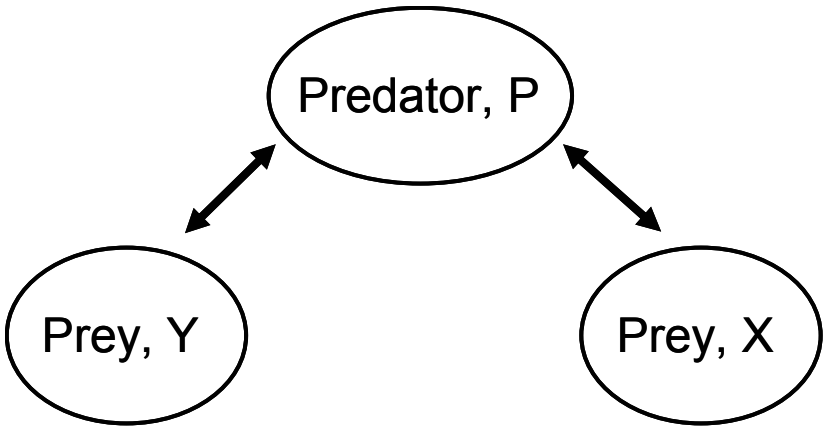
Lab 9: Predator mediated coexistence

Basic instructions:

For today's lab, the 'polyphagous predators' module will be used. To get to this module, click on 'Multi species dynamics' then on 'discrete predator-prey models'. For all questions, set 'Model Type' to 'Random', 'Generations' to 50, initial predator size to 1, $\lambda = 3$, $\lambda' = 3$, $g = .01$, $g' = .03$, and $m = .5$.

Mathematical/Biological background:

In this lab, a predator uses two competing prey species as food. It is possible to vary the strength of competition between the competitors (species X and Y), and also the degree to which the predator (P) specializes on each of the two prey species. For the detailed mathematical background, see the Populus help file.



Questions:

1. Set aX = 0, aY = 0 (Note that these are really the coefficient a_x and a_y, not a multipled by X or Y as they appear on the screen). Setting these values in this way causes the predator to go extinct because it is unable to use either prey species as food. This allows us to evaluate the outcome of competition between the two prey species in the absence of the predator.

A. Start by setting the competition coefficients of the two species to zero (i.e., $\alpha = 0$, $\beta = 0$). What are the equilibrium population sizes of the two prey species X and Y?

B. Now gradually increase the value of β. At what value of β does species Y go extinct? Why?

2. Set $\alpha = 0$ and $\beta = .5$. Set aX = 0, aY = 0. This sets up a scenario where there is no predation and where species X is the superior competitor. This results in species Y being driven to extinction.

A. Gradually increase aX. This increases the degree to which the predator is specialized to feed on species X. What happens as this value is increased? Why?

B. Reset aX to 0. Gradually increase the value of aY. This increases the degree to which the predator is specialized on species Y. What happens as this value is increased? Why?

3. Set $\alpha = 0$ and $\beta = .5$. Set aX = 0, aY = 0. This sets up a scenario where there is no predation and where species X is the superior competitor. This results in species Y being driven to extinction.

A. Gradually increase aX and aY simultaneously. What happens? Why?

B. What does your answer to A, in conjunction with your answers to 2, suggest is required for a predator to stabilize a competitive interaction so that both competitors coexist?