I. Short Answer Questions (4-16 points each) DO ALL QUESTIONS

SAQ #1. Please state and BRIEFLY explain the two major objectives of community ecology. Please use a diagram for each, AND write an explanation.

SAQ #2. What are the essential and necessary conditions for competition to occur between two species?

SAQ #3. If two species exhibit high overlap in the use of a particular type of resource (e.g., they both consume prey items of the same size), why might they NOT be competing? Please offer three totally different biologically plausible scenarios for a LACK OF COMPETITION between them.

The next several questions will asses your understanding of 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:

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

SAQ #4. Please list and briefly explain what are the principal ASSUMPTIONS of the 2 species competition model above.

SAQ #5. Please explain in words without using any symbols or notation what is the principal prediction of the 2 species competition model above.

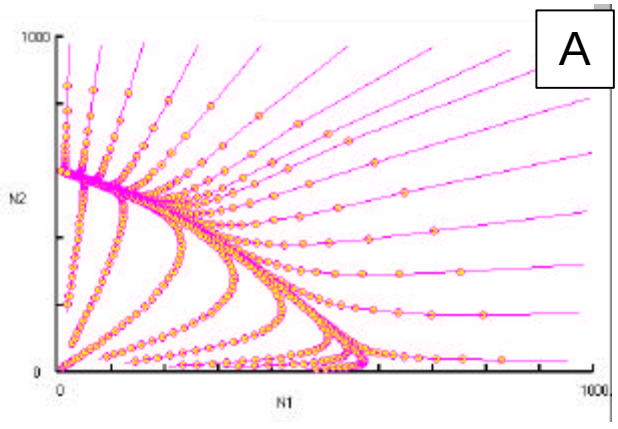
SAQ #6. It can be shown that stable competitive coexistence will always occur if two inequalities are true:

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

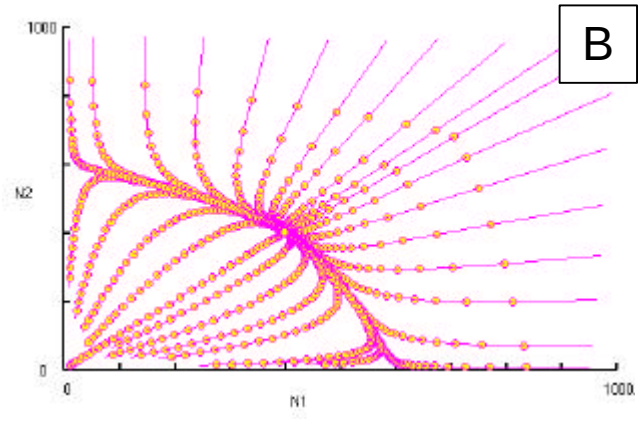
Show how EITHER ONE of these inequalities results directly from the 2 species competition equations above.

SAQ #7. Consider the two figures below that show the N_1 vs. N_2 solutions for simulations of competition with two different sets of model parameters.

{$K_1 = K_2 = 600$, alpha = 1, beta = 0.5}



{$K_1 = K_2 = 600$, alpha = beta = 0.5}



For which one is there stable coexistence? A or B (circle one)

Please explain why does one lead to stable competitive coexistence whereas the other does not?

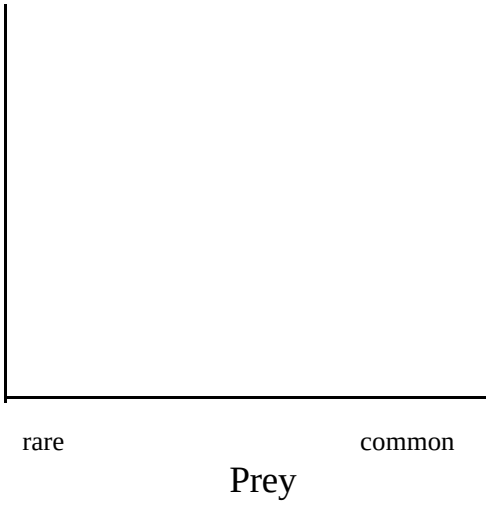
SAQ #8. Consider the simplest possible model of two species **predator/prey interaction** below:

for prey: for predator:

$$\frac{1}{\text{Prey}} * \frac{\Delta \text{Prey}}{\Delta t} = r_1 - a * \text{Predator} \qquad \frac{1}{\text{Predator}} * \frac{\Delta \text{Predator}}{\Delta t} = -r_2 + b * \text{Prey}$$

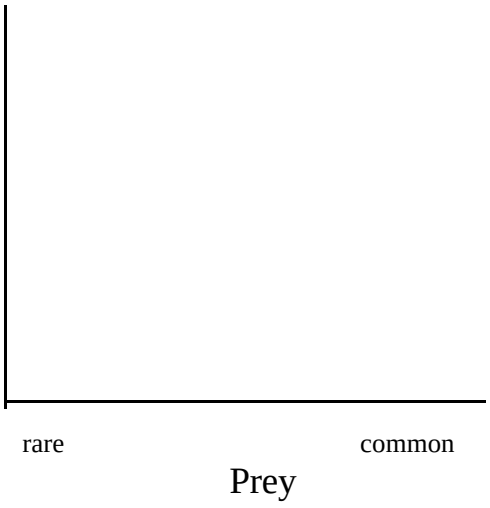
a. In the graph at right, plot the change in the population size of **Predators** using four little arrows corresponding to when Prey and Predators are common and rare.

(2 pts)



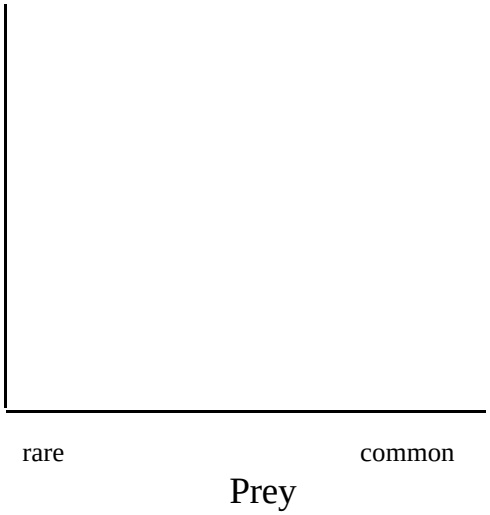
b. In the graph at right, plot the change in the population size of **Prey** using four little arrows corresponding to when Prey and Predators are common and rare.

(2 pts)



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

(4 pts)



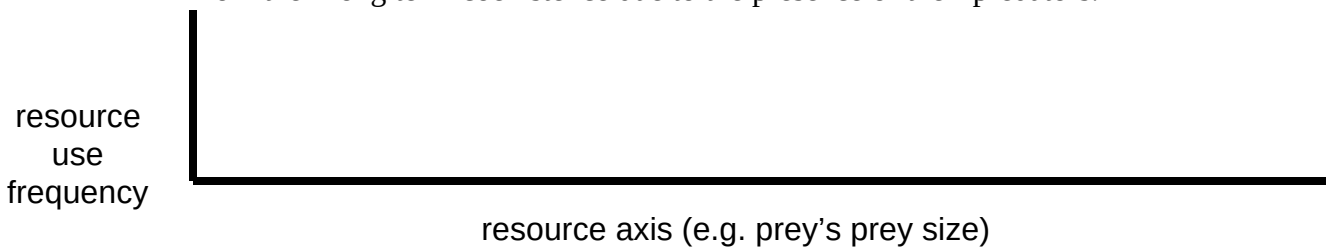
SAQ #9. According to the model from Q8, briefly explain why natural selection on the predators to improve their prey attack rate (increase alpha) will actually imperil their long term persistence.

SAQ #10. According to the model from Q8, briefly explain why natural selection on the predators to improve their prey digestive processing ability and/or reproductive rate per prey (increase beta) will actually imperil their long term persistence.

SAQ #11. Sketch a 1 dimensional resource axis for a community of species that resulted from long term competitive coexistence and with species that evolved and coevolved to reduce competition.

Briefly explain how competition can lead to increased biodiversity over evolutionary time.

SAQ #12. Sketch a 1 dimensional resource axis for a community of prey species that resulted from their long term coexistence due to the presence of their predators.



Briefly explain how predation can lead to increased biodiversity among prey over evolutionary time.

SAQ #13. According to Dr. David Reznick, who has studied life history evolution in guppies that live in streams on the Caribbean Island of Trinidad, there are major differences in guppy life history for mountain vs. lower elevation populations.

Reznick found that <u>at upstream sites</u> a small predatory fish is very common and is a voracious predator of smaller guppies, and that larger guppies have few predators. In contrast, <u>at downstream sites</u>, a different species of large-bodied predatory fish is very common and is a voracious predator of larger guppies, but that smaller guppies are not eaten.

Given these different predation regimes, what life history characteristics would you expect to evolve in the <u>guppies</u> at the high and the low elevation sites?
Specifically address your predictions about the relative differences at each population regarding: juvenile and adult mortality/ body size and age at sexual maturity/ egg size and number of eggs per reproductive event/ adult reproductive life span

LAQ#1. This question will test your understanding of Joe Connell's field studies of competition between 2 species of barnacles in Scotland.

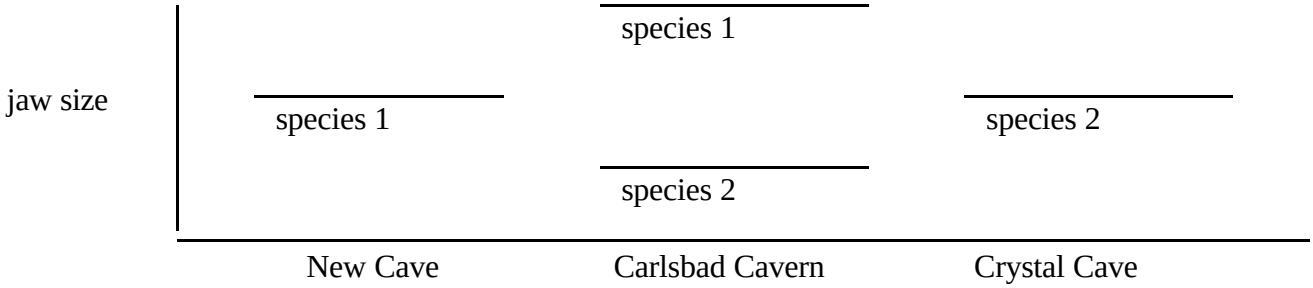
a. Please use a diagram and explain the field natural history observation that led Connell to suspect that competition might be occurring and caused him to conduct experimental studies to find out.

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 #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.



(a). Please explain how the phenomenon of "Competitive Character Displacement" could account for this pattern.

(b). Please explain how the phenomenon of "Reproductive Character Displacement" could account for this pattern.

(c). Is it essential and required to explain the pattern observed above using an hypothesis based on "coevolution" or is it possible to account for this pattern using ordinary evolution? State your position and then provide a brief supporting argument.

LAQ #3. This question will test your knowledge of the consequences of trophic interactions at the community level on the evolution of individual life histories.

a. Assume for a moment that resource supply/demand ratios completely determined the evolution of life history characters. Describe at least 5 individual life history characteristics in a population for which resource supply equals demand, (i.e. competition was at a maximum).

b. Assume for a moment that the environment were variable and unpredictable and that the relationship between juvenile and adult mortality completely determined the evolution of life history characters. Describe at least 5 individual life history characteristics in a population for which juvenile mortality were relatively high and unpredictable, (because of either competition for food or due to intense predation on juveniles by small bodied predators with bottomless appetites).