Biology 211   **Fall 2013**
Biodiversity, Ecology, and Conservation Biology   **Dr. Bob Podolsky**

EXAM 2 Study Guide

Exam 2 will include a mixture of questions similar to the first exam (quick IDs, single choice, multiple choice, short answer, Jeopardy!, true-false, false statements, and problem solving). This study guide will help to review the concepts and skills covered in lecture and readings, but it is not an exhaustive list of actual questions that could be on the exam. Because some questions will ask you to apply what you've learned to a new problem, you should do more than read the questions below and think you know the answer because you remember hearing about it. You should write down answers and work through the problems in detail. **The best way to check your understanding of the concepts is to have someone else ask you the questions and force yourself to explain answers out loud**. For this reason I recommend that you study in groups toward the end of your studying and asking each other questions.

Unit 4. Species interactions

1) Be able to use and distinguish among the following terms: biotic, abiotic, intraspecific competition, interspecific competition, competitive exclusion, niche, fundamental niche, realized niche, niche partitioning, generalist, specialist, competitive release, character displacement, predation, carnivore, herbivore, parasite, host, cryptic coloration, aposematic coloration, mimicry, mutualism, commensalism, symbiosis

2) Explain why resource limitation is necessary for competition to occur. Give examples of different types of resources that may be limited for different types of organisms in both aquatic and terrestrial environments.

3) Distinguish two possible outcomes of competition between two species. Be able to explain conditions that would lead to each type of outcome.

4) How would changes in the quantity vs. the diversity of resources affect the likelihood of competitive exclusion?

5) Compare and contrast the concepts of fundamental and realized niches. Discuss at least one similarity and one difference between the two (hint: consider the biotic and abiotic environments). .

6) Define the type of interaction that each of the following organisms is involved in, and explain what kind of outcome of the interaction is expected at the individual and population level for each organisms involved in the interaction: competitor, herbivore, predator, parasite, pathogen, pollinator, mutualist, commensalist.

7) Describe the pattern expected and the reason for why predator and prey population dynamics can track each other. Under what conditions would such cycling be expected, and when would it not be expected?

8) Describe and distinguish among three types of adaptations involving coloration that can help prey to avoid predators.

9) Imagine a new mutation that arises in a pathogen population that allows it to infect a formerly resistant host. How will the frequency of this mutation change initially in the pathogen population? What evolutionary response do you then expect in the host population, and what kind of response is then expected in the pathogen? Explain why this phenomenon is sometimes referred to as a Red Queen effect.

10) In what way does a typical parasite population have an evolutionary advantage over its host? Describe two advantages.

11) Provide some examples of mutualisms. For each example, explain the benefit for each participant in the interaction.

12) Define what it means be a resource specialist, if specialization is seen in the realized niche but not the fundamental niche. Do the same for a situation where specialization is seen in the fundamental niche. Explain which of the two cases is more likely to make a species vulnerable to extinction.

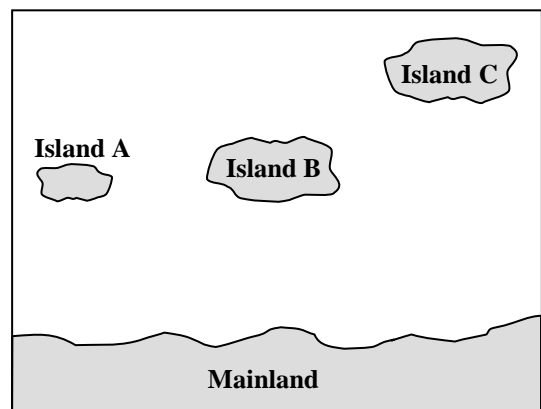**Experimental design problems**

13) Design a simple experiment to determine the fundamental and realized niche of a plant species that is found growing on north-facing but not south-facing slopes of a valley. State two different ecological hypotheses to explain this pattern, and then graph two different results that would support one or the other of your two hypotheses. Describe what each outcome would tell you about the fundamental and realized niche of the species. What additional treatment should be included in your experiment as a control?

14) Design a simple experiment to determine whether an association between two symbionts is mutualistic, commensal, or parasitic. Sketch the results that you would expect if the relationship were mutualistic and another set of results that you would expect if the relationship were parasitic.

15) Design a simple experiment to determine whether biotic or abiotic factors most strongly affect a particular plant species within a New England salt marsh community. Graph two sets of results that would reflect whether one or the other component has the strongest effect for the particular species.

16) Describe at least two alternative hypotheses (one evolutionary, one ecological) to explain the observation that two species appear to partition a resource where they are sympatric but not where they are allopatric.

Unit 5. Community ecology

1) Be able to use and distinguish the following terms: community, equilibrium vs. nonequilibrium, intermediate disturbance hypothesis, indirect effect, species diversity, species richness, keystone species, succession, primary succession, secondary succession, pioneer community, climax community, shifting mosaic model, biogeography, island biogeography

2) Explain thoroughly and give an example of how indirect effects, environmental heterogeneity, and disturbance can each promote the coexistence of species. Do these examples invalidate the competitive exclusion principle? Why or why not?

3) Be able to diagram both direct and indirect effects among a set of species interactions, for example, interactions among beavers, cottonwoods, leaf-eating beetles, and beetle predators.

4) Be able to predict the effects on community structure if a top predator prefers to eat a species that is competitively inferior vs. a species that is competitively superior.

5) Jane Lubchenko studied the effects of a snail, *Littorina*, on an algal community. She found that when the snails were common, a red alga, *Chondrus*, was very abundant in the community. When snails were removed, over time the green alga, *Enteromorpha*, became

more abundant than *Chondrus*. Predict (a) which species of algae *Littorina* prefers to eat and (b) which species of algae is competitively superior.

6) Lubchenko used three levels of herbivory in her experiment, and found that over time diversity in the algal community was greatest in the treatment with the greatest density of snails. Think and explain carefully why this result might have occurred.

7) In lecture, we discussed Sousa's research on the effects of boulder size on species diversity in an intertidal community. Compare and contrast the results of Sousa's study with Lubchenko's findings on the effect of *Littorina* on algal species richness. Explain the mechanisms that can promote or inhibit species diversity in each case.

8) According to the intermediate disturbance hypothesis, both low and high levels of disturbance can reduce species diversity. Explain the different mechanisms responsible for a reduction in species diversity at either extreme. Include in your answer an understanding of trade-offs between competitive and dispersal abilities.

9) Explain the role of competition during the process of succession. Predict how biodiversity is likely to change during the process of succession. Be able to draw connections between the process of succession and the level of species diversity resulting from different frequencies of disturbance.

10) Imagine that a new volcanic island has been formed. Predict how biodiversity on the island is likely to change over time. Graph and explain your prediction.

11) Imagine that a new land-bridge island has been formed (land bridge islands form when sea level rises, covering over parts of a former continuous land mass and leaving only the highest areas above water). Predict how biodiversity on the island is likely to change over time. Graph and explain your prediction. Contrast your answer with the previous question.

12) When humans manage landscapes they often like to reduce the effects of natural disturbances like hurricanes, floods, and fire in order to protect their own communities. Explain what effect in general these forms of control are likely have on the biodiversity of natural communities.

13) Suppose you are planning to study the bird communities on the islands shown in this figure. Islands A and B lie equal distances from the mainland but differ in area, while islands B and C are identical in area but lie at different distances from the mainland. (a) According to the equilibrium model of island biogeography, which of the islands should experience higher rates of immigration? Explain your prediction. (b) What does the equilibrium model of island biogeography predict concerning relative rates of extinction on these three islands? Explain your prediction. (c) Where would you expect the equilibrium number of species to be highest? Be able to illustrate your answers and prediction graphically.

14) Make an argument for why the theory of island biogeography can be useful for conservation biology.

15) List the four treatments used by Suarez and Case to compare growth rates in hatchling lizards. Then, explain what effect can be detected in the pairwise comparisons of treatments made from their dataset that are essential to testing their main hypotheses.

16) Contrast how diversity in a New England salt marsh would likely be affected by (a) a reduction in the frequency of natural disturbances, and (b) a reduction in the size of areas impacted by disturbances. Considering that large disturbances usually happen less frequently, is it possible to say which disturbance regime (large and infrequent vs. small and frequent) would lead to higher diversity?

17) Use the shifting mosaic model to explain how disturbance, succession, and habitat heterogeneity influence biodiversity. Sketch an area with different patches of disturbance to support your answer.

Unit 6. Ecosystems and Human Impacts

1) Be able to use and distinguish the following terms: ecosystem, biosphere, food chain, food web, trophic level, biomass, primary production, secondary production, consumer, decomposer, biogeochemical cycle, climate, microclimate, biome, ecological footprint, anthropogenic, greenhouse effect, ocean acidification

2) What determines how many trophic levels an ecosystem can support?

3) Speculate about the reason for following observation: carnivores are often less specialized in diet than herbivores.

4) Why is the biomass of producers within an ecosystem always greater than the biomass of consumers within the same ecosystem? More generally, explain what accounts for the reduction of productivity at each successively higher trophic level.

5) Compare and contrast how energy and nutrients each move through an ecosystem. Discuss at least one similarity and one difference between the two related to how they move.

6) Explain why the tilt of the earth results in different seasons.

7) List the major factors that lead to the creation of distinct climates. Give an example of how differences in these factors can lead to distinct biomes. Be able to name several major biomes and describe their basic characteristics.

8) Do a simple sketch of the global carbon cycle, including the major reservoirs for carbon and the major pathways by which carbon is moved among these reservoirs. Describe two ways in which humans are altering the movement of carbon among reservoirs.

9) Describe the historical evidence supporting the hypothesis that changes in the global carbon cycle are likely to lead to changes in global climate.

10) Describe two distinct negative consequences of introducing more CO2 into the atmosphere.

11) What kinds of land use are involved in calculating an ecological footprint?

12) Explain what an understanding of the average human ecological footprint helps us to understand about the carrying capacity of humans on the planet.

13) An enthusiastic ecology student has predicted that birds in cold climates are likely to require a different number of calories than birds in warm climates. Give the null hypothesis and the alternative hypothesis for this prediction. The student experimentally tested the prediction. The results of the t-test were as follows: $t = 1.1920$, $P = 0.09$. State the statistical hypotheses and an appropriate conclusion about them. Also, state explicitly what "P" (0.09) gives the probability of.