

Terms Winter/ Spring 2021

Prerequisites

To participate in this comps group you will need to have a background in ODEs (Math 241) and interest in mathematical modeling. You will use MATLAB or Python to carry out numerical simulations, but you can learn as you go and previous experience is not required.

Project Description

This project will explore transient dynamics within ecological ODE models to better understand how habitat loss impacts plant communities and to assess possible restoration strategies. We will

- (i) consult with University of Minnesota ecologists involved in habitat destruction-and-rescue experiments to identify questions of scientific interest,
- (ii) develop an ODE model suited to answering those questions (see the video for the types of models we'll adapt),
- (iii) analyze the model(s) we create using analytic, geometric, and numeric techniques, and
- (iv) interpret our findings to address the original questions posed.

In the course of part (iii), we'll not only use existing mathematical theory but also encounter problems that don't yet have an analytic solution. For example, in an ODE "system" with one state variable, one can solve for the time it takes for a trajectory to pass from one point to another using separation of variables; however, the same technique does not generalize to systems of two variables or higher. We can still use numerical approaches to study such systems, and based on the patterns you observe you might conjecture an analytic relationship and work to prove it. The balance between applying existing mathematical tools and developing new ones will depend on the group's interests.

Video Content

Please see the accompanying video for background on the types of ODE models we will explore, and a discussion of long-term versus transient dynamics.