

Study Guide - Midterm #1

PHYSIOLOGICAL ECOLOGY

Introduction

Climate

What is the difference between climate and microclimate? What are the main factors that determine climate? What are the factors that determine microclimate?

What are potential evapotranspiration and actual evapotranspiration? How do they relate to precipitation and temperature in determining water availability? How do they differ in warmer and cooler climates or microclimates?

What are the major biome types? How do biomes vary with climate across North America when going from north to south? from east to west? What organisms define biomes? How can climate diagrams be used to understand the distribution of biomes?

Organism adaptations and tolerance

Know the terms we discussed. What is the meaning of “adaptation”? What is the “law of tolerance”? What are its various components? How does tolerance relate to acclimatization in organisms? Over what relative time scales do adaptation and acclimatization operate? What are some examples of each?

What are phenotypes, genotypes and ecotypes? If you had plants of the same species living in different environments, describe an experiment that would help you determine if differences were genetically based. How might the results depend upon the phenotypic plasticity of that species?

Temperature relations

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

What are the components of heat gain and loss for an organism? 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?

Your text lists lots of different adaptations for 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., ectos vs. endos)?

How might global climate change influence animal temperature balance? Are mean (average) or extreme temperatures more likely to influence species' ranges?

Water relations

What is water potential and what are its fundamental components? Which components are most relevant to plants? Which direction does water flow in relation to each of those components?

What properties of air account for differences in evaporation rates? What single term best expresses the desiccating power of air? How does this relate to both water balance and thermal balance?

What is the tension-cohesion mechanism of water transport in plants?

What are some plant adaptations to habitats with low water availability? Why do plants close their stomata with low water availability and what effect does this have on photosynthesis? What are some plant adaptations to areas

with particularly high and particularly low water availability? How are heat stress, water stress, light stress and carbon fixation all linked in a plant?

What do the terms isoosmotic, hypoosmotic, and hyperosmotic mean? 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 are the inputs and outputs in the water balance for terrestrial animals? Your text lists a number of animal adaptations that regulate water balance. To which input/output components are these different adaptations relevant?

Energy and nutrient relations

How do you expect light availability (intensity and quality) to change from the top of a forest canopy to the bottom? From the surface of a body of water to the bottom? Given the absorption spectra of photosynthetic pigments, what consequences does this variation have for plants and algae?

What are light response curves for photosynthesis, and what are the important points in those curves? How does the response of photosynthesis to varying light levels differ for sun and shade plants? Why do these differences make sense given the light environments of sun and shade plants?

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)

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

$$R_0 = \sum(l_x b_x) \qquad T_G = [\sum(x l_x b_x)] / \sum(l_x b_x) \qquad r = \ln(R_0) / T_G$$

$$dN/dt = rN$$

Population distribution and abundance

Population properties. What are some of the important properties of populations? Terms and concepts to know:

Population density; relation of density to body size

Abundance

Age distribution

Immigration

Emigration

Rarity - What are the 7 types of rarity (see your textbook)? How do these relate to the probability of extinction?

Population Growth

Exponential growth. When do you use the exponential growth equation and when do you use the geometric growth equation? Know the equations, and how to use them ($N_t = N_0 e^{rt}$, $dN/dt = rN$, $N_t = N_0 \lambda^t$).

Population dynamics

Survivorship curves

What are the different kinds of survivorship curves? How do these relate to the life histories of different organisms?

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 is the relationship between λ , R_0 , and r ? Be able to calculate R_0 , T_g , and r from a fecundity table given l_x and $b_x (=m_x)$. Know what l_x and b_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?

What is the difference between s_x and l_x ?

Population Growth

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 r maximum?

What is density-dependent population regulation? Density-independent population regulation? What mechanisms are responsible for each?

Life Histories

Life history strategies

What are some important reproductive tradeoffs in life history strategies? Why do these tradeoffs exist?

What are the basic life history characteristics? What is r-selection? K-selection? How do these relate to the logistic curve? What suites of characteristics are associated with each type of selection? What are some organisms that are examples of each?

What is the C-S-R scheme of life history strategies for plants? What characteristics are associated with each?