SAQ #1. Please BRIEFLY explain the two major objectives of community ecology. Please use a diagram in each of your explanations.

SAQ #2. Some argue that a resource to individuals in a population is anything that can cause an increase in the population size if its supply is increased. By this definition, offer and explain a specific hypothetical situation for which space would be a resource.

SAQ #3. What did Gause find in his laboratory studies of the competitive interaction between two species of *Paramecium* in bottle ecosystems?

SAQ #4. Consider the full model of two species **competition** below:

species 1:

$$\frac{1}{N_1} * \frac{\Delta N_1}{\Delta t} = r_1 * \left(1 - \frac{N_1}{K_1} - \frac{a * N_2}{K_1}\right)$$

species 2:

$$\frac{1}{N_2} * \frac{\Delta N_2}{\Delta t} = r_2 * \left(1 - \frac{N_2}{K_2} - \frac{b * N_1}{K_2}\right)$$

Please list what are all of the critical biologically relevant assumptions of this model.

SAQ #5. Please explain <u>in words</u> what would be the biological interpretation of an alpha value of 1.0 in the 2 species competition model above?

SAQ #6. In the graph below sketch out the plots of <u>N_1 and N_2 vs. time</u> assuming that these two species can coexist. Assume that at time = 0, species 1 is at its carrying capacity and species 2 is rare. LABEL THE AXES and LABEL ANY RELEVANT CONSTANTS ON YOUR GRAPH!

SAQ #7. What are the strengths and weaknesses of using comparative studies vs. using experimental studies to our understanding of the importance of competition in nature? {please avoid duplicating topics on both lists}

strengths of comparative studies: strengths of experimental studies:

SAQ #8. Consider the simplest possible model of two species **predator/prey interaction** below: (2 pts.)

for prey:

$$\frac{1}{\text{Prey}} * \frac{\Delta \text{Prey}}{\Delta t} = r_1 - a * \text{Predator}$$

for predator:

$$\frac{1}{\text{Predator}} * \frac{\Delta \text{Predator}}{\Delta t} = -r_2 + b * \text{Prey}$$

Please list the major assumptions of this model (including definitions of alpha and beta)

SAQ #9. What is the biological interpretation of an alpha of 0.5 ?

SAQ #10. Consider the simplest possible model of two species **predator/prey interaction** below:...

a. In the graph at right, plot the change in the population size of **Predators** using four little arrows corresponding to when Prey and Predators are common and rare.

b. In the graph at right, plot the change in the population size of **Prey** using four little arrows corresponding to when Prey and Predators are common and rare.

c. In the graph at right, combine the arrows from the two plots above...

SAQ #11. Several theorists have noticed that the predator-prey interaction (above) is truly stabilized if the coefficient alpha in the equation for the prey per capita growth rate (at left) is modified to become an increasing function of prey density. In other words, if alpha increases with more prey and decreases when prey become rare, the predators and prey will stably coexist.

Sketch a simple line or curve on the axes below that would embody the relation between alpha and the prey population size just described.

SAQ #12. There are several biological explanations of and/or justifications for this mathematical modification that in effect inserts prey-density dependence into the prey per capita growth rate equation. Your task in this question is to ...

(a). ...explain how a prey carrying capacity (prey self regulation) might cause the predator-prey relation to become stabilized?

(b). ...explain how predators who “switch” among different prey types might cause the predator-prey r (3 pts.) become stabilized?

(c). ...explain how “prudent” predators under group selection might cause the predator-prey relation to become stabilized?

I. Longer Answer Questions (12 points each) CHOOSE ANY 3 QUESTIONS

LAQ #1. This question will asses your understanding of the conditions for stable coexistence from the 2 species competition equations:

species 1:

$$\frac{1}{N_1} * \frac{\Delta N_1}{\Delta t} = r_1 * \left(1 - \frac{N_1}{K_1} - \frac{a * N_2}{K_1} \right)$$

species 2:

$$\frac{1}{N_2} * \frac{\Delta N_2}{\Delta t} = r_2 * \left(1 - \frac{N_2}{K_2} - \frac{b * N_1}{K_2} \right)$$

(a). Please explain <u>in words</u> without using any symbols or notation what is the principal <u>prediction</u> of the 2 species competition model above.

(b). It can be shown that stable competitive coexistence will always occur if two inequalities are true:

$$\frac{1}{K_2} > \frac{a}{K_1} \quad \text{and} \quad \frac{1}{K_1} > \frac{b}{K_2}$$

Show how EITHER ONE of these inequalities results directly from the 2 species competition equations above.

(c). Please briefly explain how the conditions for stable coexistence (stemming from the inequalities above) validate the "competitive exclusion principle"" which states simply that "complete competitors cannot coexist."

LAQ #2. Below shows the jaw sizes of 2 species of blind salamanders from three different caves in southeastern New Mexico. Species 1 occurs in the left two caves and species 2 occurs in the right two caves. Note that in Carlsbad Cavern, where they co-occur, their jaws are different sizes. Please offer <u>three totally different</u> biologically plausible scenarios by which the above pattern of geographic variation in jaw size could have been caused (please do not use "random chance" as an explanation).

LAQ #3. When the *Myxoma* virus was introduced to Australia the previously out-of-control introduced rabbit population rapidly crashed since that was the main host of this virus. Interestingly, the virus present today has evolved reduced virulence relative to the earlier strains. Why? Why might reduced virulence be adaptive? (Hint: the answer I'm looking for has nothing to do with group selection).

LAQ #4. This question will test your understanding of Joe Connell's field studies of competition between 2 species of barnacles in Scotland.

a. Please use a diagram and explain the field natural history observation that led Connell to suspect that competition might be occurring and caused him to conduct experimental studies to find out.

b. Please use a diagram and explain Connell's experimental design.

c. Briefly explain what were the experimental results?

d. Exactly why do these 2 species coexist? In other words, exactly what mechanisms prevented the competitive exclusion and extinction of one of the two species?

LAQ #5. This question assesses your understanding of the role of environmental variation in stabilizing two species predator-prey interactions.

Field studies and many laboratory experiments relate a very different story about the reality of predator-prey interactions in nature than is told by the simple predator-prey equations. In particular, ecologists have noted the importance of spatial and temporal variation in the environment, and the response by the individuals of each of the interacting species to environmental differences, to the landscape-level dynamics of their coexistence. That is, coexistence occurs among all of the different patches of habitat in a landscape despite that many rapid local exclusions and/or extinctions occur all the time within many of the patches.

How might spatial and temporal variation among different patches of habitat in a landscape lead to the stability of a predator-prey system? What types of environmental variation and ecological responses are needed to enable stable coexistence to occur? Please use several of the field and lab case studies from class in your response.

Please Read This Comment: You are welcome to download some or all of the material I have posted at this site for your use in your ecology course. This does not include commercial uses for profit. If you do use any lengthy exerpts (more than 2 lines) of the material above, I request that you formally acknowledge this site and/or sites I have acknowledged as the source(s). I also request that you reciprocate and send me a copy of your ecology materials so that I may see what you have put together. Please send comments to me: grant@pop1.science.widener.edu. Copyright - Bruce W. Grant, 2000.