18. Classification, Biodiversity and Conservation

18.1 Classification

Paper 4

Question Paper

1 Bears are several species of mammal in the family Ursidae.

Climate change and loss of habitats due to human activity have reduced the size of some bear populations in recent years.

(b) Grizzly bears, *Ursus arctos horribilis*, and polar bears, *Ursus maritimus*, are found in North America.

Fig. 8.1 shows a grizzly bear and a polar bear.



grizzly bear



polar bear

Fig. 8.1

Grizzly bears have:

- a varied diet that includes grasses, roots, berries, nuts, rodents, insects and fish
- a habitat of woodland or grassland
- a maximum mass of 270 kg.

Polar bears have:

- a diet that consists of other animals, such as seals
- a habitat of land and sea ice
- a maximum mass of 450 kg.

Climate change has caused populations of grizzly bears to spread further north and populations of polar bears to spread further south. In some areas there is habitat overlap and, on rare occasions, breeding between grizzly bears and polar bears has occurred.

The offspring of grizzly bears and polar bears are known as pizzly bears.

Pizzly bears can breed together in the wild.

Fig. 8.2 shows a pizzly bear.



Fig. 8.2

With reference to **three** different species concepts, discuss whether grizzly bears and polar bears should be classified as separate species.

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2 Lichens are found growing on trees, walls, rocks and soil.

Fig. 9.1 shows a lichen of the genus *Usnea. Usnea* can tolerate only low concentrations of sulfur dioxide and does not grow in places where the air is polluted with sulfur dioxide.

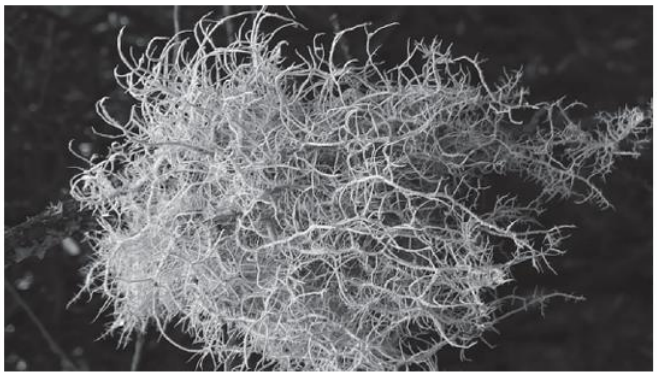


Fig. 9.1

Usnea is composed of a mixture of two types of cell:

- photosynthetic cells that are classified in the kingdom Protoctista
- fungal cells that are classified in the kingdom Fungi.

(a) Outline the characteristic features of the kingdoms Protoctista and Fungi.

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3 Genetic technology uses many different enzymes and techniques.

(a) Restriction endonucleases are used in genetic modification. These enzymes occur naturally in prokaryotic cells. More than 3500 different restriction endonucleases have been identified and it is thought there are many more to discover.

Name **two** domains that are a source of restriction endonucleases.

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4 The natural **ecosystem** on Hawadax Island in Alaska was disrupted in the 1780s when brown rats, *Rattus norvegicus*, swam to the island from a sinking ship and then rapidly increased their population size.

The rats occupied a new **niche** on the island as predators. The rats ate the eggs and chicks of birds such as the black oystercatcher, *Haematopus bachmani*, and the glaucous-winged gull, *Larus glaucescens*. These birds make nests, lay eggs and rear their chicks on the beaches of the island.

(c) Table 2.1 shows the percentage change in abundance of some of the seaweeds, invertebrates and birds found on the beaches of Hawadax Island.

Table 2.1

organism	percentage change from 2008 to 2013	percentage change from 2008 to 2019
seaweeds	+2	+49
mussel, *Mytilus*	–94	–99
sea snail, *Littorina*	–47	–91
black oystercatcher, *Haematopus bachmani*	+400	+800
glaucous-winged gull, *Larus glaucescens*	+126	+191

(i) Use Table 2.1 to state the **genus** name of **one** organism that has **increased** in abundance.

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(ii) Seaweeds were once thought to be plants but are now classified in the kingdom Protoctista.

Outline the features of the kingdom Protoctista that are shown by **seaweeds**.

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5 Yeasts are unicellular organisms from the kingdom Fungi. *Saccharomyces cerevisiae* is one species of yeast that can carry out either asexual reproduction by mitosis or sexual reproduction by meiosis.

Budding in *S. cerevisiae* is a process where a small daughter cell forms as a bud on the parent cell. The bud contains a copy of the parent cell nucleus and it eventually separates from the parent cell to form a new cell.

S. cerevisiae can exist in two forms: haploid cells or diploid cells.

- Haploid cells can be one of two different mating types: **a** and α.
- Haploid cells can only mate with other haploid cells of the opposite mating type.

Fig. 2.1 shows the life cycle of *S. cerevisiae* with its asexual and sexual reproductive stages.

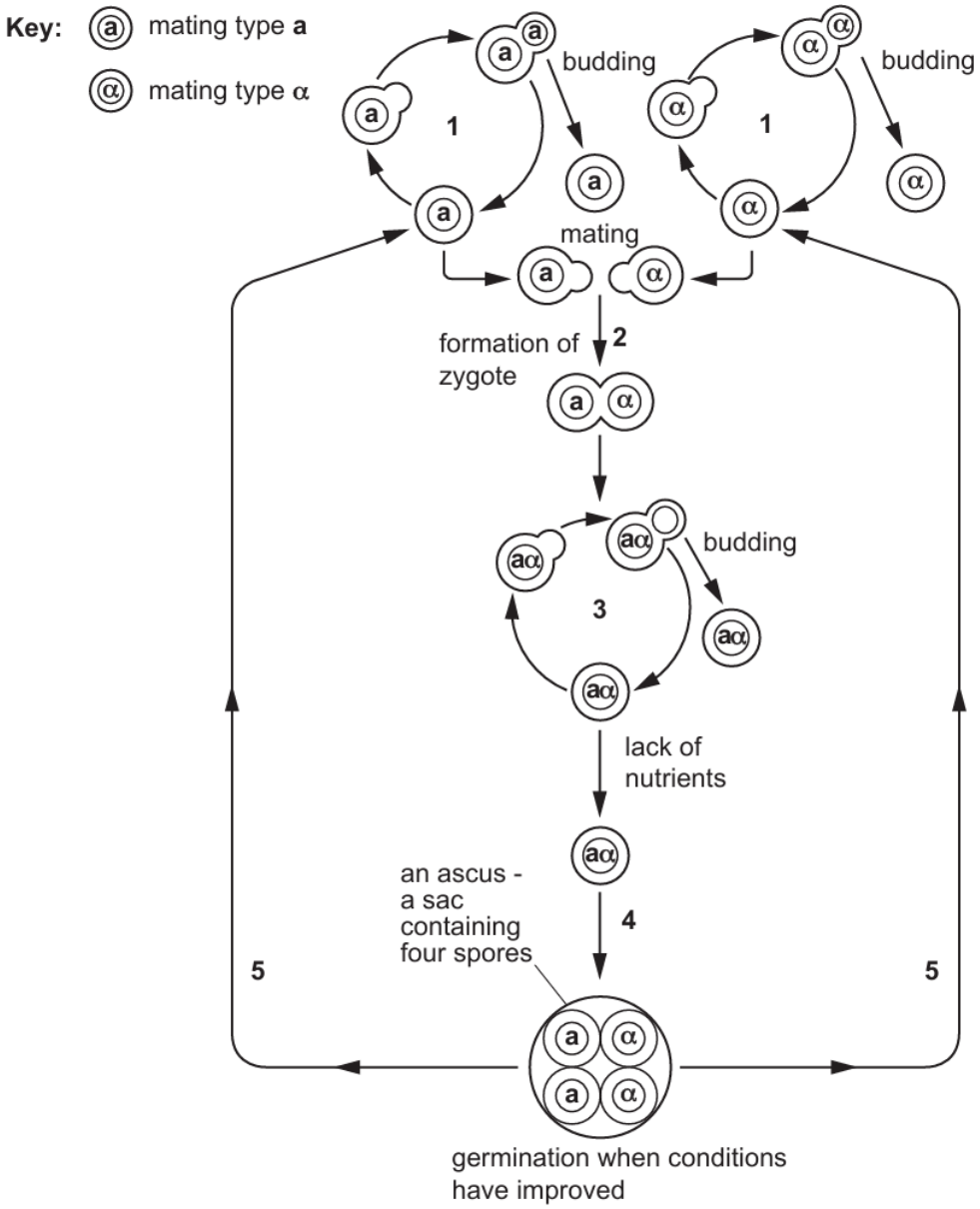


Fig. 2.1

(d) State **two** features, other than reproduction using spores, of the kingdom Fungi.

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6 **(a)** The golden mantella, *Mantella aurantiaca*, is a small terrestrial frog found in Madagascar.

Fig. 1.1 shows a golden mantella.



Fig. 1.1

(i) Name the domain and kingdom to which the golden mantella belongs.

domain .....

kingdom .....

[2]

7 The African penguin, *Spheniscus demersus*, lives along the coast of South Africa.

Fig. 10.1 shows two African penguins.



Fig. 10.1

(d) The African penguin is a member of the kingdom Animalia.

Outline the characteristic features of the kingdom Animalia.

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8 **(a)** One way to measure global biodiversity is to count the number of species of organisms.

Table 3.1 shows estimates for 2009 of the number of species in some taxa of animals.

The numbers in brackets are the numbers that were updated in 2019 from the International Union for Conservation of Nature and Natural Resources (IUCN) for three intensively studied taxa.

Table 3.1

number of species in each taxon		
kingdom	**phylum**	**class**
animals 1 438 805	arthropods 1 191 770	arachnids 102 248
		crustaceans 47 000
		myriapods 16 072
		insects 1 024 945
		other arthropod classes 1505
	chordates 63 543	fish 31 269
		amphibians 6515 (6722)
		birds 9990 (11 126)
		reptiles 8734
		mammals 5487 (5692)
	molluscs 85 000	
	other animal phyla 98 492	

(i) List **three** features shared by **animal** species.

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(ii) Explain how the classification of species into a taxonomic hierarchy assists the work of conservation bodies such as the IUCN.

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9 In 2014, scientists published a phylogenetic (evolutionary) tree diagram showing how and when different groups of insects developed from ancestral groups.

To construct the diagram, the scientists compared nucleotide **and** amino acid sequence data for 1478 genes from each of 103 different insect species. The 103 species represented all 32 orders of the class Insecta.

The data were used to arrange the species in related groups according to their degree of molecular similarity and to track how sequences changed over time.

(a) (i) Outline **three** ways in which the members of a species are similar.

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(ii) Organisms are classified in a hierarchical system of taxonomic units.

Name the domain and kingdom to which insects belong.

domain .....

kingdom .....

[2]

(iii) Explain why a phylogenetic tree diagram is useful for classifying insect species.

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(b) For this study, new software for processing large quantities of data was developed.

(i) Calculate the total number of sequences that were compared, considering both the nucleotide and amino acid sequences for each gene.

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(ii) Explain why this study needs to make use of bioinformatic techniques.

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10 A subspecies is a genetically distinct population within a species that has some phenotypic differences from the rest of the species, but is not yet reproductively isolated.

Nine subspecies of the tiger, *Panthera tigris*, have been identified. Six of these subspecies are found on mainland Asia. Three of the subspecies originate from the Sunda Islands. These islands include Bali, Java and the large island of Sumatra.

Fig. 3.1 shows these three islands.

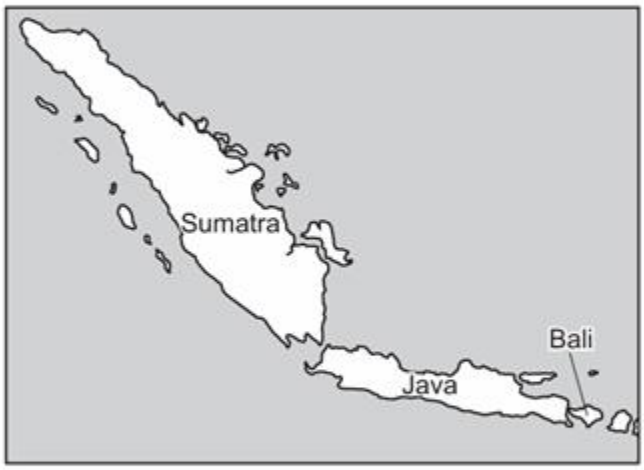


Fig. 3.1

- The Bali tiger, *Panthera tigris balica* (*P. t. balica*), became extinct in the 20th Century. The Bali tiger was found only on the island of Bali.
- The Javan tiger, *P. t. sondaica*, became extinct in the 20th Century. The Javan tiger was found only on the island of Java.
- The Sumatran tiger, *P. t. sumatrae*, lives only on Sumatra and is the closest living relative of Bali and Javan tigers.

20 000 years ago land bridges temporarily connected the Sunda Islands.

A recent study carried out a genetic analysis of the nine subspecies of tiger. Specific sections of mitochondrial DNA (mtDNA) that are useful in studies of evolution were amplified using PCR and compared to assess their evolutionary history.

- The source of DNA for the extinct subspecies came from museum specimens.
- mtDNA was extracted and polymerase chain reaction (PCR) carried out using primers based on specific sections of tiger mtDNA.
- The mtDNA sections for the three island subspecies were genetically distinct from the other six mainland subspecies.
- The mtDNA sections for the three island subspecies were all found to be very similar.

(e) Suggest why *P. t. sumatrae* is still considered to be a member of the species *Panthera tigris*.

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11 **(a)** Most organisms are classified according to a taxonomic hierarchy.

The hierarchy is shown in Fig. 8.1 but the group names are not in the correct order.

1 – kingdom

2 – order

3 – genus

4 – family

5 – domain

6 – class

7 – species

8 – phylum

Fig. 8.1

Complete Table 8.1 by writing the numbers in the correct order.

Table 8.1

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[2]

(b) Members of the Eukarya domain share similar features but will also have several differences.

Complete Table 8.2 by stating the differences between the kingdoms Fungi and Plantae.

Table 8.2

	Fungi	Plantae
type of nutrition	.....	.....
storage polysaccharide	.....	.....
main component of cell wall	.....	.....

[3]

(c) Name the domain that contains organisms with a peptidoglycan cell wall.

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(d) Viruses are not included in the three domain classification.

Outline how viruses are classified.

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..... [2]

12 Cats are members of the Felidae family. Two genera of Felidae are *Leopardus* and *Panthera*.

(a) The genus *Leopardus* consists of species of wild cats that are small and spotted. In 2013, biologists investigated the evolution of *Leopardus tigrinus* in South America.

Fig. 3.1 shows the locations in South America of two populations of. *L. tigrinus*, population **A** and population **B**.

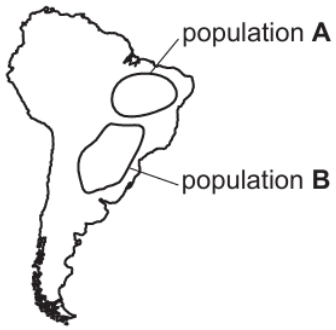


Fig. 3.1

- Population **A** lives in grassland and desert habitats and population **B** lives in forest habitats.
- The cats in population **A** have a lighter coat colour and a different pattern of spots from the cats in population **B**.
- Genetic analysis shows that population **A** is genetically distinct from population **B**.
- Population **B** has now been reclassified as a new species, *L. guttulus*.

(i) Define the term species.

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