

Protozoa Population Lab - Controlling Bacterial Pests

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Standard Statements: 4.5.12.A- Research integrated pest management
4.4.12.A- Analyze the management practices in agricultural business

Suggested Level: 10-12

Content Objectives: Students will be able to:

1. Compare population densities with economic thresholds and economic injury levels
2. Analyze and evaluate pest management practices

Assessment Strategies:

1. Correct production of graphs and labels
2. Post lab discussion ideas

Background:

The first concept of this activity is predator - prey models. These models or simulations make an ideal means of discussing pest and crop management. In this simulation bacteria represent the pests/prey while the biological control/predators are represented by the protozoa. Biological controls are organisms that control the population of another organism (pest) by reducing its numbers in some way. Most often these biocontrols are predacious at some stage of the life cycle of the pest. By utilizing biocontrols there is less dependence by the agricultural industry on various pesticides and herbicides. Less use of pesticides and herbicides means less exposure of these chemicals to the general public and agricultural workers, less resistance (the build up of a genetic immunity to chemical over time) by the pests and a reduction of non-point source chemicals in our waterways.

For the second concept in this model, the protozoa are not only going to represent a biocontrol method, but also a consumable crop. The farmer must decide at what point he will encounter an economic injury level. This economic injury level is the point where taking no action to his crop would cost more money than the action taken. An example would be at what point do I look at my strawberry field and decide that the cost of purchasing and laying out mesh over my strawberries is less than the cost of the strawberries the birds are currently consuming. In the agricultural business, as in any business, there are certain economic thresholds which must be dealt with. An economic threshold takes into account the lag time between the decision to take action and the actual action taken.

I would suggest to the teacher that you demo this model for the students using a video projector. This will enable you to explain to the students variable manipulation, show them the graphics and keyboard usage since the program is in DOS.

Learning Objectives:

- 1) Learn how computer models can simulate real life events
- 2) Learn about economic injury levels and economic thresholds
- 3) Learn alternative practices to pest management

Materials Needed:

1. Protozoa 1.0 by David Visti or any other predator-prey simulator
2. Data Table
3. Graph paper

Timeline: 90 minutes (two class periods)

Procedure:

Open Protozoa 1.0 and follow the procedure below

- 1) Manipulate any variables: Garden, Food Growth Rate, Initial food level, Initial No. of Protozoa (pests)
Perform four trials manipulating variables. On the data sheet, log your variable setup in column B or D including Trial #. **NOTE and Record Census at Time 400** (you can pause this program by hitting the PAUSE/BREAK button in the upper right hand of the keyboard, hitting ESCAPE in the upper left of the keyboard will resume play from pause).
Your goal is to have a high census of protozoa at time 400 and a low bacteria amount while staying within the variable parameters.
- 2) Set variables to any range (I suggest you use one of the lower population setup from part 1 and one of the higher setups). Run program and note census (columns B & D) at times stated on data sheet (columns A & C). Use graph paper to graph your census vs. time for trials #1 and #2 of this part of the lab.
- 3) The graphs of protozoa population will resemble a sine wave. Using a dashed line, plot the carrying capacity of this biological control organism and label the line as carrying capacity.
- 4) If the protozoa population declines below 30, pest (bacteria) population will exceed the economic injury level (the point where not using some other control method will be less costly than the consequences). Plot this line on your graph and label it as such. Think back to the IPM pyramid discussed in class, discuss alternative options to controlling these bacterial pests and write down your ideas from base (#1) to top of the pyramid.
- 5) If this organism were not only used as a control method, but could also be harvested as a food source for us or a domestic animal and the theoretical economic threshold was 10, would your setups have proved economically productive? To find out, using a straight line, plot the economic threshold on your graph and label it. Discuss with your partner methods you could use to increase the protozoa population while maintaining a low pest (bacteria) number. Think of variables outside of this simulation and write down your ideas.

Related Web Sites:

<http://microbiol.org/files/games.htm> – where you'll find protozoa 1.0
<http://paipm.cas.psu.edu>

Data Table Part 1

Trial #
Food Growth Rate
Initial Food Level
Initial No. Of Protozoa
TIME: 400
Census

Trial #
Food Growth Rate
Initial Food Level
Initial No. Of Protozoa
TIME: 400
Census

Trial #
Food Growth Rate
Initial Food Level
Initial No. Of Protozoa
TIME: 400
Census

Trial #
Food Growth Rate
Initial Food Level
Initial No. Of Protozoa
TIME: 400
Census

Data Table Part 2

Time (trail #1)	Census (trial #1)	Time (trail #2)	Census (trial #2)
0		0	
100		100	
200		200	
300		300	
400		400	
500		500	
600		600	
700		700	
800		800	
900		900	
1000		1000	