Ecology 203, Exam III. November 18, 2002. Print name:
Rules: Read carefully, work accurately and efficiently. There were two student-submitted questions.

Some useful equations:
\[
N_t = N_0 e^{rt}
\]
\[
dH/dt = rH - pHP
\]
\[
dN_1/dt = r_1N_1(K_1 - N_1 - \alpha_{12}N_2)/K_1
\]
\[
dN/dt = rN(1-N/K)
\]
\[
\frac{N_{\text{captured and marked at } t=0}}{N_{\text{total}}} = \frac{N_{\text{marked at } t=1}}{N_{\text{captured at } t=1}}
\]
\[
H' = \sum [p_i \cdot \ln(p_i)]
\]

Multiple guess. Circle the best answer (3 pts each, 24 pts total). [SS] = student submitted question.

1. The trophic cascade includes all of the following except: [SS] [TB 410]
   a. the tertiary consumer controls the size of the producer population.
   b. producers can control the size of secondary consumer population.
   c. the trophic cascade links all trophic levels within a community.
   d. predators decrease diversity in lower trophic levels.
   e. all are included in the trophic cascade phenomenon.

2. The following equation depicts what type of interaction? (Hint: think about the predictions you could and could not make with this equation) [TB 284]
   \[
dN_1/dt = r_1N_1(1 - N_1/K_1)
\]
   a. intraspecific competition.
   b. interspecific competition.
   c. exponential growth.
   d. predator-prey dynamics.
   e. none of the above.

3. The alder tree (\textit{Alnus} spp.), which raises soil nitrogen levels through the action of nitrogen-fixing bacteria, represents which of the following mechanisms, proposed by Connell and Slatyer, of community development, or succession: [SS] [TB 429]
   a. facilitation
   b. tolerance
   c. inhibition
   d. mutualism
   e. none of the above

4. In the graph to the right, lifted from your text’s “living graphs” website, one species wins over the other. If the two isoclines were brought together to lie exactly on top of each other which of the following would result, assuming we begin with a system with individuals of both species present?
   a. Both species would go extinct
   b. The same species would always win in competition.
   c. The two species would ultimately coexist at some point along the isoclines.
   d. One species would function as a predator of the other.
   e. A catastrophic trophic cascade would occur.
5. The idea that communities function like super-organisms, going through a developmental process similar to individual organisms, was favored by [L, TB: 404, 422]
   a. Frederick Clements
   b. Henry Gleason
   c. Gregg Hartvigsen
   d. Osama Bin Laden
   e. George W. Bush

6. Food webs represent
   a. networks that capture resources
   b. conceptual maps that link individuals together within a species.
   c. conceptual maps that link species together within communities.
   d. the sum total of food types consumed by an individual.
   e. none of the above.

7. The hypothetical data in the graph on the right support which principle of ecology? [L, TB 454, FG 155]
   a. competitive exclusion
   b. species-area relationship
   c. food-web dynamics
   d. coevolution of host-pathogen systems
   e. intermediate disturbance hypothesis.

8. The drawing below depicts the differences between monolayered and multilayered leaves on two different tree species found in our Research Reserve. Which of the below is the best explanation for trees having monolayered leaves? [FG: 322]
   a. It’s an exaptation.
   b. This is an example of a trait that is not an adaptation.
   c. Monolayered trees are shade-tolerant and are adapted to low light conditions.
   d. Monolayered trees are adapted to high light conditions and have dropped their interior leaves.
   e. Monolayering reduces the likelihood that trees will be struck by lightening.
Longer, thought-provoking questions. ANSWER 6 of 8. Please make it clear which questions you do not want me to grade. Please restrict your answers to the space provided. (10 points each)

1. Assume you wish to conduct an experiment investigating the competitive interactions between two species of plants (interspecific competition).
   a. Draw a design for your experiment. Make it a cartoon including all aspects necessary. (5 points)
   b. Draw a bar graph of what the results would look like if you found a significant response to competition which also resulted in asymmetry only when the plants were grown in competition. Label your axes and whatever else you might show. Annotate if necessary (5 points)
2. Assume you get stranded on an island (like in the movie Cast Away) and, after about a year of being bored, you discover two species of birds. After careful observation you observe that the big species eats big seeds and the little species eats little seeds. You quantify the distribution of beak sizes for each species and find there is no overlap in their beak sizes. Draw a histogram of your observation for each species on the line below (beak size is on the x-axis, the y-axis represents frequency). On each of the three lines below the \-------- line provide annotated histograms that show different hypotheses (draw one to be the null hypothesis) about how these birds might have come to be different. Precisely explain (don’t be vague) what ecological interaction might have led to each of these. (hint: the “interactions” are not types of selection.)

Your observation:

```
\begin{center}
\begin{tabular}{c}
\hline
\textbf{Beak size} \\
\hline
\end{tabular}
\end{center}
```

Please explain hypotheses below:

\begin{enumerate}
\item \textbf{H}_0 \quad \begin{tabular}{c}
\hline
\textbf{Beak size} \\
\hline
\end{tabular}
\item \textbf{H}_1 \quad \begin{tabular}{c}
\hline
\textbf{Beak size} \\
\hline
\end{tabular}
\item \textbf{H}_2 \quad \begin{tabular}{c}
\hline
\textbf{Beak size} \\
\hline
\end{tabular}
\end{enumerate}

3. Please show mathematically all equilibria in the predator-prey model. This should be done for both predators and prey. See equations at the beginning of exam. (10 points)
4. a. Briefly explain the technique of modeling forest development using transitional matrices (as was done for the Markov Chain model of Henry Horn). (5 points)

b. If you were to collect data in the Research Reserve to build such a model how do you determine the value of each element in the matrix (the transitional probabilities)? Work an example to get one value from the matrix. (5 points)

5. Please draw a graph below that depicts the fundamental and realized niches of two species. Include two axes (x and y), one for each of two vital resources. Draw it such that the fundamental niches overlap and the realized niches do not overlap. Explain whether these species experience intraspecific competition, interspecific competition, or neither or both. (10 points) [L, TB 445]
6. The ant-acacia coevolutionary system is a pretty convincing story of coevolution. Please provide two pieces of information that you think support, or would support, the conclusion that this is a mutualistic interaction. One of these points must be a graph depicting data. (10 points) [L, TB 391]

7. The following numbers represent the number of individuals in species found in two communities (A and B). Which community is more diverse? Discuss this in terms of species richness and the Shannon-Weaver index ($H'$). Show your work. [L, TB 417]

Community A: 7, 70, 34, 23, 6, 60
Community B: 45, 25, 43, 27, 60
8. Graph and then **analyze your graph** of the theory of island biogeography. Please provide two additional graphs: one that presents data that supports the theory and one that would lead us to reject the theory. (10 points) [L, TB 451-2]
Mandatory question. 20 points

1. Label $N_1$, $N_2$, and $K_1$ on the left graph. **Analyze the graph** on the left. Assume populations start at point on left graph. On the right graph show how $N$ changes for both species over time. Please follow populations until they both reach their equilibria. Be accurate with relative abundances of individuals in both species. Label axes on the graph on the right.

Extra Credit (4 points)

What are the four easily observed characteristics of natural selection?

1. ___________________________________________________________
2. ___________________________________________________________
3. ___________________________________________________________
4. ___________________________________________________________

Grade: 104
Points lost - _______  Extra Credit
Points earned = _______  +  _______  =  (_______  / 104 )  *  100  =  _______ %