

# A Model on Interaction Between Plant and Herbivore: Modeling on Gypsy Moth

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The interaction between a forest pest(gypsy moth) and the tree cover is moderated by availability and recycling nutrients in the soil. A non-overlapping model is developed that determines the dynamics of this interaction as a function of the total available nutrients and the nutrient uptake rate. The most interesting phenomena observed involve bistability between chaotic and stationary dynamics. We also found the existence of 8-periodical cycle is matching the fact that gypsy moth has outbreak every 8-10 years.

In the present work we consider a discrete system of the form

$$\begin{aligned} S(t+1) &= S(t) + H(t+1) - (P(t) \exp \left\{ r \left( 1 - \frac{P(t)}{P_{max}} \right) \right\} - P(t)) \\ P(t+1) &= P(t) \exp \left\{ r \left( 1 - \frac{P(t)}{P_{max}} \right) - \alpha H(t) \right\} \\ H(t+1) &= P(t) \exp \left\{ r \left( 1 - \frac{P(t)}{P_{max}} \right) \right\} (1 - \exp \{-\alpha H(t)\}) \end{aligned} \quad (1)$$

Here  $r, \alpha, P_{max}$  are positive, denote, the nutrient uptaken rate by plant, the maximum storage in plant respectively;  $S(t), P(t)$  and  $H(t)$ , stand for, respectively, the densities of nutrient in soil, plant and herbivore at the end of season  $t$ . With the assumption that the total nutrient in the forest is constant,i.e.,

$$S(t) + P(t) = S(t+1) + P(t+1) = \text{constant}$$

We believe that this is the first time such a population model has appeared in the literature. Our purpose is to discuss qualitative properties of the model (??) and explore the biological meaning of our model. From our bifurcation analysis, we can predict the outbreak of gypsy moth and through controlling the important parameters  $r$  and  $\alpha$ , we can regulate the population of pest under threshold of outbreak.

## References

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