CHAPTER 22 SUMMARY

Make a Summary

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1. For any individual/population chosen, the answer should address the following:
   - Current population status: the phase of growth that the population is experiencing (lag, log, stationary) and how this might influence an individual's involvement in reproduction as well as its likelihood of survival
   - Intraspecific competition: a description of the competition that exists among organisms of the same population for nutrients, space, mates, and other factors essential to survival and reproductive success
   - Depending on the type of population (*r*- or *K*-selected) and its current size and carrying capacity, the answer should predict whether the population will increase or decrease and what rate of change is likely. Note: It is also possible that the population has reached carrying capacity and the size will remain relatively unchanged for a period of time.
   - Density-independent/-dependent factors: identification of the role of density-dependent factors, such as disease, nutrient availability, and competition for mates, among members of the population that may influence their mortality rate and reproductive success. These factors play an increasing role as the population gets closer to the carrying capacity. As well, the answer should address the fact that there is usually one primary density-dependent factor that is most significant in limiting population growth. The density-independent factors identified may include such variables as the first frost, eruption of a volcano, an avalanche, forest fire, etc.
   - Other factors that might be identified that influence a population's rate of growth, size, or carrying capacity include growth strategies (*r* and *K*), biotic potential, or *r* value.

CHAPTER 22 REVIEW

(Pages 762–763)

Part 1

1. B
2. B
3. 1700
4. D
5. D
6. C
7. 4.9
8. C
9. C
10. A
11. 14

Part 2

12. Students' answers will vary. Students should include an example of a declining population (such as cod) and an increasing population (such as pine beetles). The cod represent economic loss as the population decreases, and the pine beetles cause economic loss as their population increases.
13. As resources in an ecosystem decline, population size declines as well. If food resources decline, less food is available to the population, so more starvation will occur, increasing the death rate. It may also increase emigration rates as individuals leave the ecosystem to find a new area with more plentiful resources. Similarly, if shelters are rare, many organisms may die or may not be able to reproduce (without available nests), which also decreases population size or slows the growth rate of the population.

14. Given: number of individuals, N, in three plots in four subsequent years (Table 1)
area, A, of plot 1 is 100 ha, of plot 2 is 92 ha, and of plot 3 is 104 ha

Required: average population density for each plot over the four-year study

First, calculate the mean number of individuals of each species in the three plots over the study.

The mean number of individuals in the population of each species per plot, N_{mean}, is the sum of the number of individuals per year divided by 4.

Therefore, for the *N. insignis* population in plot 1:

$$\begin{aligned} N_{mean} &= \frac{\sum N_1 + N_2 + N_3 + N_4}{4} \\ &= \frac{632 \text{ individuals} + 788 \text{ individuals} + 840 \text{ individuals} + 671 \text{ individuals}}{4} \\ &= \frac{2931 \text{ individuals}}{4} \\ &= 732.75 \text{ individuals} \end{aligned}$$

For the *Z. hudsonius* population in plot 2:

$$\begin{aligned} N_{mean} &= \frac{\sum N_1 + N_2 + N_3 + N_4}{4} \\ &= \frac{345 \text{ individuals} + 461 \text{ individuals} + 509 \text{ individuals} + 328 \text{ individuals}}{4} \\ &= \frac{1643 \text{ individuals}}{4} \\ &= 410.75 \text{ individuals} \end{aligned}$$

For the *N. insignis* population in plot 3:

$$\begin{aligned} N_{mean} &= \frac{\sum N_1 + N_2 + N_3 + N_4}{4} \\ &= \frac{610 \text{ individuals} + 559 \text{ individuals} + 663 \text{ individuals} + 601 \text{ individuals}}{4} \\ &= \frac{2433 \text{ individuals}}{4} \\ &= 608.25 \text{ individuals} \end{aligned}$$

For the *Z. hudsonius* population in plot 3:

$$\begin{aligned} N_{mean} &= \frac{\sum N_1 + N_2 + N_3 + N_4}{4} \\ &= \frac{102 \text{ individuals} + 188 \text{ individuals} + 173 \text{ individuals} + 80 \text{ individuals}}{4} \\ &= \frac{543 \text{ individuals}}{4} \end{aligned}$$

$= 135.75$ individuals

The average density of the *N. insignis* population in plot 1 over the course of the study is

$$D_p = \frac{N_{mean}}{A} = \frac{732.75 \text{ individuals}}{100 \text{ ha}} = 7.33 \text{ individual/ha}$$

The average density of the *Z. hudsonius* population in plot 2 over the course of the study is

$$D_p = \frac{N_{mean}}{A} = \frac{410.75 \text{ individuals}}{92 \text{ ha}} = 4.46 \text{ individual/ha}$$

The average density of the *N. insignis* population in plot 3 over the course of the study is

$$D_p = \frac{N_{mean}}{A} = \frac{608.25 \text{ individuals}}{104 \text{ ha}} = 5.85 \text{ individual/ha}$$

The average density of the *Z. hudsonius* population in plot 3 over the course of the study is

$$D_p = \frac{N_{mean}}{A} = \frac{135.75 \text{ individuals}}{105 \text{ ha}} = 1.29 \text{ individual/ha}$$

Over the course of the study, the average density of the *N. insignis* population in plot 1 was 7.33 individuals per hectare, of the *Z. hudsonius* population in plot 2 was 4.46 individuals per hectare, of the *N. insignis* population in plot 3 was 5.85 individuals per hectare, and of the *Z. hudsonius* population in plot 3 was 1.29 individuals per hectare.

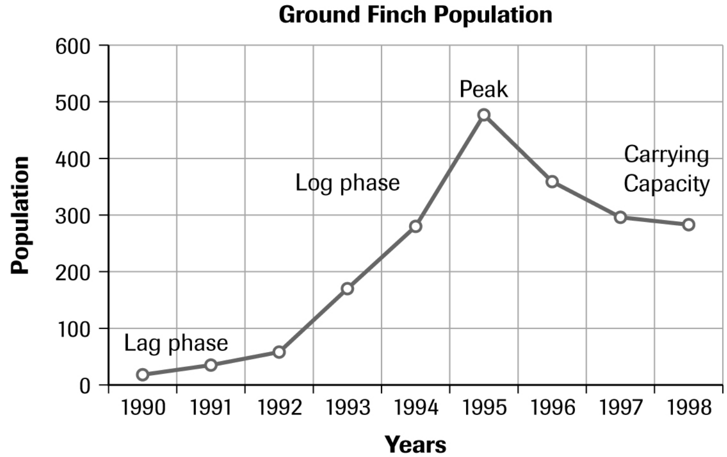
15. When the species are found together, in plot 3, they have lower population densities than when found alone. This indicates that they are competing for resources.

16. Interspecific competition and intraspecific competition are occurring in plot 3.
17. Students' answers will vary. Sample answers: It is assumed that there is no migration from other areas into the study plots. This may be a faulty assumption because it is difficult to ensure that no rodents migrate into the study area of only 100 ha during the study period. With a mark–recapture experiment, it is assumed that the population size remains constant, meaning that no births and deaths occur during the study period. This assumption cannot hold true in rodent populations over a four-year period!

    The researchers also assume that none of the "marks" are lost over the four-year period. This is also difficult to believe. The rodents may chew tags off, a chip can malfunction, a paint or dye mark can fade, and so on. Or the older rodents may die, whether marked or unmarked. There is no way to ensure that the proportion of marked to unmarked animals stays constant.

    Other assumptions that students may comment on are that food resources are assumed to be identical and that predation is assumed to be absent or negligible.

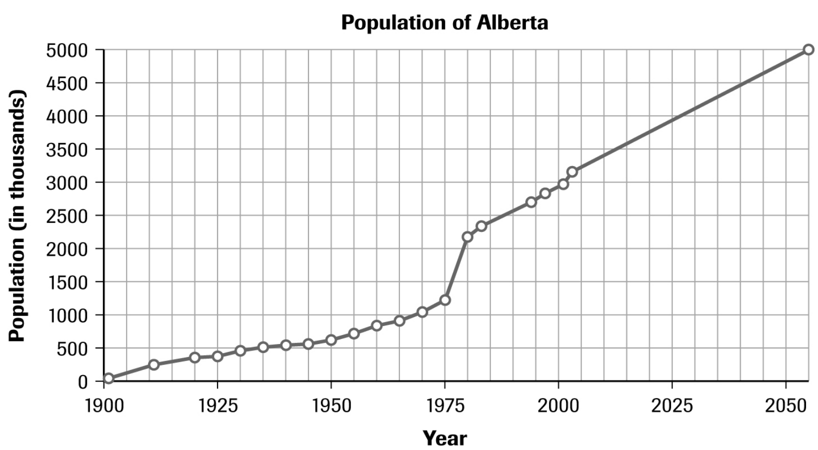
18. The experiment could be improved by replicating the fields. There should be at least two plots for each treatment.
19. (a)



(b) The carrying capacity is approximately 300.

20.
- Once the buffalo herds were depleted, there were far fewer grazers on the prairies. Before the loss of the buffalo, prairie ecosystems included grasses such as big bluestem, switchgrass, and Indian grass, as well as many flower species. Some of these grass species can grow to about 0.5 m.
- Grazing by the buffalo helped maintain the mixture of plants on the prairie by adding nitrogen to the soil by their eliminations, by keeping the grasses at lower levels, and by creating open areas on the ground from the action of their hooves.
- The plant life on the prairie also supported elk, deer, and rabbits.
- The bison were predated by humans (the Aboriginal peoples), wolves, grizzly bear, black bear, and cougar (bears and cougars would have been found most often in short-grass prairie regions).
- The loss of the buffalo affected humans that depended on them dramatically since they used the animals for more than just food. The other predators turned to elk and deer, but their populations declined nevertheless.

21.



The greatest growth occurred between 1975 and 1985. This does not appear to be sustainable as the rate of population increase has decreased since then, although it is still increasing. The estimated population in 2055 is 5 000 000 people. The population size would be 221 480 000 if the population increased 70 times in the next 100 years.

