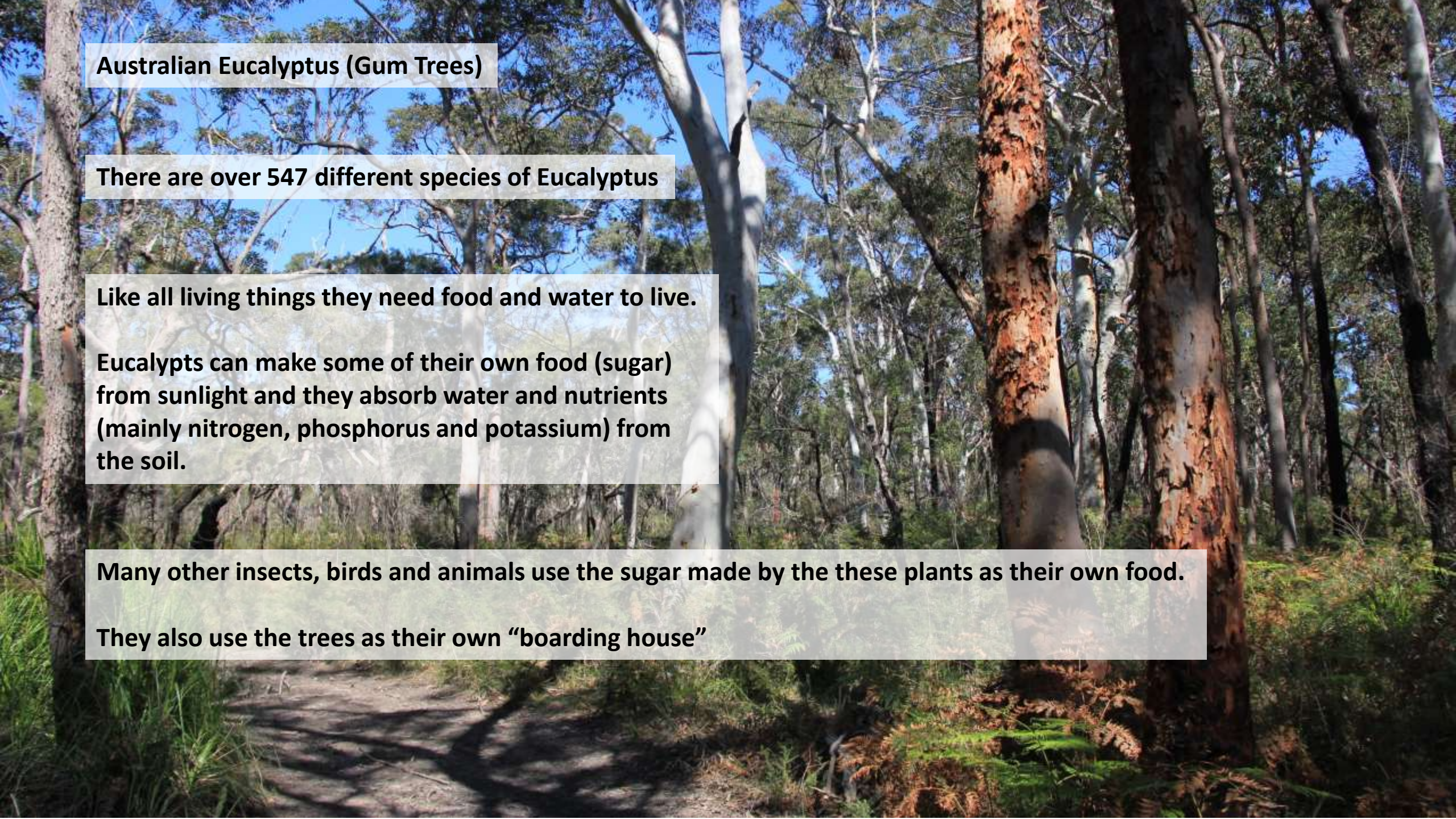
An introduction to ecosystems and our environment

using examples from the Sydney, Blue Mountains and the Hunter.

Prepared by Richard Miller.



Australian Eucalyptus (Gum Trees)

There are over 547 different species of Eucalyptus

Like all living things they need food and water to live.

Eucalypts can make some of their own food (sugar) from sunlight and they absorb water and nutrients (mainly nitrogen, phosphorus and potassium) from the soil.

Many other insects, birds and animals use the sugar made by the these plants as their own food.

They also use the trees as their own “boarding house”

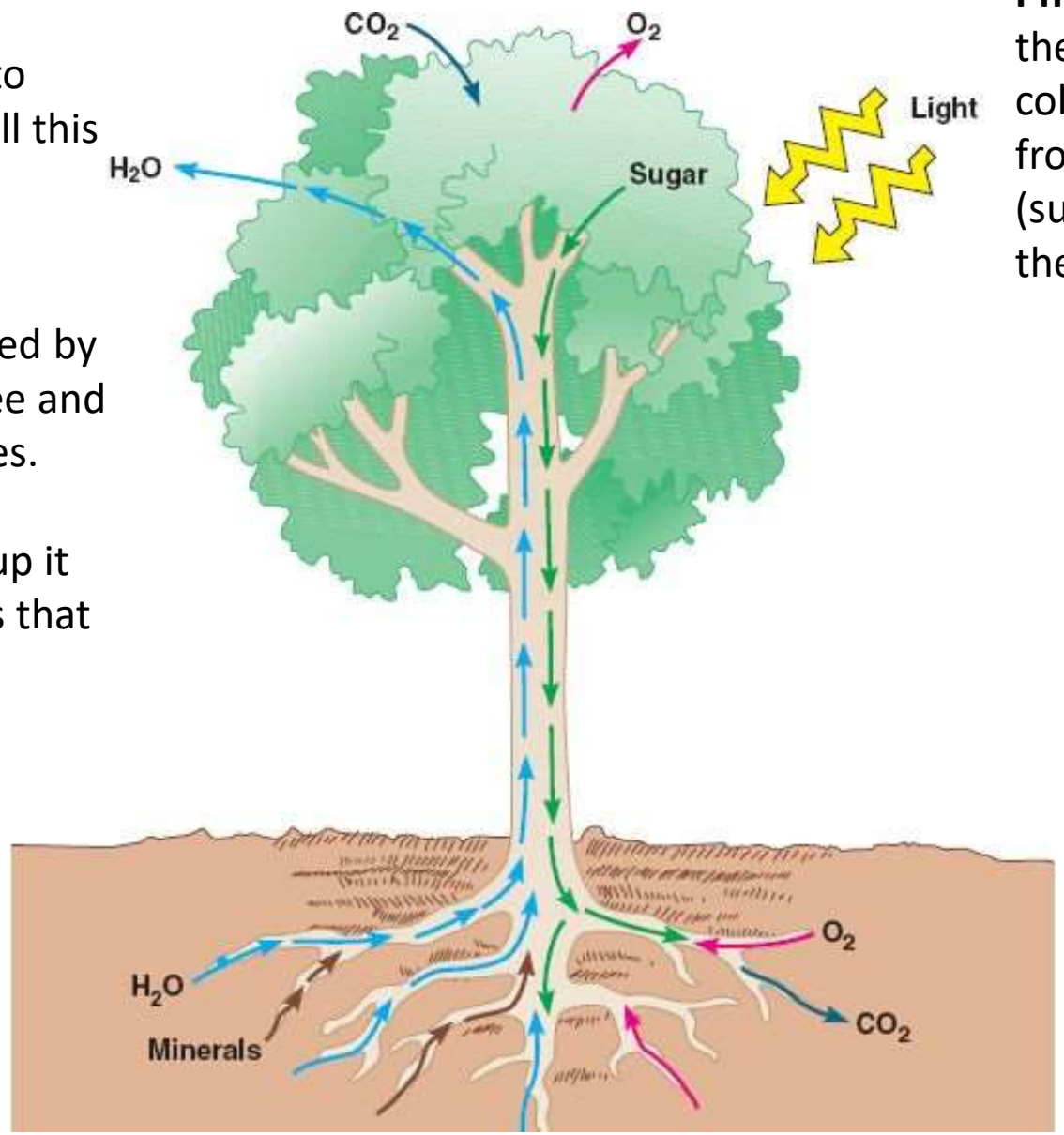
Water goes from our skin into the air to keep us cool we call this perspiration.

In a tree this is called **transpiration**. Water collected by the roots is drawn up the tree and passes out through the leaves.

As the water makes its way up it also carries food for the cells that make up the tree.

Microscopic fungi attached to the roots of the plants Collect minerals from the soil and swap them for sugars from the tree

Diagram by Jeremiah Tan



Photosynthesis is the name of the process by which the leaves collect sunlight and using water from the roots, turn it into food (sugar) and into carbon to make the tree cells.

During photosynthesis the leaves use **carbon dioxide** from the air and give off **oxygen.**

We breathe this oxygen to keep us alive.

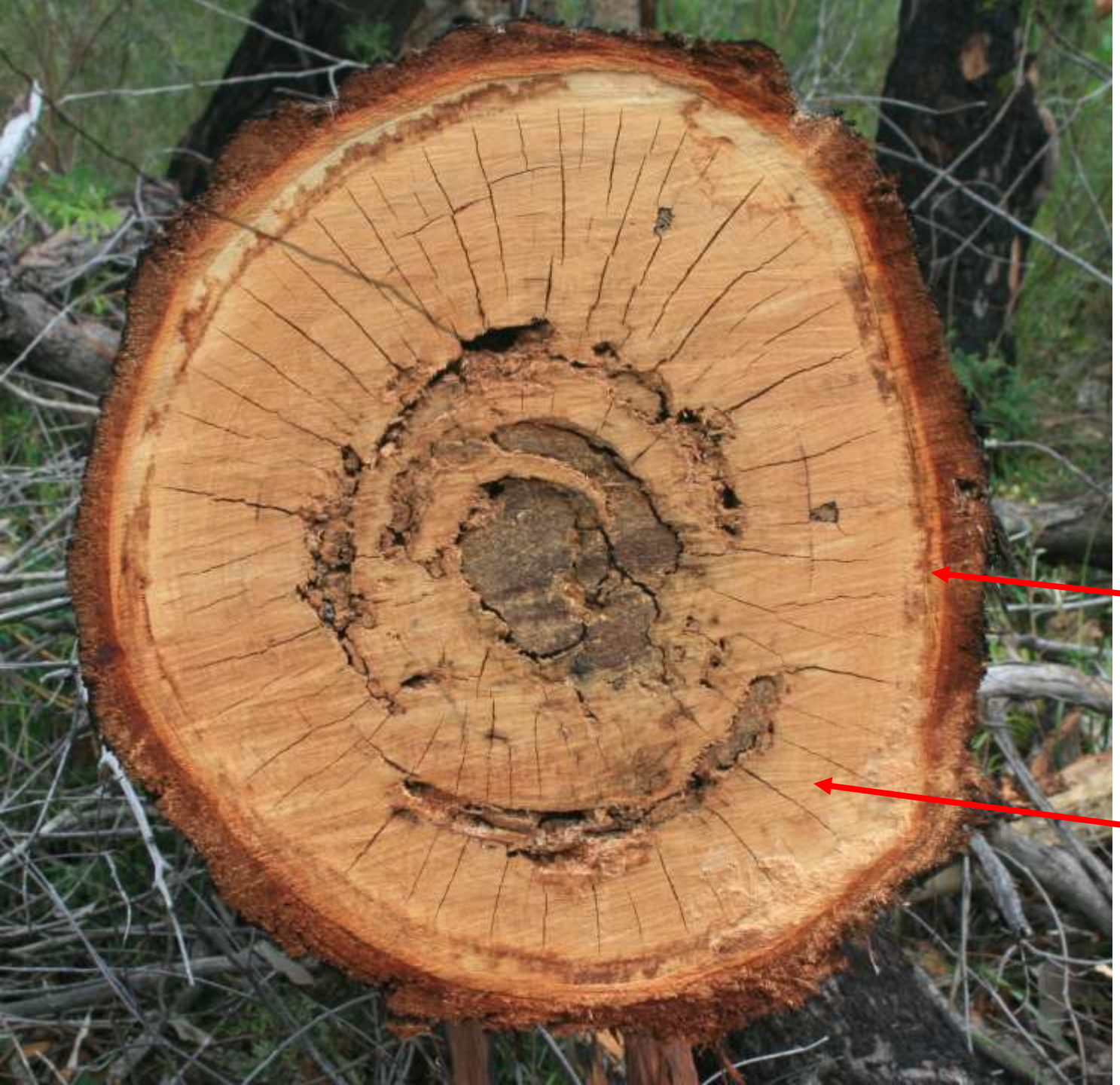
The fungi (Mycelia) living on the roots give off acids that help break up the rock.

They also break down organic matter and make soil for the plant.

Photo of Mycelia – thread-like Fungi that live on the roots of plants. Photo by Prof. Tom Roberts University of Newcastle

If the soil dries out, gets too wet or the Mycelia are attacked by other fungi, the trees may not get enough minerals and may die. This is just one of the causes of Eucalyptus Dieback.

Photo: DWPA Western Australia



Just under the dead outer bark is the living bark. This is similar to the arteries of a human (blood vessels). Sap, which is mostly water, moves up and down the tree.

Phloem sap is made from the sugar which, after collecting in the leaves, sinks down to the roots to be stored. It is then sent to the tree cells to feed them.

Xylem sap is pulled up the tree as the sun dries out the water in the leaves. It brings in it minerals to feed the tree cells.


The water vapour and oil that is transpired from Eucalyptus leaves make a blue haze over our forests.

A Eucalyptus tree makes an ideal “Boarding House”. With plentiful sugary sap, large size and many hollows, hundreds of other plants, animals and insects make the trees their home and use them for food.

Some will suck the sap straight from the leaves or burrow into them.

Some will eat the leaves.

Some will use them as ladders to get to the sunlight

An **ecosystem** is the relationship between living things and their physical surroundings.

In an ecosystem we can see different ways that living things relate to each other.

Competition—when two or more living things rely on the same thing for survival

Predation— the behaviour of one animal feeding on another

Symbiosis—the close relationship of two dissimilar organisms

a) Mutualism—a symbiotic relationship where both organisms benefit

b) Commensalism—a symbiotic relationship where one organism benefits and one does not, but is unharmed

Parasitism—a symbiotic relationship where one organism benefits and one is harmed

Let’s look at some of these relationships in the Eucalypt forests around us.

First some Symbiotic relationships

Termites or “white ants” live in colonies and eat the wood of eucalypts.

The centre of a Eucalyptus trunk (the “heart wood”) often rots after the tree is big enough to stand in the wind.

Termites eat the “heartwood” and many make nests inside the trunks or outside on a branch.

In most cases this does not hurt the tree.

The dark lines are the mud cases of tunnels that termites use to protect themselves. This stops them from drying out when exposed to the open air and also hides them from predators. Mostly the tunnels are inside the tree or underground but these are outside.

This nest, on the outside of the tree, is called an **arboreal** nest.
Some termites have nests in the ground, others live inside trees.


Most termite nests
are not as large as
this.

On this bush track the dark line is a termite tunnel. They are not usually so close to the surface.

The worker termites were inside the tunnel.


The mud in the heartwood of this tree is part of a termites' nest.

Sometimes the termites weaken the tree so much that they break in storms.

Often the standing part of the tree will continue to grow.

Branches hollowed by termites can break off in storms. This allows birds, bats and small animals to use the hollows as homes.


Brush-tail Possum


Rainbow Lorikeet


Sugar Glider Possum


Sacred Kingfisher


Noisy Miner


Laughing Kookaburra


Boobook Owl


Eastern Rosella


Ghost Bat

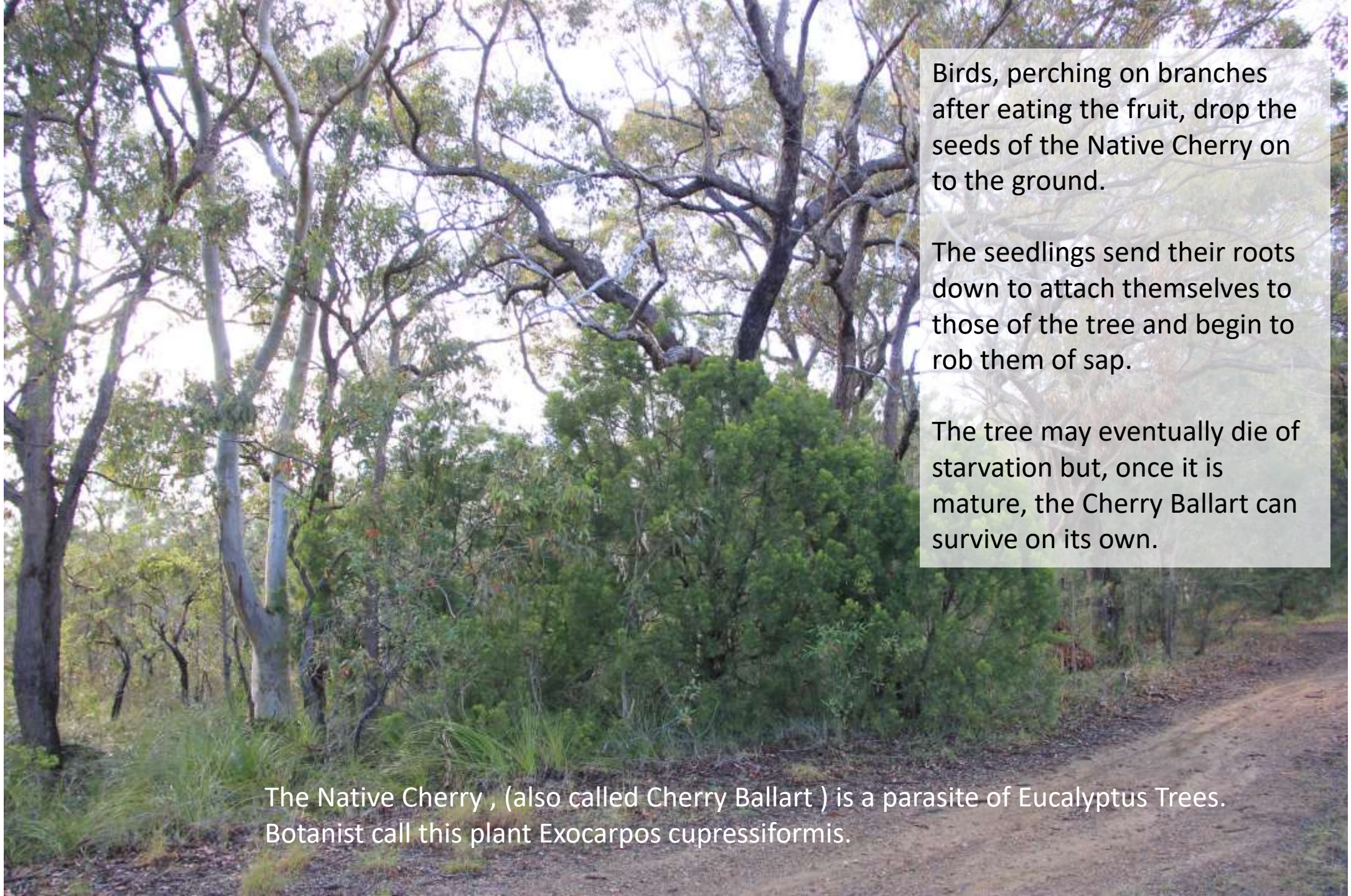
All these animals and birds nest in tree hollows. They often have to **compete** to use them. If we cut down or burn out hollow trees they may not all find homes.

The droppings of the birds, bats and animals fall to the base of the tree and this is fertilizer for the tree's roots.

All the living things involved in this relationship, the trees, termites, and the birds and animals that live in the hollows, are gaining from living together.

We call this **Symbiosis**.

A **Parasitic** relationship occurs when one organism benefits and one is harmed



Birds, perching on branches after eating the fruit, drop the seeds of the Native Cherry on to the ground.

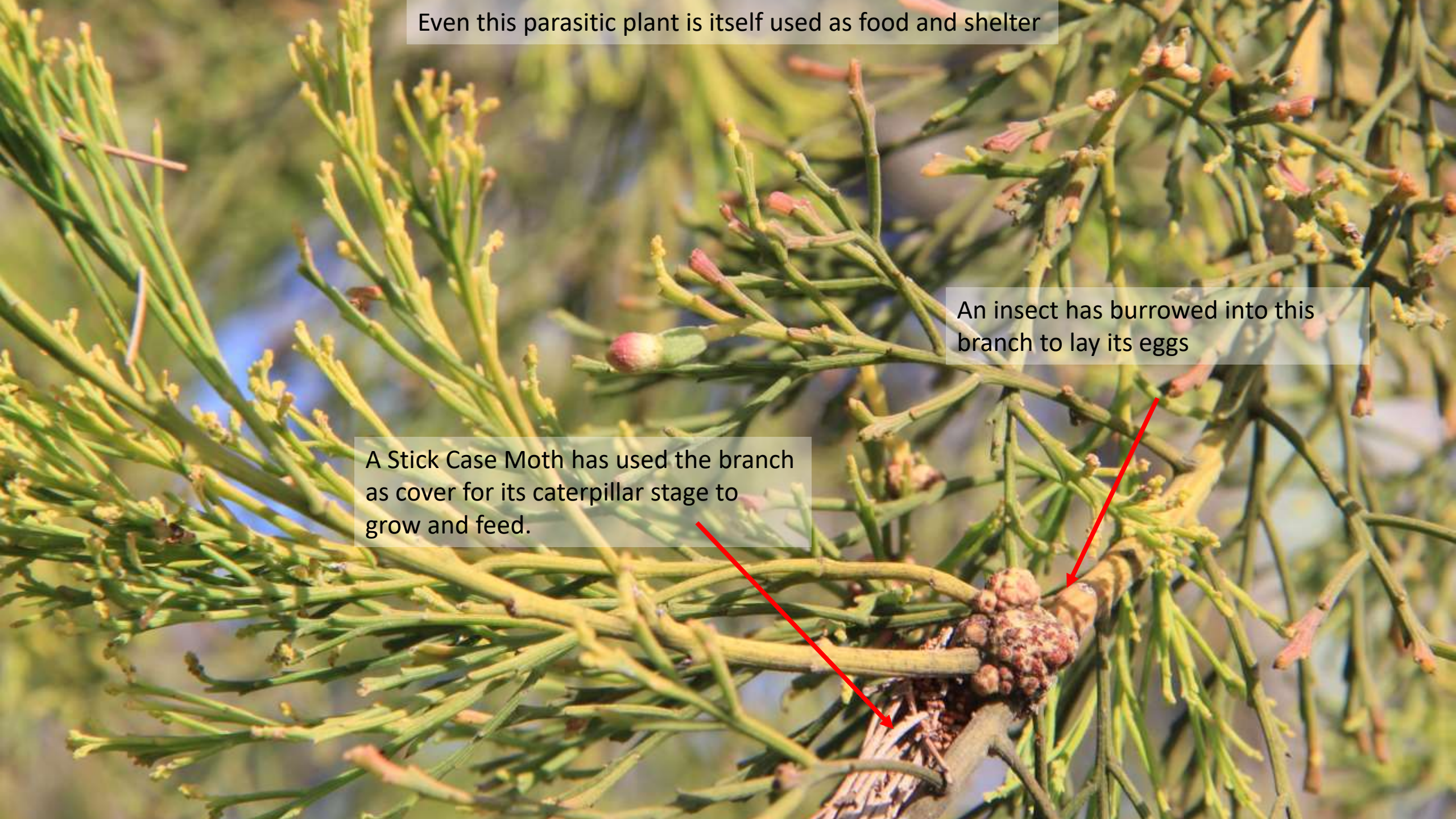
The seedlings send their roots down to attach themselves to those of the tree and begin to rob them of sap.

The tree may eventually die of starvation but, once it is mature, the Cherry Ballart can survive on its own.

The Native Cherry , (also called Cherry Ballart) is a parasite of Eucalyptus Trees. Botanist call this plant Exocarpos cupressiformis.

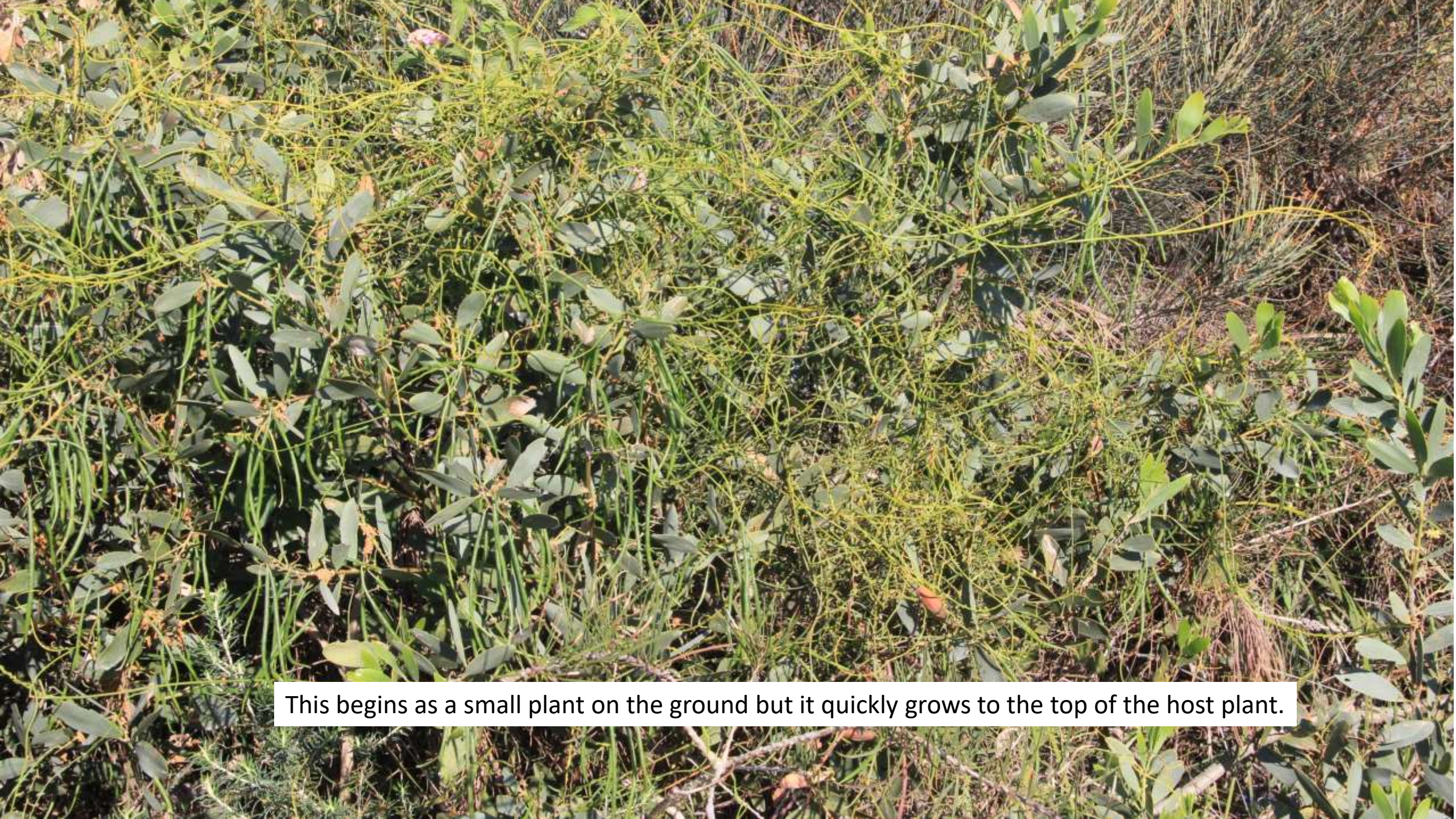
This is the fruit and seed of the Native Cherry.

The fruit is a native food . If you can beat the birds to them they are very sweet and high in vitamin C


Even this parasitic plant is itself used as food and shelter
An insect has burrowed into this branch to lay its eggs
A Stick Case Moth has used the branch as cover for its caterpillar stage to grow and feed.


The Cherry Ballart has made a **Gall** around
an insect in its stem. Can you see the Stick Case Moth?

Another parasite is the climbing plant called Devil's Twine



This begins as a small plant on the ground but it quickly grows to the top of the host plant.

The plant sends suckers into the branches to collect sap.
Once in position, the roots in the ground die off.
It may eventually kill the host plant.

Clematis is another common climber. When it flowers it looks like the trees are covered in snow.


Clematis can reach the tops of very tall trees

The weight of the vines and leaves can be so great that the trees fall over in storms.

Predation (where one animal kills another to feed) is so common that there are complex **food chains** in almost all environments. Here is an example. Do you know what the animals and insects are?

Woodlice
(Slater)

Brown Antechinus

Boobook Owl

Diamond Python

Christmas beetles feed on the leaves of Eucalypts.

They can strip a tree of its leaves and take away its food source

Squirrel gliders and Tawny Frogmouths both eat the beetles

The eggs of Christmas Beetles are laid on the ground and turn into Curl Grubs.

These live under the ground and feed on the roots of the trees, shrubs and grasses.

In this photo a male Parasitic Wasp is carrying a female with whom he will mate.

She does not have wings so he carries her to the flowers of shrubs and trees so that she can fill up on nectar.

This gives her the energy to produce eggs.

She then burrows into the ground to find and sting a curl grub. She then lays an egg into it.

Red sap or Kino is leaking out of this tree.

It is very sticky but can set hard and trap the insect that has bored into the trunk.

Aboriginal peoples used the Kino as a glue and also a medicine.

Many moths and borers lay their eggs on the bark and the larvae then tunnel into the trunk and eat the Phloem of the tree.

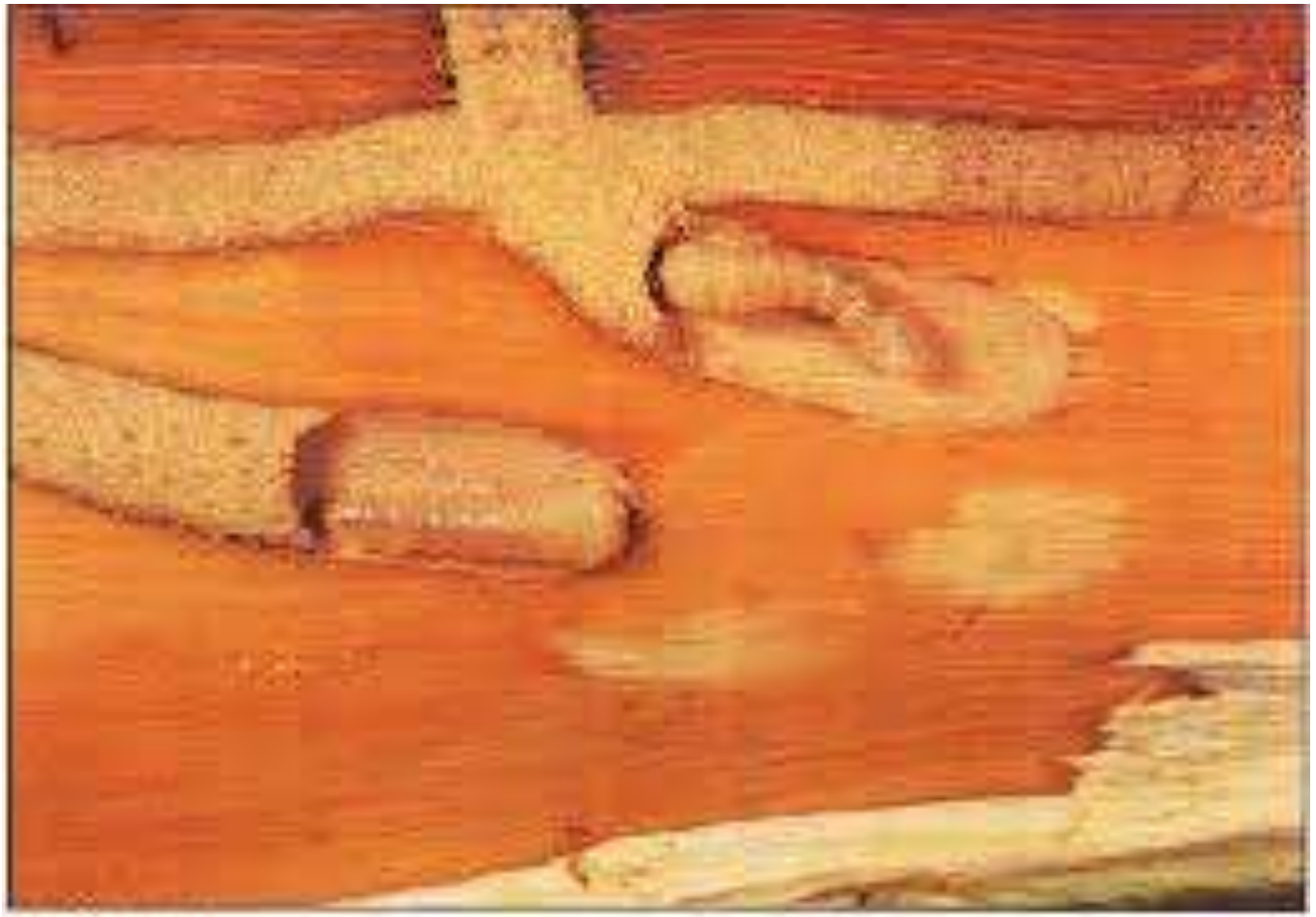
This **Common Eucalypt Longicorn** (*Phoracantha semipunctata)* is as its name suggests a very common borer beetle.

Females lay their eggs under loose bark and the larvae hatch and burrow into the cambium layer of the tree.

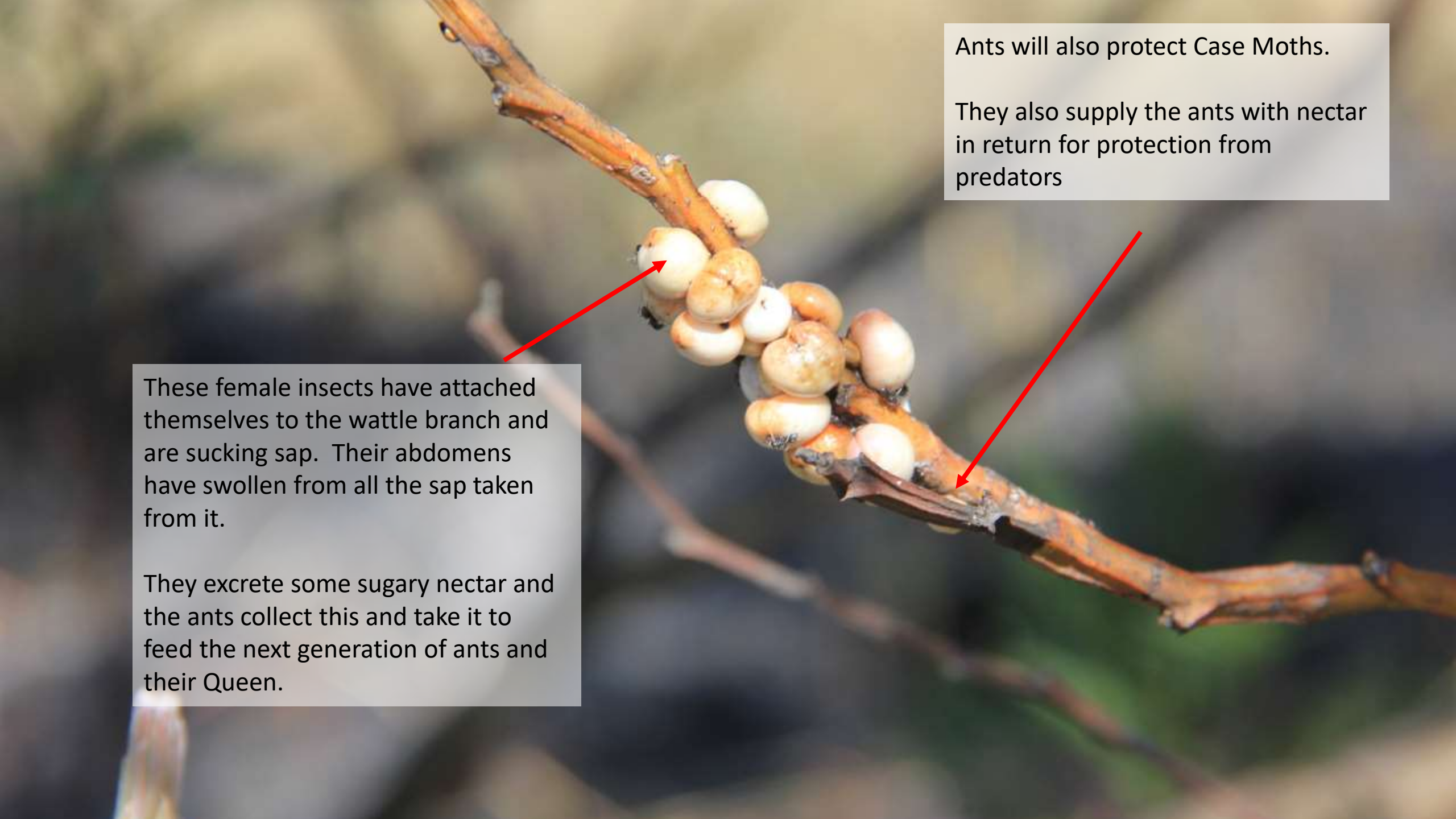
The activity of many larvae can kill the tree by “ringbarking it”.

Sometimes the larvae are still in wood after it has been sawn. The beetles can appear out of the frames of buildings and furniture.

Sometimes when you are chopping wood they will fly out of their tunnels.




Ants have a symbiotic relationship
with many sap sucking insects



Ants will also protect Case Moths.

They also supply the ants with nectar in return for protection from predators

These female insects have attached themselves to the wattle branch and are sucking sap. Their abdomens have swollen from all the sap taken from it.

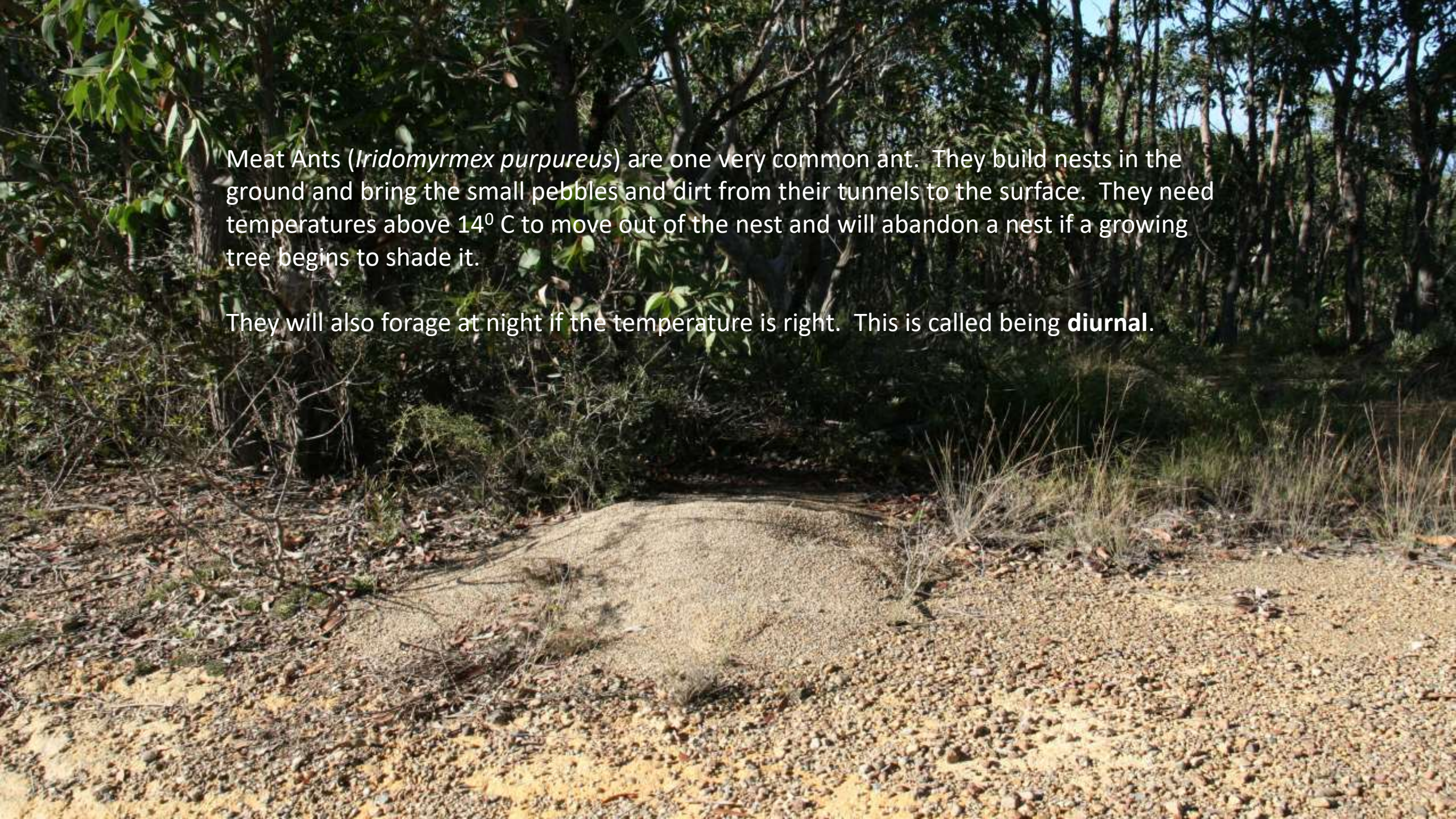
They excrete some sugary nectar and the ants collect this and take it to feed the next generation of ants and their Queen.

There are at least 1100 species of ants in Australia.

It is common to see ants going up and down the trunks of trees and shrubs to collect nectar from flowers or from the many sap sucking insects.

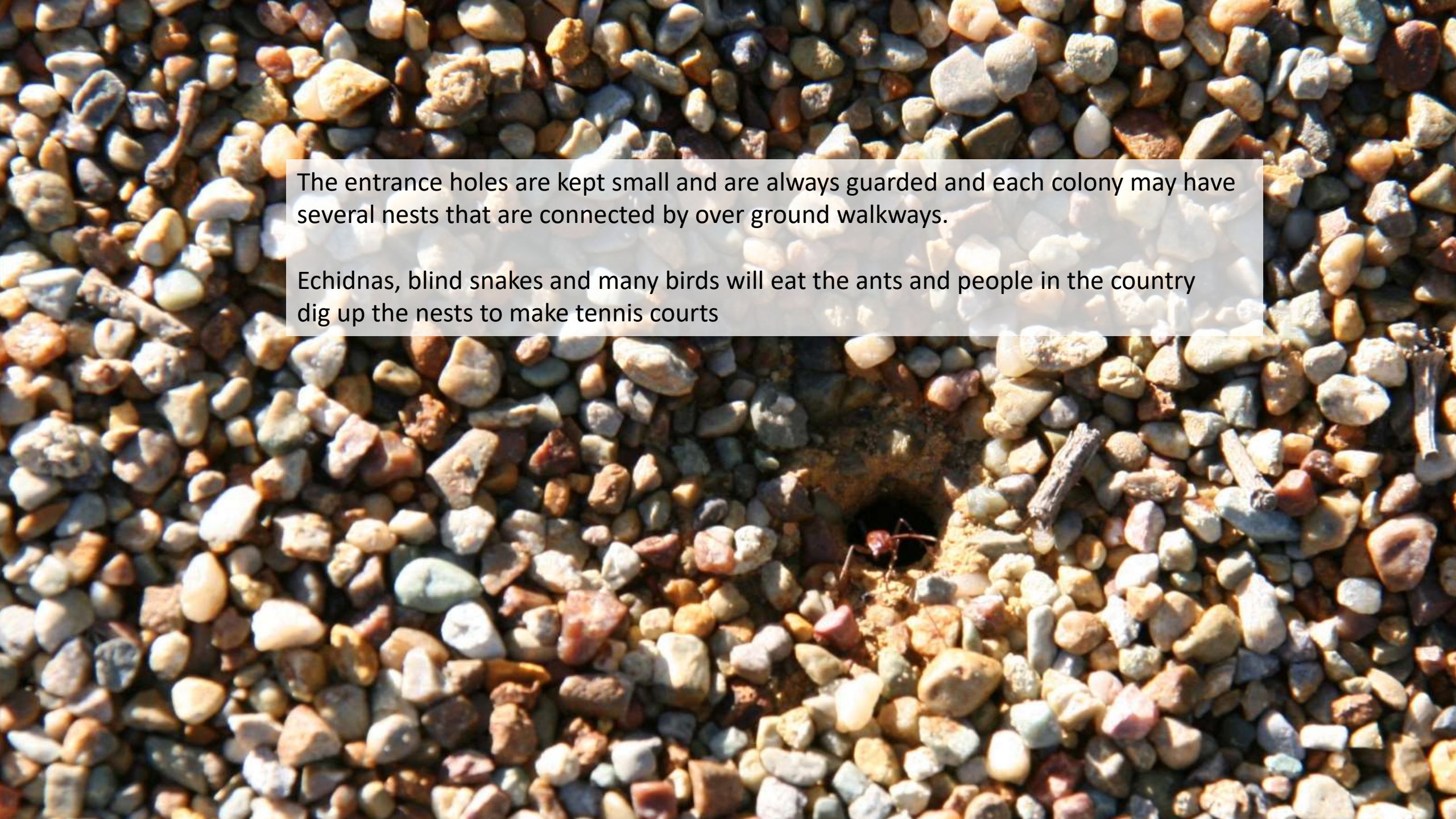
Some ants also eat dead insects and animals. This **Recycling** is very important to the environment.

Ants also collect seeds and take them to their homes in the ground and many plants germinate from there.



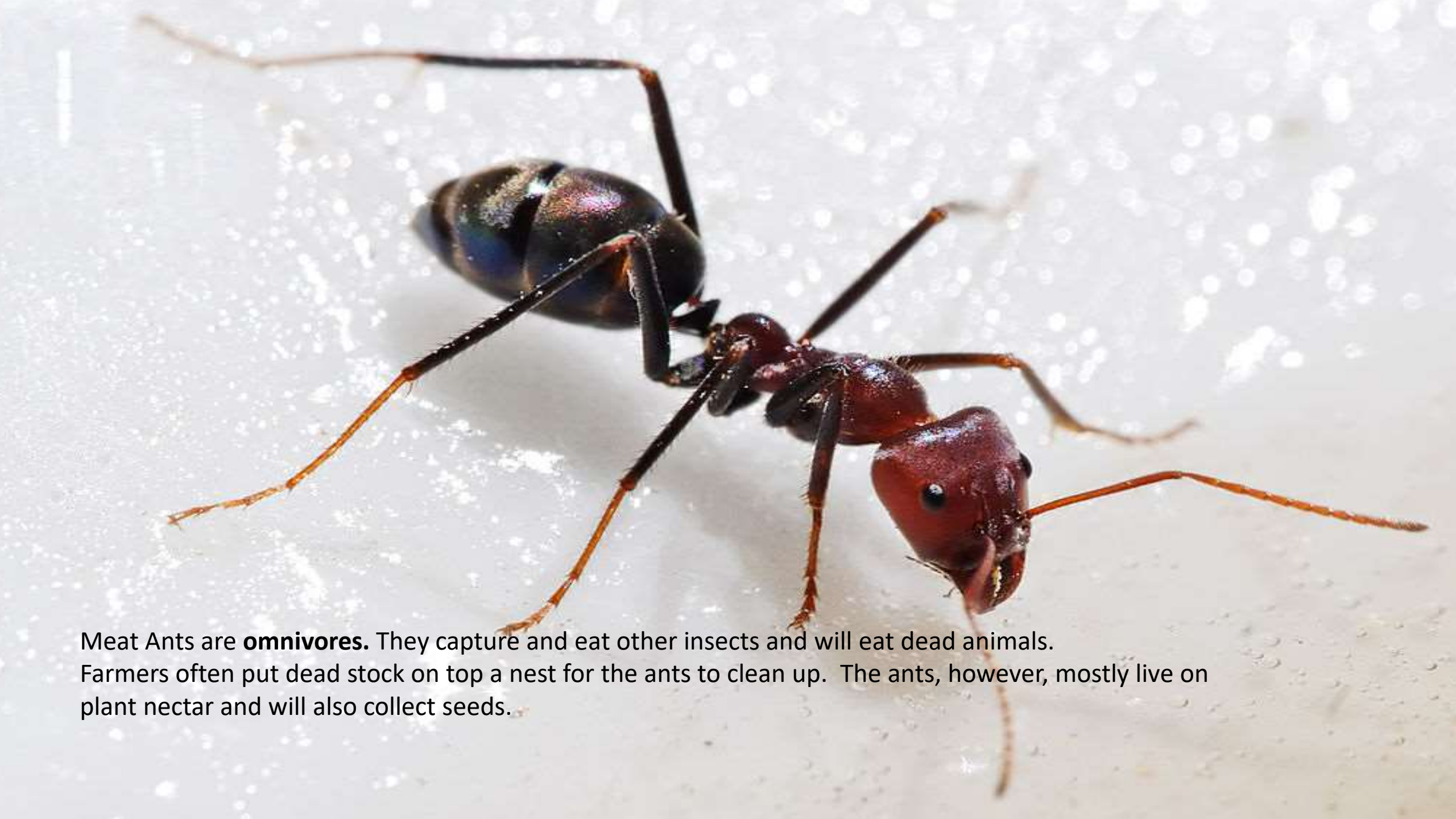
Meat Ants (*Iridomyrmex purpureus*) are one very common ant. They build nests in the ground and bring the small pebbles and dirt from their tunnels to the surface. They need temperatures above 14^0 C to move out of the nest and will abandon a nest if a growing tree begins to shade it.

They will also forage at night if the temperature is right. This is called being **diurnal**.



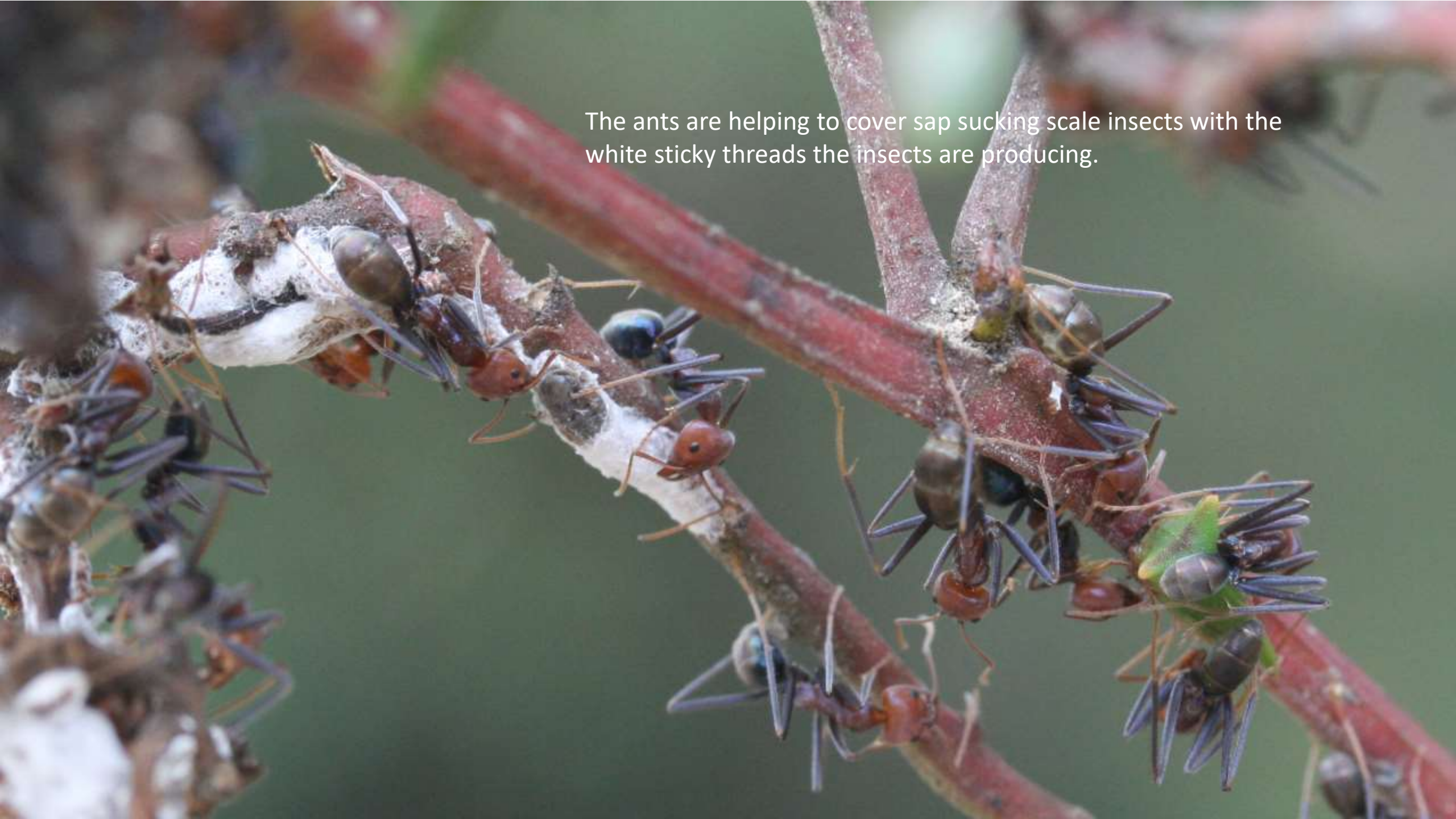
The entrance holes are kept small and are always guarded and each colony may have several nests that are connected by over ground walkways.

Echidnas, blind snakes and many birds will eat the ants and people in the country dig up the nests to make tennis courts

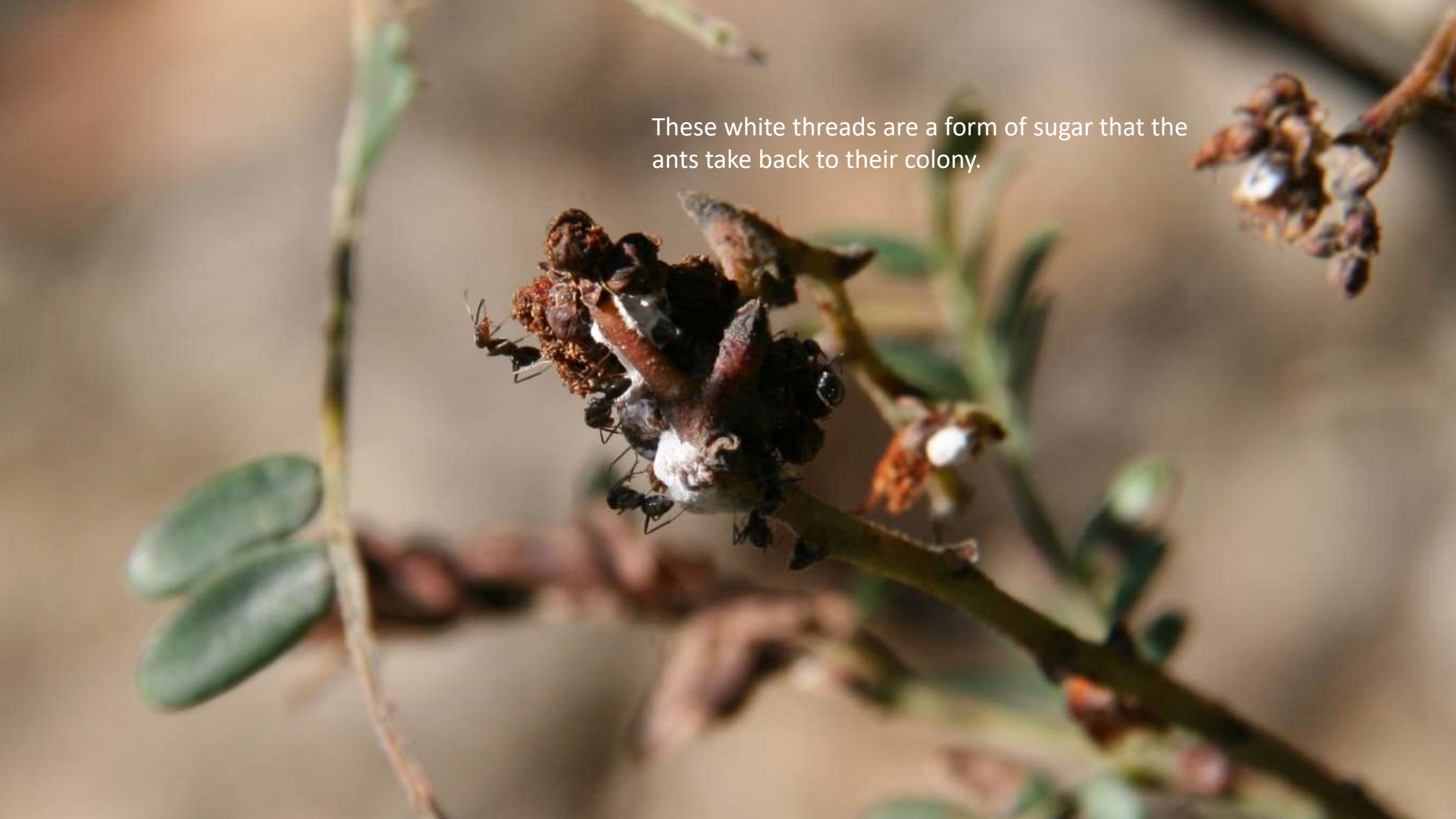


Meat Ants are **omnivores.** They capture and eat other insects and will eat dead animals.
Farmers often put dead stock on top a nest for the ants to clean up. The ants, however, mostly live on plant nectar and will also collect seeds.

This is a Sunshine Wattle (Acacia Terminalis). Meat Ants from a nearby nest helped protect the scale insects that were feeding on the wattle stems.

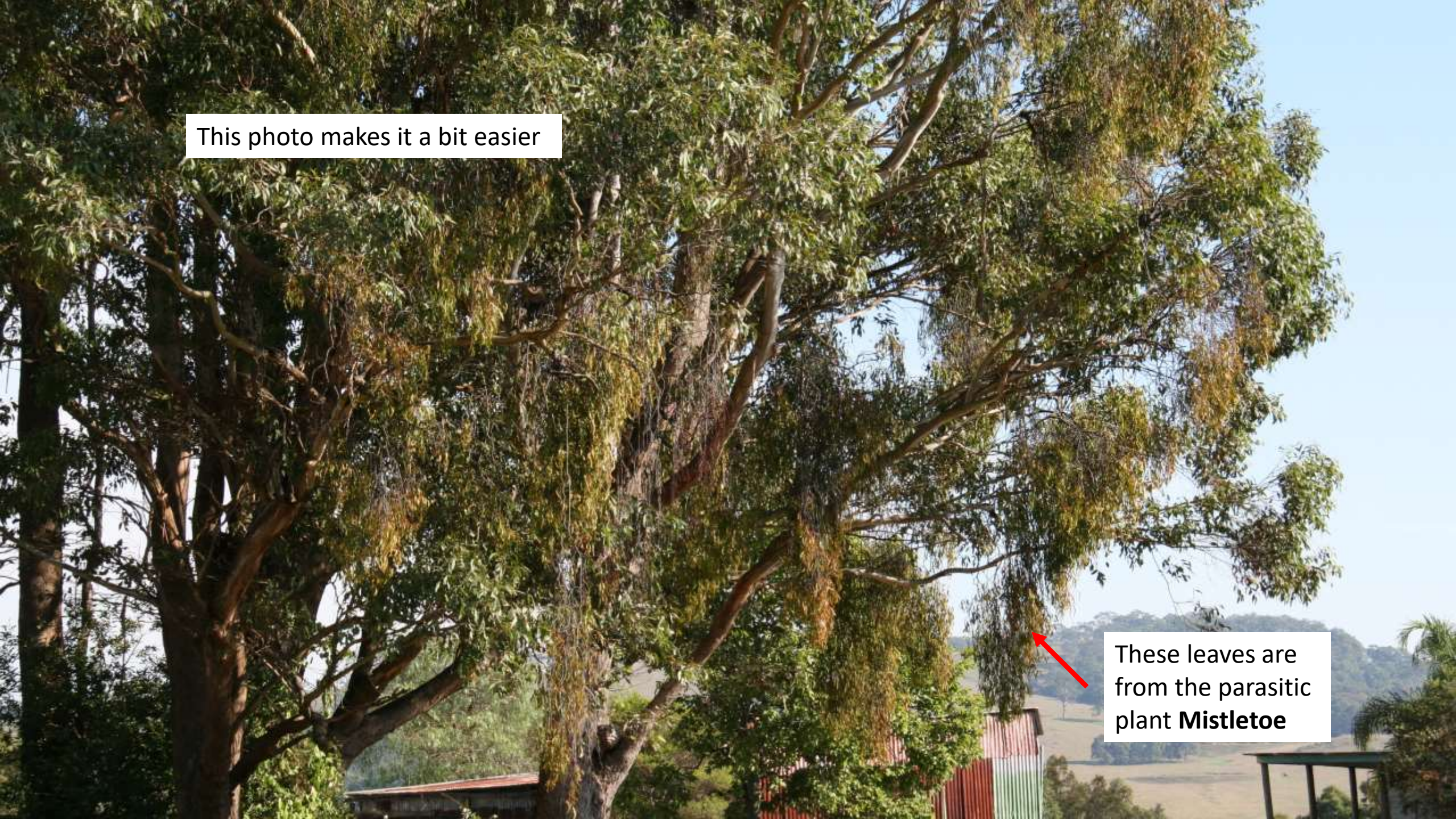


The ants are helping to cover sap sucking scale insects with the white sticky threads the insects are producing.


These white threads are a form of sugar that the ants take back to their colony.

When the insects are covered with threads the ants then collect dead flowers and cover the insects to hide them from predators.


Can you see that there are two different types of leaves on this tree?

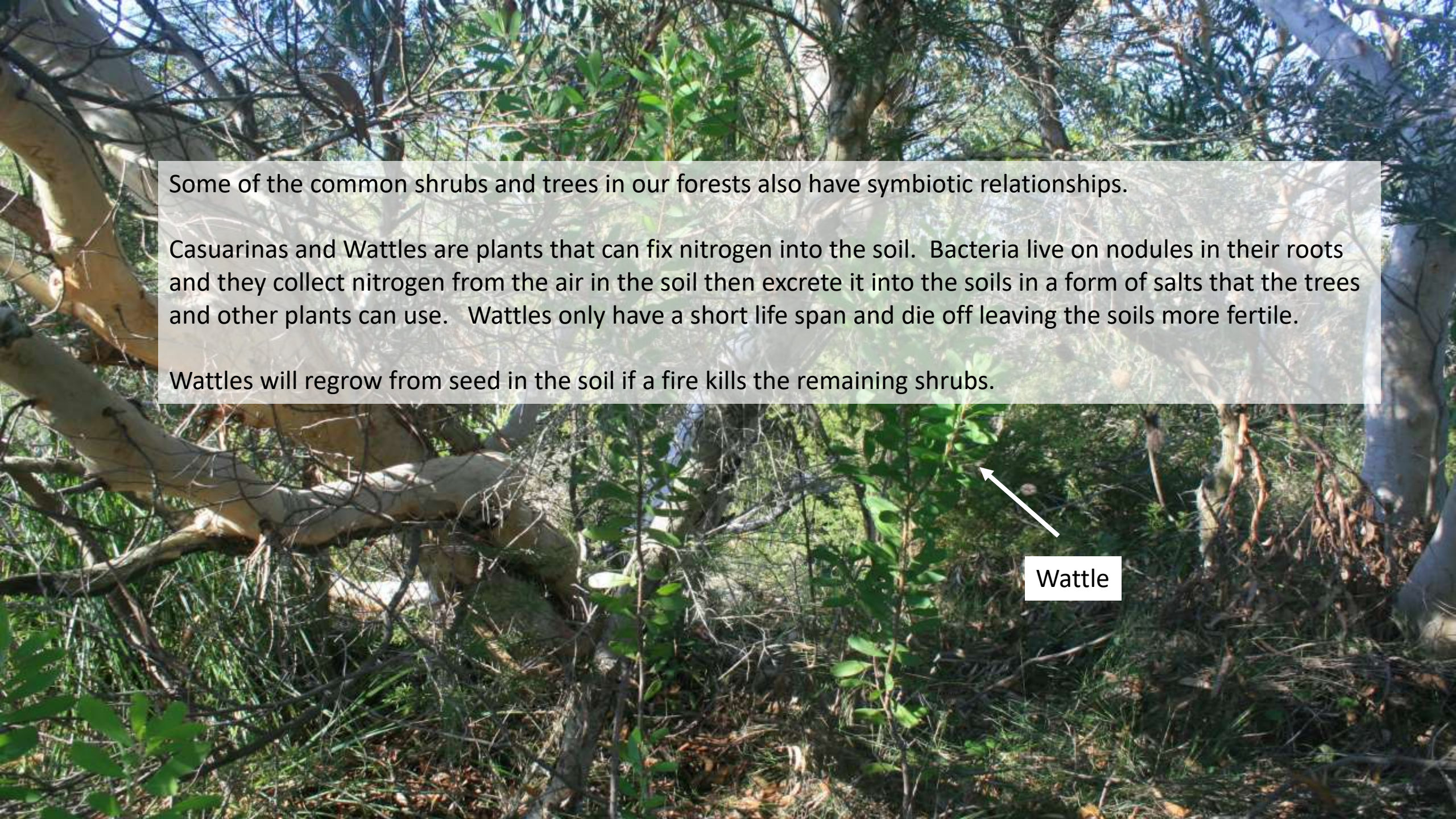

This photo makes it a bit easier
These leaves are from the parasitic plant **Mistletoe**

There are several different Mistletoe. In this photo you can see green leaves of a Mistletoe growing on the branch of a She Oak (Casuarina).

The Mistletoe Bird is responsible for spreading and cultivating Mistletoe plants. It collects and places the seed of the Mistletoe plant onto a branch where it can send roots into it, to get sap.

The bird first feeds the seed to its chick. The seed, after it passes through the chick, is softened and ready to germinate.

You will find the nests of these birds on the branches of nearby shrubs. They are largely made out of cobwebs.

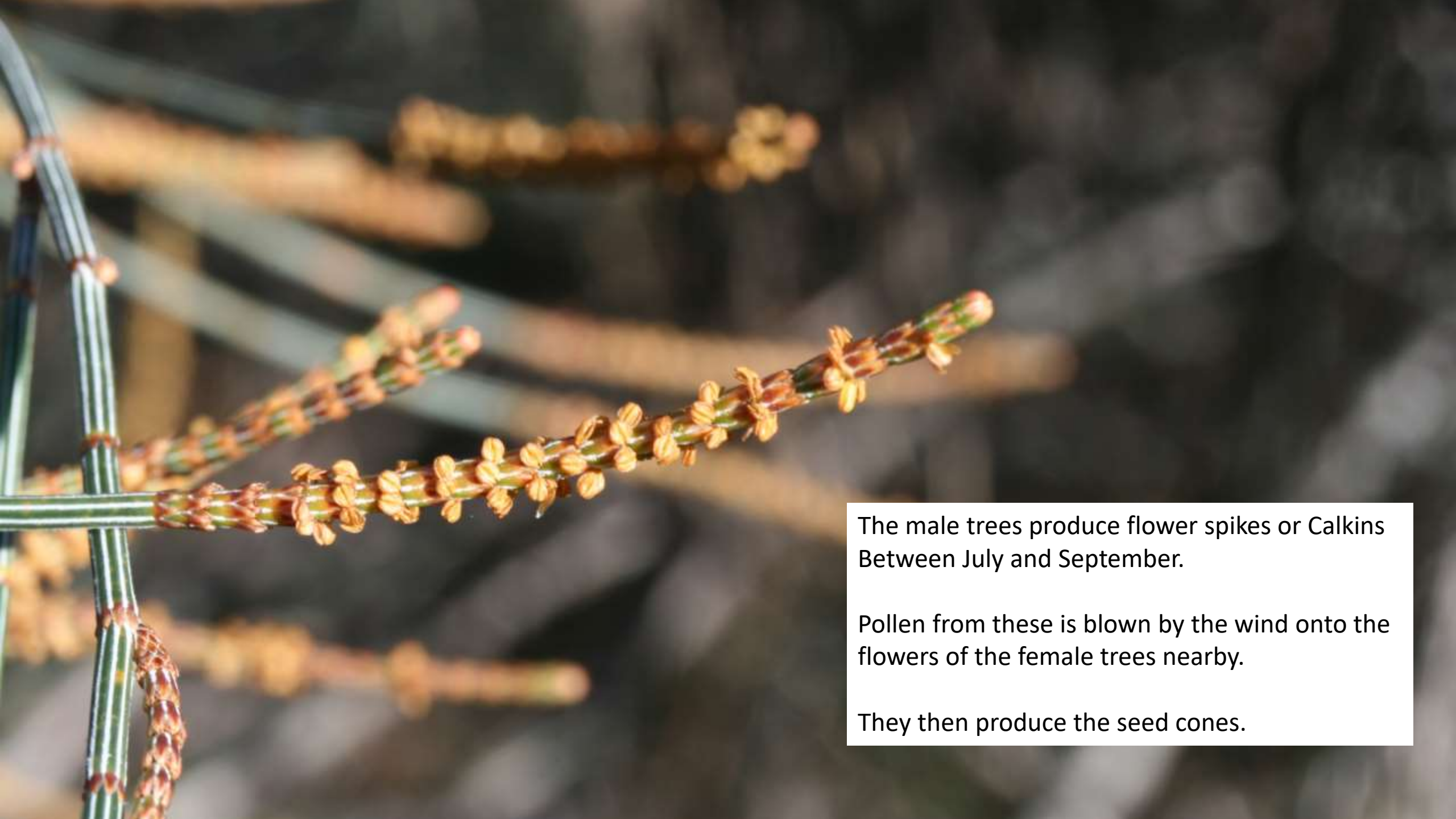


Some of the common shrubs and trees in our forests also have symbiotic relationships.

Casuarinas and Wattles are plants that can fix nitrogen into the soil. Bacteria live on nodules in their roots and they collect nitrogen from the air in the soil then excrete it into the soils in a form of salts that the trees and other plants can use. Wattles only have a short life span and die off leaving the soils more fertile.

Wattles will regrow from seed in the soil if a fire kills the remaining shrubs.

Many Casuarina trees, like this Scrub She-oak, are either male or female



The male trees produce flower spikes or Calkins Between July and September.

Pollen from these is blown by the wind onto the flowers of the female trees nearby.

They then produce the seed cones.

A female flower of a Scrub She-oak (Allocasuarina Distyla)

The winged seeds that grow inside the cones are a favourite food of Glossy Black Cockatoos

These are just some of the thousands of relationships in the ecosystem that we live in. It is important that we understand them and also the effect that we have on the living things around us.

Adapting to an environment

Over time living things can change their form or shape, to fit the conditions in which they live. This can take a long time and overtime the conditions themselves can change

Eucalyptus trees are one of the most common and distinctive Australian plants. They live in many different environments: from mountains covered in winter snow, rainforests and hot dry plains and there are over 800 different species that we call “Gum trees”.

The most common difficulties they face are:

a) Heat and drought

b) Frequent fires

Photo R Miller

Adapting to Heat and Drought

Australia has been and is moving to the North and the climate over many thousands of years has become drier.

Many of the nutrients that plants need have been leached (washed out) of their soils that are mostly millions of years old.

In places with very cold winters plants are often deciduous and drop their leaves to avoid being killed. In their short summers, they need to collect sunlight to make food. Large leaves which face the sun allow them get as much sunlight as possible.

Very few places in Australia are like this. Eucalypts are evergreens, they have leaves all year. Too much sun is a major problem for them and so they have changed their leaves to overcome this.

The leaves have become thick, leathery and tough and so cannot easily be dried out and wilted.

Photo R Miller

When a young plant is growing on the floor of the forest there is not as much sunlight available.

Often the juvenile leaves are held at right angles to the sun to collect as much light as possible.

As the tree grows the adult leaves hang down and turn their edges to the sun. This reduces the heat on the leaf surface and prevents moisture loss.

Photo R Miller

Photo Field of Mars Environmental Education Centre

In the photo above the leaves are on part of the tree that gets direct sunlight only in the morning and from the right.

The juvenile leaves of a Scribbly Gum, in the photo to the left, are upright and wider than the mature leaves.

Like many other Eucalyptus species the juvenile leaves are also opposite each other on the stem.

In heatwaves to prevent moisture loss the plants firstly close the stomas in their leaves and this stops photosynthesis

If the heat continues and the soil dries, trees can reduce the amount of water that they loose by shedding many of their leaves. Over a two week period many can loose 10% of their leaves.

In a long drought they can shed 50% of their leaves.

Photo R Miller

Photo R Miller

In long droughts branches with insufficient water become brittle and can fall in windy conditions. This is especially likely in old trees.

Eucalypts have to cope with a variable climate; with frequent dry, cold and hot spells. They have adapted to change the flower petals for caps called opercula. These cover the flowers as they develop.

The opercula prevent the flower from drying out and help protect it from attack by insects.

They are so effective that another native species has also adapted to have them. This is the Corymbia (bloodwoods and spotted gums on the NSW Central Coast).

Photo R Miller

The fruit of Eucalyptus Robusta, the Swamp Mahogany

Adapting to Fire

Australian plants are often subject to fires. About % are caused by lightning strikes but most are caused by people who let fire escape accidentally or deliberately light them.

Aboriginal people used fires to create areas of short grass to attract kangaroos to an area and also to fire to drive them towards a group of hunters.

They kept paths open with fire and used it to clear ground for plants that they grew.

Photo R Miller

Eucalypts adapted to frequent fires that burnt their leaves by have buds under their bark from which they could quickly grow new leaves. These are called Epicormic buds.

Photo R Miller

Each year Eucalypts drop seeds onto the forest floor. They have a hard covering that stops most of them from germinating.

The covering can be dissolved by “smoke water” that is water filtered through ash on the ground after a fire.

New leaves can also grow from swellings at the base of the their trunks. These swellings are called Lignotubers.

Photo R Miller

After a fire has burnt the leaves in a tree's crown Eucalypts may shed branches to reduce the amount of water that they will need to grow new leaves.

This can expose new tree hollows and provide shelter for surviving wildlife.

Photo R Miller

Photo R Miller

Not only have many Eucalypts adapted to survive fires many also have adapted to spread fire.

The thick waxy leaves can stay alight and bee carried in the smoke column many kilometres ahead of the fire.

Photo R Miller

Photo R Miller

Once embers enter tree hollows, they can smoulder for months. If the tree has an opening low in the trunk, wind can cause the tree to act like a chimney and spread embers for many metres.

The Scribbly Gum in these photos was near the edge of the fire when Rural Fire Service fire fighters brought it under control. Two weeks later strong winds caused the to “chimney” and reignite the fire. In 2013 this fire burnt from Doyalson to Catherine Hill Bay.

Photo R Miller

Trees with soft and fibrous bark, like the Red Bloodwood in the photo to the left, burn readily and carry fire up to the leaves.

The burning leaves then spread the fire.

Some Eucalyptus trees have bark that hangs in ribbons. In Victoria this has bark has been recorded to have spread fire up to 30 km.