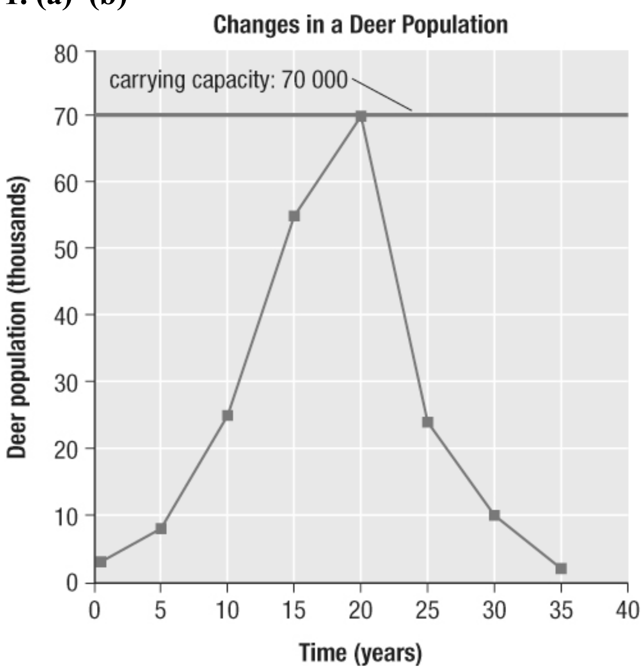
12.3 Section Questions, page 609

1. (a)–(b)



(c) Answers may vary. Sample answer: The deer population may have decreased after year 20 because once the population reached its carrying capacity it overgrazed, destroying the trees that it depended on for food. Another possibility is that as the deer reached their carrying capacity, they became too crowded and disease caused the population to decrease rapidly.

(d) The management plan initially seemed to be effective because the deer population grew rapidly after the management plan was put into place.

(e) Answers may vary. Sample answer: Without human interference and the deer management plan, the deer population likely would have grown initially and then fluctuated in a normal logistic growth pattern.

2. During exponential growth the population density of an organism increases more and more rapidly as more individuals are available to reproduce, creating the J shape. In logistic growth the population density of an organism initially increases slowly in a positive acceleration phase; then increases rapidly, approaching an exponential growth rate as in the J-shaped curve. As the organism reaches its carrying capacity, the rate of growth slows and finally fluctuates around zero growth, resulting in the growth curve tapering off to a horizontal phase, and creating the S shape.

3. Carrying capacity is the is the maximum population size of the species that the environment can sustain indefinitely, given the food, habitat, water and other resources available in the environment. It is an important statistic when describing the environment because it determines the optimal population size for a given environment.

5. Answers may vary. Sample answer: Could the earth's resources sustain such a population? If not, how large a human population can live decently on this planet? What steps can we take now to avoid growing beyond our carrying capacity?

6. (a) Given: initial population, $N_I = 650$
intrinsic growth rate, $r = 0.450/\text{day}$

Required: initial instantaneous growth rate

Analysis: initial instantaneous growth $= r \times N$

Solution: Calculate the initial instantaneous growth.

$$\begin{aligned}\text{initial instantaneous growth} &= r \times N \\ &= r \times N \\ &= (0.450/\text{day}) \times (650) \\ \text{initial instantaneous growth} &= 292.5\end{aligned}$$

Statement: When the population size is 650, the initial instantaneous growth rate is 292.5 individuals per day.

(b) Given: intrinsic growth rate, $r = 0.450/\text{day}$

Required: doubling time, t_d

Analysis: $t_d = 0.69 \div r$

Solution: Calculate the time it will take for the population to double in size.
Use the following formula:

$$\begin{aligned}t_d &= 0.69 \div r \\ &= 0.69 \div (0.450/\text{day}) \\ &= 1.533 \text{ day}\end{aligned}$$

Statement: The mosquito population will double in size every 1.533 days.

(c) The population of mosquitoes will exceed 1 000 000 after 11 doubling periods, where the population will be 1 331 200, $N_1 \times 2^P$. This represents 16.8 days, $t_d \times P$.