Exam II

Name________________________________________
Total = 100 points

1 ( 5 points) __________  5 (12 points) __________
2 (15 points) __________  6 (13 points) __________
3 ( 5 points) __________  7 (25 points) __________
4 (25 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 spiders is growing exponentially with \( r = 0.7 \) individuals/individual*year. Predict the population size in 12 years. (5 points)

2. A central problem in community ecology has been understanding the mechanisms by which predator and prey coexist. Explain two such mechanisms, and describe a field experiment that could be used to distinguish between the mechanisms (15 points)
3. Define Allen’s Rule or Bergmann’s Rule. (5 points)
4. A population of spiders (predator) and flies (prey) are growing in perfect accordance with the Lotka-Volterra predation equations. For this predator-prey system, you measure the following coefficients:

\[ r = 2.0 \text{ flies/fly*week} \quad \alpha = 0.2 \text{ (flies/fly*week) / spider} \]

\[ q = 0.5 \text{ spiders/spider*week} \quad \beta = 0.1 \text{ (spiders/spider*week) / fly} \]

a) How many spiders are needed to maintain the fly population so that \( \frac{dV}{dt} = 0 \) ? \( \text{(5 points)} \)

b) If there are 100 flies and 100 spiders, calculate the growth rate of the spider \( \frac{dP}{dt} \) and the fly \( \frac{dV}{dt} \) populations \( \text{(10 points)} \)

c) In the space below, graph the isoclines for the predator and victim populations, and indicate the trajectory in the phase space for an initial population of 6 flies and 10 spiders. \( \text{(10 points)} \)
5. You are studying competition between red and grey foxes, which potentially share similar food resources. You suspect that character displacement might be occurring in jaw size, so you measure the jaw length (in mm) of foxes in allopatric and sympatric populations. Here are the results you obtain:

<table>
<thead>
<tr>
<th></th>
<th>Allopatric Populations</th>
<th>Sympatric Populations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red fox</td>
<td>120 mm</td>
<td>100 mm</td>
</tr>
<tr>
<td>Grey fox</td>
<td>80 mm</td>
<td>100 mm</td>
</tr>
</tbody>
</table>

Do these data appear to confirm or refute the hypothesis of character displacement in jaw length? Explain your answer (12 points)

6. List the assumptions of the simple predator-prey model (Lotka-Volterra) discussed in class and in your textbook. (13 points)
7. A “just so” story. The Garcia Beetle occurs widely throughout the U.S. and has grown to large population sizes since the 1960s. Recently, populations of the Garcia Beetle have declined due to competition with the Phish Bug, an introduced pest species first discovered in Nectar’s Lounge, downtown Burlington. For the Garcia Beetle, $K_1 = 50$ and $\alpha = 2$. For the Phish Bug, $K_2 = 20$ and $\beta = 0.3$. Suppose the initial population sizes are 10 Garcia Beetles and 10 Phish Bugs.

a) Graph the fully-labelled state space and isoclines for each species, and plot the point representing the initial population sizes in the state space. (15 points)

b) Predict the short term dynamics of each population (increasing, decreasing, or no change) and the final outcome of interspecific competition. (10 points)