Chemical Espionage of the *T. brassicae* and *T. evanescens* on *P. brassicae*

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Background Information

Pieris brassicae

Trichogramma evanescens

T. brassicae on *P. brassicae*

T. evanescens parasitizing *P. brassicae* egg

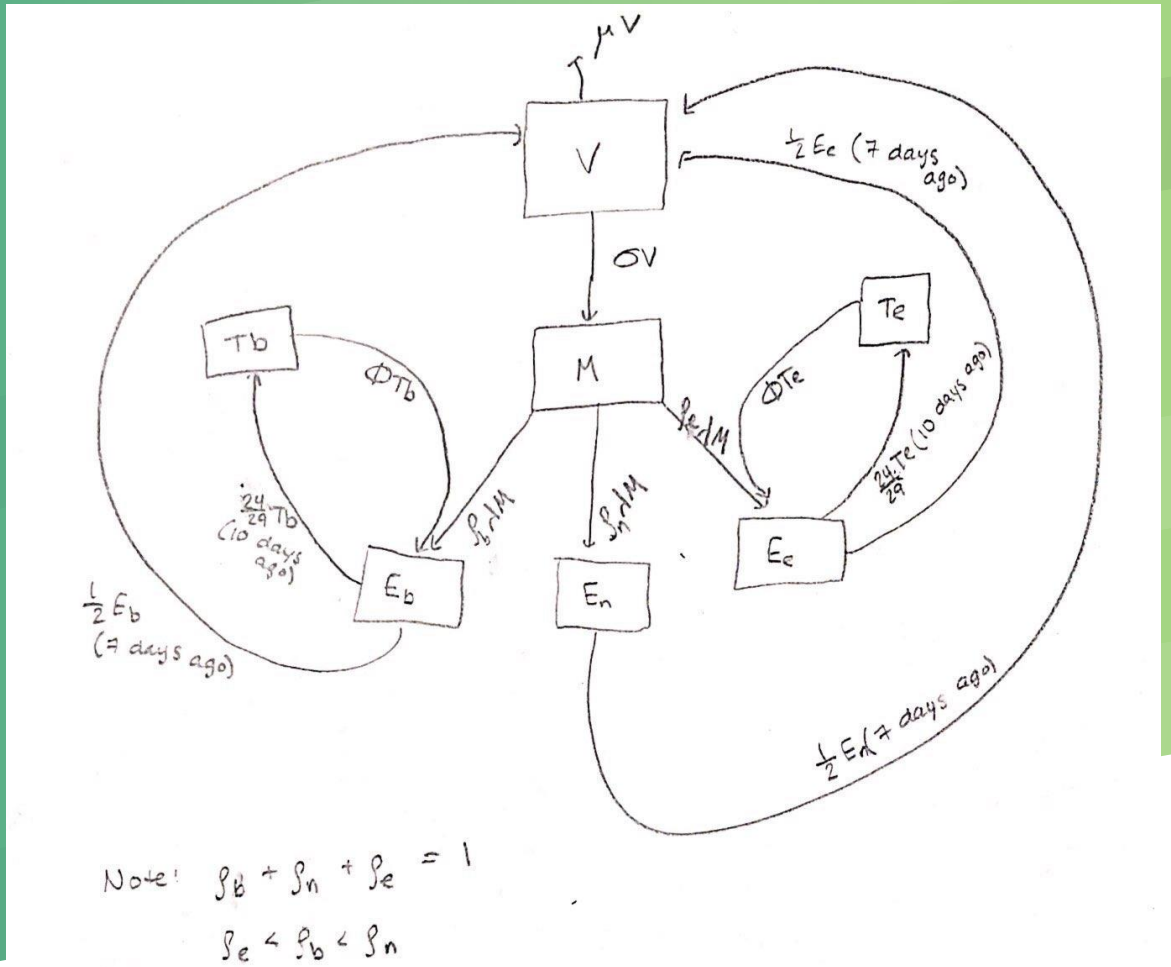
What we sought to model:

The long-term effects on the butterfly population with the anti-aphrodisiac versus without the anti-aphrodisiac.

Our Assumptions (with anti-aphrodisiac model)

- Male and female populations of butterflies are always equivalent (0.5 of eggs hatched will be female)
- *T. brassicae* and *T. evanescens* have a sex ratio of 24:5 (female to male)*
- 7.1% of egg patches will be parasitized by *T. brassicae**
- 6% of egg patches will be parasitized by *T. evanescens*
- Females die immediately after laying eggs*
- Female butterflies will each lay one egg patch containing 35 eggs*
- Female wasps parasitize 29 of the eggs*
- Every egg hatches
- T. brassicae and T. evanescens are significantly more attracted to mated P. brassicae in comparison with virgins and males*

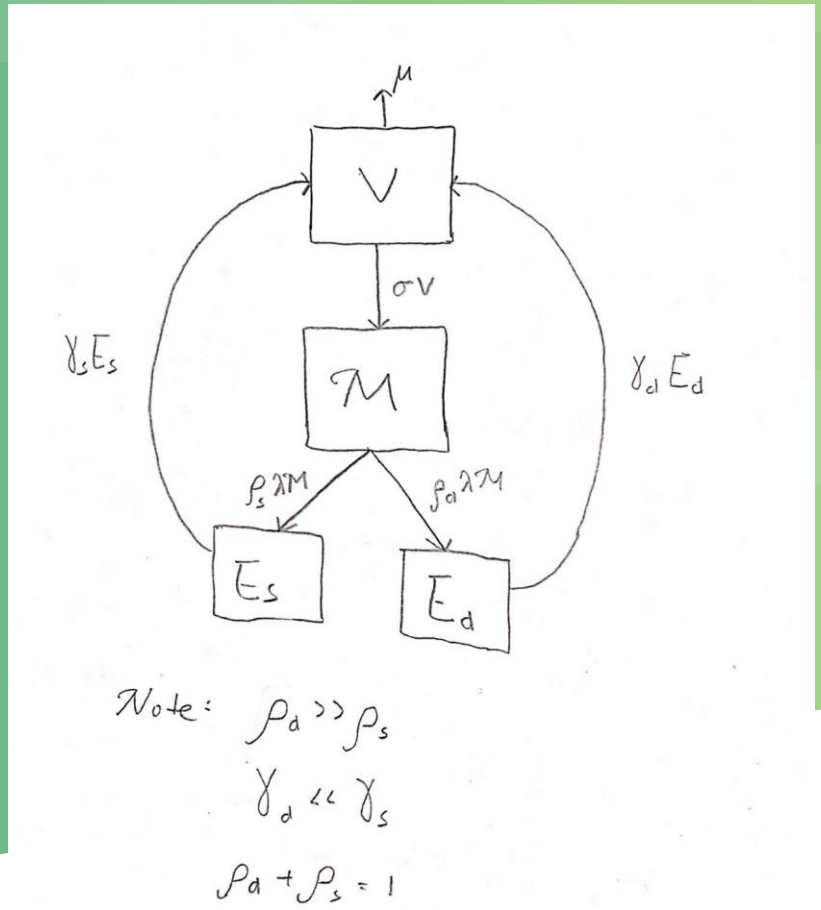
Our Model Including Anti-Aphrodisiac



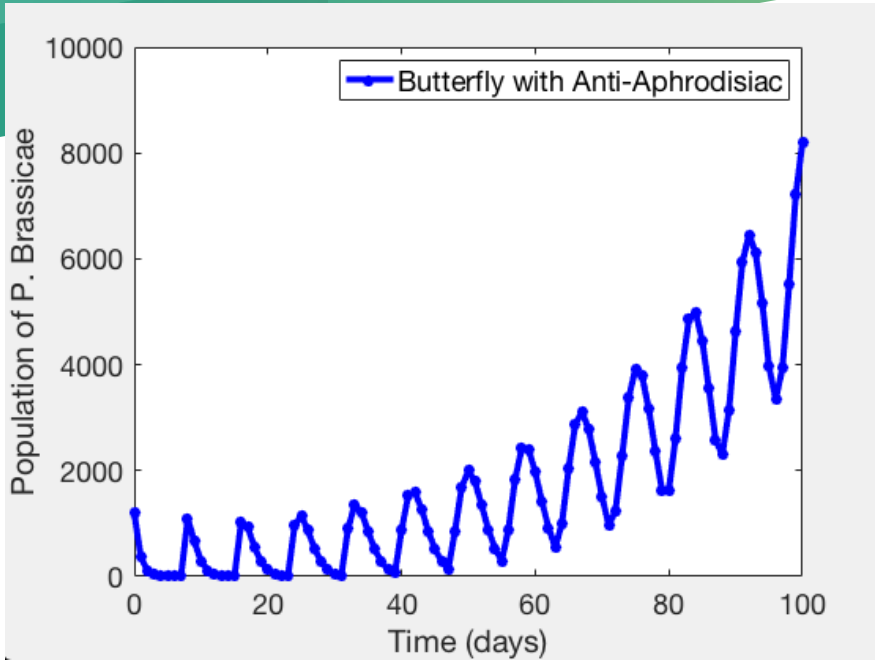
Our Assumptions (without anti-aphrodisiac model)

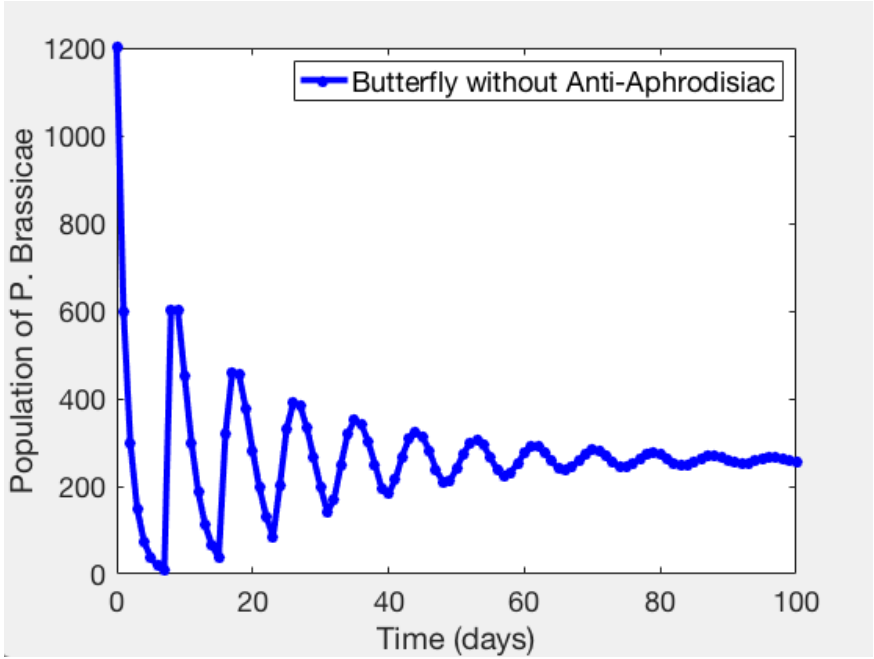
- Male and female populations of butterflies are always equal
- Females die after laying eggs*
- Female butterflies will each lay one egg patch containing 35 eggs*
- When bothered by males, females will lay their eggs in an “unsafe” place 3/4 times
- Every egg laid in a safe place that hatches will survive
- Egg laids in an unsafe place will only survive 30% of the time

Our Model Excluding Anti-Aphrodisiac



Our Findings





Limitations

- Sex ratio for butterflies is 3:2 (female to male)*
- Some constant parameters unknown
- Didn't account for when eggs don't hatch
- Struggled with accounting for the lifespan of butterflies and wasps (roughly 14 days after hatching) *
- Simplified the fact that *T. evanescens* are more likely to parasitize eggs after one successful ride*
- Didn't account for carrying capacity for both populations

Conclusion from our model

From our models, we saw that, over time, the butterfly population increased with the anti-aphrodisiac but decreased without the anti-aphrodisiac. This is supported by the empirical observation that enforcement of monogamy provides *P. brassicae* a selective advantage.

Additional Issue (#3)

- 3) How would your model change if the effectiveness of the anti-aphrodisiac depends on the time of the day? For example, the anti-aphrodisiac may not be as effective in lower temperatures in the early morning as opposed to midday.

Sources

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- Waage, J.K. and Ming, N.S., 1984. The reproductive strategy of a parasitic wasp: I. optimal progeny and sex allocation in Trichogramma evanescens. The Journal of Animal Ecology, pp.401-415.