MODELING GYPSY MOTH SEASONALITY

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ABSTRACT

Maintaining an appropriate seasonality is perhaps the most basic ecological requisite for insects living in temperate environments. The basic ecological importance of seasonality is enough to justify expending considerable effort to accurately model the processes involved. For insects of significant economic consequence, seasonality assumes additional importance because management decisions are often based on seasonal timing. In gypsy moth management, timing of BT applications and determining an efficient sampling interval for placement of pheromone traps are two such applications. We are, therefore, in the process of developing models required for representation of gypsy moth seasonality. Model representations currently under consideration are those for egg diapause and embryogenesis, and larval phenology.

The conceptual basis for our diapause model is founded in two generally accepted first principles. These are (1) there are two important temperature dependent rate related processes that define diapause, that of diapause development and that of embryogenesis, (2) the relationship between these two temperature dependent rate processes results in arrested development that is the outward manifestation of diapause. We differ from traditional interpretations, however, in that we conceptually allow the relationship between these two phases to be more flexible than conventional models. In particular, we acknowledge that the relationship may allow concurrent phase development as well as the more traditional strictly sequential progression through phases. Larval phenology is modeled by a flexible modeling paradigm developed by Logan (1988). The empirical foundation for this model resulted from a reevaluation of data published by Casagrande *et al.* (1987).

Linking the models of egg diapause with that of within season dynamics results in a composite representation of seasonality. The resulting model allows long-term representation and analysis of gypsy moth seasonality. In this paper, we discuss: (1) the structural detail of the two modeling approaches (2) coupling of the models to produce a composite model that links one year to the next, and (3) implications, both basic ecological and applied, of long-term simulation experiments with the seasonality model.