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NZQA
NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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Level 3 Biology, 2011

90717 Describe processes and patterns of evolution

2.00 pm Tuesday 15 November 2011
Credits: Three

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

ASSESSOR'S USE ONLY	Achievement Criteria	
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Describe processes and patterns of evolution. ☐	Describe processes and explain patterns of evolution. ☐	Describe processes and discuss patterns of evolution. ☐
Overall level of performance ☐		

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You are advised to spend 45 minutes answering the questions in this booklet.

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QUESTION ONE

The New Zealand parrot family (Strigopidae) consists of two genera of parrots, *Nestor* and *Strigops*. The genus *Nestor* consists of the kea, kākā, Norfolk Island kākā and Chatham Island kākā, whilst the genus *Strigops* contains the flightless ground-dwelling kākāpō.

Nestor and *Strigops* diverged from the proto-kākā / kākāpō ancestor 60 – 80 million years ago. Since then *Nestor* has gone through further divergence, as shown below.

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http://wapedia.mobi/en/File:Nestoridae_phylogeography.svg#3

(a) Describe the pattern of evolutionary change shown in the diagram, and explain how this type of pattern can arise.

(b) Discuss the reasons for divergence of *Nestor*, and why the same evolutionary processes have not been evident in *Strigops*.

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In your answer consider:

- the events likely to have caused ecological divergence of *Nestor*
- the processes that have led to speciation in *Nestor*
- reasons why there has been little evidence of speciation in *Strigops* (the kākāpō).

There is more space for your answer to Question One (b) on the following page.

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QUESTION TWO

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Hebe odora, Leucogenes leontopodium and *Celmisia haastii* are three low-growing, shrubby plants with small leathery leaves, ideally suited to their exposed mountain habitats. Despite these similarities, they are not related.

Hebe odora
http://wozawanderer.blogspot.com/2010/02/mt-richardson-beech-forest.html

Leucogenes leontopodium
www.slacktopnurseries.co.uk/expression/index.php/plants/C19/

Celmisia haastii
www.flickr.com/photos/stationalpinejosephfourier/2091557272/

(a) Explain the pattern of evolution shown by these three different plant species.

(b) The *Hebe* is New Zealand's largest genus of shrubs. There are about 100 species of Hebe found in New Zealand.

The main genera of the *Hebe* complex probably evolved five million years ago, after the arrival of a single ancestral founding species. *Hebe* then evolved into about 100 species during the last million years.

Four diverse examples are shown below.

Species	Habitat	Structure	Chromosome No (n)
For copyright reasons, this resource cannot be reproduced here. *Hebe speciosa* http://loveplantlife.com/2010/10/28/resplendent-natives/dsc04860/	Exposed sea cliffs on the western side of both islands.	Leaves 5–10 cm long; rounded shrub up to 2 m tall.	20
For copyright reasons, this resource cannot be reproduced here. *Hebe hectorii* http://www.eecrg.uib.no/projects/AGS_BotanyExp/NewZealand/Photos/NZ%20gallery/pages/Hebe%20hectorii.htm	Wet sub-alpine scrub and tussock of the South Island.	Whipcord plant; erect, rigid plant that grows up to 0.75 m tall.	20
For copyright reasons, this resource cannot be reproduced here. *Hebe gracillima* www.hebesoc.org/hebes/hebes_g/hebe_gracillima/hebe_gracillima.htm	Damp swampy places in the South Island.	Leaves 1–2 cm long; shrub up to 2 m tall.	40
For copyright reasons, this resource cannot be reproduced here. *Hebe venustula* www.plantdatabase.co.uk/Hebe_venustula	Sub-alpine, mostly North Island.	Leaves 1–2 cm long; erect bushy shrub up to 1.5 m tall.	60

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Compare and contrast the processes of **polyploidy** and **geographical isolation** and how they are **both** likely to have impacted on the evolution of *Hebe* species in New Zealand.

In your answer:

- describe the process of adaptive radiation
- explain how both polyploidy and geographical isolation could occur
- discuss the impact of both processes on reproduction and gene flow within the *Hebe* genus.

There is more space for your answer to Question Two (b) on the following page.

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QUESTION THREE

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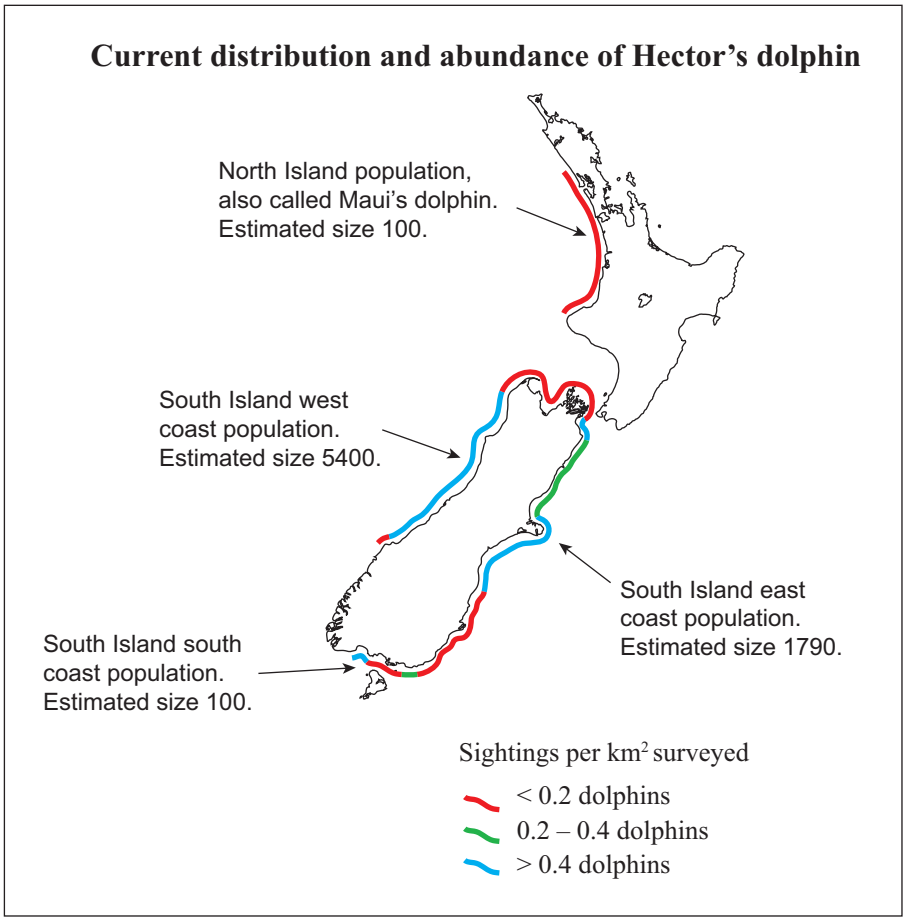
Hector's dolphins are found only in New Zealand waters. DNA studies have verified the existence of four regional populations.

The North Island and South Island populations are reproductively isolated, as measured by DNA differences. Levels of gene flow between the three regional South Island populations are very low. Evidence suggests that the south coast population is a founder from the west coast South Island population. It appears the populations are isolated by distance, and dispersal happens only between immediately adjacent populations.



Dawson et al 2004, Slooten et al 2004, 2005

Discuss the evolutionary processes that appear to be happening between the three **South Island** populations of Hector's dolphin.

In your answer consider:

- the selection pressures acting on the individual populations that contribute to their isolation
- the type of evidence that would suggest the south coast population is a founder from the west coast population
- the significance of the finding that there appears to be little or no gene flow between the three populations.

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Extra space if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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