Chapter 20: Review Answers

Student Textbook pages 740–741

Answers to Understanding Concepts Questions

1. Student answers may include the following:

- Population crash if carrying capacity of the environment is exceeded
- Intraspecific and interspecific competition for limited resources such as food
- An increase in parasites or disease
- Human intervention such as pesticide spraying or addition of toxins to the environment
- Increased predation
- Abiotic/density-independent factors such as harsh weather (a particularly cold winter or hot summer), fire, drought, or flood

2. Student responses should include the names of the species, a description of the environment, the nature of the competition (e.g., the factors that were in contention), and evidence of a drop in population size of one species.

3. Births (b), immigration (i), deaths (d), and emigration (e)

4. $D_p = \frac{N}{V}$

$$= \frac{(4 + 6 + 5 + 3 + 6 + 6)\ \textit{Paramecia}}{6\ \text{drops}}$$

$$= 5\ \textit{Paramecia}/\text{drop}$$

$N_{(40\ mL\ sample)} = (5\ \textit{Paramecia}/\text{drop})(20\ \text{drops/mL})(40\ \text{mL})$

$= 4000\ \textit{Paramecia}$

5. The birth rate must be greater than the death rate.

6. The two types of symbiotic relationships are parasitism and mutualism. The bacterium is acting as a parasite in the first case (where it produces an ulcer) because the bacterium benefits and the host is harmed. In the second

case, where the presence of the bacterium in the stomach can prevent the development of esophageal cancer and acid reflux in the host, the relationship is one of mutualism, as both bacteria and host benefit.

7. $cgr = \frac{\Delta N}{N}$

$= \frac{[b + i] - [d + e]}{N}$

$= \frac{[106 + 42] - [53 + 15]}{1000}$

$= 0.08$

8. The *r*-selected reproductive strategies that make species ideal for the early successional role include the generation of many offspring per reproductive cycle, ability of offspring to survive with little or no parental care, an early reproductive age, and living close to their biotic potential, all of which ensure a large number of offspring will quickly populate the area. Although it may not be intuitive to students, a short life span also helps ensure the area is populated quickly as it ensures less competition between the parent and its large number of offspring.

9. The three patterns of distribution are random, uniform, and clumped. Patterns of distribution are influenced by the distribution of resources in a habitat and the interactions among community members.

10. It limits the growth of populations.

11. Both predation and parasitism decrease the number of organisms per area or volume, and so the number of organisms of reproductive age and the birth rate will decrease.

12. The plants supply food to the herbivores in the same way that the prey supplies food to the predators. In turn, the population of herbivores limits the population of the plants in the same way that predator populations limit their prey populations. In both cases, if the herbivores or the predators become too numerous for their food source, they could cause a crash in the plant/prey population that will in turn cause a crash in their own population.

Answers to Applying Concepts Questions

13. (a) The age pyramid will be an inverted pyramid.

(b) The population size would decrease over time. The death rate would be greater than the birth rate because there are few youths, indicating a low birth rate, and a large elderly population, indicating a relatively high death rate.

14. Environmental resistance to population growth is the result of the combined effects of various, interacting limiting factors. Environmental resistance prevents a population from growing at its biotic potential and determines the carrying capacity of the habitat.

15. $gr = \frac{\Delta N}{\Delta t}$

$\Delta N = (gr)(\Delta t)$

$\Delta N = (10 \text{ plants/year})(5 \text{ years})$

$\Delta N = 50 \text{ plants}$

final number of individuals in population $= \Delta N + N =$ 50 plants + 100 plants = 150 plants

16. The activity should include a defined space, representation of two or three populations, and representation of a fixed amount of resources. Activities should be evaluated in terms of practicality for classroom demonstration, the level of involvement of the theoretical students, and outcomes that show the effect on population growth without creating mayhem in the classroom.

17. ■ *Bacterium:* Biotic or density-dependent growth limiting factors include lack of appropriate nutrients, and intraspecific and interspecific competition. Abiotic or density-independent factors include inhospitable temperature and the presence of growth limiting agents such as antibiotics or toxins.

■ *Tree:* Biotic or density-dependent growth limiting factors include lack of appropriate nutrients, lack of light, and intraspecific and interspecific competition. Abiotic factors include drought, inhospitable temperatures, a change to intolerable soil pH, fire or flood, presence of growth limiting agents such as toxins, and soil erosion.

■ *Mammal:* Biotic growth limiting factors include lack of food, water, or shelter; lack of suitable nesting sites; predation; and intraspecific and interspecific competition. Abiotic factors include harsh weather conditions and presence of growth limiting agents such as toxins.

18. (a) Mutualism. The ants benefit by receiving the food package and the plant benefits by having its seeds dispersed away from the parent, limiting intraspecific competition as they mature. The plant also benefits because its seeds are protected from fire and seed-eating organisms.

(b) ■ Commensalism. The Argentine ant benefits, but the plant does not.

■ Interspecific competition

■ Differing niches

(c) The small seeds are protected from fire and seed-eating insects, so they are more likely to mature and produce offspring than the large seeds. Due to this natural selection, the allele frequency for the small seeds will increase and the plant will produce more small seeds over time.

19. The main danger in increasing the numbers of mollusks is that the increased population may turn to other food sources once the algae has been reduced and in the process, change the ecosystem of the sea. If it did not

adapt to other food sources, the mollusk population itself would crash.

20. Comparison of Early and Late Stages of Succession

Characteristic	Early Succession	Late Succession
amount of available light	high	low
biodiversity	low	high
plant biomass	low	high
interspecific competition	low	high
intraspecific competition	low	high

Answers to Making Connections Questions

21. *Possible Benefits:* Because population growth will slow over time, China's resources will be stretched less thinly and the standard of living will be higher. Spread of disease may be less, as living conditions will improve and allow for better hygiene.

Drawbacks: The policy has resulted in an overabundance of males who will have great difficulty finding a mate, and an even greater number of spoiled only children. The impact of abiotic events such as pandemics or natural disasters will be more severe in a slower growing population. The social structure may not be able to support a one-child policy that leaves one family of any marriage without support.

22. (a) Fragmented Forest:

$$D_p = \frac{N}{A}$$

$$= \left(\frac{5 + 12 + 8 + 4 + 11}{5}\right) \text{caterpillars/leaf}$$

$$= 8 \text{ caterpillars/leaf}$$

Continuous Forest:

$$D_p = \frac{N}{A}$$

$$= \left(\frac{8 + 6 + 10 + 9 + 3}{5}\right) \text{caterpillars/leaf}$$

$$= 7.2 \text{ caterpillars/leaf}$$

(b) Fragmented Forest:

(2000 leaves/tree)(8 caterpillars/leaf) = 16 000 caterpillars/tree

Continuous Forest:

(2000 leaves/tree)(7.2 caterpillars/leaf) = 14 400 caterpillars/tree

(c) The assumption was made that the caterpillars were distributed uniformly on the leaves throughout the tree.

(d) Parasitism

(e) Fragmented Forest:

$$\text{Average infection rate} = \frac{\left(\frac{3}{10} + \frac{2}{12} + \frac{2}{8} + \frac{4}{12}\right)}{4}$$

$$= 0.26$$

Continuous Forest:

$$\text{Average infection rate} = \frac{\left(\frac{2}{6} + \frac{3}{8} + \frac{4}{8} + \frac{6}{12}\right)}{4}$$

$$= 0.43$$

(f) Because more caterpillars are infected in the continuous forest sample area, which also has a smaller population of caterpillars, one can reasonably conclude that the flies are killing off some of their hosts.

(g) No, there could be fewer caterpillars in the continuously forested area for many reasons. For instance, a type of bird that preys on the caterpillars may require an unfragmented forested habitat. Thus, there are larger numbers of the predators in the continuous forest and the caterpillar population is smaller as a result. In another scenario, humans may have sprayed pesticide on the continuous forest but not on the fragmented forest, thus reducing the population size in the former. Finally, the caterpillars may prefer the leaves of species of trees found in the fragmented forest only.

(h) Secondary succession