Study Guide for Midterm #2

CLIMATE AND PHYSIOLOGICAL ECOLOGY

Chapter 5 - Temperature relations

What are ectotherms, endotherms, and heterotherms? What are homeotherms and poikilotherms? How do these terms relate to each other? What organisms are examples of each?

What is the basic equation for heat balance? What are the six primary components? Which ones are one-way fluxes and which are two-way fluxes? What are the primary variables that determine the magnitudes of each of those components of heat flux?

Chapter 5 lists lots of different adaptations for both ectotherms, endotherms, and heterotherms for maintaining heat balance. While there are a wide variety of adaptations, in one way or another each manipulates one (or more) of the six fundamental heat flows. Categorize those adaptations according to which pathway they act upon. Which adaptations influence more than one pathway? Which adaptations are specific to one group of organisms or another (e.g., plants vs. ectos vs. endos vs. heteros)?

How might global climate change influence animal temperature balance? Are mean or extreme temperatures more likely to influence species ranges? How do temperature adaptations and tolerance relate to the law of tolerance discussed previously?

Chapter 6 - Water relations

What is water potential and what are its fundamental components? Which components are most relevant to plants and in what ways? to animals? Which direction does water flow in relation to each of those components? What is the tension-cohesion mechanism of water transport in plants and how does it work? What are the main "control points" of this water flow and how do plants regulate them? How do air temperature and relative humidity account for differences in evaporation rates? What are field capacity and wilting points (conceptually) in soils? How does evaporation relate to both water balance and thermal balance in organisms? How are different approaches to this link exemplified by cicadas and scorpions in desert environments? How does evaporation/transpiration relate to photosynthesis in plants? What is the difference between vapor-limited vs. membrane-limited rates of evaporation? How do these relate to habitat and behavioral limitations for moist-skinned species? Are there tradeoffs for non-moist-skinned animals? What controls evaporation rates from moist-skinned animals? Does this hold for all animals? What about plants?

What are the inputs and outputs in the water balance for terrestrial animals and plants? The book lists a number of animal and plant adaptations that regulate water balance. To which input/output components are these different adaptations relevant? Are any of them restricted to certain groups of organisms?

What is the difference between isoosmotic, hypoosmotic, and hyperosmotic? In which environments would you expect to find organisms of these different types? How does water stress differ for animals in marine and freshwater systems? What adaptations do organisms in these different systems have to cope with their particular environment? Do all fish do this in a similar way? What must happen physiologically with respect to these adaptations to hypoosmotic and hyperosmotic environments when salmon migrate from fresh to salt water and back again?

We covered the following questions on the previous test, but they're also relevant to water balance: What are the primary differences among C3, C4, and CAM photosynthesis? What are the advantages and disadvantages of each? Under what conditions would you expect plants to use these different photosynthetic mechanisms? How do you account for the difference in distribution between C3 and C4 grasses?

POPULATION ECOLOGY

Equations (you don't have to memorize these, but you do need to know how to use and manipulate them)

$$N_t = N_0 e^{rt} \qquad N_t = N_0 \lambda^t \qquad e^r = \lambda, \text{ or } r = \ln(\lambda)$$

$$R_0 = \Sigma(l_x m_x) \qquad T_G = [\Sigma(x l_x m_x)] / \Sigma(l_x m_x) \qquad r = \ln(R_0)/T_G$$

$$dN/dt = rN \qquad dN/dt = r_{max} N(1-K/N)$$

Chap. 9. Population distribution and abundance

Population properties. What are some of the important properties of populations? Terms and concepts to know: Population, distribution, Abundance, Density, Age distribution, Immigration, Emigration, growth rate, demographics

What factors limit the distribution of a population of organisms? What do patterns of distribution (random vs. regular vs. clumped) tell us about the ecology of individuals in that population? How does organism size influence population density (number of individuals in a given area)?
Rarity - What are the 3 factors involved in describing rarity? What are the 7 types of rarity? How do these relate to the probability of extinction?

Chap. 11. Population Growth
Geometric and exponential growth. When do you use the exponential growth equation and when do you use the geometric growth equation? In what sorts of ecological situations do each of these apply? Know how to use and manipulate these equations. What is the relationship between r, birth rates, death rates, immigration and emigration?   What are the critical points for r and lambda that determine whether a population is increasing or decreasing? Does r change over time in the exponential growth equation, and if so how? How do body size and life history influence typical values of r for different types of organisms? How does this relate to the idea of r and K selection (below)?

Logistic growth.
What is the equation for logistic growth? What is the typical pattern of logistic growth? What is carrying capacity? What are the assumptions of the logistic growth equation? What is the inflection point?   How do dN/dt and r change as population size changes under logistic growth? When is dN/dt maximum? When is realized r the highest?
What is density-dependent population regulation? Density-independent population regulation? What mechanisms are responsible for each?

Human demographics
How does human population distribution differ across continents? Within continents? What pattern describes human population growth over the previous 2000 years? Is this likely to change in the foreseeable future? What is K for humans on this planet? What factors are likely to influence that? What is Ehrlich's equation for how human population influences the environment (and ecosystem services and K)? How does age structure in different countries influence their likely patterns of growth in the near future (i.e., next couple of decades)?

Chap. 10. Population dynamics
Survivorship and fecundity curves
What are the different kinds of survivorship curves? How do these relate to the life histories of different organisms (e.g., tradeoffs in survival and reproduction, r- vs. K-selection)?
What are the different kinds of life tables? How are they generated? What are some of the assumptions or difficulties of each?

Age distributions - how are these useful? What can they tell you (or not tell you) about a population's growth or decline? What is a stable age distribution?

Life tables
What information is necessary to estimate population growth rates using a life table?
What are the differences between overlapping and non-overlapping generations? Discrete vs. continuous reproduction? What is the relationship between λ, R_o, and r? Be able to calculate R_o, T_g, and r from a fecundity table given l_x and m_x . Know what l_x and m_x are, how they are calculated, and what they tell you about the life history of an organism (e.g., regarding the three basic types of survivorship curves). What is r and how does it relate to birth rates, death rates, immigration and emigration?

Chap. 12. Life Histories
 Understand and be able to describe the basic tradeoffs in different life history strategies (e.g., growth vs. reproduction, different strategies for reproduction)? How might different environments select for different strategies? Can you give some examples of each from the lecture and the book?
What is the difference between r- and K-selection? How does this differ from Grime's CSR model of life histories? What kinds of traits are involved in each? Under what environmental conditions might different strategies be advantageous?

BIODIVERSITY AND COMMUNITY STRUCTURE
Introduction
<u>Terms and concepts</u>: Richness, evenness, composition, species dominance/abundance, Shannon-Weiner index, alpha diversity, beta diversity, gamma diversity, global diversity, log-normal distribution, rank abundance curves
What are the five main global changes and which are currently having the strongest effects on biodiversity loss? What is meant by the "sixth extinction"? What are ecosystem services and how do they relate to ecosystem processes? What does the term "biodiversity" mean and what does it encompass, both in terms of levels of ecological organization and different aspects of diversity?

COMMUNITY INTERACTIONS
Chap. 13 Competition
What are the basic types of community interactions? What are interference and exploitative competition? Intraspecific vs. interspecific competition? How does intraspecific competition relate to the logistic curve of population growth? What is a niche and why is a niche described as an "n-dimensional hypervolume"? What are fundamental and realized niches? Why might they differ for a given organism? How are they related to population distributions (Chap. 9)? How are they related to competition, predation and mutualisms? How does the relationship of among *Galium* species relate to fundamental and realized niches?
What is the competitive exclusion principle and how does it relate to the concepts of resource partitioning and character displacement? Why might character displacement be described as the 'ghost of competition past'? Why might the outcome of competition depend on environmental conditions? Can you relate this to the law of tolerance that we discussed for the last exam? How can interactions with other species (e.g., predators) alter predictions of competitive exclusion? What two key assumptions must met for a predator to allow coexistence between two species that might otherwise exclude each other?
What are Lotka-Volterra competition equations? How do they relate to logistic growth equations? What predictions do they make for coexistence of two species? What parameters do those predictions depend on? What are the assumptions of the Lotka-Volterra models?