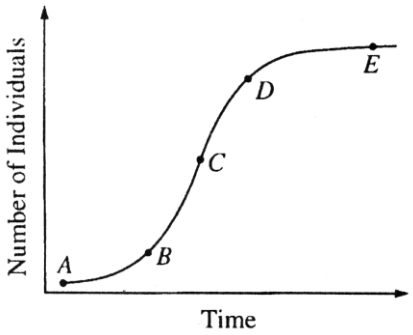
Ecology Review: Key

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

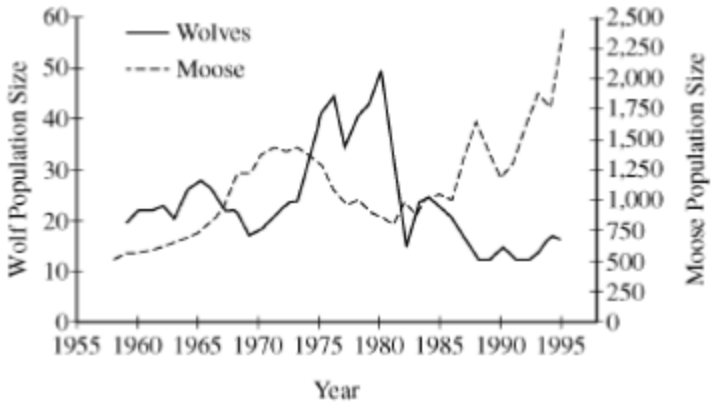
2. Which of the following is true about secondary consumers in an ecosystem?
   a. They eat only plants.
   b. They are eaten by primary consumers.
   c. They are smaller and weaker than are primary consumers.
   d. They are fewer in number than are primary consumers.
   e. They contain the greatest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

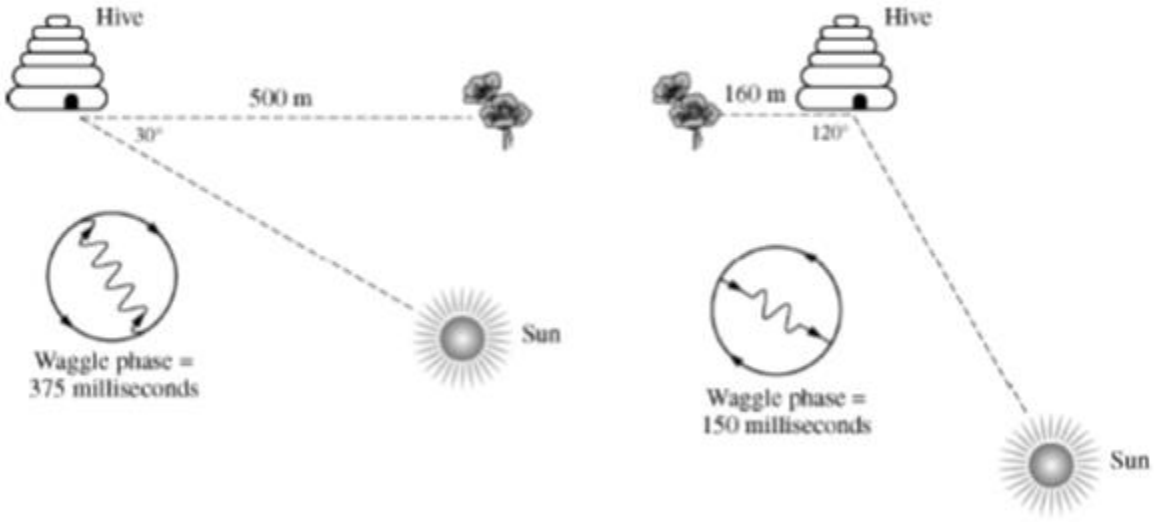


4. Which of the following best explains why there are seldom more than five trophic levels in a food chain?
   a. Most carnivores function at more than one trophic level.
   b. Trophic levels above this number contain too many individuals.
   c. Top carnivores are too few in number to prey effectively.
   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.

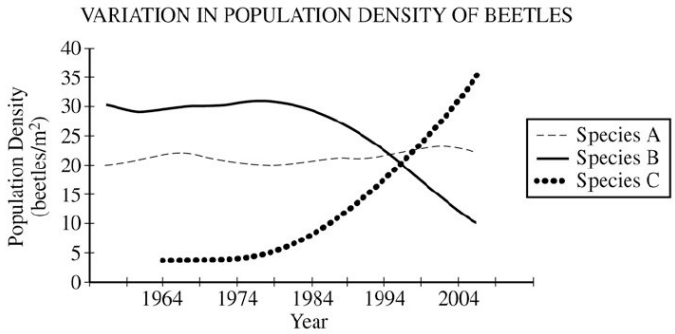
Species	Number of individuals
1	20
2	34
3	4
4	10
5	68

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.

0.64-0.66

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.

Species C is a non-native species. It is able to experience exponential growth in the new environment. Because it is not native it is under less control of density dependent limiting factors.

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.

The introduction of species C causes a decline in Species B and has no impact on the population density of species A. Species C and B probably occupy the same niche and species C is able to out compete species B. Species A and Species C must not have any overlap in their niches, so there is little to no competition between these species. You wouldn't have to use the term niche to answer this question – describing environmental needs would be enough.

c. Predict the population density of species C in 2014. Provide a biological explanation for your prediction.

By 2014 the population of Species C would reach a plateau of approximately 40 beetles / m^2. The population would reach carrying capacity because of the influence of density dependent limiting factors. As food sources, as an example, become more scarce because of the large population size some individuals will not be able to get enough food to survive and reproduce.

d. Explain why invasive species are often successful in colonizing new habitats.

When an invasive species enters a new habitat it is able to outcompete the native species. There are no predators or diseases native to the invasive species in the new habitat. Because of this the population can grow faster than the native species, which have to deal with their native dependent limiting factors.

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.

The autotrophs / producers absorb solar energy and convert it into usable energy – starting the flow of energy through the ecosystem. As the energy flows through an ecosystem from producers to each level of consumer only 10% of the available energy to passed to the next trophic level. Energy is lost as heat, through the process of cellular respiration, waste produced by the organism and nonconsumed portions of the organism.

b. Discuss the impact of the following on energy flow on a global scale

- Deforestation

Deforestation eliminates a large portion of the primary consumers in forested ecosystems. With fewer trees available, the number of primary consumers in an ecosystem will also decrease which will impact all the trophic levels above. You could add some statements about nutrient cycles too – not directly related to the energy flow but it can earn you "bonus points".

- Global climate change

Similar answer to above – climate change will decrease the numbers of producers that can not adapt quickly enough to the change in temperature in a given ecosystem. Warming will increase productivity in arctic areas but decrease productivity in equatorial areas.

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

a. Explain the difference between gross and net primary productivity.

Gross productivity is the total amount of photosynthesis done by all the producers in an ecosystem – the conversion of solar energy into usable energy. Net primary productivity is the Gross primary productivity – the amount of Respiration completed by the producers. The Net primary productivity represents the amount of energy passed to the primary consumers.

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

This is the Dissolved Oxygen Lab we did in class.
Put pond water in two different bottles – measure the initial amount of oxygen in the water sample.
Cover one bottle with aluminum foil or place in a dark environment. Leave the other bottle open to the sunlight.
After 24 hours measure the amount of oxygen.
The decrease in oxygen in the dark bottle was cause my respiration allow.
Subtract the amount of oxygen consumed in the dark bottle by the amount of oxygen produced in the light bottle (the light bottle is going through photosynthesis and cellular respiration)

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.

A more diverse population is more likely to survive environmental changes or diseases. There is a higher probability that some individuals will be able to survive, because of their genetic makeup. These individuals will survive and reproduce passing on their benefical genes. If all individuals are genetically identical and those genes do not give them an advantage, all individuals will die and the species will go instinct.

b. Choose ONE of the examples below and discuss why the population is at risk of extinction.

- California condor
- Prairie chickens
- African Cheetah