Overview

We can write logistic equation for population growth as

$$p' = kp(1 - p/M)$$

where k is the the maximum per-capita rate of growth and M is the carrying capacity of the species.

Suppose we are considering a commercially valuable species that can be harvested. In this lab, you will compare two different harvesting schemes. In the first scheme, we harvest a fixed number of individuals (H) per unit time. The equation is

$$p' = kp(1 - p/M) - H$$

In the second scheme, we harvest a fixed proportion h of the individuals per unit time. If the current population is p, the harvest rate is hp, and the equation is

$$p' = kp(1 - p/M) - hp.$$

Objective

Investigate the effects of the harvesting schemes on the population dynamics. Write an essay that concisely and clearly explains what you have learned. You will want to include a **few** well-chosen diagrams. Your essay must be typewritten and no longer than three pages, including all diagrams.

The lab is due **Friday, October 22**.

Suggestions

In the course of working on this lab, you may want to try looking at the following. These are suggestions of things to look at while you make your analysis, not what to present in your analysis.

- Take advantage of Octave to help you visualize what the solutions look like in various cases.
- Reduce the number of parameters by converting to unitless variables (see the lecture on 10/11 for how to do this).
- Calculate the number and stability of the equilibria. Your answer will depend on the values of H and h.
- Compare the situation with harvesting to our analysis of the standard logistic equation.
- Try to find the largest H or h such that there is a stable equilibrium.

- Are there situations that can lead to the species going extinct?
- Draw a bifurcation diagram.
- Describe the effect that the harvesting terms have on the solutions as compared to the solutions without harvesting.
- Alaska law requires that resources be managed according to a principle of maximum sustainable yield. What harvest levels would you suggest using for each harvest strategy?