Investigating food webs and the impact of the chytrid fungus

Acknowledgement
This teaching sequence was developed by students in the Issues in Science and Environmental Education (ESS439) unit in trimester 1, 2017. Peta White lead the unit and had support from colleagues Kieran Lim, John Cripps Clark, Ian Bentley, Russell Tytler, Jorja McKinnon, and Connie Cirkony who supported the students in the initial sequence design. Research scientists were invited from the Faculty of Science and the Built Environment and contributed their research and ideas as the basis for the students to then develop teaching sequences that result in contemporary science practices being infused into secondary school science. All sequences were edited by Mary Vamvakas prior to publishing.
Thanks to the following students for their efforts in generating this innovative teaching sequence:
Kate McLaughlan; Lach Mundy; Thao Nguyen; and Esme Wright.

Background

Chytridimycosis, discovered in 1993, is a scientific name for the amphibian chytrid fungus disease, which is now found worldwide (Sheele et al. 2014). This fungal disease is confirmed to be responsible for declines in Queensland frog populations (Department of Sustainability, Environment, Water, 2015). The infectious disease was later found to have been present since the 1970's and was spread wide over Australia (Department of Sustainability, 2015). The disease is believed to afflict certain species of frogs' skin in regard to its osmotic-regulation factor (Department of Sustainability, Environment, Water, 2015).

One species in particular which is currently threatened by the chytrid fungus is the philoria frosti, commonly known as the Baw Baw frog, as their population has reduced at an unusual rate to that of other frog species afflicted, but due to the unknown factor (Scheelings, 2015). Scientists have undertaken research and conservation efforts to support and help the species (Scheelings, 2015). Surveys conducted on the Baw Baw frog since 1983 have shown a 98% reduction in the numbers of adult male frogs of the species (Scheelings, 2015).

Don Driscoll from Deakin University studied the population decline of the Alpine Tree Frog (ATF) due to chytridiomycosis and is currently researching the effects on the Baw Baw frog. What makes the Baw Baw Frog unique in regard to this disease, is their lower rate of decline, which at this stage is due to an unknown reason (Skerratt et al. 2016). Research is currently underway to discover whether the Baw Baw Frog has similar features to that of the Alpine Tree Frog, as it may be vital to aid the conservation of all amphibian species around the globe suffering from the same disease. Due to the Baw Baw frog habitat and population covering only 130 km^2 of Victorian Alpine in the Central Highlands (Scheele et al., 2016), researchers and scientists are also seeking a vaccine for the fungus to prevent the further spread (Wheaton et al., 2008).

Interview with Don Driscoll: https://video.deakin.edu.au/media/t/0_zohao0cw

Rationale

The focus of this sequence relates to the Year 9 Science Understanding content, focusing primarily on ecosystems and the interactions occurring within them. Students have investigated food webs and chains in earlier years according to the Australian Curriculum sequence ACSSU112, however, a key focus in this sequence involves examining them on a richer level and gaining a deeper understanding of the interactions occurring within them. This is demonstrated specifically through the activities relating to Don Driscoll's research, which provides some local context to the class and focuses on the authentic use of the information they are learning.

The key outcome for this lesson sequence is for the students to explore interactions between organisms and the environment with a focus on alpine tree frogs and the Baw Baw frogs as case studies. This species was chosen based on its endangered status due to the chytrid fungus, currently being studied by Don Driscoll and his team. The students gradually explore the different relationships in the form of a food web that can show the distribution of energy flow and when there is a sudden change in the environment. The students should be able to understand the importance of studying and preserving ecosystems and biodiversity by the end of this lesson sequence.

Learning Concept	Teaching Input	Guiding / Scaffolding / Misconceptions / Questions	Student Activity	Resources	Assessment FOR and OF learning
Lesson 1. Exploring interactions between organisms such as predator/prey, parasites, competitors, pollinators and diseases. **ACSSU176** Elaboration 1	Introduce food webs as an expansion from a food chain. Explain terms using examples other than those of Alpine region; eg: aquatic – krill, fish, seals, orca. Discuss rationale – complexity of interspecies interactions, importance of research, climate change affecting species. Discuss scientific method - Hypothesis building and what it means to be a scientist. Introduce species	Why do we eat? What is a food chain and how long are they usually? Why are they short? What could be the difference between a food chain and a food web? Why are there so many different kinds of species? How do scientists investigate phenomena? **Terms**: Autotroph,	**1. a. Class Presentation** - you are a scientist in the 80s and have noticed a decline in Alpine Tree Frog (ATF) numbers. What could be causing it? Students work in pairs and consider the possibility of <u>one of the following causing a decline in numbers</u>: (predation, pollution disease, loss of habitat, human interaction, competition for resources, drought etc.) Refer to the Alpine Tree Frog Profile: <u>http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10494</u> Report back to class. **b.** Students to review the news article on ATF --> Discuss the steps the scientists would have taken in the lead up to the article being written. **2. Research activity. (WS)** **Activity 1:** Assign students into	**News Review** News article on Alpine Tree Frog: <u>Frogs surviving deadly chytrid fungus</u> Possible websites to visit (Appendix A) for additional information. Students will need access to the internet.	**News Review** In small groups, read news article and discuss the steps the scientists would have taken in the lead up to the article being written. What were they thinking? Why investigate a frog? Refer to scientific method. Share ideas as a class – teacher to consolidate these into a shared google doc. **Glossary** *Ongoing throughout*

	loss effects on food webs using Alpine Tree Frog (ATF) as an example.	heterotroph, producer, consumer, detritivore, herbivore, carnivore, scavenger, parasite, food chain, food web, pollinate, predate, biotic, abiotic, cooperation, competition, community, diversity, population, interspecific, intraspecific	groups of 4-5. Give students a set of species cards (Appendix B), then write about the species. What kind of organism? Use terminology learnt. Where does it sit in a food web? Which other species does it interact with and how? Can use internet for research. Hand back to teacher for safe-keeping with names. Students will be handed back their species cards in the next lesson.	*Refer to Investigating Food Webs Worksheet (Appendix C):* **For Research activity:** Copy picture of the species on an A4 or A5 page (Appendix B). Students to fill in: "what eats me and what I eat" on the other side of page and describe the species – autotroph / consumer / omnivore etc. **Hypothesis testing:** Some students may prefer to investigate alone: Frog pond interactive	Create a glossary of terms. **Pictionary/ Charades** Class is split in 2 groups, students take turns selecting a term which they need to draw or act out for their team to decipher.
Lesson 2. Examining factors that affect population size such as seasonal changes, destruction of habitats,	Re-cap previous lessons key ideas to tie in relevance from the start of class. Facilitate discussion, looking at the dynamics involved in	Why is the disease important if it doesn't affect humans? Why are other organisms affected even though the disease doesn't	**Food web Role-play. (WS) Activity 2** Student groups use species cards from lesson 1 and string to construct a food web on the floor (OR could do this on whiteboard with Blu tac) *(Refer to Appendix A for example)* *Optional: Students to then draw food web on paper.*	*Refer to worksheet (Appendix C)* Lesson 1 food web activity supplies. Add string to connect species (students).	**Formative Assessment**- None to five method. (Students indicate their confidence in their understanding by number of fingers

introduced species. **ACSSU176** **Elaboration 2**	populations, how increases and decreases have ripple effects, ie, Competition, seasonal change, natural disaster. Discuss whether these factors are preventable (habitat loss from logging) or fixable (disease or natural disaster) factors? Relating the new content into the food web activity but looking at factors of introduced species and seasonal changes	affect humans? How do you know the difference between an invasive and non-invasive species? What's competition in organisms, they don't play sport? (I've had year 10 boy ask me that exact question)	**Research Activity**- 15 min, groups (3 students per). Research activity on a natural disaster, seasonal change or disease. **a.** In groups brainstorm on a butcher's paper examples of natural disasters, seasonal changes or diseases. **b.** Each student to research using Laptops/tablets other examples of natural disasters, seasonal changes or diseases and continue to fill in butcher's paper. **c. Peer to Peer Learning**- Continue discussion by building a visual layout on whiteboard allowing students to draw connections between different factors on how they affect populations in similar ways. (Graffiti Board/wall) **Food Web Role-play**. **Factors Affecting populations. (WS)** **Activity 3**. Re-enact the food web from the start of lesson, but alter to see how factors	Australian Government introduced and invasive species https://www.pestsmart.org.au *Refer to worksheet (Appendix C)*	Clenched fist (zero) or appropriate number of fingers **Graffiti Board,** like a concept map but students are encouraged to not only write but also draw their examples when presenting. **Exit card**, 3 questions on the class to assess individually how students went with the new content.

			(competition, disease, seasonal changes, natural disasters, invasive species) not only affect a target organism but also the ripple effect on the other organisms. *<u>Optional:</u> Annotate drawn food web to show the impacts.*		
Considering how energy flows into and out of an ecosystem via the pathways of food webs and how it must be replaced to maintain the sustainability of the system. **ACSSU176** Elaboration 3	Source of all energy – sun Prey/predatory Energy flow What happens if food is taken away? - use the food web from before - eliminate species Teacher to guide the students to see what happens when a species of animals or plant is removed from the food web Teachers to guide the students to see what happens when a slow killing disease is introduced	The flow of energy does not just disappear – distributed in the food web The interactions in the ecosystem is highly complex – not all species will have only one energy resource What happens when the disease kills off one species?	**Watch Don Driscoll's Video** Further information about <u>Don Driscoll</u> is linked here. **Impact of chytrid fungus on food web. (WS) Activity 4** Students will work in their groups and will simulate the food web on a smaller scale. Recreate the food web from the second lesson using the species of the groups: <u>You will need to make multiple copies of the</u> following organisms • plants → insect → alpine tree frog → predatory bird • 2 trees consumed by 4 insects, 4 insects consumed by 4 frogs, 4 frogs consumed by 2 predatory birds	**Watch**: Video of scientist discussing research. Interview with <u>Don Driscoll</u> *<u>Refer to worksheet (Appendix C)</u>* Re-use the resource from lesson 2 - add **chytrid fungus**	Students to be able to recreate the food web displayed in lesson 2 on a smaller scale Food web created based on interactions using string to join them physically getting up to participate. Students to be able to understand the energy flow in the food web – how population is a factor in how energy flows in the ecosystem Students to understand how energy flows change when one type of animal is

			The above numbers represent the population for one year. Each is linked by string according to the number of a particular population. Introduce the chytrid fungus into the food web - 1 chytrid fungus consumes 3 frogs - remove 3 frogs from the food web – reconnect the links where possible: **Answer the question on the worksheet** Simulate the food web for one more year with the chytrid fungus. Assume that all remaining organism numbers double every year. Answer the questions on the worksheet		removed What will happen to the food web if a species has been removed from it? **Formative Assessment** Students to create their own food web for their chosen species. Students to identify what caused the species to be endangered. What will happen to the other species in the food web? What will/is happening to their chosen species? What changes are there to the energy flow?
Investigating how ecosystems change as a result of such events such as bushfires, drought and flooding. **ACSSU176**	Facilitating – Start the class by reminding the students about the previous activities that tie into this discussion – mind map of ideas.	What animals can flee? Are they able to migrate to different areas? Why is the Baw Baw Frog isolated to the Baw Baw Plateau? What effects can	**Research Activity** There are new examples of ecosystems presented, and the class has to set them up, and investigate what the result would be if different factors were to affect the ecosystem and food web.	A hand out of the different ecosystem types with lists of the organisms present and options for the disruption. A device to research own	Mind map of ideas presented in previous class. Class discussion of ecosystem examples. **Summative Assessment**

Elaboration 4	Provide the new context and lead the discussion, allowing the class to work independently as needed	events such as flooding and bushfires have on an ecosystem? Are they only negative effects?	Some ecosystem examples can represent what may happen in a bushfire/flooding, however, there will also be examples directly referencing the Baw Baw frog and the Baw Baw Plateau	ecosystem.	Create own ecosystem and write a paragraph on a specific disruption and how it may affect the organism present.

References:

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Scheele, B., Hunter, D., Banks, S., Pierson, J., Skerratt, L., Webb, R. and Driscoll, D. (2016). High adult mortality in disease-challenged frog populations increases vulnerability to drought. *Journal of Animal Ecology*, 85(6), pp.1453-1460.

Scheelings, T. (2015). Fighting Extinction: Zoos Victoria's Commitment to Endangered Herpetofauna. *Journal of Herpetological Medicine and Surgery*, 25(3-4), pp.100-106.

Skerratt, L, F, Berger, L, Clemann, N, Hunter, D, A, Marrantelli, G, Newell, D, A, Phillips, A, McFadden, M, Hines, H, B, Sheele, B, C, Brannelly, L, A, Speare, R, Verteegen, S, Cashins, S, D, & West, M (2016), Priorities for management of chytridiomycosis in Australia: saving frogs from extinction, *Wildlife Research*, vol. 43, no. 2, pp. 105-120

Wheaton, l., Donnellan, S., Gardner, M. and Hollis, G. (2008). *Isolation of polymorphic tri- and tetranucleotide microsatellite loci for the highly endangered Baw Baw frog (Philoria frosti).* Molecular Ecology Resources, 8(3), pp.593-595.

Appendix A – Teacher resource

Alpine Area:

Flora and Fauna in Alpine region:
http://www.environment.nsw.gov.au/bioregions/AustralianAlps-Biodiversity.htm

http://www.enviroactive.com.au/alpine/flora-fauna

https://museumvictoria.com.au/melbournemuseum/discoverycentre/wild/victorian-environments/alps/mountain-pygmy-possum/
https://theaustralianalps.files.wordpress.com/2013/11/fauna.pdf

Alpine Tree Frog Profile:
http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10494

Small food web in Aus Alps: https://prezi.com/xkpbi6s_hneh/the-australian-alps/

ACT threatened species list:

http://www.environment.act.gov.au/cpr/conservation_and_ecological_communities/threatenedspecieslist

Amphibians of Alpine region: http://www.enviroactive.com.au/alpine/amphibians

Alpine region food web

Use the below examples to guide students in creating their species cards.

Picture of the connections present between the different aspects of the food web:

Tiger Quoll

Dasyurus maculatus

Fromholtz, MJ 2011, 'Tiger Quoll 2011', Wikimedia commons
https://commons.wikimedia.org/wiki/File:Spotted_Tail_Quoll_2011.jpg (CC BY-SA 4.0)

Mountain Pygmy-possum

Burramys parvus

Australian Alps collection - Parks Australia, Flickr, Creative Commons 2003
https://www.flickr.com/photos/australianalps/6954940609 (CC BY-NC-ND 2.0)

Platypus

Ornithorhynchus anatinus

Carr, M 2016, 'Platypus', Wikimedia Commons
https://commons.wikimedia.org/wiki/File:Taxidermy_platypus_%22Death_and_Taxidermy%22_video.png (CC BY-SA 3.0)

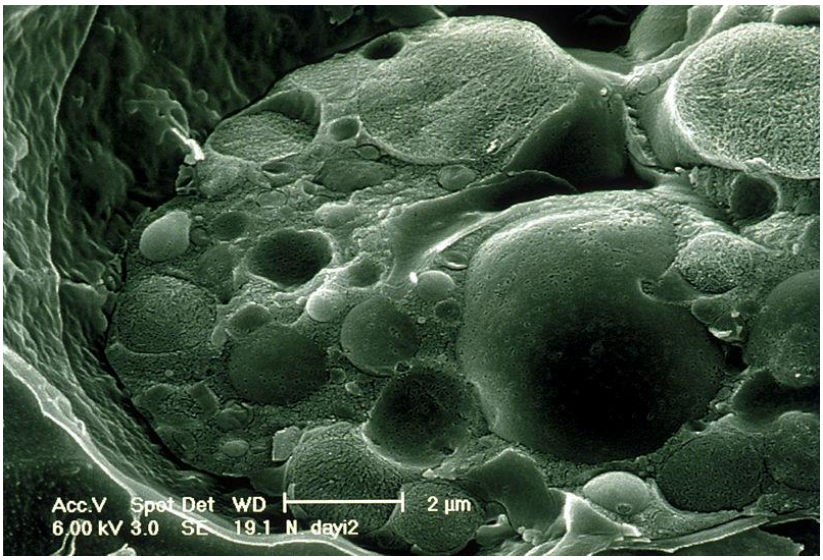
Koala

Phascolarctos cinerais

Quartl 2009, Wikimedia Commons
https://commons.wikimedia.org/wiki/File:Friendly_Female_Koala.JPG (CC BY-SA 3.0)

Chytrid fungus

Chytridio michosis



Hyatt, A 2003, 'CSIRO ScienceImage 1168 Scanning Electron Micrograph of Chytrid Fungus' Wikimedia Commons
https://commons.wikimedia.org/wiki/File:CSIRO_ScienceImage_1168_Scanning_Electron_Micrograph_of_Chytrid_Fungus.jpg (CC BY 3.0)

Eastern Grey Kangaroo

Macropus Giganteus

Leo, 2017, Flickr Creative Commons
https://www.flickr.com/photos/0ystercatcher/35083810231 (CC BY-NC-SA 2.0)

Powerful Owl

Ninox strenua

Kavanagh, P 2013, Flickr, Creative Commons
https://www.flickr.com/photos/patrick_k59/8460185041 (CC BY 2.0)

Alpine Tree Frog

Litoria verreauxii alpine

CSIRO 2008, 'ScienceImage 7488 Whistling Verreauxs Tree Frog', Flickr, Creative Commons https://commons.wikimedia.org/wiki/File:CSIRO_ScienceImage_7488_Whistling_Verreauxs_Tree_Frog.jpg (CC BY 3.0)

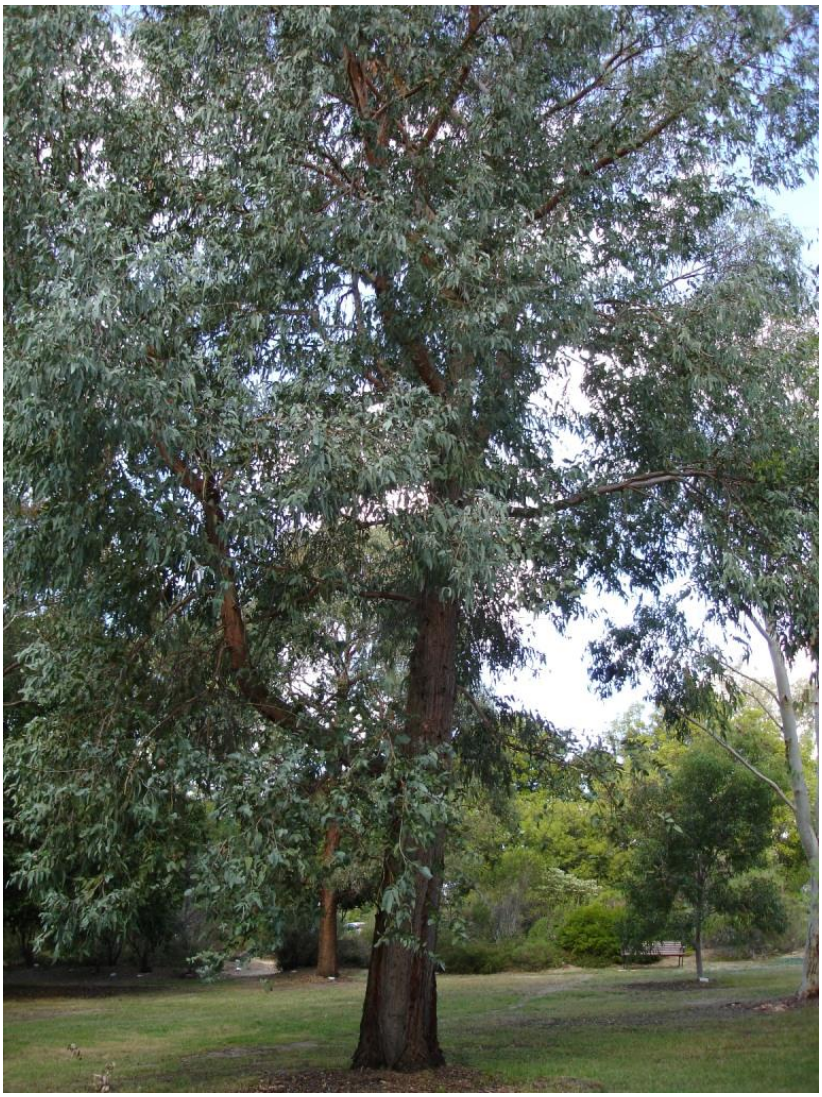
Emu

Drumaius novaenollandiae

Fischer 2014, 'Emu', Wikimedia Commons https://commons.wikimedia.org/wiki/File:Emu_2014.jpg (CC BY-SA 4.0)

Eucalypts

Myrtaceae



2007, 'Eucalyptus chapmaniana', Wikimedia Commons
https://commons.wikimedia.org/wiki/File:Eucalyptus_chapmaniana.jpg (Public Domain)

Mountain Ash Tree

Plantae Myrtales

Matthews, C 2008, 'Rowan Tree (Mountain Ash)', Wikimedia Commons https://commons.wikimedia.org/wiki/File:Rowan_Tree_(Mountain_Ash)_-_geograph.org.uk_-_998385.jpg (CC BY-SA 2.0)

Sun

Sol

NASA (2015)
https://spaceplace.nasa.gov/templates/featured/sun/sunburn300.png (Public Domain)

Wingless Cockroach

Blatta orientalis

plenty.r. 2008, 'Blatta orientalis', Flickr, Creative Commons
https://www.flickr.com/photos/plenty/2459543717 (CC BY-SA 2.0)

Gould's wattled bat

Chalinolobus gouldii

Department of Environment & Primary Industries 2012, 'Gould's Wattled Bat', Flickr, Creative Commons
https://www.flickr.com/photos/dsevictoria/6753047927/ (CC BY-NC 2.0)

Lesser Long-eared Bat

Nyctophilus geoffroyi

Matt 2013, 'Lesser Long-eared Bat (Nyctophilus geoffroyi)', Wikimedia Commons
https://commons.wikimedia.org/wiki/File:Lesser_Long-eared_Bat_(Nyctophilus_geoffroyi)_(8656888933).jpg (CC BY-NC 2.0)

She-oak Skink

Cyclodomorphus casuarine

Zosterops 2011, 'Tasmanian She-Oak Skink', Flickr, Creative Commons
https://www.flickr.com/photos/zosterops/6157587858 (CC BY-NC 2.0)

Originally, this photo was *Cyclodomorphus praealtus* but I had to change the species to find a copyright picture. This one seems to belong to Tasmania.

Mountain Galaxias

Galaxias olidus

'Codman 2005, Mountain Galaxias', Wikimedia Commons
https://commons.wikimedia.org/wiki/File:Mountain_Galaxias_(1).jpg (CC BY-SA 3.0)

Bogong Moth

Agrotis infusa

CSIRO 2002, 'CSIRO ScienceImage 2193 A Bogong Moth', Wikimedia Commons
https://commons.wikimedia.org/wiki/File:CSIRO_ScienceImage_2193_A_Bogong_Moth.jpg
(CC BY 3.0)

Cushion Caraway

Oreomyrrhis ciliata

Rudman, T 2005, 'Oreomyrrhis ciliata', Flickr, Creative Commons
https://www.flickr.com/photos/tindo2/5210495669 (CC BY-NC 2.0)

Originally, this photo was *Oreomyrrhis pulvinifica* but I had to change the species to find a copyright picture. This one seems to belong to Tasmania.

Moss

Sphagnum

Nagel, N 2011, 'Sphagnum – moss', Wikimedia Commons
https://commons.wikimedia.org/wiki/File:Sphagnum_-_moss_-_Moos_01.jpg (CC BY-SA 3.0)

Flightless Mountain Grasshopper

Acripeza reticulata

MomentsForZen 2014, 'Mountain Katydid - Acripeza reticulata - Mountain Grasshopper', Flickr, Creative Commons
https://www.flickr.com/photos/momentsforzen/12668905905 (CC BY-NC-ND 2.0)

Alpine Copperhead

Austrelaps ramsayi

Johnson, N 2011, 'Austrelaps ramsayi - Highlands Copperhead', Flickr, Creative Commons https://www.flickr.com/photos/ingirumimusnocte/6552084651 (CC BY-NC-SA 2.0)

Flame Robin

Petroica phoenicea

Collin, T 2013, 'Flame Robin, Eaglehawk Neck', Wikimedia Commons https://commons.wikimedia.org/wiki/File:Flame_Robin,_Eaglehawk_Neck..jpg (CC BY-SA 3.0)

Tussock Grass

Nassella trichotoma

King, A 2011, Tussock Grass NZ, Wikimedia Commons
https://commons.wikimedia.org/wiki/File:Tussock_Grass_NZ.JPG (CC BY-SA 3.0)

Larvae

Medetera 2012, 'Larvae of Archips cerasivoranus', Wikimedia Commons
https://commons.wikimedia.org/wiki/File:Larvae_of_Archips_cerasivoranus.JPG (CC BY-SA 3.0)

Fruit fly

Drosophila sp.

Cooper, M 2014, 'Fruit Fly (Drosophila immigrans)', Wikimedia Commons
https://commons.wikimedia.org/wiki/File:Fruit_Fly_(Drosophila_immigrans)_(13114869053).jpg (CC BY 2.0)

Baw Baw frog

Philoria frosti

Canley 2014, 'Baw Baw Frog', Wikimedia Commons
https://commons.wikimedia.org/wiki/File:Baw_Baw_Frog.jpg (CC BY-SA 4.0)

Species	What I eat	What eats me
Koala ***Phascolarctos cinerais*** ***Koala***	Eucalyptus leaves	None - Detritivores consume dead flesh
Eastern Grey Kangaroo ***Macropus Giganteus*** ***Eastern Grey Kangaroo***	Tussock grass	None - Detritivores consume dead flesh
Alpine Tree Frog ***Litoria verreauxii alpina*** ***Alpine Tree Frog***	Beetles, flies, spiders and moth larvae	Chytrid fungus, Alpine Copperhead
Emu ***Drumaius novaenollandiae*** ***Emu***	Fruits, seeds and growing shoots of plants, Tussock grass roots	Feral cats
Eucalypts ***Myrtaceae*** ***Eucalyptus tree***	Sun, nutrients from soil	Koala Gang Gang Cockatoo
Mountain Ash Tree ***Plantae Myrtales*** ***Mountain Ash Tree***	Sun, nutrients from soil	Bogong Moth (flowers)
Bogong Moth ***Agrotis infusa*** ***Bogong Moth***	Nectars and fruits, Cushion Caraway	Mountain Pygmy-possum
Platypus ***Ornithorhynchus anatinus*** ***Platypus***	Worms, insect larvae	Feral animals (young only), Tiger Quoll
Mountain Pygmy-possum ***Burramys parvus*** ***Mountain Pygmy Possum***	Bogong Moths, seeds and fruits	Feral Cats
Tiger Quoll ***Dasyurus maculatus*** ***Tiger Quoll***	Small mammals, reptiles, fish, Platypus	Owls
Tussock grass ***Nassella trichotoma*** ***Tussock Grass***	Sun, nutrients from soil	Eastern Grey Kangaroo, Emu
Flame robin ***Petroica phoenicea*** Flame Robin	Insects, spiders and small arthropods	Snakes
Wingless Cockroach ***Blatta orientalis*** ***Cockroach***	~whatever is available~ omnivore	Birds, feral cats
Powerful Owl ***Ninox strenua*** ***Powerful Owl***	Carnivore – small mammals, marsupials and birds	
Gould's wattled bat ***Chalinolobus gouldii*** ***Gould's Wattled Bat***	Bogong Moth, Insects	Owls, feral cats
Lesser Long-eared Bat ***Nyctophilus geoffroyi*** ***Lesser Long-eared Bat***	Insects - bogong moth	Owls, snakes
She-oak Skink ***Cyclodomorphus praealtus*** ***She-oak Skink***	Insects	Feral cats, Foxes
Mountain Galaxias ***Galaxias olidus*** ***Mountain Galaxis***	Insects, worms and spiders	Trout, redfin
Alpine Copperhead ***Austrelaps ramsayi*** Alpine Copperhead	Lesser Long-eared Bat, Flame robin, Alpine Tree Frog	Feral cats
Cushion Caraway ***Oreomyrrhis pulvinifica*** ***Cushion Caraway***	Sun, nutrients from soil, water	Bogong Moth
Moss ***Sphagnum*** ***Moss***	Sun, nutrients from soil, water	Insects
Flightless Mountain Grasshopper ***Acripeza reticulata*** ***Flightless Mountain Grasshopper***	Cushion Caraway, Tussock Grass, Eucalypts	She-oak Skink, Lesser Long-eared Bat, Mountain Galaxias, Platypus, Flame robin
Sun ***Sol*** ***Sun***	In a billion years i will eat the earth!!!	Eucalypts, Mountain Ash Tree, Moss, Cushion Caraway
Chytrid fungus ***Chytridio michosis***	Skin of Alpine Tree Frog and Baw Baw frog	Unknown
Insect larvae ***larvae***	Grasses, dead flesh	Birds, fish, frogs
Fruit Fly ***Drosophila pseudoobscura*** ***Fruit fly***	Fruit, some vegetables, dead matter	Frogs, birds, kangaroos
Baw Baw Frog ***Philoria frosti*** ***Baw Baw frog***	Small insects, worms, invertebrates	Birds, snakes, tiger quoll, chytrid fungus

Investigating Food Webs Worksheet

Activity 1: Research Activity

a. Student to arrange into groups of 4-5.
b. Collect a set of species cards provided. Research using the internet and annotate on the back of each card the following.
    - Kind or organism. Can use more than one (producer, consumer, autotroph, heterotroph, carnivore, omnivore, herbivore)
    - What other species does it interact with and how? i.e what does it eat, what eats it?
    - Any other useful information

Activity 2: Food Web Role Play

a. In groups assigned previous lesson, using all the Species Cards you annotated from Activity 1 and some string, construct a food web on the floor. (Option can also do this on a whiteboard using markers and Blu tack). You will already have written on the back of each species card identifying type of organism, what they eat and what eats them.
b. On a large piece of paper draw the food web you constructed ensuring your arrows face in the correct direction (order of energy flow). Annotate on your food web the following: Producer, 1st order consumer, 2nd order consumer etc.
c. **Organisms to include in your food web:**

Tiger Quoll, Mountain Pygmy-possum, Platypus, Koala, Eastern Grey Kangaroo, Powerful Owl, Alpine Tree Frog, Emu, Eucalyptus, Mountain Ash Tree, Tussock Grass, Wingless Cockroach, Gould's wattled bat, Lesser Long-eared Bat, She-oak Skink, Mountain Galaxias, Bogong Moth, Cushion Caraway, Moss, Flame Robin.

Activity 3: Factors affecting populations

a. Re-enact the food web from Activity 2. Consider how factors such as competition, disease, seasonal changes, natural disasters, invasive species not only affect a target organism but also the ripple effect on the other organisms.
b. Annotate on drawn food web to show and explain some of these impacts.

Activity 4: Impact of chytrid fungus on food web

a. Students will work in their groups and will simulate the food web on a smaller scale. You will recreate the food web from Activity 2 using the species only from the following groups: plants, insects, alpine tree frog and predatory birds.
b. <u>You will need to make multiple copies</u> of the organisms according to the total numbers specified below.

    - plants → insect → alpine tree frog → predatory bird(s)

    - 2 trees consumed by 4 insects, 4 insects consumed by 4 frogs, 4 frogs consumed by 2 predatory birds

c. The above numbers represent the population for one year. Each is linked by string according to the number of a particular population.

d. Once your food web is completed Introduce the chytrid fungus into the food web
    - 1 chytrid fungus consumes 3 frogs
    - remove 3 frogs from the food web – reconnect the links where possible.

Answer the following questions:

Q1. Once the chytrid fungus is introduced what will happen to the frogs in the food web?

Q2 What will happen to the other organisms on this food web in the short term? Explain.

Q3 What will happen to the other organisms on this food web in the long term? Explain.

Q4. How does the energy flow change in this food web?

Simulate the food web for one more year with the chytrid fungus. Assume that all remaining organism numbers double every year.

Q5. Which species have increased in population size? Explain why.

Q6. What species have reduced in population size? Explain why

Q7. What are the long-term implications for the food web as a result of the chytrid fungus infection?