 | 6 | 0-3 | 4-71 | >71 |
| | 7 | 0-9 | 10-77 | >77 |
| | 8 | 0-15 | 16-83 | >83 |
| | 9 | 0-21 | 22-89 | >89 |
| | 10 | 0-27 | 28-95 | >95 |
| | 11 | 0-33 | 34-101 | >101 |
| | 12 | 0-39 | 40-107 | >107 |
| | 13 | 0-45 | 46-113 | >113 |
| | 14 | 0-51 | 52-119 | >119 |
| | 15 | 0-57 | 58-125 | >125 |
| 500 | 7 | 0-6 | 7-159 | >159 |
| | 8 | 0-18 | 19-171 | >171 |
| | 9 | 0-30 | 31-182 | >182 |
| | 10 | 0-42 | 43-194 | >194 |
| | 11 | 0-53 | 54-206 | >206 |
| | 12 | 0-65 | 66-218 | >218 |
| | 13 | 0-77 | 78-229 | >229 |
| | 14 | 0-89 | 90-241 | >241 |
| | 15 | 0-100 | 101-253 | >253 |
| | 16 | 0-112 | 113-265 | >265 |
| | 17 | 0-124 | 125-277 | >277 |
| | 18 | 0-136 | 137-288 | >288 |
| | 19 | 0-148 | 149-300 | >300 |
| | 20 | 0-159 | 160-312 | >312 |
| | 21 | 0-171 | 172-324 | >324 |
| | 22 | 0-183 | 184-335 | >335 |
| 1000 | 7 | 0-10 | 11-334 | >334 |
| | 8 | 0-34 | 35-359 | >359 |
| | 9 | 0-59 | 60-383 | >383 |
| | 10 | 0-84 | 85-408 | >408 |
| | 11 | 0-108 | 109-432 | >432 |
| | 12 | 0-133 | 134-457 | >457 |
| | 13 | 0-158 | 159-482 | >482 |
| | 14 | 0-182 | 183-506 | >506 |
| | 15 | 0-207 | 208-531 | >531 |
| | 16 | 0-231 | 232-555 | >555 |
| | 17 | 0-256 | 257-580 | >580 |
| | 18 | 0-280 | 281-604 | >604 |
| | 19 | 0-305 | 306-629 | >629 |
| | 20 | 0-329 | 330-654 | >654 |
| | 21 | 0-354 | 355-678 | >678 |
| | 22 | 0-379 | 380-703 | >703 |
| | 23 | 0-403 | 404-727 | >727 |
| | 24 | 0-428 | 429-752 | >752 |

Appendix 1. Equations used to generate sequential sampling plans for 1/40th acre fixed plot samples in various habitats.

| Threshold (EM/acre) | Decision Stop Line[a] | |
|---|---|---|
| | Continuously Forested Habitat | Urban/Suburban Habitat[b] |
| 250 | y = 6.095x ± 17.722 | y = 6.089x ± 34.013 |
| 500 | y = 12.178x ± 32.706 | y = 11.781x ± 76.258 |
| 1000 | y = 24.580x ± 79.461 | y = 24.576x ± 162.128 |

[a]Decision stop line in the form y = mx ± b, where y = cumulative sum required to stop sampling, m is the slope, x is the sample number and b is the intercept. The positive value of the intercept gives the upper stop line and the negative value gives the lower stop line.

[b]Defined as ≥ 1 house per ten acres.