Ecology Review

A: Top Ten

1. Populations
    - Group of individuals of same species living in the same area at the same time
    - Habitat vs. niche
    - Competition

    a. Survivorship curves
        - Type 1 = most live long life = k selected
        - Type 2 = constant death rate
        - Type 3 = most die young = r selected

    b. Age structure

    c. Population growth
        - $\Delta N / \Delta T = rN$
        - Biotic potential
            - Age at reproductive maturity, clutch size, frequency of reproduction, reproductive lifetime, survivorship of offspring
        - Limiting factors
            - Density dependent
            - Density independent
        - Exponential growth
        - Carrying capacity

    d. Human population growth

2. Communities

    a. Interspecific competition
        - Competitive exclusion principle – no two species can occupy the same niche
        - Resource partitioning – species seemingly coexist in same area, but actually occupying slightly different niches
        - Character displacement – selection of adaptation that reduce competition
        - Keystone species – important regulating effect on community

    b. Symbiosis = species interaction (just in case the terms are used in a question)
        - Mutualism
        - Commensalism
        - Parasitism
        - Predation
        - Competition

    c. Coevolution
        - Defense mechanisms

    d. Ecological succession
        - Predictable change in composition of species in community over time
        - Pioneer species (lichens and moss) ------shrubs ----- small trees ----- large trees / climax community
        - Primary vs. secondary

    e. Island Biogeography

3. Ecosystems

    a. Net Primary Productivity and Gross Primary Productivity

    b. Energy flow / production = energy flows through; 90% lost at each trophic level and 10% transferred to next level
        - Trophic levels
        - Ecological pyramids
        - Food chains & food webs

    c. Nutrient cycles = flow of essential elements from environmental pool through food web and recycled back by decomposers
        - Cycles: water, carbon, nitrogen

4. Human impact

    a. Greenhouse effect / global warming

    b. Ozone depletion

    c. Pollution
        - Biomagnificaiton
        - Eutrophication

    d. Deforestation

    e. Loss of species diversity

B: Sample Multiple Choice Questions

1. All of the following are density-dependent factors that limit animal populations EXCEPT
   a. Weather
   b. Predation
   c. Birthrate
   d. Food competition
   e. Mortality

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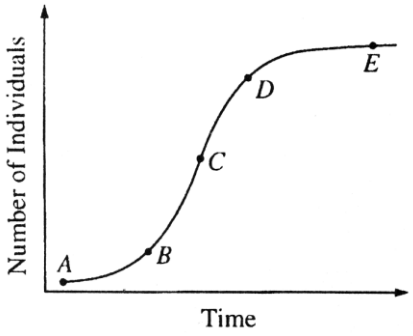
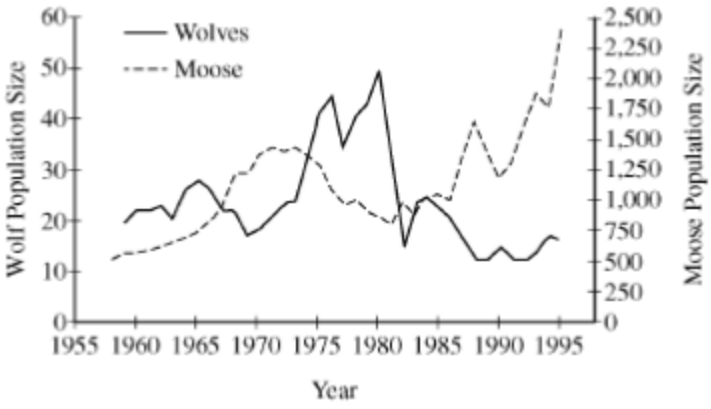
2. Which of the following is true about secondary consumers in an ecosystem?
   a. They eat only plants.
   b. They are eaten by primary consumers.
   c. They are smaller and weaker than are primary consumers.
   d. They are fewer in number than are primary consumers.
   e. They contain the greatest total biomass in the system.

3. Which point on the curve in the diagram below best represents the carrying capacity of the environment for the population shown?
   a. A
   b. B
   c. C
   d. D
   e. E

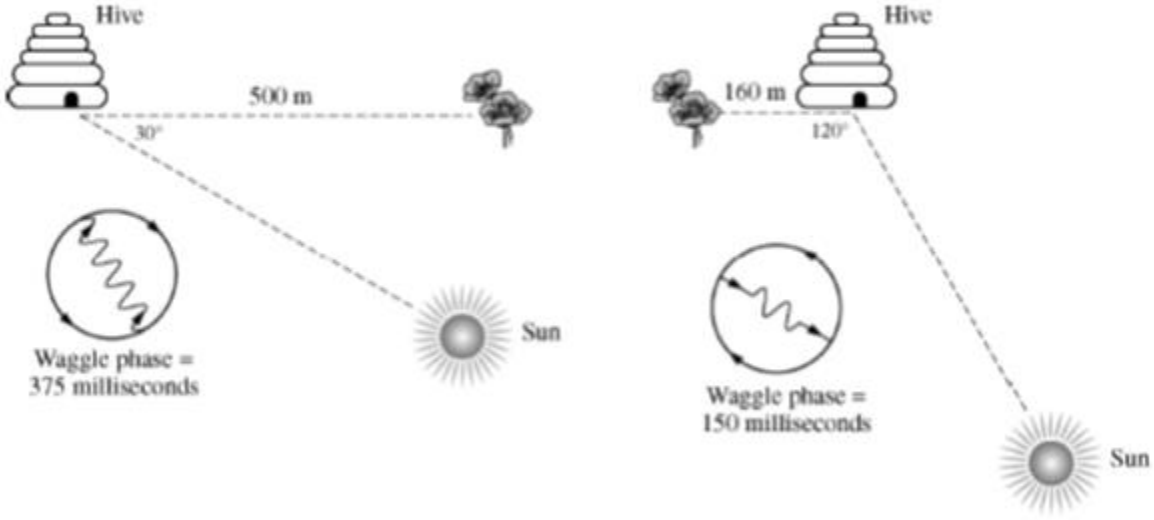


4. Which of the following best explains why there are seldom more than five trophic levels in a food chain?
   a. Most carnivores function at more than one trophic level.
   b. Trophic levels above this number contain too many individuals.
   c. Top carnivores are too few in number to prey effectively.
   d. The ecosystem contains too much biomass.
   e. Energy is lost from each trophic level.

5. Two populations of a species of squirrel are geographically isolated from each other. Although they have the same population density, one population is significantly larger in number than the other. A new bacterial disease, which is easily spread and extremely virulent, affects both populations at the same time.
Which if the following is the best prediction of how the new disease will affect the two populations?
A. The two populations will be equally affected, because the ability to trigger the immune response is randomly distributed among all squirrels of that species.
B. The larger population will be less affected by the disease than the smaller population, because the mutation rate of the larger population is higher than the mutation rate of the smaller population.
C. The smaller population will be more affected than the larger population, because the smaller population has less genetic variation that the larger population.
D. The smaller population will be less affected than will the larger population, because the smaller population exhibits more genetic drift than the larger population exhibits.



6. The graph represents the number of individuals in a population of wolves and in a population of moose observed in the same isolated geographic area over a 40-year period, from 1955 to 1995. Which of the following statements about the two populations is best supported by the information presented in the graph?
A. The reproductive rate if the wolves was greater than the reproductive rate of the moose.
B. Mutualism allowed the two populations to reproduce while occupying the same ecological niche.
C. Speciation occurred when the two populations became reproductively isolated from each other.
D. The wolves were predators of the moose, which were otherwise reproductively successful.



7. As depicted in the diagram, honeybees communicate the location of flower patches to members of their hives with waggle dances that give information about the direction and distance to the flowers. Which of the following statements about how honeybees communicate the position of flower patches is most consistent with the model?
A. The number of repetitions of the waggle dance indicates the quality of the pollen source.
B. The total area covered by any waggle dance leads bees to the target flowers.
C. The angle of the waggle phase relative to the vertical plane indicates the position of the target flowers relative to another beehive.
D. The farther the target flowers from the hive, the longer the waggle phase.

8. **Completion Question.** Biological communities containing a large number of species that are evenly distributed exhibit high species diversity – a concept that encompasses both species richness (the number of different species present) and the relative abundance (the number of individuals of each species). One measure of species diversity is Simpson's index of diversity, which is represented by the following mathematical equation.

$$D_s = 1 - \frac{\sum n_i(n_i - 1)}{N(N-1)}$$

Where D_s = index of diversity for a community
N = total number of individuals of all species
n_i = number of individuals in each individual species

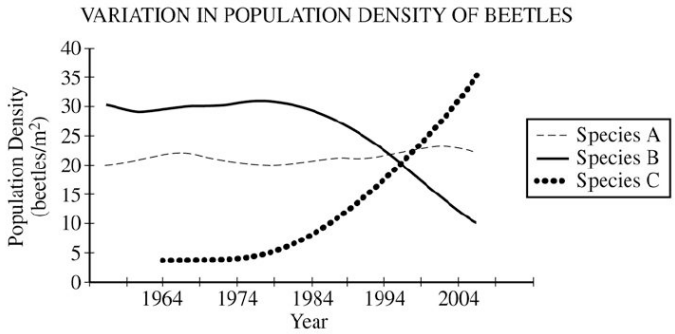
The following data were collected from a community of trees.

Species	Number of individuals
1	20
2	34
3	4
4	10
5	68

Calculate the Simpson's index of diversity for the community of trees. Enter your answer as a value between 0 and 1 to the nearest hundredth.

C: Sample Free Response Questions

1.



According to fossil records and recent published observations, two species of leaf-eating beetles (species A and B) have existed on an isolated island in the Pacific Ocean for over 100,000 years. In 1964 a third species of leaf-eating beetle (species C) was accidently introduced on the island. The population size of each has been regularly monitored as shown in the graph above.

a. Propose an explanation for the pattern of population density observed in species C.
b. Describe the effect that the introduction of beetle species C has had on the population density of species A and species B. Propose an explanation for the patterns of population density observed in species A and species B.
c. Predict the population density of species C in 2014. Provide a biological explanation for your prediction.
d. Explain why invasive species are often successful in colonizing new habitats.

2. The energy flow in ecosystems is based on the primary productivity of autotrophs.

a. Discuss the energy flow through an ecosystem and the relative efficiency with which it occurs.
b. Discuss the impact of the following on energy flow on a global scale
- Deforestation
- Global climate change

3. Consumers in aquatic ecosystems depend on producers for nutrition.

a. Explain the difference between gross and net primary productivity.
b. Describe a method to determine net and gross primary productivity in a freshwater pond over a 24-hour period.

4. Fiddler crabs are common residents of salt marshes feeding on dead partially salt marsh grass (detritus). A group of students visited a salt marsh. Using one-meter quadrats they randomly sampled 6 different locations and counted the number of fiddler crabs in each one square meter plot. The data are presented in the table.

Quadrat	Fiddler crabs
1	16
2	5
3	12
4	7
5	2
6	8

The size of the marsh is 20 Km^2. Calculate the average number of fiddler crabs per square Km in the marsh. Give your answer to the nearest thousand.

5. The introduction of new species often has devastating consequences on native species.
Choose one of the below and discuss how it was introduced and the consequences of its introduction.

- Zebra muscle
- Asian carp
- Dutch elm disease

6. A population's ability to respond to changes in the environment is affected by its genetic diversity.
    a. Explain why genetic diversity is beneficial to the long-term survival of a population.
    b. Choose ONE of the examples below and discuss why the population is at risk of extinction.
        - California condor
        - Prairie chickens
        - African Cheetah

Principles of Life: Chapter Breakdown (Essential Exam Content)

Chapter 41: The Distribution of Earth's Ecological Systems

41.1 Ecological Systems Vary over Space and Time

- Organisms and their environments are ecological systems
- Ecological systems can be small or large

41.4 Biogeography Also Reflects Geological History

- Phylogenetic methods contribute to our understanding of biogeography

41.5 Human Activities Affect Ecological Systems on a Global Scale

- We are altering natural ecosystems as we use them
- We are replacing natural ecosystems with human-dominated ones
- We are blurring biogeographic boundaries
- Science provides tools for conserving and restoring ecological systems

Chapter 42: Populations

42.1 Populations are Patchy in Space and Dynamic over Time

- Population density and population size are two measures of abundance
- Abundance varies in space and time

42.2 Births Increase and Deaths Decrease Population Size

42.3 Life Histories Determine Population Growth Rates

- Life histories are diverse
- Resources and physical conditions shape life histories

42.4 Populations Grow Multiplicatively, but the Multiplier Can Change

- Multiplicative growth with constant *r* can generate large numbers very quickly
- Populations growing multiplicatively with constant *r* have a constant doubling rate
- Density dependence prevents populations from growing indefinitely

42.5 Immigration and Emigration Affect Population Dynamics

42.6 Ecology Provides Tools for Conserving and Managing Populations

Chapter 43: Ecological and Evolutionary Consequences of Interactions within and among Species

43.1 Interactions between Species May Increase, Decrease or Have No Effect on Fitness

- Interspecific interactions are classified by their effect on fitness
- The effects of many interactions are contingent on the environment

43.2 Interactions within and among Species Affect Population Dynamics and Species Distribution

- Interspecific interactions can modify per capita growth rates
- Interspecific interactions affect population dynamics and can lead to extinction

- Interspecific interactions can affect species distribution
- Rarity advantage promotes species coexistence

43.3 Species are embedded in Complex Interaction Webs
- Consumer-resource interactions form the core of interaction webs
- Losses or additions of species can cascade through communities
- The cascading effects of ecological interactions have implications for conservation

43.4 Interactions within and among Species Can Result in Evolution
- Intraspecific competition can increase carrying capacity
- Interspecific competition can lead to resource partitioning and coexistence
- Consumer-resource interactions can lead to an evolutionary arms race
- Mutualisms involve conflict of interest

Chapter 44: Ecological Communities

44.1 Communities Contain Species That Colonize and Persist

44.2 Communities Change over Space and Time
- Species composition varies along environmental gradients
- Several processes cause communities to change over time

44.3 Community Structure Affects Community Function
- Community function is affected by species diversity

44.5 Community Ecology Suggests Strategies for Conserving Community Function
- Island Biogeography suggests strategies for conserving community diversity

Chapter 45: The Global Ecosystem

45.1 Climate and Nutrients Affect Ecosystem Function
- NPP is a measure of ecosystem function
- NPP varies predictably with temperature, precipitation and nutrients

45.2 Biological, Geological and Chemical Processes Move Materials through Ecosystems
- The forms and locations of elements determine their accessibility to organisms
- Movement of matter is driven by biogeochemical processes

45.3 Certain Biogeochemical Cycles are Especially Critical for Ecosystems
- Water transports materials among compartments
- Within-ecosystem recycling dominates the global nitrogen cycle
- Movement of carbon is linked to energy flow through ecosystems
- Biogeochemical cycles are not independent

45.4 Biogeochemical Cycles Affect Global Climate
- Earth's surface is warm because of the atmosphere
- Recent increases in greenhouse gases are warming Earth's surface
- Human activities are contributing to changes in Earth's radiation budget

45.5 Rapid Climate Change Affects Species and Communities
- Rapid climate change presents ecological challenges
- Changes in seasonal timing can disrupt interspecific interactions
- Climate change can alter community composition by several mechanisms
- Extreme weather events also have an impact

45.6 Ecological Challenges Can be Addressed through Science and International Cooperation