Midterm Exam, Plant Ecology
IB 154, Spring 2000

Name: ______________________________

READ EACH QUESTION CAREFULLY, ANSWER ONLY ONE IF YOU ARE OFFERED A CHOICE. PUT YOUR NAME ON EACH PAGE. IF YOU NEED TO YOU CAN WRITE ON THE BACK SIDE OF THE PAGE IN WHICH THE QUESTION APPEARS.

Choose ONE of the following two:

1. You have just been hired as a seed germination specialist for a rare plant management program. You have 6 species of rare plant that are critically endangered and must start a captive rearing, seed production program to enhance dwindling field populations. Initially you know only the genus and species name for each species. You have a limited number of seeds with which to work for all species so you want to make as few mistakes as possible.

   A. Describe two pieces of critical information you should acquire before you begin any lab work that will help you predict the types of dormancy and germination syndromes these plants are likely to have. What will each of these pieces of information tell you? Give examples.
   B. What are the some of the critical factors you might vary to break dormancy? How do these compare with factors needed to stimulate germination?

2. Howe and Smallwood present three hypotheses to explain the evolution of dispersal mechanisms in plants. Describe the "escape hypothesis" and explain two mortality factors that might work to favor dispersal. How would you distinguish between the role of these factors? (Describe an experiment)

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EVERYONE MUST ANSWER EACH OF THE NEXT THREE:

3. Aplet and Laven used a 4 stage transition matrix model (seedlings, juvenile and small versus large adults) to estimate how many individual plants they need to outplant each year to stabilize their *Tetramolopium* populations in Hawai'i. They left out the seed stage.
   a. Discuss the benefits and limitations of their approach. Include in your answer how they represent recruitment in their model.
   b. If you found out that pollinator limitation to seed set was important for this species…how would you incorporate this into a modeling exercise or how would you change their model?
   c. How might Aplet and Laven's conclusions change if the species has a large seedbank and specialized germination conditions?
   d. Describe a scenario under which the duration of their study might affect their conclusions.

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4. What causes inbreeding depression and why is it absent in selfing species?

5. Explain why the classical (Hutchinsonian) formulation of the niche provides an inadequate understanding of the realized niche and describe how Leibold resolves this problem.

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Answer **ONE** of the following two questions (6 OR 7).

Use these symbols: A = population density before competition, B = population density after competition, and k (killing power) = $\log_{10}$ B/A

6. A. Use a pair of graphs plotting k versus $\log_{10} B$ to illustrate the distinction between pure contest and pure scramble competition. Be sure to indicate the expected slopes for each situation.

   B. Discuss several reasons why plant populations rarely exhibit the pure form of either contest or scramble competition.

7. There has been great interest in demonstrating that resistance to herbivory is costly to plants. Why does this interest exist? From your readings, evaluate the evidence in support of the existence of costs and possible limitations to generalization from these studies.

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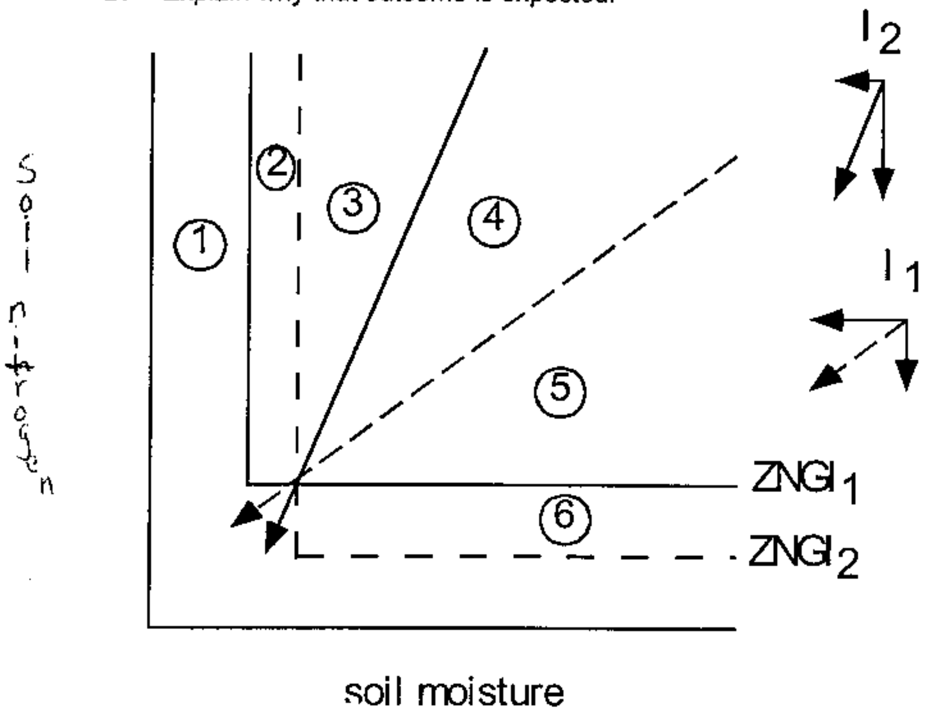
Answer **ONE** of the following two questions. (Answer either question 8 or 9).

8. The figure below illustrates a model of competition between two plant species. For supply points in each of the **SIX** sections indicated (the six circled numbers)

   A. Describe the expected equilibrium outcome.

   B. Explain why that outcome is expected.



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9. The hypothetical plant *Prunus obscuris* produces two types of defense compounds: alkaloids and tannins. Alkaloids contain both nitrogen and carbon whereas tannins are primarily carbon based. Further, in its natural habitat, *P. obscuris* occurs in both sun and shade situations, but its growth is always limited by nitrogen-poor soil. You have just collected data from a field experiment in which you manipulated light and nitrogen availability. In this experiment, you planted seedlings into four different treatments: (1) full sun, nitrogen-poor soil (control), (2) full sun, fertilized with nitrogen, (3) shaded, nitrogen-poor soil, (4) shaded, fertilized with nitrogen. At the end of the experiment, you harvested the plants and obtained: (1) leaf alkaloid content, (2) leaf tannin content, and (3) total plant biomass. The first thing you notice as you analyze the data is that you added sufficient nitrogen in the shaded, fertilized treatments to cause plants to become light-limited. You also discover that your results fit the predictions made by the Carbon/Nutrient Balance (CNB) and Growth/Differentiation Balance (GDB) theories of plant defense.

A. Use bar charts to illustrate the experimental outcome you found. Be sure to indicate the responses expected by each of the three variables in each of the four treatments.

B. Explain why CNB and GDB theories predict these outcomes.