Finishing the *Lemna* Pilot Study: Data Analysis

A. Graphical Analysis

Create plot of your data that shows the change in number of leaves during the course of the pilot study (# thalli vs. day) using a separate line for each cup. Compare your graph to Figure 1 in the handout. Does either of your lines correspond to one of the phases identified in that figure? If so, indicate which.

Then compare your two lines. Are they similar, or are there clear differences in the shape of the lines? Why or why not?

B. Numerical Analysis

To better understand any differences between the 2 plant and 15 plant treatments, we can calculate a measure of growth rate. In this case, we will compare treatments using the instantaneous per-capita rate of natural increase, symbolized by r. This parameter is sometimes called *'biotic potential'* since it represents the maximum growth rate of the population under optimum conditions. We can approximate the growth of *Lemna* in the cups during the experiment using the exponential growth equation from the Population Growth using *Lemna* handout.

This formula for exponential growth is

$$\mathbf{dN/dt = rN}$$

where dN/dt is the rate of change in population size (N) over time (t), and r is the instantaneous per-capita natural rate of increase (a measure of growth rate per individual).

If we integrate the exponential growth formula in order to predict a population size over a give time interval we get

$$\mathbf{N_t = N_0 e^{rt}}$$

where N_t is the predicted population size at time t, N_0 is the starting population size, and e is the base of natural logarithms.

To calculate r for a population, given data on the starting and ending population sizes over a given time interval (i.e. the data you have collected for the *Lemna* pilot project) we have to isolate r on one side of the equation.

The first step is to take the natural logarithm of equation 2:

$$\mathbf{\ln(N_t) = \ln(N_0) + rt}$$

then subtract $\ln(N_0)$ from both sides;

$$\mathbf{\ln(N_t) - \ln(N_0) = rt}$$

then we can simplify a bit using the rules of logarithms, which state that the expression $\ln(N_t) - \ln(N_0)$ is equivalent to $\ln(N_t/N_0)$;

$$\mathbf{\ln(N_t/N_0) = rt}$$

and finally divide both sides by t to get

$[\ln(N_t/N_0)]/t = r$

You can use equation 2 to calculate r for each of your cups, using the starting and ending number of thalli in the cup, and the elapsed time (in this case, 7 days). Note that the units for r are 'new thalli per existing thalli per day'.

Once you have calculated r for your two cups, record it in the table below and put your data on the board.

Initial condition	Calculated value of r
2 plants	
15 plants	

Once the entire class has compiled their date on the board, complete the table below:

<table>
<tr><th>Initial condition</th><th>Calculated value of r</th><th>Average value of r</th></tr>
<tr><td rowspan="8">2 plants</td><td></td><td rowspan="8"></td></tr>
<tr><td></td></tr>
<tr><td></td></tr>
<tr><td></td></tr>
<tr><td></td></tr>
<tr><td></td></tr>
<tr><td></td></tr>
<tr><td></td></tr>
<tr><td rowspan="8">15 plants</td><td></td><td rowspan="8"></td></tr>
<tr><td></td></tr>
<tr><td></td></tr>
<tr><td></td></tr>
<tr><td></td></tr>
<tr><td></td></tr>
<tr><td></td></tr>
<tr><td></td></tr>
</table>

Ensure that the data is recorded in your lab notebook. Then summarize the class discussion of the data by answering the following question:

Since all of the plants are from the same species (Lemna minor), how would you use this data table to give a best estimate of r for the species?