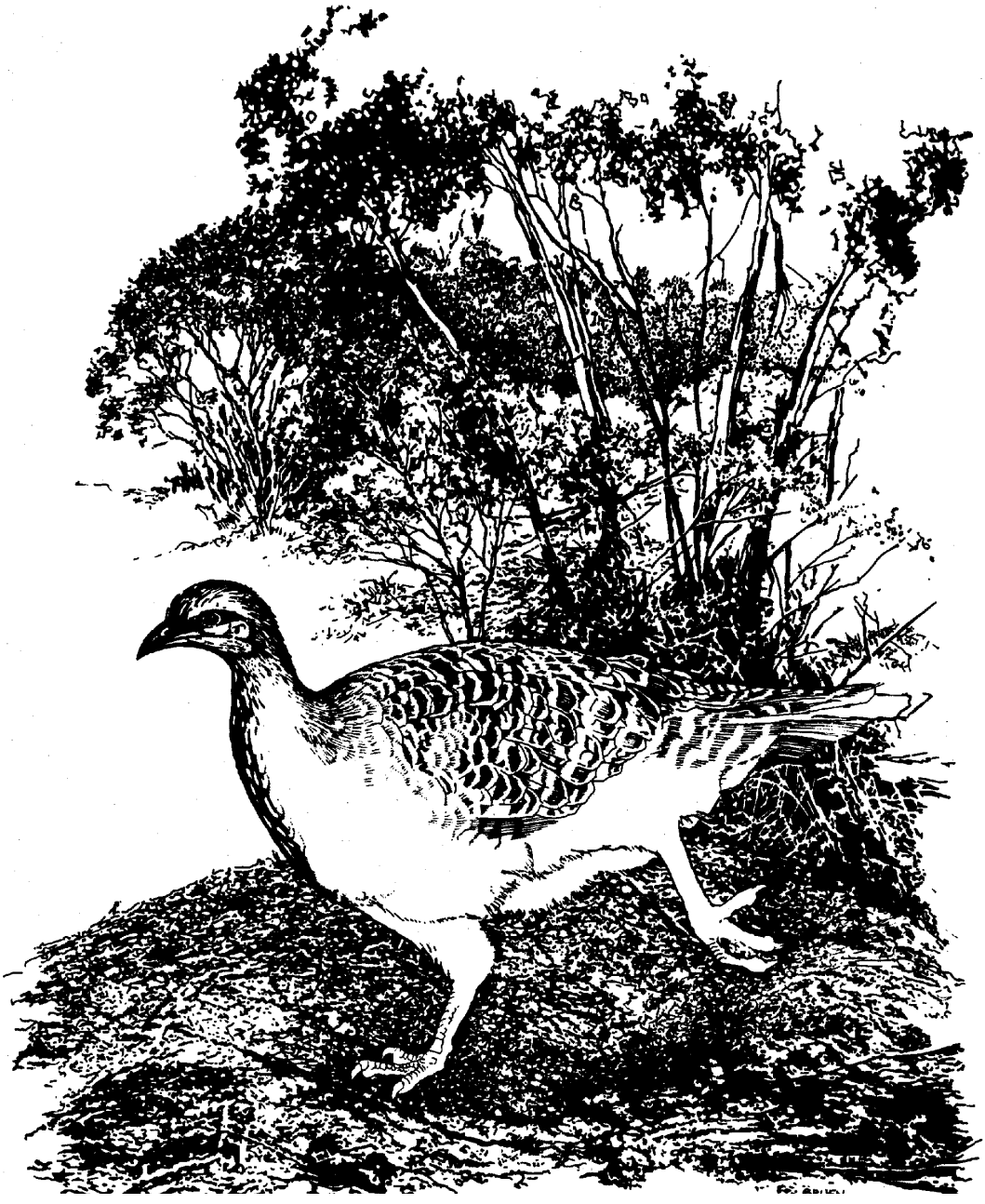
INFORMATION RESOURCES

Discover...

Plants of the Mallee Shrublands



AUSTRALIAN NATIONAL BOTANIC GARDENS

Artwork

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The Australian National Botanic Gardens –
growing, studying and promoting Australian flora.

The Australian National Botanic Gardens is part of Environment Australia

The Mallee

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Planning the Excursion

We want you to use the Information Resource Notes and example Student Worksheets as resources for planning your excursion. ***Select questions that relate to the purpose of the excursion, cut and paste, modify and add your own activities.*** There is some repetition of concepts and students cannot complete all activities within an hour. The concepts can be adapted to all levels, and the activities tailored to the time available in the Gardens.
Let us have a copy of your finished worksheets so we can share your ideas with others.

While students are in the Gardens it is more beneficial for them to be observing, discovering and developing attitudes and values rather than reading swags of text and writing comprehensive answers to questions. This is where good pre-visit and post visit activities are important.

About the Questions

- The questions are open-ended so that students are encouraged to observe and think.
- They are intended as mind joggers for teachers to develop their own questions based on the outcomes they want.
- There are too many questions included here for students to successfully answer in one visit. Post-visit activities could take in more of the questions.
- They are written for adult readers and may need to be modified for students.

Purpose

Plants of the Mallee Shrublands activities focus on investigating some adaptations of plants to the Mallee environment, with its distinctive soils and climatic conditions.

Curriculum links

The activities in this walk allow for links across the curriculum, particularly in Studies of Society and Environment, Science, Technology and English. (Suggested level years 6-12).

Mallee

Mallee is an Aboriginal name for a group of eucalypts which grow to a height of 2 - 9 metres and have many stems arising from a swollen woody base known as a lignotuber. They have an umbrella-like leaf canopy and the trees shade 30-70% of the ground.

Several layers of vegetation grow in association with Mallee eucalypts, including large shrubs up to 3m high and smaller shrubs 30cm to 2m high. There is a lot of bare ground and any leaf litter decomposes slowly in the dry conditions.

Mallee is also a name given to the type of vegetation community in which the Mallee eucalypts grow. Mallee areas are generally very flat, and without hills or tall trees it is very easy to become lost. This probably accounts for the fear of the Mallee felt by many early explorers and settlers.

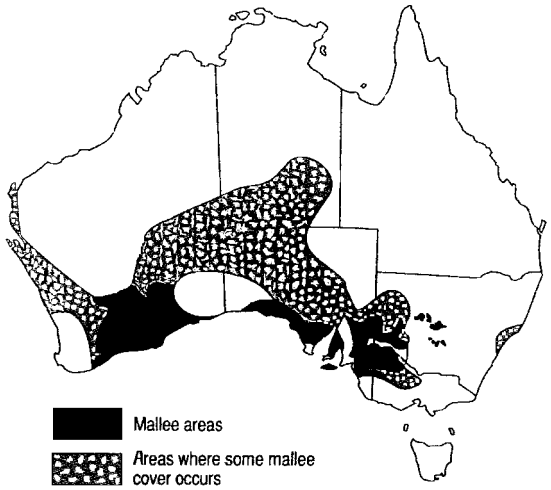
The Mallee is a complex and sensitive environment. It contains a great diversity of organisms many of which are under threat. Since European settlement one third of all mammal species have disappeared from the Mallee of south-eastern Australia and in the Victorian Mallee more than a dozen plant species are now considered threatened or rare as a result of clearing and grazing.

Mallee soil is generally sandy and in some areas contains a high proportion of lime. In other areas the soil is quite salty and/or very shallow It is often covered by a 'crust' of lichens and algae.

The soils of the Mallee Shrubland section of the Australian National Botanic Gardens have been specially prepared to suit these plants by the addition of sand and the alteration of the soil pH (acidity). The site is very well drained. There is another Mallee vegetation site in the Gardens at Section 100. It is well worth the visit if time permits.

Distribution

Mallee shrublands occur in southern Australia, as shown on the map.



Distribution of Mallee Shrublands

Climate

The Mallee Shrublands are dry (semi-arid) with a rainfall of 225-400mm per year.

Winter in these areas is short, cool and at times quite wet, whereas the summer is long, hot and dry.

The plants in cultivation at the Gardens must cope with colder, longer winters and shorter summers which can be quite wet.

Fires are common in Mallee areas. The Discover series "Plant Adaptations" booklet investigates survival against fire in more detail.

European settlement

The first settlers had very little interest in the Mallee. Their sheep and cattle grazed on the grasslands nearby. Some stock grazed in the Mallee but it could only support one sheep to 12 hectares.

In the late 1800's large scale clearing of the Mallee began. At first the farmers merely knocked over the thin Mallee stems with horse drawn balls and chains, burned the vegetation and ploughed the land. Ploughing was extremely difficult as the ploughs were continually being broken by the solid rock-like lignotubers known as 'Mallee roots'. Many farmers did not persist.

Stump-jump plough

The stump-jump plough invented in 1876 changed this. The stump-jump plough was invented by Mr. R. Smith of the Yorke Peninsula in South Australia. As its name implies this device jumped over the Mallee roots which remained in the ground. This allowed farmers to prepare large area of Mallee for crop growing.

It wasn't long before the farmers confronted another problem - the amazing ability of Mallee eucalypts to regenerate. New stems grew as quickly as the wheat and no matter how frequently they were cut off they reappeared.

Digging out individual roots was far too expensive in time and labour. Some farmers attempted to grow special long-strawed varieties of wheat. The ears of wheat would grow above the Mallee shoots; they could then be harvested and the thick stubble which was produced could be burned after the harvest. It was hoped this burning would destroy the Mallee stems (shoots) along with the stubble. However, after burning, the Mallee root-stocks produced even more vigorous shoots.

During World War I the struggle to clear and tame the Mallee country continued, particularly in South Australia and Victoria. By cutting and burning after every harvest the farmers managed to keep the Mallee shoots below the level of the growing wheat and more and more land was opened up for wheat farming.

Today at least 75% of the original Mallee vegetation in South Australia and about 60 – 65% in Victoria has been cleared and developed for farming.

Mallee roots for firewood

The Mallee roots, once removed, were left in huge piles on the land. Here they provided shelter for large colonies of rabbits which would emerge at night to feed on the wheat crops. To remove the rabbits' breeding places the farmers burnt the Mallee roots. These roots produced a very hot, clean flame, burning evenly and slowly to form a very small amount of fine ash. Their potential for use as

firewood had been realised. Farmers encouraged people to remove the roots from their properties for a small fee. However it was not until the Depression that farmers (in dire financial straits) began selling Mallee roots to people in the cities for firewood. This continued until recent years.

Soil erosion

Problems which surfaced in the early 1930's included serious wind erosion caused by removal of the covering vegetation and overuse of the land for cropping. The lichen 'crust' which covered much of the soil was disturbed, exposing the soil to the agents of erosion. The fertility of the soil was greatly reduced as large quantities of the surface layer were blown away by the wind.

Aboriginal People in the Victorian Mallee

Groups of aboriginal people living in what is now the Swan Hill area near the Murray River moved into the 'Nowie' or sunset country (the Mallee) after rain. They moved from one water source to another.

A large seasonal camp was established at the north-west point of Lake Tyrell and many family groups gathered there. The hearths remaining today are spread over at least a square kilometre. Other signs of occupation are found around Lake Tyrell and many of the smaller Mallee lakes. When the lakes dried, food became scarce and groups would move back to their more permanent river camps.

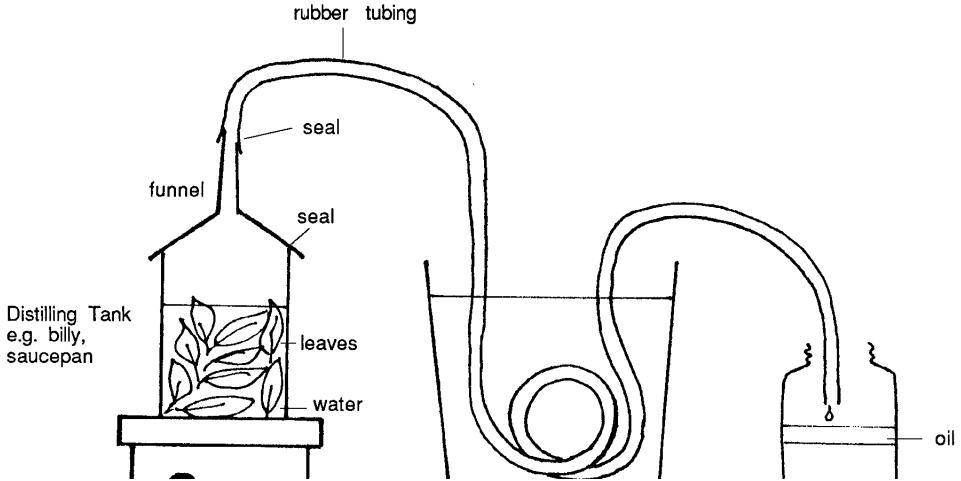
Aboriginal people knew how to obtain water from the trees of the Mallee. One way was to dig a trench around the base of a certain type of tree, locating the roots which ran out from just under the surface of the soil. They then removed the roots of the tree, cut them into pieces up to a metre long and stood them against the tree. The water draining from these pieces was collected.

Groups of aboriginal people living in the area are the Boora Boora, Wamba Wamba and the Watty Watty.

Oil from eucalypts

Most of us are familiar with the fragrance of *Eucalyptus* oil when we crush *Eucalyptus* leaves or walk in the bush on a hot day. We can even see the glands containing the oil as little dots when we hold a *Eucalyptus* leaf up to the light.

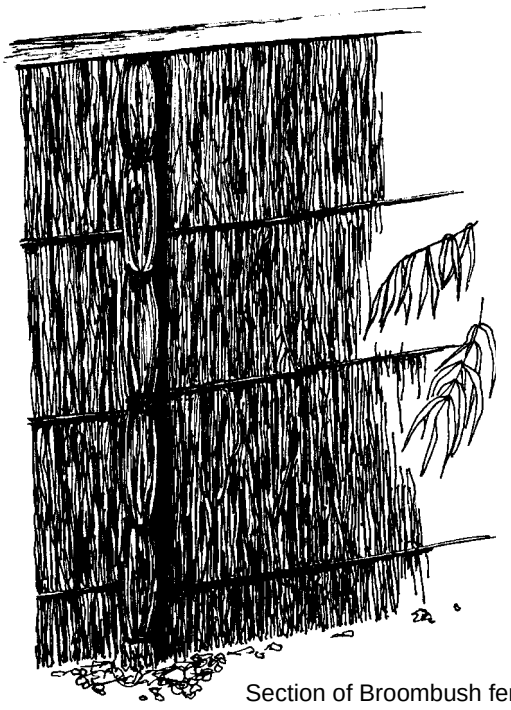
Extraction of oil from eucalypt leaves has gone on in Australia for many years. Trees used for this purpose include *Eucalyptus viridis* (Green Mallee) and *Eucalyptus polybractea* (Blue Mallee).



Eucalyptus oil is distilled by a simple process in which water is boiled to form steam which passes through the leaves, vaporising the oil in them. The mixture of oil and water is then cooled and collected. The oil settles on top of the water and can be collected when the water is siphoned off.

The advantage of using Mallee as the source of leaves is that there can be regular harvesting of regrowth from the lignotubers. The leaf crop is thus kept low and accessible. The leaves can even be harvested with mechanical equipment designed for other crops.

Broombush harvesting



Section of Broombush fence

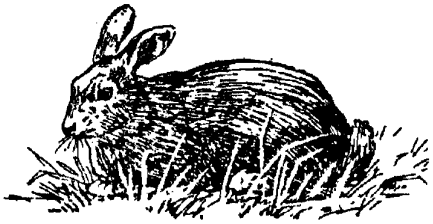
Brush fencing has been a popular form of domestic fence throughout Southern Australia since the depression years of the 1930's. Commercial broombush harvesting began in the Victorian Mallee in 1972, after South Australia placed restrictions on this activity. Broombush (*Melaleuca uncinata*) is used for luxury brush fencing. Such harvesting has been a great threat to Victoria's Mallee wilderness. Following considerable controversy it was phased out in Mallee public lands in 1990.
As the brush-cutters moved into sensitive heathlands, particularly in sandy dune country, their vehicles caused irreparable damage. The tracks increase erosion and allow easy introduction of weeds and feral animals. This greatly reduces the wilderness value of these areas. As well it is a threat to animals such as the Malleefowl and Pygmy Possum.

Grazing

The Mallee has been heavily grazed by sheep and cattle and those grasses, shrubs and trees most palatable to them have been greatly reduced and in some areas eliminated. At the same time the numbers of spiky and unpalatable shrubs have increased.

Feral animals

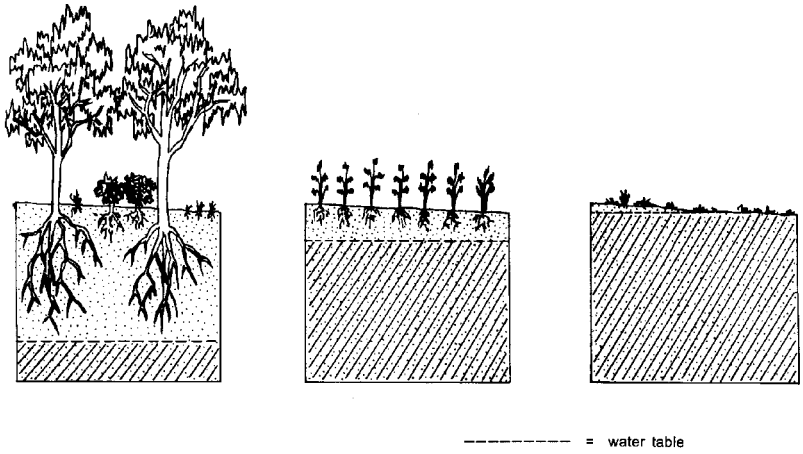
Rabbits have had a devastating effect on the Mallee. They devour large quantities of saltbush and chew the bark of trees such as *Callitris* (Cypress pines). Foxes and feral cats kill many native animals such as small marsupials, native rodents and Malleefowl. The effects of feral animals can be very obvious. However, it is the subtle changes they cause which threatens many sensitive species.



Salting of the soil

Soil salting is a serious problem in parts of the Mallee. Trees are the natural vegetation and they constantly remove water from the soil as they transpire and grow. This means the groundwater level remains deep in the subsoil. When the trees are removed and replaced with crops, the crops remove water from the soil at a much slower rate. The groundwater level rises and this water brings with it salts from the soil. When the groundwater gets close enough to the surface to be evaporated the dissolved salts are left behind in the surface soil. As more and more water rises to the surface and evaporates, more and more salt accumulates at the surface.

Irrigation of crops increases the amount of water in the soil and speeds up the rise of groundwater and salt to the surface.



Salting of the soil

Adaptations o

Plants of the Mallee shrublands have special adaptations to help them withstand the dry conditions and high temperatures. Most of these adaptations are shown by their leaves because this is where most water is lost.

1. Some physiological adaptations

Besides physical characteristics which we can easily observe there are a number of physiological adaptations that are more complex to understand. Stomates, the pores in leaves, open to allow the exchange of oxygen and carbon dioxide with the atmosphere. As a consequence of opening leaves lose

water by evaporation. Stomates close when the water loss from the leaf becomes too high e.g. eucalypts open their stomates in the early morning but generally close them by late morning on a dry day. Some succulent plants can actually absorb water from the atmosphere in the early mornings when dew forms.

Another physiological adaptation involves the ability to tolerate salty soil conditions. Some plants including *Rhagodia* species, *Enchylaena* species and many succulents absorb salty water through their root system and excrete it as deposits from the stomates in the leaves.

2. Xerophytes

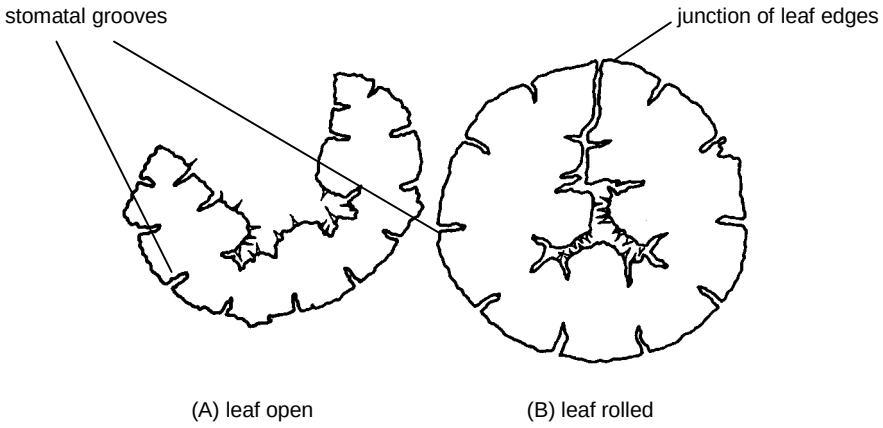
These plants have characteristics which enable them to **survive dry climates**. They do this by :

- **reducing the surface area of their leaves** in order to minimise water loss. They can do this in a number of ways:

  (a) having **tiny leaves** e.g. *Callitris* species, *Phebalium* species

  (b) **rolling their leaves** during the hottest part of the day e.g. grasses such as *Triodia* species (porcupine grass), *Phebalium* species, *Dianella* species (flax lily).

When the leaf is rolled fewer stomatal grooves are exposed to the drying atmosphere.



Section through a leaf of Triodia species

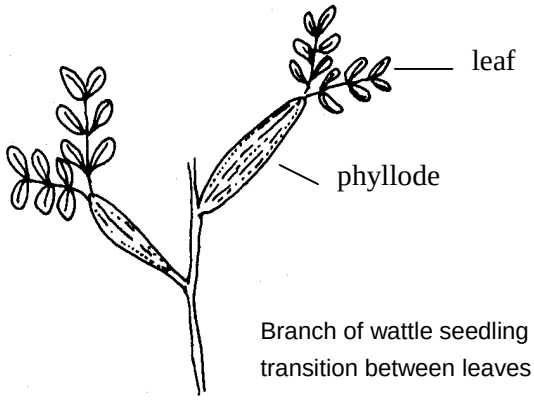
species,
or **needle shaped leaves** e.g. *Hakea* species

- having **leaves which reflect heat and light.**
  Some plants have shiny leaves, with waxy cuticles that reflect heat e.g. *Eucalyptus* species
  Light coloured leaves, especially if they are hairy, reflect significantly more radiant energy than do smooth leaves e.g. *Rhagodia* species, *Eremophila* (Emu Bush).

  These fine, white hairs decrease the air movement close to the surface of the plant, thus reducing water loss by evaporation. More stomates are located on the under surfaces of leaves and it is on this surface that most hairs are found e.g. *Phebalium* species, *Lasiopetalum* species, *Rhagodia* species

- having **leaves which hang vertically and edge-on** to the sun, reducing total surface area exposed to the sun e.g. *Lasiopetalum* species, *Eucalyptus* species

- having **reduced numbers** of leaves.
  In some plants e.g. *Acacia* flattened leaf stems called **phyllodes** have replaced leaves. In others e.g. *Bossiaea* a flattened stem or **cladode** takes on the function of the leaves and the leaves themselves are reduced to tiny spikes. The phyllodes and cladodes do not lose as much water by evaporation as leaves do because they have far fewer stomates.



Branch of wattle seedling showing transition between leaves and phyllodes

- having **very extensive and deep root** systems.
  Many plants have a tap root to reach deep for soil water, and an extensive surface system to absorb water from any small falls of rain. This accounts for the "bare" spaces between eucalypts in Mallee areas. The surface roots out-compete other plants and reduce their chances of becoming established.
  Triodia species are also examples of plants that have a very extensive and deep root system. They also grow in a manner that provides total shade for the soil underneath, and hence reduces its temperature, and reduces water loss after rain or heavy dew.

3. Sclerophylls

These plants have hard, leathery leaves which reduce wilting and thick waxy cuticles which reduce water loss e.g. *Eucalyptu*s species

4. Succulents

These plants store water in fleshy stems or leaves e.g. *Enchylaena* species, *Carpobrutus* (pigface), *Myoporum* species (boobialla) and *Einadia* species and *Atriplex* species (Saltbushes).

5. Ephemerals or Annuals

Ephemerals are plants which last for just a short time (less than one year).

The plants cannot resist heat and drought; however their seeds can. These are drought evaders. The plant completes its life cycle very quickly and sets large quantities of seed which can resist heat and drought

Bracteantha bracteata (Paper Daisy)

for long periods. The seeds germinate quickly when rain comes e.g. *Senecio* species, *Bracteantha* species

6. Some other adaptations

Some coastal Mallee plants, like coastal *Goodenia* species form low, dense bushes; the salt-laden winds blow over the tops. The leaves of these salt tolerators have a thick cuticle. The lower leaves are protected from the salty air.

Some plants produce hard, woody fruits that protect the seeds from drying out, e.g. eucalypt capsules, *Callitris* cones.

Some plants are parasitic and do not have to depend on their own root systems for finding water, e.g. *Exocarpos* species, mistletoes.

7. Special Features of the Mallee Eucalypts

Epicormic Shoot

Mallee eucalypts are specially adapted to cope with fire as well as damage caused by other agents such as frost and attempted clearing.

They shoot vigorously from the **lignotuber**. This is a large underground woody rootstock which stores water and from which new branches can grow when the tree is damaged. They also shoot from dormant (epicormic) shoots which occur just below the bark. Growth from these dormant shoots accounts for the appearance of bright green bushy foliage along main branches of eucalypts shortly after a bushfire.

Student Worksheet ANSWERS

Suggested answers/ discussion points *(in brackets, in italics)*

The sign at the beginning of the Mallee Shrublands walk introduces the Mallee and shows the areas of Australia where it is found. **Mark these areas on the map of Australia.**
(See map at beginning of these notes)

1. The soil in this area of the Gardens is highly modified, with huge amounts of sandy material being brought in. The plantings have also been less dense than in other parts of the Gardens. **Suggest why these measures have been taken.**
(Sandy Mallee soils are porous and do not hold water well; Mallee plants cannot tolerate heavy, water-logged soils. In the Mallee plants tend to be spread out, giving each one greater space to capture surface water with their widespread surface roots.)

2. ***Phebalium*** species, like many Mallee shrubs, are well adapted to the hot, dry conditions of summer. The leaves are small, hairy underneath and curled over at the edges. **Suggest how each of these features might help it survive.**
(Small – means small surface area, so reduced water loss and reduced heat gain from hot sun)
(Hairs – reduce air movement near leaf surface so reducing water loss from evaporation)
(Curled leaves – reduce air movement around under surface of leave, reducing water loss; less area exposed to direct sun)

3. Ephemeral plants are common in Mallee areas. Some plants, like ***Senecio*** species and ***Bracteantha*** species are drought evaders. Find out the meanings of the words ephemeral and drought-evader. **Suggest how these plants are well adapted to Mallee conditions.**
(They are opportunistic in that they germinate, flower and set seed in rapid succession when conditions are suitable ie there's enough moisture about. The seeds are dispersed by wind and remain dormant until the next period of wet. Hence the species survives.)

4. Many plants, including some of the ***Goodenia*** species grow along the southern coastal Mallee areas of Australia and are subject to strong winds and sea spray. **Suggest how they cope with this situation.**
(waxy cuticle so that salt doesn't penetrate, grow as low spreading bushes - wind goes over the top and the majority of leaves underneath are protected)

5. ***Enchylaena tomentosa*** is one of the many different kinds of "saltbushes". It persists throughout the year (perennial). **Suggest a feature that assists it to survive in the driest times.**
(Succulent – holds a lot of water; hairy – reduced air movement near surface and so reduced water loss)

6. ***Triodia scariosa*** (Porcupine Grass) provides excellent habitat for many animals including reptiles. **Suggest why.**
(Physical protection,cool shaded soil underneath and hence reduced drying out of the animals)

If you have a hand lens look closely at the shape of the leaves. **Suggest how the shape is useful in allowing this plant to survive in a dry environment?**
(Rolling leaves reduces surface area for water loss. Sharp spines not attractive to herbivores.)

7. ***Melaleuca uncinata*** (Broombush) gets its name from its branches which are used to make brush fencing, still popular in Adelaide and Melbourne. **Suggest how its leaves allow it to cope with the Mallee environment.**
(Long, narrow – reduced exposure to direct sun so don't heat up. They have a large surface area because of the length, and this helps to increase heat loss from the area not in direct sun)

8. ***Exocarpos*** species (native cherry) is semi-parasitic, attaching its roots to those of nearby plants. **How is this advantageous?**
(It doesn't have to find its own water and mineral nutrients)

9. ***Lasiopetalum behrii*** exhibits a set of adaptations that help it to survive. **Suggest some.**
(drooping leaves and curved edges -- reduces surface area exposed to the sun; reducing water loss. Leaf hairs on under surface – reduced air movement and therefore reduced water loss.)

10. ***Callitris preissii*** subspecies ***verrucosa*** (Scrub Cypress Pine) is an example of a conifer, a tree which bears cones. Conifers do not have flowers. The seed are protected within the scales of the cone. **Suggest why the cone is so thick and woody.**
(protection for seed from drying out and being eaten)

Its leaves are very tiny and wrap themselves around the green stems. **Look closely at the leaves and suggest why mature pines tend to thrive in Mallee areas.**
(decreased exposure of stomates to the air so less water loss)

11. ***Eucalyptus nortonii*** (Large-leaved Box) has a lignotuber and many stems growing from it. Notice other Mallee eucalypts nearby. Lignotubers enable the plants to regrow after fire, drought or other damage. **Suggest how this can happen.**
(The damage triggers special cells in the lignotuber to start producing new stems and leaves. The lignotuber holds a large store of food to provide the energy for this to occur.)

Notice how the leaves hang vertically. **How might this help the tree withstand the harsh conditions of the Mallee?**
(reduced surface area exposed to the sun's heat, leaf doesn't get so hot, reducing water loss.)

12. ***Acacia havilandi*** (Needle Wattle) only has leaves when it is young. What you see here are really flattened leaf stalks called phyllodes. Phyllodes have far fewer stomates than do leaves. **How does this help the plant survive long periods of heat and drought?**
(less pores through which to lose water)

There might be some seed pods or seeds on the ground. The seeds of many wattles remain viable for many years and can survive fires which occur periodically in the Mallee. **How do they accomplish this?**
(hard, thick testa (seed coat) which insulates embryo in the seed from heat and dehydration.)

They often germinate after the first rains following a fire. **Explain how this happens and why it is advantageous to do so.**
(Heat of the fire causes small cracks/weaknesses in the seed coat water soaks in. After a fire there's little or no competition from other plants for soil water, light or minerals from the ash bed)

13. ***Bossiaea walkeri*** (Cactus Bossia), unlike *Acacia havelandi,* does have true leaves but you can hardly see them. These flattened stems are called cladodes. **What is the adaptive value of having such tiny leaves?**
(very few stomates, so very little water loss)

14. ***Melaleuca lanceolata*** is widespread in the Mallee. It tolerates salty soil conditions, indicating that there are probably many more adaptations that we cannot easily observe. Many of these are physiological and relate to the chemistry of life within the plant. Many Mallee species,

including melaleucas and eucalypts produce enormous amounts of very fine seed within hard woody fruits. **Suggest how these factors might be useful for a Mallee plant.**
(many seeds – ensures some will survive (from ants, birds, other foragers);
very small seeds – means they can be widely dispersed by wind and some will find a suitable microhabitat;
woody fruits – protection from fire, foragers and drying out.)

15. ***Rhagodia spinescens*** (another Saltbush) has distinctive grey leaves. **How is this useful for living in hot conditions?**
(reflects heat and decreases evaporative loss)

In the Mallee these leaves often have salt encrusted on the under-surface, yet there might not be a salt lake nearby**. Explain.**
(tolerates salty ground water and excretes it through stomates in leaves)

Note the under-surface of these leaves is quite hairy. **How is this an advantage?**
(reflects heat, reduces air movement around stomates and reduces water loss)

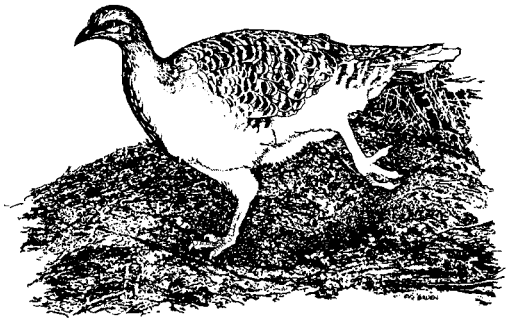
The Malleefowl

Description

The Malleefowl or Lowan (*Leipoa ocellata*) is about the size of a large domestic hen, shades of grey and brown above and white underneath. The back feathers have black and white crossbars and a prominent black stripe runs along the breast.

It prefers to walk or run away from danger, but its flight is rapid when it is cornered.

Although seldom heard, the Malleefowl has a loud, booming call, and is the only mound building bird to live in a dry area.



Habitat

Mallee fowl live in dry areas of woodland and Mallee, and even in the desert, in New South Wales, Victoria, South Australia and Western Australia.

Area of Mallee Shrubland

Food

Seeds (particularly *Acacia* species), berries and tubers are favourite foods but insects are also eaten. The birds search for food amongst the leaf litter.

Mound building

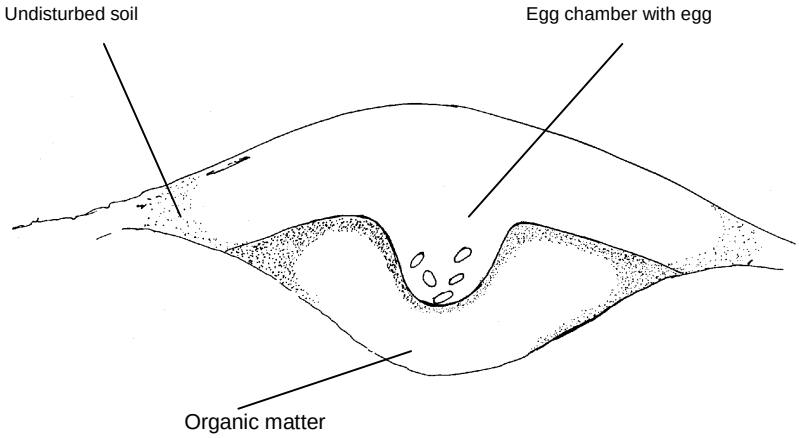
The male digs a hole in the soil nearly a metre deep and 2 metres wide. This is usually done in sandy soil and the work is relatively easy. Leaf litter from around the nest is scraped into the hole, thus filling it with a mixture of leaves, twigs and sand. The bird can drag litter from up to 50 metres around the nest site and the ground nearby becomes quite bare.

The construction of the nest begins early in winter. The male does most of the building and caring for the nest, rarely moving more than 300 metres from it. With the winter rains, the leaf litter in the nest becomes soaked and by August decay begins and the temperature of the mound rises (as happens in a compost heap). The male then digs out an egg chamber in the top of the next. This is a hole 30cm wide by 60cm deep. Sticks are removed and the hole is re-filled with a mixture of broken leaves and

soil. Soil is then heaped back over the nest to form a mound until it has a height of 1 metre and a diameter of up to 6 metres. If there is no rain, the Malleefowl will not nest.

While the male organises the nest mound the female prepares herself to lay the large eggs by eating more food. When she is ready to lay, the egg chamber of the mound is opened by the male. After each thin-shelled egg is laid the male carefully covers it with soil.

A very large egg, weighing about 10% of her body weight, is produced about once a week on average and the final number of eggs laid depends on the season. Between 6 and 30 eggs are laid in a season.



Cross section of a Malleefowl mound

The male has the job of keeping the egg chamber at a constant temperature of 33°C. This is quite a challenge when the air temperature can range from below freezing at night to more than 38°C during the day.

Malleefowl chick

In order to achieve the required stable temperature, the male tests the temperature of the mound each morning by pushing his beak into the soil. The temperature is measured with the lining of the mouth or the tongue. If too hot, the bird opens the mound in the early morning to cool it down. In the cooler weather of autumn the mound is opened around mid-day and the sun's energy warms it.

Each egg takes 7-9 weeks to incubate and after hatching the well-developed chick must push its way to the surface. The chick emerges from the mound dry and fluffy and after a short rest walks swiftly off into the surrounding scrub. It doesn't recognise its parents and can fend for itself as soon as it leaves the mound.

Predators

Foxes are a great threat to the Malleefowl and they are feared by the adult birds. The native goannas, hawks and dingoes also eat them.

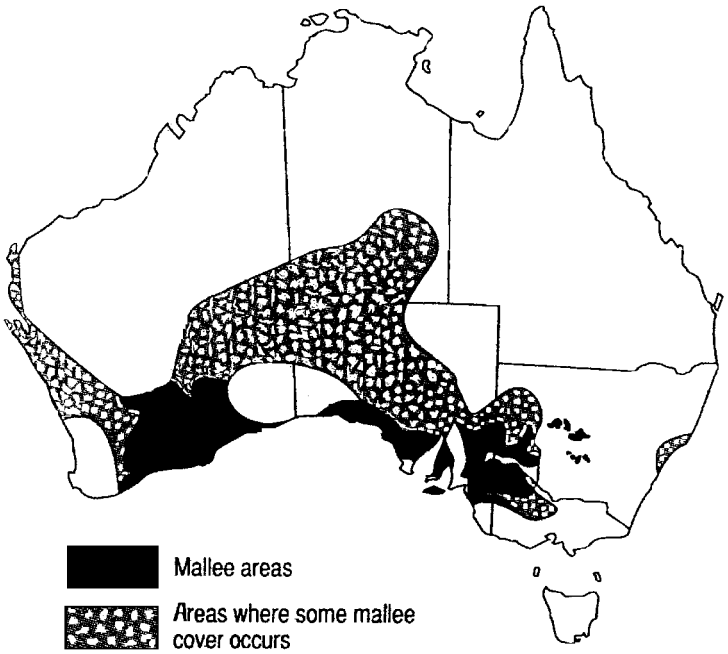
Life Cycle

Birds are mature at 2 years and may live for 25 years. They live singly or in pairs.

Conservation Status of the Malleefowl

Australia-wide the Malleefowl is considered VULNERABLE. Its conservation depends on active management of habitat areas.

Distribution of the Malleefowl



Distribution of the Malleefowl : past and present.
Solid area- present distribution; stippled area- prior distribution.
(Source : Blakers et al, *1984)*

The Brush Turkey

This is another Australian bird which makes mounds to incubate its eggs. It lives in tropical and subtropical rainforest areas. Students may be interested in comparing this bird and its habitat with the Malleefowl.

Changing Views of the Mallee

These quotes could be used as stimulus material for creative writing about this complex and very special environment.

"Mallee is one of the most barren regions in the world ...there were tufts of a prickly bush, which tortured the horses and tore to rags the men's clothes about their ankles."

Thomas Mitchell, Explorer 1836

". . . a more worthless sand-desert country, in its natural state, cannot be imagined. There is plenty of vegetation, but it is useless."

William Lockhart Morton, Explorer 1861

"The monstrous and dismal look of an extensive scrub is depressing. The equal height of the vegetation, the dull glaucous colour of the foliage, look in the distance like a rolling sea reaching the horizon."

Dr Richard Schomburgk, SA Government Botanist 1876

"The wholesale destruction of timber in the Mallee, which has brought about terrific dust storms now almost threatening to drive the settlers off the land, has also been the cause of the departure of many birds."

Shaw Neilson, Poet 1938

"Grazing herds of kangaroos broke our approach, astonished emus popped up, . . . Pink clouds of galahs and Major Mitchell cockatoos exploded, reformed and wheeled to scream at the intruders and the deep golden regent parrots flew eastward at incredible speeds to their morning drink. An occasional sandhill stood high above the rest and from these hills could be seen a sea of Mallee stretching to the horizon in every direction. It was a real wilderness . . . it is a delight to the naturalist."

R Kenyon, Naturalist 1968

"Unfortunately the ecological diversity, complex forms of adaptation of Mallee flora and fauna, the role of Mallee vegetation in maintaining soil stability and regulating soil water tables and its intrinsic conservation and scientific values have not been understood or appreciated by the majority of Australians since the earliest colonial days."

Dr Malcolm Calder, Botanist 1989.

Mallee Bibliography (August 1998)

The Australian Environment – Deserts
V. Serventy. Hodder and Stoughton, 1982
Good photos and diagrams, written in an easily understood style.
Good for primary students.

Deserts and Woodlands Activity Book
D. Pugh. Rainforest Publishing, 1987
Excellent drawings and activities. Suitable for primary students.

The Mallee in Flower
I. McCann. Victorian National Parks Association, 1989
Beautiful photos of plants from the Mallee of Victoria, eastern South Australia and southern New South Wales.

The Flowers of Central Australia
A. Blombery. Kangaroo Press, 1989
Many plants depicted in this book occur in the Mallee. Some very good photos.

Birds of the Victorian Dry Country
Gould League of Victoria, 1976
This book has sections on land use in the Mallee as well as plants and animals of the Mallee.

Malleefowl – the Incubator Bird
P. Reilly. Kangaroo Press, 1990
A simple story with beautiful illustrations, suitable for primary students.

Mediterranean Landscapes in Australia – Mallee ecosystems and their management
Edited by J. Noble and R. Bradstock, 1989
This is a readable though quite scientific book, containing the latest information on many aspects of the Mallee ecosystem.

The Mallee Lands – A Conservation Perspective
Edited by J. Noble, P. Joss, G. Jones
A CSIRO publication, it is composed of the proceedings of the National Mallee Conference, Adelaide, 1987
A similar publication to the one above, contains some excellent general and specific information particularly for senior students.

Habitat – Australia
Journal of the Australian COnservation Foundation August 1989 and June 1990
These contain very good articles which consider the future of the Victorian Mallee

ECOS Number 46, Summer 85/86
CSIRO publication on science and the environment
Two articles : Fire in the Mallee and Irrigation and Salinity

ECOS Number 56 Winter 88

Article titled *Oil from Eucalypts*

Search – Science and Technology in Australia and New Zealand
March/April 1987
Salinity and waterlogging in the Murray-Darling Basin. For senior students.

Australian Natural History
Volume 21 Number 4, 1984. The Malleefowl.

Some pre-visit and post-visit ideas

1. **Animals** of the Mallee are also very well adapted to the conditions which exist there.
   Find out about some of the following animals. Include a description of the animal, what it eats, where it lives, its reproduction, how it is specially adapted to the hot, dry conditions of the Mallee and any predators it has.

Malleefowl	**grey kangaroo**
stumpy-tail lizard	**hairy-nosed wombat**
echidna	**Mallee black-faced Kangaroo**
pigmy possum	**Mitchell's hopping mouse**
Gould's sand goanna	**red-lored whistler**
Mallee ringed parrot	**emu**

2. Mallee lands are under threat in a variety of ways.
   Choose two of the following and find out how it threatens these areas.

   - broombush cutting
   - feral animals, e.g. rabbits, cats and goats
   - grazing and farming
   - wind erosion

3. Write a story of 1-2 pages describing your life as an early settler/farmer in the Mallee

   or

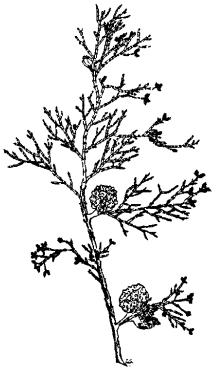
   Write a story about your life as a member of an Aboriginal group living in the Mallee lands near the Murray River before the Europeans arrived.

4. Much of the Mallee has been cleared for farming, particularly agriculture. Find out about measures that are being undertaken to conserve remnant bushland.

5. The dust storms that hit Melbourne in 1984 were very dramatic and some excellent photographs were published at the time and since. To people living in Mallee areas dust storms are not unusual. This time the Mallee blew into Melbourne, and even dirtied the snow in New Zealand. Find out how land management practices are changing in order to protect the soils that remain.
6. Here are three plants of the Mallee. Each has characteristic that are special to the natural ecosystem and/or to people. Investigate these plants further, and other Mallee plant in terms of their importance to:

- native animals
- traditionally living Aboriginal people
- people today

Scrub Cypress Pine (*Callitris preissii* subspecies *verrucosa*)
Qld, Vic, SA, WA

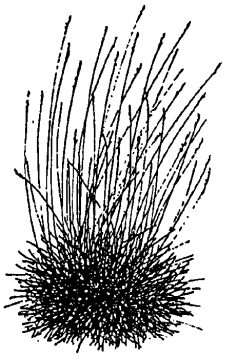


- A slender, erect tree which grows to about 15m.
- Small leaves which adhere very closely to the stem.
- Produces large warty cones.
- The seeds have two narrow wings.
- Timber is resistant to termites.

Broombush (*Melaleuca uncinata*)
NSW, Vic, SA, WA, Qld

- Tall shrub to 5m which can withstand dry conditions.
- The fluffy, cream flowers appear in spring and summer.
- This shrub is cut and dried to make brush fencing.
- Leaves chewed by Aboriginal people to alleviate colds and respiratory complaints.

Porcupine Grass (*Triodia scariosa*)
NT, SA, NSW, Vic



- Often wrongly called ‘spinifex’.
- Clump-forming grass with sharp, stiff leaves.
- Leaves curl tightly to reduce surface area.
- Resin from the base of the leaves of other *Triodia* species was used as a fixative by Aboriginal people.
- Very important as a refuge and foraging area for reptiles and small mammals.