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A Comparison of Two Methods of Quantifying Mating Success in Low Density Gypsy Moth (Lymantria dispar) Populations

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Introduction

- The Eurasian gypsy moth (*Lymantria dispar*) is a tree defoliator that is invading eastern and midwestern North America
- Range expansion of *L. dispar* determined by female ability to attract a mate in low-density populations at the invasion front (Keitt et al. 2001)
- Effects of low-density population on mating behavior can be examined using:
  Mate-finding ability – luring mass-released males into traps baited with caged pheromone-releasing females (Thompson et al. 2016)
  Mating success – tethering females for 24 hours and counting those mated by mass-released males
- Both methods have been used to estimate mating success of gypsy moth in the past

OBJECTIVE: to quantify the relationship between mate-finding by male *L. dispar* and mating success in females

Methods

Release:

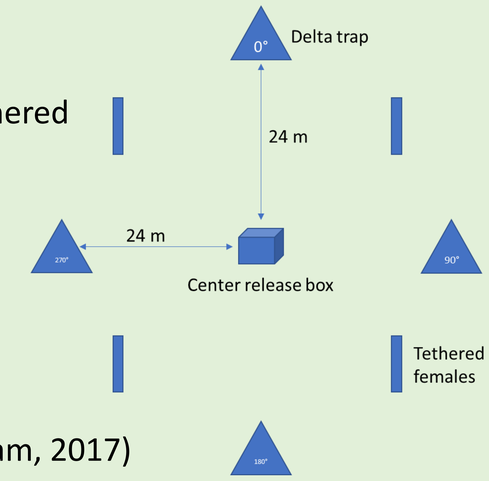
- <24-hr old adult females either caged in delta traps or tethered to PVC pipes, alternated around circular plot
- Males released from center of plot

Variables measured:

- Number of males caught in baited delta traps
- Mated/unmated status of tethered females
- Line-transect survey of vegetation stem diameter

Statistics:

- Bayesian hierarchical model in R Studio v. 3.4.0 (R Core Team, 2017)



Hierarchical model:

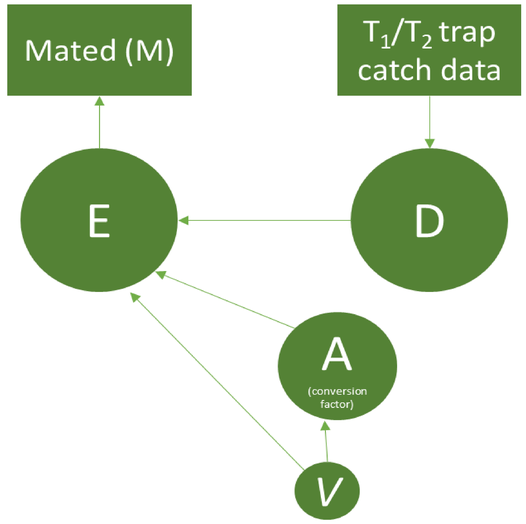
$$D_i \sim gamma(\sum_{i=1}^{n} C_i, n)$$

$$C_i = -(T_1)_i * exp(V_{1,i} * b_1) - (T_2)_i * exp(V_{2,i} * b_1)$$

$$E_i = D_i * \exp(V_{0,i} * b_2) * A$$

$$M_i = binom(E_i, f)$$

n = Tethered female location
D = Latent male moth abundance
C = Expected number of males arriving to trap
E = Expected number of males *arriving* at tethered females
M = Number of mated females at a location
A = Conversion factor of males at traps to males finding tethered females
V = Vegetative cover principle component 1
b_1 = Effect of *V* on *E*
b_2 = Effect of *V* on *C*
f = Number of tethered females at a location



Summary of Results

Parameter	*Median*	*95% confidence interval*	
A	2.73	[1.67	4.69]
b_1	-0.68	[-1.23	-0.15]
b_2	-0.39	[-0.72	-0.06]

Where *A* allows for adjustment from the number of males entering a trap and probability of mating, b_1 is the effect of vegetation on males mating with tethered females, and b_2 is the effect of vegetation on males caught in delta traps.

Two females tethered at James River Park.

Discussion and Conclusions

- Delta traps reduce a male's ability to find a female by a factor of 2.73 (~67%)
- Thick understory vegetation with diameter <6.0 cm has a negative effect on female mating success (see b_1) and a lesser negative effect on males caught in traps (see b_2)
- Baited delta traps underestimate the underlying ability of males to locate and mate with a female
- Research seeking to use counts of males in pheromone-baited traps as proxy for mating success should use adjustment factor to equate methods of quantifying reproductive behavior in *L. dispar*

A male gypsy moth in laboratory.

Acknowledgements
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Works Cited
Keitt et al. (2001). *The American Naturalist* 157: 203-216
Thompson, LM, Grayson, KL, Johnson, DM. (2016). *Entomologia Experimentalis et Applicata* 158: 295-303.