MULTI-YEAR EVALUATION OF MATING DISRUPTION TREATMENTS AGAINST GYPSY MOTH

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ABSTRACT

Mating disruption is the use of synthetic pheromone flakes that are aerially applied to foliage with the goal of interfering with male gypsy moths' ability to locate females and mate. Mating disruption is the primary tactic against gypsy moth used in the Gypsy Moth Slow-the-Spread Project (STS) [Tobin et al. 2004. *Amer. Entomol.* 50:200]. Since 1996, over 1.8 million acres have been treated using this tactic, which accounts for ≈75% of all the acreage treated in STS (Decision Support for the STS Project, *http://da.ento.vt.edu*). We were motivated by preliminary field data that suggested residual flakes from previous treatments may obfuscate our interpretation of the effect of this tactic. We thus explored historical STS treatment data, from 1996-2004, to determine if there was a pattern that would suggest potential residual effects of mating disruption.

We first conducted preliminary field studies in 2004 and 2005 to determine if there were biological effects from residual pheromone flakes in the years after treatment. In both years, we observed a reduction in male moth capture in plots previously treated with pheromone flakes relative to an untreated control, while plots treated in the current year still showed the greatest reduction in trap catch. This is of critical concern in STS since treatment evaluation is based on moth abundance in the year after treatment. If residual pheromone flakes are present, then we are potentially overestimating the effect of this tactic, and more importantly, we are potentially underestimating the abundance of the gypsy moth colony that we are attempting to eradicate.

In STS, the efficacy of treatments is evaluated through an Index of Treatment Success [Sharov et al. 2002. *J. Econ. Entomol*. 95:1205], T1, which is based on the philosophy of Abbott's formula [Abbott 1925. *J. Econ. Entomol*. 18:265]. It considers the population abundance in the treatment block before and after treatment, while adjusting for the respective change in population in nearby, untreated areas that serve as a "control." In our analysis, we expanded T1, the Index of Treatment Evaluation, to include two additional indices, T2 and T3, that measure the potential effects of mating disruption treatments up to 2 years after application:

T1 – Measures changes in moth density 1 year before and 1 year after treatment. Currently the STS treatment evaluation standard.

T2 – Measures changes in moth density 1 year before and 2 years after treatment.

T3 – Measures changes in moth density 1 year after and 2 years after treatment.

A total of 250 mating disruption blocks across the gypsy moth transition zone were examined from 1996 to 2004. Based on the respective behavior of T1, T2, and T3, there were four principle patterns:

PATTERN 1. T1, T2, and T3 indices all suggested a successful application of the mating disruption treatment, which was seen in 120 of the 250 blocks. In these blocks, the population in the treated area declined following treatment, and remained low 2 years later. This is the desired outcome of the STS program when treatments are deployed.

PATTERN 2. T1, the current STS standard, suggested an unsuccessful treatment, while T2 and T3 suggested a successful application. This pattern was seen in only 11 of 250 blocks, and could be indicative of a scenario in which residual pheromone flakes interfered with mating finding in the year after initial application, thereby leading to a continual reduction in abundance.

PATTERN 3. T1 and T2 suggested treatment success, but T3 suggested failure. This was seen in only 19 of 250 blocks. This could be indicative of some effect of residual pheromone flakes, which resulted in decreased male moth abundance 1 year following treatment; however, it remains unclear if some part of this reduction was due to an underestimate of the male moth abundance.

PATTERN 4. T1, the current STS standard, suggested a successful treatment, while T2 and T3 suggested a failure. This was seen in 100 of the 250 blocks, and represents the most problematic pattern. In this pattern, we have overestimated the long-term efficacy of our treatment, and/or potentially underestimated, due to interference from residual flakes, moth abundance after treatment. It is noteworthy that 2 years following treatment, mean moth density in treated blocks was similar to those in nearby, untreated blocks.

The deployment of mating disruption tactics against gypsy moth under STS is the largest such program in the world, and hence could serve as a paradigm for the development of related insect pest management programs. These results could effectively alter our current method of evaluating the efficacy of mating disruption. They also pose interesting biological questions regarding the degree towards which residual pheromone flakes in the environment alter moth behavior. We are currently examining historical STS treatment data for residual effects up to 3 years following treatment. We also plan to compare these results with blocks treated with *Bacillus thuringiensis kurstaki*, which is the second most used gypsy moth management tactic in STS and one in which there are little, if any, residual effects.