Gypsy Moth

Lymantria dispar (Linnaeus)
Lepidoptera: Lymantriidae

Liebhold, A.; Luzader, E.; Reardon, R.; Roberts, A.; Ravlin, F. W.; Sharov, A.; Zhou, G. 1998. Forecasting gypsy moth (Lepidoptera: Lymantriidae) defoliation with a geographical information system. *Journal of Economic Entomology* 91: 464-472.

Objective: To describe quantitatively the spatial relationship of *L. dispar* infestations in order to improve the quality of defoliation forecasts.

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 maximum likelihood estimation procedure was used to fit 15 regression models that predict noticeable defoliation in 1 ha grids from egg mass density, male moths, presence of defoliation in the previous year, distance to the population boundary, and their interaction.

Models that included egg mass density and distance to the population boundary provided the most reliable predictions of defoliation. Decision errors were greatest for models that incorporated a single independent variable. Models 1, 5 and 11 yielded the lowest decision errors and included egg mass density as an independent variable. The results indicated that the use of traditional egg mass density thresholds may perform as well or better than the logistic models with the exception of models 5 and 11. However, the associated errors for all models are rather high and improved techniques for predicting defoliation were, therefore, recommended.

Sampling Procedure: Data on defoliation levels, egg mass densities, pheromone trap catches, and proximity to the population boundary were obtained from infestations in Virginia and West Virginia, and were used to construct and validate model accuracy.

Gypsy moth traps were deployed annually on 2 by 2-km grids and baited with disparlure (Schwalbe 1981). At the end of the season, the number of moths was recorded in each trap. If greater than 200 moths were caught, egg mass densities were sampled using three to ten 100-m^2 plots (Liebhold and others 1994). Values were estimated for unsampled locations as weighted means of values in nearby locations. Distance to the population boundary was determined using the best classification method (Sharov and others 1995).

Fifteen logistic regression equations were used to predict the probability of defoliation as >30%. All possible combinations of the four variables were evaluated. All coefficients were found significant and made biological sense (refer to original publication). Decision errors were greatest for models that incorporated only one independent variable. Models 1, 5, and 11 yielded the lowest decision errors, and include egg mass density as an independent variable. Results indicate that the use of traditional egg mass density thresholds may perform as well or better than the logistic models with the exception of models 5 and 11. Both models include egg mass density and distance to population boundary variables. The capture of male moths was a poor indicator of subsequent defoliation.

Notes: The authors provide a detailed example of two scenarios to illustrate the choice of an egg mass density threshold for use in decision-making, and then discuss clearly the effect of each error. The data used in these models were collected by the Appalachian Integrated Pest Management program (AIPM) at the leading edge of *L. dispar* advancement. Therefore, these models may not be applicable in other locations (i.e., New England) where populations have been established, and variables such as proximity to population boundary are unlikely to be useful indicators of defoliation levels.

References:

*Liebhold, A.; Thorpe, K.; Ghent, J.; Lyons, D. B. 1994. Gypsy moth egg mass sampling for decision-making: a user's guide. NA-TP-04-94. Morgantown, WV: *U.S. Department of Agriculture, Forest Service, Northeastern Area*; 12 p.

Schwalbe, C. P. 1981. Disparlure-baited traps for survey and detection. In: Doane, C. C.; McManus, M. L. editors. The gypsy moth: research toward integrated pest management. Tech. Bull. 1584. Washington, DC: *U.S. Department of Agriculture, Forest Service*; 542-548.

Sharov, A. A., Roberts, E.A.; Ravlin, F. W.; Liebhold, A. M. 1995. Spread of gypsy moth (Lepidoptera: Lymantriidae) in the central Appalachians: three methods for species boundary estimation. *Environmental Entomology* 24: 1529-1538.