Module 3: Biodiversity and Evolution
2.3.1 Biodiversity
June 2009-January 2013
Questions

(a) define the terms *species*, *habitat* and *biodiversity*;
(b) explain how biodiversity may be considered at different levels; habitat, species and genetic;
(c) explain the importance of sampling in measuring the biodiversity of a habitat
(d) describe how random samples can be taken when measuring biodiversity;
(e) describe how to measure species richness, species evenness in a habitat;
(f) use Simpson's Index of Diversity (D) to calculate the biodiversity of a habitat, using the formula $D = 1-(\Sigma(n/N)2)$
(g) outline the significance of both high and low values of Simpson's Index of Diversity (D);
(h) discuss current estimates of global biodiversity

5 Scientists have identified approximately 1.8 million different species. The number of species that actually exist is likely to be significantly higher than 1.8 million.

(a) Suggest **two** reasons why the number of species identified is likely to be lower than the actual number of species present on Earth.

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(b) Many organisations, such as the International Union for the Conservation of Nature (IUCN), gather annual data about the number of species that are known to exist and to what extent they are considered to be endangered.

Fig. 5.1 shows the total number of species assessed by the IUCN over a 10 year period and the number of those species assessed that are considered to be threatened with extinction.

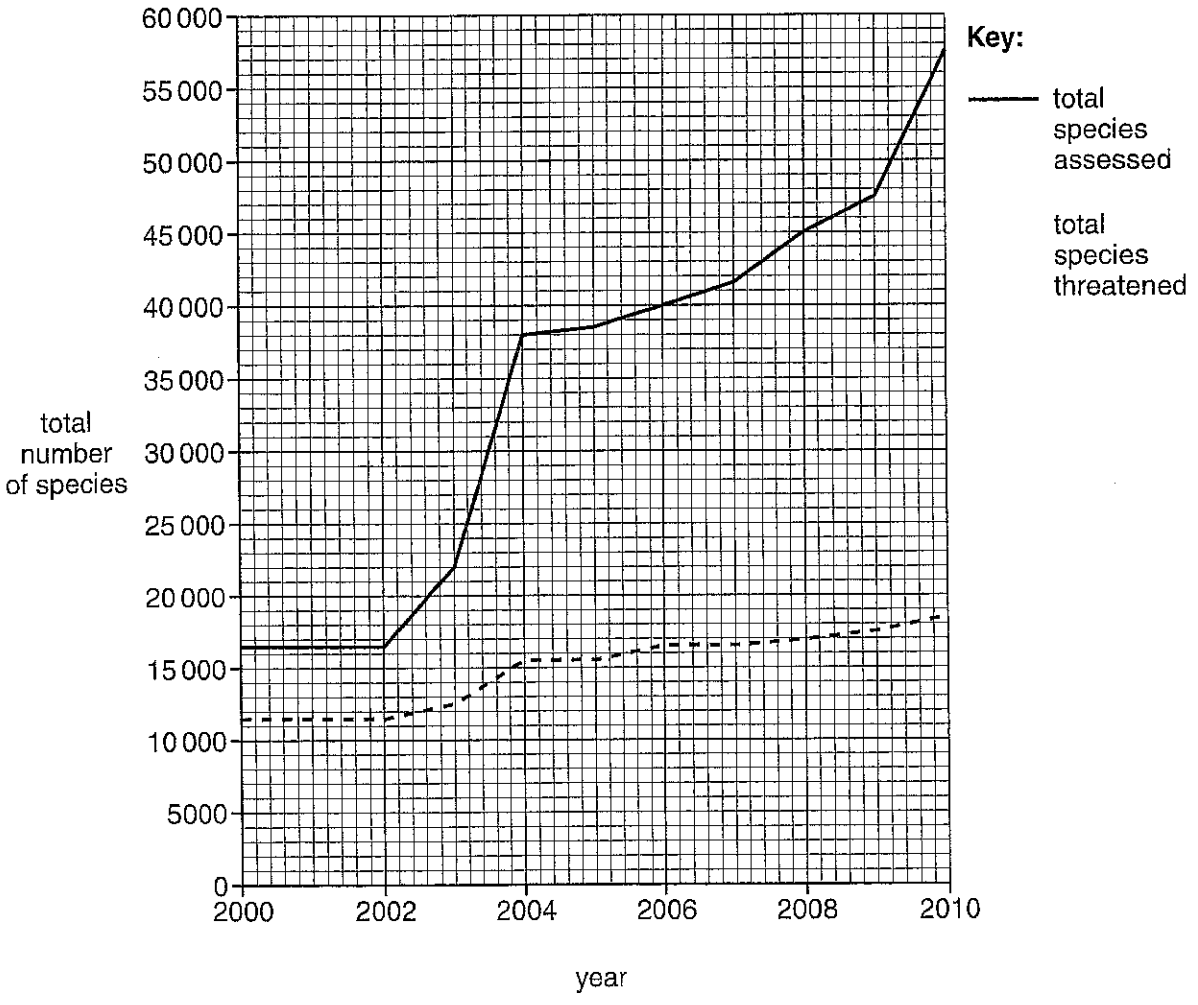

Fig. 5.1

(i) Using Fig. 5.1, **compare** the changes in the total number of species assessed with the changes in the total number of threatened species over the 10 year period.

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(ii) Using Fig. 5.1, calculate the percentage of species assessed that were threatened with extinction in **2010**.

Show your working. Give your answer to the **nearest whole number**.

Answer = ... % [2]

(iii) Suggest explanations for the shape of the two curves between **2005** and **2010**.

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(c) A study of the biodiversity of an area considers not only the total number of species but also the relative number of individuals within each species.

State **one** further factor that could be taken into account when describing the biodiversity of an area.

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(d) In any attempt to protect global biodiversity, cooperation between countries is important.

Two examples of such international cooperation are:

- Convention on International Trade in Endangered Species (CITES)
- Rio Convention on Biological Diversity.

Other than the conservation of biodiversity, state **two** aims for each of these conventions.

Convention on International Trade in Endangered Species .....

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Rio Convention on Biological Diversity .....

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[Total: 14]

7 Select the most appropriate term from the list below to complete the table.

abundance	**habitat**	**Simpson's diversity index**
biodiversity	**percentage cover**	**species evenness**
biased	**quadrat**	**species richness**
community	**quantitative**	**systematic**
dichotomous	**random**	**taxon**
ecosystem	**sample**	**transect**

definition	term
sampling in which the observer does not decide when and where to take measurements	
a representative group of organisms that are selected from a population	
an area in which an organism lives	
a measure of the relative numbers of individuals in each species	
the frequency of occurrence of plants in a particular area	
the number of species present in a particular area	

[6]

[Total: 6]

END OF QUESTION PAPER

3 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 species

(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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(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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(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.

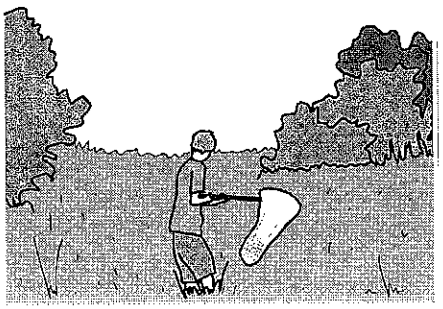

Fig. 3.1

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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(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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[Total: 12]

6 **(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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(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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(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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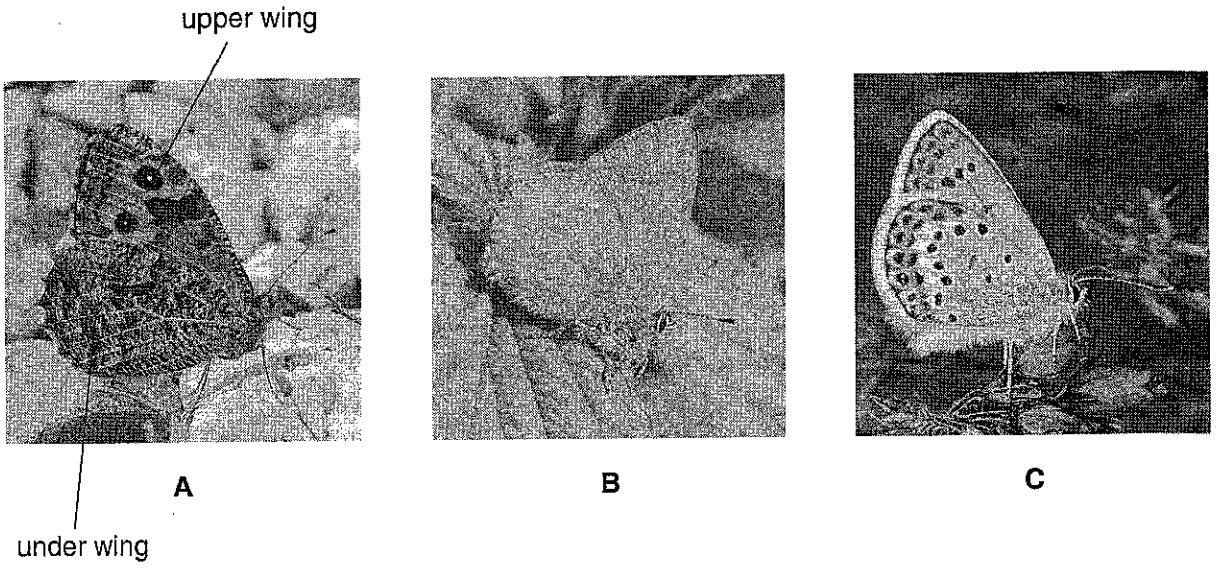

Fig. 6.1

(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

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QUESTION 6(c)(ii) STARTS ON PAGE 24

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

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[Total: 18]

END OF QUESTION PAPER

7 Fig. 7.1, **on the insert**, shows a photograph of a part of a heathland habitat. A study was carried out on the biodiversity of this habitat.

(a) Define the terms:

habitat .....

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biodiversity .....

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(b) In this study, a student placed his quadrat on areas he considered to have the most biodiversity.

Explain what is wrong with this technique.

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(c) The student looked at the abundance of three plants at different distances from the bottom of the slope.

The results table drawn by the student is shown below.

Table 7.1

distance from bottom of slope	percentage cover of each plant species		
	cotton grass	ling	bracken
0 m	76	0	0
10 m	68	0	0
20 m	0	2	0
30 m	0	35	0
40 m	0	50	0
50 m	0	60	7
60 m	0	40	17
70 m	0	10	42
80 m	0	0	68
90 m	0	0	71
100 m	0	0	74

(i) The format of the student's table is incorrect.

Suggest **one** way in which the student could correct the table.

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Fig. 7.2 is a graph showing the distribution of cotton grass and bracken at different distances from the bottom of the slope.

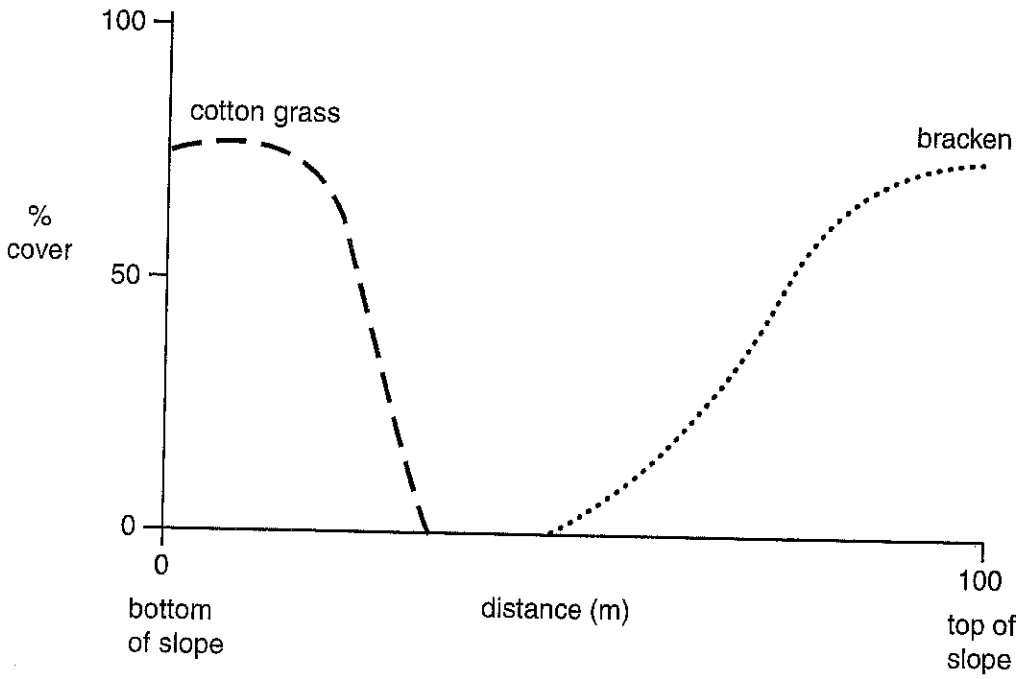

Fig. 7.2

(ii) Using the information in Table 7.1, **sketch on Fig. 7.2** a curve to show the distribution of **ling**. **[3]**

(iii) Describe the distribution of **bracken**.

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QUESTION 7(d)(i) STARTS ON PAGE 26

(d) (i) The student was asked to calculate the biodiversity using Simpson's Index of Diversity.

Suggest what additional data he would need to **collect** in order to calculate Simpson's Index of Diversity in this habitat.

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(ii) The student calculated Simpson's Index as 0.2. This is a low value.

State the **significance** of this low value for this habitat.

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[Total: 14]

END OF QUESTION PAPER

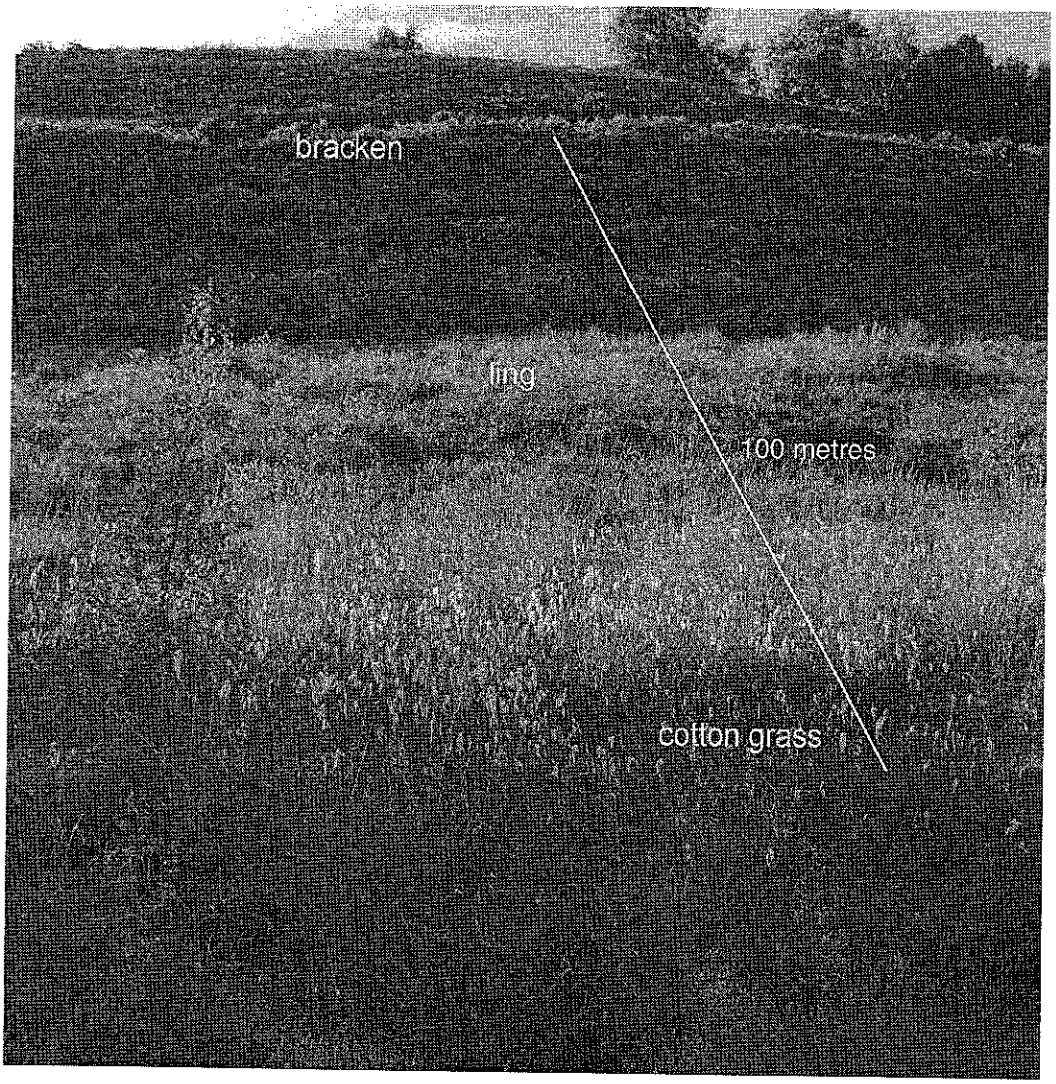

Fig. 7.1