1. Nov/2022/Paper_41/No.5

A large number of alpine plant species grow in the mountains of New Zealand's South Island. Alpine plants are defined as plants that live above the treeline, which is the height above which trees cannot grow. The current treeline for most of South Island is 1200 m.

(a) The alpine areas nearest to South Island are 1500–2000 km away across the sea. Many of South Island's alpine species live nowhere else in the world.

Explain how a large number of alpine plant species developed on South Island.

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(b) Fig. 5.1 shows two aspects of the history of South Island over the last 3.9 million years.

- The dashed line shows how the mean height of mountains in the Clyde region of South Island increased over time. The mountains in this range have a mean height of 2400 m at the present time.
- The solid line models the height of the treeline over time based on geological climate data. The treeline was higher when the climate was warmer, and the treeline was lower when the climate was colder, during ice ages.

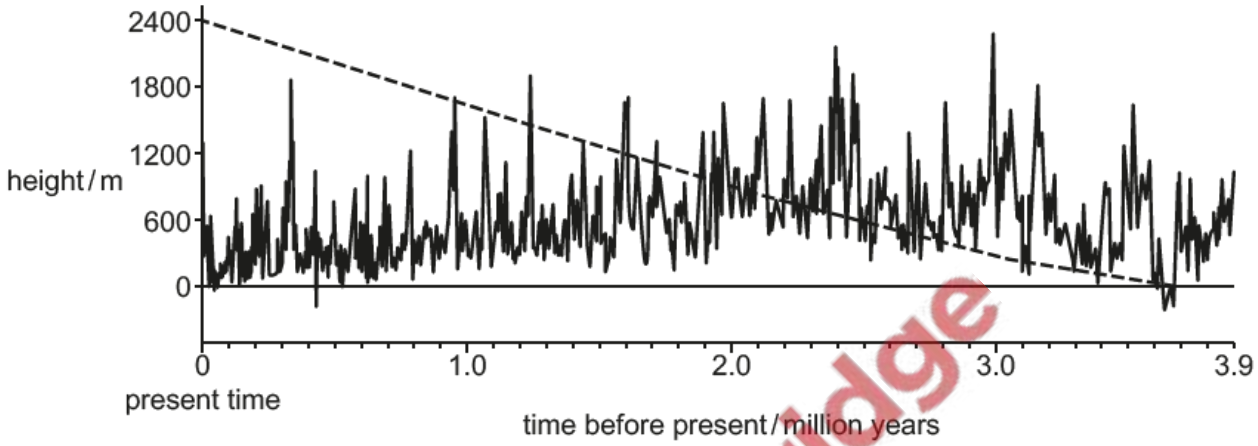

Fig. 5.1

(i) With reference to Fig. 5.1, identify with reasons the time period when South Island's alpine plant species developed.

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(ii) Suggest how DNA sequence data could be used to confirm the time period you identified in **(i)**.

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[Total: 10]

2. Nov /2022/Paper_42/No.1

The Asiatic lion, *Panthera leo persica*, is found only in the Gir Forest National Park in the Gujarat region of western India.

Fig. 1.1 shows a female Asiatic lion.

Fig. 1.1

(a) The Asiatic lion is at risk of extinction in the wild and is categorised as endangered by the International Union for Conservation of Nature (IUCN).

Outline the role of the IUCN.

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(b) The Maldhari community is a tribe of herdsmen that lives in the Gir Forest. The Maldhari have co-existed with the Asiatic lions for thousands of years. The Maldhari place old and weak cattle at the edges of their cattle enclosures.

Suggest why the Maldhari place old and weak cattle at the edges of their cattle enclosures.

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(c) Some zoos use assisted reproduction techniques, such as IVF, in their captive breeding programmes for endangered species.

Describe how IVF can be used with an endangered species such as the Asiatic lion.

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[Total: 9]

3. June /2022/Paper_42/No.5

Myosotis is a genus of small flowering plants. Many different *Myosotis* species grow on the islands of New Zealand, which are an important site of *Myosotis* evolution. Lowland *Myosotis* species grow at low altitude while alpine *Myosotis* species grow at high altitude at the tops of mountains.

(a) Scientists wanted to obtain molecular data to determine the evolutionary relationships of New Zealand's *Myosotis* species. They extracted DNA from individuals of *Myosotis* species collected from three different islands in New Zealand.

To carry out a polymerase chain reaction before DNA sequencing, the DNA samples were mixed with primers, deoxynucleotides and *Taq* polymerase and put through 35 cycles of treatment. Each treatment cycle involved one minute at 95 °C, followed by one minute at 50 °C and then four minutes at 72 °C.

Describe what happened to the DNA at each temperature.

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(b) Fig. 5.1 shows the three largest New Zealand islands.

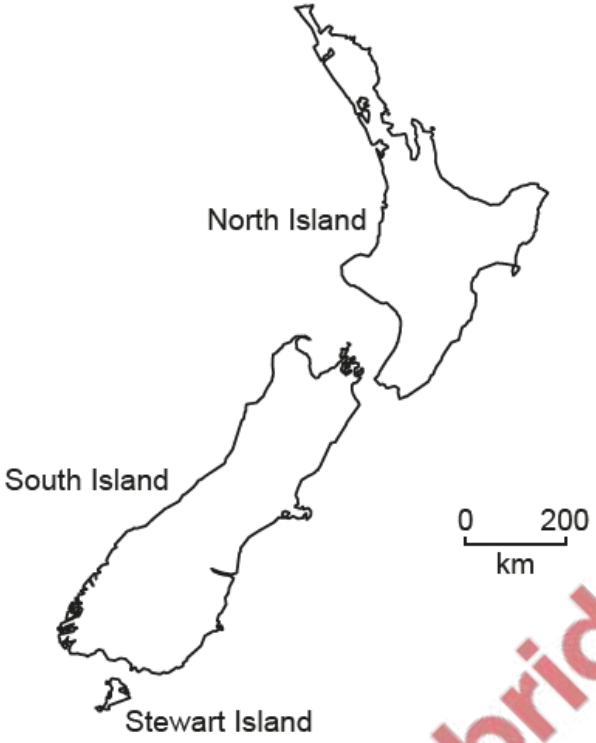

Fig. 5.1

North Island has mostly lowland habitat. South Island and Stewart Island have mountains with alpine habitats that are above the tree line.

DNA sequence data for three *Myosotis* species were compared. The results are described in the bullet points.

- In the alpine species *M. pygmaea*, individuals on South Island showed genetic differences from individuals of *M. pygmaea* on Stewart Island.
- In the alpine species *M. pulvinaris*, individuals from different mountains on South Island showed genetic differences.
- In the lowland species *M. pottsiana*, individuals from different areas of North Island showed overall genetic similarity.

Discuss reasons for the results in the three species.

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(c) State **two** factors, other than natural selection, that could drive genetic changes in populations of *Myosotis*.

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