



SUPERVISOR'S USE ONLY

3

Draw a cross through the box (☒) if you have NOT written in this booklet

+

91603



916030



Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 3 Biology 2024

91603 Demonstrate understanding of the responses of plants and animals to their external environment

Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of the responses of plants and animals to their external environment.	Demonstrate in-depth understanding of the responses of plants and animals to their external environment.	Demonstrate comprehensive understanding of the responses of plants and animals to their external environment.

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 2–16 in the correct order and that none of these pages is blank.

Do not write in the margins (//////). This area will be cut off when the booklet is marked.

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

QUESTION ONE: Relationships in the forest

Kauri snails/pūpū-rangi (*Paryphanta spp.*) belong to the group of northern giant land snails, which evolved in New Zealand before the introduction of the nocturnal predator species: possums and hedgehogs. The snails live in areas of fertile soil, rich with earthworms, and may live to 20 years or more. The snails are most active at night. They usually spend the day under leaf litter or vegetation.

Faecal analysis shows their diet is mainly earthworms and some small snails, with the small snails' shells being a source of dietary calcium.

Snail mating occurs mostly between April and July, and appears to be triggered by climatic conditions, such as rainfall. The kauri snail lays about six eggs, three times a year. The eggs are protected by a hole dug by the snails or under leaf litter at the base of a tree.

Like the kauri snails, hedgehogs (*Erinaceus europaeus*) are also active at night; however, in cold areas they can hibernate for a few months per year if the ground temperature is below 11 degrees Celsius. Their diet includes kauri snails.

Nocturnal brushtail possums (*Trichosurus vulpecula*) also eat kauri snails and, from a position in trees, they can spot the large invertebrate as it slowly moves along.



Adult pūpū-rangi.



Pūpū-rangi shell.



A hedgehog eating a snail.



Brushtail possum.

QUESTION TWO: Bumblebees and kōwhai

The kōwhai (*Sophora spp.*) is a New Zealand native tree. The brightly coloured flowers bloom in late winter or early spring. Auxins are essential at each stage in the life cycle, including root development, growth, and flowering. Once the plant flowers, pollination occurs via animals such as the bumblebee (*Bombus terrestris*).

In New Zealand, the bumblebee forages for food during daylight hours, but is more active in the cooler times of the day. Bumblebees also live in the Arctic. During the Arctic summer, there is constant 24-hour daylight. An experiment was conducted in the Arctic to observe the foraging behaviour of a bumblebee colony under constant light conditions. Results for two bumblebees are shown in Figure 1 below.



A bumblebee foraging in kōwhai blossom.

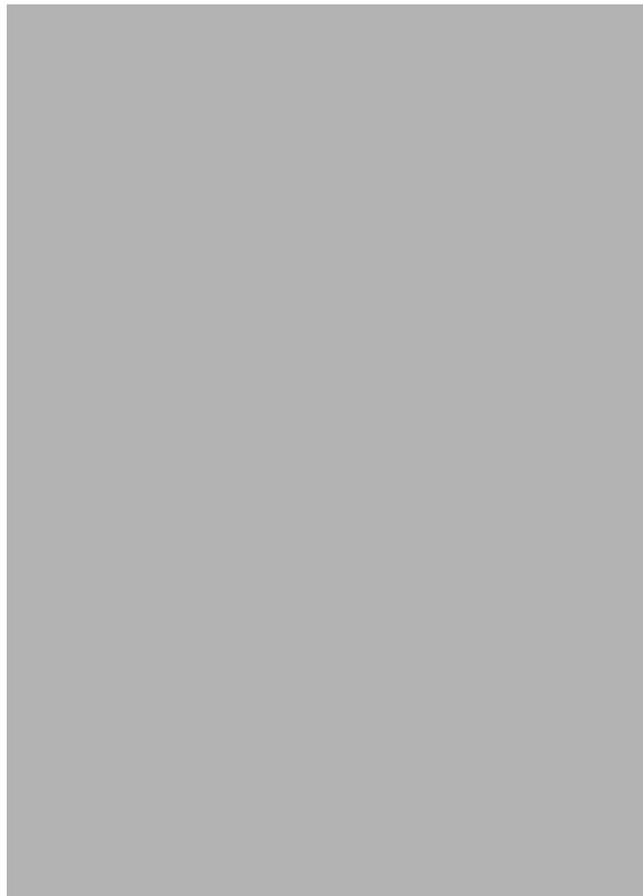


Figure 1: Double-plotted actograms showing foraging times of two individual worker bees from a colony under constant light conditions.

Discuss how the control of life processes through biological clocks results in kōwhai success.

In your answer, include discussion of:

- whether the kōwhai is a long-day plant or a short-day plant, including evidence
- the mechanism for the geotropic response of the kōwhai shoots
- the type of movement response of the bumblebee to the kōwhai nectar
- whether the New Zealand bumblebee and the kōwhai have biological clocks that are entrained to environmental factors.

QUESTION THREE: Cooperative breeding

Australian chestnut-crowned babbler (*Pomatostomus ruficeps*) are known for their social behaviour. They live in groups of up to approximately 25 individuals and participate in activities such as dust bathing, preening, and feeding. Together, they look for food, including insects, spiders, small amphibians, crustaceans, and reptiles, as well as fruit and seeds from plants.

At night, they crowd together in one large, central nest and, when alarmed, they may huddle together under dense foliage or fly up into the under-canopy of trees and shrubs, chattering noisily.

Breeding usually occurs between July and November with a single, large clutch of eggs (i.e. many eggs) from all the breeding pairs.

The entire group helps to build the one nest, feed the incubating females, and defend the breeding territory. Reproduction without support is rarely attempted. Researchers confirm there are often about 4 breeding males but up to 12 non-breeding, helper-males. Kin selection appears to be important, as females will not support the care and development of young with which they have no genetic relationship.



Adult babbler.



A babbler with an insect it has caught.



Babblers are social in their behaviour.



A babbler coming off its nest.

Examine how social behaviour can lead to successful reproduction.

In your answer, include discussion of:

- the terms territory and kin selection, including definitions
- an advantage of a group being involved in finding food together and of preening each other
- why the larger number of helper-males supports the population, and why the non-related females do not support the care and development of the young.

Acknowledgements

Material from the following sources has been adapted for use in this assessment:

Page 2

<https://www.pfk.org.nz/post/kauri-friends-kauri-snail>
<https://www.inaturalist.org/taxa/108955-Paryphanta-busbyi>
<https://www.pestsbanned.com/snails/do-hedgehogs-eat-snails/>
<https://www.eurekalert.org/news-releases/533215>

Page 6

<https://www.nzgeo.com/stories/kowhai/>
<https://bmcbiol.biomedcentral.com/articles/10.1186/1741-7007-8-93>

Page 10

<https://ebird.org/species/chcbab2>
<https://mdahlem.net/birds/19/chcrbab.php> (images 2–4)