Biodiversity

Question Paper

Level	Pre U
Subject	Biology
Exam Board	Cambridge International Examinations
Topic	Ecology
Sub Topic	Biodiversity
Booklet	Question Paper

Time Allowed: **86 minutes**

Score: **/71**

Percentage: **/100**

Part - A

1 Reef-building corals are marine invertebrates found in shallow, clear, tropical oceans. The corals secrete an exoskeleton of calcium carbonate that becomes the underlying structure of the coral reef ecosystem.

Zooxanthellae are a group of unicellular algae from the genus *Symbiodinium* that live within the cells of reef-building corals. The relationship has been described as mutualistic since it is beneficial to both coral and zooxanthellae.

(a) Evidence shows that the mutualistic relationship between zooxanthellae and reef-building corals has evolved by free-living algae invading corals that did not contain algae.

(i) Corals that do not need zooxanthellae can live at a greater depth than reef-building corals.

Explain why this is so.

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(ii) Suggest the benefits **to the zooxanthellae** of their association with the corals.

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Under conditions of stress the relationship between the reef-building corals and the zooxanthellae can break down. Loss of zooxanthellae and the subsequent whitening that occurs, shown in Fig. 24.1, is known as coral bleaching. Coral bleaching can lead to death of the coral.

Fig. 24.1

(b) Suggest **one** reason why permanent loss of zooxanthellae can lead to death of the coral.

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.....[1]

(c) Increased sea temperature associated with global climate change is known to be an environmental stress that can cause coral bleaching. The temperature range for healthy survival of reef-building coral is 25 °C–29 °C.

(i) Explain why the areas of sea containing coral reefs are susceptible to increased temperature resulting from global climate change.

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(ii) Raw sewage released into the oceans can contain bacteria that cause disease in corals.

Suggest how global warming increases the rate of coral bleaching caused by bacterial disease.

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Recently, the International Union for Conservation of Nature (IUCN) has assessed over 47% of reef-building coral species as threatened, or near-threatened, with a global risk of extinction.

(d) Explain why the loss of reef-building corals has been described as an example of 'reduced biodiversity on a number of levels'.

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(e) Elkhorn coral, *Acropora palmata*, is one species of coral that is threatened. It has been suggested that elkhorn coral is a keystone species.

What are the features of a keystone species?

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[Total: 14]

Part - B

2 Fig. 1.1 shows an American eel, *Anguilla rostrata*, which lives for part of its life in the rivers and mountain streams of the Eastern USA. Adult fish migrate to the Atlantic Ocean when they are ready to breed. After breeding the adults die.

Young eels migrate from the sea back to the rivers and streams and may live for five years or more before reaching the stage when they are ready to breed.

This species of fish has become rare in mountain streams over recent years.

Fig. 1.1

As part of a long-running study to find out more about the biology and behaviour of *A. rostrata*, mark-release-recapture was used to estimate the population size in one mountain stream in Virginia. Very young eels were not marked.

Table 1.1 shows the results of the mark-release-recapture.

Table 1.1

year	total number of fish caught	number of fish marked	total number of fish captured one year later	number of marked fish recaptured one year later	population estimate
2000	334	279	352	98	1002
2001	352	226	290	57	1150
2002	290	149	180	25	1073
2003	180	76	232	11	1603
2004	232	116	184	21	.....

(a) (i) Complete Table 1.1 by calculating the population estimate for the year 2004.

[1]

(ii) Comment on the accuracy of the population estimates for eels recorded in Table 1.1, including limitations of the mark-release-recapture method for estimating population size.

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The annual growth of the eels was also measured. Fig. 1.2 shows a box-whisker plot of the results for growth in length and growth in mass of eels in one stream that were marked with tags and then recaptured from 2000 to 2005.

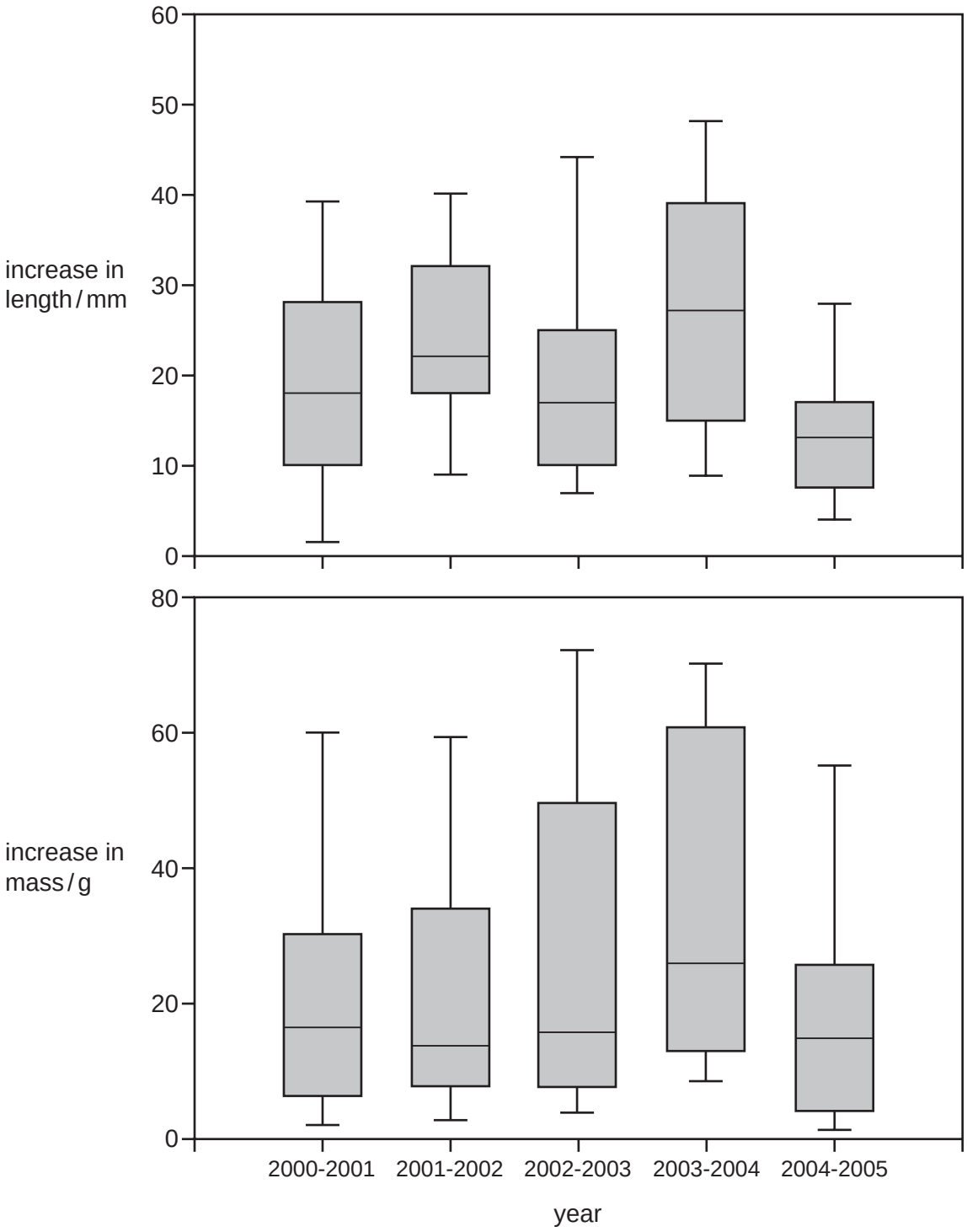

Fig. 1.2

The horizontal line in each box represents the median. The top and bottom of each box show 25th and 75th percentiles. The 'whiskers' show the 10th and 90th percentiles.

(b) (i) Describe the results shown in Fig. 1.2.

[3]

(ii) Suggest advantages of using box-whisker plots to show these data rather than bar charts or histograms.

[3]

(c) *A. rostrata* is not officially recognised as an endangered species, but its numbers are in decline.

Discuss the limitations of the results of this study in terms of providing sufficient information to inform the conservation of *A. rostrata* in Virginia.

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[Total: 17]

Adapted to survive in a harsh habitat

The Shetland Islands lie in the Atlantic 100 km north of mainland Scotland (Fig. 5.1). The Keen of Hamar (Fig. 5.2) is a rocky headland in northern Shetland where there are large areas of stony ground known as debris, which are almost bare of vegetation.

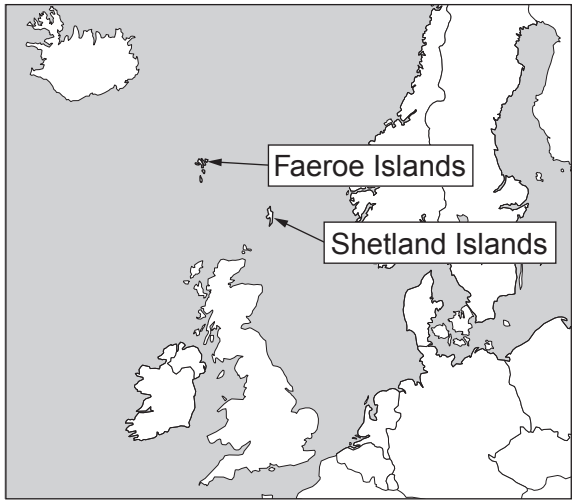

Fig. 5.1

Fig. 5.2

Fig. 5.3

Fig. 5.4

Shetland, the most northerly part of the UK, is only 400 km south of the Arctic Circle but it has an oceanic, rather than an arctic, climate with mild winters (relatively little frost) and cool summers. Most of Shetland is not bare like the Keen but is covered in vegetation, mainly grassland, heather moor and peat bog. The Keen is a Site of Special Scientific Interest (SSSI). The debris, with its shallow, nutrient-deficient, sandy, freely-draining soil may look bare, but quite a number of plant species grow amongst the small stones on the surface. Of particular scientific interest is the Shetland mouse-ear, *Cerastium nigrescens* (Fig. 5.3 and Fig. 5.4), which is almost entirely confined to the Keen debris. This species is believed to have always been restricted to this area, where it evolved in response to local environmental conditions.

The Shetland mouse-ear almost certainly evolved from the Arctic mouse-ear, *Cerastium arcticum*, a species which remains widespread on bare stony soil in the northern parts of Scandinavia, Russia, Siberia and North America. The nearest population of Arctic mouse-ear to the Keen is 200 km to the north-west, in the Faeroe Islands (Fig. 5.1).

At the end of the last Ice Age, the Arctic mouse-ear is thought to have been widespread not only on Shetland, but also further south, growing on stony ground left bare by melting ice. Over the next few thousand years vegetation, such as forest, heath or grassland, spread north to cover most of the land. The Keen debris habitat was one of the exceptions to this and it remained bare despite no longer having an arctic climate. It has probably changed little in 10 000 years.

3 (a) Suggest **and** explain the possible advantages of the following distinctive features of the Shetland mouse-ear for its survival on the Keen of Hamar:

relatively large flowers .....

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leaves which are thick and very hairy .....

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relatively large seeds .....

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(b) Explain how the Shetland population of mouse-ear could have become a different species from the Arctic mouse-ear.

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[Total: 10]

4 Discuss how an understanding of ecosystems can contribute to the goal of sustainable development of human populations. [30]