Executive Summary: Maximizing Butterfly Reproduction via Aphrodisiacs and Anaphrodisiacs

Presented to: SCUDEM IV 2019

1. **Project Background:** The large cabbage white butterfly (Pieris Brassicae) is an invasive species of produce eating insects that originated in Europe, spreading internationally through trade and human introduction. The mating process for Pieris Brassicae involves a series of complex chemical signals that regulates the cycle. The reproductive cycle begins when the females secretes an aphrodisiac. Once the male is attracted, they begin to mate while the male begins to produce the anti-aphrodisiac. The combination of pheromones attracts wasps that bury larvae inside the butterfly's eggs. The mating process is complicated due to the tradeoffs with chemical signaling or the production of pheromones. If the male butterfly does not produce enough anti-aphrodisiac, it causes mating competition and will ultimately produce less successful eggs. However, if too much anti-aphrodisiac is produced then the males will attract wasps which will lay larvae within the eggs, ultimately lowering the amount of successful offspring.

2. **Project Objective:** This research paper and project attempts to model the effect of pheromones on the population of successful offspring, defined as fertilized eggs successfully lived that lived to maturity.

3. **Scope:** This project looks at a population of Pieris Brassicae within a localized geographic region, small enough that the entire population can be represented with our model.

4. **Model:**

$$\alpha = 45 \cdot E \cdot W \cdot X \cdot t$$

This equation models the successful hatching of eggs by the number of females within the environment. The predatorial and environmental factor will lower the ideal value to match the actual successful offspring. The units of the equation will be in the number of eggs and will be dependent on the amount of anti-aphrodisiac produced by male butterflies.

a. **Independent Variable:** t, time in number of days

b. **Dependent Variable:** α, represents the population of successful eggs

c. **Parameter:**

    i. E, the percent likelihood of survivability within the environment. The quality, size, and species of leaves available to lay eggs. E represents the environment factor within the equation.

    ii. W is the percent of the population that will be consumed by wasps. W represents the predatorial factor.

    iii. X, population of female Pieris Brassicae

d. **Constant:**

    i. 45 is a constant that represents the amount of eggs a female butterfly will lay in a day. If a butterfly will lay 60 eggs a day on average, and do so on 75% of all days, then they will lay an average of 45 eggs a day over the entire time frame.

e. **Assumptions:**

    i. No female butterfly will die over this time frame and the population will remain constant.

    ii. The environmental factors are dependent upon the level of anaphrodisiac, determined upon a specific environment.

Works Cited

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