For Supervisor's use only

3

90717

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Level 3 Biology, 2005

90717 Describe patterns of evolution

Credits: Two
9.30 am Tuesday 15 November 2005

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 answer 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 2–7 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.

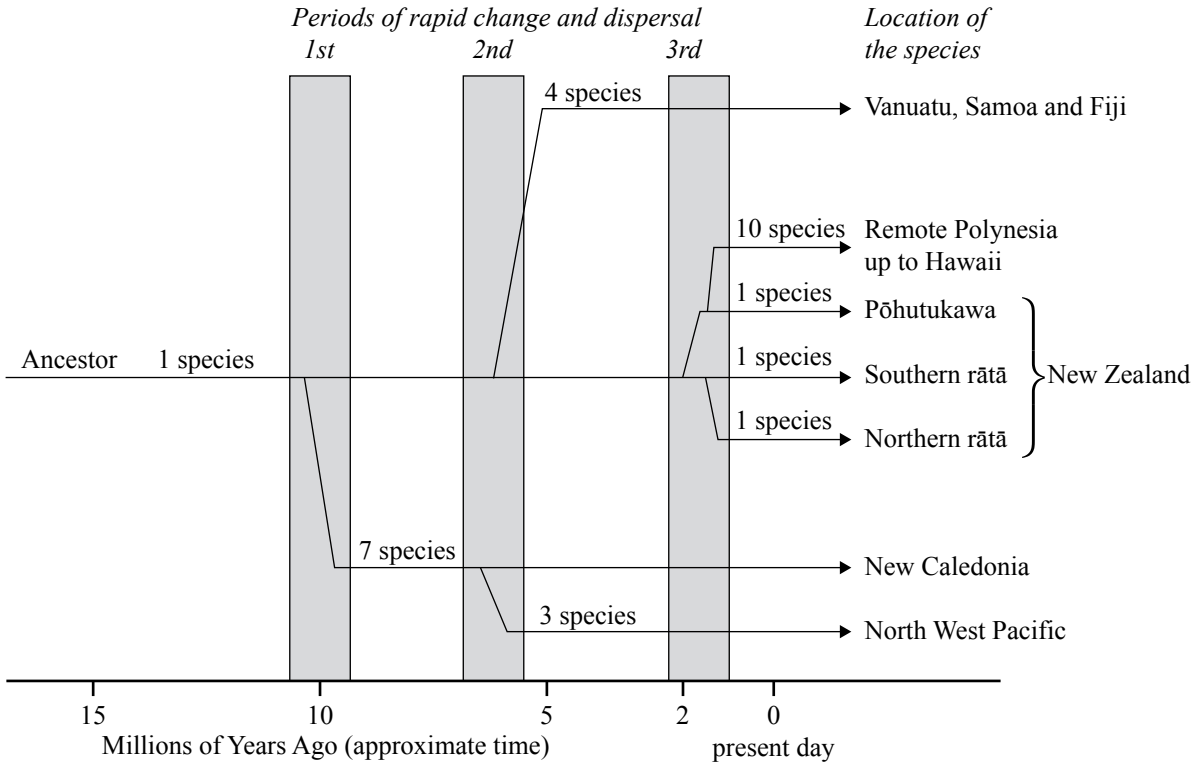
For Assessor's use only	**Achievement Criteria**		
Achievement	**Achievement with Merit**	**Achievement with Excellence**	
Describe biological concepts and processes relating to patterns of evolution.	Explain biological concepts and processes relating to patterns of evolution.	Discuss biological concepts and processes relating to patterns of evolution.	
Overall Level of Performance			

You are advised to spend 35 minutes answering the questions in this booklet.

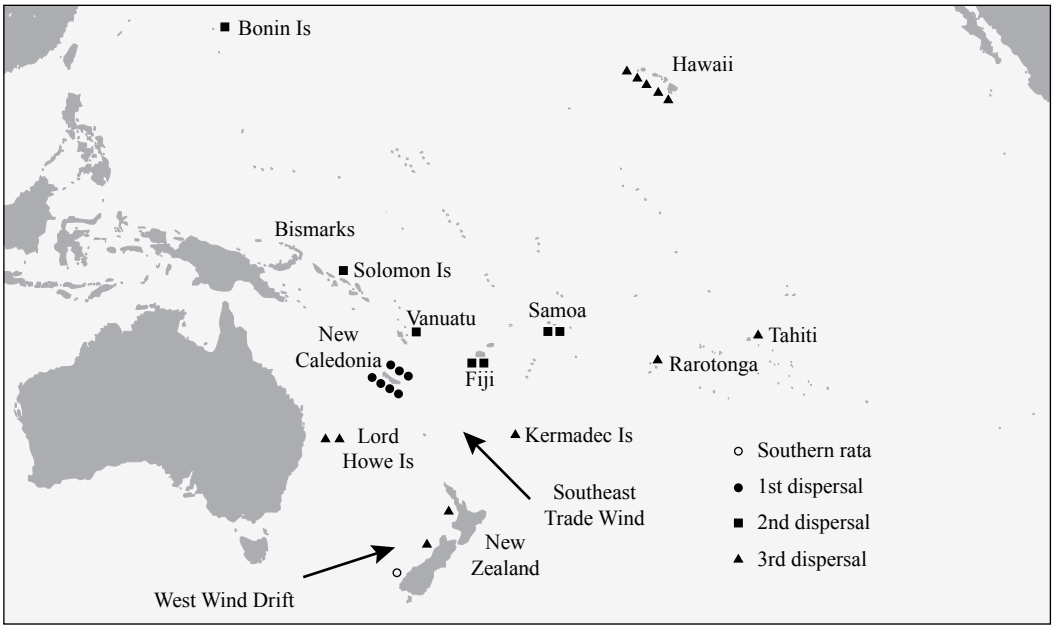
Assessor's use only

QUESTION ONE

The genus *Metrosideros* includes New Zealand's pōhutukawa and rātā species. Both these trees belong to a subgenus that DNA studies suggest originated in New Zealand with *Metrosideros umbellata* (southern rātā) as the ancestral species. Southern rātā is known to have been in New Zealand for more than 50 million years and has given rise to 3 related groups of *Metrosideros* over time. The diagram below shows when these 3 related groups separated due to periods of rapid change and dispersal.



The following map shows the present distribution of these species of *Metrosideros*.



Metrosideros has small wind-dispersed seeds carried by wind speeds as slow as 5 km / h. Its seeds can still germinate and grow after being in very low temperatures (down to –30°C), or in sea water for more than a month.

Pōhutukawa (*Metrosideros excelsa*) is the only New Zealand tree that can colonise bare lava. All *Metrosideros* species have adaptations that allow them to grow in high wind, high light intensity and poor soils, and to withstand drought conditions.

[FOR COPYRIGHT REASONS, THIS RESOURCE CANNOT BE REPRODUCED HERE. SEE BELOW.]

Southern rātā flower, Charles Fleming Collection, Te Papa Tongarewa, Museum of New Zealand.

Assessor's use only

(a) The *Metrosideros* has undergone **divergent evolution**. Describe the process of divergent evolution.

The development of northern rātā from southern rātā occurred about 2 million years ago. Southern rātā grows mainly in cooler, high-rainfall areas. Northern rātā requires high light intensities for growth and does not grow well below the northern part of the South Island.

(b) Explain how speciation of northern rātā from southern rātā may have occurred.

(c) Discuss how the genus *Metrosideros* supports the process of **adaptive radiation**, including why it supports ONE of **punctuated equilibrium** or **gradualism** and not the other.

Assessor's use only

Assessor's use only

The flowers of pōhutukawa and rātā are animal pollinated. The pollinators are birds that visit the flowers during the day and the native short-tailed bats that visit the flowers at night. Some of the birds (tūī, bellbirds and stitchbirds), and the native bats have similar brush tips on their tongues that help them to sip the plentiful nectar.

(d) Explain how the development of brush tips on the tongues of our honey-eating birds and the short-tailed bats can be considered to be an example of convergent evolution.

Note that Question Two is on Page 6.

QUESTION TWO

Assessor's use only

Discuss how **instantaneous speciation** occurs and why this is an example of **sympatric speciation**. In your discussion refer to the **causes** of instantaneous speciation and the relevant **reproductive isolating mechanisms** that develop to make this speciation effective.

Extra paper for continuation of answers if required.
Clearly number the question.

Assessor's use only

Question number	