

SCUDEM IV 2019

PROBLEM CHOSEN: PROBLEM C (CHEMICAL ESPIONAGE)

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INTRODUCTION

Our model is aimed at striking a balance between the butterfly population and the wasp population such that none goes to extinction. This model deals with the interaction of the large cabbage white butterfly *Pieris Brassicae* and Parasitic Wasps. In order for the female cabbage white butterfly to reproduce, she releases a chemical signal that attracts male cabbage butterfly.

In response to this chemical signal, the male after mating with her releases a chemical signal called the ANTI-APHRODISIACS which helps in egg fertilizing and makes her less likely bothered by other males. However, this anti-aphrodisiac also attracts the female wasp in laying her egg next to the butterfly eggs. But with time, the larva of the wasp eat up the eggs of the butterfly.

In this model, we try to find a way to balance the pressure between the two parties.

BACKGROUND

First, we identified our variables, the dependent variables are population of the male and female butterfly, population of the wasp and wasp larva, quality of the antiprophrodisiac. The only independent variable is Time. We faced some challenges as we tried to build a model. The challenges are mostly due to inability to accurately determine the relationship between our variables. Due to this, we made few assumptions many of which are proportionality based. We also assumed the Wasp Larva to be an ectoparasitic one which makes them a separate variable from the butterflies' eggs.

METHODS

This model consists is made up of two ordinary differential equations, one which relates the relationship of the butterfly eggs to the male and female butterfly. The other gives relationship between the butterfly eggs and wasps. The solution is our guide and we deduced our conclusions from the solution of these two equations.

CONCLUSIONS

1. In the worst case scenario captured in this model, there would still be some butterflies existing. They can only cease to exist when the wasps increase infinitely. In which case, a predator would feed on more wasps than butterflies.
2. The growth of the wasps must be limited and the population of male butterflies must increase in the system to guarantee a successful balance for both wasps and butterflies to continue to exist in the long run. This can be achieved by introducing a predator into the system that feeds on wasps only.