Ecology 203, Exam III. April 7, 2004. **Print name:**_____

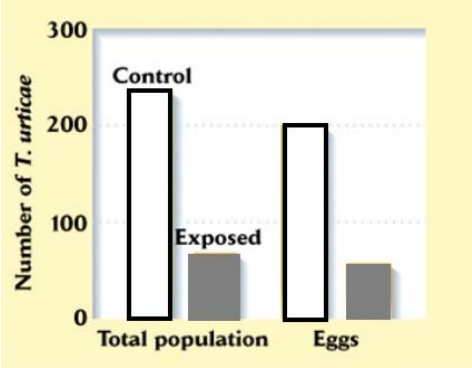
Read carefully. Work accurately and efficiently. There is the possibility of earning 115 points on this exam, including the five extra credit points. Choose **<u>four of nine</u>** concept-exploring questions (40%). There are three "Principles of Ecology" questions (30%). "SS" represents student submitted questions.

Some useful equations:

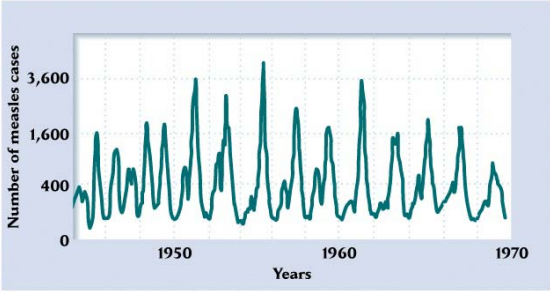
$N_t = N_o\lambda^t$	$dR/dt = rR - cRP$	$dN_1/dt = r_1N_1(K_1 - N_1 - \alpha_{12}N_2)/K_1$
$N_t = N_oe^{rt}$	$dP/dt = acRP - dP$	$dN_2/dt = r_2N_2(K_2 - N_2 - \alpha_{21}N_1)/K_2$
$H' = - \Sigma [p_i * \ln(p_i)]$	$dN/dt = rN(1-N/K)$	$dI/dt = L_oV*E + e^c*O\lambda O*G^y$

Multiple alternatives. Circle the **<u>best</u>** answer (3 pts each, 30 pts total)

1. What is not one of the three mechanisms governing plant community development? [SS] [TB: 429]
   a. Facilitation (species "paving the way" for the next species)
   b. Inhibition (climax species inhibiting previous species within community development)
   c. Seasonal cycles (warming and cooling over the year, regardless of magnitude, which is necessary for community development)
   d. Tolerance (indifference of the establishment of one species based on the presence of others)
   e. None of the above.
2. The figure on the right depicts the total number of herbivorous spider mites (*T. urticae*) and their eggs recovered from an experiment. "Control" and "exposed" refer to the host plants which were either exposed or not exposed to spider mites in the past. The reason the "exposed" mean population sizes are smaller is likely due to [TB: 341]
   a. chemical defenses in the plants.
   b. chance (or sampling error).
   c. the presence of predators.
   d. all of the above.
   e. none of the above.



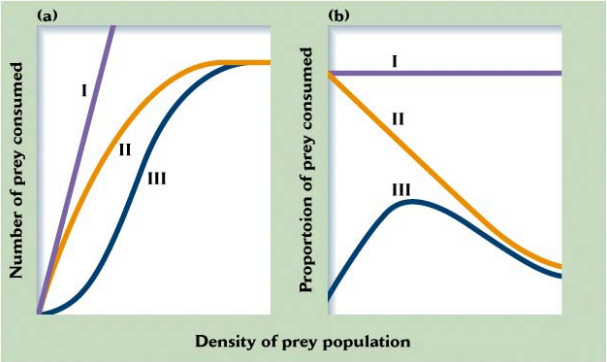
3. Which of the following is not an adaptation of prey to avoid predation? [L, TB: 334]
   a. chemical offense
   b. chemical defense
   c. crypsis
   d. predator satiation
   e. reduced population growth rates
4. The graph of the number of people with measles in London (right) is best represented by which interaction: [TB: 349]
   a. intraspecific competition
   b. predator-prey.
   c. host-pathogen.
   d. mutualism.
   e. commensalism.



5. Steve Hubbell's work in the forest of Barro Colorado Island in Panama suggests that the main reason there is high species richness of tree species is because
   a. herbivores preferentially feed on the most abundant tree species.
   b. tree species basically get into sites randomly.
   c. leaf-cutter ants disperse seeds evenly throughout the forest.
   d. of the Janzen-Connell hypothesis.
   e. none of the above.
6. "Gause's landmark experiments on the coexistence of species in laboratory cultures led to" (Ricklefs, page 369) which of the following principles of ecology? [L, TB: 369]
   a. competitive exclusion principle.
   b. competitive coexistence principle.
   c. the intermediate disturbance hypothesis.
   d. all of the above.
   e. none of the above.
7. Lichens represent which of the following interactions: [FG: 206]
   a. A paired, competitor system
   b. A predator-prey system.
   c. Commensalism.
   d. Ammensalism.
   e. none of the above.
8. The beaks of the Galapagos finches were found to be similar on small islands but different when the birds of two species were found on the same, larger island. These data are probably best explained through which of the following principles of ecology? [L, TB: 390]
   a. character displacement resulting from competition.
   b. competitive exclusion.
   c. special creation of bird species having significantly different beak sizes.
   d. coevolution of complementary characters.
   e. none of the above.
9. If members of two species are grown together and we discover that the two species respond differently to the presence of the other species our results are consistent with which of the following statements?
   a. Both species exhibit a response to competition.
   b. Both species exhibit asymmetric response to predation.
   c. The two species exhibit oscillations consistent with predator-prey dynamics.
   d. All of the above.
   e. None of the above.
10. A keystone species is a species that
   a. resides at the base of a food chain.
   b. when removed, has no effect on community dynamics due to redundancies.
   c. feeds on all species below in the food web.
   d. satisfies all the above definitions.
   e. is not defined above.

Concept-exploring questions. These are hard. Please take your time. Place a very big "**X**" through the space for answers for questions you DO NOT WANT ME TO EVALUATE. **Choose 4 of 9.** (10 pts each, 40 pts total)

1. Explain the difference between these functional responses and ***explain*** which of them is an assumption of the standard Lotka-Volterra predator-prey model? [TB: 356]



2. Community A has four species with 25, 30, 40, and 140 individuals and community B has three species with 290, 300, and 310 individuals. Calculate the following:

Community	A	B
Species Richness	_____	_____
Shannon-Weiner (*H'*)	_____	_____

Which community is more diverse? Explain.

3. Graph the herbivore optimization hypothesis. Explain whether this could or could not occur in a predator-prey relationship. Label your axes clearly.

4. Why is the world green? [L, TB: 340, FG: 258-262]

5. Define Phyllis Coley's "resource availability hypothesis" and provide a graph of data that would be consistent with this hypothesis. Explain briefly why your graph supports the hypothesis.

6. Provide two graphs that depict two different forest communities where two species of owls occur. The graphs should have two axes with one resource being the vole population (N) and the other being the abundance of bunnies (B). In the community on the left (left graph) the owls have overlapping fundamental niches for both resources but have not been observed to compete. In the community in the graph on the right the two species have overlap in their realized niches yet still coexist.

7. How would you test for competition in the above example? Provide a graph of expected results that would support the hypothesis that the species compete.

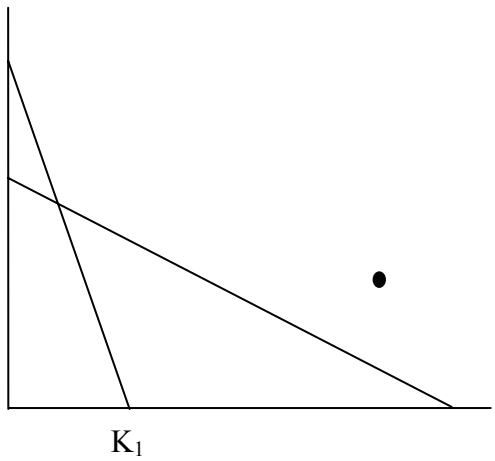
8. Draw a graph of the intermediate disturbance hypothesis. Be very careful in deciding what the axes should be. Provide units and estimated values for the axes. Explain this concept.

9. You decide you're going to build a Markov-chain model (like Henry Horn!) of the research reserve. Fortunately you discover there are only two species: oak and maple. Under all the oaks there are 130 seedlings, 80 are oak and 50 are maple. Under the maple there are 40 seedlings and 20 are oak and 20 are maple. Assuming you have 50 maple trees and 50 oak trees what will the forest look like in one time step? Be sure to show your work.

"Principles of Ecology" questions. (30 pts total)

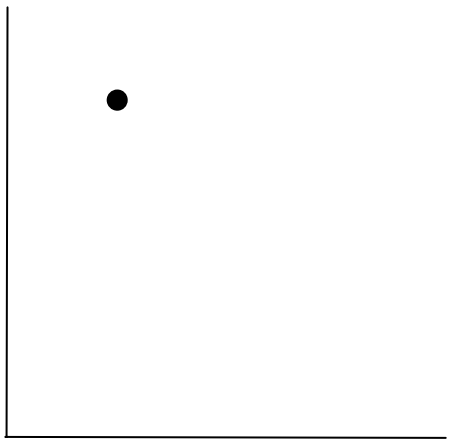
1. Lotka-Volterra competition model. (10 points)

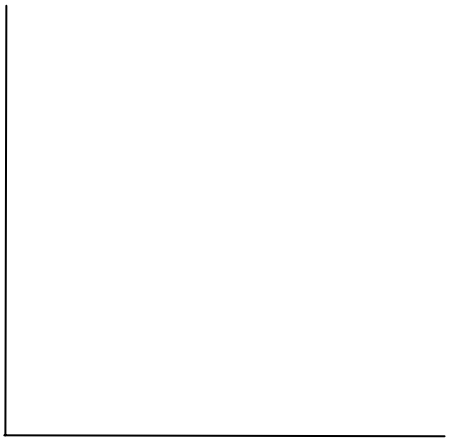
Label axes and lines for the graph on the left below. **Analyze the graph**. Using arrows show where the two populations end up, if they follow the standard Lotka-Volterra competition model and begin at the dot. **On the right** make a graph of N versus time for this system, assuming the two species begin at the dot on the left. Follow them until they reach an equilibrium. (8 pts)



2. Lotka-Volterra predator-prey model. (10 pts)

Assume density dependence and the Allee effect for the prey (R) and density dependent regulation for predators. Draw the phase-plane graph of predators versus prey below on the left. Assume that the number of herbivores that just sustains the predator population (dP/dt = 0) is just below the carrying capacity for the prey species when prey are grown in absence of predators. **Analyze the graph.** On the right provide a graph of N versus time and assume that the two species begin at the dot on the left graph. (8 pts)





3. Draw the graph for the equilibrium number of species predicted by the theory of island biogeography. Do this for four islands (two small islands that are near and far, and two large islands that are near and far). **Analyze the graph**. Briefly explain how this model would be useful for studying birds in the SUNY Geneseo Roemer Arboretum. [L, TB 451] (10 pts)

Extra Credit

Identify, describe, and provide a graph for a "principle of ecology" not covered in this exam. Analyze the graph. (5 points)