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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 3 Biology, 2013

91605 Demonstrate understanding of evolutionary processes leading to speciation

2.00 pm Tuesday 12 November 2013
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of evolutionary processes leading to speciation.	Demonstrate in-depth understanding of evolutionary processes leading to speciation.	Demonstrate comprehensive understanding of evolutionary processes leading to speciation.

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 space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–8 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.

TOTAL

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You are advised to spend 60 minutes answering the questions in this booklet.

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QUESTION ONE

Skinks belonging to the genus *Oligosoma* are endemic to New Zealand, and appear to have undergone a rapid phase of divergence 23 to 35 million years ago, when it was estimated that much more of New Zealand's land mass was under water.

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O. smithi

http://www.ryanphotographic.com/scincidae.htm

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O. suteri

http://whereisremi.files.wordpress.com/2010/02/024-2.jpg

Two *Oligosoma* species (shore skink, *O. smithi,* and egg-laying skink, *O. suteri*) exist as sympatric species in north-eastern New Zealand. Despite living within the same area, the species are not closely related.

O. smithi are medium-sized skinks, active in daylight and give birth to live young. *O. smithi* is widely distributed in both coastal regions and off-shore islands, and shows genetic variation.

In contrast, *O. suteri* are significantly larger, nocturnal and lay eggs. Distribution of *O. suteri* is much more limited (northern off-shore islands), and shows remarkably little genetic variation.

Discuss the natural selection pressures that have most likely affected speciation and distribution of these two *Oligosoma* species over the past 35 million years.

In your answer you should:

- describe the type of speciation that has happened between these *Oligosoma* species, with reasons
- explain how biological and geographical factors have contributed to speciation
- evaluate differences in genetic diversity and distribution patterns between the two species.

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QUESTION TWO

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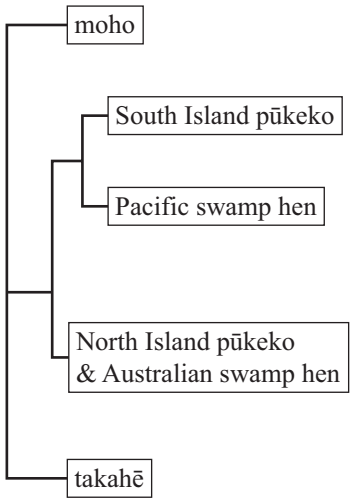
The pūkeko (*Porphyrio melanotus*) and takahē (*Porphyrio hochstetteri*) look similar and share a common ancestor, but have evolved differently.

Fossil evidence suggests takahē have been present in New Zealand lowlands and forest margins for at least 5 million years. It is flightless, a slow breeder and now endangered. There are an estimated 227 adult birds in Fiordland's isolated alpine habitat and on four predator-free off-shore islands. The North Island takahē or moho is extinct.

The pūkeko invaded New Zealand within the past 1 000 years. A cooperative breeder, it has become well established within open grassland, swamps, and agricultural lands.

Recent DNA evidence points to the pūkeko in the North Island having close connections with the Australian swamp hen, whereas South Island pūkeko show close relation to the Pacific swamp hen.

The lineage is shown below.



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Takahē
www.teara.govt.nz/files/p10553pc.jpg

For copyright reasons, this resource cannot be reproduced here.

Pūkeko
http://www.tiritirimatangi.org.nz/pukeko

Analyse both the pattern of evolution and the processes that have led to the establishment of takahē and pūkeko as separate species in New Zealand.

In your answer:

- describe what is meant by punctuated equilibrium, and explain why the takahē / pūkeko pattern of evolution is an example of this
- explain the evolutionary selection pressures acting on both species over time
- compare and contrast how the takahē and pūkeko became established in New Zealand.

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QUESTION THREE

Monarch flycatchers (*Monarcha castaneiventris*) are small, insect-eating birds, commonly found in the Solomon Islands of the Pacific.

A study of two populations of the same species from neighbouring islands found that birds on the island of Makira are completely black in colour; whereas on smaller adjacent islands, some of the birds are completely black and others are black with a chestnut-coloured belly. The geographical distance between islands is very small.

Chestnut-bellied and black monarch flycatchers.
http://news.sciencemag.org/sciencenow/2009/06/15-01.html

The male birds are fiercely territorial, but researchers found that the males don't react when a differently coloured bird of the same species enters their territory.

A study of the bird's genomes found only one variation. The MC1R gene regulates production of melanin, which gives skin and feathers colour. The completely black and chestnut-bellied birds had different versions of the MC1R gene, resulting in a single amino acid mutation.

Discuss how the MC1R gene mutation could lead to speciation in populations of the monarch flycatcher.

In your answer you should:

- describe speciation
- explain how the MC1R gene may impact on the monarch flycatcher populations
- evaluate the possible long-term effects of this process on the species.

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

QUESTION NUMBER

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