Answers to Questions for Comprehension

Student Textbook page 705

Q1. (a) Population density is defined as the number of individual organisms in a given area or volume.

(b)

$$D_p = \frac{N}{A} \text{ or } D_p = \frac{N}{V}$$

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Q2 Distribution patterns are influenced by the distribution of resources in a habitat and the interactions among members of a population or members of a community.

Q3 Random distribution in a habitat is characterized by individuals or pairs of organisms distributed throughout a suitable habitat with no identifiable pattern. It occurs when resources are abundant and members of a population do not have to compete with one another or group together for survival. Random distribution in nature is rare. An example is the summer population of individual bull moose and female moose (*Alces alces*) with calves.

In clumped distribution, members of a population are found in groups within their habitat. Most populations exhibit a clumped pattern of distribution, congregating in an area where food, water, or shelter is most abundant. Members of the population are grouped together for survival and share scarce resources. Examples cited in the text are humans, aspens (*Populus tremuloides*), and the snail (*Physella johnsoni*.)

In uniform distribution, members of a species are evenly spaced over a habitat. The members avoid direct competition over resources by dividing up the territory. Examples of this pattern are birds of prey and other organisms that show territoriality to defend their resources and protect their young. The golden eagle (*Aquila chrysaetos*) is a specific example of a species exhibiting uniform distribution.

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Q4 The four processes that affect population size are births (b), immigration (i), deaths (d), and emigration (e).
$\Delta N = (b + i) - (d + e)$

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Q5 Population growth rate (gr) refers to the change in population size (ΔN) over a specific time frame (Δt). The per capita growth rate (cgr) takes into account the initial size of the population and is determined by calculating the change in population size (ΔN) during a given time interval (Δt), and then dividing the change in population size by the original number of individuals in the population (N).

Q6
$$gr = \frac{\Delta N}{\Delta t}$$
$$= \frac{2300 \text{ deer} - 2000 \text{ deer}}{1 \text{ year}}$$
$$= 300 \text{ deer/year}$$

Q7
$$cgr = \frac{\Delta N}{N}$$
$$= \frac{2300 \text{ deer} - 2000 \text{ deer}}{2000 \text{ deer}}$$
$$= 0.15$$

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Q8. The biotic potential (*r*) of a population is its highest possible per capita growth rate.

Q9. Four factors that determine the biotic potential of a species are

(1) the number of offspring per reproductive cycle;

(2) the number of offspring that survive long enough to reproduce;

(3) the age of reproductive maturity and the number of times that the individuals reproduce in a life span; and

(4) the life span of the individuals.

Q10. An exponential growth pattern is a growth pattern that begins with a brief lag phase (slower growth), followed by much more rapid growth as the number of individuals capable of reproducing continues to increase. This type of growth pattern has a J-shaped curve on a line graph.

Q11. A population growing at its biotic potential would be expected to follow an exponential growth pattern. In the beginning, the growth of a small population is slow since only a few individuals reproduce. The small initial population constitutes the "lag phase," shown by a gentle slope in the curve. As more organisms reproduce, the population will grow in greater and greater quantities, exhibited by a steep increase in the growth curve. Because the birth rate during this phase of exponential growth is much greater than the death rate, the population size increases rapidly.

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Q12. Carrying capacity (*K*) is the theoretical maximum population size that an environment can sustain over an extended period of time. It represents the number of individuals in a population that can live in a given environment without depleting the resources they need or harming their habitat or themselves.

Q13. Density-dependent factors are biotic; that is, they are directly related to living organisms. These factors have a greater impact when population density is high. Examples of density-dependent factors include disease and parasites (which spread more rapidly in a dense population), scarcity of resources due to intense competition, and increased predation, since a dense population means there is an abundance of prey for predators. This differs from density-independent factors, which are abiotic and limit the growth of a population, regardless of its size or density. They include extreme temperatures, drought, floods, forest fires, and destruction of habitat through human intervention.

Q14. Environmental resistance to population growth refers to the combined effects of interacting limiting factors. Environmental resistance prevents a population from growing to its biotic potential and determines the carrying capacity of the habitat.

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Q15.

***r*-selected life strategies**	***K*-selected life strategies**
live close to their biotic potential	live close to the carrying capacity of their environment
many offspring per reproductive cycle	few offspring per reproductive cycle
offspring receive little or no parental care	one or both parents care for their young.
short life span	long life span
early reproductive age	later reproductive age
dependent on favourable environmental conditions	not dependent on favourable environmental conditions

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Q16. Intraspecific competition is the competition for resources among members of the *same* species in a community. Interspecific competition is the competition for resources between two or more *different* species in the same community.

Q17. When there is competition for limited resources (e.g., water, light, nutrients, nesting locations, mates), usually the best-adapted individuals get the most access to the resources and survive to reproduce. When the resources are abundant, almost all individuals will get what they need to survive and reproduce. When the carrying capacity of a habitat is reached, the less well-adapted or less healthy individuals will fail to thrive and are unlikely to reproduce, cutting the growth rate of the population.

Q18. When a non-native species competes with a native species, either the native species can out-compete the non-native species and the latter will die out, or the non-native species can out-compete the native species, which will die out.

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Q19. In producer-consumer relationships, consumers drive the natural selection of the producers in that those producers able to avoid being chosen by consumers for eating are more likely to survive and reproduce. Likewise, the scarcity or protective adaptations of producers limit the population of consumers that depend on them.

Q20. One hypothesis to explain hare-lynx population cycles is that predator-prey interactions cause the cycles. According to this hypothesis, increasing numbers of the prey population will cause an increase in the number of the predator population (due to greater food supply), which will eventually lead to a decrease in the number of prey, followed by a corresponding reduction in the predator population. Another hypothesis is that greater numbers of hares deplete their food supply, leading to lower quantity and quality of available food, which leads eventually to a population crash.

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Q21. protective coloration

Q22. An organism displaying Batesian mimicry deters predators by looking like another species that is well-defended. The species it is mimicking may be unpalatable, harmful, or poisonous, but the mimic is not. Instead, it relies upon its similarity to the other species to deter predators. Müllerian mimicry is a co-

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Q23. Symbiosis is the direct or close relationship between individuals of different species that live together. The relationship can be mutual, parasitic, or commensal.

Q24. Students will most likely choose either lichen or *Acacia* trees/ants. In lichen, the algal partner photosynthesizes, providing food for itself and the other partner, a fungus. The fungus provides protection from the elements for the alga. In *Acacia* trees, the leaves produce food (protein and sugar) that stinging ants consume, and thorns provide a living space for the ants. The ants attack other herbivores that would feed on the tree and remove branches of other plants that would compete with the *Acacia* for light.

Q25. Commensalism is a symbiotic relationship in which one partner benefits and the other neither benefits nor is it harmed.

Q26. In a parasitic relationship, one partner benefits at the expense of the other. This is the only symbiotic relationship that results in harm to one of the partners.

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Q27. Succession is the sequence of invasion by and replacement of species in an ecosystem over time, as a result of abiotic and biotic factors.

Q28. (a) Primary succession establishes soil in environments in which no life is present, such as bare rocks left behind by a retreating glacier or on a hardened lava bed. Secondary succession refers to the recolonization of an area after an ecological disturbance, such as a forest fire, flood, or agricultural activity. Soil is already present in such cases.

(b) The first species to colonize an area and initiate succession is considered to be the pioneer community. As succession progresses, one species replaces another. The latecomers in the process form a climax community that will remain relatively stable if there are no major environmental changes.

Answer to Question for Comprehension

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Q29 Sustainability refers to the concept of living in a way that meets our needs without compromising the health of future generations or the health of the planet.

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Q30. An age pyramid is a tool that helps demographers assess a population's potential for growth.

Q31. An age pyramid is a stack of layers representing different age categories (usually in five year intervals) showing the percentage of males on the left and percentage of females on the right in each layer. The structure of an age pyramid makes it easy to see the proportion of a population in each of three stages of development, defined as the pre-reproductive stage (0-14 years), reproductive stage (14-44), and post-reproductive stage (45 and older).