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.

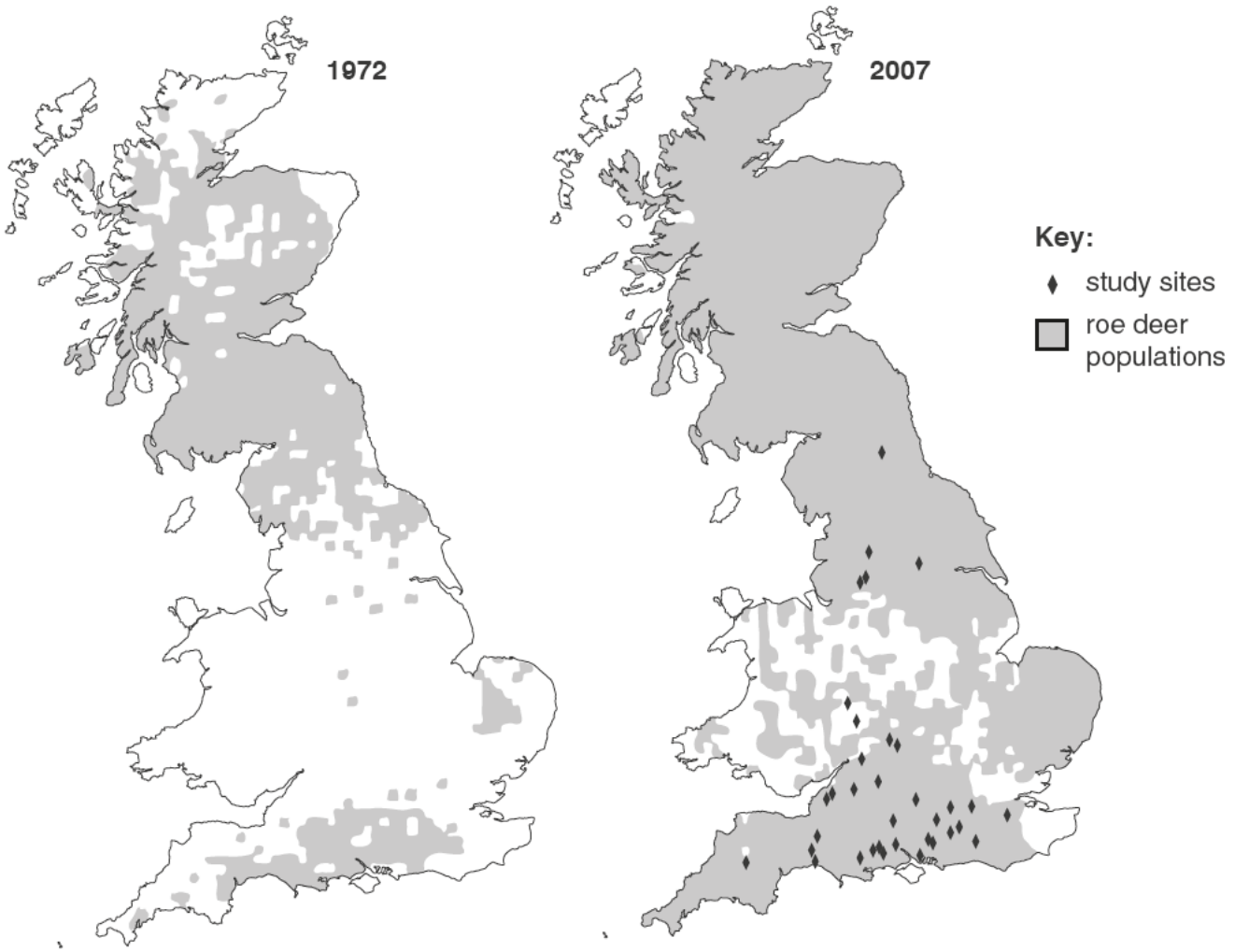


Fig. 3.1

(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 .....

.....

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.

.... **[1]**

(b) Explain why it is sometimes necessary to conserve a plant species, such as *N. thermarum*, outside its natural habitat (*ex situ*).

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.... **[3]**

(c) The Royal Botanic Gardens also manages the Millennium Seed Bank, which aims to store seeds from one quarter of all plant species.

Give **three** advantages of conserving plant species as seeds and **not** as adult plants.

1 ....

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2 ....

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3 ....

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[3]

(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 .....

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2 .....

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3 .....

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[3]

[Total: 14]

3 On a biology field trip, a pair of students collected some data about plant species in an area of ash woodland. Their results are shown in Table 4.1.

Species	Number of individuals (n)	n/N	$(n/N)^2$
Dog's mercury	40		
Wild strawberry	13	0.13	0.0169
Common avens	43		
Wood sorrel	4		
	N =		$\Sigma(n/N)^2$ =
			$1-(\Sigma(n/N)^2)$ =

Table 4.1

(a) (i) Use the information in the table to work out the Simpson's Index of Diversity (D) for the area of woodland sampled using the formula:

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

Where: n = number of individuals of a particular species.
N = total number of individuals in all species.
Σ = sum of.

Complete Table 4.1.

You may use the space below for your working. **[3]**

(ii) Simpson's Index of Diversity takes into account both species richness and species evenness.

In a school exercise book a student wrote the following definitions:

> Species richness is a measure of the amount of species in an area.
>
> Species evenness shows how many individuals there are of a species in an area.

The teacher did not award a mark for either of these statements.

Suggest how each statement could be improved.

Species richness .....

.....

Species evenness .....

.....

[2]

(iii) If the value for Simpson's Index of Diversity is high, this indicates that the biodiversity of the habitat is high.

Outline the **implications** for a habitat if the Simpson's Index of Diversity is **low**.

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

(b) When collecting data on the field trip, the students placed quadrats in 15 locations and calculated a mean number of plants for each species.

Suggest two **other** steps they could have taken to ensure that their value for Simpson's Index of Diversity was as accurate as possible.

1 .....

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2 .....

.....

[2]

[Total: 9]

4 At the beginning of the nineteenth century, one species of squirrel, *Sciurus vulgaris*, the red squirrel, inhabited Great Britain.

In 1879, some individuals of *Sciurus carolinensis*, the grey squirrel, were introduced to southern England from the USA. Since then, the number and range of grey squirrels have increased and the number and range of red squirrels have decreased dramatically.

Grey squirrels are larger, spend more time on the ground and are less frightened of people than red squirrels.

(a) Northumberland is one of the few areas of England that still has a large population of red squirrels.

In an attempt to preserve the population of red squirrels, and the biodiversity of the UK, the government has funded a cull (trapping and killing) of grey squirrels in Northumberland.

(i) Define the term *biodiversity*.

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

(ii) Suggest **two** specific reasons why the government feels it is important to conserve red squirrels in a particular area, such as Northumberland.

1 .....

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2 .....

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[2]

(III) Some local residents have objected to the culling of grey squirrels.

Give **one** reason why people might disagree with the culling of grey squirrels.

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.....

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

(b) Environmental groups have asked members of the public to report sightings of grey and red squirrels. In parts of Northumberland, the **reported number of sightings** of grey squirrels is higher than that of red squirrels.

Suggest **two** reasons why the **actual number** of grey squirrels might **not** be higher than the actual number of red squirrels in these areas.

1 .....

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2 .....

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[2]

(c) In 2010, a company applied for permission to build a wind farm in rural Northumberland. Before permission was granted for the development, an Environmental Impact Assessment (EIA) was carried out by the local authority.

State **three** criteria that would have been considered when the EIA was carried out.

1 .....

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2 .....

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3 .....

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[3]

[Total: 10]