18. Classification, Biodiversity and Conservation

18.3 Conservation

Paper 4

Question Paper

1 **(a)** The Asian common toad, *Duttaphrynus melanostictus*, arrived accidentally in eastern Madagascar in 2010 on a ship.

Fig. 9.1 shows an Asian common toad.



Fig. 9.1

The Asian common toad is now regarded as an invasive alien species because:

- it breeds fast in the warm, wet conditions of eastern Madagascar
- it can travel up to 2.5 km per year
- its skin contains poison, which is highly toxic to humans and predators.

Suggest ways in which the Asian common toad may affect the ecosystem of eastern Madagascar.

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(b) Zoos work with local groups around the world to help conserve endangered species.
One example of this is the use of assisted reproduction, such as IVF, with endangered mammals such as the eastern black rhino.

Outline the process of IVF.

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2 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.

(a) The International Union for Conservation of Nature (IUCN) has a role in the conservation of species, such as species of bear.

Outline the role of the IUCN in the conservation of species.

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3 The red ruffed lemur, *Varecia rubra*, is a mammal found only in the rainforests of the Masoala region in north east Madagascar.

Fig. 9.1 shows a red ruffed lemur.



Fig. 9.1

(a) The International Union for Conservation of Nature (IUCN) Red List of Threatened Species™ states that the red ruffed lemur is critically endangered.

Suggest why the red ruffed lemur has become critically endangered.

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(b) Many zoos around the world operate captive breeding programmes for the red ruffed lemur.

Fig. 9.2 shows the numbers of captive-born red ruffed lemurs in North American zoos from 1970 to 2020.

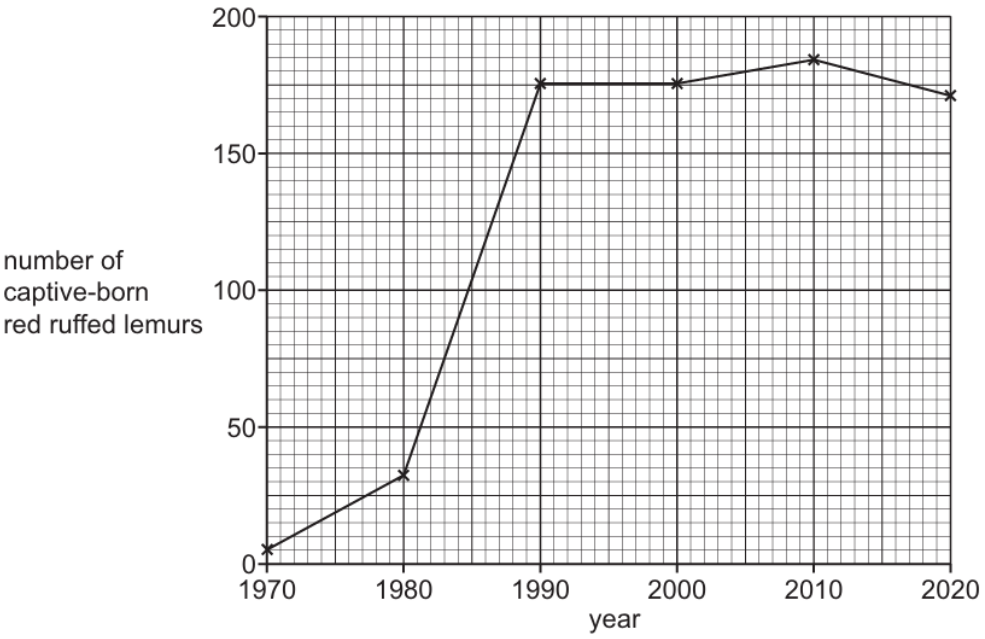


Fig. 9.2

Describe the results shown in Fig. 9.2.

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(c) Captive breeding programmes for endangered mammals such as the red ruffed lemur can vary in their success rate.

(i) Suggest problems that may affect the success of captive breeding programmes of mammals like the red ruffed lemur.

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(ii) Occasionally, wild-caught red ruffed lemurs are introduced into captive breeding programmes.

Suggest why this is done.

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4 **(a)** Many zoos around the world are involved in captive breeding programmes for endangered species.

Outline the role of zoos in the conservation of endangered species, **other than** captive breeding programmes.

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(b) Chester Zoo, in the United Kingdom, controls the European captive breeding programme for the eastern black rhinoceros, *Diceros bicornis michaeli*.

Fig. 10.1 shows an eastern black rhinoceros.

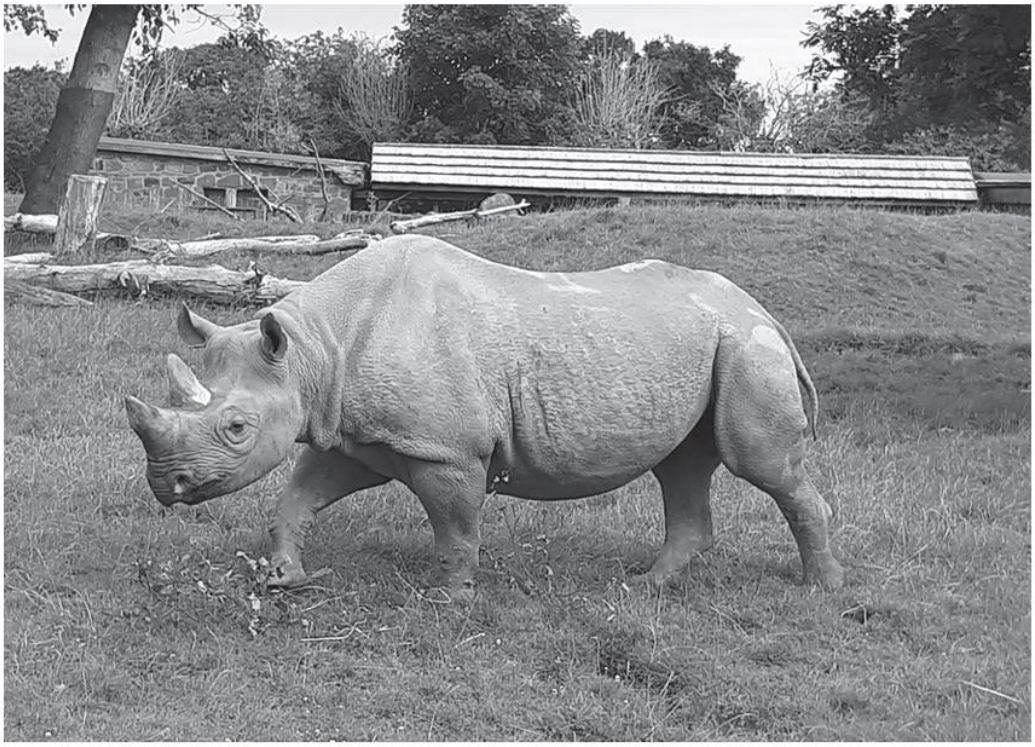


Fig. 10.1

In the captive breeding programme for the eastern black rhinoceros, 15.8% of females breed each year while in the wild 23.7% of females breed each year.

Suggest reasons why fewer females breed in captivity than in the wild.

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(c) Sometimes assisted reproduction is used in captive breeding programmes for the eastern black rhinoceros.

Fig. 10.2 outlines the process of IVF that is used in these programmes.

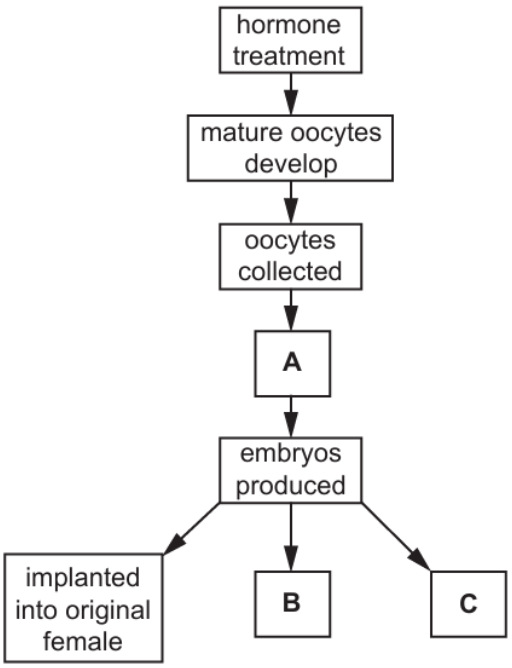


Fig. 10.2

Outline:

- the event **A** that occurs in the production of the embryos
- the **two** other possible outcomes, **B** and **C**, for the embryos that have been produced.

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5 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.

(d) To evaluate the success of the Hawadax Island restoration project, the ecologists obtained data from other islands near to Hadawax Island.

- Some islands had never been occupied by rats (rat-free islands) and had a healthy ecosystem.
- Some islands were still occupied by rats (rat-occupied islands) and had a disrupted ecosystem.

Table 2.2 shows the percentage differences in the abundance of organisms in rat-free islands compared with rat-occupied islands.

Table 2.2

organism	percentage difference in rat-free islands compared to rat-occupied islands
seaweeds	+68
mussel, *Mytilus*	–97
sea snail, *Littorina*	–83
black oystercatcher, *Haematopus bachmani*	+883
glaucous-winged gull, *Larus glaucescens*	+914

With reference to Table 2.1 and Table 2.2, suggest **and** explain how removing rats has restored the ecosystem on Hawadax Island.

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6 **(b)** Himalayan balsam, *Impatiens glandulifera*, is an annual plant native to Pakistan, India and Nepal. It was first introduced into the United Kingdom (UK) in 1839 because of its attractive flowers. Individual plants can produce thousands of mature seeds. These can be dispersed for long distances when the capsules that contain the seeds burst.

Fig. 10.1 shows Himalayan balsam growing in a woodland.



Fig. 10.1

Himalayan balsam has now become established in the UK. It is listed as an invasive alien species and attempts are being made to eradicate (remove) the plant.

Not all alien plant species are considered to be invasive.

Suggest why Himalayan balsam has been listed as an invasive alien species in the UK.

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7 Biodiversity can be assessed at three different levels. One of these is the genetic variation within each species.

(d) Genetic variation is considered important in the conservation of species. Low genetic variation is assumed to decrease the chance of the long-term survival of a species.

Fig. 2.1 shows how the International Union for the Conservation of Nature (IUCN) categorises species according to their conservation status.

Common species with the lowest conservation status (least risk of extinction) are categorised as Least Concern (LC).

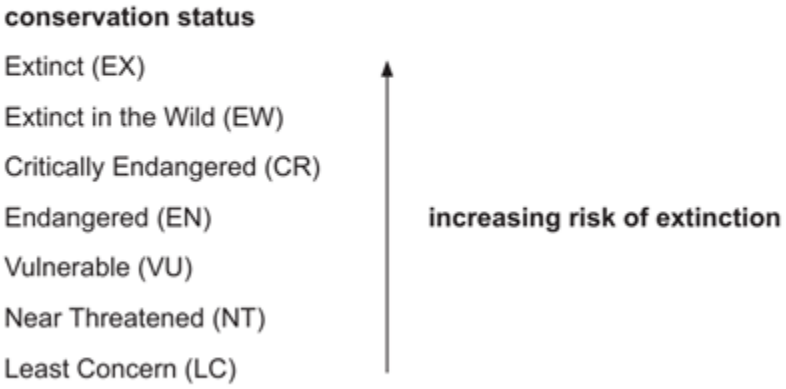


Fig. 2.1

(ii) Question **2(d)** states that 'low genetic variation is assumed to decrease the chance of the long-term survival of a species'.

Predict the relationship between genetic variation and conservation status if this assumption is true.

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Fig. 2.2 shows the mean number of nucleotide differences per site of some species and sub-species of mammal and their conservation status.

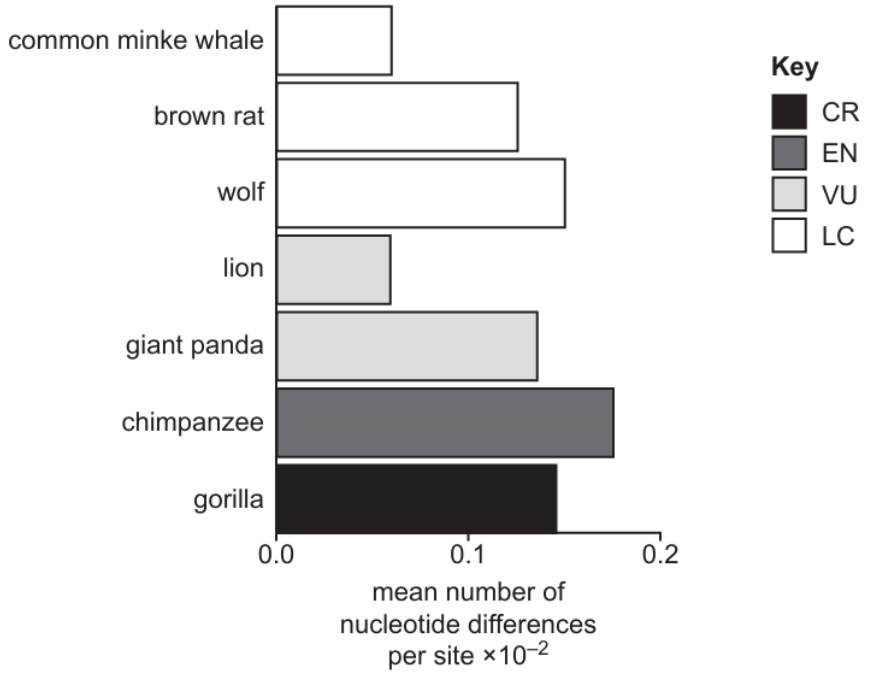


Fig. 2.2

(iii) Assess whether the data in Fig. 2.2 provide support for the prediction you made in **2(d)(ii)**.

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8 The wild Bactrian camel, *Camelus ferus*, lives only in the desert regions of Mongolia and northern China.

Fig. 1.1 shows a wild Bactrian camel.



Fig. 1.1

(a) The wild Bactrian camel is at risk of extinction in the wild and is categorised as critically endangered by the International Union for Conservation of Nature (IUCN). There are only 950 wild Bactrian camels left in their natural habitat.

Suggest reasons why the wild Bactrian camel has become critically endangered.

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(b) Outline the role of the IUCN.

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(c) Some zoos use assisted reproduction techniques, such as embryo transfer, in their captive breeding programmes for endangered species. Embryo transfer has resulted in domesticated dromedary camels giving birth to wild Bactrian camel calves.

Describe the procedure of embryo transfer in a mammal such as a camel.

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9 **(a)** Over the past 200 years, many species of animals and plants have become extinct.

Fig. 8.1 shows the changes between the years 1800 and 2000 in:
- the number of species becoming extinct
- the size of the world human population.

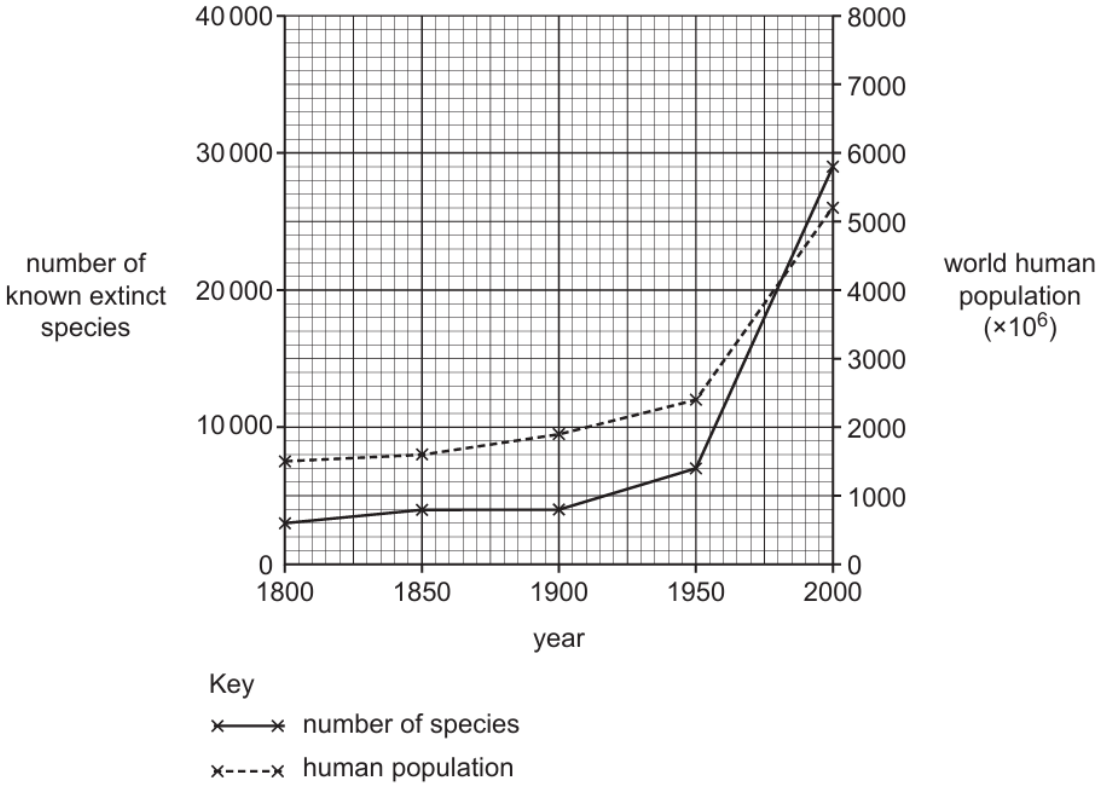


Fig. 8.1

(i) It has been suggested that there is a correlation between the number of species becoming extinct and the size of the world human population.

Suggest reasons for this possible correlation.

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(b) Extinction of animal and plant species reduces biodiversity.

Explain why it is important to maintain biodiversity.

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

Fig. 10.1 shows two African penguins.



Fig. 10.1

(b) The International Union for the Conservation of Nature (IUCN) Red List of Threatened Species has categorised the African penguin as endangered and could become extinct.

Suggest reasons why the African penguin has become endangered and could become extinct.

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(c) Fig. 10.2 shows the estimated numbers of African penguins in the years of 1800, 1900 and 2000.

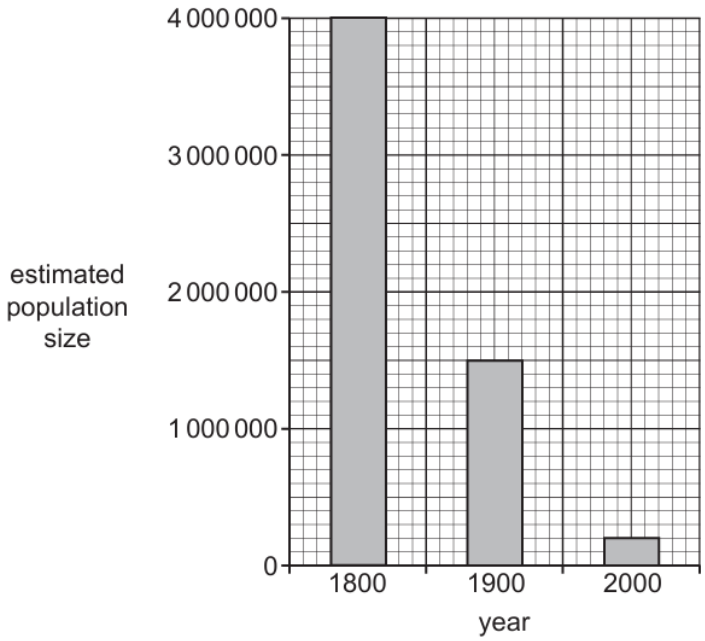


Fig. 10.2

Calculate the mean yearly decrease in population size of the African penguin between 1900 and 2000.

answer = ... yr^{-1} [1]

11 **(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	

(iii) Table 3.1 shows that the number of species of amphibians, birds and mammals has increased between 2009 and 2019.

Discuss whether the increase in numbers means that these classes of chordate are being successfully conserved.

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(b) An analysis in 2019 concluded that twice as many insect species have populations that are decreasing in size compared with chordate species. This analysis focused on developed countries that have large human populations.

(i) Outline **two** factors that may cause populations of insects to decrease in size in developed countries that have large human populations.

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(ii) Explain how the introduction of crops that are genetically modified to express the Bt toxin can benefit biodiversity.

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12 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.

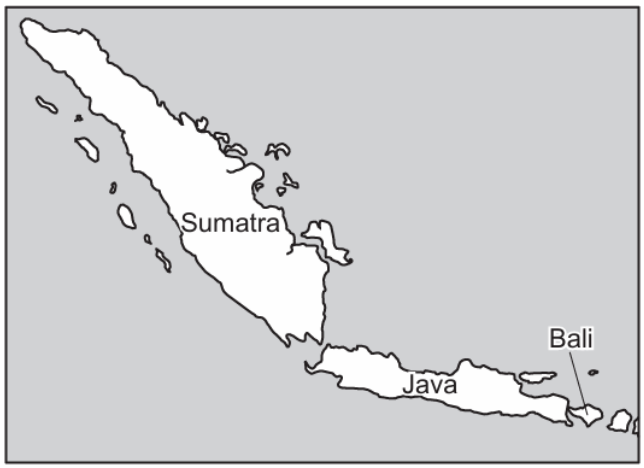


Fig. 3.1

- 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.

(d) Suggest **two** reasons why *P. t. balica* and *P. t. sondaica* became extinct.

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13 Ecological surveys are conducted before conservation decisions are made. For example, surveys can be carried out before deciding whether to reintroduce a species to its former habitat.

(b) Table 3.1 lists some mammal species that became extinct in Great Britain or were introduced into Great Britain in the last 12400 years.

The reasons for each extinction or introduction and the time of each event are shown.

Table 3.1

species	number of years before present time	event	reason
arctic fox	12400	extinction	climate change
sheep	5400	introduction	farming
house mouse	3500	introduction	accidental
lynx	1500	extinction	hunting
fallow deer	900	introduction	food
South American coypu	86	introduction	fur
South American coypu	33	extinction	conservation culling

With reference to Table 3.1, state **and** explain the factors that have had a negative impact on biodiversity in Great Britain.

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(c) Non-governmental and government organisations are working together to reintroduce a lynx population to its former habitat in a remote part of Great Britain. Lynx are predatory big cats.

Fig. 3.1 shows a lynx.



Fig. 3.1

Suggest the factors that need to be considered by organisations to successfully reintroduce and restore a breeding population of lynx in Great Britain.

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14 DNA barcoding is used in species identification.

To create a DNA barcode, a specific region of DNA is sequenced so that it can be compared to an online database of reference DNA. One region of DNA that is commonly used is 648 base pairs long within a mitochondrial gene, coding for the enzyme cytochrome c oxidase I.

(c) Customs officers at airports can use a hand-held DNA barcoding device to identify biological specimens entering or leaving a country.

Suggest how this helps protect endangered species.

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15 Palm oil is a vegetable oil that is used very widely in food products. The oil is extracted from the fruit of the oil palm tree.

(a) Oil palm trees have a higher oil yield than that of other oil-producing plants.

Fig. 8.1 shows the oil yield of four crop plants.

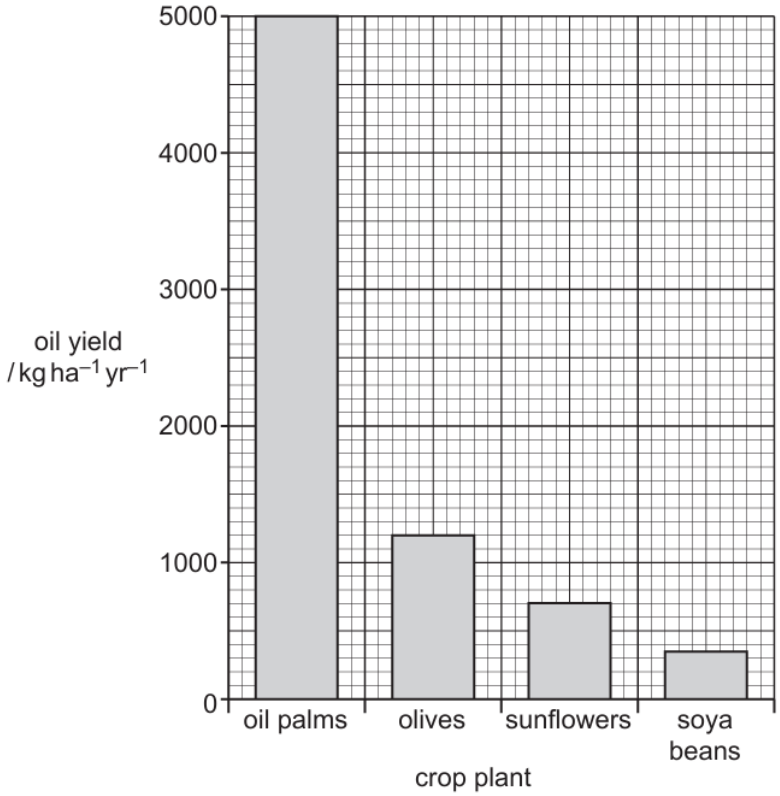


Fig. 8.1

Calculate how many hectares of soya bean plants would be needed to produce the **same** yield of oil as one hectare of oil palm trees.

Show your working and write your answer to **one** decimal place.

answer ..... hectares [2]

(b) Oil palm plantations in Malaysia and Indonesia have been created by cutting down rainforests. This reduces biodiversity.

Outline reasons why it is important to maintain biodiversity.

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(c) Palm oil companies are now being asked to produce palm oil in a sustainable way. This means that no more deforestation should take place.

Suggest ways in which individual consumers can encourage manufacturers to use palm oil from sustainable sources.

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16 The Sumatran tiger lives on the island of Sumatra, Indonesia.

Fig. 1.1 shows a Sumatran tiger.



Fig. 1.1

(a) The International Union for Conservation of Nature (IUCN) is the world's largest global environmental organisation. The IUCN Red List of Threatened Species™ evaluates the conservation status of plant and animal species.
The Sumatran tiger is categorised as critically endangered on the IUCN Red List. There are approximately 400 Sumatran tigers left in the wild.

Suggest reasons why the Sumatran tiger has become critically endangered.

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(b) Some zoos in Europe have captive breeding programmes for the Sumatran tiger, which breeds well in captivity. Once cubs have reached maturity they may be moved to other zoos. For example, as part of a coordinated breeding programme carried out in 2013, one tiger born in Chester Zoo in England was moved to France and another tiger born in the same zoo was moved to Germany. This type of coordinated breeding programme is essential for the survival of the Sumatran tiger.

Explain why it is important to the gene pool of Sumatran tigers to move tigers from one zoo to another.

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(c) Some animals do not breed well in captivity.

List the methods of assisted reproduction that may be used with animals that do not breed well in captivity.

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17 The Sumatran orangutan, *Pongo abelii*, is found only on the island of Sumatra, Indonesia.

Fig. 1.1 shows a Sumatran orangutan.



Fig. 1.1

(a) The International Union for Conservation of Nature (IUCN) is the world's largest global environmental organisation. The IUCN Red List of Threatened Species™ evaluates the conservation status of plant and animal species. The Sumatran orangutan is categorised as critically endangered on the IUCN Red List.

The Sumatran orangutan spends most of its time in trees and is very sensitive to habitat destruction.

Table 1.1 shows the area of natural forest of Sumatra and the numbers of orangutans in 1985 and 2016.

Table 1.1

	1985	**2016**
area of natural forest / million hectares	25.3	12.4
number of orangutans	25 000	7300

(i) With reference to Table 1.1, state the relationship between area of natural forest and number of orangutans.

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(ii) Calculate the mean annual decrease in orangutan numbers between 1985 and 2016.

Show your working.

Give your answer to the nearest whole number.

mean annual decrease = ...[2]

(iii) Use your answer from **(a)(ii)** to estimate the number of years after 2016 that it will take for the Sumatran orangutan to become extinct in the wild, if conservation work is unsuccessful.

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(b) Suggest **two** reasons for the decrease in numbers of Sumatran orangutans, other than habitat loss.

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(c) Outline the role zoos can take in the protection of the Sumatran orangutan.

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18 The Bali starling, *Leucopsar rothschildi*, is found on the island of Bali, Indonesia.

Fig. 1.1 shows a Bali starling.



Fig. 1.1

(a) The International Union for Conservation of Nature (IUCN) is the world's largest global environmental organisation. The IUCN Red List of Threatened Species™ evaluates the conservation status of plant and animal species.

The Bali starling is categorised as critically endangered on the IUCN Red List, which means that it is nearly extinct in the wild.

The Bali starling is protected by Indonesian law and trapping of the birds for sale as pets is illegal. In 2001 there were only six Bali starlings in the wild and about 1000 in captivity.

(i) Suggest reasons, other than the trapping of the birds for sale as pets, for the very low numbers of Bali starlings in the wild.

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(ii) Describe the roles zoos can take in the protection of the Bali starling.

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