

SPACE-TIME INTERACTIONS BETWEEN GYPSY MOTH AND ASSOCIATED ENTOMOPATHOGENS IN NEWLY ESTABLISHED POPULATIONS

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ABSTRACT

Two major pathogens infect gypsy moth (*Lymantria dispar* (L.) [Lepidoptera: Lymantriidae]) in North America: the gypsy moth nucleopolyhedrovirus (LdMNPV) and the fungal pathogen *Entomophaga maimaiga*. Both pathogens can regulate gypsy moth populations, minimize the duration and intensity of gypsy moth outbreaks, and thus be important biological control agents. However, limited empirical studies exist on how long it takes these pathogens to follow gypsy moth invasions. This issue is of particular importance for areas newly colonized by the gypsy moth and has broader implications in the context of natural enemy-victim interactions. We conducted field studies in Wisconsin in 2005, 2006, and 2007 along the leading edge of the gypsy moth population front to quantify the temporal and spatial lag between newly established gypsy moth populations and presence of *E. maimaiga* and LdMNPV. Prior-year gypsy moth density was a significant predictor of *E. maimaiga* ($P < 0.01$) and LdMNPV ($P = 0.04$) presence, and fungal and viral presence was more likely than not found at moth densities that were more

than 68 and more than 252 males/trap in the prior year, respectively. Also, pathogen presence, based upon the prior year's population threshold boundaries, tended to be behind the boundary at which 30 moths or less per trap are captured but generally ahead of the 300 moths/trap boundary. In the case of *E. maimaiga*, only the distance from the 100 moths/trap threshold was a significant predictor of its presence ($P = 0.03$), while for LdMNPV, only the distance from the 300 moths/trap threshold was significant ($P = 0.04$). Our future work will attempt to develop a spatially and temporally explicit model of the dynamics between gypsy moth and associated entomopathogens as the gypsy moth invades new areas. With renewed interest in classical biological control for managing biological invasions (i.e., emerald ash borer, *Sirex* woodwasp), there is a consequential need to improve our understanding of the space-time relationship between natural enemies and their target victims, and the gypsy moth-pathogen system provides an ideal model system for which field data exist.