1 Roe deer, *Capreolus capreolus*, is the most common species of native deer in the UK.

Fig. 3.1 shows the distribution of roe deer in the UK in 1972 and 2007. It also shows the location of the sites that were studied in 2007.

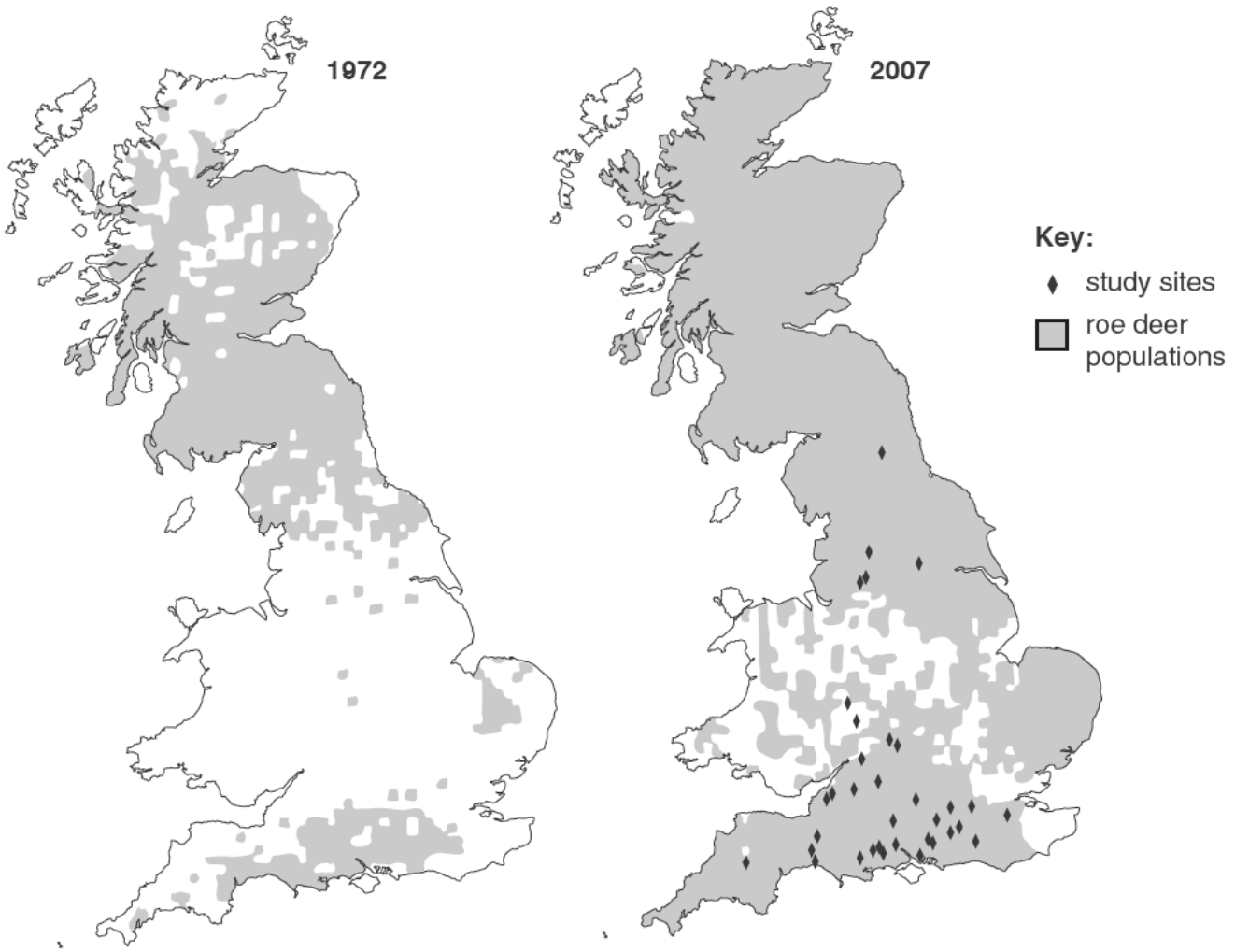


Fig. 3.1

(a) How has the distribution of roe deer changed between 1972 and 2007?

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..... **[1]**

(b) In 2007, scientists studied the effect of roe deer on the biodiversity of the habitat at a number of sites, shown on Fig. 3.1.

At each study site, the scientists sampled plants and animals in unfenced areas where roe deer were present and in fenced areas where roe deer could not go.

(i) Explain the importance of sampling in measuring the biodiversity of a habitat.

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..... **[2]**

(ii) Why was it important to take samples in fenced and unfenced areas?

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..... **[1]**

(iii) The scientists needed to measure species richness and species evenness to calculate Simpson's Index of Diversity.

Explain the difference between species richness and species evenness and why both measurements are needed to assess biodiversity.

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..... **[3]**

(iv) In areas where the population of roe deer was high, the Simpson's Index of Diversity was low for shrubs (medium-height plants) and was also low for woodland birds.

Roe deer eat plants. Most woodland birds do not eat plants.

Suggest **one** reason why a large roe deer population might decrease the diversity of woodland birds.

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..... **[1]**

(v) Outline the significance of a low value of Simpson's Index of Diversity.

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..... **[2]**

(c) In the past, the roe deer's main natural predator in Britain was a large carnivore of the cat family, the Eurasian lynx, *Lynx lynx*. The lynx became extinct in Britain around 1000 years ago.

Populations of Eurasian lynx still survive in parts of mainland Europe.

Plans are being considered to re-introduce the Eurasian lynx from these European populations to the wild parts of Britain to improve biodiversity.

(i) Suggest **one** reason why some people might object to this re-introduction.

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..... **[1]**

(ii) A small population of Iberian lynx, *Lynx pardinus*, exists in parts of Spain. The Iberian lynx is critically endangered and, with around 100 individuals left, it is the world's most endangered species of cat.

The Iberian lynx and Eurasian lynx were once classified within the same species, based on their observable features.

In the last 10 years, the Iberian lynx has been re-classified as a separate species within the genus *Lynx*, on the basis of its phylogeny.

Define the term *phylogeny* and explain how phylogeny is related to classification. Use the two lynx species as examples.

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..... **[4]**

(iii) Suggest why it is only in the last 10 years that the Iberian lynx has been classified as a separate species.

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..... **[1]**

(iv) Outline **three** reasons why it is important to conserve the Iberian lynx.

1 .....

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2 .....

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3 .....

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[3]

[Total: 19]

2 The Royal Botanic Gardens at Kew plays an important role in plant conservation. One plant that has been conserved at Kew is the world's smallest water lily, the thermal lily, *Nymphaea thermarum*.

In its natural habitat, the thermal lily grows in hot water springs in central Africa.

(a) State the genus to which the thermal lily belongs.

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(d) When measuring the biodiversity of a habitat, it is difficult to count every organism. It is therefore necessary to sample a proportion of the habitat. The sampling process must not be biased.

Outline an unbiased sampling method that can be used to measure the biodiversity of plant species in grassland.

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..... **[4]**

(e) Scientists try to estimate the total number of species on Earth.

Suggest **three** reasons why such estimates are not likely to be accurate.

1 .....

.....

2 .....

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3 .....

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[3]

[Total: 14]

3 DNA and RNA are nucleic acids.

(a) The table below contains a number of statements relating to nucleic acids.

Complete the table, using a letter **D**, **R** or **B**, to show whether each statement applies to:

- DNA only (**D**)
- RNA only (**R**)
- both DNA and RNA (**B**).

The first one has been done for you.

statement	DNA only (**D**) or RNA only (**R**) or both DNA and RNA (**B**)
contains thymine	D
contains ribose	
consists of two chains connected to each other with hydrogen bonds	
has a sugar-phosphate backbone	
has four different nitrogenous bases	
contains a pentose sugar	
is found in the nucleus and cytoplasm	

[6]

(b) It has been found that 98.4% of chimpanzee DNA is identical to that of a human.

(i) Suggest how the information obtained by DNA analysis can be useful to taxonomists.

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..... **[2]**

(ii) State **two** types of evidence, other than biochemical evidence, that are used by taxonomists when classifying organisms.

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..... **[2]**

(c) Cytochrome C is a protein found in living organisms. The structure of cytochrome C varies between different organisms. However, closely related organisms have similar cytochrome C.

Fig. 5.1 shows a possible evolutionary tree for vertebrates.
Common ancestors are indicated by the number 1 and various letters.

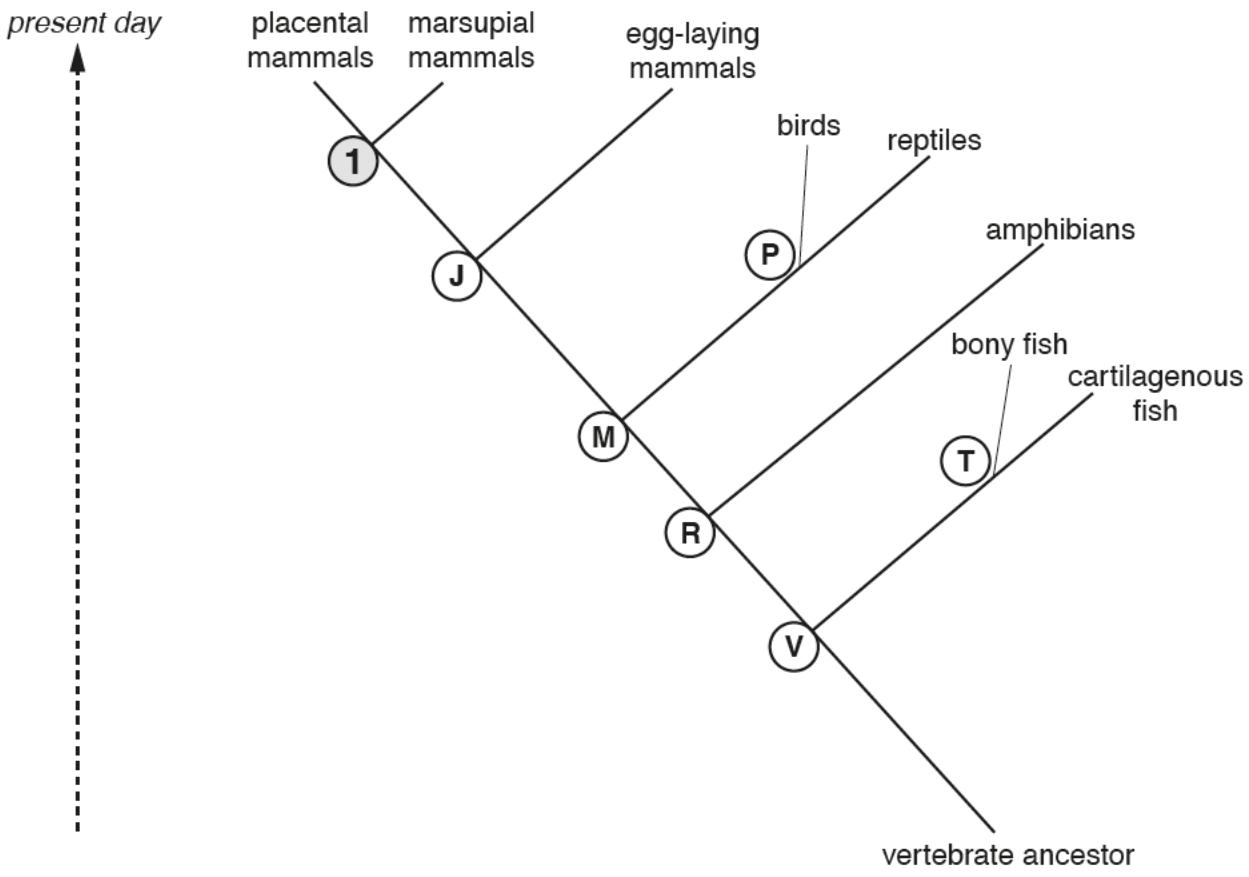


Fig. 5.1

State the **letter** of the common ancestor that has cytochrome C which will be:

most similar in structure to common ancestor **1** .....

ure to common ancestor **1** ..... **[2]**

(d) The pine marten is a small mammal that is rare in the United Kingdom. Its numbers are particularly low in Wales and there have been few confirmed sightings of this animal in the past 50 years. There have been plans to introduce pine martens from other areas of the United Kingdom into Wales to increase the size of the population.

The DNA of museum specimens of Welsh pine martens in the National Museum of Wales was tested, the most recent specimens dating from 1948. The DNA analysis suggests that Welsh pine martens are genetically distinct from those found elsewhere in the United Kingdom.

(i) The relevance of this analysis has been questioned by some scientists.

Suggest why the findings from the museum specimens may not relate closely to the current pine marten population of the United Kingdom.

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..... **[1]**

(ii) Suggest why some people are concerned about the plan to introduce pine martens from other areas into Wales.

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..... **[1]**

[Total: 14]

4 **(a)** Before any major development can take place, an Environmental Impact Assessment (EIA) needs to be carried out.

One such development is the proposed extension to the M27 motorway in Hampshire. This extension would cut through an important heathland ecosystem.

Suggest **three** aspects of this development that would need to be considered when carrying out the EIA.

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..... **[3]**

(b) An ecologist carried out a survey of butterfly species on the heathland.

The ecologist walked along a marked path on four different days in June. She counted

- the number of butterfly species
- the number of individual butterflies of each species.

(i) Suggest how this method of collecting data could be improved.

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..... **[3]**

(ii) The ecologist's results are shown in Table 6.1.

These results can be used to calculate the Simpson's Index of Diversity (D) for butterflies in this heathland using the formula:

$$D = 1 - [\Sigma (n/N)^2]$$

where n = number of individuals of a species in the sample
N = total number of individuals of all species in the sample

Complete the table by filling in the **three** missing values.

Table 6.1

species	n	n/N	$(n/N)^2$
Grayling (*Hipparchia semele*)	3	0.0968	0.09370
Large Heath (*Coenonympha tullia*)	11	.....	0.12588
Gatekeeper (*Pyronia tithonus*)	6	0.1935	0.03744
Green Hairstreak (*Callophrys rubi*)	2	0.0645	0.00416
Silver-studded Blue (*Plebeius argus*)	2	0.0645	0.00416
Small Heath (*Coenonympha pamphilus*)	7	0.2258	0.05099
		Sum (Σ)	.....
		$1 - \Sigma$	D = ...

[3]

(iii) Suggest the implications of a high value of Simpson's Index of Diversity on planning decisions.

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..... **[2]**

(c) (i) The six species of butterfly identified by the ecologist in the survey are shown **on the insert** in Fig. 6.1.

The ecologist used a dichotomous key to identify these butterflies. This key is shown below:

Key:			
Question 1	Round spots on the under wing	yes no	go to question 2 go to question 4
Question 2	Orange upper wing	yes no	go to question 3 **Silver-studded Blue**
Question 3	One spot on upper wing	yes no	**Gatekeeper** **Large Heath**
Question 4	Spots on upper wing	yes no	go to 5 **Green Hairstreak**
Question 5	One spot on upper wing	yes no	**Small Heath** **Grayling**

Identify the butterflies shown in Fig. 6.1 using the key.

Complete Table 6.2 below. One butterfly has been identified for you.

Table 6.2

species	letter
Grayling (*Hipparchia semele*)	
Large Heath (*Coenonympha tullia*)	
Gatekeeper (*Pyronia tithonus*)	
Green Hairstreak (*Callophrys rubi*)	
Silver-studded Blue (*Plebeius argus*)	
Small Heath (*Coenonympha pamphilus*)	E

[5]

(ii) State why Small Heath and Large Heath butterflies both share part of their scientific name.

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..... **[2]**

[Total: 18]