STUDENT BOOK ANSWERS

Chapter 3 Biodiverse ecosystems

Question set 3.1

1 The biosphere consists of terrestrial and aquatic biomes.

2 Biological hotspots are biogeographic regions that are both home to a high number of endemic species and threatened with destruction. Hotspots are reservoirs of the most diverse, yet most threatened, sites of biodiversity on the planet.

3 **a** Biodiversity is the number and variety of different species living in an area.

b Endemic species are only found in a particular country or geographic region.

c Topography is the arrangement of physical features, both natural and artificial, of an area.

4 **a** The community is the sum of all the living organisms in a habitat. A population within the community is a group of individuals belonging to the same species, living in the same habitat at the same time.

b The environment is the abiotic and biotic components of the ecosystem. The habitat is an area where an individual or species lives within an ecosystem.

c The living components of an ecosystem are biotic. Non-living components of an ecosystem are abiotic.

5 Responses will vary.

Experiment 3.1: Soil analysis

Discussion questions

1 Responses will vary.

2 Plants with deep taproots can bring up nutrients to the topsoil from deeper down. Plants with fibrous roots that spread out near the soil surface have roots that are easily decomposed, adding organic matter. The greater the density of vegetation, the less likely the occurrence of erosion and loss of topsoil and the more organic matter added to the soil.

3 The amount of oxygen dissolved in water is quite low compared to atmospheric oxygen. Waterlogged soils have fewer air spaces between soil particles compared to aerated soils and lower levels of oxygen.

4 Clay soils formed the longest ribbon, indicating that clay has good water-holding capacity. With excess water, this can lead to waterlogged soil.

5 The properties of the soil will determine the vegetation types at a certain location. Students will relate their sample soils to the vegetation found.

6 Rainforest ecosystems have a high rate of plant debris decomposition due to high rainfall and warm temperatures. This is an ideal habitat for decomposers. A desert environment has very little rainfall and extremes of temperature. Decomposers are not suited to these conditions so the rate of decomposition would be much lower.

Question set 3.2

1 Environments and ecosystems are classified by their abiotic features, component species and species interactions. Ecosystems are usually named after the most dominant species in the community, along with its overall distribution.

2 Eutrophication is the increased concentration of nutrients, phosphates and nitrates in a waterway that promotes algal bloom.

3 An open ecosystem is one where some organisms enter (immigrate) and some leave (emigrate), whereas a closed ecosystem is one where there is no immigration and emigration.

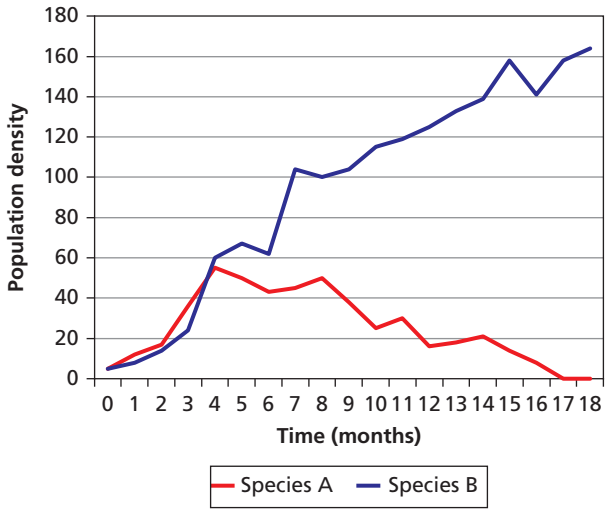
4 Qualitative data refers to data that is descriptive, whereas quantitative data refers to data that can be measured.

5 The altitude is one limiting factor. *N. rajah* only grows between 1500 and 2600 m above sea level. Other limiting factors include the need for humid, well-drained, grassy areas that have high levels of magnesium and iron, and low levels of silica in the soil.

Activity 3.1: Competitive exclusion principle experiment

What did you discover?

1



2 Species A

3 16 months

4 Species B

5 **a** Species A steadily increased in density for the first 8 months. It then steadily declined until, at 17 months, there were no more left.

b The biodiversity is reduced as the number of species decreases.

6 Species A would increase in density, species B would decrease in density.

7 **a** More of species C would be produced in a certain amount of time. The density of species C would increase. It is likely that the density of both species A and B would decrease.

b The diversity of the ecosystem decreases.

8 Gause concluded that two similar species competing for the same resource cannot coexist in the same community. One will be able to obtain and use the resource more effectively and, in turn, reproduce more quickly than the other. This is observed in this experiment.

9 Responses will vary.

Question set 3.3

1 The way a species functions within its environment is known as its ecological niche. The example will depend on the students' response.

2 Organisms within an ecosystem generally differ in the food source they prefer, their use of space and the timing of their activities. This method of using resources reduces competition and is called resource partitioning.

3 Fundamental niche: the 'ideal' niche a species would occupy if there were no competitors, predators or parasites.

Realised niche: the actual niche it occupies due to its ability to exploit the resources and cope with restrictions.

4 Gause found that when he grew each species as two separate cultures, with a constant source of food, the population numbers increased exponentially until they reached the carrying capacity of the culture. However, he found that when the two species were grown in the same culture, one had a competitive advantage and was able to obtain the food more effectively than the other and drove it to extinction.

5 The species live at different heights and inhabit different niches within the tree. They are not competing for the same food or space. In other words, the warblers are not competing for the same resources so they are able to co-exist.

Question set 3.4

1 Responses will vary. One example of collaboration could be dolphins working together to herd schools of fish.

2 Disease can increase the biodiversity of a region if it reduces the number of predators. On the other hand, disease can decrease the biodiversity of an ecosystem if it kills many individuals.

3 Interspecific relationships are those that exist between different species; for example dolphin and fish, whereas intraspecific relationships are those that exist between members of the same species; for example, wolves collaborating with each other.

4 In a predator–prey relationship, one organism, the predator, kills another organism, the prey, or consumes part of it for its food.

5 Responses will vary. One example of the effect of predation on the biodiversity of an ecosystem is the release of nutrients into the soil caused by decomposing animal carcasses left behind by predators, which allows for micro-organisms to survive in the ecosystem.

Question set 3.5

1 **a** Symbiosis is used to describe the relationship between individuals of two or more species that interact together and in which at least one of the species benefits.

b Predation is a relationship between individuals in which one of them acts as a predator that captures and feeds on other organisms that serves as the prey.

c Parasitism is the relationship between individuals where one species benefits at the expense of the other.

d Mutualism is the relationship between individuals where both species in the relationship benefit and neither is harmed.

e Commensalism is the relationship between individuals where one species benefits and the other neither benefits nor is harmed.

2 Pollinators are essential for many flowering plants to reproduce. They rely on the pollinators to transfer pollen from one plant to another. Seed dispersers are also essential to ecosystem biodiversity. These organisms eat fruits and seeds for nutrition, and when the animal defecates, it deposits the seeds in a new location where it can germinate and grow. Seeds do not get damaged in the animal's digestive system and therefore remain viable for germination.

3

Type of symbiosis	Species 1	Species 2
Parasitism	+	−
Mutualism	+	+
Commensalism	+	0

4 Responses will vary.

Parasitism: If the presence of the parasite kills varieties of individuals, this will reduce the diversity of the ecosystem.

Mutualism: If species cannot survive by themselves because of their dependence on other species, the absence of these relationships would cause the species to become threatened or extinct. Diverse ecosystems would not be built.

Commensalism: Species that benefit from the relationship will suffer if the relationship is absent. This would cause the species to become threatened and in the same way as mutualism, diverse ecosystems would not be built.

5 Seed dispersers are distinct from seed predators in that the seeds do not get damaged in the animal's digestive system and therefore remain viable for germination. Seed predators use the seeds for food.

Question set 3.6

1 Coexistence describes different species living together peacefully. A keystone species prevents any one of the organisms in the lower trophic levels from monopolising food resources and space.

2 A keystone species increases an ecosystem's biodiversity by controlling populations of other species that would otherwise dominate the community or by providing critical resources for a wide range of species.

3 A keystone species is often a species of relatively low abundance, whereas a dominant species is one that is more numerous than other species in the ecosystem.

4 The name keystone species was derived from the practice of using a wedge-shaped stone to support the top of an arch in a bridge or other construction. Other stones in the construction depend on the keystone for support. Species in the Yellowstone National Park depend on the Yellowstone cutthroat trout to support and maintain them in their ecosystem.

Chapter review questions

1 Terrestrial environments are classified mainly on vegetation type, topography, soil type and climatic variation such as temperature, water, light and wind. Aquatic environments are classified on salinity, size and permanency of the body of water.

2

Abiotic factors	Terrestrial	Aquatic
Pressure	Lower	Higher, particularly at lower depths
Temperature	Wider range	Narrower range
Gas availability	Freely available	Limited availability

3 Competitors compete for the same resources whereas collaborators are species that work together to benefit each other.

4 **a** Biosphere: the layer of the Earth where the land, atmosphere and water interact in ways that sustain life. Biome: sections of the biosphere.

b Environment: the biotic and abiotic factors in the environment. Ecosystem: the system comprising the community of living things together with the conditions in their habitat.

c Ecosystem: community of living things. Habitat: area where organisms live within an ecosystem.

d Community: the sum of all the living organisms in a habitat. Population: group of individuals belonging to the same species, living in the same habitat at the same time.

e Environment: the biotic and abiotic factors in the environment. Habitat: area where organisms live in the environment.

f Ecological niche: the role of an organism in its relationships with other organisms and the non-living components of its ecosystem. Ecosystem: community of living things.

5 A keystone species allows the coexistence of a number of lower trophic level organisms in a particular area. They significantly alter their ecosystem increasing the biodiversity.

6 Biodiversity is increased when species benefit from their symbiotic relationships. It could be that they gain more food, shelter and are distributed more widely. Any advantage to a species increases their chances of survival.

7

Relationship or interaction	Description	Example
Ecosystem	Different species living together and sharing the same resources	Forest, pond, swamp etc.
Commensalism	One organism benefits and the other neither benefits or is harmed	Shark and remora
Intraspecific interactions (competition)	Rivalry between species for particular resources	Many throughout the text
Mutualism	Both species in the relationship benefit and neither is harmed	Pistol shrimp and the goby fish
Pollinators	Transfers pollen between flowers	Birds, insects, small mammals
Predator	An animal that kills for food	Many throughout the text
Keystone species	A species of relatively low abundance that is seen to have a large influence over lower trophic levels to allow the coexistence of these species in a particular area	Purple sea star
Seed disperser	An organism that feeds on fruits and seeds for nutrition and, when the animal defecates, it deposits the seeds in a new location where they can germinate and grow	Cassowary

8

Species	Name of ecosystem	Rainfall and temperatures
A	Dry sclerophyll forest	Mild wet winters, hot summers, high rainfall
B	Woodland	Constantly hot, very wet and humid
C	Shrubland	Hot and dry, low rainfall
D	Wet sclerophyll forest	Temperate, high rainfall all year round

9 If the species introduced was a predator, it could reduce the biodiversity. If it was a species that benefited other species, the biodiversity would increase. It may also be that there is no change to the biodiversity.

10

Abiotic feature	Terrestrial environment: desert	Terrestrial environment: rainforest	Aquatic environment: marine	Aquatic environment: lake
Pressure variation	Low	Low	High	Medium (depending on depth of lake)
Temperature variation	High	Medium	Low	Medium
Nutrient concentration	Low	High	Medium	Medium
Salinity	Low	Low	High	Low
Oxygen availability	High	High	Low	Low
Water availability	Low	Medium	High	High

11 a The dominant species is A.

b The total surface area covered by species A is 120 m^2. The percentage cover is 37%.

c The environment is classified as a eucalypt forest.

d The sample plot may not be representative of the whole area. A number of sample plots would be needed and the data collated (aggregated).

e Differences in light intensity, slope, availability of water due to different soil conditions, and so on. Some species may grow more rapidly than others and affect the survival of other species by competing more successfully for requirements.

12 Mutualism: Both partners benefit and neither is harmed. The elephant obtains food and the seeds are dispersed.

13 This will depend on students' responses.

14 a

Ecosystem	Temperature range (°C)	Precipitation range (mm)
Boreal forest	−17 to 15	25 to 205
Desert	3 to 31	0 to 24
Grassland	−10 to 31	0 to 78
Permanent ice	−20 to −5	0 to 125
Temperate deciduous forest	0 to 22	37 to 175
Temperate rainforest	5 to 23	198 to 263
Tropical rainforest	13 to 32	150 to 320
Tundra	−18 to 12	0 to 37

b Grassland

c Boreal forest

d This will depend on students' response.

15 Fragmentation reduces the amount of available habitat for species within an ecosystem. This leads to greater competition for resources and, particularly for plants, may lead to their destruction. Organisms cannot move between fragments creating small populations that may be more vulnerable to environmental fluctuations causing extinction of the species.

16 a The prey population is usually larger than the predator population because one predator usually depends on more than one member of the prey population for its food.

b Because of the dynamic relationship between predator and prey there could be a time during a period of adverse conditions that the prey population decreases. When this occurs, there is increased intraspecific competition in the predator population. Predators turn to alternative prey species and it allows the original prey population to grow again.

17 Changing patterns (fluctuations) in predator and prey numbers (see Figure 3.15).

18 This will depend on students' responses.

19 a This will depend on students' responses.

b *B. balanoides* and *C. stellatus* are similar and compete for the same resources, but they do not coexist on the same rocks because *B. balanoides* dries out on higher rocks. *B. balanoides* obtains and uses the resources more effectively than *C. stellatus* and in turn reproduces more quickly. It is only when *B. balanoides* is removed that *C. stellatus* can inhabit the entire rock.

20 This will depend on students' responses.

21 This will depend on students' responses.

22 This will depend on students' responses.