Week 51

A-Level Biology

Homework bundle for this week

本周作业合集

exercises.lol

Contents 目录

A-Level Biology Name: ______________ Score: ________

1. The biological species concept defines a species as a group whose members:
   - ☐ can breed together to produce fertile offspring
   - ☐ simply look alike
   - ☐ live in the same place
   - ☐ have the same number of cells
2. The smallest, most specific group in the taxonomic hierarchy is the ________.

   ____

3. An ecosystem is:
   - ☐ all the living things in an area together with their non-living surroundings
   - ☐ a single species
   - ☐ only the non-living environment
   - ☐ a type of sampling
4. Which is a cause of extinction?
   - ☐ loss and damage of a species' habitat
   - ☐ higher biodiversity
   - ☐ random sampling
   - ☐ a larger gene pool
5. A group whose members can breed together to produce fertile ________ is a biological species.

   ____

6. Which level is the smallest, most closely related group?
   - ☐ species
   - ☐ kingdom
   - ☐ phylum
   - ☐ class
7. Biodiversity is measured at three levels: ecosystems/habitats, species/abundance, and:
   - ☐ genetic variation within each species
   - ☐ the number of atoms

☐ the temperature

☐ the soil pH

8. Two organisms in the same genus are more closely related than two that only share the same class.

☐ True ☐ False

9. Conserving a species in its natural habitat (e.g. a nature reserve) is called _________ conservation.

____

10. Random sampling is used so the sample is not biased and fairly represents the whole area.

☐ True ☐ False

A-Level Biology

1. **can breed together to produce fertile offspring**

   The biological concept uses interbreeding to produce fertile offspring; other concepts use appearance or ecological role.

2. **species**

   Domain → kingdom → phylum → class → order → family → genus → species.

3. **all the living things in an area together with their non-living surroundings**

   An ecosystem includes the living community and the abiotic surroundings; a niche is a species' role within it.

4. **loss and damage of a species' habitat**

   Habitat loss (plus climate change, competition and hunting) can drive a species extinct.

5. **offspring**

   A mule (horse × donkey) is sterile, so horses and donkeys are different species.

6. **species**

   Species is the most specific level; kingdom is the broadest.

7. **genetic variation within each species**

   The three levels are ecosystem diversity, species diversity (and abundance), and genetic diversity.

8. **True**

   The further down the hierarchy two organisms still match, the more closely related they are.

9. **in situ**

   In situ = in place (the habitat); ex situ = off-site (zoos, seed banks).

10. **True**

    Picking spots by chance (e.g. with coordinates) stops you only choosing the interesting-looking places.

18.1 Classification

Name: ____________ Class: ________ Date: __________ **Total: 11 marks**

KEY WORDS class 纲 • taxonomic hierarchy 分类层级 • kingdom 界 • species 物种 • domain 域

Objective

Build the skills to answer exam questions on **classification** — the meaning of **species** 物种, the three **domains** 域, the **taxonomic hierarchy** 分类层级, the four **kingdoms** 界, and how viruses are classified.

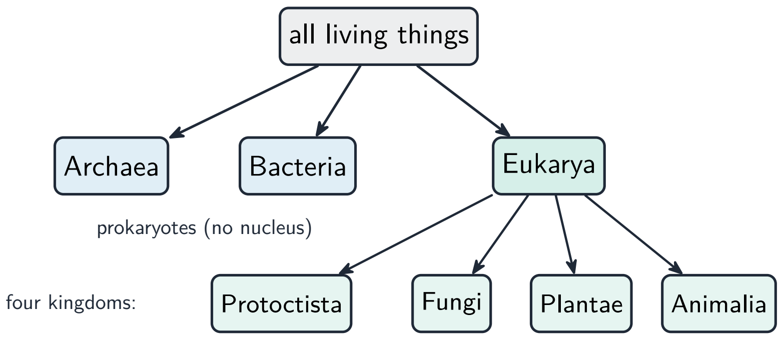
You must be able to:

- discuss the biological, morphological and ecological species concepts
- describe the three domains and the taxonomic hierarchy
- outline the four eukaryotic kingdoms and how viruses are classified

1 Worked examples

■ Species and domains

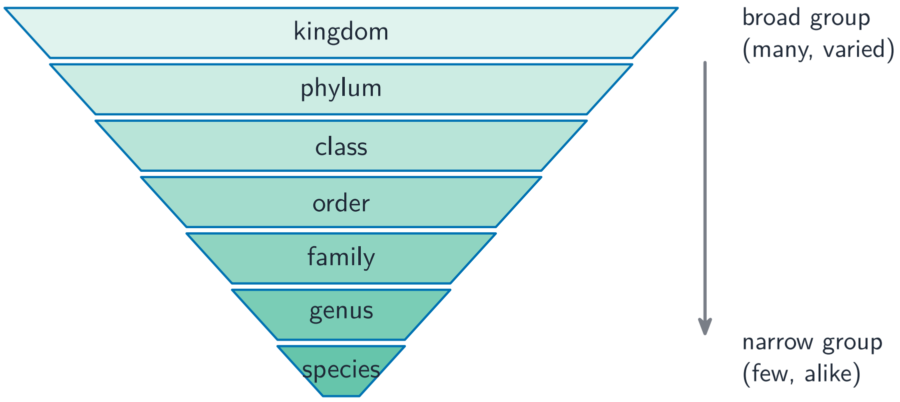
A **species** can be defined by the **biological** (can interbreed to give fertile offspring), **morphological** (look alike), or **ecological** (same niche) concept.



Three domains: Archaea and Bacteria are prokaryotes; the Eukarya split into four kingdoms

Archaea 古菌 and **Bacteria** 细菌 are prokaryotes but differ in membrane lipids, ribosomal RNA and cell-wall make-up. **Eukarya** have a nucleus.

■ The taxonomic hierarchy



Kingdom → *phylum* → *class* → *order* → *family* → *genus* → *species*

The four eukaryotic kingdoms: **Protoctista** (mostly single-celled), **Fungi** (absorb food, chitin walls), **Plantae** (photosynthesise), **Animalia** (feed on others). **Viruses** are classified by their **nucleic acid** (DNA or RNA) and whether it is single- or double-stranded.

2 Practice

2.1 State the biological species concept. [1]

2.2 Put these in order from largest to smallest group: family, kingdom, genus, order. [2]

3 Exam-style questions

3.1 To which domain do organisms with a nucleus belong? [1]

- **A** Archaea
- **B** Bacteria
- **C** Eukarya
- **D** Protoctista

3.2 Viruses are classified according to: [1]

- **A** the kingdom they belong to

- **B** the type of nucleic acid and whether it is single- or double-stranded
- **C** their cell wall composition
- **D** the number of chromosomes

3.3 (a) State **two** features that distinguish the kingdom Fungi from the kingdom Plantae. [2]

(b) Explain why Archaea and Bacteria are placed in separate domains even though both are prokaryotes. [2]

3.4 Explain a limitation of the biological species concept. [2]

Solutions

2.1 a group of organisms that can interbreed to produce fertile offspring.

2.2 kingdom → order → family → genus.

3.1 C. Organisms with a nucleus are in the Eukarya domain.

3.2 B. Viruses are classified by nucleic acid type and strandedness.

3.3 (a) Fungi feed by absorbing food (not photosynthesis); Fungi have chitin cell walls (Plantae have cellulose).
(b) they differ in their membrane lipids, ribosomal RNA and cell-wall composition, showing they are only distantly related.

3.4 it cannot be applied to organisms that reproduce asexually / to extinct/fossil species / where two groups rarely meet to test interbreeding.

2 *Exserohilum turcicum* is a fungal pathogen. The growth of the mycelium of the fungus damages the leaves of maize plants, *Zea mays*. Leaf damage reduces crop yield.

(a) **(i)** Complete Table 2.1 to show **one** structural difference and **one** functional difference between *E. turcicum* and *Z. mays*.

Table 2.1

	E. turcicum	***Z. mays***
structural difference		
functional difference		

[2]

(ii) Describe the principles by which organisms such as *E. turcicum* and *Z. mays* are classified in the taxonomic hierarchy.

....

....

....

....

....

....

....

.... [4]

(b) Two inbred varieties of maize, SKV50 and CML153, were crossed. The resulting F1 hybrids were self-crossed to produce F2 offspring. The F2 plants were grown, and the percentage area of leaf damage caused by *E. turcicum* was measured.

Fig. 2.1 shows the results for the F2 generation. The arrows show the mean percentage area of leaf damage for the two parent varieties.

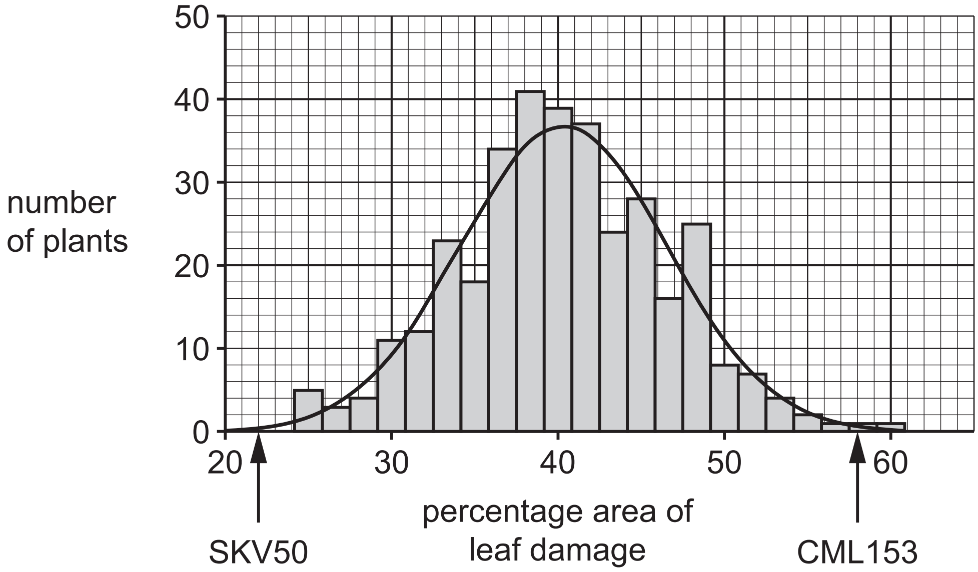


Fig. 2.1

(i) Explain how Fig. 2.1 can be used to determine which parent maize variety shows the greatest resistance to infection by *E. turcicum*.

....

....

....

.... [2]

(ii) State the name of the type of variation shown by the maize F2 generation in Fig. 2.1.

.... [1]

(iii) Explain the **genetic** basis of the type of variation shown by the maize F2 generation.

....

....

....

....

....

....

....

.... [4]

[Total: 13]

7 The kakapo, *Strigops habroptila*, is a species of large, nocturnal (active at night) parrot and is found only in New Zealand. The bird does not fly and lives on the ground.

The kakapo is classified as critically endangered on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species™.

Fig. 7.1 shows a kakapo.

Fig. 7.1

(a) Complete Table 7.1 to show the classification of the kakapo.

Table 7.1

taxonomic group	**name**
domain	Eukarya
kingdom	Animalia
....	Chordata
class	Aves
....	Psittaciformes
family	Strigopidae
genus	....

[3]

(b) The kakapo was widely distributed before humans arrived in New Zealand. The Kakapo Recovery Programme started in 1995. Birds were moved to protected areas. In 2024 they were only found in these protected areas.

This is shown in Fig. 7.2.

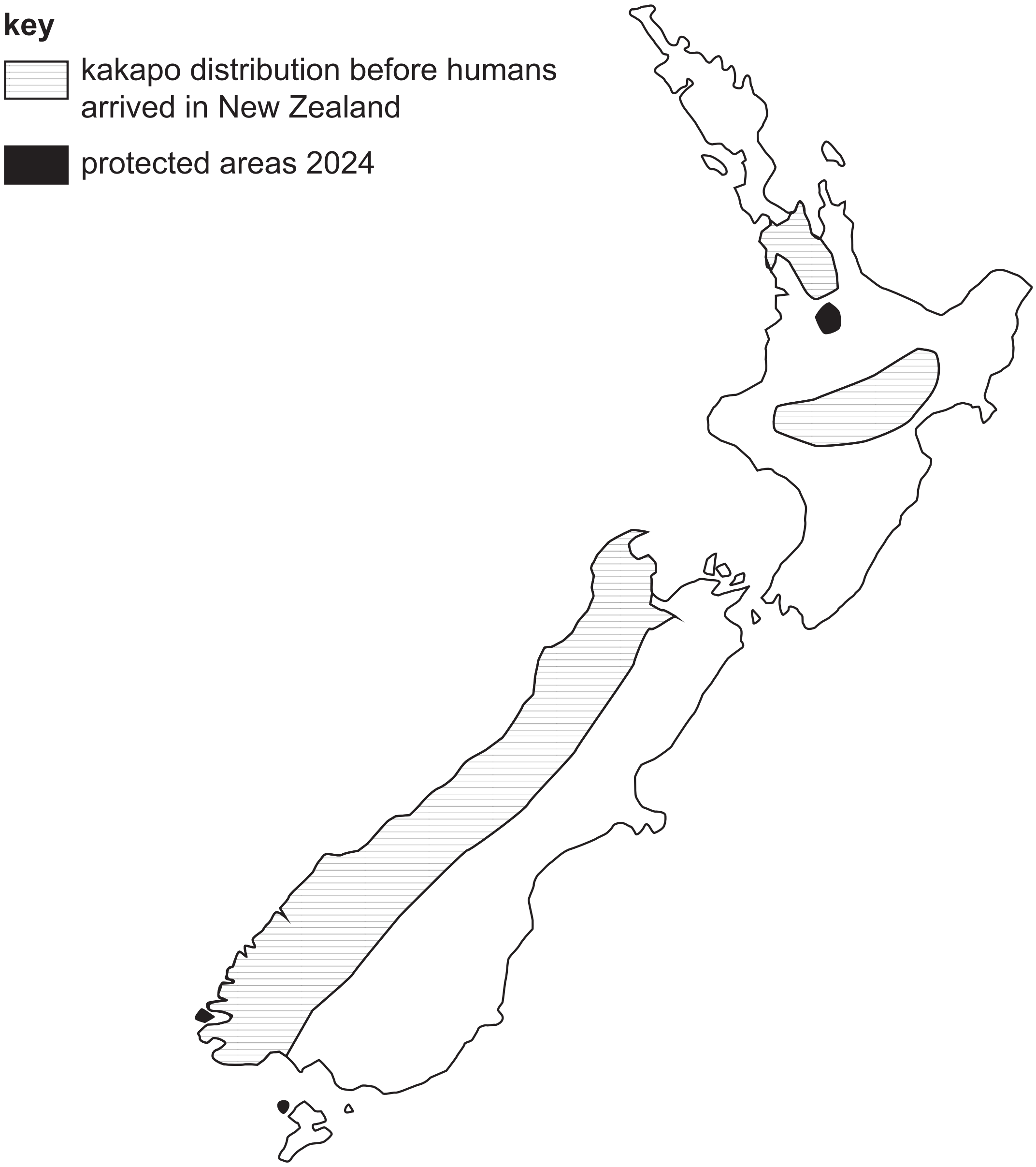


Fig. 7.2

Suggest the ideal features of a protected area for the kakapo.

....

....

....

....

....

....

.... [3]

(c) DNA has shown that the kakapo population may have gone through one or more genetic bottlenecks after the arrival of humans in New Zealand.

Suggest the consequences of a genetic bottleneck to the kakapo population in New Zealand.

....

....

....

....

....

....

....

....

.... [4]

[Total: 10]

9 A species is classified into one of three domains.

(a) Two of the domains contain only prokaryotic species.

With reference to the two prokaryotic domains, describe the features used to classify prokaryotic species into two different domains.

....

....

....

....

....

....

.... [3]

(b) Tigers are large mammals that live in many parts of Asia.

Fig. 9.1 shows a tiger, *Panthera tigris*.

Fig. 9.1

Complete Table 9.1 by writing the domain, kingdom and genus in which tigers are classified.

Table 9.1

taxon	**name**
domain	
kingdom	
phylum	Chordata
class	Mammalia
order	Carnivora
family	Felidae
genus	

[3]

[Total: 6]

A-LEVEL BIOLOGY • EXERCISE SHEET

18.2 Biodiversity

Name: ____________ Class: ________ Date: __________ **Total: 11 marks**

KEY WORDS biodiversity 生物多样性 • ecosystem 生态系统 • simpson's index 辛普森指数 • simpson's index of div
• random sampling 随机取样

Objective

Build the skills to answer exam questions on **biodiversity** — **ecosystem** 生态系统 and **niche** 生态位, the levels of biodiversity, **random sampling** 随机取样 methods, and **Simpson's index** 辛普森指数.

You must be able to:

- define ecosystem and niche and explain the levels of biodiversity
- describe sampling methods (quadrats, transects, mark-release-recapture)
- use the Lincoln index and Simpson's index of diversity

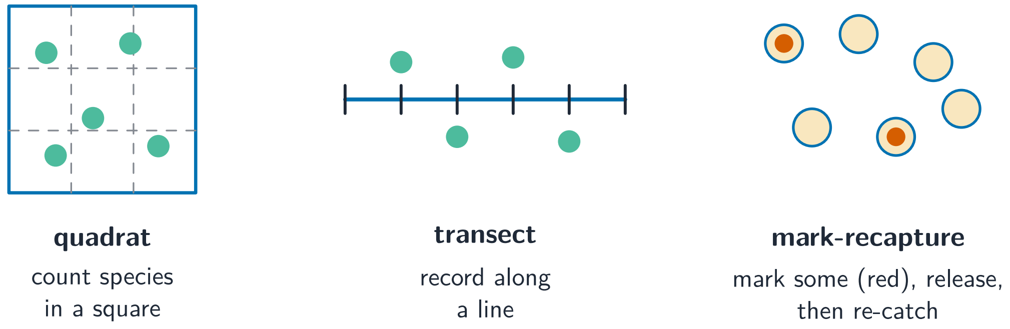
1 Worked examples

■ Levels of biodiversity

Biodiversity = the range of ecosystems, the number of species (and abundance), and genetic variation within a species

An **ecosystem** is the living things in an area plus their non-living surroundings; a **niche** is a species' role and place within it.

Sampling methods



Quadrats and transects sample fixed organisms; mark-release-recapture estimates mobile animals

Random sampling avoids bias. The **Lincoln index** estimates a population: $N = \frac{n_1 \times n_2}{m}$ (first catch × second catch ÷ marked recaught).

Simpson's index of diversity

$$D = 1 - \sum \left(\frac{n}{N}\right)^2$$

where n = number of one species and N = total of all species. A higher D means more diverse and usually more stable.

2 Practice

2.1 Define the term **niche**. [1]

2.2 Name a sampling method suitable for (a) plants in a field and (b) mobile beetles. [2]

3 Exam-style questions

3.1 Why is random sampling important when measuring biodiversity? [1]

- **A** it counts every organism
- **B** it avoids bias and gives a fair, representative sample
- **C** it is faster than other methods
- **D** it only samples the rarest species

3.2 A higher value of Simpson's index of diversity (D) indicates: [1]

- **A** fewer species
- **B** a more diverse, usually more stable, community
- **C** a smaller area
- **D** more abiotic factors

3.3 In a mark-release-recapture study, 60 snails are caught, marked and released. Later, 80 are caught, of which 24 are marked.

(a) Use the Lincoln index to estimate the population size. [2]

(b) State **one** assumption of this method. [1]

3.4 A pond contains 3 species with 5, 3 and 2 individuals (N = 10). Calculate Simpson's index of diversity, D. [3]

Solutions

2.1 the role and position of a species within its ecosystem.

2.2 (a) quadrats / transects; (b) mark-release-recapture.

3.1 B. Random sampling avoids bias, giving a representative result.

3.2 B. A higher D means greater diversity and usually greater stability.

3.3 (a) $N = \dfrac{60 \times 80}{24} = 200$ snails.
(b) any one: no births/deaths/migration; marks do not affect survival; marked animals mix randomly.

3.4 $\sum(n/N)^2 = (5/10)^2 + (3/10)^2 + (2/10)^2 = 0.25 + 0.09 + 0.04 = 0.38$; $D = 1 - 0.38 = 0.62$.

8 **(a)** Palm oil is the most widely used vegetable oil. It is obtained from the African oil palm, *Elaeis guineensis*. Oil palms are the highest yielding vegetable oil crop, needing only 10% of the land area required by other crops to produce the same quantity of oil.

On the island of Borneo, tropical rainforests are cut down and cleared to create oil palm plantations. This has a large effect on biodiversity.

The Bornean orangutan, *Pongo pygmaeus,* is only found on the island of Borneo and is classified as critically endangered on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species™.

Fig. 8.1 shows Bornean orangutans.

Fig. 8.1

Suggest ways in which the Bornean orangutan may be conserved.

....

....

....

....

....

....

....

....

.... [4]

(b) Biodiversity can be assessed at different levels.

Outline the main levels at which biodiversity can be assessed.

....

....

....

....

....

.... [3]

(c) The biodiversity of a habitat can be measured by calculating Simpson's index of diversity (*D*).

The formula for Simpson's index of diversity (*D*) is:

$$D = 1 - \left(\Sigma\left(\frac{n}{N}\right)^2\right)$$

Key to symbols:

n = number of individuals of each type present in the sample

N = the total number of all individuals of all types present in the sample

A survey of shrubs and trees in a temperate woodland was carried out. The results are shown in Table 8.1.

Table 8.1

common name	n	$\frac{n}{N}$	$\left(\frac{n}{N}\right)^2$
maple	807	0.196	0.0384
alder	6	0.001	0.0000
hazel	1856	0.451	....
hawthorn	82	0.020	0.0004
blackthorn	40	0.010	0.0001
willow	101	0.025	0.0006
birch	78	0.019	0.0004
wild rose	84	0.020	0.0004
oak	1036	0.252	0.0635
dogwood	29	0.007	0.0000
N =	4119	Total =	....

(i) Complete Table 8.1. [2]

(ii) Calculate the value for Simpson's index of diversity (*D*).

D = ... [1]

(iii) Using your value for *D*, comment on the biodiversity of this temperate woodland.

....

....

....

....

.... [2]

[Total: 12]

5 The Galápagos is a group of islands with a high biodiversity.

(a) *Geospiza fortis* is one of the many species of finch that live on the Galápagos islands. On one of the Galápagos islands, Daphne Major, scientists measured the bill size (length, width and depth) of individuals in a population of *G. fortis* over several years.

Fig. 5.1 shows a *G. fortis* female.

Fig. 5.1

G. fortis feed on seeds. Seed size and bill size vary. It is easier for *G. fortis* with smaller bills to eat small seeds and for *G. fortis* with larger bills to eat large seeds.

In 1977, a drought occurred on Daphne Major, which resulted in a large decrease in the availability of seeds, particularly small seeds.

Scientists observed an increase in the mean bill size in the *G. fortis* population on Daphne Major after the drought.

(i) State the type of natural selection that occurred in the *G. fortis* population on Daphne Major as a result of the drought.

.... [1]

(ii) Fig. 5.2 shows the distribution of bill size in the *G. fortis* population before the drought in 1977.

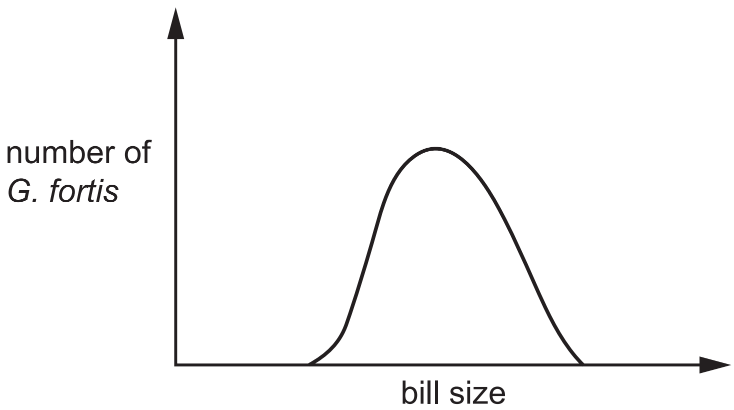


Fig. 5.2

Sketch a new curve on Fig. 5.2 to snow the distribution of bill size in the *G. fortis* population after the drought.

[1]

(b) *G. fortis* also lives on Santa Cruz, another island in the Galápagos.

Most of the seeds available for *G. fortis* to eat on Santa Cruz are either small or large. There are few intermediate sizes of seed.

Fig. 5.3 shows the distribution of bill size in the *G. fortis* population on Santa Cruz.

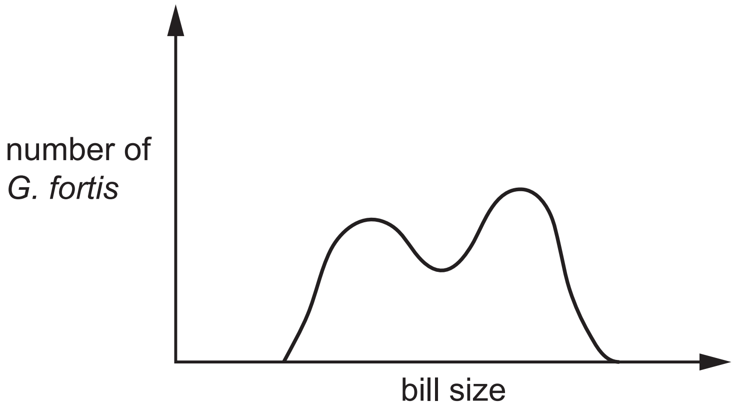


Fig. 5.3

Explain how natural selection in the *G. fortis* population on Santa Cruz has resulted in the distribution in bill size shown in Fig. 5.3.

....

....

....

....

....

....

....

....

.... [4]

(c) Scientists studied the effect of an increase in the number of tourists each year on the number of invasive alien species present in the Galápagos islands.

The scientists recorded the number of invasive alien species present each year in the Galápagos islands over many years. The scientists also recorded the number of tourists visiting the islands each year.

Fig. 5.4 shows a graph of the data for five different years during the study.

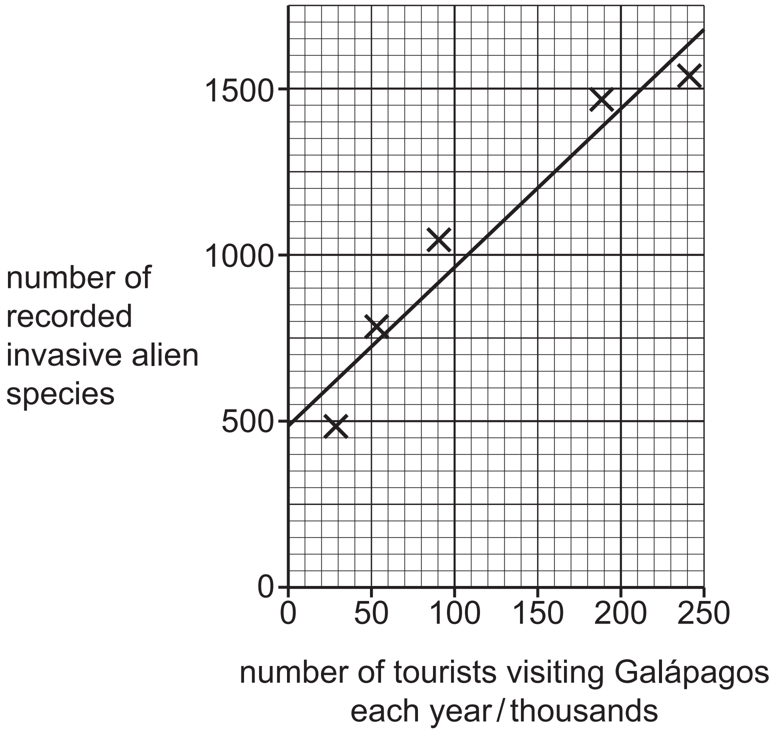


Fig. 5.4

(i) The scientists carried out a Pearson's linear correlation calculation for the data in Fig. 5.4.

The scientists calculated an ***r*** value of 0.930.

The scientists concluded that there is a significant correlation between the number of tourists visiting the Galápagos islands each year and the number of invasive alien species present.

Table 5.1 shows a probability table of critical values for Pearson's linear correlation.

Table 5.1

number of observations	**probability level (*p*)**	
	0.05	**0.01**
3	0.997	1.000
4	0.950	0.990
5	0.878	0.959
6	0.811	0.917
7	0.754	0.875

With reference to Table 5.1, explain why the ***r*** value of 0.930 indicates that there is a significant correlation between the number of tourists and the number of invasive alien species.

....

....

....

.... [2]

(ii) Invasive alien species are thought to have contributed to extinctions recorded in the Galápagos islands.

Discuss the negative effects of introducing invasive alien species to an ecosystem.

....

....

....

....

....

....

....

....

.... [4]

(iii) State **two** factors, other than competition and the introduction of invasive alien species, that can cause extinction.

1 ....

2 ....

[2]

[Total: 14]

A-LEVEL BIOLOGY • EXERCISE SHEET

18.3 Conservation

Name: ____________ Class: ________ Date: __________ **Total: 12 marks**

KEY WORDS conservation 保护 • extinct 灭绝 • endangered species 濒危物种 • invasive species 入侵物种 • seed bank 种子库

Objective

Build the skills to answer exam questions on **conservation** — why species become **extinct** 灭绝, ways to conserve them, **assisted reproduction** 辅助生殖, **invasive species** 入侵物种, and the roles of **IUCN** and **CITES**.

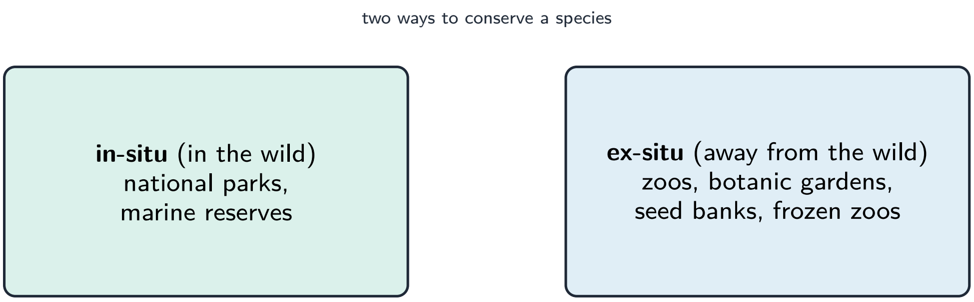
You must be able to:

- explain the causes of extinction and reasons to maintain biodiversity
- outline conservation methods (in-situ and ex-situ) and assisted reproduction
- explain the control of invasive species and the roles of IUCN and CITES

1 Worked examples

Extinction and conserving species

Species become **extinct** through **climate change** 气候变化, competition (often from invasive species), hunting by humans, and habitat loss. We maintain biodiversity because species give food, medicines and materials, keep ecosystems stable, and have value in themselves.



Conservation is in-situ (protect in the wild habitat) or ex-situ (keep and breed away from the wild)

Conservation protects biodiversity at every level

- **in-situ** 就地: protected areas — national parks, marine parks.
- **ex-situ** 迁地: **zoos** 动物园, **botanic gardens** 植物园, **seed banks** 种子库, 'frozen zoos'.

Assisted reproduction and invasive species

For rare mammals: **IVF** 体外受精, **embryo transfer** 胚胎移植, **surrogacy** 代孕. **Invasive species** are controlled because they out-compete native species. **IUCN** lists how threatened each species is; **CITES** controls international trade in endangered species.

2 Practice

2.1 State **two** causes of extinction. [2]

2.2 State the difference between in-situ and ex-situ conservation. [2]

3 Exam-style questions

3.1 Which is an example of **ex-situ** conservation? [1]

- **A** a national park
- **B** a marine reserve
- **C** a seed bank
- **D** a protected wetland

3.2 What is the role of CITES? [1]

- **A** to list how threatened each species is
- **B** to control the international trade in endangered species
- **C** to run IVF programmes
- **D** to remove invasive species

3.3 (a) Explain why invasive species are controlled in conservation. [2]

(b) Outline how a seed bank helps to conserve plant species. [2]

3.4 Explain **two** reasons why maintaining biodiversity is important. [2]

Solutions

2.1 any two: climate change; competition / invasive species; hunting by humans; habitat loss/degradation.

2.2 in-situ — conserving a species in its natural habitat; ex-situ — keeping and breeding it away from the wild.

3.1 C. A seed bank keeps species away from the wild — ex-situ.

3.2 B. CITES controls international trade in endangered species.

3.3 (a) invasive species out-compete native species for resources, reducing native populations / biodiversity.
(b) seeds are stored (frozen/dry) for the long term; they can be grown later to restore a species if it is lost from the wild.

3.4 any two reasons explained: species provide food/medicines/materials; they keep ecosystems stable; they have intrinsic value.

6 The distribution of the large blue butterfly, *Phengaris arion*, extends across Europe and Asia. It is assessed by the International Union for Conservation of Nature (IUCN) on the Red List™ as 'Near Threatened' globally and 'Endangered' in Europe.

In Europe, *P. arion* became extinct in the Netherlands in 1964 and in the United Kingdom in 1979.

Fig. 6.1 lists the conservation status categories in the IUCN Red List™.

conservation status

Extinct (EX)

Extinct in the Wild (EW)

Critically Endangered (CR)

Endangered (EN) ↑ **increasing risk of extinction**

Vulnerable (VU)

Near Threatened (NT)

Least Concern (LC)

Fig. 6.1

Fig. 6.2 shows *P. arion*.

Fig. 6.2

(a) **(i)** Explain how IUCN Red List™ assessments help to conserve biodiversity.

....

....

....

....

....

[3]

(ii) With reference to Fig. 6.1 and the IUCN assessments for *P. arion*, suggest how the abundance of the butterfly differs across its distribution.

[2]

(b) *P. arion* has been successfully re-introduced in the United Kingdom at 12 sites. These sites were restored to flower-rich grassland.

The conservation management actions designed for *P. arion* also resulted in the re-establishment or increase of other species at the restored sites. These included 12 species of flowering plant, 8 other butterfly species and 4 species of other insects.

(i) Use the information given to suggest why *P. arion* went extinct in the United Kingdom in 1979.

[2]

(ii) Outline the advantages of restoring habitats for endangered species.

[4]

[Total: 11]

8 **(a)** Palm oil is the most widely used vegetable oil. It is obtained from the African oil palm, *Elaeis guineensis*. Oil palms are the highest yielding vegetable oil crop, needing only 10% of the land area required by other crops to produce the same quantity of oil.

On the island of Borneo, tropical rainforests are cut down and cleared to create oil palm plantations. This has a large effect on biodiversity.

The Bornean orangutan, *Pongo pygmaeus,* is only found on the island of Borneo and is classified as critically endangered on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species™.

Fig. 8.1 shows Bornean orangutans.

Fig. 8.1

Suggest ways in which the Bornean orangutan may be conserved.

....

....

....

....

....

....

....

....

.... [4]

(b) Biodiversity can be assessed at different levels.

Outline the main levels at which biodiversity can be assessed.

....

....

....

....

....

.... [3]

(c) The biodiversity of a habitat can be measured by calculating Simpson's index of diversity (*D*).

The formula for Simpson's index of diversity (*D*) is:

$$D = 1 - \left(\Sigma\left(\frac{n}{N}\right)^2\right)$$

Key to symbols:

n = number of individuals of each type present in the sample

N = the total number of all individuals of all types present in the sample

A survey of shrubs and trees in a temperate woodland was carried out. The results are shown in Table 8.1.

Table 8.1

common name	n	$\frac{n}{N}$	$\left(\frac{n}{N}\right)^2$
maple	807	0.196	0.0384
alder	6	0.001	0.0000
hazel	1856	0.451	....
hawthorn	82	0.020	0.0004
blackthorn	40	0.010	0.0001
willow	101	0.025	0.0006
birch	78	0.019	0.0004
wild rose	84	0.020	0.0004
oak	1036	0.252	0.0635
dogwood	29	0.007	0.0000
N =	4119	Total =	....

(i) Complete Table 8.1. [2]

(ii) Calculate the value for Simpson's index of diversity (*D*).

D = ... [1]

(iii) Using your value for *D*, comment on the biodiversity of this temperate woodland.

....

....

....

....

.... [2]

[Total: 12]

7 The kakapo, *Strigops habroptila*, is a species of large, nocturnal (active at night) parrot and is found only in New Zealand. The bird does not fly and lives on the ground.

The kakapo is classified as critically endangered on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species™.

Fig. 7.1 shows a kakapo.

Fig. 7.1

(a) Complete Table 7.1 to show the classification of the kakapo.

Table 7.1

taxonomic group	**name**
domain	Eukarya
kingdom	Animalia
....	Chordata
class	Aves
....	Psittaciformes
family	Strigopidae
genus	....

[3]

(b) The kakapo was widely distributed before humans arrived in New Zealand. The Kakapo Recovery Programme started in 1995. Birds were moved to protected areas. In 2024 they were only found in these protected areas.

This is shown in Fig. 7.2.

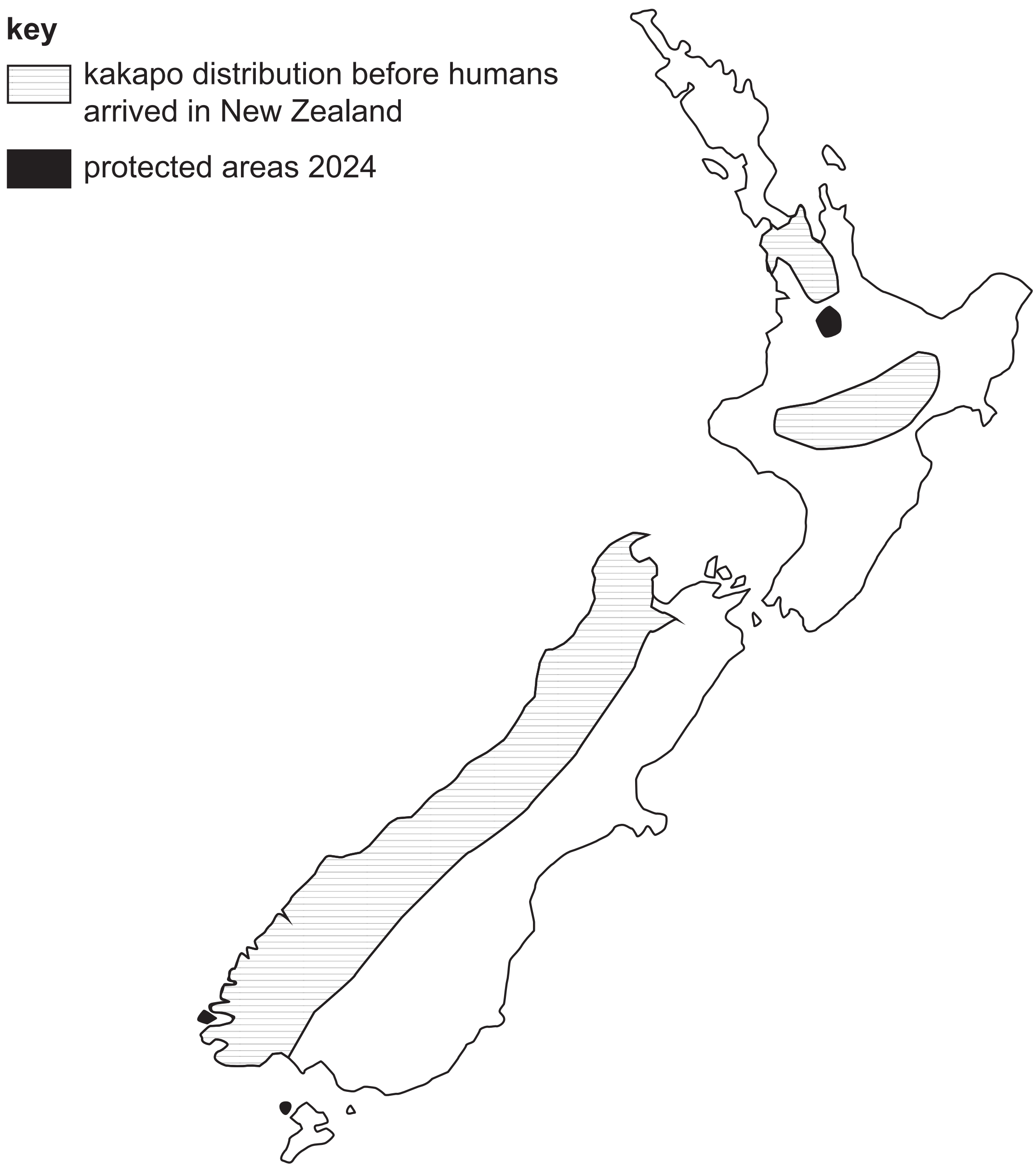


Fig. 7.2

Suggest the ideal features of a protected area for the kakapo.

....

....

....

....

....

....

.... [3]

(c) DNA has shown that the kakapo population may have gone through one or more genetic bottlenecks after the arrival of humans in New Zealand.

Suggest the consequences of a genetic bottleneck to the kakapo population in New Zealand.

....

....

....

....

....

....

....

....

.... [4]

[Total: 10]