1 On Christmas Eve 1987, the last female Spix's Macaw, *Cyanopsitta spixii*, was removed from the wild in Brazil. The last remaining male bird continued to live in the wild for a further six years. This male bird, having lost its partner, mated with a Blue-winged Macaw, *Propyrrhura maracana*.

(a) Explain why eggs produced by this mating did not hatch.

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

(b) Spix's Macaws became endangered because the birds were illegally trafficked to collectors in other parts of the world. This is against the CITES agreement.

(i) State what the abbreviation CITES stands for.

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

(ii) State **two** of the aims of the CITES agreement.

1 .....

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2 .....

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

(c) Once it was realised that the Spix's Macaws were in danger of becoming extinct, the collectors were "invited" to allow their macaws to take part in a breeding programme.

Suggest **two** factors to be taken into consideration when selecting individuals for this breeding programme.

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

(d) Finally, a captive bred female Spix's Macaw was released into the original male's territory.

What could be done to try to ensure the success of this release programme?

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

[Total: 10]

2 Part of the Cairngorms National Park in the Scottish Highlands is at an altitude of approximately 1000 metres. It presently supports a range of plants and animals including some that are normally found in sub-arctic conditions.

Table 3.1 shows the breeding success of a number of bird species between 1970 and 2000. Specialist sub-arctic species are marked with an asterisk *.

Table 3.1

species	number of young raised per year			
	1970	1980	1990	2000
snow bunting *	78	69	36	2
Lapland bunting *	7	3	0	0
ptarmigan *	1280	1134	960	876
red grouse	890	920	933	962
wheatear	209	240	190	231
meadow pipit	23	45	48	82
ring ouzel	23	21	29	26
dotterel *	45	43	39	35

* = specialist sub-arctic specie

(a) (i) Using the data in Table 3.1, compare the breeding success of the sub-arctic species and the non sub-arctic species between 1970 and 2000.

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(ii) Suggest **two** reasons for the trends described.

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

(b) A study of insects was carried out in the same area of the Cairngorms National Park to determine species richness.

(i) What is meant by species richness?

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

(ii) The insects were sampled using a sweep net method. Fig. 3.1 shows a sweep net being used. With this method, a net is swept through the vegetation. Insects are removed, identified and counted.

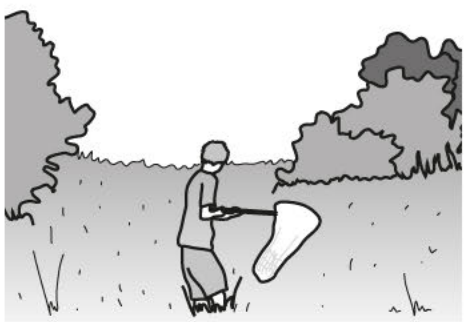


Fig. 3.1

Describe **three** ways in which the sampling procedure could be designed to try to make sure that a representative sample was obtained.

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

(iii) Species evenness also contributes to the measurement of biodiversity.

Explain the importance of species evenness in determining the biodiversity in a habitat.

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

[Total: 12]

3 **(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]

4 In India, the population of the white-backed vulture, *Gyps bengalensis*, has fallen by 97% to an estimated 4 000 vultures. This vulture is now considered to be 'critically endangered'. Reasons for the decline in numbers include:

- vultures feed on carcasses including those from farm animals.
- these farm animals may have been treated with a pain killer. This particular pain killer causes kidney failure in the vultures.
- the use of this pain killer is being phased out. However, many farmers continue to use up their stocks of the drug.
- this pain killer is not easily biodegradable and will remain in the environment for many years.

(a) **(** Suggest what is meant by *critically endangered*.

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

(ii) Calculate the **original** population of the white-backed vulture.

Show your working.

Answer = ... **[2]**

(b) In an effort to save the white-backed vulture, a captive breeding programme has been set up.

Three centres in India have been built, each housing up to 40 individuals. These vultures have been collected from different areas of the Indian subcontinent.

(i) Explain why the decision was made to conserve the species in captivity (*ex situ*) rather than in the wild (*in situ*).

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

(ii) Explain why the white-backed vultures in the captive breeding programme were,

- collected from several different areas
- housed in three separate centres.

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

(c) Outline **three** reasons why the conservation of the white-backed vulture is important.

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3 .....

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

(d) Suggest **three** measures that could be taken **in the long term** to preserve the numbers of white-backed vultures, once the captive bred individuals have been released into the wild.

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

[Total: 16]

5 In the first half of the nineteenth century, a large proportion of the population of Ireland relied on potatoes as their main source of food.

In 1845, almost the whole of the Irish potato crop became infected with a disease known as potato blight, which ruined the crop and led to widespread starvation.

Some varieties of potato plants, including wild types growing in South America, are unaffected by the disease.

(a) Genetic variation in the Irish potato plant population was very low following years of selective breeding and asexual reproduction.

(i) Suggest why this lack of genetic variation might have contributed to the rapid spread of the disease.

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

(ii) Suggest why, despite the low genetic variation, the average yield of potato plants varied from year to year.

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

(iii) Some potato plants carry a gene that gives the plants resistance to potato blight.

State the most likely cause of this genetic variation.

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

(b) Describe how it is possible to use selective breeding to improve the overall disease resistance of a crop, such as potatoes, in both the short and long term.



In your answer you should include precautions that should be taken to ensure disease susceptibility does not become a problem in the future.

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