In the natural world, there seems to be patterns that exist within ecosystems, yet our understanding of them is not perfect. For example, when trying to understand a predator-prey system (for example, foxes and rabbits living in the same space) mathematicians try to take population data from the environment and formulate an abstraction of the real system to discover fundamental truths about species interactions using various methods. Despite extensive work on this problem, many modeling systems are limited in what they can describe about the real world. Here, we describe ways to try and improve our current models to be more biologically accurate so that in the future we can make more accurate predictions about how the environment will change in response to certain ecological factors. We are approaching this using two different methods, firstly using a computer simulation to try and recreate naturally occurring data, and secondly taking a dynamical systems approach to describe the changing populations.

The direction that will be discussed here is a dynamic systems analysis. To date, a commonly accepted model that is used to describe a predator-prey system is the Lotka-Volterra system of differential equations. This model contains many assumptions such that the resources available to the prey is unlimited. Here, we eliminate this assumption by addition of a differential equation describing the behavior of a resource (such as grass) that the rabbits will consume in order to sustain their population, generating a simple food chain for the particular ecosystem. We hypothesized that our model solutions would resemble the oscillatory solutions observed in the Lotka-Volterra model. We conclude that populations under given conditions will trend toward an equilibrium state, and depending on the stability of the environment, all organisms either trend toward extinction, or to a given steady state. Understanding what causes this model to either converge or diverge from an equilibrium can help us to understand what environmental conditions are required to sustain populations over time.