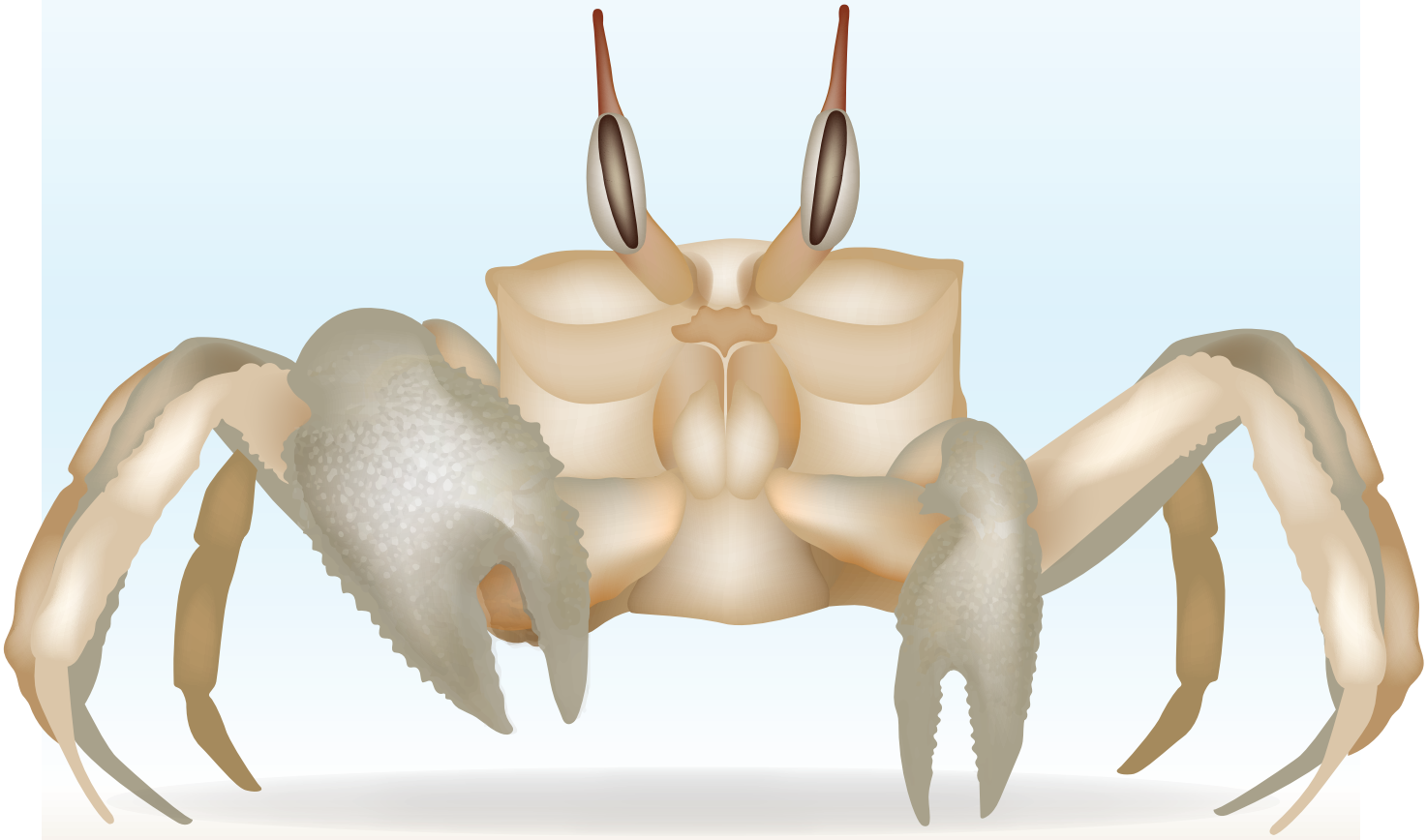

Exploring Australian Food Webs

BIOLOGICAL SCIENCES

QGC | FUTUREMAKERS | QUEENSLAND MUSEUM | Queensland Government

Introduction

The Biodiversity Collection at the Queensland Museum contains over 2.5 million specimens. Most specimens are from Queensland's terrestrial and marine provinces. There is also substantial comparative material from the adjacent Indo-Pacific region, and a smaller number of exotic species acquired for comparative purposes.

On top of this, the Queensland Museum Network has an irreplaceable collection of more than 34,000 animal type specimens used to identify and name species. These types are a vital national and international resource for scientific research and identification verification. Researchers at the Queensland Museum have played a role in discovering over 4000 new species since 1862!

Our Biodiversity Collections:

— Represent a pivotal resource for the study of tropical Australasian biodiversity.

— Provide verifiable tools that allow us to gain new knowledge of Queensland's unique animals, and those that are also common elsewhere in the Asia-Pacific region.

— Provide insight into the evolution, connectivity and dispersal of life throughout this region.

The Biodiversity Collection steadily grows as we increase our inventory and understanding of Queensland's natural resources.

This educational resource can be used with Queensland Museum Loans.

This resource complements the *Wild State Exhibition* at the Queensland Museum, and may be used in conjuction with the *Wild State Teacher Resource*.

Future Makers is an innovative partnership between Queensland Museum Network and Shell's QGC project aiming to increase awareness and understanding of the value of science, technology, engineering and maths (STEM) education and skills in Queensland.

This partnership aims to engage and inspire people with the wonder of science, and increase the participation and performance of students in STEM-related subjects and careers — creating a highly capable workforce for the future.

Activity Overview
Exploring Australian Food Webs

Examine an ecosystem, create a food web, and use the food web to answer questions.

TEACHER TIPS

- Scientists work collaboratively. The questions and activities can be conducted in groups of 3 – 4 to maximise learning. Answers can also be shared in discussion groups with the class.
- Students may use the information from **Table 1: An Example Ecosystem** to develop their food web. Alternatively, different groups could choose different Australian ecosystems. Five Queensland ecosystems are on display in the *Wild State* exhibition at the Queensland Museum, or you may choose an ecosystem from one of the Queensland Museum loans kits, or select a local ecosystem.

ASSUMED KNOWLEDGE

- Procedures for constructing a food chain and food web. (Note: The arrows indicate the direction of energy flow and go from prey to predator.)
- Definitions and examples of producers, first-order (or primary) consumers, second-order (or secondary) consumers, trophic levels, predator-prey relationships, parasite-host relationships, and competition.

Australian Curriculum Links

YEAR 7

Science Understanding

Biological Sciences

Interactions between organisms, including the effects of human activities can be represented by food chains and food webs *(ACSSU112)*

Science Inquiry Skills

Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships in data using digital technologies as appropriate *(ACSIS129)*

Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence *(ACSIS130)*

Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate *(ACSIS133)*

Science as a Human Endeavour

Scientific knowledge has changed peoples' understanding of the world and is refined as new evidence becomes available *(ACSHE119)*

Solutions to contemporary issues that are found using science and technology, may impact on other areas of society and may involve ethical considerations *(ACSHE120)*

People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity *(ACSHE121)*

YEAR 9

Science Understanding

Biological Sciences

Ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems *(ACSSU176)*

Science Inquiry Skills

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence *(ACSIS170)*

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations *(ACSIS174)*

Science as a Human Endeavour

Values and needs of contemporary society can influence the focus of scientific research *(ACSHE228)*

Feeding Relationships — Water Mouse

Scientists study food webs so they can better understand how natural and human changes may affect ecosystems.

For example, the Water Mouse *Xeromys myoides* (once known as the False Water Rat) is a small, nocturnal, native rodent that lives in mangrove forests (Figure 1).

Research by Dr Steve Van Dyck from the Queensland Museum first documented the habitat and food requirements of this rare Australian mouse. Scientists collected data through observation and tracking, and analysed scats and gut content to understand feeding relationships. The Water Mouse also creates middens of discarded food, often made predominately of the remains of shells and crabs, which help scientists understand their diet. This information can be used to develop a food web so that we can understand the relationships between organisms in the mangrove habitat.

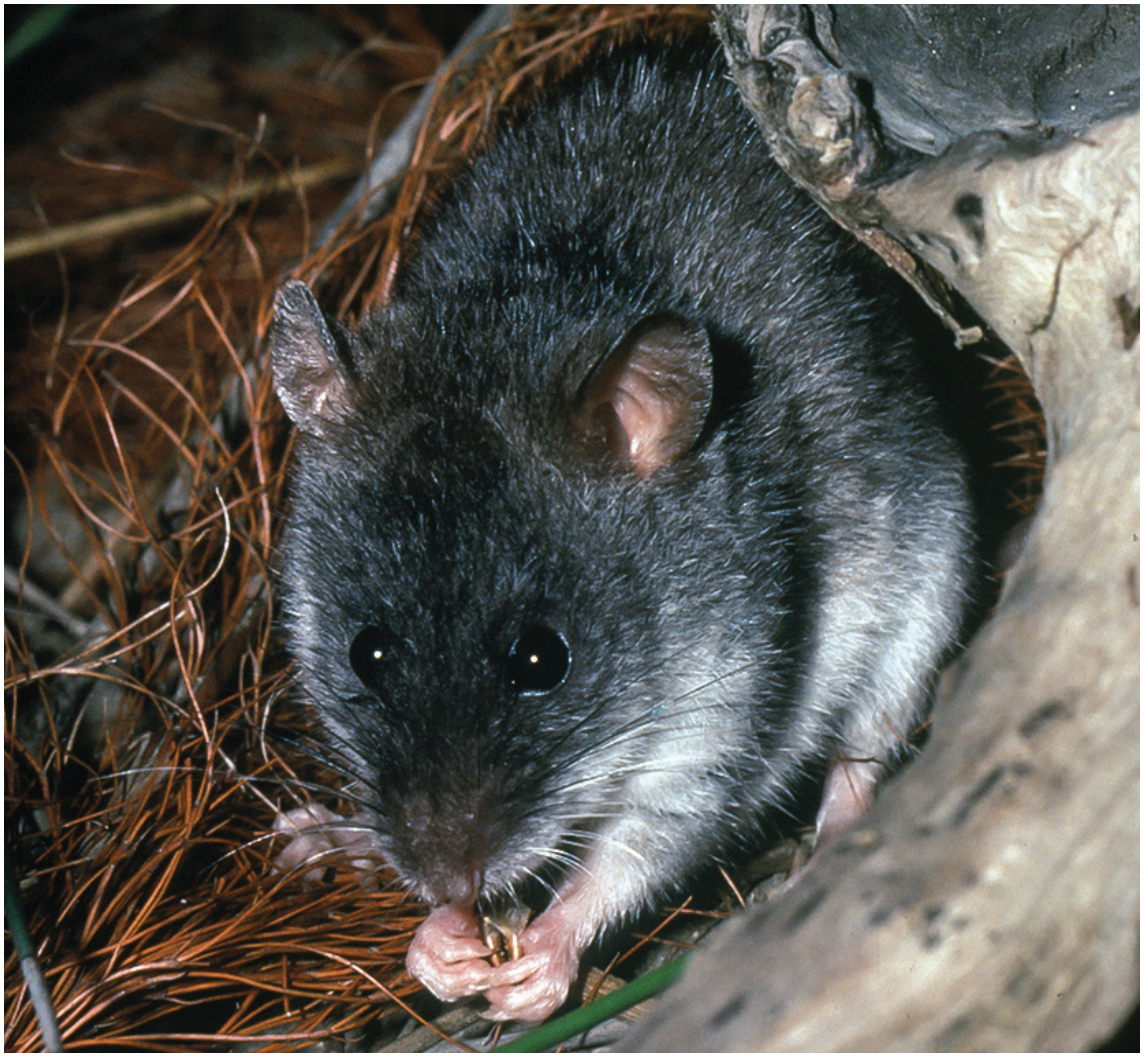

Figure 1: The Water Mouse (Xeromys myoides) is one of Australia's rarest native rodents. It builds a nest mound out of peat and mud that can be up to 60 cm high. Much of what is known about this endangered mouse is the result of Queensland Museum research. Image: QM, Bruce Cowell

When conducting field work, scientists also need to consider safety. It is difficult to collect data on the Water Mouse in northern Queensland due to the risk of crocodiles on the mangrove flats, particularly at night. It is for this reason that more data has been collected on southern populations of Water Mouse, and the feeding relationships between the mouse and crocodiles are still relatively unknown.

In science experiments only one thing is changed, the independent variable, to determine how this factor affects the results of the experiment. This can be more difficult in the field. The Water Mouse population that Dr Van Dyck and his team were researching faced many human-induced pressures, including vehicle damage, acid sulfate soils, pesticide spraying for mosquitoes, and introduced predators such as foxes, cats, dogs and feral pigs. This can make it more difficult to pinpoint the stressors that have the most negative effect on the Water Mouse.

This animal's coastal wetland habitat has been extensively cleared and redeveloped, particularly in south-east Queensland. The loss of habitat is known to have a negative effect on the Water Mouse, because like all living things it needs a certain environment to survive. As a result of the loss of its habitat, the Water Mouse is now classified as a threatened species.

Figure 2: The mangrove ecosystem is an important habitat for animals that thrive both in the sea and on land. In this image you can see mangrove stilt roots and pneumatophores on North Stradbroke Island. Image: QM, Bruce Cowell

Discussion

You are working with a group of scientists studying the Water Mouse. Look at the food web (Figure 3) and discuss how the below scenarios may impact the ecosystem.

a) Introduced predator: Foxes have been introduced to Australia.

b) Loss of producer: Mangroves are cleared for coastal developments.

c) Climate change: Scientists believe that the Water Mouse may be particularly vulnerable to sea level rise. Explain why.

d) Survival: What would you suggest to help ensure the survival of the Water Mouse?

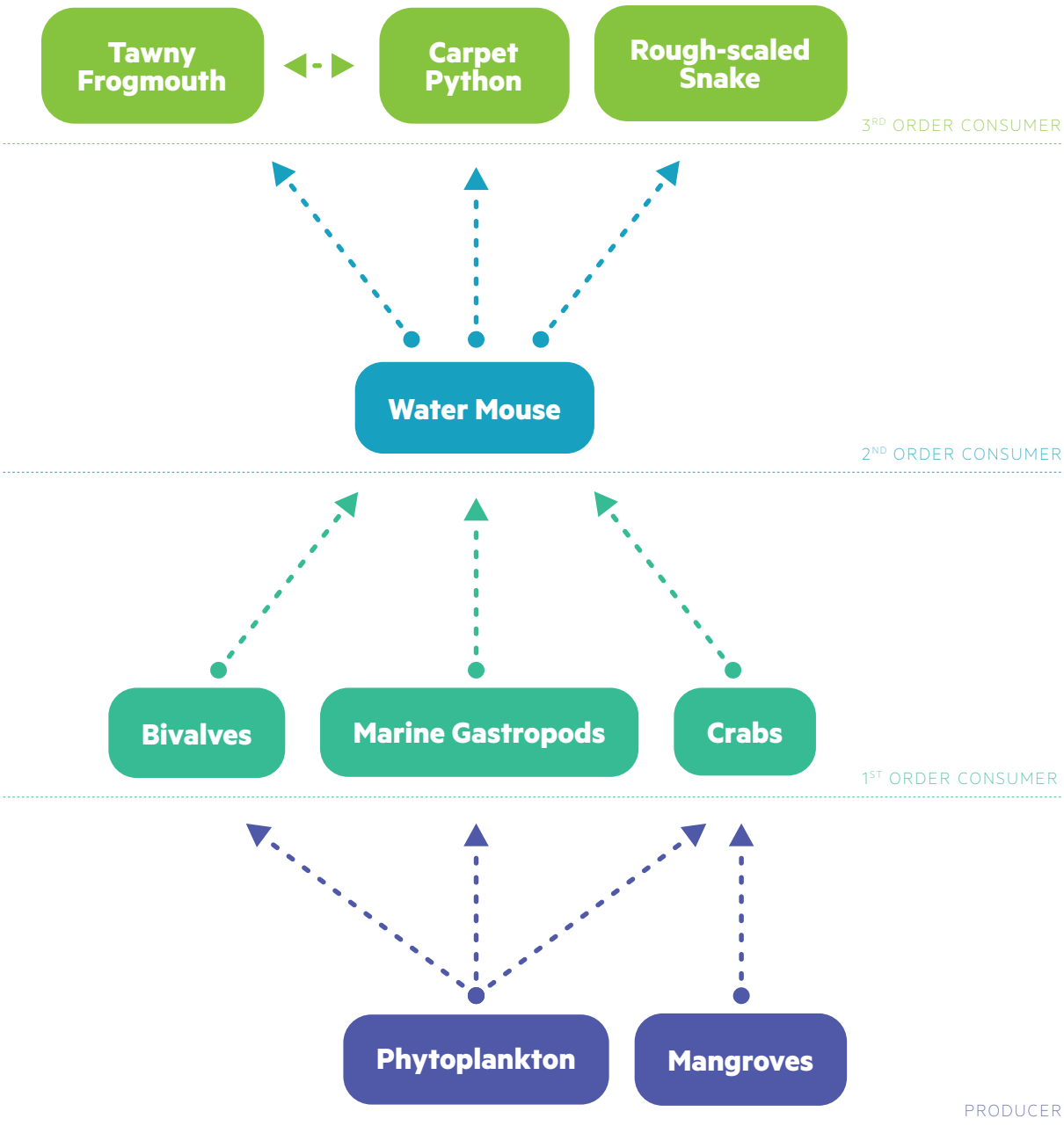

Figure 3: A simplified food web of a southern Queensland mangrove ecosystem, including the threatened Water Mouse.

Activity:
Building an Australian Food Web

Objective

To construct a food web and use the food web to interpret relationships between organisms.

Method

1. In groups of 3 – 4, examine the organisms in Table 1. (Alternatively you may use the *Wild State Exhibition*, a Queensland Museum loans kit, **or** your own environment. The *Queensland Museum Network Field Guide to Queensland Fauna* can be used to help identify species.)
2. Construct a food web of your chosen habitat. (Hint: Start with all the producers (plants) at the bottom of a large, blank A3 page. Add the organisms that feed on these plants and work your way up the page.)

Extension Questions

1. Examine the food web you have made. Make a list of the **producers, first-order consumers, second-order consumers,** and so on. Some organisms may be on more than one trophic level.
2. Explain how the **producers** make their food. If all the producers disappeared, what would happen to the energy in the ecosystem? Justify your answer.
3. What are the top **predators** in this food web? Explain what may happen if all the top predators were removed from this ecosystem.
4. List at least five relationships that could be classified as **predator-prey** relationships. Write the predator first, followed by the prey.
5. A **competitor** is defined as an organism that requires the same resources as another organism. Organisms can compete for food, shelter, mates or space. List some competitors in your food web and explain what they are competing for.
6. Which organisms could pollinate the plant species they feed on? List the **pollinator** and the plant species it is **pollinating**.
7. List a **parasite-host** relationship.
8. A **keystone species** is a plant or animal that has a disproportionately large effect on the communities in which it occurs. Without a keystone species, the environment would be dramatically different. Which animal would change your food web the most if it were to disappear? Explain the effect on the other species and the ecosystem.
9. What is the biggest **threat** to this ecosystem? Design a poster or multimedia presentation to teach the community how they can help protect this ecosystem.

Extension Activity

10. Think of an ecosystem around your home or school. Can you build a food web of the plants and animals in your environment?

Table 1: An Example Ecosystem – Queensland's Coastal Scrub.

Name	What do I eat?	What eats me?
Jumping Plant Lice/ Psyllids *(Glycaspis brimblecombei)*	Sap from leaves, especially eucalypts like the Forest Red Gum.	Birds, small mammals, and other insects.
Coastal Banksia *(Banksia integrifolia)*	Producers make their own food.	Lorikeets, honeyeaters, possums, gliders, bees and other insects all eat the nectar.
Titan Stick Insect *(Acrophylla titan)*	Leaves of many shrubs and trees.	Birds, especially the Pacific Baza and small mammals. Ants and other insects prey on eggs and small nymphs.
Laughing Kookaburra *(Dacelo novaeguineae)*	Small birds, mammals, lizards, frogs, snakes and insects.	Pythons, Lace Monitors, birds of prey.
Forest Red Gum *(Eucalyptus tereticornis)*	Producers make their own food.	Koalas and caterpillars eat leaves. Scale insects, lerps and cicadas suck sap. Lorikeets, honeyeaters, possums, gliders, bees, wasps and butterflies eat nectar and pollen.
Termite *(Nasutitermes walkeri)*	Dead trees as well as buried timber.	Echidnas, blind snakes, ants and other predatory insects.
Lace Monitor *(Varanus varius)*	Dead animals (carrion), small lizards, birds and mammals, eggs and chicks from birds' nests, turtle eggs.	This top predator has few enemies. Young and eggs are eaten by birds, snakes and other lizards.
Squirrel Glider *(Petaurus norfolcensis)*	Beetles, caterpillars and other insects. When insect numbers are low, wattle sap, eucalypt pollen, nectar and sap are eaten.	Lace Monitor, pythons, eagles, hawks and owls.
Black Wattle *(Acacia concurrens)*	Producers make their own food.	Caterpillars, beetle larvae, and wallabies eat leaves, cicadas and scale insects suck sap, rosellas and cockatoos eat seeds.
Mistletoe *(Amyema pendula)*	Mistletoe penetrates the branches of trees such as the Black Wattle and the Forest Red Gum to access water and nutrients. However they can also make their own food through photosynthesis.	Squirrel Gliders and Rainbow Lorikeets and many other birds eat the nectar and pollen. Possums, gliders and some insects also feed on the leaves.

Table 1 (continued): An Example Ecosystem – Queensland's Coastal Scrub.

Name	What do I eat?	What eats me?
Hedge Grasshopper *(Valanga irregularis)*	Leaves, mostly broad-leafed shrubs and palms.	Birds, lizards, bandicoots and small mammals.
Eastern Brown Snake *(Pseudonaja textilis)*	Mostly mammals and reptiles (particularly when young).	This top predator has few enemies. Young are eaten by Lace Monitors, birds of prey and larger snakes.
Eastern Koel *(Eudynamys orientalis)*	Fruit and insects.	Birds of prey, Lace Monitors and pythons eat eggs and young.
Sandpaper Fig *(Ficus coronata)*	Producers make their own food.	Caterpillars and beetle larvae eat fig leaves. Humans, birds and possums eat fruit. Considered to be an important food for the critically-endangered Coxen's Fig Parrot.
Razor Grinder Cicada *(Henicopsaltria eydouxii)*	Nymphs use their piercing mouthparts to suck sap from eucalyptus roots, adults suck sap from trees.	Bandicoots dig up nymphs. Birds, bats, gliders, spiders and lizards eat adults.
Tawny Frogmouth *(Podargus strigoides)*	Insects, lizards and other small animals.	Larger birds of prey and pythons.
Pacific Baza *(Aviceda subcristata)*	Stick insects, lizards and tree frogs.	Larger birds of prey and pythons.
Native Ginger *(Alpinia caerulea)*	Producers make their own food.	Grasshoppers, caterpillars, and wallazbies eat leaves, and birds eat fruit. People eat the fruit and shoot tips, and the leaves can be used around meat cooked in earth ovens.
Double-headed Hawk Moth *(Coequosa triangularis)*	Caterpillars feed on leaves of banksia, macadamia and related plants, while moths feed on nectar.	These large caterpillars and moths are a popular food for Tawny Frogmouths, other birds and small mammals.
Rainbow Lorikeet *(Trichoglossus moluccanus)*	Mainly nectar from flowering trees, and some seeds.	Birds of prey.

STEM CAREERS IN REAL LIFE:
Heather Janetzki, Collection Manager

The Queensland Museum has a collection of over 60,000 mammals and birds, and Heather Janetzki is in charge of this collection. The first thing people want to know when asking about the collection is where the specimens come from. Most animals are sent in by people with collection permits who collect dead animals all around Queensland, often National Park Rangers, wildlife carers and other scientists. Common sources of dead animals include roadkill, window strikes, dog and cat kills, or specimens washed up on beaches. They are all stored in a freezer at -18˚C until the specimens can be processed.

Figure 4: Heather Janetzki with some specimens from the Biodiversity Collection at Queensland Museum, including an albatross. Image: Queensland Museum

While some specimens are kept for display, the majority are preserved for research (Figure 6), which may include taxidermy, as well as preserving tissue samples and skeletons. The preservation of specimens is a great way of documenting the biodiversity in Queensland. Heather helps researchers from all over the world access specimens and information from the Queensland Museum's Biodiversity Collection. Specimens can be used for measurement and comparison. They can also be used in genetic studies and isotope tests, which can show what animals were eating and where they were living at the time of their death (even if the specimen is 150 years old!). Recently preserved specimens are compared to older specimens and fossils to see how the environment has changed over time. Sometimes when animals go extinct, the only source of information we have about them is preserved material in the museum collection.

Additionally the specimens can be used in taxonomy, the naming of species, to determine if a specimen is an existing species or a newly discovered species. The collection is also accessed regularly by artists who use it as a reference tool for paintings, sculptures, and jewellery, even using the colours and patterns for clothing or colour palettes.

While all specimens are valuable, Heather does have a few favourite specimens – one is an albatross that was tagged by scientists on the Crozet Islands near Madagascar in 1969, and then washed ashore on South Stradbroke Island 30 years later (Figure 4)! Another is the skull of a Longman's Beaked Whale. The first skull of this species was collected in Mackay for the Queensland Museum in 1882, and the next specimen was not seen until the 1950's when a skull was found in a fertiliser factory in Somalia. The Queensland Museum now has two more Longman's Beaked Whales after specimens from a mass stranding in New Caledonia were donated to the museum.

Along with the important job of preserving and protecting mammal and bird specimens for the future, Heather also conducts field work. Much of her current research is based on Australian native rodents. You can learn more about Heather Janetzki and the process of taxidermy on the Queensland Museum website.