Chapter 16

Populations

End of Chapter Questions

Simple Review Questions

16.1 Organisms and Their Environments

1. What is ecology?

2. Explain the difference between the abiotic features and the biotic features of an organism's environment.

3. What is the difference between a community and an ecosystem?

16.2 Population Growth

4. Describe exponential growth. Under what conditions do organisms grow exponentially?

5. Why do populations that live in unstable environments often grow exponentially and then crash?

6. Describe logistic growth. Under what conditions do populations experience logistic growth?

16.3 Life History
7. What are the differences between Type I, Type II, and Type III survivorship?

8. What type of life history is typical of a top predator?

16.4 Human Population Growth
9. Explain how global human population size is expected to change during the 21st century.

10. What is the age structure of a population? What can you learn from a population's age structure?

11. What is an ecological footprint? What does the ecological footprint tell us about how the global human population is consuming resources today?

12. The human population exceeds 7 billion. The total number of humans who have ever lived, however, is on the order of 110 billion. How have these 110 billion humans not exceeded Earth's resources?

(CLICK TO CHECK YOUR ANSWERS)

Challenging Review Questions

16.1 Organisms and Their Environments
13. Does a community contain multiple populations? Explain your answer.

14. A scientist studies how water cycles through a desert habitat, and how organisms make use of this water. Is this a population-level study, a community-level study, or an ecosystem-level study? Defend your answer.

15. A scientist studies how the number of coyotes in Death Valley National Park, California, has changed over the last decade. Is this a population-level study, a community-level study, or an ecosystem-level study? Defend your answer.

16. A scientist examines how the presence of a nonnative bird species, the starling, affects other species of birds, such as the northern flicker, a kind of woodpecker. The starling (left) and woodpecker (right) in the photo below, for example, are fighting over food and space. Is this a population- level study, a community-level study, or an ecosystem-level study? Defend your answer.
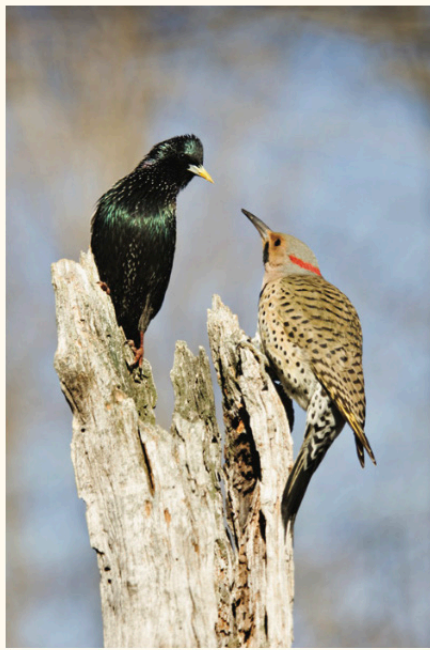

16.2 Population Growth
17. How are exponential growth and logistic growth different? Under what real-world circumstances can populations grow exponentially? When will exponential growth in such a population stop?

18. What factors could cause population growth to slow as population size increases (which is what happens during logistic growth)?

19. The graph below shows the growth of a population of single-celled *Paramecium* in the lab. Did the population grow exponentially or logistically? Can you estimate the car- rying capacity of the habitat?
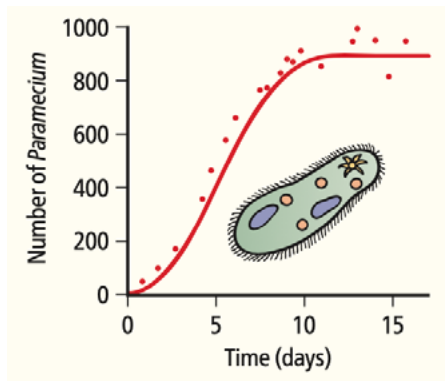
20. Suppose that the carrying capacity of a specific habitat is 50 songbirds. Is it possible for this carrying capacity to change? What could cause the carrying capacity to increase? What could cause the carrying capacity to decrease?

16.3 Life History
21. What is a survivorship curve? What are some characteristics of a population with a Type I survivorship curve?

22. Why is a baby elephant considered an "expensive" offspring?

23. Would you expect a tiger to have a Type I, Type II, or Type III survivorship curve?

24. Name an organism that you might see in your backyard or at the park that has a Type III survivorship curve. What evidence suggests it has a Type III survivorship curve?

16.4 Human Population Growth

25. The graph below shows survivorship curves for males and females in Great Britain and India in 1999. What differences do you see between Great Britain and India in 1999? What might explain these differences?
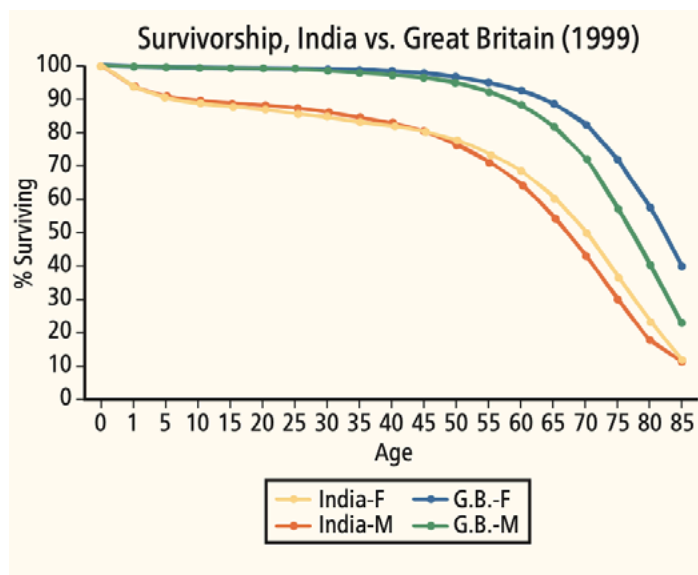
26. The graph below shows survivorship curves for males and females in Great Britain in the 17th century and in 1999. How did survivorship in England change from the 17th century to 1999?

Survivorship, Great Britain (1999) vs. 17th-C England
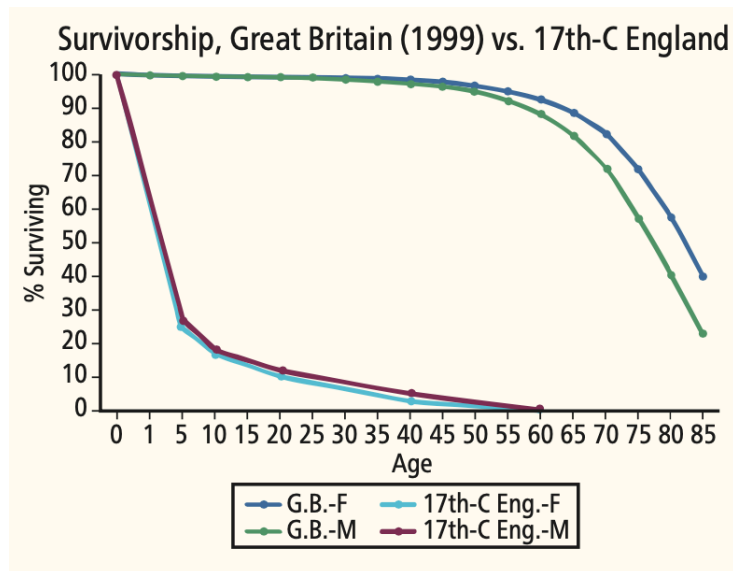
27. All else being equal, will a person who eats a vegetarian diet or a person who eats meat regularly have a larger ecological footprint? Defend your answer.

28. What does it mean that the world human population is in "ecological overshoot"?

(CLICK TO CHECK YOUR ANSWERS)

© *Conceptual Biology by Jennifer Yeh*

29. A habitat's carrying capacity for a population can change over time. For example, a forest may be able to support a certain number of bears, but when the trees are cut down and the land is paved over, the carrying capacity drops (probably to zero). What other factors could cause the carrying capacity of a habitat to change? How has Earth's carrying capacity for humans changed over time? Does technology influence how many people Earth can support?

30. What type of survivorship curve characterizes humans? What other characteristics are associated with this type of survivorship curve? Do humans show many of these other characteristics?

(CLICK TO CHECK YOUR ANSWERS)

End of Chapter Solutions

Simple Review Solutions

1. Ecology is the study of how organisms interact with their environments.

3. A community consists of all the organisms that live in a specific area. An ecosystem consists of all the organisms that live in a specific area and all the abiotic features of their environment.

5. Good conditions start exponential growth. When resources run out, the population crashes.

7. Type I organisms have low death rates early in life, with most individuals surviving until fairly late in life. Type III organisms have high death rates early in life, with few individuals surviving until late in life. Type II organisms fall between Type I and Type III. Type II organisms experience a steady death rate throughout life-individuals are as likely to die early in life as late in life.

9. According to United Nations projections, the world human population is expected to increase throughout the 21st century and exceed 11 billion by 2100. However, growth is expected to slow during the second half of the century. These projections assume that fertility will continue to decline in high-fertility countries and that death rates continue to decline everywhere.

11. An ecological footprint is a measure of how much land and water area a human population needs in order to produce the resources it consumes. The size of this footprint takes into account the population's use of water, soil, energy, food, and other resources. Measuring ecological footprints allows us to understand how resources are being consumed, and how this compares with what Earth can provide. For more than 40 years, the global human population has been in ecological overshoot, consuming more resources each year than Earth can provide. In fact, would need 1.7 Earths to sustain our current rate of consumption.
And, if current trends continue, we will need 2 entire Earths by 2030.

Challenging Review Solutions

13. A community includes all the organisms in a specific area. A population, on the other hand, is a group of individuals of the same species in a specific area. So yes, a community consists of multiple populations, one for each species found in the community. For example, a community could include a population of ladybugs, a population of aphids, a population of hummingbirds, and many, many other populations.

15. This is a population-level study because it considers a group of individuals of a single species that occupies a given area.

17. A population that is growing exponentially increases in size more and more quickly as time goes on. Under logistic growth, population growth slows as the population approaches the habitat's carrying capacity. What kind of population grows exponentially? In theory, exponential growth occurs when a population has unlimited resources. Although resources are never truly unlimited in the real world, they are sometimes extremely plentiful. For example, organisms may find very plentiful resources when they colonize a new habitat, and their population may begin to grow exponentially.

19. This is an S-shaped logistic curve. Carrying capacity appears to be around 900 individuals per mL.

21. A survivorship curve is a graph that shows the proportion of individuals that survive to a specific age. Type I organisms have low death rates early in life. Most individuals survive till fairly late in life. Populations with Type I survivorship curves typically have large bodies, reach sexual maturity late, have few "expensive" offspring to which they devote considerable resources each, and a long life expectancy. These populations often live in stable environments and show logistic population growth.

23. A tiger would be expected to have a Type I survivorship curve—it produces expensive offspring that survive reasonably well.

25. There is more infant and early mortality in India than in England in 1999. This is likely because poverty affects more people in India, and more people are unable to get proper medical care.

27. All else being equal, a meat-eater has a larger ecological footprint than a vegetarian. By eating higher on the food chain, a meat-eater ends up using more of Earth's resources. This is because it takes more area to grow the grain to feed animals for consumption (such as cows or chickens) than it would take to supply a person with a vegetarian diet. This goes back to the "10% rule" regarding energy flow through an ecosystem -- 10 percent of the energy available at each level of the food chain moves up to the next level of the food chain.

Apply & Discuss Solutions

29. Many answers are possible. Climate is one obvious variable that can affect carrying capacity. Years with good rainfall may increase carrying capacity for producer populations as well as for populations of species higher up the food chain. Drought may result in a reduced carrying capacity for many populations in the habitat. The introduction of new species into a community can also affect the carrying capacity, if this new species competes with or preys on the population of interest. Earth's carrying capacity for humans has increased over time as a result of technological advances such as the origin of agriculture and the green revolution. However, as human activities cause global warming, Earth's carrying capacity for humans may decrease.