Forest ecosystems

National curriculum link – **Yr 9 Science**

Understanding – Biological sciences: Ecosystems (curriculum code ACSSU176)

What is a forest ecosystem?

An **ecosystem** is a self-sustaining and self-regulating community of living organisms and its non-living environment.

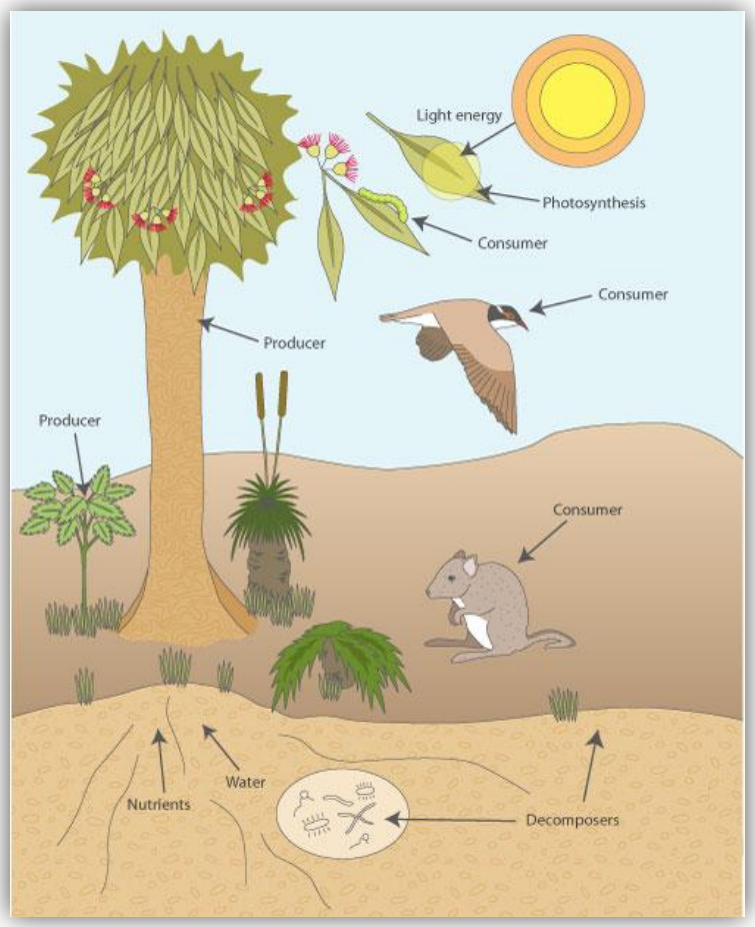
Forest ecosystems are dominated by trees that can mature to at least 2 metres in height and provide a canopy of at least 20% cover, together with all the native wildlife, including birds, mammals, marsupials, amphibians, reptiles, insects, plants, as well as moss, fungi, micro-organisms and non-living things such as water, soil and air interacting within the same area. An example of a forest ecosystem type is the river red gum forest of south-western NSW (above).

Non-living things can also be referred to as '**abiotic**' factors, while living things are often called '**biotic**'. Some organisms found in Australian forest ecosystems include moss (above right) and Murray's skink (*Eulamprus murrayi)* (right).

What role do organisms play in a forest ecosystem?

A **community** of organisms living in a forest ecosystem depend on each other through a complex series of interacting relationships called **food webs**. These complex food webs are dependent on simpler **food chains**. Both food webs and food chains are characterised by the transfer of energy originating from the sun. Animals cannot convert sunlight to energy, so are dependant on the plants and trees to do this through the process of photosynthesis. In **photosynthesis**, sunlight energy is converted to simple sugars in plants, the type of organisms known as the '**producers**' (refer to diagram below).

These sugars provide material for plants to grow and a source of food for the primary consumers known as '**herbivores**'. Herbivores are animals that only eat plants. These animals are then eaten by secondary consumers, animals known as '**carnivores**' that only eat meat.



Some animals however are '**omnivores**' that eat both plants and animals. '**Decomposers**' also contribute to food webs. They tend to be bacteria and fungi on the forest litter and in topsoil that break down dead plant and animal material and recycle it to a form that can be used again by plants, including mineral ions such as nitrate.

Diagram: Transfer of energy in an ecosystem
(Source: Geography unit, Westone, WA Government)

Food webs and food chains

Within a food web there are '**predators**', that is, animals that hunt and prey on smaller animals for a source of food. In the following diagram of a food pyramid the Wedge Tailed Eagle is a predator to the Tawny Frogmouth Owl, its '**prey**'.

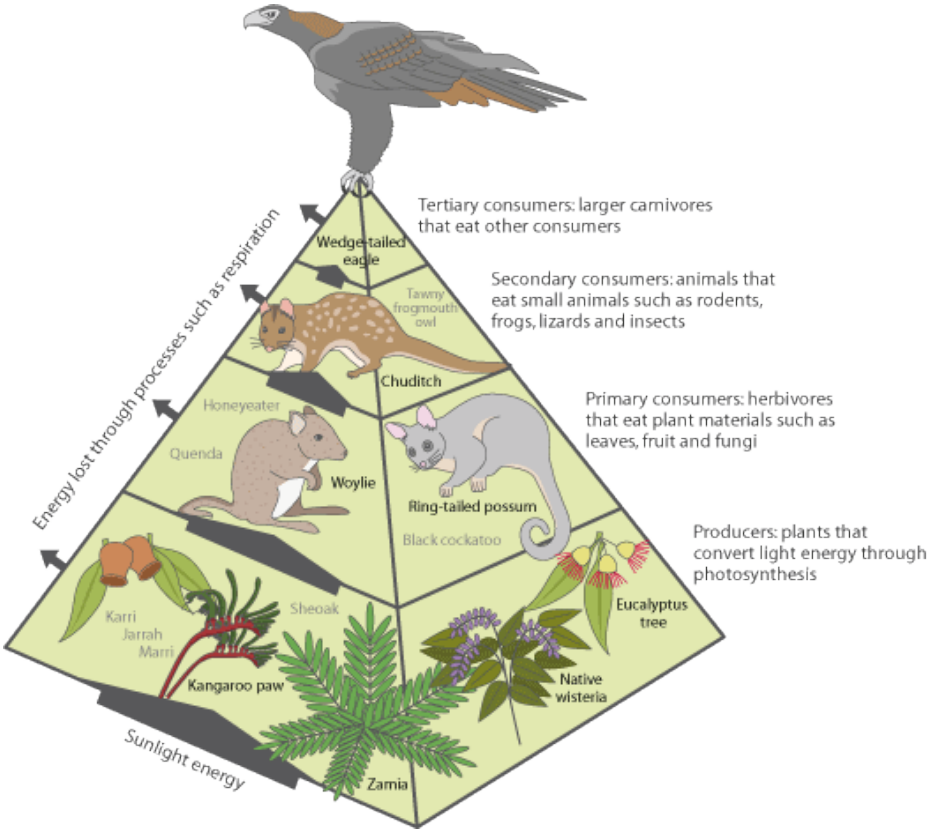


Diagram: Energy pyramid and transfer through a forest ecosystem (Source: Geography unit, Westone, WA Government)

In a food chain, the transfer if energy begins with the producer and ends with the highest order consumer, as follows:

tree → insect → mouse → owl → eagle

However, in a food web the interaction between organisms becomes more complex. The following diagram illustrates an example of a food web for a River Red Gum ecosystem. Notice that most of the mammals are **nocturnal**, that is they forage for plants and hunt for prey by night. For example, the brush tail possum eats leaves and flowers from the river red gum, then falls prey to foxes when they come to the ground to move on to another tree. There are other animals that are also prey for the fox.

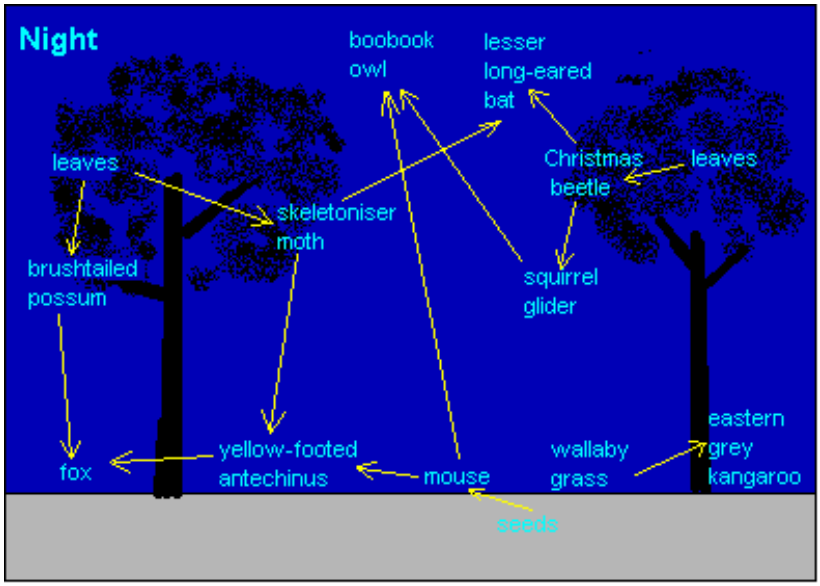


Diagram: Food web for a River Red Gum ecosystem by night (Source: Riverina Environmental Education Centre)

Parasites

Some organisms in a forest ecosystem can be '**parasitic**'. Parasites are organisms that feed and shelter off other organisms and reduce their chance of survival. An example is the mistletoe plant, frequently seen in eucalypt trees as dense masses of leaves, often orange in tone (left), and with a parasitic root system that grows into the host tree where it draws out nutrients and water. The mistletoe bird is the agent responsible for dispersing the seed of this parasite between trees (right).

Pollinators

Insects and birds play a very important role in forest ecosystems as **pollinators** for many trees species that cannot self-pollinate, including eucalypts. Pollination involves carrying pollen from the flower of one tree to the flower of another tree to assist in the reproductive process. When flowers are successfully pollinated, the ovary of the flower develops into a fruit or nut, providing food for animals and new seeds. The native bee is a common pollinator of trees in Australia (right).

Competition and population sizes

Within a forest ecosystem there is **competition** between and within populations of living organisms for the limited resources available. A '**population**' of organisms can be defined as a group of organisms of one species that interbreeds and lives in the same place at the same time. When resources become scare, competition occurs, and for animals, it is the fittest of a population that normally survives when food or prey is limited.

When trees of a particular species compete for soil moisture, nutrients and sunlight, growth becomes restricted and tree trunks remain slender. This is the reason that '**thinning**' is a common practice used by foresters to reduce density of commercial stands of trees (left). This allows the remaining trees to grow in girth which increasing the potential use of the remaining timber and its monetary value.

What role do forest ecosystems play in sustainability?

Forest ecosystems play a crucial role in **sustainability** through the efficient capture and conversion of energy from the sun and its storage into plant material. This plant material provides food, energy and fibre for other organisms, including humans that rely on timber and non-timber forest products in their everyday lives. However, forests must be managed properly to support the sustainable long term capture and supply function.

Why do forest ecosystems change over time?

Forest ecosystems change in composition over time (referred to as **dynamic**). This can occur naturally as forests grow, or in response to invasion by pests and diseases that attack particular populations of organisms.

Change can also be in response to external pressures such as long term change to rainfall and temperature patterns, or abrupt events such as bushfires and floods. Droughts can have major impacts. Global temperatures are rising with climate change and already creating conditions that are more favourable to some destructive pests and diseases of trees.

Biosecurity risks are increasing as pests and diseases are accidentally brought into Australia from other countries, or as a result of new species emerging from mutation (change in genes). Myrtle rust is a fungal disease recently discovered in Australian wattles, tee tree and eucalypts (below). This disease poses a serious threat to forest ecosystems as the yellow-orange spores can infect leaves and growing points of susceptible trees and shrubs, causing them to buckle up, twist and potentially die.

Student question

What are the roles of producers, consumers and decomposers within a forest ecosystem? Give examples.

Word search

★ Forest ecosystems

S N O X Y B X X A T R E E S R R E H V J
F Q K L S U C E N E R G Y E X W E N C Y
D M S C A W K M U C Z I M A Y R O I I D
K X M V N E L P A S K U T J O I T Y T E
B T S J I T T N L R S S J V T O K U O C
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C C Q Q L B H S P R O D U C E R Q H C I
Q H I G T J C D I T V B Q M T H D V A J
Y R Z J S P L A N T S H B J P E R F L A

POPULATION CONSUMER COMPETITION FOREST

FOODCHAIN PARASITE ORGANISMS BIOTIC

POLLINATION ENERGY ANIMALS CARNIVORE

PRODUCER OMNIVORE PLANTS TREES

PHOTOSYNTHESIS MOSS HERBIVORE DECOMPOSITION

ECOSYSTEM ABIOTIC

Class activity

Visit a forest ecosystem in your school neighbourhood being careful not to disturb the environment:

(i) Draw and label a two dimensional diagram of this forest, including trees, smaller plants and any animals you observe. Can you see any fungi or moss growing on dead and decaying logs on the forest floor? Draw some of the non-living features also.

(ii) Look for the presence or evidence of any animals in this forest ecosystem. Draw a food chain for a group of organisms you believe to live in this forest.

Problem to solve

In relation to the following food chain, explain what would most likely happen to the population of owls if the beetle population was wiped out due to an extreme storm event?

Eucalypt leaves → beetles → squirrel glider → Boobook owl

Analysing the situation

1. Research a pest or disease found in Australian eucalypt plantations:

(i) Name the pest or disease, giving both its common and scientific names

(ii) Describe how this pest or disease attacks the host tree

(iii) Identify any factors that can increase susceptibility of the trees to attack

(iv) Explain what measures foresters can use to control outbreaks

2. There is strong debate in Australia over whether to harvest some areas of native forest to get timber used for making wood products (sustainable harvest), or close them all up for conservation with the aim of protecting native animal habitat. In the latter case, society would be entirely reliant on plantation forests for the supply of domestic timber.
Hold a class debate on this topic, and write down the major ideas that emerge from discussions, with the view to forming your own opinion on the topic.

Acknowledgements

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References

Westone. Energy circulation in ecosystems. Geography unit for the WA Government. http://www.westone.wa.gov.au/k-12lrcd/learning_areas/geography/geog2B/content/cell4_spatial_impact/html/d4_energy_circulation.html)

Riverina Environmental Education Centre. http://www.reec.nsw.edu.au/geo/scirrg/scrrg15.htm