

# 3

91605M



NEW ZEALAND QUALIFICATIONS AUTHORITY  
MANA TOHU MĀTAURANGA O AOTEAROA

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KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

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## Koiora, Kaupae 3, 2016

### 91605M Te whakaatu māramatanga ki ngā tukanga o te kunenga mai e whakaputa ai i te whakamomotanga

2.00 i te ahiahi Rāpare 10 Whiringa-ā-rangi 2016  
Whiwhinga: Whā

Paetae	Kaiaka	Kairangi
Te whakaatu māramatanga ki ngā tukanga o te kunenga mai e whakaputa ai i te whakamomotanga.	Te whakaatu māramatanga hōhonu ki ngā tukanga o te kunenga mai e whakaputa ai i te whakamomotanga.	Te whakaatu māramatanga matawhānui ki ngā tukanga o te kunenga mai e whakaputa ai i te whakamomotanga.

Tirohia mēnā e rite ana te Tau Ākongā ā-Motu (NSN) kei runga i tō puka whakauru ki te tau kei runga i tēnei whārangi.

**Me whakamātau koe i ngā tūmahi KATOĀ kei roto i tēnei pukapuka.**

Mēnā ka hiahia whārangi atu anō koe mō ō tuinga, whakamahia ngā whārangi wātea kei muri o tēnei pukapuka, ka āta tohu ai i te tau tūmahi.

Tirohia mēnā e tika ana te raupapatanga o ngā whārangi 2–23 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

**ME HOATU RAWA KOE I TĒNEI PUKAPUKA KI TE KAIWHAKAHAERE Ā TE MUTUNGA O TE WHAKAMĀTAUTAU.**

TAPEKE

MĀ TE KAIMĀKA ANAKE

## TŪMAHI TUATAHI: TE PORAKA WAEHŌ O MĒHIKO

Kitea ai te poraka wae hō o Mēhiko (*Spea multiplicata*) i te puāwanga o Te Hononga o Amerika me Mēhiko. I ngā repo e itiiti ana ngā kai me te tino kiato o ngā punua poraka, e rua ngā taupori kei te kaha ake. Ko tētahi taupori (e kīia ana ko te momo kaikiota) he porowhita te tinana me tētahi kōpiro roa, he paku ngā uua kauae, he maene ngā wāhanga o te waha, ā, he kaikiota ia, ko ngā pūkohu wai me ngā kōupaka e kitea ana i raro o te repo ana kai. Ko tētahi atu taupori (e kīia ana ko te momo kaikiko) he whāiti te tinana me tētahi kōpiro poto, he nui ngā uua kauae, he niho ō te waha, ā, he kaikiko motuhake ngā kai, ko ngā kōuraura e kitea ana i te wai.

I tua atu i tēnei, i ngā repo e tino matomato ana ngā kai me te tino iti o ngā punua poraka, kotahi anake te taupori, o te tohuāhua waenga, ka kitea.

Whakatauritehia te pānga o te whiriwhiri tauwhati, whakapūmau hoki ki te rerenga iranga ME te matapaki ka pēhea te puta o te whakamomo i roto i te poraka wae hō o Mēhiko.

I tō tuhinga me:

- whakaahua i te rerekētanga ā-ira
- whakaahua i ngā kupu “whiriwhiringa tauwhati, whakapūmau hoki”, me te whakaahua ko (t)ēhea ngā taupori poraka wae hō o Mēhiko kei te whai pānga ki ia momo whiriwhiringa
- whakamārama mai i ngā pēhanga whiriwhiri e hāpai ana i te whiriwhiringa tauwhati ME ngā pēhanga whiriwhiri e hāpai ana i te whiriwhiringa whakapūmau i roto i te poraka wae hō o Mēhiko.

Ka tāea te whakamahi hoahoa whai tapanga nahanaha hei tautoko i tō tuhinga.



Whakaahua 1: Ngā hua poraka wae hō o Mēhiko mai i tētahi repo kiato nui, iti te kai. *Runga*: te momo kaikiota. *Raro*: te momo kaikiko  
<http://labs.bio.unc.edu/pfennig/LabSite/Photos.html>

**He wāhi anō mō tō tuhinga  
mō tēnei tūmahi kei te  
whārangi 4.**

**QUESTION ONE: MEXICAN SPADEFOOT TOAD**

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The Mexican spadefoot toad (*Spea multiplicata*) is found in southwestern United States and Mexico. In ponds with low abundance of food resources and high density levels of tadpoles, two populations predominate. One population (called the omnivore morph) has a round body with a long intestine, small jaw muscles, smooth mouth parts, and has a generalist omnivorous diet of algae and small crustaceans found on the bottom of the pond. The other population (called the carnivore morph) has a narrow body with a short intestine, enlarged jaw muscles, teeth-like mouthparts, and has a specialist carnivorous diet of fairy shrimps found in the water column.

On the other hand, in ponds of high abundance of food resources and low density levels of tadpoles, only one population, of intermediate phenotype, is found.

Compare and contrast the impact of disruptive and stabilising selection on genetic diversity AND discuss how speciation could occur in the Mexican spadefoot toad.

In your answer you should:

- describe genetic variation
- describe the terms disruptive and stabilising selection, and describe which population(s) of Mexican spadefoot toad tadpole is associated with each type of selection
- explain the selection pressures that promote disruptive selection, AND the selection pressures that promote stabilising selection in the Mexican spadefoot toad tadpole.

Well labelled diagrams can be used to support your answer.



Figure 1: Mexican spadefoot toad tadpoles from a high density, low food resource pond. *Top*: the omnivore morph. *Bottom*: the carnivore morph.  
<http://labs.bio.unc.edu/pfennig/LabSite/Photos.html>

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## TŪMAHI TUARUA: TE IKA TARATORU (THREE-SPINED STICKLEBACK)

He ika pakupaku (30 – 90 mm) te ika taratoru (*Gasterosteus aculeatus*), e kitea ana i Te Tuakoi Raki. Noho ai ētahi taupori ki ngā nōhanga o te taha moana, ā, noho anō ai ētahi atu taupori ki ngā wai māori.

Kāore ngā ika taratoru e whai unahi pērā i ētahi atu ika; engari he pereti kōiwiiwi me ngā taratara kē ō rātou (hei pare). He tino maha ngā pereti kōiwiiwi me ngā taratara roa o ngā taupori ika taratoru e noho ana i te taha moana, ēngari he iti noa ngā pereti kōiwiiwi me ngā taratara poto o ngā taupori e noho ana i te wai māori. E ai ki ngā taunakitanga iranga nā tētahi irakētanga ki te ira Ectodysplasin (EDA) ka pā mai te rerekētanga ki te maha o ngā pereti, ā, ka puta i te irakētanga ki te ira PITX1 he rerekētanga ki te roa o ngā taratara.

Ko ngā kaikonihī matua o ngā ika taratoru i ngā nōhanga moana ko ngā ika nui ake. I ngā nōhanga wai māori, ko ngā kaikonihī matua ko ngā ngārara kapokapo (pēnei i te tūngou kapowai), otirā ki ngā ika taratoru pūhou. Kāore hoki i te tino rawaka ngā wāhi whakaruruhau i ngā nōhanga moana mō ngā ika taratoru, ēngari anō ngā nōhanga wai māori he nui ngā wāhi whakaruruhau. Ko te pāpātanga tipu me te whakaterenga/terenga kowhera o ngā ika taratoru he teitei ake ina itiiti rawa ngā pereti kōiwiiwi.

Matapakitia he pēhea te pānga mai o ngā irakētanga EDA me te PITX1, ME te whiriwhiri māori ki te kunenga o ngā ika taratoru.

I tō tuhinga me:

- whakaahua i ngā kupu irakētanga ME te whiriwhiri māori
- whakamārama he pēhea te rerekē o ngā pēhenga whiriwhiri i roto i ngā nōhanga taha moana ME te wai māori ki te maha o ngā pereti kōiwiiwi me te roa o ngā taratara
- matapaki i te mahi a te irakētanga ME te whiriwhiri māori ki te kunenga o te ika taratoru.



Whakaahua 2. *Runga*: Ika taratoru nō tētahi taupori moana. *Raro*: Ika taratoru nō tētahi taupori wai māori. I poapoatia ngā ika ki te alizarin whero kia miramiratia ai ngā pereti kōiwiiwi me ngā taratara.

<http://unews.utah.edu/wp-content/uploads/sticklebackfigure1.jpg>



Whakaahua 3. Ngā kaikonihī noa o ngā ika taratoru i ngā wāhi noho moana me ngā wai māori.

<http://learn.genetics.utah.edu/content/selection/stickleback/>

**He wāhi anō mō tō tuhinga  
mō tēnei tūmahi kei te  
whārangi 10.**



## QUESTION TWO: THREE-SPINED STICKLEBACK

The three-spined stickleback (*Gasterosteus aculeatus*) is a small (30 – 90 mm) fish found in the Northern Hemisphere. Some populations live in coastal marine habitats, while other populations live in freshwater.

Three-spined sticklebacks lack the scales typical of most fishes; instead they possess (protective) bony plates and spines. Three-spined stickleback populations living in a marine habitat have high numbers of bony plates and long spines, whereas freshwater populations typically have low numbers of bony plates and short spines. Genetic evidence suggests that a mutation in the Ectodysplasin (EDA) gene causes variation in plate number, and a mutation in the PITX1 gene causes variation in spine length.

The main predators of three-spined stickleback in marine habitats are larger fish. In freshwater habitats, grasping insects (such as dragonfly larvae) are the main predators, especially of juvenile three-spined stickleback. Marine habitats typically have low amounts of shelter suitable for the three-spined stickleback, whereas freshwater habitats have high amounts of shelter. The growth rate and acceleration/burst speed of three-spined sticklebacks is highest when the bony plate number is lowest.

Discuss how EDA and PITX1 gene mutations AND natural selection have affected evolution in three-spined stickleback.

In your answer you should:

- describe the terms mutation AND natural selection
- explain how selection pressures in marine AND freshwater habitats act differently on bony plate number and spine length
- discuss the roles of mutation AND natural selection on three-spined stickleback evolution.



Figure 2. *Top*: Typical three-spined stickleback from a marine population. *Bottom*: Typical three-spined stickleback from a freshwater population. Fish have been stained with alizarin red to highlight bony plates and spines.

<http://unews.utah.edu/wp-content/uploads/sticklebackfigure1.jpg>



Figure 3. Typical three-spined stickleback predators in ocean and freshwater habitats.

<http://learn.genetics.utah.edu/content/selection/stickleback/>

**There is more space for your answer to this question on page 11.**



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**There is more space for your answer to this question on page 13.**





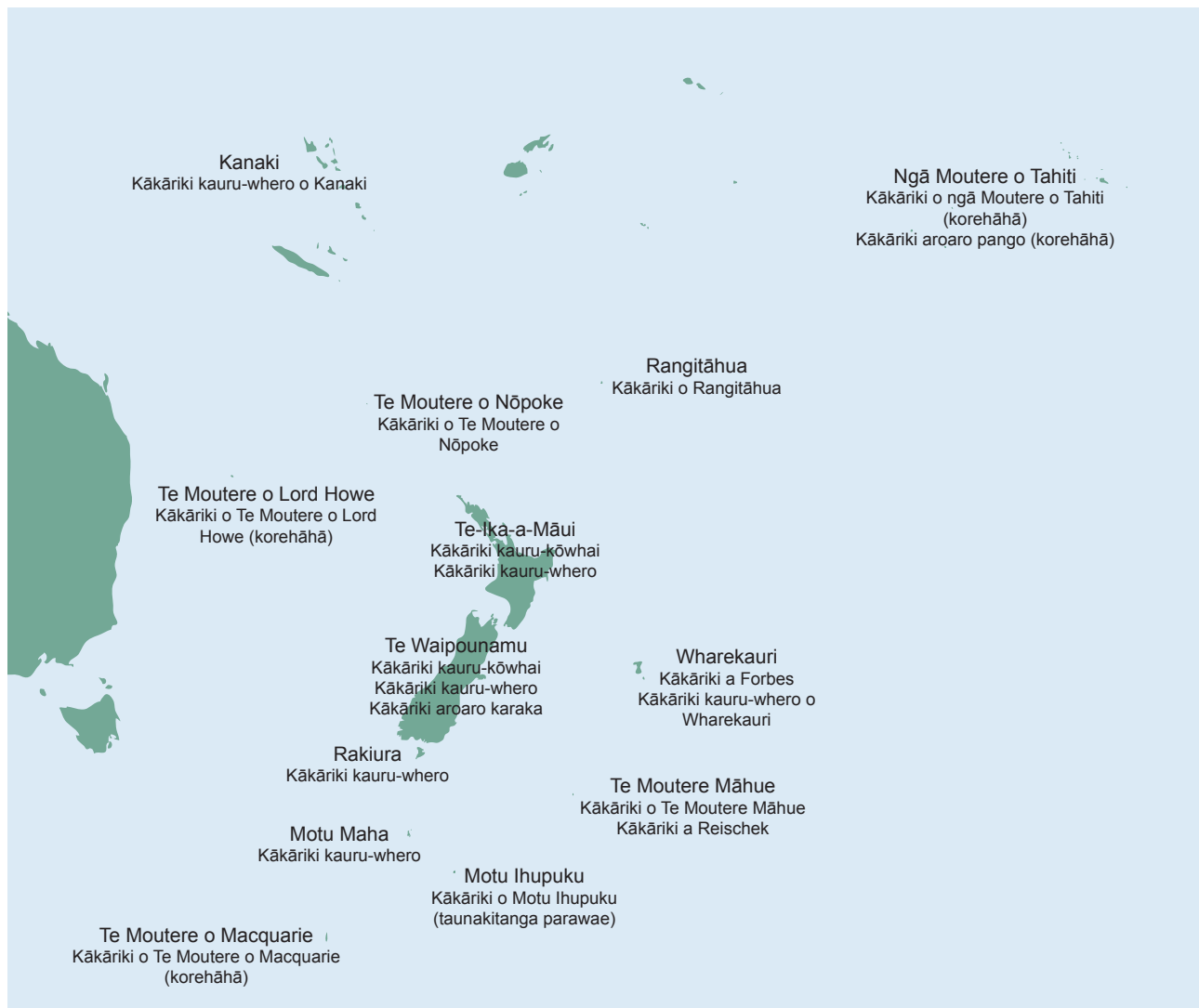
## TŪMAHI TUATORU: TE KĀKĀRIKI

Ko te kākāriki te momo manu e kitea noatia ana o te puninga *Cyanoramphus*, ā, e tuarhia ana puta noa i Te Moananui-a-Kiwa (Whakaahua 5). Kei Aotearoa te nuinga o ngā momo. Noho ai ngā kākāriki i te whānuitanga o ngā nōhanga rerekē, tae atu ki ngā pātītī taranui i ngā moutere ki te raki o Te Kōpakatanga ki te Tonga (te kākāriki o Te Moutere Māhue me te kākāriki a Reischek), i ngā uru rākau tawai i Aotearoa (kākāriki kauru-kōwhai me ngā kākāriki aroaro karaka), me ngā ngāoreore (kākāriki kauru-whero o Kanaki).



Whakaahua 4. Kākāriki a Forbes, Wharekauri.

[www.nzbirdsonline.org.nz/species/forbes-parakeet](http://www.nzbirdsonline.org.nz/species/forbes-parakeet)



Whakaahua 5: Te tuaritanga o te kākāriki i Te Moananui-a-Kiwa.

### QUESTION THREE: KAKARIKI

Kakariki are the most common species of parakeet in the genus *Cyanoramphus* and are distributed throughout the South Pacific (Figure 5). Aotearoa has the largest number of species. Kakariki live in a wide range of habitats, including subantarctic tussock (Antipodes Island kakariki and Reischek's kakariki), beech forests in mainland Aotearoa (yellow-crowned kakariki and orange-fronted kakariki), and tropical rainforests (New Caledonian red-crowned kakariki).



Figure 4. Forbes' kakariki, Chatham Island.

[www.nzbirdsonline.org.nz/species/forbes-parakeet](http://www.nzbirdsonline.org.nz/species/forbes-parakeet)

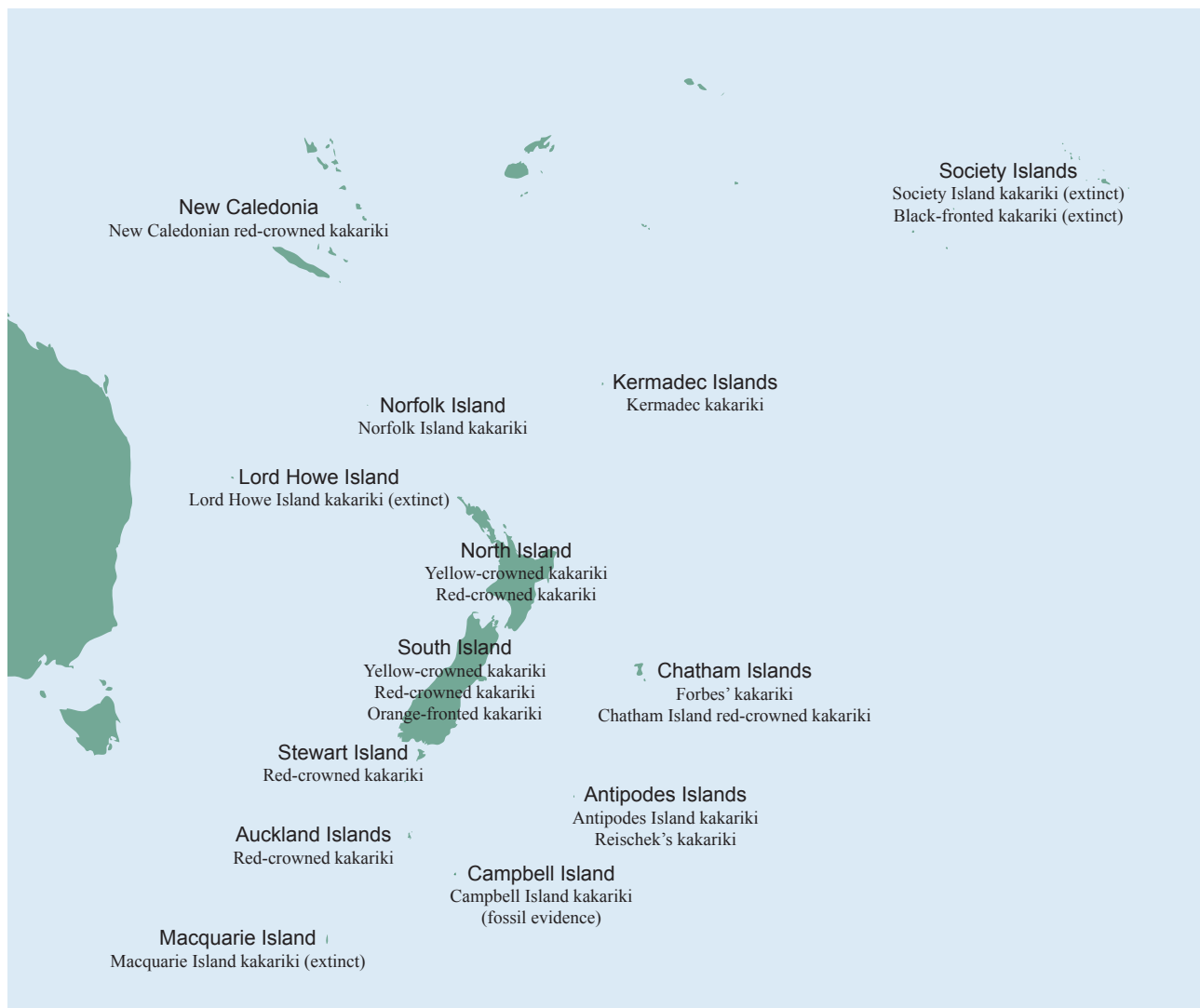
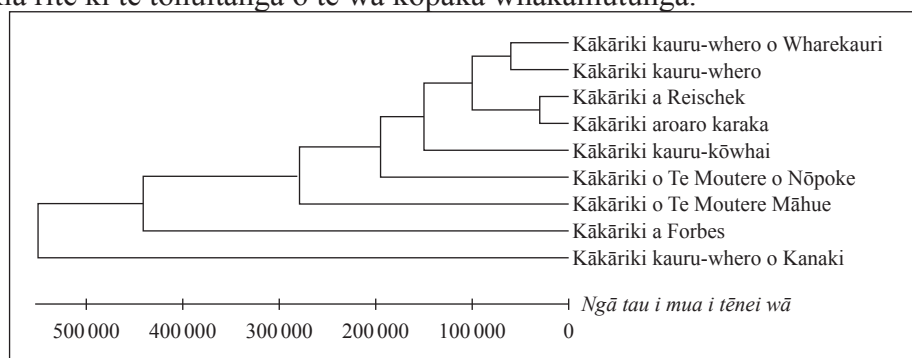


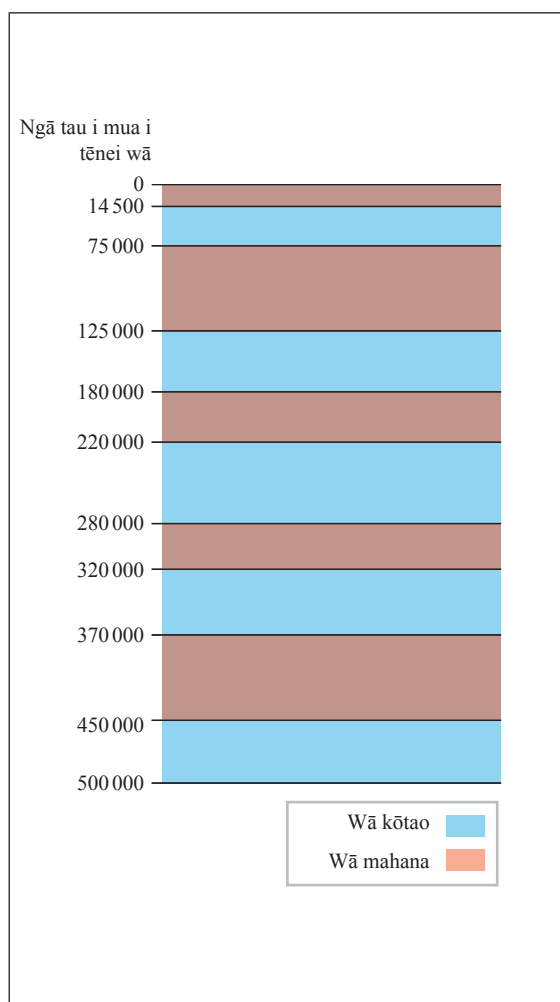
Figure 5: Kakariki distribution in the South Pacific.

Kua whakatauhia ngā pānga kunenga o ngā momo kākāriki mā ngā tātaritanga raupapa o te pītaurira o te pata pūngao. Kei te Whakaahua 6 te hoahoa irangapori mō tēnei tātaritanga. E whakaaturia ana i te Whakaahua 7 te āhuarangi mō tēnei wāhanga, ā, e whakaaturia ana i te Whakaahua 8 te taupoki otaota he mea hanga anō kia rite ki te tōnuitanga o te wā kōpaka whakamutunga.



Whakaahua 6. Hoahoa irangapori mō te *Cyanoramphus*.  
E tohua ana i runga te āwhata wā mō te tīhoitanga kunenga.

He mea urutau mai i Boon, W. M mā (2001). 'Molecular systematics and conservation of the kakariki (*Cyanoramphus* spp.)', *Science for Conservation*, 176 (Te Papa Atawhai, Te Whanganui-a-Tara).



Whakaahua 7. Ngā wā kōpaka i Aotearoa.

He mea urutau mai i [www.teara.govt.nz/en/diagram/10741/glacial-periods-in-new-zealand](http://www.teara.govt.nz/en/diagram/10741/glacial-periods-in-new-zealand)



Whakaahua 8. Ngā taupoki otaota i Aotearoa 19 000 – 29 000 tau ki mua i tēnei wā he mea waihanga anō mai i ngā taunakitanga hae, paraewhānui, tawai, mātāwhenua hoki.

He mea urutau mai i: Newnham, R, mā (2010). 'The vegetation cover of New Zealand during the last glacial maximum', *terra australis*, 32, wh. 59 (ANU E Press, Canberra). <http://press.anu.edu.au/wp-content/uploads/2011/02/ch0417.pdf>



The evolutionary relationships of kakariki species have been determined using mitochondrial DNA sequence analysis. The phylogenetic tree based on this analysis is shown in Figure 6. The climate during this period is shown in Figure 7, and the reconstructed vegetation cover at the height of the last glacial period is shown in Figure 8.

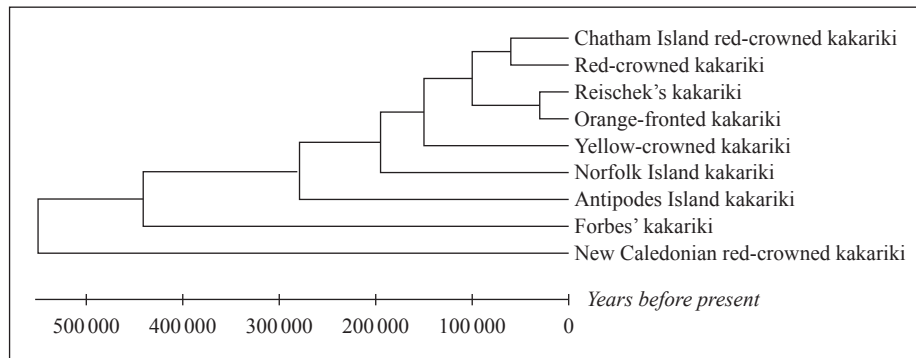


Figure 6. Phylogenetic tree for *Cyanoramphus*.  
The time scale for evolutionary divergence is indicated above.

Adapted from Boon, W. M. *et al.* (2001). 'Molecular systematics and conservation of the kakariki (*Cyanoramphus* spp.)', *Science for Conservation*, 176 (Department of Conservation, Wellington).

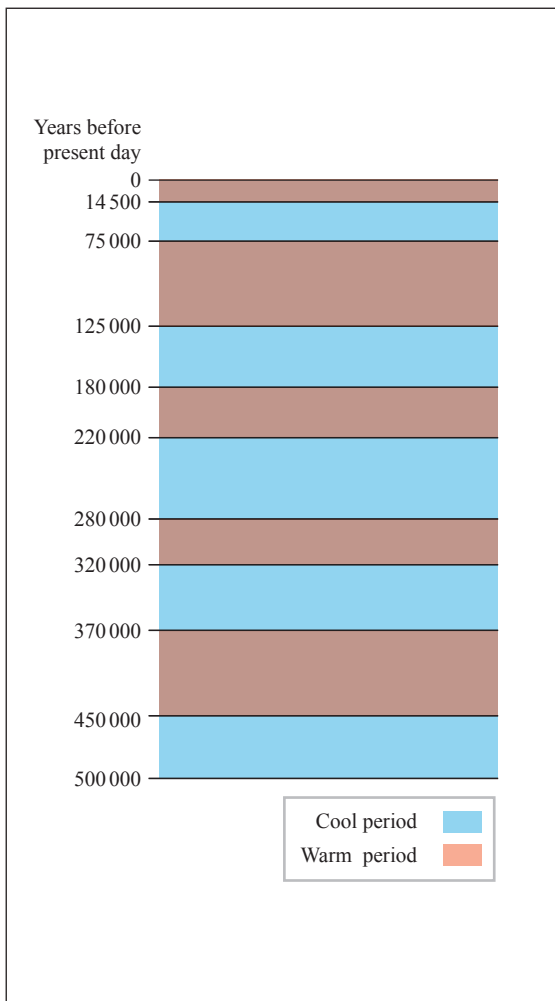


Figure 7. Glacial periods in Aotearoa.  
Adapted from [www.teara.govt.nz/en/diagram/10741/glacial-periods-in-new-zealand](http://www.teara.govt.nz/en/diagram/10741/glacial-periods-in-new-zealand)

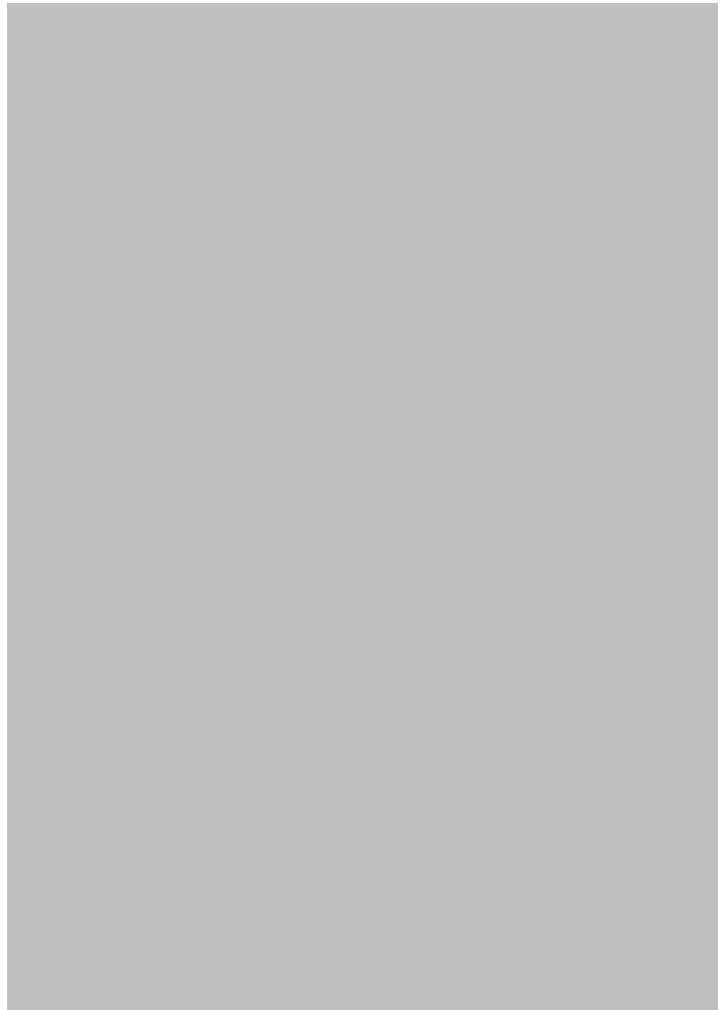


Figure 8. Aotearoa vegetation cover 19 000 – 29 000 years b. p. as reconstructed from pollen, macrofossil, beetle and geographic evidence.

Adapted from: Newnham, R, *et al.* (2010). 'The vegetation cover of New Zealand during the last glacial maximum', *terra australis*, 32, p. 59 (ANU E Press, Canberra). <http://press.anu.edu.au/wp-content/uploads/2011/02/ch0417.pdf>

Matapakitia te tauira kunenga i roto i ngā kākāriki, me ngā take i whai pānga ki te kunenga o te kākāriki.

I tō tuhinga me:

- whakaahua i te tauira kunenga ME te momo whakamomo e tautuhia ana e ngā rauemi
- whakamārama mai i te takenga mai me te tuaritanga o ngā kākāriki i Aotearoa e ai ki te hoahoa irangapori
- mā te whakamahi i ngā kōrero kua tukuna mai, matapakitia mai i pēhea te pānga o ngā take koiora, mātāwhenua hoki ki te whakamomo kākāriki.

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**He wāhi anō mō tō tuhinga  
mō tēnei tūmahī kei te  
whārangi 21.**

Discuss the pattern of evolution in kakariki, and the factors that have affected kakariki evolution.

In your answer you should:

- describe the evolutionary pattern AND type of speciation indicated by the resource material
- explain the origin and distribution of kakariki in Aotearoa with reference to the phylogenetic tree
- using the information provided, discuss how biological and geographical factors have contributed to kakariki speciation.

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**There is more space for your  
answer to this question on  
page 22.**









*English translation of the wording on the front cover*

## **Level 3 Biology, 2016**

### **91605 Demonstrate understanding of evolutionary processes leading to speciation**

2.00 p.m. Thursday 10 November 2016  
Credits: Four

91605M

<b>Achievement</b>	<b>Achievement with Merit</b>	<b>Achievement with Excellence</b>
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 room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–23 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.**