Exam I

Name________________________________________

Total = 100 points

1 (15 points) __________
2 (10 points) __________
3 (15 points) __________
4 (10 points) __________
5 (25 points) __________
6 (10 points) __________
7 (15 points) __________

There are 4 pages and 7 questions.

To receive full credit for numerical problems, show your calculations and give the correct units for your answer. Partial credit will be given, so try to provide an answer for all questions.

1. A population of 1000 garter snakes produces 100 offspring during a single year. During the same year, 50 animals die. Calculate $r$, and predict the size of the garter snake population in 5 years. (15 points)

2. List the biological assumptions that are necessary to achieve exponential population growth. Of these assumptions, which is the most critical, and why? (10 points)
3. In the space below, draw a graph of the population growth rate \( \frac{dN}{dt} \)
as a function of population size \( N \) for the exponential growth curve
and draw a graph for the logistic growth curve. For the logistic graph,
be sure to label \( K \) in your drawing. (15 points)

4. You are studying a population of lobsters that is growing according to
the logistic equation. The population growth rate \( \frac{dN}{dt} \) is 2.4
lobsters / month. The carrying capacity is 100 lobsters, and
population size is 60% of the carrying capacity. What is \( r \) for this
population? (10 points)
5. Here are some life-table data for an hypothetical population.

<table>
<thead>
<tr>
<th>age (years)</th>
<th>l_x</th>
<th>b_x</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0.4</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>0.2</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0.1</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>0.0</td>
<td>0</td>
</tr>
</tbody>
</table>

For these data, calculate $R_0$, $r$, $G$, and the doubling time. **(25 points)**
6. A common criticism of the logistic growth equation is that the model predicts a population will achieve a stable size at carrying capacity. But in nature, populations rarely remain stable.

Discuss one variant of the logistic model that predicts a variable population size. What assumption of the simple logistic model has been altered, and what are the qualitative predictions of the model? It is not necessary for you to write the equation for the model, just describe its predictions. **(10 points)**

7. You are studying a species of tropical tree fern that only occurs on mountain slopes above 6000 feet elevation.

   a) Suggest two hypotheses that might explain why this species is restricted to high elevations. One of the hypotheses must be for an *abiotic factor* and the other hypothesis must be for a *biotic factor*. **(5 points)**

   b) Propose a field experiment, with appropriate controls, that will test one of your hypotheses. What experimental result would cause you to reject your hypothesis? **(10 points)**