General Certificate of Education
June 2008
Advanced Subsidiary Examination

ENVIRONMENTAL SCIENCE   **ESC3**
Unit 3   The Biosphere

Tuesday 3 June 2008   1.30 pm to 2.30 pm

You will need no other materials.
You may use a calculator.

Time allowed: 1 hour

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Answers written in margins or on blank pages will not be marked.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The maximum mark for this paper is 60.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English, clear presentation and appropriate use of specialist vocabulary. Question 6 should be answered in continuous prose. Quality of Written Communication will be assessed in this answer.

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ANSWER IN THE SPACES PROVIDED

Answer **all** questions in the spaces provided.

1 The following is a list of ecological terms.

A   Population
B   Biome
C   Quadrat
D   Ecosystem
E   Habitat
F   Community
G   Abiotic
H   Biomass
I   Trophic level
J   Niche
K   Biotic
L   Food chain
M   Transect

Complete the table to give the letter to match the term to the appropriate definition. The first one has been done as an example.

	Letter
A frame used to sample an area in order to study the organisms that it contains	**C**
A sequence of organisms through which energy is transferred	
A measure of the amount of living matter present in a unit area	
A large area, usually named for its dominant vegetation group, which has distinctive climatic and soil conditions	
A community of living organisms interacting with each other and with the non-living environment	
The position in a food chain at which an organism feeds	

(5 marks)

5

Turn over for the next question

Turn over ▶

2 The Humpback whale (*Megaptera novaeangliae*) used to be common in the western North Atlantic, with an estimated population of over 100 000. When commercial whaling began, the population was reduced and it is estimated that 90–95 % were killed. Populations are now increasing because the species was classified as 'threatened' and given special protection.

Actual length: 9–18 m

2 **(a)** Humpback whale populations are estimated from photographs taken from ships or aircraft. They have very distinctive natural markings so that individuals can be distinguished.

The table shows the number of Humpback whales sighted in two consecutive years.

Number photographed in year 1	**1200**
Number photographed in year 2	**1157**
Number of whales recognised in both sets of photographs	**120**

2 **(a)** **(i)** Use the Lincoln Index to calculate the population size of Humpback whales in year 2. Show your working.

$$\text{Population size} = \frac{n_1 \times n_2}{n_m}$$

where n_1 = number seen in year 1
n_2 = number seen in year 2
n_m = number recognised in both years

Answer ....
(2 marks)

2 **(a)** **(ii)** Suggest **three** reasons why this figure may not be accurate.

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(3 marks)

2 **(b)** Describe how methods of protection of whales have allowed the number of Humpback whales to increase.

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(5 marks)

10

Turn over for the next question

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3 (a) A predator-prey experiment was set up in a laboratory. The prey species was supplied with food and all environmental conditions were kept constant. The numbers of the two species were recorded over several months. The results are shown in the graph.
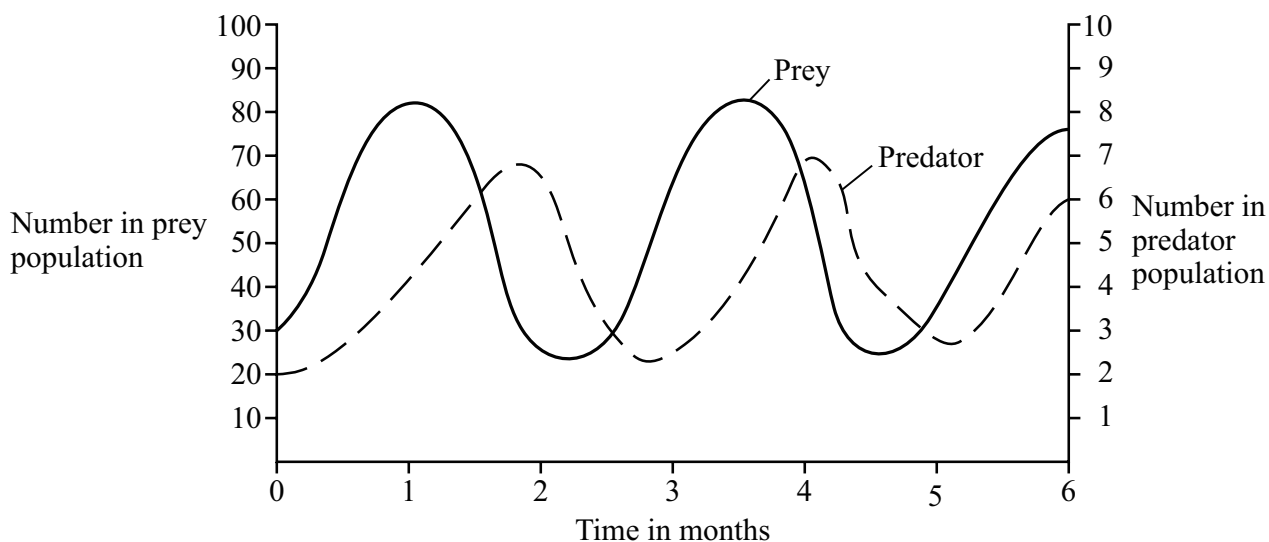
3 (a) (i) Describe the relationship between the number of predators and the number of their prey.

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(2 marks)

3 (a) (ii) Suggest an explanation for this relationship.

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(4 marks)

3 **(a)** **(iii)** Explain why the shape of the graph may be less regular for wild populations.

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(2 marks)

3 **(b)** The diagram shows the homeostatic regulation of population size by negative feedback.

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   Increased                                    Overpopulation
  reproduction

  decreased                                      increased
 environmental        Optimum                   environmental
  resistance      population size                resistance

  Underpopulation                               Decreased
                                                 survival
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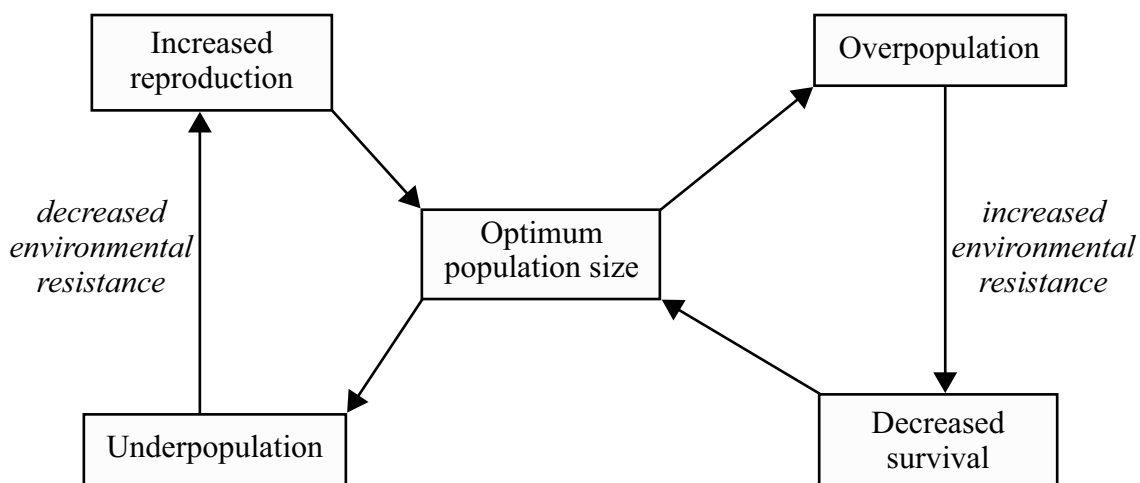
Explain the meaning of the terms:

3 **(b)** **(i)** homeostasis

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(1 mark)

3 **(b)** **(ii)** environmental resistance.

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(1 mark)

Turn over ➤

10

8

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the box will
not be scanned
for marking*

4 The Earth is a suitable distance from the sun to allow a range of temperatures that supports living organisms.

4 (a) (i) Give **two** reasons why a suitable range of temperatures is important to living organisms.

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(2 marks)

4 (a) (ii) With reference to the effect of temperature on the rate of photosynthesis, explain what is meant by a limiting factor.

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(2 marks)

4 (b) Abiotic factors, such as temperature, control the distribution of species because survival depends on an organism being well adapted to both the physical and biological environments.

Suggest why:

4 (b) (i) fish die if the temperature of the water they live in is artificially raised, for example, by waste hot water from a power station

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(2 marks)

4 (b) (ii) extreme cold weather in spring causes bird populations to decrease.

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(2 marks)

4 (c) Give an example to illustrate how **one other** abiotic factor affects the distribution of a **named** organism or group of organisms.

Abiotic factor ....

Effect on named organism ....

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(2 marks)

10

Turn over for the next question

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for marking*

5 **(a)** In 2006, the UK government introduced a new agri-environmental scheme, Environmental Stewardship, to give financial reward to farmers and other landowners for good land management.

> 'The scheme builds on the success of the Environmentally Sensitive Areas and Countryside Stewardship Schemes and its main aims are to:
>
> - conserve wildlife biodiversity
> - maintain and enhance landscape quality and character
> - protect natural resources
> - promote public access and understanding of the countryside.'

Source: Crown Copyright material is reproduced with the permission of the Controller of HMSO and the Queen's Printer for Scotland.

Suggest methods of good land management that might be rewarded under the scheme.

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(3 marks)

5 **(b)** There are about 6500 Sites of Special Scientific Interest (SSSIs) in England, Wales and Scotland.

Explain:

5 **(b)** **(i)** why an area might be designated a SSSI

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(3 marks)

5 **(b)** **(ii)** the implications for the users of the land of SSSI status.

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(2 marks)

5 **(c)** Give **two** reasons why the conservation of biodiversity is important.

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2 ....

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(2 marks)

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6 **(a)** In an investigation, the population density of the daisy (*Bellis perennis*) in a regularly cut lawn was compared with that of a lawn which was cut only occasionally. The results are shown in the table.

Species	Mean population density / number of daisy plants per m^2	
	Regularly cut lawn	**Occasionally cut lawn**
Daisy	36.0	18.6

6 **(a)** **(i)** Describe a practical technique which could be used to find the mean population density of daisies in a lawn.

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(3 marks)

6 **(a)** **(ii)** Explain the advantage of measuring the population density rather than the percentage cover of daisies.

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(2 marks)

6 **(b)** Using an example, describe and explain the process of primary succession.

Quality of Written Communication will be assessed in this answer.

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(10 marks)

15

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