Predator-Prey Interactions: POPULUS

Introduction

The study of predator-prey interactions is a key part of the study of ecology. Research on how one species effects the other is vital information in the preservation and conservation of wildlife. Generally, we assume that as one of a pair fluctuates, the other will react to the change. For example, if we are talking about cats and mice, if the population of mice increases then the population of cats should increase with the new surplus of food. On the other hand, is the population of mice decreases, then the population of cats will decrease since their food supply has diminished.

As the density of prey increases, predators can respond by either 1) consuming more prey per predator (a functional response), or 2) by increasing in number (a numerical response).

Three types of functional responses are recognized. A Type 1 functional response is a linear response between the number of prey consumed and the prey density (up to a plateau in some circumstances). As prey densities increase the portion of prey eaten does not increase corresponding. In a Type II response, the consumption of prey increases but reaches an asymptote. This is because the portion of prey eaten decreases with increasing prey density. A graph of a Type III response produces a sigmoid (S-shaped) curve. At low densities of prey, the portion of prey eaten increases but not as fast as the density of prey increases. At medium densities of prey, the portion of prey eaten increases at a rate that corresponds to the increased prey density. At high densities of prey, the portion of prey eaten decreases with increasing prey density, producing a line that approaches an asymptote. The Type III response exhibits true density-dependence. In both Type II and Type III responses, the asymptote can be the result of factors such as 1) satiation of the predator, 2) increase in the amount of time the predator spends handling the prey, 3) decreased hunting efficiency, etc. Since the regulation of population density ultimately requires density-dependent mechanisms, the Type III response is most likely to regulate prey populations.

In this lab you will use a software program called POPULUS to observe the effects of populations of predator and prey on each other over time depending on the type of functional response.

Procedure

1. Work in groups by lab table.
2. Insert the CD labeled POPULUS and launch the program. Since this is an old DOS program you will need to double click on the drive containing the CD and then double click on the icon labeled "POPULUS" with the blue bar across the top. The hit "enter" to continue into the program.
3. Read the introduction. NOTE that since this is an old DOS program you must use the arrow keys to move around from field to field. After reading the introduction, hit "enter" to continue.
4. From the menu that appears, select "Multi-Species Interactions" and hit enter.
5. From the "Multi-Species Interactions" menu that appears, select "Theta-Logistic Predator-Prey" and hit enter.
6. You will be running the model three times, once for each type of functional response. You will sketch the graphs that the model produces each time and answer some questions about it.
7. For all three times you run the model, make sure that you select "P, N vs t" under the first question "Which plot would you like to view?". By selecting this option the graph will have population size on the y-axis and time (generation #) on the x-axis. The graph will have one line that illustrates what the predator population does and another line that shows what the prey population does.
8. The only thing that you will change over the course of the three times you run the model is your selection under the question "Which functional response type do you want to use?". For your first run you will chose "Type I", for the second run you'll chose "Type II", and for the third run you'll chose "Type III".
9. Run the model three times as indicated above. Sketch the graphs. Try to be accurate enough in your sketch that the overall trend of the graph is conveyed. You DO NOT have to try to replicate the graph down to the unit level of accuracy. DO use different colors, patterns, or clear labels to differentiate the predator line from the prey line on the graph.

Predator-Prey Interactions- POPULUS LAB WRITE-UP:

Submit pages 3-4

Student Name: ____________________ **Lab Date:** __________

Lab Instructor: ____________________ **Section #:** __________

Results (Data)

Figure 1. Results of theta-logistic predator-prey model, using Type I functional response.

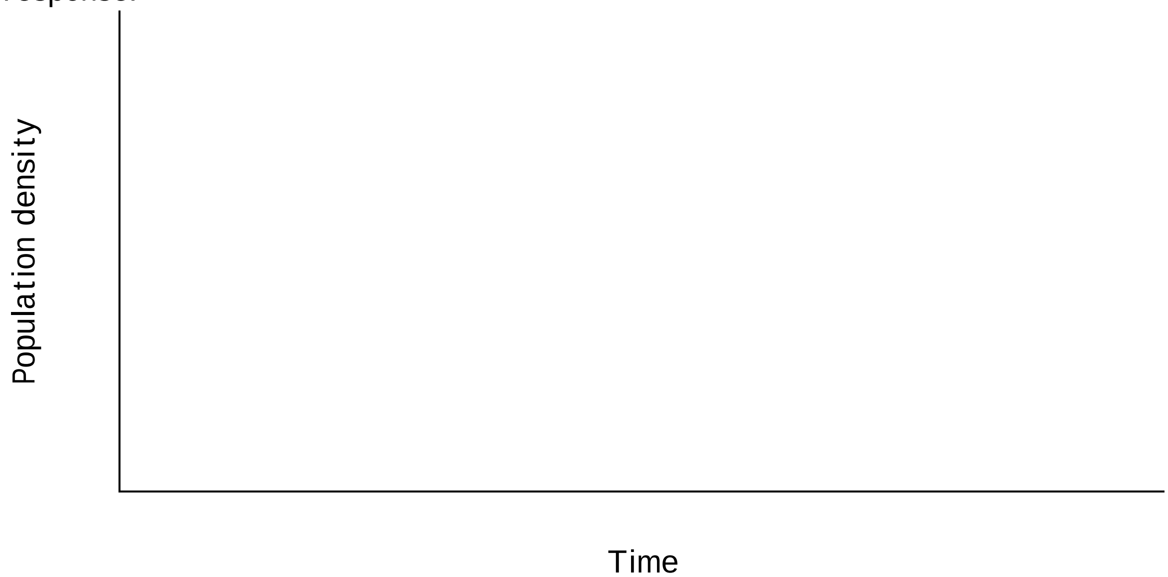

Figure 2. Results of theta-logistic predator-prey model, using Type II functional response.

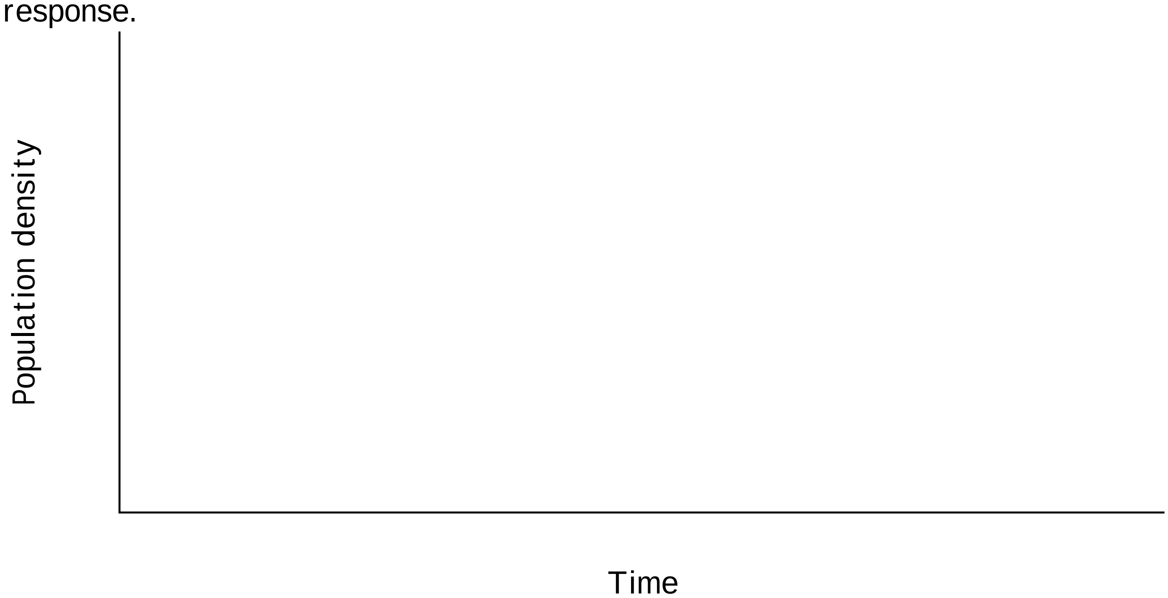

Figure 3. Results of theta-logistic predator-prey model, using Type III functional response.

Conclusions (Questions)

1. Does either the predator or prey population ever go extinct in any of the runs and, if so, which one(s)?

2. Does the predator population ever exceed the prey population in any of the runs and, if so, which one(s)?

3. Are cycles of predator and prey populations ever established in any of the models and, if so, which one(s)?

4. Is a stable level of population ever reached for either the predator or the prey populations in any of the runs and, if so, which one(s)?