Concept 8-1 Ecology

Thinking Questions

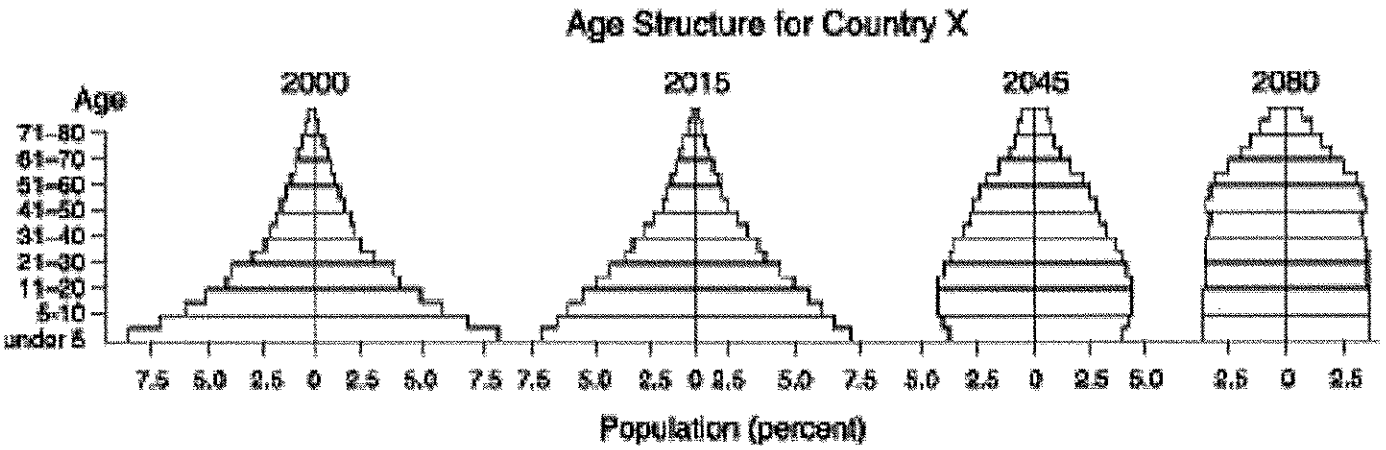
1. Invasive species are species that are introduced into an environment but are not naturally found in that environment. One example of an invasive species is the American gray squirrel, introduced into Britain at the end of the 18th century. Until 1876 the only native squirrel in Britain was the European red squirrel, which was found in deciduous and coniferous forests. By 1940 the gray squirrel had displaced the red squirrel across most of the British Isles, and by 1984 the red squirrel was only found in isolated coniferous woodland areas. After its initial introduction, the gray squirrel population increased rapidly; however, in recent years population sizes within specific environments have become stable.
   a. Explain why the newly-introduced gray squirrel initially showed rapid population growth and why the native red squirrel showed a population decline.

Both species likely compete for the same resources with the gray squirrel being more successful at obtaining those resources than the red squirrel.

   b. Why has the population size of the gray squirrel become stable in recent years?

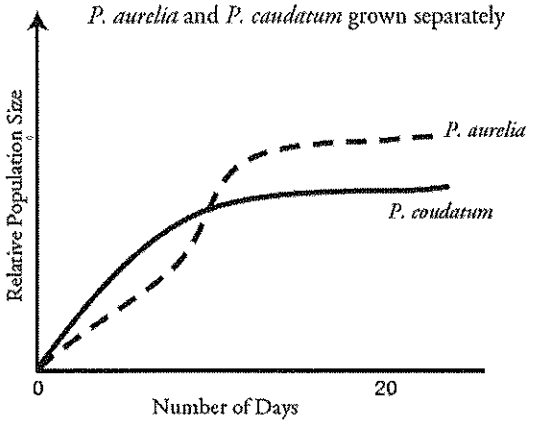
As the squirrel population increases their resources become more scarce, putting a limit on population size.

2. The first age structure graph below for country X shows the percent of the population in each age group for the year 2000. The remaining three graphs are projections of how the age structure of country X will change. From these age structure diagrams construct a graph of population size vs. time for 2000-2080 and justify your prediction.

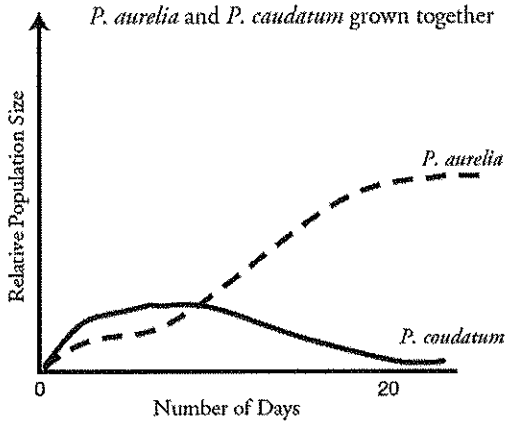


In 2000 the life expectancy in this country was short, as shown by the small percentage over age 40. By 2080 life expectancy has significantly increased. The graph shows that there are equal percentages of the population at every age up to the 60s. If more people are surviving, population must grow.

Graph A



Graph B



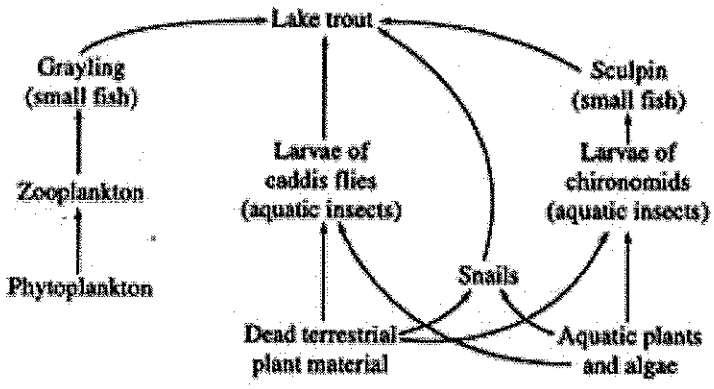
a. The population growth of which bacteria is more affected by growing conditions? Explain how you know.

P. caudatum's population size drops off significantly when growing conditions change. P. aurelia is relatively unaltered.

b. Using the information provided in the graphs, make a prediction as to why the bacteria identified in part a is more affected by growing conditions than the other bacteria.

The two species probably compete for the same resources. When grown apart both species have enough resources, but grown together, P. aurelia outcompetes P. caudatum.

4. Interdependence in nature is illustrated by the transfer of energy through trophic levels. The diagram below depicts the transfer of energy in a food web of an Arctic lake located in Alaska.



a. Identify an organism from each of the 5 trophic levels (producer, primary consumer, secondary consumer, teritiary consumer and decomposer) and explain how energy is obtained at each level.

Producer – Aquatic Plants: Photosynthesis
1° Consumer - Zooplankton: Eats producer
2° Consumer – Grayling: Eats 1° Consumer
3° Consumer - Lake Trout: Eats 2° Consumer
Decomposer - Snail: Eats dead material

b. Describe the efficiency of energy transfer between trophic levels of this food web.

Approximately 90% of the energy is lost between each trophic level. Not all organisms that die are eaten. Not all parts of the organism are eaten.

c. Explain how the amount of energy available at each trophic level affects the size of each population.

Organisms must have enough energy to survive. Since available energy is a limited resource it controls the size of the population.

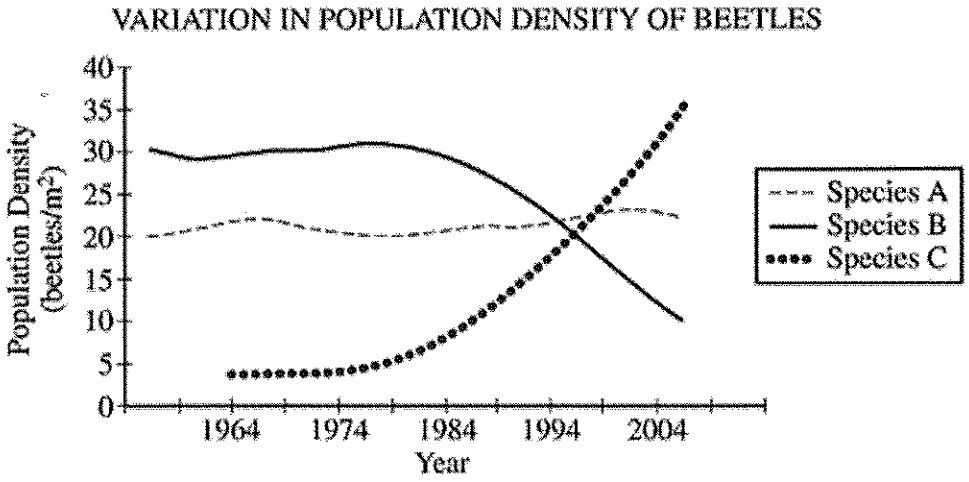
d. If the cells in the dead terrestrial plant material that washed into the lake contained a commercially produced toxin, what would be the likely effects of this toxin on this food web? Explain.

Due to biomagnification the effects would be most extreme at the top of the food chain. Toxins accumulate from all of the organisms that are eaten.

e. If all of the Sculpin in this ecosystem were removed, predict how it would impact the following and explain each prediction:

- The population of lake trout - May decrease due to fewer prey, but also may eat more other food sources.
- The population of snails May decrease due to more being eaten by trout in place of sculpin
- The population of algae Decrease as the larvae of chironomids grows rapidly due to loss of predator. These eat algae.
- The amount of oxygen produced in the ecosystem Decrease due to explanation above and a decrease in phytoplankton due to increased zoo plankton.
- The amount of light energy absorbed by the ecosystem
  Same as above.

Ecology Long Free Response (10 points)



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 accidentally introduced on the island. The population size of each species 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 in 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.

(a) **Propose** an explanation for the pattern of population density observed in species C. **[3 points]**
1. Description of curve [1 point]: Type of growth is exponential growth (logarithmic or J-shaped curve acceptable).
2. Explanation must describe the growth using an understanding of [1 point each, 2 points maximum]:
   - Lack of limiting factors
   - Low competition
   - Abundant food
   - Low predation
   - Ideal environmental conditions (habitat, temperature, moisture, etc.)
   - Access to mates

(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 in species B. **[4 points]**
1. Describe effect [1 point]: Species C has had little or **no effect** on species A; however, as **species C increases, B decreases. Both lines must be addressed for the point.**
2. Explanation for species A or dashed line [1 point]: **No or little competition** (No niche overlap).
3. Explanation for species B or solid line [1 point]: **Competition or Niche overlap**.
4. Identification of the niche **"Competitive Exclusion Principle"** [1 point]: by name or description.

(c) **Predict** the population density of species C in 2014. Provide a biological **explanation** for your prediction. **[2 points]**
1. Prediction [1 point]: The population will **increase, decrease, or stabilize (level off)**.
2. Explanation [1 point]: Tie a correct explanation to the prediction.
   - **Increase**—tie to abundant resources and freedom from competition.
   - **Decrease**—tie to exhaustion of a key resource or density-dependent cause.
   - **Stabilize or level off**—tie to carrying capacity or a limiting resource.

(d) **Explain** why invasive species are often successful in colonizing new habitats. **[2 points—from either or both areas below]**
1. They have **lost a controlling population factor** from their original habitat: predator, pathogen, or parasite.
2. They **have a novel evolutionary advantage** brought to the island from their original habitat: an aspect that provides an advantage—a chemical defense, flight advantage, novel enzyme, etc.