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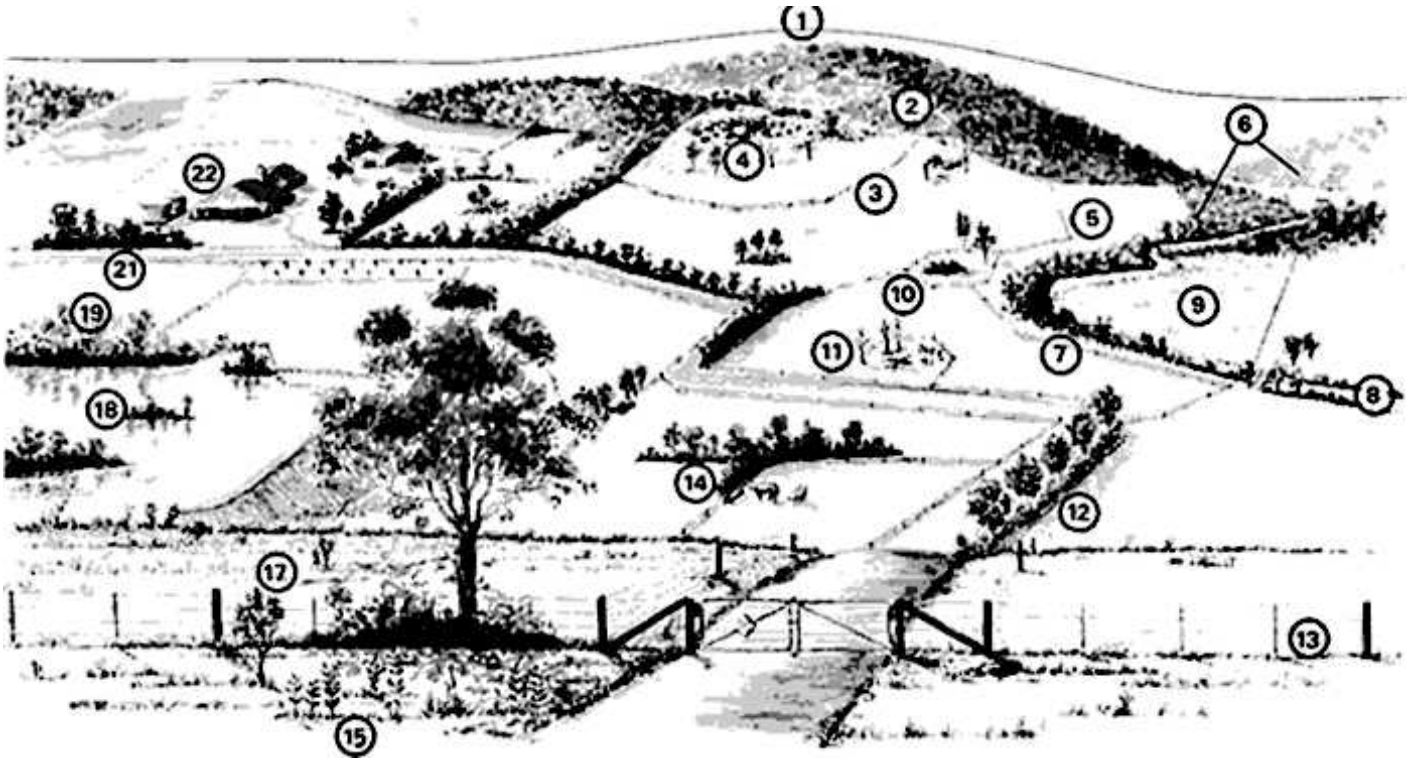
Contents

2. 22 ways to integrate wildlife conservation with farm management

What you can do.

The following list of points for integrating wildlife conservation with farm management are more fully explained in other Notes in this series.

1. Retain & protect remnant vegetation.
2. Allow leaf litter, fallen logs & branches to accumulate in all habitat areas (not "cleaned").
3. Fence areas near native bush to allow regeneration.
4. Retain & protect rocky areas. Native grasses provide drought fodder.
5. Fence to restrict livestock access to sensitive areas such as streambanks, rocky areas.
6. Provide vegetation 'corridors' along streams & between properties.
7. Vegetate stream banks with local native species such as gums, wattles, native ferns and grasses.
8. Leave river snags in place as fish habitat.
9. Fence natural wetlands and allow them to flood (not drained).
10. Fence remnant trees to encourage regeneration.
11. Preserve dead trees with hollows.
12. Protect embankments with local native plants.
13. Place wombat gates in fence lines to allow access without damage.
14. Plant local native trees, shrubs and grasses to shelter livestock.
15. Protect roadside remnants. Save native grasses for fire prevention. Encourage regeneration.
16. Use pesticides and fertilizers wisely away from habitat areas.
17. Place fire breaks inside fences where native species are outside the fence. Alternatively, place a new fence inside the existing fence to encourage regeneration in the paddock.
18. Construct a 'Wildlife Dam' (with an island or peninsula, shallow edges, natural vegetation, flight path, fenced, siphon water to troughs).
19. Leave standing & fallen timber in and around dams.
20. Encourage regeneration or plant local native trees, shrubs, and grasses to assist salinity and erosion control on slopes/ watercourses.
21. Protect the homestead from fire with local native fire-retarding species. Keep development compact.
22. Control pets (particularly at night).



3. Creating habitat corridors for wildlife

Why create habitat corridors?

Clearing of land for agriculture, urban development and many other changes to the natural environment have greatly reduced the amount of habitat available to wildlife in Victoria. The fragments of natural vegetation that remain are often small and isolated from one another by man-made environments, such as open pasture and housing, which can act as barriers to wildlife movement.

Wildlife is constantly on the move. The search for food, dispersal of young to new home ranges and annual and seasonal migrations are essential wildlife movements. But wildlife in a habitat 'island' may have no adjacent habitat to forage in or disperse along.

Animals in an 'island' situation are vulnerable to catastrophes such as disease and bushfire, and to gradual changes like inbreeding and variations in climate.

Single 'islands' may not provide all the resources one species requires for food, shelter and breeding. Each habitat `island' is thus not reaching the potential it could have if connected to other natural areas which may contain these resources.

Links between isolated stands of vegetation can allow migration to replenish a declining wildlife population or recolonise an area where a wildlife species has become locally extinct.

Habitat corridors, or strips of natural vegetation connecting 'island' habitats, have been proposed as a means of re- connecting isolated populations of wildlife. A system of corridor links is more likely to sustain wildlife populations throughout the fluctuations and catastrophes that they inevitably undergo. Thus, habitat corridors can increase the value of existing isolated habitats.

Where?

A habitat corridor may exist across any landscape and between habitat `islands' of any size but they are best designed to follow natural environmental contours. The Murray river forms a natural corridor of forest vegetation where it passes through the mallee region of north-western Victoria. Remnant corridors of native vegetation exist along many of our country roads, disused stock routes and railway reserves; and planted corridors, like farm shelterbelts and windbreaks, have been created by humans.

What a corridor should include:

Important components of a wildlife corridor are:

(i) that the corridor be continuous and link areas of wildlife habitat;

(ii) that the corridor provide a diverse natural vegetation.

All forms of vegetation (trees, shrubs and ground cover, including fallen logs and leaf litter) should be represented where these are natural to the area;

(iii) that the corridor be wide enough, and have suitable habitat, for the animals to live in as well as to move through; and

(iv) that the corridor is managed in a way that maintains the habitat requirements and other resources required by wildlife (see LFW Note No.4).

Some steps you can take:

Streamsides, disused stock routes and areas adjacent to roads, rocky hilltops, along fencelines and disused railways are all places where habitat corridors might be created in cleared land. Co-operative action between several landowners may be necessary to link habitat areas. The exact location of corridors on a property should fit in with the overall plan for the property having taken into account the various management options for each area. See Whole Farm Planning2.

Streamsides and their associated vegetation are high value areas for protection or restoration as habitat corridors for wildlife. Limiting stock access with a fence along most of the streamside will protect the bank from erosion and enable any remaining native vegetation to regenerate. Improved water quality, flood mitigation, erosion protection, land conservation and recreational fishing are additional benefits.

Replanting or seeding the bank with local riverside native plants may be necessary if very little is left of the original vegetation. Check the General Reference List for help in identifying which plant species are appropriate or contact the Department of Environment, Land, Water and Planning. Local native vegetation can prevent erosion - it has been doing so for hundreds of years. Willows and other introduced species have little value for Australian wildlife, however, you may find that leaving such trees in place, whilst you establish natives, then removing them as the natives develop, will maintain control of the river bank.

Improve the value of roadside reserves to wildlife by not grazing these areas except in extreme circumstances and by placing firebreaks inside the fence-line. Avoid disturbing native grasses along the roadside by cultivation or more fire-prone introduced species such as Phalaris are very likely to take over. Consider the value of replacing an old fence with a new fence inside the existing one to allow for natural regeneration from seeds thrown by natural roadside vegetation. This technique can double the width of the vegetated corridor with minimum effort. It also provides a potential wood supply and shelter for stock in extreme weather. It may be necessary to lightly scarify compact paddock soil. Do so when seeds in adjacent natural vegetation are ripe (month depends on the species)[1].

Shelterbelts and windbreaks can also act as habitat corridors for wildlife. Try using local native species and planting a wide range of plants including trees, shrubs, and ground covers. Remember that tree and leaf litter, and topsoil are all elements which enhance suitability for native fauna. The more diverse your shelter belts can be in this regard, the better the chance of them withstanding extreme conditions or natural disasters without special management. Planted corridors can extend existing strips of natural vegetation, or they could provide links across open farmland between patches of bushland.

There are many opportunities to incorporate corridors into a Whole Farm Plan[2]. They may benefit not only wildlife, but also the ecological balance and health of the rural and urban environment.

References:

1. *How to Collect Native Tree Seed Easily*, Greening Australia
2. Garrett, B.K. (ed)(1988) *Whole Farm Planning, Principles and Options*, Department of Conservation and Environment.

Further Reading:

Breckwoldt, R. (1986) *The Last Stand,* pp 11-18, AGPS, Canberra;

Breckwoldt, R. (1983) *Wildlife in the Home Paddock*, Chapter 3, Angus & Robertson, Aust.

4. Wildlife management considerations on private land – a summary

Introduction

Why are our native wildlife species disappearing? Understanding the causes for the decline in wildlife populations can assist us to change the way in which we manage land so that we make a positive contribution to the conservation of wildlife whilst at the same time looking at better ways of managing the land for sustainable production without harmful side-effects. Wildlife conservation and wise land use are compatible and can be complementary. For example, encouraging birds and bats can reduce pasture insects, thereby improving overall productivity. Without changing the way we manage private land the scenario of decline and extinction of wildlife species will continue.

This Note explores some reasons for the decline of wildlife populations on private land in Victoria. The emphasis is on providing examples of alternative management that would reduce the effects of each 'threatening process'. These might be viewed as goals to work toward in managing your property within your own constraints and may be applicable to areas designated for management as wildlife habitat within the range of management demands for the full property. Management strategies compatible with maintaining the quality of wildlife habitat are shown in italics. These strategies should be incorporated into property management plans wherever possible.

The principal causes for the decline in wildlife populations are 1. Habitat destruction, 2. Habitat change and degradation, 3. Introduced animal competitors and predators.

How to maintain wildlife habitat - a list of threatening processes.

Clearing / habitat removal: Removal of habitat is obviously disastrous for wildlife as all food, shelter and breeding sites are completely removed. Erosion and salinity are other problems associated with clearing.

Avoid clearing wherever possible. Ensure that at least some mature forest remains on the property because of the time involved to replace it. (Tree hollows may take between 100 - 300 years to form).

Isolation and fragmentation of wildlife habitat by clearing limits the movement of wildlife species and can result in patches of habitat with smaller populations of a species in each patch. Such populations may be less viable because of the limited resources and mates available and can die out.

Habitat corridors along rivers, roads and between properties can reduce this threat.

Barriers such as river dams, roads and fences can restrict wildlife movement (refer to LFW **Note No. 3**). Avoid creating barriers. Modify structures e.g., place fish ladders beside dams, wombat gates in fences.

Grazing animals (sheep, cows, goats, horses, rabbits, etc) may selectively remove young plants, reduce seed set by eating flowers and destroy cover used by many species of wildlife. Large animals can also compact the soil so that water cannot penetrate, and microscopic soil plants and animals are killed. This can prevent new plants growing.

The overall result is a major change in the structure and composition of vegetation which can be to the detriment of wildlife. Grazing can, in effect, be de facto clearing, due to lack of regeneration, if continuous over a long period.

Fencing off sensitive or special areas will provide protection. Some areas of natural vegetation are useful for summer grazing or drought fodder only and restricting stock access to non-sensitive times (e.g. after flowering and seed set) will reduce the impact of stock without completely closing off the area to production.

Mowing has much the same effect as grazing. Avoid mowing in habitat areas, particularly when ground plants are flowering and setting seed.

Introduced species compete with wildlife for resources and prey on wildlife (see predation). Non-native plants replace native ones and, in the process, change wildlife habitat, often to the detriment of the wildlife.

Avoid introducing non-native plants and animals. Control those that already are present in habitat areas.

Weeds can replace local native species and invade native bushland, changing its structure and composition. They are assisted in doing this by soil disturbance (either mechanical or by introduced animals) and the application of fertilizers. Introduced plants (plants foreign to Australia or native but not naturally growing in your area) are generally less desirable for wildlife conservation because the local wildlife has not evolved to make use of them. Stock can spread weeds either in their faeces or through feed. Avoid disturbance to natural bushland. Plan to control or remove weeds from wildlife habitat. Prevent stock grazing in sensitive or special areas.

Predation by introduced predators such as foxes, cats and dogs is a major threat to wildlife. Control of foxes, feral cats and dogs and alternative management of your pets, such as restraining them at night, should be considered.

Changes to the soil: The return of nutrients to the soil through decay is vitally important to the health of vegetation. Soil microorganisms assist this process and improve the structure and composition of the soil for plants.

Allow fallen leaves, branches and logs to lie on the ground and rot. These also provide wildlife with shelters, food and cover when hunting. Fence off sensitive areas. Avoid soil contamination with residual chemicals that may be harmful to soil micro-organisms.

Soil erosion removes fertile topsoil and places it in streams, dams or lakes as sediment often destroying wildlife habitat along the way. Erosion can reduce the land's capacity for production. Sediment fouls fish habitat and water supplies. Erosion prevention measures such as leaving steep areas covered in natural vegetation may be integrated with wildlife habitat. Stream banks are best surrounded by a natural vegetation buffer (20m is the recommended width).

Soil compaction (see Grazing): Excessive trampling by heavy animals, vehicles or people can compact soil so tightly that seeds are unable to germinate and small soil organisms cannot exist. It can cause a lack of regeneration of plants, just as can direct removal via grazing. Avoid moving heavy vehicles about in native vegetation. See Grazing.

Soil disturbance from cultivation, weeding, walking paths, vehicles, etc. Many weeds are suited to invading disturbed natural vegetation. Plan to avoid this type of disturbance as much as possible. In particular, avoid soil disturbance in natural vegetation. This may have implications for vermin control techniques.

Fertilisers promote the establishment of weeds in remnant vegetation. They can also be harmful to fish populations if washed into streams or dams, by promoting algal growth.

Use fertilisers wisely and in appropriate areas. Avoid applying fertilisers to native vegetation.

Pesticides can be harmful to wildlife by accumulating in the food chain. They may also be directly harmful to many species. The increased presence of insect-eating birds, bats and other animals in habitat managed for wildlife should reduce the need to use these chemicals which are also dangerous to human health. Soil organisms may also be killed. Avoid using pesticides in habitat areas. Pesticides should not be used near to rivers as they can be harmful to fish. Wise use of pesticides is recommended and only where necessary.

Fire is an essential part of the natural environment. At the same time, it can be a threat to human safety. Many types of native vegetation require burning every so often to enable seeds to germinate and other processes to occur although not all plant communities will benefit from burning. For example, rainforest communities do not tolerate severe fires. The frequency, intensity and timing of fires are important. Without the changes brought about by fire, many species of wildlife that are adapted to use vegetation during a defined period following fire will die out. Where the road reserve adjacent to the property contains native vegetation, plan to place firebreaks inside the fence line rather than outside. The tillage will benefit your ground in any case. To maintain a healthy bushland, consider the benefits of a controlled 'natural' burn at frequencies similar to the natural regime. This activity will also reduce the fire carrying capacity during the fire season. Follow CFA fire prevention principles when determining where vegetation is located and when burning can take place. Imitating the natural fire regime wherever possible will maintain the integrity of the vegetation.

Disease / dieback: Disease can spread rapidly throughout vegetation and wildlife. Most natural populations will be able to survive the effects of disease. Contrary to this are examples of vegetation or wildlife under stress from significant changes to the environment which may result in dieback[1] (refer to Campbell et al. 1988). In such cases, disease may irreparably destroy vegetation and wildlife.

Maintain the health of vegetation and wildlife by managing wildlife habitat similarly to the natural system for that vegetation type. Avoid major changes to natural vegetation. Do not introduce soil from other areas onto your property as it may contain new plant diseases. Propagate from seeds instead or use soil-sterilized nursery stock. Avoid isolating plants into small, unprotected clumps.

Altered flood regimes/ drainage of wetlands: Floods play an important role in rejuvenating the soil, in creating habitat for waterbirds and providing areas for tadpoles and young fish to grow up. The management of wetlands on a property to permit flooding may need to be considered by all the landholders in the catchment and the local water authority. Flooding through irrigation can be detrimental to the soil and wildlife habitat because of the extensive areas covered and the frequency of these artificial 'floods'. The effects of salinity can also destroy wildlife habitat.

Allow wetlands to flood. Avoid drainage. A natural flood regime is desirable for wildlife.

Rock removal: Rocks provide shelter for wildlife. Rocks are an important part of wildlife habitat and should be left wherever possible. Loose rocks are particularly important.

Wildlife collecting occurred indiscriminately in the past for the pet trade and overseas collectors. All wildlife is protected in Victoria and may only be kept in captivity with an appropriate authorisation under the Wildlife Act 1975.

Make sure that illegal collecting is reported and encourage your family to appreciate wildlife in its natural environment.

Disturbance: Many native species, especially ground-frequenting birds, will not establish if continually disturbed by dogs and cats. Disturbance by humans can also be a problem for some wildlife species. Feeding wildlife disturbs natural foraging activities and makes wildlife dependant on food supplies that are unreliable.

Control the activities of pets and observe wildlife cautiously. Avoid regular free-feeding of wildlife.

Firewood collection: Many wildlife species (e.g. goannas, echidnas, tree frogs) require dead trees with hollows, fallen logs and litter (bark, twigs and leaves) as part of their habitat. Pole stands of production timber are generally not suitable for wildlife.

Plan firewood needs with these considerations in mind.

Timber harvesting: ***S***ee soil disturbance and compaction, firewood collection. Avoid harvesting in habitat areas by creating a woodlot or harvest selectively to avoid the removal of hollow-bearing trees and major forest disturbance.

Reference:

1. Campbell, R. et al. (1988), *Victoria Felix: Improving Rural Land with Trees,* Department of Conservation. Forests & Lands, Monash University.

Further reading:

Leigh, J. et al, (1984), *Extinct and Endangered Plants of Australia*, MacMillan.

Koehn, J. & O'Connor, W.G. (1990), Threats to Victorian native freshwater fish, *Victorian Naturalist*, **Vol 107.**

6. Wildlife needs natural tree hollows

What is the importance of tree hollows to wildlife?

Tree hollows are a valuable, and often essential, resource for many of Victoria's wildlife species. They offer refuge from the weather and predators, and safe sites for breeding. Removal of hollow-bearing trees from an area will lead to the displacement or death of wildlife dependant on those hollows.

Recent wildlife research has highlighted the importance of remnant hollow-bearing trees on private land. Two species of bats were captured and radio-tagged at their foraging site in young forest in the Strzelecki Ranges, South Gippsland. To the amazement of the researchers, who followed the bats in a plane, females of one species returned to a large Manna Gum on private land some thirteen kilometres from the point of capture and over six kilometres from the forest boundary. The single tree contained hundreds of bats of several species including mothers producing milk. The young forest in which the bats were foraging did not provide suitable hollows for females to roost although males did use the younger trees.

This research highlights the importance of remnant habitat, particularly large old hollow-bearing trees, on private land. Such trees may be used as bat nurseries for many generations.[7]

The Red-tailed Black Cockatoo is a hollow-nesting species which is endangered in Victoria. In a study of the species in Western Victoria[1], Leo Joseph (1989) found that of twelve nest sites located, all were on private land and ten were in dead trees (generally Red Gums) on cleared agricultural land close to their bushland foraging areas.

Large dead trees with hollows, on private land, are clearly very important to the survival of this species where live trees with suitable hollows are no longer available.

What type of hollows do wildlife need?

Animals do not select hollows at random; factors such as entrance size and shape, depth, degree of insulation, etc. greatly affect the frequency and seasonality of hollow use.

Hollows in fallen timber are also used by wildlife. Some native fish use hollow logs in streams for shelter and egg attachment. Under-bark 'hollows' are used by bats, lizards and invertebrates.

A range of hollow sizes and shapes is necessary[2]. Large hollows are not necessarily best; hollows with an entrance diameter larger than 15 cm are probably not preferred by many species. The great majority of hollow-users prefer small entrances through which they can just fit. These range from narrow cracks for bats to larger (12-15cm) diameter holes for the Common Brushtail Possum and cockatoos. Many hollows lack suitable characteristics and so are unsuitable for use by wildlife.

One hollow may be used by more than one species in a year[3]. One individual may use several hollows. For example, individual Squirrel Gliders were found to use up to six hollows over a twelve month period[4].

Many wildlife species use hollows but are not dependent upon them. For example, echidnas may shelter in a burnt- out hollow at the base of a tree.

How do hollows form?

Young trees are usually strong and healthy. They do not contain hollows suitable for wildlife. As trees age they are subject to the natural forces of wind, fire, heat, lightning, rain and to attack from insects, fungi, bacteria, termites, beetles and so on. Although the outer living skin of the tree may remain healthy, the inner dead wood can be digested by fungi and excavated by water, be chewed up and carted away by termites or burnt out by fire. The resulting hollow branches and trunk provide the hollows used by wildlife. Many species of wildlife will further fashion the trunk using beak, teeth or claws. Some eucalypts shed their lower branches as they reach maturity

(self-prune) exposing the point of branch attachment and thus opening the developing hollows for use by wildlife.

How long do hollows take to form?

The rate of hollow formation is dependent on the species of tree and its history. As a general guide, small hollows in eucalypts, suitable for wildlife such as Feathertail Gliders, will take about one hundred years to form. Medium-sized hollows, such as those used by small parrots, will form in two hundred years, whilst the very large hollows, necessary for large cockatoos and owls may take even longer[3,5]. It is important to note that hollow-bearing trees are a resource that takes a very long time to replace, if removed.

What tree species produce hollows?

Gum trees are the major hollow producers in Victorian forests[2], particularly those with 'Gum' (smooth) bark. River Red Gum is probably the best-known hollow producer. Manna Gum, Mountain Grey Gum and Swamp Gum are others. As a general rule, species of Symphomyrtus (a sub- genus of Eucalyptus) form hollows more readily than Monocalyptus[2] (refer to a reference such as Costermans[4] for the names of eucalypts in this group). Other native tree and shrub species, such as Callitris (native pine), may also produce hollows used by wildlife.

Most introduced trees, such as willows, pines, and conifers, do not produce hollows used by Victoria's wildlife.

How many hollow trees per hectare?

To provide for the requirements of the full range of wildlife species in an area over time there needs to be enough hollow-bearing trees to meet the current requirement for hollows and, in addition, sufficient recruitment of immature trees into the age group that provides hollows to replace those that are lost. As a general guide, three to ten hollow-bearing trees, with as many as thirty hollows, may be required per hectare to support a diverse wildlife population. This figure will vary depending on the number of wildlife species, habitat type and so on. Note that many hollow entrances are small and may not be visible from the ground.
Fewer hollow-bearing trees does not necessarily mean fewer individuals of each wildlife species surviving. As the number of hollows is reduced, larger, more aggressive hollow users, such as Common Brushtail Possum, will take over the available hollows forcing smaller species to utilize less satisfactory shelter and consequently suffer increased exposure to weather and predation. Thus, providing a reduced number of hollows will not necessarily result in the conservation of all the species of hollow users. It may simply allow a few large aggressive species to persist at the expense of smaller species whose conservation status is often more precarious[2].

Hollows must be considered as part of an ecosystem. If suitable food sources are not within reach of hollows their value to wildlife is clearly restricted.

Sugar Glider occupying its leafy nest in a tree hollow.

(Photo: B. Golding/courtesy of Monash University[7])

What species of wildlife use hollows?

Gliders, possums, ducks, kookaburras, owls, tree martins, parrots, kestrels, falcons, kingfishers, echidnas and bats are some of the wildlife species that use tree hollows (a full list is given below).

Introduced species can also use hollows. These species, which include the Common Myna, Starling and introduced bee, should be discouraged from using hollows required by native wildlife.

What you can do.

1. Retain mature hollow-bearing trees, whether alive or dead and even if you only have a few.

2. Plant species native to your area that produce hollows.

3. Ensure that some trees are always left to grow to maturity so that the supply of hollow-bearing trees is continuously replenished. Timber use, for firewood or construction, should be planned to accommodate this.

4. Discourage introduced species from using hollows.

References

1. Joseph, L, (1989) *Report on the status of the Red-tailed Black Cockatoo (Calyptorhynchus banksii graptogyne) in Victoria*. Department of Conservation, Forests and Lands, Victoria.
2. Menkhorst, P., Pers comm.
3. Menkhorst, P.W. (1984) Use of Nest Boxes by Forest Vertebrates in Gippsland: Acceptance, Preference and Demand, *Aust. Wild. Res*., **1984, 11**, pp 55-64.
4. Costermans, L. (1983) *Native Trees and Shrubs of South-Eastern Australia*, 2nd ed. Rigby Publishers.
5. Mackowski, C.M. (1984) The ontogeny of hollows in Blackbutt (Eucalyptus pilularis) and its relevance to the management of forests for Possums, Gliders and Timber, pages 553-67 in *Possums and Gliders*, ed. by A.P. Smith and I.D. Hume, Australian Mammal Society, Sydney,1984.
6. Calder, T.G., (1983) Management for arboreal species in the Wombat State Forest, Monash Univ. Grad. Sc*. Env. Sci., Env. Rep*. **No. 16**. p 7. Cherry, K., Pers comm.

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CONTENTS

A list of hollow-using wildlife for Victoria

(Mammals, birds, fish, invertebrates, reptiles and amphibians.)

Hollow dependent
+ uses hollows but is not dependent on them,
F Reptiles and amphibians that use small crevices, gaps under bark, standing and/or fallen timber. Fish listed here use submerged hollows for shelter and egg attachment.

Mammals

+	Montremes	Short-beaked Echidna
#	Dasyurids	Yellow-footed Antechinus
#	Dasyurids	Brown Antechinus
+V	Dasyurids	Tiger Quoll
#R	Dasyurids	Brush-tailed Phascogale
#	Brushtail Possums	Mountain Brushtail Possum
+	Brushtail Possums	Common Brushtail Possum
#	Pygmy-possums	Feathertail Glider
+	Pygmy-possums	Western Pygmy-possum
+	Pygmy-possums	Eastern Pygmy-possum
#E	Gliders and Ringtails	Leadbeater's Possum
#	Gliders and Ringtails	Yellow-bellied Glider
#	Gliders and Ringtails	Sugar Glider
#R	Gliders and Ringtails	Squirrel Glider
#	Gliders and Ringtails	Greater Glider
+	Gliders and Ringtails	Common Ringtail Possum
#?	Sheathtail-bats	Yellow-bellied
#	Mastiff-bats	Little Mastiff-bat
#	Mastiff-bats	White-striped Mastiff-bat
#	Vesper Bats	Gould's Wattled Bat
#	Vesper Bats	Chocolate Wattled Bat
#	Vesper Bats	Eptesicus baverstocki
#	Vesper Bats	King River Eptesicus
#	Vesper Bats	Large Forest Eptesicus
#	Vesper Bats	Little Forest Eptesicus
+I	Vesper Bats	Large-footed Myotis
#	Vesper Bats	Lesser Long-eared Bat
#	Vesper Bats	Gould's Long-eared Bat
#R	Vesper Bats	Greater Long-eared Bat
#	Vesper Bats	Great Pipistrelle
#	Vesper Bats	Western Broad-nosed Bat
#I	Vesper Bats	Eastern Broad-nosed Bat
#X	Rats and Mice	Rabbit-eared Tree Rat - now extinct

Birds

I#	Black-Cockatoo	Glossy
E#	Black-Cockatoo	Red-tailed
#	Black-Cockatoo	Yellow-tailed
#	Budgerigar	Budgerigar
#	Cockatiel	Cockatiel
#	Cockatoo	Gang-gang
I#	Cockatoo	Pink
#	Cockatoo	Sulphur-crested
#	Corella	Little
#	Corella	Long-billed
#	Dollarbird	Dollarbird
#	Duck	Maned
+	Duck	Pacific Black
+	Falcon	Peregrine
#	Galah	Galah
+	Kestrel	Australian
+	Kestrel	Sacred
#	Kookaburra,	Laughing
#	Lorikeet	Little
#	Lorikeet	Musk
#	Lorikeet	Purple-crowned
#	Lorikeet	Rainbow
#	Martin	Tree
*+	Myna	Common
R#	Owl	Barking
#	Owl	Barn
I#	Owl	Masked
R#	Owl	Powerful
R#	Owl	Sooty
#	Owl	Southern Boobook
#	Owlet-nightjar	Australian
+	Pardalote	Spotted
+	Pardalote	Striated
+	Pardalote	Yellow-rumped
#	Parrot	Australian King
#	Parrot	Blue Bonnet
#	Parrot	Blue-winged
#	Parrot	Elegant
#	Parrot	Mallee Ringneck
#	Parrot	Mulga
#	Parrot	Red-rumped
R#	Parrot	Regent
R#	Parrot	Superb

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Birds (cont)

R#	Parrot	Turquoise
+	Robin	Flame
#	Rosella	Crimson
#	Rosella	Eastern
#	Rosella	Yellow
+	Shelduck	Australian
+	Shrike-thrush	Grey
*+	Starling	Common
+	Thornbill	Buff-rumped
#	Thornbill	Chestnut-rumped
#	Treecreeper	Brown
#	Treecreeper	Red-browed
I#	Treecreeper	White-browed
#	Treecreeper	White-throated
+	Whiteface	Southern

Fish

#	River Blackfish	River Blackfish (lowland)
#	Murray Cod	Murray Cod

Invertebrates

Invertebrates also use hollows

Reptiles & Amphibians

F+	Tree Frogs	Green and Golden
F+	Grass Frog	Growling Grass Frog
+	Grass Frog	Blue Mountains Tree Frog
+	Grass Frog	Southern Brown Tree Frog
+	Grass Frog	Plains Brown Tree Frog
+	Grass Frog	Large Brown Tree Frog
+	Grass Frog	Spotted Tree Frog
F#	Grass Frog	Peron's Tree Frog
F+	Southern Frogs	Southern Smooth Froglet
F+	Southern Frogs	Victorian Smooth Froglet
F+	Southern Frogs	Spotted Marsh Frog
F+	Southern Frogs	Haswell's Froglet
F+	Southern Frogs	Bibron's Toadlet
F+	Southern Frogs	Dendy's Toadlet
F+	Southern Frogs	Southern Toadlet
F+	Geckos	Southern Spiny-tailed
F#	Geckos	Tree Dtella
F+	Geckos	Marbled Gecko
+	Geckos	Thick-tailed Gecko
+	Dragons	Tree Dragon
+	Dragons	Nobbi Dragon
+	Dragons	Norris's Dragon
+	Dragons	Eastern Bearded Dragon
+	Dragons	Central Bearded Dragon
+	Dragons	Gippsland Water Dragon
F+	Dragons	Lined Earless Dragon
+	Dragons	Sand Goanna
+	Dragons	Tree Goanna
F+	Skinks	Southern Rainbow Skink
F+	Skinks	Carnaby's Wall Skink
+	Skinks	Black Rock Skink
+	Skinks	Tree Skink
F+	Skinks	Three-toed Skink
F+	Skinks	Delicate Skink
F+	Skinks	Garden Skink
F+	Skinks	Weasel Skink
F+	Skinks	Coventry's Skink
F+	Skinks	Grass Skink
F+	Skinks	Glossy Grass Skink
F+	Skinks	Metallic Skink
F+	Skinks	Eastern Three-lined Skink
F+	Skinks	Red-throated Skink
F+	Skinks	Lerista punctatovittata
F+	Skinks	Boulenger's Skink
F#	Skinks	McCoy's Skink
#	Skinks	Spencer's Skink
+	Skinks	Eastern Water Skink
+	Skinks	Spenomorphus tympanum(CT)
+	Skinks	Spenomorphus tympanum(WT)
+	Pythons	Diamond Python
+	Pythons	Carpet Python
F+	Front-fanged Snakes	Eastern Small-eyed Snake
F+	Front-fanged Snakes	White-lipped Snake
+	Front-fanged Snakes	Tiger Snake

7. How you can help koalas on private land

In the past

Before European settlement, koalas (*Phascolarctos cinereus*) were widespread but probably uncommon throughout the forests of eastern Australia, ranging from north Queensland to South Australia. Hunting by aborigines, dingoes, owls and Wedge-tailed Eagles, along with bushfires, controlled population numbers. Disease, as a factor controlling Koala numbers, may have increased in significance with the decline of aboriginal populations.

Upon the arrival of European settlers, vast areas of forest were cleared for grazing, crop cultivation and urban development. Unfortunately, much of this land contained koala habitat. The uncontrolled hunting of koalas for their fur also compounded this problem by reducing koala numbers.

Figure 1. This trailer load of 3600 Queensland koala skins is from the 1927 open season. With the passage of time our views have changed and koalas are now fully protected.

Koalas today

By the early 1900s, in Victoria, it was feared that koalas were endangered in the State (In 1934 Lewis estimated that only 1000 remained wild in Victoria). Translocations of koalas were carried out from French Island and Phillip Island where over-population had become a problem. Following successful translocation programs, koalas are now considered to be well re-established in Victoria and occur over much of their former range.

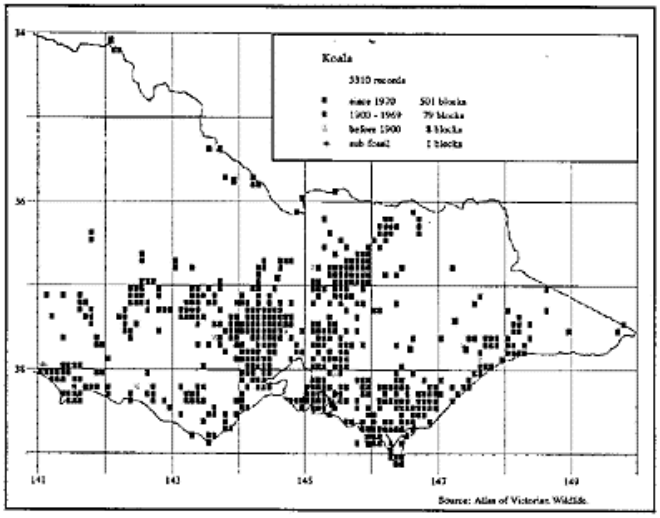

Figure 2. The distribution of koalas in Victoria. Source: Atlas of Victorian Wildlife.

Although koalas occur in many parts of Victoria, their numbers in many areas remain low, mainly due to the lack of suitable habitat. The clearing of vast areas of forest has meant that koalas are often restricted to thin strips of remnant vegetation, such as along rivers and roadsides, or in single isolated trees. These are not ideal areas for koalas as it is difficult for them to find food and mates. Koalas living in such small patches of bush can cause severe defoliation of trees and may eventually die of starvation. If they are forced to travel between areas, they face the risk of predation by dogs or of being hit by vehicles.

About Koalas

Koalas live a largely solitary life although males seek out females during the breeding season. Healthy females are able to breed each year and commonly single young is born during the warmer months of summer. Young are weaned by twelve months although they will stay near the mother for a further year.

Female young often establish a home range near the mother whereas males are evicted from the mother's home range when about two years old and then are nomadic for three years or so or until they are big enough to establish their own home range. Home ranges are usually less than three hectares although this varies with koala densities and food availability.

Adults weigh between 4 and 14 kg, with males weighing up to 50% heavier than females. Koalas can live to 18-19 years of age.

Figure 3. The koala, "a little Australian we'd all hate to lose". Loss of habitat is the main problem facing koalas.

Many koala populations are affected by *Chlamydia psittaci*, a bacterium that is sexually transmitted. This natural pathogen can damage the reproductive tract causing urinary infections and infertility. Although it appears that *Chlamydia* occurs in koalas over much of their range, *Chlamydia* does not appear to be a threat to koala populations in which it has been present for some years. Some Koala populations are much more seriously affected by the organism than others. Stress resulting from over-population or habitat destruction is thought to be a factor. Humans cannot be infected by the Koala *Chlamydia*.

Where do koalas live?

Koalas prefer open forests and woodlands to forests with closed canopies. They live in areas without extremely cold weather and so are more common in coastal lowlands than forests at higher altitudes. They favour the eucalypts growing in the more fertile soils of alluvial flats and gullies and so are frequently found in trees close to watercourses but will range and feed widely up the surrounding drier slopes also.

Although koalas are renowned for their preference for the leaves of only a few eucalypt species, they occasionally eat non-eucalypt species including tea trees and wattles.

Feeding preferences can vary between individuals, seasons and areas and can depend on what tree species are available and how many other koalas live in an area.

In Victoria, koalas show a particular liking for the following eucalypt species: Manna Gum (*Eucalyptus viminalis*), Swamp Gum (*E.ovata*), Blue Gum (*E.globulus*), River Red Gum (*E.camaldulensis*) and Long- leafed Box *(E. goniocalyx)*.

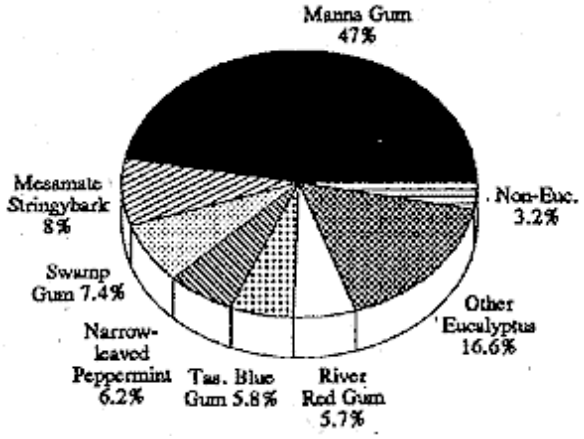

Figure 4. Food preference by koalas

These species are often found along watercourses where soils are deep and fertile. (refer to Costermans, 1983 for distribution and identification of these species).

Koalas on private land

It is estimated that about half the koalas in Victoria live on private land. The retention and restoration of koala habitat and creation of habitat corridors for wildlife species on private land plays an important role in the koalas continued survival.

Locating koalas

Although difficult to glimpse in the treetop, Koalas can be identified from their droppings (Triggs, 1984), the grunting and snoring-like calls made by males, the high-pitched wailing cries of females, and from scratch marks left on tree trunks.

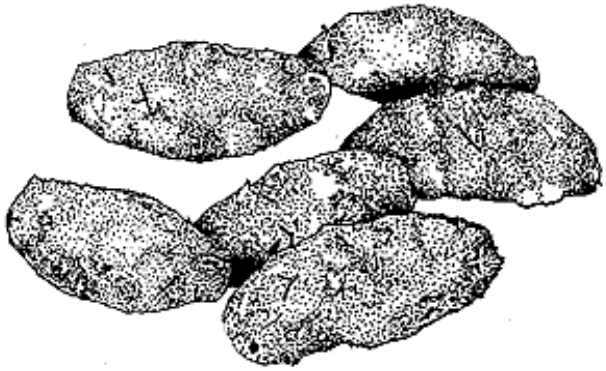

Figure 5. Koala scats are dry green-brown pellets of vegetable matter usually found at the base of trees and, when fresh, smelling strongly of eucalyptus

What you can do for koalas

Habitat loss poses the greatest threat to koalas in Australia today.

Retaining or restoring koala habitat is the most beneficial step you can take and there are many additional benefits for your property (see below).

Shelterbelts and habitat corridors can be created by planting and/or seeding strips of land. For koalas, it is best to use a range of local native species, including eucalypts that are known to be preferred dietary items. Try to avoid planting "koala species" which would not occur naturally in your local area, or seed/seedling stock originating from outside the general locality. Pest animal and weed control programs may need to be organised to help establish these habitat corridors. Fencing-off remnant stands of trees will protect them from damage caused by stock and will also encourage regeneration.

Koalas obtain their food from the eucalypt species already mentioned. They would benefit from an area of habitat large enough to support a breeding group. A diverse shrub and ground layer will support insect-eating birds thus reducing the effect of foliage-eating insects competing with koalas for food.

Fencing a wide buffer along a stream frontage would potentially offer habitat for koalas whilst also protecting other river values. Revegetation of rivers and streams is discussed in other Notes in this series (refer to **Note No. 8**). The understorey also provides cover from predators of koalas whilst travelling on the ground.

Controlling your pets, particularly dogs at night when koalas are likely to be on the ground will help. It is preferable that pets are always kept out of wildlife habitats as they may also chase or harass kangaroos, wallabies, lyre-birds, and other larger fauna and may disturb ground-roosting or nesting species such as quail, quail-thrushes, nightjars, etc.

Retaining large habitat trees will assist koalas (they show a preference for larger trees). Linking habitat areas with corridors (see LFW **Note No. 3**) of vegetation will assist koala movement. A "neighbourhood" approach to the establishment of koala habitat/corridors can build upon individual contributions.

Finally, exercise caution when driving vehicles, particularly where bushland abuts the road.

How to prevent koalas defoliating trees!

If you already have koalas on your land that are restricted to isolated patches of vegetation, they may begin to defoliate your trees. The long-term solution is to plant more local native trees, shrubs and ground cover on your property which can be linked up with patches on adjoining properties and to larger areas of habitat (State Parks, etc). One way to tackle this problem in the short term is to install metal guards made of flat galvanized iron (at least 1.5m high) and placed around the tree trunk or branches. This will prevent koalas reaching the leaves.

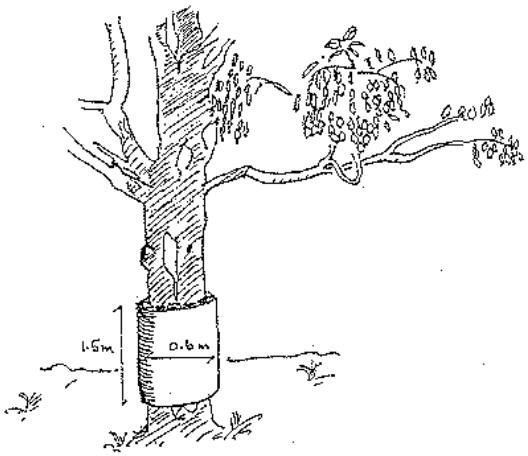

Figure 6. A cylindrical metal guard around a tree can deny koalas access where defoliation is a problem.

Wildlife habitat can be a valuable asset

Provision of koala habitat provides many opportunities to enhance the economic, social and recreational values of a property. The retention and restoration of habitat can provide shelter for stock, windbreaks, a wood supply, natural insect control with less pesticides, improved fish habitat, scenic picnic spots, wildlife sights and sounds, improved property resale potential and can help combat erosion and salinity.

"The species which make up the world of koalas are many and varied. The possums and gliders and many insectivorous bats seek refuge in and feed from and around the eucalypts preferred by koalas. Owls and parrots and a host of tiny insect-eating birds are also concentrated in these areas. Many migrating honeyeaters move along rivers and streams, feeding and resting in the trees of the banks and adjoining woodlands. Lyre-birds, bowerbirds and echidnas scurry amongst the leaf litter on the forest floor and platypus burrow into the banks secured by the roots of river red gums. Snakes, goannas and water dragons bask in the sun as wombats snooze in their burrows and wallabies cautiously graze on grass- shoots. This, but superficial, look at the complex ecosystem which koalas sit quietly representing, should serve to remind us that conservation needs to be about habitats and not just individual species. If habitats are protected so too will be their occupants." (Phillips, 1990)

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8. Principles of river and stream improvement for wildlife

There are many potential benefits to landholders and wildlife from adopting a more environmental approach to the management of river and stream frontages (see over page for examples). The simple four step process described here may be suitable for watercourses on your property. Steps 2 & 3 must be carried out simultaneously. This process may not be sufficient in cases of extreme erosion.

Streams can be beautiful places. They carry one of our most important resources. (Photo F.Nicholls)

Fence to exclude stock

Fencing is necessary to avoid soil disturbance caused by trampling and to prevent stock from eating the vegetation, including any new seedlings. Short periods of light grazing may be acceptable. Leave access to the stream for tankers in case of fire. You might pipe water to a trough for animals or leave one access point unfenced.

The recommended width of a stream buffer is 20 metres although smaller widths may also be satisfactory.[1]

Encourage natural regeneration or plant local natives

Vegetation will bind the soil, thus helping to prevent or arrest erosion. Natural riverside vegetation from your district is adapted to the local soils, the local climate and is resistant to most local pests and diseases. It is the most appropriate for local wildlife.

Ground covers are equally important as larger shrubs and trees in controlling erosion and providing habitat for wildlife. So, you should revegetate with a diverse range of native plants from local rivers and streams. It may be best not to remove introduced species, such as willows, until the native vegetation is well established. Careful observation of the local natural riverside vegetation is a useful introduction to planning revegetation works and is highly recommended.

Natural regeneration is the preferred method to use initially where there is an available seed source. It may occur without assistance following fencing. If no natural regeneration occurs within one or two years, soil compaction or competition from weeds may be the cause. Note that eucalypts may not flower and set seed every year. Light scarification and/or mulching (beware of encouraging weeds and erosion) or a controlled light burn may solve these problems. These techniques should be timed to precede native seed fall (for many species this occurs in summer). They should firstly be applied to select areas, representative of the area under management, to see if they are appropriate before using over wider areas. A controlled burn must be conducted in accordance with fire regulations. Warm autumn or spring rains will provide the stimulus for germination. A controlled burn will assist with the germination of hard-seeded natives such as wattles (the fire cracks the seed coat allowing water to enter for germination) and help reduce competition from other plants.

If natural regeneration is not an option, direct seeding or plantings of seedlings grown from local native seeds, appropriate for the location and soil type, is the second-best option.

Control pest animals and plants

It may be necessary to plan for the use of alternative pest management strategies in the area under revegetation to that of an open paddock. Pressure fumigation, 1080 bait trails and other techniques can be used to control pest animals in these areas, where necessary. There are a range of techniques, compatible with conserving environmental quality, that are available for weed control. Consider environmental effects before using any chemical method. Chemicals may kill microscopic soil flora and fauna, thereby reducing soil quality, with subsequent effects on above-ground vegetation. Pest animals, such as rabbits, can prevent successful regeneration by eating seedlings or stripping bark. Individual plant guards may be required, in conjunction with a rabbit control program, where this is a significant problem. Insects may also require control. Foxes are very skilled at catching native wildlife and are known to take Platypus. An on-going program to reduce pest animals and plants should be developed, preferably in conjunction with neighbouring landholders. Local Landcare groups may be able to offer additional support and advice on this aspect of management.

Leave ground litter and river snags

Ground litter reduces the impact of rainfall, hence helping to prevent and control erosion. It provides nourishment for the soil which in turn supports a range of plant species. Ground litter also provides important wildlife habitat. Snags in streams are very important to fish as a refuge. Some species, such as the River Blackfish and Murray Cod deposit their eggs in hollow submerged branches. The riverside vegetation will drop litter into the stream thus providing a source of food for many small stream animals and ultimately larger consumers like the Platypus. If there is a weir in the stream or other barrier, ensure that it has a "fish ladder" to allow migrating species access to feeding and breeding areas upstream. Rocks and logs provide moist sites for germination of seedlings, thereby contributing to the on-going maintenance of the habitat.

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Bradley, J., (1988), *Bringing Back the Bush*, Landsdowne.

9. What your property can do for you

This Note should be used in conjunction with Note No. 10 which includes descriptive values and research results related to the benefits shown below. An integrated approach to land management can result in a wider range of benefits being obtained from a property. Below is a list of values which, with appropriate management, could be obtained by integrating wildlife habitat with the other uses of a property such as primary production. They can make a property a more pleasant and healthy place in which to live whilst also maximising the values of that property and contributing to its sustainable productive use. Such action also plays a part in reducing Greenhouse gases. Could you and your property benefit by incorporation of some or all of the values listed in this Note?

Shade and shelter for stock

These hollow-bearing Red Gums provide shade and shelter for stock. They also provide important wildlife habitat. Fencing to exclude stock, and thus encourage regeneration, plus the planting of local native understorey species, would significantly improve their value to wildlife whilst ensuring their long-term survival as shade and shelter. (Photo P. Dixon)

Timber for fence posts and construction

Many native plants provide timber suitable for fencing, house construction, furniture and so on. Blackwood is a widespread attractively shaped Victorian tree that is used to make fine furniture. It is also valuable to our fauna, including many invertebrate species

Alternative crops

The native yam shown above was the staple food of Victorian aborigines prior to its disappearance following European settlement. Could broombush harvesting or native yams (with carrot-like roots), offer alternative sources of income whilst also providing habitat for wildlife? (Photo: S. Platt)

Natural pest control, less chemicals

Most of our birds, bats, and many native ground-dwelling mammals and reptiles, eat insects. Natural pest control contributes to the ecological 'health' of a property and may offer an alternative to harmful chemicals. (Photos L-R Superb Fairy- wren, Shaneen Smith; Lesser Long-eared Bat, L. Lumsden; Fat- tailed Dunnart, A. Bennett)

Reduced fire risk

Undisturbed perennial native grassland can have much lower fuel loads, and thus fire risk, than disturbed areas invaded by exotic annual grasses such as Canary Grass (Phalaris spp). This photo shows attractive native grassland either side with a disturbed area in the centre invaded by introduced annuals. (Photo: S. Platt)

A glimpse of the past, record of our history

L.E.W.'s 'Mt Corio', 1 June 1849, an unidentified hill. "The bare plain, the she-oak timbered slopes, the gum-fringed creek, the shepherd with his flock, the crows, the carcass - all were typical". From: Brown, P.L. (ed.), 1959, Clyde Company Papers, Vol IV, 1846-50. This is what the country west of Melbourne would have looked like prior to settlement. Inset: One of the dominant grasses on that plains, Kangaroo Grass. (Photo: S. Platt)

During the above control burn of a native grassland reserve flames were able to be controlled using wet hessian sacks. Could there be advantages in preserving or establishing native grasses on your property boundaries as an alternative to high- fuel introduced species? The dominant grass shown here, Kangaroo grass, is easily grown and is a summer-growing perennial valued by some for seasonal grazing. (Photo: S. Platt)

Erosion/Salinity Control

Leaving natural vegetation along the banks of this stream would have prevented erosion. Natural vegetation has the potential to arrest erosion and can contribute to salinity control whilst also attracting wildlife.

Improved landscapes

The environment in which we live influences our enjoyment of life. Pleasant landscapes add to the joy of living. They are part of 'living in the bush'.

Better recreational opportunities.

Bushland habitat for fauna, such as might be established along a stream frontage, can offer places to picnic and improved fish habitat for recreational fishing as well as being valuable to wildlife such as koalas and platypus.

The photo (below left) shows Miss Jean Galbraith's family relaxing by the Tyers river in Gippsland at the turn of the century with books and violin.

Clean water, flood mitigation

Wetlands, such as the one shown above, act as natural reservoirs, retaining flood waters and are important for wildlife. They can also supply aquifers that may be drawn upon for town water supplies. (Photo: A. Corrick)

Attractive places to visit, natural beauty

Evening shadows reflect in a tranquil, natural pool fringed by red-flowering Callistemons west of the Grampians. Aged Red Gums stand amidst this beauty. Such spots could occur on your property or you may already have them.

Wildlife sounds

Rural environments are often characterised by the native animals that live in them. The shriek of a Galah, the dawn chorus of birdsong, frogs at night around a pond. These sounds add to many peoples' enjoyment of living in rural Victoria. You can encourage wildlife sounds by providing appropriate habitats. Could you identify a Sugar Glider or Bush Thick-knee from its night-time call?

Wildlife sights

Observing wildlife at close hand is a memorable experience. Many native wildlife species are attractive and have extraordinary adaptations to life in our bushland. What species are resident on your property?

The satisfaction of contributing to the survival of wildlife species

The Bush Stone-curlew, or Bush Thick-knee, is a large, slim, mainly nocturnal, ground-dwelling bird. Bush Stone-curlews have a wide-ranging diet, but prefer to feed on insects, molluscs, small lizards, seeds and occasionally small mammals. Feeding takes place at night. During the breeding season, nesting birds will search for food in the vicinity of the nest site, while at other times, birds may travel large distances. All food is taken from the ground. Private land can play a major role in contributing to the survival of this and many other species of flora and fauna. (Image and text: https://www.birdlife.org.au/bird-profile/bush-stone-curlew)

10. How wildlife habitats can benefit your property

This Note is a companion to Land for Wildlife Note No. 9 'What your property can do for you'. Over recent years there has been a growing awareness that land should be managed in an 'ecologically healthy' and sustainable way. To obtain the most from a property, it is worth considering the full range of benefits it has to offer. Similarly, in counting any loss in production from fencing areas for revegetation, it is also necessary to consider the considerable gains that might be made. Wildlife habitat, appropriately incorporated into a property, can play a role in obtaining these benefits and has the added advantage of supporting wildlife species.

Shade & shelter for stock & crops

Native vegetation can be used to provide shelter and windbreaks to protect stock and crops from exposure to extreme weather. Bird (1990) has shown that shade and shelter benefits alone mean that 10 per cent of a farm can profitably be devoted to trees in the higher rainfall areas of southern Australia. Although 'trees' are mentioned, more benefits are likely to come from vegetation including trees, shrubs and ground covers.

Local climate modification

"Trees can shelter an area downwind for at least 15 times their own height"[1].

"Trees conserve precious ground moisture."[1] [by reducing wind speed].

Reduced death rates, higher birth rates

"Studies in the eastern highlands have shown that lambing losses can be reduced by 50%. Average losses without shelter were 36% for twins and 16% for single births.

When shelter was provided, the figures dropped to 18% for twins and 8% for single lambs. In a flock of 1000 ewes, such a 50% drop in mortality is going to mean 100 extra lambs which survive the critical first 48 hours of life - the time when cold stress takes its greatest toll".[1]

"CSIRO results predicted that a newly shorn sheep in the rain can die at 5°C in still air. If an 18km/h wind is blowing, the lethal temperature rises to 19°C. At anything below this sheep can die. A national survey put the annual loss of newly-shorn sheep at over 1 million".[1] Shelter prevents death by exposure.[2]

Wool/liveweight gains

"Lack of shelter not only kills stock, it also affects how much wool, meat and milk they produce".[1]

"In one five-year study at Armidale, sheep on sheltered plots produced 35% more wool and 6kg more liveweight than those without shelter. This effect was most noticeable at the highest stocking rate used".[1]

"Heat depresses milk production and can depress liveweight gains of cattle by up to 0.6kg a day".[2]

Reduced heat stress

Temperatures as high as 88°C [have been] recorded from wool on the backs of exposed sheep. The temperature in a woodlot of trees may be a cool 22°C while in the open it is as high as 36°C".[1]

"Heat stress reduces wool growth by reducing feed intake, and is detrimental to ram fertility, ovulation rate and conception in ewes, and foetal development".[2]

"Failure to dissipate heat will lead to heat exhaustion. The animal will try to reduce its metabolic activity by eating less and being less active".[3]

"Heat stress can markedly reduce stock fertility, milk production, and weight gain, and increase mortality of calves and sheep".[3]

"For pregnant cows heat stress may cause abortion and certainly causes calves to be born undersized and consequently more susceptible to heat stress".[3]

"Studies involving both Jerseys and Holsteins have suggested that milk production declines as air temperature rises above 20°C, dropping steeply as the temperature reaches 27°C".[3]

"Shorthorn cows resting in shade continue to chew

their cud whereas cows in the sun abstain. Because rumination increases the heat produced, heat-stressed stock abstain so as to reduce metabolic heat production. After grazing, chewing cud is the second most important activity of cattle, so abstaining directly affects productivity".[3]

Reduced cold stress

"Cold stress has been shown to depress wool growth by 25% and live-weight gain by 6kg in sheep and with cattle, liveweight gain has been reduced by 31% over several weeks".[2]

"Milk yields are similarly depressed by cold at a rate of up to 1.34kg per day (4% fat corrected milk)".[2]

"Rain also reduces the insulating value of an animal's coat by up to 30%. This is particularly a problem for sheep".[3]

"If the still air temperature is 4°C a modest wind of 20km/h reduces the effective temperature to approximately -4°C".[3]

Improved crop yields

"Many overseas studies have shown that crop yields can increase by more than 20% when windbreaks are established".[1]

"Sand blasting of cereal crops, at the seedling stage, by wind leads to reduced plant growth due to moisture stress and physical damage".[2]

Shelterbelts increase production by about 30% to a distance about ten times the height of the trees beyond the area of reduced production (=to height of trees).[2]

"Wind can destroy blossom prior to setting, damage and discolour fruit, increase fruit fall and increase insect damage."[3]

Natural pest control, less chemicals

Wildlife contributes to the health of natural vegetation by preying upon invertebrates directly and by acting as vectors for parasites and diseases that reduce invertebrate populations. In this way wildlife can help protect natural vegetation which is important in providing social, environmental and economic benefits to landholders. Wildlife also preys directly upon some pasture and crop pests. There is limited quantitative information available.

Regular bird surveys were undertaken over seven years as wildlife habitat was being established on a dryland wheat and sheep property in north-eastern Victoria. By the end of this time, 106 bird species had been recorded. Sixty-seven per cent of these were largely or exclusively insect-eating birds, which foraged on all parts of the farm.[4]

It is estimated that insectivorous birds and honeyeaters consume about 24 to 38 kg of invertebrates (mainly insects) per hectare, per year, in eucalypt woodland, New England, NSW. (10-11 from leaves, 4 to 7 from bark, 9 to 18 from the ground and 1 to 2 from the air). Based on energetics, it is estimated that in the same woodland type 16.4kg of insects are produced from eucalypt leaves per hectare per year. It is also estimated that 10-11 kg of insects are consumed by birds from leaf substrates. Thus, one can estimate that birds may consume some 60-67% of the available insects [from leaf substrates]. There is some evidence that birds, along with many other natural agents, control the populations of potentially harmful herbivorous insects in healthy eucalypt woodland in New England.[5]

"By establishing habitats for birds and small mammals, trees and shrubs help control insects and should eventually reduce reliance on insecticides".[6]

"It has been estimated that a colony of 250 000 common bent-winged bats at Mt Etna (Queensland) ate one tonne of insects per night".[7] [bats are common in rural Victoria where shelter is provided].

"The Australian Straw-necked Ibis, sometimes called 'the farmers friend', feeds on small animals such as mice, crustacea, and insects, especially grasshoppers. Researchers estimated that one ibis rookery in Victoria consumed about 500 tonnes of food per day."[11]

"Birds eat a wide variety of insects. Parrots, although usually considered herbivorous, eat many lerp-insects and scale-insects. Cuckoos are well known predators of hairy caterpillars, including stinging cup-moth larvae and even sawfly larvae. Sacred kingfishers, as well as eating lizards, consume large

numbers of Christmas beetles and other scarabs. Whistlers and grey shrike-thrushes prefer beetles, especially leaf beetles and weevils, and sometimes larvae. Honeyeaters are generalised feeders but lerp-insects and scale-insects are important foods, with beetles, spiders, flies and ants also eaten frequently. Noisy friarbirds and other larger species eat Christmas beetles. Treecreepers eat mostly ants whereas varied sitellas and shrike-tits eat many beetles. Pardalotes also eat lerp insects and scale-insects as well as many beetles".

"Thornbills eat small beetles, ants and caterpillars, as do robins and fairy-wrens. Wood swallows take large beetles, including chrysomelids and scarabs. Black-faced cuckoo-shrikes also favour large beetles, snatching them from the foliage of eucalypts. Magpies are important predators of scarab larvae, and an adult may eat up to 40 of them per day. Clearly, many of the insects that have been blamed as serious defoliators of eucalypts (scarabs, chrysomelids, caterpillars and other larvae, weevils, sap-sucking lerp insects and scale insects) are eaten frequently by many of the common birds".[8]

"The sugar glider, one of the most common and widespread tree-dwelling mammals in Australia, feeds extensively on scarabs, caterpillars, weevils, lerp-insects and scale-insects".[8]

"Over the whole year, on the average, 81 per cent of invertebrate production is consumed by vertebrate predators, and in summer and autumn this consumption causes a decline in the standing crop (of invertebrates). Clearly, vertebrates are important predators on insects and other invertebrates on eucalypt branches, and encouragement of wildlife in eucalypt woodland would aid in controlling insect defoliation".[8]

Erosion/salinity control

Erosion and salinity reduce the area available to a landholder for social and/or productive uses. The figures for Victoria are shown below. It is easy to think that this is a problem for someone else. However, even if a property is not directly affected, as many are, its water supply might be, as might other industries in the area that together support infrastructure, such as schools and hospitals, upon which landholders depend.

Excessive salt in our water and soil has already damaged 2500 square kilometres (about the size of the Australian Capital Territory) of the State's [Victoria] land and threatens an area of more than twice that size.[9]

Salinity costs Victoria over $50 million a year. Much of this loss is in farm production. Crops yield much less and some farming land cannot be used at all.[9]

Loss of income borne by farmers amounts to $32 million each year in irrigation areas and $4 million in dryland areas. This could treble within the next 30 years without control.[9]

The physical environment changes too, not only in the immediate area but downstream from the salt-affected areas. Rivers and streams receive salt laden run-off and silt as soil structure changes and erosion occurs.[10]

The quality of water supplies for towns, livestock and domestic purposes also deteriorates.[10]

140 000ha of irrigated land is seriously salinized.[11]
100 000ha of dryland farming area is seriously salinised.[11] The area affected by salt is likely to increase four-fold over 50 years whether or not remedial action is taken.[11]
3 200 000ha of land is affected by erosion, acidity and compaction.[11]
7 800 000ha is at high risk of degradation.[11]
25 000km of streams are actively gullying or vulnerable.[11]
65% of stream length in cleared areas is in poor or very poor condition.[11]

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Salinity/Southern Australia

3% of agricultural land in southwestern Australia is unproductive because of soil salinization.[3]

The area affected is increasing by 25 000 ha per year.[3] Nearly 20% of this agricultural land could be rendered useless for cereal cropping within the next 30 years.[3] Revegetation can control rain-water accessions to the water table.[6]

Dryland salinity now affects 45 000 hectares of Victoria while 140 000 hectares suffer from irrigation salinity. Annual losses due to salinity is estimated at $40 million.[6]

Increased rainwater run-off has accelerated the natural processes of erosion in rural streams some 1000 to 100, 000 times; approx. 25, 000 kilometres of gullies are either actively eroding or vulnerable to erosion. Crop land erosion costs $25-30 million per year in lost productivity. Water erosion now effects 0.6 million hectares of crop land and 2.6 million hectares of grazing land.[6]

Declining agricultural productivity allows fewer families to make a living from the land, in turn reducing the services and quality of life for those who remain. The effect multiplies and rural communities decline.[6]

There are at least five mammals, sixteen birds and thirteen reptiles and amphibians, whose survival is dependent upon habitats occurring substantially on private land, currently on the threatened species list for Victoria. The Helmeted Honeyeater, our State faunal emblem, occurs only in one small crown reserve. Other habitats are on private land.

There are at least 500 plants threatened with extinction in Victoria, many of these also occur on private land.

Many threatened plants and animals occur on private land. The long-term viability of isolated reserves, without interlinking corridors of vegetation, is now in doubt.

Private land can play a major role in connecting isolated remnants of natural vegetation.

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There may be opportunities to manage commercial crops in ways that benefit wildlife on private land. Some examples follow:

Sale of seed collected from naturally occurring species.

There will be more demand for seed as the technique of direct seeding gains popularity.

Australian potpourri.

Using hakea, banksia, callistemon pods, gum nuts, dried leaves, bark, flower heads.

Honey production using native species. Cut native flowers.

Species of Banksia, Grevillea, Callistemon and Thryptomene can be grown for the cut flower market and for export. In future, more unusual species such as Atriplex (Saltbush) and Eriostemon (Wax Flower) may become popular. An Ag note is available on cut flower cultivation.

Dried flowers and foliage.

Evergreen foliage may be used in floral arrangements. Fencing material such as Broombush (Melaleuca uncinata). Sustainable production of Broombush on private land may be profitable in some areas.

Swamp Paperbark (Melaleuca ericifolia) and other ti-trees can be used as pickets for domestic fences. Cut ti-tree regenerates by shooting from underground stems.

11. Giant Gippsland earthworm – nature's plough

One of the world's largest earthworms

The Giant Gippsland Earthworm Megascolides australis is one of the world's largest earthworms and is restricted to a small area, in the Bass River Valley, of South Gippsland. Despite wide publicity in the 100 years since its discovery, very little is known about the worm's basic biology. It is listed by the International Union for the Conservation of Nature (IUCN) as a 'vulnerable' species. This means that the species may be at risk of becoming extinct if there is continued pressure on the population through habitat destruction and disturbance.

What do the worms look like?

The Giant Gippsland Earthworm is certainly a giant amongst the 3,000 known species of earthworms. It has an average length of 80cm with a diameter of 2cm. When a worm is relaxed, it can more than double in length and worms of up to 2 metres have been reported. The worm has 300-500 body segments, and the first one third of the body (including the head) is dark purple with the remainder of the body being a pinkish-grey colour. The worms lay large, amber coloured egg capsules that range in size from 4-8cm in length by 2cm in diameter. The egg capsule is made of a tough, semi-transparent, horny material called chitin, which gives it the appearance of being made of plastic and resemble cocktail sausages in shape. They are laid close to the soil surface at an average depth of 20cm.

Egg capsules of the Giant Gippsland Earthworm

The Giant Gippsland Earthworm. At an average length of 80cm, it is one of the world's largest earthworms.

Where are the worms found?

The Giant Gippsland Earthworm is thought to be found in only 100,000 ha of the Bass River Valley in an area roughly bounded by Loch, Korumburra and Warragul (Figure 1.) Within this area the distribution of the worm is very patchy and is generally confined to dark blue-grey clay soils. Worms are found mainly on creek or riverbanks, associated with springs or soaks, and sometimes on the south or west facing slopes of hills.

Distribution of the Giant Gippsland Earthworm

How do I know if I have worms on my property?

One of the easiest ways to tell if worms are present in a particular area, without disturbing the soil, is to stamp on the ground and listen. In wet conditions worms often make a loud gurgling sound as they retreat down their tunnels (it sounds like water draining out of a bath!) However, this is not as obvious in the warmer months when the ground is dry.

Although the worms are not normally seen, as they spend the whole of their lives under the soil, they have been seen in exceptional circumstances. Flooding has been reported as driving them onto the surface and there have been many reports of the worms being eaten by kookaburras and occasionally magpies.

The worms make large tunnels that do not usually come to the surface and may reach depths of up to 2 metres. These tunnels are about 2cm in diameter and are very noticeable if one is digging in Giant Worm habitat. Unlike many other earthworms, that leave their waste products (casts) above ground, the Giant Gippsland Earthworm leaves its cast material below ground inside its tunnel. The mounds surrounding the entrances to yabbie burrows are often mistaken as cast material of the giant worm. Yabbies and Giant Gippsland Earthworms are often found in the same area.

It has been claimed that the tunnels of the Giant Gippsland Earthworm can undermine the walls of farm dams. This is unlikely as these walls will be of well compacted soil. The holes seen in these situations are more likely to be those of yabbies.

The farmer's friend

The beneficial effects of earthworms on soil fertility have long been recognised. The terms 'Farmer's Friend' or

'Nature's Plough' have been aptly used to describe the worm's actions. Some of the ways in which earthworms help to improve the soil include:

- Breaking up organic materials and mixing them into the soil
- Breaking up root mats in pastures and thick layers of leaf litter
- Increasing microbial activity in the soil
- Increasing the availability to plants of nutrients in soils and organic matter
- Improving crumb structure of soils, and so
- Increasing the amount of water that can be held in soils
- Allowing better penetration of plant roots, oxygen and water into soil and
- Increasing crop and pasture yields.

What can I do to help conserve the worm?

Recent studies showed that the worm was only found in 6% of the area surveyed and that over 80% of the worms were found within 40m of creek banks. Therefore, the most important way of conserving the earthworm is to protect its' habitat - the stream banks.

Specific measures for conserving stream banks are outlined in Land For Wildlife **Notes 2 & 8**. Some of the most important points are briefly summarized here:

1. Fence sensitive areas along stream banks to restrict livestock access. This helps avoid soil disturbance caused by trampling and allows regeneration of native vegetation.

2. When natural revegetation is not possible, vegetate streams with local native species such as gums, wattles, native ferns and grasses appropriate for your area, the soil type and associated conditions. Vegetation will help bind the soil and thus help prevent soil erosion.

3. Allow leaf litter, fallen logs and branches to accumulate in habitat areas. This provides a food source for the worm and a refuge for many other species.

Other ways you can help protect the worm are:

4. By refraining from ploughing or using pesticides or herbicides in and near the worm's habitats such as near stream banks and wet gullies. Ploughing and stumping can cause direct damage to worms and pesticides can be carried into the worm's habitat by

run-off and natural drainage.

5. Because of the size of the worms, they are extremely fragile and even slight bruising kills them. Their soft body means that they are easily broken. If you cut a Giant Gippsland Earthworm in two, the pieces will not regenerate, and the worm will die.

If you unearth an intact Giant Gippsland Earthworm or an egg capsule, you should rebury it gently and carefully as the weight of large clods of wet soil can damage otherwise intact worms.

Protection of stream sides has many additional benefits to the landowner (see Land for Wildlife Notes 3, 8 & 9) such as improved water quality, flood mitigation, land conservation and recreational fishing.

By helping to protect and conserve the habitat of the Giant Gippsland Earthworm you will not only be helping to improve the soil and the land you live off but also helping to conserve an important part of the South Gippsland Heritage and one of Australia's' unique native animals.

As information on the worm is still being collected, you can help in furthering our knowledge by reporting any Giant Gippsland Earthworm sightings to the Department of Environment, Land, Water and Planning, 310 Commercial Road, Yarram, 3971.

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12. Bats in Rural Victoria

Bats are common and widespread in rural Victoria. Even so, many landholders would be generally unaware of the diversity and abundance of bats that may frequent their property.

Bats may play an important role in maintaining the health of the rural environment as most species are insectivorous, consuming up to half their body weight in insects each night.

Greater natural control of agricultural pests by bats and other wildlife means less dependence on potentially harmful chemicals.

Bats survive in rural areas better than most other mammals. Most Victorian species roost in tree hollows but the precise patterns of use of available habitats in rural areas are still not clear. Habitat destruction has affected bats, especially the forest-dependent species, such that now some species are restricted to large areas of native vegetation. No extinctions of bats are known to have occurred in Victoria, although a number of species are rare.

Bats are flying mammals and give birth to live young that suckle milk from their mothers. Like many other Victorian mammals, they are active at night and are best observed when they leave their roost at dusk. Most bats are equipped with an echo-location system that allows them to navigate and capture prey in complete darkness. Study of bat echo-location has led to many technological advances of benefit to man including navigational radar and medical scanners. When Gerard Kreft, a naturalist active in the 1850's, asked aborigines along the Murray to collect bats for him they refused because they regarded bats as 'a departed friend and relative'.

Some of the species found in Victorian rural areas

Bats can be considered in two groupings:

- Megachiropterans (nectar and fruit eaters - flying foxes)
- Microchiropterans (small insect eating bats)

Megachiropterans (nectar and fruit eaters - flying foxes)

Grey-headed flying fox

Figure 1. Grey-headed flying fox

This species is generally not resident in Victoria but comes in nomadically from NSW with most records from south of the Great Dividing Range. Small colonies have become established in Melbourne's Botanic Gardens, in Rosalind Park Bendigo and other regional locations around Victoria.

These bats roost in fairly open situations in the tree canopy and are visible during the day. They mainly eat nectar from blossoms and soft fruit.

Little red flying-fox

No illustration

This species is more nomadic than the grey headed flying fox and is usually found inland of the divide. There is a close association with flowering river red gums. They will attack orchards for soft fruit such as nectarines and peaches. They can be a localised pest, but never a widespread problem. They have excellent day as well as night vision

Microchiropterans (insect eaters)

Of the eighteen insectivorous bat species in Victoria, fifteen use tree hollows whilst only 3 use caves as roosting and breeding sites. Approximately twelve species can occur in rural areas. Roosts are mainly in tree hollows or under bark (in living or dead trees) but can also be in the roofs or walls of buildings or other dark places like clothing hanging in a shed.

Tree dwelling Microchiropterans

Lesser long-eared bat

Figure 2. Lesser long-eared bat

One of the commonest and most widespread bats in Victoria. It is highly manoeuvrable and can hover over leaves to catch tree dwelling insects. This bat is often caught by cats, probably because of its low fluttering flight.

Gould's wattled bat

Figure 3. Gould's wattled bat

Also common in rural areas e.g. in red gums along creeks. It emerges early after dark and feeds on moths, beetles, caterpillars and crickets.

Eptesicus spp

Figure 4. Vespadelus spp (e.g., V. vulturnus; V. regulus)

Vespadelus spp. (also known as small forest bats) hunt small insects in forests. They are agile fliers, able to manoeuvre as they move through the forest after their prey. They usually eat their prey as they fly. The smallest species weighs less than 5g.

Western broad-nosed bat

Figure 5. Western broad-nosed bat

This generally uncommon species has apparently adapted well to open rural environments inland of the Divide. Colonies of substantial numbers have been recorded in houses.

Yellow-bellied sheathtail-bat

Source: Lindy Lumsden

Figure 6. Yellow-bellied sheathtail-bat

This species is the largest Victorian microchiropteran weighing up to 50g. It forages high above the tree canopy. Specimens are easy to recognise having a cream or pure white belly. Although common in northern Australia there are only 15 confirmed Victorian records. These records are mostly from autumn, and it is possible that this species is a migrant, if not a vagrant, to Victoria. Specimens have been found during daylight, alive on a footpath or hanging on a wall, in an exhausted condition in both urban and rural areas. If any specimens are found, of this or any other species of bat, please report details to a Wildlife Officer of the Department of Environment, Land, Water and Planning.

White-striped mastiff-bat

Source: Lindy Lumsden

Figure 7. White-striped Mastiff-bat

This is also called a free-tailed bat. The echo-location call of this species ("chioo" repeated) is clearly audible (most other species' calls are too high in frequency for humans to hear). It is a large bat feeding on large insect prey. It usually forages above the tree canopy although it will also come to the ground to seek prey. This bat is common in urban areas where its call is sometimes mistaken for 'pinging' power lines, insects etc. White stripes are present on the underbelly and can sometimes be seen when the bat is in flight.

Little mastiff-bat

Source: Lindy Lumsden

Figure 8. Little Mastiff-bat

This species is distinct from most others in having half the tail free of the tail membrane. It forages high above the canopy but will also come down to the ground to feed. It may then need to climb to a high point to resume flight. This bat has often been found roosting with Western Broad-nosed bats. Like most bats, it is an agile swimmer if knocked into water.

Cave-dwelling Microchiropterans

Common bent-wing bat

Source: Lindy Lumsden

Figure 9. Common Bent-wing bat

This is the most likely cave-dwelling bat to be encountered in Victoria. it roosts in caves and mine shafts and can move large distances. For example, 200 km may separate a winter roost site from a maternity cave. The cave temperature and humidity are critical in determining the selection of maternity sites where up to 60,000 females may congregate. May be sensitive to inner-cave temperature variations of as little as 0.1 of one degree. Like most bats it is long lived and has been recorded living up to 20 years.

Insectivorous Bat Diet

Most insectivorous bats are opportunistic feeders and will' take what is common and available, therefore moths and beetles are particularly prevalent in the diet. Mosquitoes, caterpillars, flies, flying ants and many other invertebrates are also eaten. There is little information on the diet of bats in rural areas, so it is not possible yet to establish in detail the effect of bats on reducing agricultural pests.

Enhancing a property for Bats

The following measures would he beneficial for bats in rural environments:

- Retaining living or dead trees with hollows. In areas lacking sufficient natural hollows, nest boxes designed especially for bats can be installed.
- Planting up areas to provide roosts is a long-term aim, as tree hollows develop only after many decades, but trees which have sloughing (peeling) ribbon or sheet bark may provide roost sites for some species long before hollows develop. Planting understorey and ground-layer plants will benefit bats that forage below the tree canopy.
- Reduced use of pesticides will benefit bats, since they may ingest large quantities from the numerous affected insects eaten. Any increase in bats should compensate for reduced pesticide usage. Bats have high metabolic rates and can eat up to one-half of their body weight in insects per in ht; this amounts to huge numbers of insects consumed.
- If you know of bats using a cave or a mine, the best action to take is to leave the bats undisturbed. Where you know of people disturbing cave-dwelling bats, please report this to the Department of Environment, Land, Water and Planning so that expert advice can be obtained on an appropriate course of action. Note that anything that causes a change in the cave's microclimate may harm its value to bats.

Living with Bats

When bats are in large and persistent numbers in buildings can they occasionally cause problems, such as staining and smell.

Where bats are a problem, outdoor nest boxes may be used to deter them from using the building. A "bat flap"* can be used to allow exit from a roof without allowing re-entry. Some pest controllers are still unaware of bats being protected wildlife and that it is illegal to apply pesticides to remove them.

Further Information

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Land for Wildlife **Note 6** discusses wildlife & tree hollows and **Note 14** provides information on suitable nest box designs.

13. Natural regeneration: principles and practice

What is Natural Regeneration?

'Natural regeneration' refers to the natural process by which plants replace or re-establish themselves. Cremer (1990) defines 'natural regeneration' as "reproduction from self-sown seeds or by vegetative recovery (sprouting from stumps, lignotubers, rhizomes or roots) after the tops of the plants have been killed (by fire, cutting, browsing, etc.)". Temple and Bungey (1980) define it as "regrowth which occurs naturally after stress or disturbance. It may be growth from seed of both pioneer or permanent species, or growth from lignotuber (e.g. *Eucalyptus spp.*), rootstock (e.g. *Melaleuca spp.*), etc; remaining in the ground". Planting seedlings and direct seeding are alternative methods of re-establishing vegetation.

Why use Natural Regeneration?

Natural regeneration is a powerful tool for anyone wishing to re-establish vegetation on a property at minimum cost and is an essential part of managing a bushland area.

Areas that are managed in a way that enables natural regeneration to occur can be self-sustaining and may not require further expensive establishment costs. Natural regeneration ensures that the plants established on a site are from parents that currently occupy the site. Hence it helps to preserve genetic identity and variation throughout Victoria's plant species. This natural 'conditioning' to a site means that these plants are capable of withstanding long-term natural fluctuations and should do well, once established. Natural regeneration is particularly useful for establishing plants on a broad scale but can also be used in localised areas. Natural regeneration has also been used as a means of producing seedlings for planting in other areas.

Throughout much of rural Victoria this natural process is no longer occurring. Mature plants are reaching the end of their lifespan and the benefits associated with them are being lost (e.g. shade and shelter, wildlife habitat).

Under what circumstances is Natural Regeneration a useful option?

So long as there are mature and healthy native plants on the site, natural regeneration is an option. It is limited in many areas by the depleted, and therefore limited range, of species existing at a site compared to its natural diversity. Supplementary planting or the introduction of seed from other areas is often required to attain full natural diversity. Natural diversity is essential to re-establish a 'healthy' ecosystem. Natural regeneration can be a sporadic event. It is therefore not as reliable to produce results in a given season as planting might be, however, when it is successful, the results are often dramatic. For many species, natural regeneration is effective only near the parent plant.

In a healthy ecosystem natural regeneration is an inbuilt part of the process that maintains the ecosystem, its communities of plants and animals. Under natural conditions, human interference is not desirable.

How can I encourage Natural Regeneration?

A number of factors, both natural and man-made, are believed to be involved in the control of natural regeneration in rural Victoria. Some of these are discussed below and some management options are proposed. There are likely to be other factors not covered here.

The controlling factors are:

1. seed supply
2. soil condition
3. competition
4. predation of young plants
5. natural hazards and controls

1.Seed supply

Problem: No seed, or seed of poor viability. This may be due to the absence of fertile plants with viable seed; seed harvesting by ants & predation by other insects, birds and mammals; lack of fire; lack of pollinators or seasonal variations.

Absence of fertile plants with viable seed

Background:

The lack of suitable plants from which seed/spores (etc.) can be generated may preclude natural regeneration. This may occur because the plants that are present are too old or stressed, because some species are no longer present at the site, due to bad seasons, or because both sexes are no longer present in plants with separate males and females (e.g. She-oaks *Casuarina*).

Management options:

In some instances, seed may not be available at the site immediately but may be carried in from nearby sources by water, wind or wildlife. In this case, simply waiting can produce results. Direct seeding or planting may be the only option in areas cleared of native vegetation. It should be noted that native plants do not produce seed in equal quantities each year. Heavy seed fall in some eucalypts is infrequent. Monitoring of seed fall may be necessary using a suitable seed trap. It may be necessary to wait for a better season, plant individuals of the other sex (in plants with separate males and females) or pollinate existing females from elsewhere.

Seed harvesting by ants and predation by other insects, birds and mammals

Background:

Ants can be very effective harvesters of seed and may take 100% of the year's crop of seed for food and nest-building. This may prevent germination. Other arthropods also feed on seeds. In contrast, many insects, including ants, (& birds and mammals) also play a beneficial role in seed dispersal and germination. For example, Berg (1975) found that 1500 species of Australian plants are regularly dispersed by ants because of ant-attracting structures (elaiosomes) on their seeds or fruits.

Management options:

Light raking of the soil during seed fall may hide sufficient seed from ants that consume seeds. Insect numbers vary seasonally and in most cases no action is required to prevent opportunistic predation of seeds by other species.

Lack of fire

Background:

Many native plants shed seed following fire, usually from woody capsules that are designed to protect the seed from the intense heat of the fire, then open immediately following its passage. Other species, such as some *Acacias*, produce seeds with thick seed coats that must be cracked by the heat of a fire before germination can occur. Controlled burning of such vegetation, to stimulate seed release or germination, may be a pre-requisite to achieve natural regeneration.

Most Australian vegetation is adapted to withstand fires of a certain frequency and intensity. Frequencies vary from 2-5 years for grassland habitats, to 60-90 years for wetter forest types, and may be as infrequent as every 200 years. Rainforest species are usually not tolerant of fire. Fire plays a major role in the ecosystem, affecting what plants will be present at a site, in what densities and at what time in the life of that vegetation community.

Management options:

Use fire to promote seed release in woody-fruited species (e.g. *Banksia*, *Hakea*) and for seed germination (e.g. some *Acacia* spp.). Fire can also be used to reduce pest insect populations. Timing should be as close to natural occurrence as is permissible under fire restrictions. Contact your local government office for more information on fire regulations in your region.

Lack of pollinators

Background

In severely disturbed or isolated areas, there may be a lack of natural pollinators (birds, bees, moths, butterflies, etc). Thus, no seed may be set or, due to a lack of outcrossing (pollen transfer between plants rather than between flowers of the same plant), any seed that is set may be of poor viability.

Management options:

Supplementary planting of local natives to improve natural diversity and support natural pollinators, by providing habitat for them. Connecting remnants to other remnants with corridor plantings may encourage re-establishment of pollinators. Use of honeybees (*Apis mellifera*) as pollinators is not recommended. Note that honeybees may adversely affect wildlife by occupying hollows used by wildlife, by denying large quantities of nectar to wildlife, by increasing in-crossing (pollination by a plant of its own flowers) of native plants and may also have adverse effects on native bees.

Seasonal variations

Seed supply, dispersal and viability will vary seasonally due to a range of climatic and biological factors. These factors should be considered as 'natural events' and should be planned for rather than reacted too.

2.Soil condition

Problem: Seed germination and establishment will be impaired by 'unhealthy' soil conditions. Such conditions might include: no suitable site for germination as a result of soil compaction, loss of topsoil, an unstable site, lack of mychorrhizal fungi (fungi which associate with plant roots and assist with nutrient uptake), lack of an 'ash bed' (nutrient pool created by fire), loss of the cryptogamic (lichen & moss) mat or changes to soil chemistry.

Soil structure

Soil compaction

The heavy hooves of stock, including cattle, sheep, horses and goats, can compact soil and destroy soil structure.

This diminishes the air spaces in the soil and reduces its capacity to absorb and retain water, leading to greater runoff, and has detrimental effects on biological activity in the soil. These changes may prevent or restrict germination by excluding penetration by seedling roots, increasing the chance of desiccation (drying out), killing helpful soil micro-organisms which associate with plants and decay organic matter, and by causing other effects.

Loss of topsoil

Topsoil contains most of the organic material from which plants obtain their nutrients. Where it has been removed, such as by erosion, seedlings may be unable to establish due to a lack of nutrients.

Unstable site

Soil provides anchorage for plant roots. If there is movement of soil, plants may fail to remain stable and may fall over, have their roots damaged and opened to infection or suffer other ailments.

Cryptogamic mat

The 'cryptogamic mat' provides a sheltered, moist environment at the soil surface. Its presence in some vegetation types (e.g. grasslands) may play an important role in assisting seedling establishment.

Soil structure - management options:

Exclude stock by fencing or reduce stocking rate. If necessary, lightly scarify compact soils at time of seed fall. Follow up weed control with a knockdown (not residual) herbicide may be required. In severely degraded soils, where no topsoil remains, addition of weed-free, pathogen-free topsoil may be necessary. Alternatively, use native pioneer species such as *Cassinia* which can, over time, re-condition the soil. Sterile hybrid grasses (e.g. ryecorn) have been used as 'cover-crops' to arrest erosion. Addition of a small soil sample from healthy vegetation of the same type can reintroduce lost soil microorganisms. Care must be taken that the soil sample is from healthy vegetation and is free of weed seeds and potential pathogens. Mulching will aid water retention, slowly add to the organic content of the soil and reduce weed competition but if applied too heavily will prevent germination. Where erosion is severe, other erosion control practices should be employed.

Soil chemistry

Application of chemicals

Many of Victoria's soils contain naturally low levels of elements that are important to plant growth, such as phosphorous and nitrogen. Much of our native vegetation is adapted to these low levels of soil nutrients and has developed efficient strategies for recycling nutrients. Application of superphosphate ('super'), weedicides and pesticides has changed the chemistry and biology of the soil (worms and 'super' don't mix). 'Super' favours the rapid growth strategy of introduced pasture annuals over native species. The resulting competition from weeds may effectively exclude native plants.

Lack of an 'ash bed'

Some native plants have specific soil-bed requirements for germination. For example, some species need a fire to release nutrients for use during establishment.

Management options:

Do not apply fertiliser to areas that are to be regenerated or managed to retain native vegetation. Chemicals should be used with care and in minimal quantities to achieve a management aim.

Fire may be used to promote conditions for germination (e.g. ash bed for germination) in appropriate vegetation communities. Expert advice should be sought.

3.Competition

Problem: Competition from the same or other plant species may prevent successful seedling recruitment. This may be due to weeds, parent plant allelopathy (chemical inhibition) or fungal attack.

Competition from weeds

Background:

Weeds can be very efficient at occupying space, using available nutrients and consuming water. In this way they may outcompete native species in the 'race' to grow.

Weeds can be expected to be a major problem in areas that have been previously fertilized and that have been subject to seedfall from weedy species (either native 'environmental weeds' or introduced).

Management options:

There are several options available. The technique employed will depend on your situation (natural bush versus pasture), time constraints and area being managed.

Briefly, the options are: hand weeding using an appropriate technique such as the Bradley Method; mulching, although this can prevent regeneration if applied too heavily; chemical methods (application of weedicides can be very effective although note concerns above re: soil chemistry); use of fire as a means of selecting out fire-sensitive species (e.g. Sweet Pittosporum *Pittosporum undulatum*) or to remove above-ground vegetation for a short period. Fire may be particularly useful where it is necessary to retain the binding capability of plant roots in areas subject to erosion. Removal of the top few centimetres of soil (scalping) can be used to remove unwanted seeds and can be a useful technique if done at the time of seedfall of the species to be regenerated. Positive weed control strategies in areas abutting 'improved' pasture are usually required. For example, a buffer (e.g. screen of tall plants, weeded area) may be needed to prevent *Phalaris* spreading from paddocks into fenced natural areas.

Parent plant allelopathy

Background

Many species of plants (e.g. *Eucalyptus*, *Allocasuarina*) produce chemicals that inhibit germination of their own seedlings beneath them. This prevents competition from the seedling with the parent plant. Typically, the zone of inhibition extends to the width of the crown of the plant.

Management options:

Landholders need to be aware of this effect. The area managed for regeneration should not be restricted to the base of the parent plant. If only a small area can be fenced, it should be offset downwind.

Fungal attack

Background

Soil fungi, whilst vitally important to plant growth (c.f. mychorrizae), can also be pathogens of young seedlings. Attack by fungi can be a problem for seedlings.

Management options:

Sterilization of the soil is neither practical nor desirable. Fungal problems are likely to be seasonal, so repeated attempts may be necessary. Revegetation of areas with contaminated soil containing *Phytophthora* or other soil pathogens must be avoided.

Other seedlings

Background

Where there is a range of plants all germinating together (same or different species) there will be competition between individuals for the available resources. Some plants (of a species), or other species, may do better than others. This should not necessarily be seen as a problem unless the successful competitors are weeds (see above). Some seedlings may die whilst stronger and more successful ones survive.

Management options:

If the aim of management is to increase diversity, you may wish to selectively remove competition against 'rare' species by selectively weeding around them using a suitable technique (e.g. hand-weeding).

4.Predation of young plants

Problem: Seedlings may be destroyed by predators such as insects and other invertebrates; stock; rabbits and hares; or wildlife. Seedlings and young stems may lack natural deterrents (toxic or unpalatable chemicals, hard leaves or leaf structures such as thorns and hairs) and so be relatively defenceless compared to mature plants. Grazers may select particularly palatable species. Thus, some species may be particularly vulnerable.

Insects or other invertebrates

Caterpillars, crickets, beetles, mites, nematodes, and other invertebrates eat seeds and seedlings.

Stock

Stock, including cattle, sheep, horses and goats eat seeds and seedlings and may selectively choose a particularly palatable species.

Introduced species

Deer, rabbits and hares eat native plants. Rabbits and other species may strip bark from young plants and ringbark them.

Native wildlife

Native animals including kangaroos, bandicoots, Swamp Rats and others may feed on seedlings.

Management options:

The most effective control for larger predators is good fencing. Reducing the stocking rate has also been effective in some instances, particularly if commensurate with a rabbit control program. An effective rabbit control program is essential in areas subject to large numbers of rabbits. Invertebrates are difficult to exclude and are likely to be bad in one season and less of a problem in another. Snail and slug baits could be used over small areas or natural predators encouraged by providing cover, feeding and breeding requirements. 'Benign' chemicals, such as white oil, may be useful in specific instances.

5.Natural hazards and controls

Problem: There may be natural climatic, biological and physical constraints upon natural regeneration. These include fire, flood, wind, drought, temperature extremes (e.g. frosts), time of year and light conditions.

Background:

Natural events can affect the survival of seedlings. Drought, fire or flood may kill seedlings. Some species require natural events to occur prior to germination. For example, acacia seeds germinate following fire, whilst River Red Gums respond to flooding. Severe wind may be hazardous to young plants, particularly in exposed situations. There is some evidence that large-scale regeneration events are more likely to be

successful in particularly 'good' years (years with above average rainfall when the soil is warm). Lack of light or water can prevent germination (e.g. in a rainforest the collapse of a mature tree may allow light to the forest floor and initiate germination). Germination may fail to occur in a vegetation community during drought. The first heavy rains may initiate germination on a massive scale.

Management options:

Changes in the pattern of natural events may be linked to a deficiency of regeneration. There is little that can be done to prevent nature taking its course. It is advisable not to put all your effort into one season. Instead, spread your effort across the year and try to time work around normal rainfall events.

Some basic rules

A number of management options have been outlined above to deal with many factors that may be preventing natural regeneration. The practical application of natural regeneration techniques is considered next. What is done, where it is done and when it is done are all important.

It is suggested that you take note of the following general principles:

- Do not apply a technique to the whole area under management until you have tested it on several small representative areas.
- Do not put all your effort into one season.
- Don't be surprised if at first you fail. Your chances of success, as with all techniques, will improve with experience. The rewards are great for those who are prepared to show some dedication, are open to investigation or experimentation and can learn from experience. There are no guarantees with natural regeneration. Talk to those people who have experience in your area.
- Be patient, if it doesn't happen this year, it may next year.

The tools

The following practices form the basic inventory of 'tools' available to encourage natural regeneration. Others may be devised from the suggestions given here.

Fencing to control stock and pest animals; select a fencing technique that is the most appropriate for your stock and which may avoid any pest animal problems that you would expect to occur on your property.

Destocking to control soil damage and browsing caused by stock; may not protect ground flora.

Scarifying (loosening the top few centimetres of soil with a suitable hoe or tiller) to loosen compacted soils, and crack seed coats of soil-stored seed (e.g. wattles).

Burning to promote seed release and conditions for germination of many native plants, as a means of weed control and to promote germination (crack seed coats, etc.).

Hand-weeding to control weeds; labour intensive but avoids using harmful chemicals.

Soil scalping to remove seeds present in the topsoil as a method of weed control; usually not suitable if ground flora is to be conserved and it can be destructive.

Mulching to improve water/soil retention and suppress weeds; can prevent natural regeneration by eliminating light.

Supplementary sowing (direct seeding) to add species where the full natural complement of species is not present, and you do not wish to wait for wind/water or animal dispersed seed to establish.

Planting to add species to those that regenerate naturally with the aim of introducing local native species which can become natural regenerators.

Pesticide application to control insect predation on seed/seedlings; use of pesticides, which may have other less beneficial effects, should be avoided wherever possible.

1080 application, warren fumigation, warren ripping, etc. alternative methods of pest animal control, particularly for rabbits. Contact your local Landcare network for more advice.

Raking/repellent emulsions to hide seed from predators and ants; bitumen emulsions have been used to deter ants in direct-seeding trials.

Erosion control to stabilise soil; specific advice is available from your local Landcare network.

Soil supplementation to reintroduce soil micro-organisms to degraded soils where there is a lack of seedling vigour; healthy soil from vegetation of the same type must be used and it is advisable to try other techniques first.

The use of fertilisers and supplementary watering regimes are not recommended. Fertilisers may alter soil chemistry whilst supplementary watering should be unnecessary if the plant stock is local. Both treatments add costs.

The methods

The method of achieving natural regeneration will vary according to the situation. For example, bushland areas would be managed differently to paddocks.

Bushland areas

'Natural' techniques are usually the most appropriate in native bushland. Natural processes should be allowed to continue as often as possible. A controlled fire will probably be necessary to retain diversity, but advice should be sought first. Hand-weeding or burning are the preferred methods for removing weeds, though chemicals may be the only practical means in some circumstances. Soil disturbance by humans should be avoided in remnant native vegetation, as this can promote weeds. Human access is best confined to areas with no remaining natural ground flora.

Farms and disturbed sites

There is no definitive formula that will provide the desired results every time. If natural regeneration does not occur, further investigation will be needed as to the cause. Some strategies are suggested below (see also **Note 16**):

Strategy one: Fence and do nothing else.

This will almost always be the first step on land under production or other use. (i.e. not necessarily in bushland). Fencing can be carried out at any time, but early autumn is the most likely time for regeneration to occur (spring- summer in cold wet climates). Follow-up plantings of additional understorey and ground species may be required. Problems with weeds should be anticipated. Patience is usually essential.

Strategy two: Fence and scarify.

To regenerate species in an area with compacted soil, such as a stock paddock, attempt to fence and 'tickle up' the soil adjacent to remnant native vegetation. Problems with weeds may necessitate secondary measures.

Strategy three: Fence, apply weed control and/or fire with light soil scarification.

1. Fence in early spring. 2. Apply weed control just prior to seed fall (from February for most species), with follow up occurring throughout the period of germination, and/or apply fire in early autumn taking advantage of dry fuel produced by fencing before spring growth (take note of fire restrictions and precautions). 3. Lightly scarify the soil at the time of seed fall. Rapid regrowth of weeds can be expected. Fast growing acacias and other species may overshadow and eventually exclude some weeds.

Strategy four: Reduce stocking rate and control pest animals

If fencing is not an option, reducing the stocking rate, particularly if combined with an effective pest animal control program, can achieve successful regeneration especially in 'good' seasons for plant growth. There are many other strategies that could be devised using the tools suggested previously.

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14. Nest boxes for wildlife

The role of nest boxes

A range of native animals require natural hollows that develop in trees and some shrubs for shelter and/or breeding. A comprehensive list is given in Land for Wildlife **Note No. 6 'Wildlife needs natural tree hollows'.**

The nest boxes described in this Note are not the equivalent of natural hollows. Natural hollows occur in vegetation at a specific time in the development of the plant community. If the plant community is severely disturbed, merely replacing hollows with a substitute is no compensation for other changes to that habitat such as disruption and loss of food sources from understorey shrubs and interference with the natural cycles that maintain the health of the ecosystem. It takes many years (often decades) for natural hollows to develop. Many eucalypts live for hundreds of years providing safe hollows for many generations. The nest boxes described here will last up to ten years.

Nest boxes are used by people who want to observe the wildlife occurring in their area and something of its natural history in a convenient location. In some instances, nest boxes have been used as substitutes for a lack of natural hollows and as a research tool. Once again, it should be emphasized that artificial hollows are no substitute for real hollows. As a first step in assisting wildlife, you should consider how natural hollows can be protected in your area and make provision for the development of natural hollows, should they be in short supply, by re-establishing local native vegetation. Natural hollows are often destroyed during firewood collection, fencepost cutting, land clearance, burning and timber harvesting. Think about how you might reduce the impact of these practices in your area. Don't use hollow logs for nest boxes. Natural hollows are valuable resources for wildlife and should be left in place on a tree or on the ground.

How do I build a nest box?

General nest box requirements

1. A space to allow for ventilation.

- For weather protection the lid must slope from the back and overhang the front by at least 25mm. It should also overhang the sides. DO NOT use sheet metal on the lid, timber has superior insulating qualities.

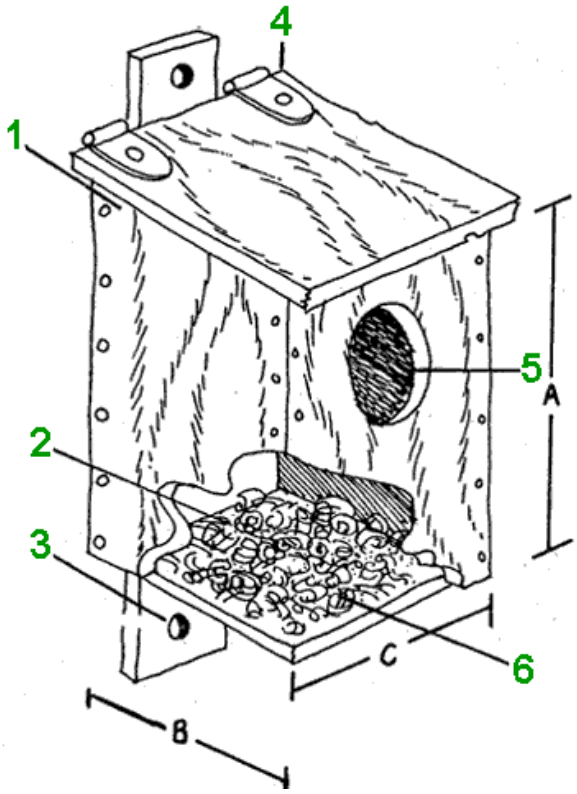
2 20mm deep wood shavings, decayed wood or shredded bark should cover the floor.

3 Fix a mounting strip to blocks attached to the back of the box to make attachment to a tree trunk easier. Pre- drill nail holes in the strip to prevent splitting and use 100mm galvanized flat-head nails.

- Box must be stable. A slight forward lean will assist drainage and exit by young.
- Place box 3 to 5 metres above ground. Boxes placed high in trees present a safety hazard – placing boxes high in trees does not mean animals will use them more. Boxes at 3m high often attract wildlife.
- Arrange timber with growth rings radiating away from the centre of the box. 'Warping' will force the box together rather than apart. See diagram below.

4 A hinged lid or front panel extending 2/3 depth of the box and angle cut for drainage permits inspection and cleaning out after use.

- Floor should be recessed inside walls, loose knots glued in place with PVA (nontoxic) and any gaps that do occur sealed with a quality mastic.
- Use galvanised/nickel-plated screws to join all parts.
- Nesting boxes are best made from rough-sawn plantation-grown timber so animals can get a grip and should be a minimum of 19-25mm thick to provide insulation. DO NOT use treated timber, toxic paints, chipboard, smelly glues or leave any sharp objects such as projecting nails or screws. Avoid wood that is inclined to warp. External construction grade plywood 25mm to 30mm thick is durable and provides a good level of insulation.

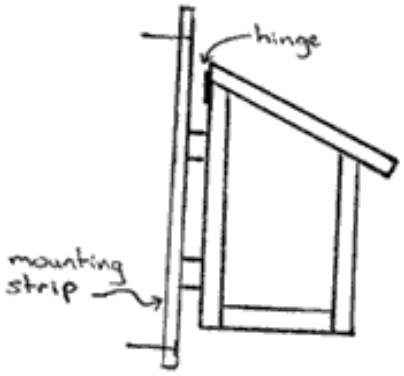


5 Entrance holes should be no bigger than is necessary for the animal the box is intended to house (a critical dimension). Placing the hole near the top will ensure that inside of box is dark.

- Inside walls must have toe holds so the young can climb out.
- Use rough-sawn timber, roughen up with coarse sandpaper or notch with a circular saw before assembly.

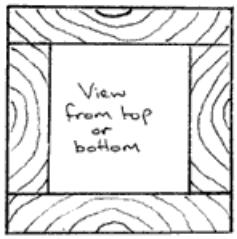
6 Three small (<10mm) drainage holes should be drilled in the floor towards the front (lower side). Avoid creating an updraft.

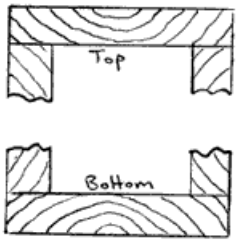
- Box must be weatherproof and dark inside.



Side view

- After assembly, paint the outside of the box with three coats of non-toxic dark coloured outdoor water-based acrylic paint.





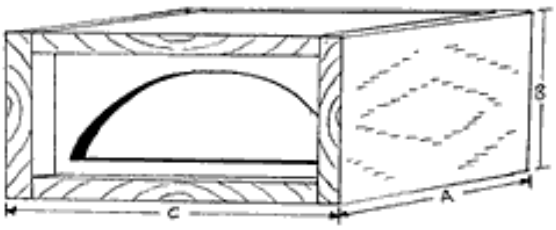
- Layout of wood showing grain orientation to compensate for cupping (warping)

*Table 1: Inside dimensions (all in millimetres) All depths are minimum. Many other native species use hollows. See **Note 6** for a complete list. Some species that will use the general nest box design*

Species	A (height)	B (depth)	C (width)	D (entrance)
Brushtail Possum (also suits ducks)	500	250	290	100-120
Ringtail Possum	400	240	200	70-80
Sugar Glider	400	240	200	32-35/
Tuan	400	240	200	35-40
Rosellas	400	240	200	70
Red-rumped Parrot	400	190	170	60
Treecreepers	400	190	170	45-50
Owlet nightjar	400	190	170	45-50
Ducks - Grey Teal, Chestnut Teal	500	250	290	100
Black duck	500	250	290	130

Horizontal box for Kookaburras, etc.

Young kookaburras and other kingfishers need to excrete from the front of the box so a small sill (<40mm, don't forget to allow for shavings) is desirable. Notes as for general design.



Box for pardalotes

Internal diameter of entrance pipe must be 30mm. (Class 12, 25mm water pipe has ID = 30, OD = 32)

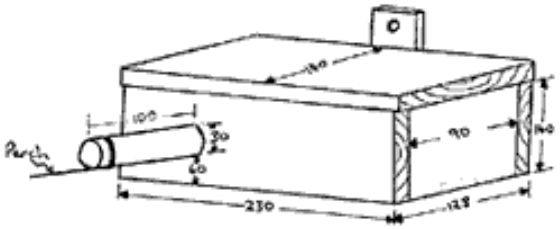


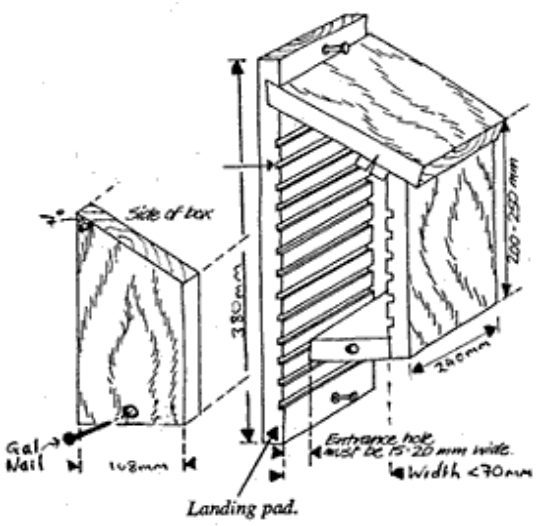
Table 2 : Species using horizontal box

Species	A (height)	B (depth)	C (width)	D (entrance)
Laughing Kookaburra	600	150-200	290	
Grey Shrike Thrush (lid on box not essential)	200-300	150-200	150-200	

Bat roost box

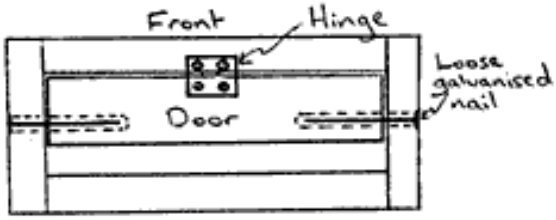
Comments for general box design plus:

- Bats prefer an entrance at the bottom, hence the alternative design.
- Roughen all internal surfaces with shallow, horizontal saw cuts.
- Use 25mm rough-sawn timber.
- You could experiment with hanging some hessian from the inside roof or reduce the cavity.



Bottom view

- There must be a tight seal at all joints to avoid draughts.
- Install on tree, clear of branches, or on wall of house, under eave.
- Internal dividers and greater dimensions will potentially house a larger colony. Bats prefer tight surrounds.
- Don't open the box when it is occupied by bats. Watch at dusk for exit of bats.
- Spraying the box with guano (bat droppings) and water may help attract bats



Where do I place the nest box?

Nest boxes should be placed out of reach of human hands, to avoid vandalism, and potential predators, such as cats. The site may be in a tree or dense shrub or an inaccessible place around a dam, swamp or over water (these boxes will only be used by birds). Some species, such as bats, may prefer a more open site. Duck boxes don't have to be over water. If you are fortunate enough to have bats move into your bat box, you could find that the local mosquito problem is largely taken care of whilst they are there.

The nest box should be given protection from weather, including cold, rain and the direct heat of the sun. Fixing boxes just south of east, about 110° magnetic, has been found to be satisfactory. Bats may appreciate some warmth, particularly in cool climates. You may need to try various orientations and exposure. The entrance should face away from prevailing winds and rain.

The nest box must be firmly attached to its support. 100 mm galvanised nails can be used. Any type of strapping around the supporting plant must take account of the future growth of the plant and so is best avoided. Place a nail in the tree first to support the box then lift the nest box onto it and finish attachment.

Read all you can about the natural nest site of the species for which your box is intended and try to imitate this as much as possible. Some experimentation with box design and placement may be necessary. Note that some mammals, such as Phascogales, can have large litters and build substantial nests. These species may need a box size that is much greater than needed for one animal.

Pardalote Box

Sugar Glider nest box in position on a tree trunk

Problems you might encounter.

Pest species are a major concern. Starlings, Common Mynas, sparrows, honey bees, Black Rats, feral cats and other introduced species may take advantage of the nest box. Their occupation of natural hollows is a concern for the conservation of wildlife. These species may be humanely destroyed. Natural nest predators, including owls, goannas and hawks are a part of the natural ecosystem and may be themselves endangered by introduced species. They are protected native wildlife and must not be harmed.

Regular (weekly) inspection of the nest box is necessary to prevent its use by pest species. Should a nest box be frequented by a pest species you may need to close it off for a period, remove the nesting materials and/or eggs of a pest bird and close the box for a period, control access by selection of an appropriate entrance hole size (70mm prevents Brush-tailed Possums, 45mm prevents Common Mynas, 35-40mm prevents Starlings, 28mm prevents House Sparrows and 26mm prevents Tree Sparrows), completely remove the box and look for an alternative location or desist from using nest boxes and

concentrate on habitat protection and production. If Starlings are seen in a box, check to see that they haven't removed nesting material. Parrots do not provide their own nesting material and so you may need to replace it. Black Rats will be home during the day when they can be caught. Unlike most native animals Black Rats build nests using any suitable material including man-made materials such as newspaper. Phascogales and Antechinus may also use a variety of materials, so it is best not to discard the nest until you are certain of its occupant's identity. Honey Bees can be removed by suspending a pest strip on a wire inside the box for a couple of days. Place the strip inside the box at night when the cold will keep the bees quiet. This will kill the bees and they will have to be removed. Alternatively, see if a local apiarist will remove the bees. Remember that pest species have a major impact on native wildlife through competition for scarce resources and predation. Please do not give them any assistance. If nest boxes are placed within a woodland or open forest habitat, greater than sixty metres from the edge, they will not be used by Starlings, mynas or sparrows. We recommend that you DO NOT feed wildlife. Placing a feeding station within a nesting territory (approx 50 metre radius for rosellas) will disturb nesting activity as the nest guardians will waste time chasing away other species tempted by the food source.

Once a nest box is occupied by a native species, the temptation to look inside the box should be avoided. Regular observation from outside will indicate what is going on. You might like to keep a log of these observations. Frequent inspection is very likely to lead to desertion of the nest box.

Don't be surprised if your box isn't used for some time. Wildlife, such as rosellas, may use the nest box almost immediately, if erected at the correct time (late Winter- early Spring for rosellas). Other species may take longer.

Note that under the Wildlife Act 1975 it is illegal to be in possession of protected wildlife. This means that you cannot interfere with or restrain protected wildlife in any way.

Living with Possums

Under natural conditions the Common Brushtail Possum makes its den in a tree hollow. However, it may also seek daytime shelter in the roof of a house, particularly where natural hollows are in short supply. Nest boxes can form part of the solution to ridding a house of this possum.

Note that Common Brushtail Possums are territorial. Removing a possum from your roof without taking any further steps will simply leave a vacant territory which may soon be re-occupied by another possum. The Common Ringtail Possum usually builds a nest or drey of twigs and leaves, in dense foliage such as Paperbarks, a few metres above the ground. It seldom enters house roofs.

Like all other native animals, possums are protected under the Wildlife Act 1975. They must not be harmed in any way or retained without a permit.

To live with possums:

1. Block all access to your roof by placing collars made from sheet iron, 60cm wide and 60cm above the ground, around the trunks of all trees giving access to the roof or lopping branches which lead to the roof.

2. Make or buy a nest box and install it nearby as an alternative den site for the possum.

3. Block all known entrance points to the roof once possums have left. If you cut off all known access points, as in 1 above, possums will still be able to leave but not return.

Collars can also be used to keep possums out of fruit trees. Ornamental plants or fruit being eaten by possums may be protected by placing blood and bone fertiliser around the base of plants or by making a solution of hot english mustard (mustard powder and water) which can be sprayed or painted on the affected fruits or foliage.

Trapping and removal of possums is not recommended. Released possums may displace other wildlife from hollows, they may cause problems for plants in release areas through over browsing or may be killed by cars, foxes or dogs as they attempt to home or compete with the local possums for a den site.

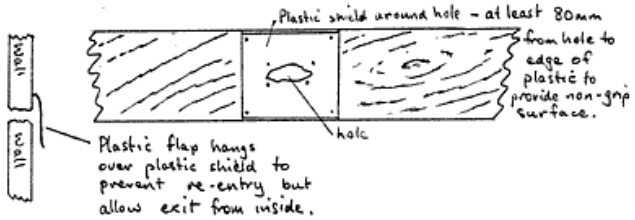
Hence, provision of an alternative den-site by placement of a nest box in a suitable location is an appropriate part of the solution to removing possums from your roof. Other species, including Brush-tailed Phascogales, may also choose to live inside a house and may be dealt with similarly.

If you do decide to have a possum removed from your roof, please contact a pest controller authorised to trap possums.

Living with Bats

Bats may also frequent a house and may take up residence in the wall cavities or roof. As a protected species they may not be harmed. A simple method of removing bats from a house, with one or few manageable entrances to the roof or walls, is to place a bat exclusion flap over each entrance. Provision of alternative accommodation outside the house for bats may encourage them to stay around and keep down insect numbers. Bats are able to use extremely small entrances.

Bat exclusion (one way) flap



Heinrichs, J., (1987), Build your own bat house, reprinted in *NSW Zoological Soc. Mammal Section newsletter*, **March 1987**.

Comments by Leigh Ahern, John Burtonclay, Lindy Lumsden, Peter Menkhorst, Jim Reside and Ian Temby.

Further reading:

Wildlife needs natural tree hollows, Land for Wildlife **Note No. 6**.

Fleming, A., (1986), *Tree Hollows for Wildlife*, Bird Observers Club of Australia.

Home is a Hole, Healesville Sanctuary Education Service (contains additional size recommendations), Strahan, R. (ed.), (1983), *The Complete Book of Australian Mammals*, Angus and Robertson.

Ready-made nest boxes, including bat boxes, are available from:

Wildlife Nest Boxes (Bendigo)

https://wildlifenestboxes.com.au/

Phone: 0427 591 269

LaTrobe University Nesting Boxes (Bundoora)
https://www.latrobe.edu.au/wildlife/nesting-boxes
Phone: (03) 9479 1206

EnvirOnest, Fadersons Road, Mandurang VIC 3551. Phone (03) 5439 5710.

Various Men's Sheds around Victoria may also make nest boxes according to need.

References:

McCulloch, E. & Thomas, R., (1986) *Nest Boxes for Australian Birds, 2nd ed*., Bird Observers Club of Australia, brochure.

The Yarra Book, an urban wildlife guide, MMBW. Stebbings, B. and Walsh, S., (1985), *Bat Boxes: A guide to their History, Function, Construction and Use in the Conservation of Bats,* The Flora and Fauna Preservation Soc., Britain.

15. Wildlife And Farm Dams

Many economic and social benefits can be obtained by incorporating wildlife habitat with a farm dam, including: reduced evaporative losses, improved water quality, wildlife sights and sounds, increased fish and wildlife production, improved stock safety, a source of shade and shelter for stock and humans, emergency fodder, a potential timber supply, fishing, natural pest control in pastures by wildlife, improved farm appearance, a relaxing recreational spot and improved property values as a result of the above.

This Note explains easy, inexpensive ways to improve the habitat value of your dam - both existing and newly constructed dams. It does not explain the engineering principles involved in building a dam. Such advice is available from the Catchment Management Authority in your region or your local reputable contractor.

Provision of suitable habitats around and within a farm dam may provide for a wide range of wildlife including birds, frogs, bats and other mammals, lizards and snakes, fish, yabbies, and a wide range of insects such as butterflies and dragonflies.

The main advantage of fencing and revegetating a dam is the improvement to the overall 'health' of the dam. The healthy dam will contribute to the health of the property and your enterprises.

To achieve optimum results from a 'wildlife dam' it is worthwhile to first consider the whole catchment, the property, and your aims for the property. A Whole Farm Plan is a useful method of integrating all these values and provides an opportunity to consider all the management issues, such as erosion and salinity, that might affect your plans for the dam. Contact the Catchment Management Authority in your region for further advice.

1. Fencing

The first step in improving a farm dam is usually to exclude stock to allow for the establishment of native vegetation, prevent erosion, fouling of the water and reduce the risk of stock drowning. Specially designed fences can be used to exclude other problem species, but care should be taken to determine what effect this might have on wildlife.

By piping water to a trough or leaving a small area unfenced near deeper water and providing a gravel ramp, stock access to water can be maintained. The latter will allow kangaroos, wallabies, emus and wildlife species that might be blocked by a fence to drink at the dam if this is your aim.

A number of wetland birds prefer open space (unfenced, short grass) beside water (swans, maned geese, shelducks, purple swamphens). Kangaroos and some small birds choose open sites for drinking. Extending the area of stock access to a wider section of deep water may benefit such species by keeping the vegetation close cut.

DO NOT PREVENT ACCESS TO FARM DAMS FOR FIRE FIGHTING EQUIPMENT. Ensure gates function properly and vegetation is kept clear of the best access point.

2. Vegetation

Vegetation can provide habitat for wildlife, a sediment and chemical filter zone around the dam, enhance the natural beauty of the property, provide shade and shelter for stock or crops, screen views, reduce evaporation and increase dissolved oxygen. Retain any naturally occurring species adjacent to the dam. Local native vegetation including trees, shrubs and ground covers typical of local wetland.

3. Secure areas

Vegetation is the main source of security for wildlife around and in the dam.

A log, living or dead tree, earth or 'floating' island (without access to predators such as foxes) can also be used to provide security and roost sites. Rocks and ground litter (branches, twigs and leaves) provide secure places for ground fauna and should be retained. Fencing can also provide security if designed to exclude certain species, but can have disadvantages (see fencing).

4. Breeding areas

Dense vegetation provides excellent breeding for a range of species. Examples of where wildlife will breed are: in tree branches, in tree hollows, in the dense crowns of tea trees and other shrubs, in reed beds and amongst dense grass, under rocks and logs. Insects will also use the above sites for breeding. A diversity of habitats will cater for a wide range of wildlife species. Some species of fish need underwater hollows for breeding such as occur in submerged hollow logs. A pipe can be used as a substitute. Where tree hollows are not available, nest boxes can be used as a short-term alternative (see LFW **Note No. 14**). Breeding is linked to security from predators and weather, and food sources. Tall dense nesting cover (grasses, reeds, etc.) is important for many species. The resultant growth of pasture following fencing may provide such cover in its simplest and most easily attained form. Some wetlands are naturally open and can be dominated by large areas of grasses and rushes with taller plants accounting for less than 10% of the cover. Others are crowded with taller shrubs and trees. Both are desirable for wildlife. Grazing by stock is possible after trees and shrubs have developed but it should be quick and light and should be done only in the non-breeding season, usually November - April. Grazing can be used to control heavily suckering woody species such as Black Sheoak Casuarina littoralis but may also have negative consequences such as removing cover and affecting regeneration. Maintenance or renovation of tall dense nesting cover which has thinned, fallen or matted can be done by grazing or burning.

An island in the dam (usually included during construction) may also be used by birds for breeding. The cost of an island can be reduced if it is placed in the shallows and a moat constructed. Deep water is essential to reduce access by some predators. Alternatively, a vegetated "floating island" (punt) can be built on an existing dam.

Keeping track

Keep records of your work. You might wish to take regular photographs. A record of the species of wildlife you observe (before and after), their numbers, breeding records (and the fate of clutches) will give you an indication of how successful you have been. If you are not successful you will need to compare your approach with those of others who have been successful.

You might also consider keeping a record of salinity, variations in water depth and other measures of the physical attributes of your new wetland dam. Further advice is available from the Catchment Management Authority in your region.

Whilst most wetland plants can be easily propagated at home or transplanted to the wetland, there are nurseries that specialise in this field. Insist on local native species only. Many nurseries will be pleased to discuss propagation of plants from seed or stock supplied by you, ensuring local origin.

HINTS

* Stockpile topsoil before construction of the dam and replace it over all surfaces of the finished dam, including those that will be underwater. This is essential to re- establish plants.

* Design vegetation to act as a natural silt trap or build a silt trap above the dam during construction.

* A slight increase in the height of an existing dam wall might flood shallow areas increasing the value of the dam to wildlife.

* Don't plant trees on the dam wall as the roots may mine the wall and lead to its failure.

* Walking/compressing clean straw into the edge of a new dam will supply aquatic organisms with a source of food and kick-start the new food web whilst reducing erosion.

* Natural fluctuations in dam water levels are desirable but should be taken into account when considering the amount of shallow water available in summer and to ensure the dam doesn't dry out.

* Islands should be built high enough to prevent inundation when water levels are high and in windy weather.

* Island edges should have flat (1:5 or flatter) entry to the water to prevent edge erosion.

* Logs jutting out into the water are used by waterbirds for preening and roosting and by water rats. Some should be in the shade. Shade and shelter are important to wildlife as they are to stock.

* Avoid using chemical fertilizers, herbicides and pesticides near water bodies. They may destroy dam vegetation or interfere with the biological life or chemical processes occurring in the dam. Accumulation of chemicals may prove harmful to stock. Problems with algae are usually due to a combination of excess nutrients and sunlight.

Further reading

Nest Boxes for Wildlife, Land for Wildlife Note No. 14

Wetlands and waterbirds of the Snowy River and Gippsland Lakes Catchment, Corrick, A.H. & Norman, F.I. (1980), Proc. Roy. Soc. Vict. Vol. 91, no. 1, pp 1-15.

Wetlands of Victoria II. Wetlands and waterbirds of South Gippsland, Corrick, A.H., (1981), Proc. Roy. Soc. Vict. Vol. 92, pp 187-200.

Wetlands of Victoria III. Wetlands and waterbirds between Port Phillip Bay and Mount Emu Creek, Corrick, A.H. (1982), Proc. Roy. Soc. Vict., Vol 94, no. 2, pp 69-87.

Australian Freshwater Life, The Invertebrates of Australian Inland Waters, Williams, W.D., (1980), MacMillan.

Explore Melbourne's Wetlands, Cowling, S., (1991), National Trust, Victoria.

16. Natural regeneration – case studies on the farm

This Note should be used in conjunction with **Note 13**. The advantages of natural regeneration over the alternatives of direct seeding or planting are considerable. The principal advantage to the farmer is the low cost, both in terms of labour and cash, of establishing large numbers of suitable plants. It is also ideal for wildlife.

Other advantages include:

Natural regeneration:

- can usually be accomplished with little additional equipment than that normally found on a farm
- is suitable for broadscale or localised areas
- maintains the local character of an area
- can produce massive numbers of plants eg. 1700 000 stems/ he (White Cypress Pine, in Venning 1986);
- damage due to insects, rabbits, etc. is likely to affect a smaller percentage of the plants;
- expensive individual plant guards can often be avoided; large numbers of plants closely spaced can shelter each other
- ensures that the plants that are established are genetically related to other natural remnants and will not become environmental weeds
- produces plants that are adapted to local conditions and more likely to survive, not only during establishment but over the years ahead.

Natural regeneration can be quite a simple process, as many of the examples provided here will show.

In priority order, the most likely obstacles to natural regeneration occurring on a farm are the absence of remnant vegetation from which native seeds will spread, grazing, weeds and lack of fire. Other factors may prevent regeneration. These are discussed in detail in **Note 13**. Hence the most common solutions involved fencing or grazing restriction, various forms of weed control and controlled burning.

Natural regeneration may not occur for a considerable time. Even when it does occur the resulting plants may appear to be slow growing and subject to attack by pest species. This is frequently observed in the drier climates where one might presume that the newly established plants are spending more effort on establishing a root system than on above ground growth of stems and foliage. However, the ecological strategies and pest resistant qualities of local species of plants are properties, unrivalled by alternatives, that assist the landholder in the long term.

This note looks at some successful examples of natural regeneration on private farmland in Victoria.

Regeneration from rootstocks

Case 1: Graeme and Frankie MacLennan – coastal Woodside Plain, Gippsland

Method: Fence to exclude stock and promote Swamp Paperbark regeneration from existing rootstocks. Follow up planting to increase diversity.

The area is flat, over cleared and any remnants are in severe decline. Prevailing winds are from the south-west. The native vegetation, especially in the low-lying areas was Swamp Paperbark (*Melaleuca ericafolia*) with Drooping She-Oak (*Allocasuarina verticillata*) and Coastal Manna Gum (*Eucalyptus pryoriana*).

In 1978, Graeme put a central laneway, running east-west, through the sheep grazing property. A few dying sticks of Swamp Paperbark remained along the fence line; over the years, the cattle had destroyed most of the plants and any regeneration had been grazed. The laneway is 15 metres wide. It was double fenced on the southern side, leaving seven metres for natural regeneration of Swamp Paperbark. Regrowth has been rapid and dense, particularly in areas without phalaris grass (*Phalaris sp*.). Slower areas have been given some encouragement by spraying with glyphosate, but this was generally unnecessary. After five or six years, good shelter was achieved.

Note in the photograph the new shoots in the laneway which are pruned by the sheep eliminating any woody weed problems in the pasture.

Resident reptiles also find the northern edge an ideal spot on a sunny day - there is a Red-Bellied Black

Snake which Graeme sees nearly every day! The dense ti-tree is good habitat for small insectivorous birds like the Superb Fairy- wren.

With trends to wider shelterbelts, Graeme has decided to move the fence out into the southern paddock another two metres. The four-wire electric fence is stock proof although the odd lamb finds a way in. I have planted some She-Oaks where there are gaps in the ti-tree. As the ti-tree grows older and taller, gaps will appear at ground level. This may necessitate some chainsaw pruning in the future. It would be impossible to achieve the same density of shelter by planting. There would be at least 20 plants to the square metre.

In our area, this has been a very successful and inexpensive way to achieve a self-sustaining shelterbelt.

Frankie MacLennan.

The laneway (1991) can be used for emergency off-shears shelter for sheep. On a cold windy day, when using the laneway, we can appreciate the shelter it provides!

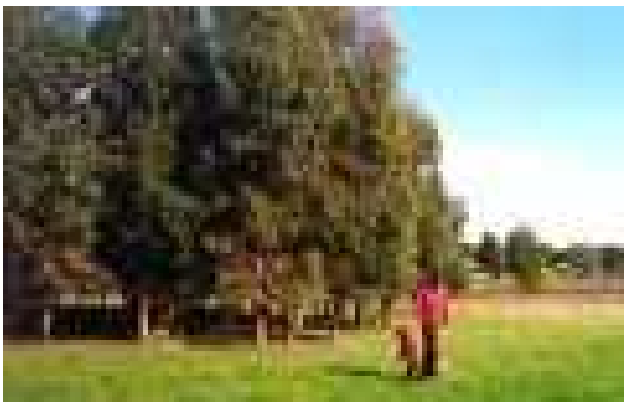
When horse and cattle grazing was removed from this bushland, native tussock grasses returned from rootstocks. The resulting understory is excellent wildlife habitat and visually attractive

Case 2: Jack Frewin, Violet Town

Method: Remove stock (2 years), burn off stubble, scarify lightly. Seed source - a roadside remnant of native vegetation adjacent to the property.

Jack Frewin observed that, following an autumn stubble burn (and light soil disturbance), young native seedlings were regenerating in his paddock. The regeneration was adjacent to a remnant of native vegetation that had persisted along a narrow track bordering the property. Grey Box *Eucalyptus microcarpa* was the predominant species. Jack excluded stock (sheep) from the area for two years to allow the plants, which grew vigorously, to get well above browsing height.

To achieve a self-maintaining ecosystem, additional diversity will be necessary including a range of understorey and ground-cover plants. Total exclusion of stock is preferable.



Native understorey species may spread from the adjacent roadside, be brought in by birds or mammals, or could be sown or planted from native seed gathered nearby.

Case 3: Glenn Wilkin, Sedgewick

Method: Rabbit control, perhaps combined with a particularly good season. Seed source - an isolated remnant tree on the property.

Glenn found that a remnant native tree had successfully regenerated in a paddock that is subject to sheep grazing. He believes that a particularly successful rabbit control program combined with a 'good' year were the key factors responsible. The fastidious nature of stock may also be important. Some flocks appear to prefer the 'taste' of seedlings whilst others will leave them alone. In a good season stock may select alternative feed to young seedlings.

A range of fencing options are available for small patches in paddocks. Fencing combined with supplementary planting of other native species are recommended to achieve a self-maintaining patch of vegetation that has high farm and wildlife value.

Natural regeneration in a paddock subject to grazing.

Case 4: Peter Hamilton - Mt Camel Range, Toolleen.

Method: Soil scalping.

The Mt Camel Range, 40 km west of Bendigo, has largely been cleared of its original Drooping She Oak *Allocasuarina* and White Box *Eucalyptus albens* vegetation association. The range is grazed and so there is no natural regeneration except along roadsides. Pasture/weed growth is vigorous and is dominated by wild oats, variegated thistle, brome grasses, sub clover and sorrel. Soils are of Cambrian greenstone (very old, altered basalt), a red-chocolate colour and loamy. Annual rainfall is about 550mm.

Peter has a ridgetop paddock which has had trees planted and stock excluded for the last 5-6 years. During this period there has been some favourable rainy springs, however, there is no regeneration of any of the remnant White Box *Eucalyptus albens*, Long-leaved Box *E. goniocalyx* or Yellow Box *E. melliodora* except adjacent to a roadside where works have stripped off the topsoil and cut into the gravelly subsoil and underlying rock. Here, some Long-leaved Box has established, and the reason why there is no regeneration elsewhere becomes evident. The pasture/weed growth on the graded portion, although still present, has been dramatically reduced in density and height by the removal of surface soil. Elsewhere, the weed growth is very dense and up to six foot high in early summer.

This site demonstrates that, on fertile ground in dry areas, fencing alone is unlikely to bring about regeneration due to competition for moisture by weeds. However, weed growth can be reduced in the long term by topsoil removal. This means the treatment does not have to be tied to a heavy seeding year.

WARNING: Removal of topsoil is inappropriate where native ground flora exists. It may be detrimental to plant root systems if carried out too close to the plant. Where there is a risk of erosion, precautions should be taken, or this technique avoided.

Case 5: Jim Kilpatrick, Great Western

Method: Rabbit-proof fencing, knockdown herbicide treatment.

Jim has been regenerating Red Gum *Eucalyptus camaldulensis* for 5-6 years mainly to produce very cheap bare-rooted seedlings for transplanting to other parts of the farm. The property receives around 530mm of rain annually and Red Gum occurs on the lower parts of creek flats with some Yellow Box *E. melliodora* grading to Yellow Box-Yellow Gum *E. leucoxylon* on the higher portions of the flats. Soils are duplex clay but fairly silty. Pastures consist of rye, bromes, barley grasses and silver grasses *Vulpia sp*, capeweed and sub clover i.e. predominantly annual species.

Jim selects trees with a large seed crop in early winter. He then sprays glyphosate herbicide (e.g. Round Up) at the appropriate rate during the first warm days at the end of winter (usually mid-August).

If the pasture/weed growth is more substantial than usual he would spray four weeks earlier than this and respray in mid-late August.

Jim has observed that most of his Red Gums start dropping their seed with the first warm days of late winter (this may not be the case elsewhere). Seedlings are first visible in mid-late September and Jim points out that soil moisture over this two week period is *critical*, good results depending on adequate rainfall.

Areas of poorer soil, e.g. gravels, should be avoided in favour of more moisture-retentive ground and he suggests that microclimatic effects are very important e.g. avoid exposed windy areas, north facing slopes, etc.). Jim avoids ripping as he believes it would reduce surface moisture.

Top dressing pasture with superphosphate will increase the weed growth in the following year(s) and should therefore be avoided in areas where revegetation is contemplated. Jim uses an undercutting blade 'plough' to cut the seedling's tap roots and produce healthy bare- rooted seedlings.

Problems: Apart from unreliable spring rains, the main problem is grasshoppers which can decimate Red Gum seedlings in their first season. Jim considers rabbit netting vital to success in his area, even though rabbits are not in large numbers. Successful regeneration has also occurred through fencing alone, although it may take a few years for weeds to become less dominant and regeneration is *more* dependent on good spring rains.

Further reading:

Land for Wildlife Note No. 13.

Curtis, D., (1991), Monitoring Regeneration, in Offor, T. & Watson, R., (1991), *Growback '91*, Growback Publications

17. Wattles and wildlife

Wattles are one of the most widely recognised native plants. This Note explores the less well-known relationship between wattles and wildlife and highlights some qualities of wattles that are of benefit to landholders.

It should be remembered that wattles are only part of a plant community. To create a sustainable habitat for wildlife requires consideration of all the other species typical of the plant community and location.

Wattles and Birds

The seeds of wattles are eaten by birds including Red-tailed Black Cockatoo[1], Gang Gang[2], Emu[3], Crimson Rosella, Red Wattlebird, Superb Fairy-wren, various honeyeaters[4], King Parrot[5] and Brush Bronzewing[1].

Certain birds glean insects directly from the foliage of wattles. The Brown Thornbill feeds mainly from acacias[1]. Fan-tailed Cuckoos are common amongst wattles[1].

Yellow-tailed Black Cockatoos use their massive beaks to rip open the wood of wattles to expose and consume wood- boring grubs.

Many wattles possess glands at the base of the leaves or edge of the phyllode (leaf stem that has been modified to appear and function like a leaf). During flowering this gland may produce a sugary fluid that attracts a wide variety of birds including silvereyes, honeyeaters (New Holland, White-naped, Yellow-faced, White-plumed, Crescent, Spiny-cheeked) and thornbills. Wattle pollen has been observed in bird feathers and birds are known to act as pollinators of some wattles[2]. Josephine Kendrick[6] described how her team used mist nets to catch the bird pollinators of Sunshine Wattle *Acacia terminalis*. Among the many species they caught were honeyeaters, spinebills, thornbills, tree-creepers and several kinds of wren.

The Little Corella has been observed feeding on wasp larvae from galls on *Acacia* spp[1].

Taller species, such as Blackwood *Acacia melanoxylon*, are used as perches by hawking species, including birds of prey. The compact shape, dense foliage (e.g. Blackwood) or prickly nature (e.g. Prickly Moses *A. verticillata*) of some wattles, provide shelter and roost sites for birds.

Gilmore[1] proposes that the structure and composition of insectivorous bird communities is largely determined by the structure of the vegetation. The diverse range of forms and characteristic of wattles, some of which have fine feathery foliage whilst others are broad-leaved, adds considerably to the vegetation structure and foraging opportunities for birds.

Wattles and Mammals

"Research in rural forest remnants in Victoria has shown that the number of Sugar Gliders is determined by the amount of plant exudates available during winter. The most important exudates are the gums produced by certain species of wattles, particularly Black Wattle (*Acacia mearnsii)*. The density of Sugar Gliders has been shown to range from a minimum of one animal per hectare where wattles are absent, to as many as 12 per hectare where wattles are abundant"[7]. Sugar Gliders (and Squirrel Gliders) use acacia gum as an important source of carbohydrate during winter when other sources of energy- rich food, such as nectar and some insects, are scarce. The quality and quantity of gum produced by different acacia species is highly variable. The gum of Black Wattle is water-resistant and persists on the plant throughout the year whereas Blackwood is not a gum producer[7].

The rare Leadbeater's Possum *Gymnobelideus leadbeateri*, which is found in the Mountain Ash (*Eucalyptus delegatensis)* forests of Victoria's central highlands, feeds on the carbohydrate-rich sap of certain wattles. Where hollows are not limiting, the abundance of suitable wattles is the next most important factor determining the numbers of this possum.

Wattles and Invertebrates

Most of the insects which visit or live on wattles do not pollinate the flowers but come to take leaves, pollen or nectar. Ants, native bees and wasps are attracted to the sugars produced by wattle glands

during the flowering period. Wattle seeds possess an oil-rich attachment (*elaiosome*) that is designed to attract ants which aid in seed dispersal. Some weevils may predate so heavily on wattle seed that they can reduce annual seed production by 15-25%. The branches and trunk of wattles can be damaged by wood-boring beetles[3].

A study conducted near Melbourne identified sixty species of moths, some rare, on wattles. Thirty-six species of wattle are known to be food plants for Australian butterflies[3].

Galls, such as those found on some wattles, are produced in response to infection by flies, wasps, psyllids, thrips, scale insects, beetles, bugs, mites, nematodes, fungi and bacteria.

Why plant wattles?

Apart from attracting wildlife, wattles possess many qualities that can be of value to landholders.

For revegetation or as 'nursery' species

Their ability to fix atmospheric nitrogen allows wattles to grow well in soils low in both nitrogen and phosphorus, the absence of which inhibits nitrogen uptake. Wattles regenerate rapidly and are regarded as instrumental in restoring the nitrogen balance within forest ecosystems following fires[1].

Wattles and other native legumes have considerable potential in revegetation programs because they establish rapidly, condition the soil and provide shelter for the slower-growing species, such as eucalypts. Wattles are 'pioneer' (first coloniser) species that exploit the high light and low competition that occurs following a bushfire. These qualities have been utilised for revegetation following mining operations[8].

Some wattles produce stems from their roots and so spread without producing seedlings. This feature is useful where establishment of plants is difficult (eg due to competition from pasture).

Natural pest control

In suitable habitat, especially where wattles are present to provide essential winter food, Sugar Gliders can be common (over 10/hectare). Sugar Gliders prey upon scarab beetles and other invertebrates which defoliate eucalypts and contribute to dieback. One study estimated each Sugar Glider ate 3.24 kgs of insects per year[9]. Hence, wattles and other understorey species which are important to larger predators indirectly contribute to biological control of pests and maintain the health of native vegetation.

In California, orange groves have been interplanted with wattles because they can host a range of predatory insects that provide biological control of pests of the orange trees. This natural pest control quality is equally valuable where wattles are interspersed with eucalypts. Predatory insects, hosted by the wattle, range across to the eucalypt keeping down the number of foliage-eating and sap-sucking insects that can reduce the health of the tree.

Shade and shelter

The dense foliage and compact shape of some wattles, such as Blackwood, makes them suitable for shelterbelt plantings in some areas. Wattles have a reputation for being short-lived. This is true of many species but not all. "Most acacia tree species (especially those with bipinnate foliage) tend to be short-lived, and some are rather susceptible to borers and disease"[10]. Golden Wattle *Acacia pycnantha* may live 8-10 years in cultivation[11]. Other species, such as Lightwood *Acacia implexa* and Blackwood *Acacia melanoxylon* live considerably longer (more than 100 years).

Timber

The timber of Blackwood *A. melanoxylon* has been acclaimed as one of the world's finest furniture timbers. The potential of other species may be yet to be realised.

Erosion control

Wattles establish quickly, even in poor soils. Species of wattle grow along watercourses and therefore have potential in revegetation programs aimed at reducing erosion, filtering input to streams and mitigating flooding.

Colour and scent in the winter landscape

One of the finest qualities of wattles, which has made them famous world-wide and as garden specimens, is the variety and beauty of their foliage and vibrant yellow flowers. Many wattles flower in winter and early spring providing a colourful display when most other species are not in flower. This characteristic can be exploited to improve the farm landscape.

Bee-keeping

The abundant pollen is a source of protein during winter which is important for 'build-up' conditions for bee-keeping.

Other uses

Some wattles have been used for commercial tannin production and (by aborigines and early settlers)[15] as hop substitutes.

Warning - wattles can be poisonous

Smith[7] notes that stock preferentially graze young wattles even when other foods are available in abundance and regards this as being responsible for their absence in most unfenced vegetation remnants. However, many wattles are known to be poisonous or distasteful to stock. Wattle foliage contains the poisons tannic acid and cyanide which probably serve to deter some insect predators. If wattles are going to be used in stocked paddocks landholders should seek advice on the toxicity of the species.

Warning - environmental weeds

The attractive qualities of wattles and their widespread cultivation have led to many introductions of species that did not naturally grow in Victoria and to changes in the distribution of Victorian wattles. Some species have established themselves outside of their previous range and colonised areas of bushland where they previously did not occur. This threatens the nature of the bushland.

*Cootamundra wattle *A. baileyana*, *Early Black Wattle *A. decurrens*, *Cedar Wattle *A. elata*, White Sallow Wattle *A. floribunda*, Flinders Ranges Wattle *A. iteaphylla*, Sallow Wattle *A. longifolia*, Rain Wattle *A. prominens*, *Golden Wreath Wattle *A. saligna* and Coast Wattle *A. sophorae* have been recorded invading native vegetation (environmental weeds) in Victoria[12]. *denotes naturalised in Victoria[13].

How to grow wattles

The use of LOCAL native seed is highly recommended. Costermans[10] and Rogers[16] have produced useful field guides for species identification.

Cross-pollination (pollen transfer between two plants) is important for successful seed set in Sunshine Wattle *A. terminalis*[2] and probably for many other species. Pollination is affected by birds and probably some insects.

Seed collection can usually be done by hand. An upside- down umbrella or tarpaulin can be useful. Seed pods are collected when they change colour from green to brown. Seed shed can be rapid in hot weather. The seed can be sorted from other material using a suitable sieve. Seeds should be stored clean in paper or cloth bags where they will remain viable for long periods.

The seed of wattles possesses a thick seed coat. This prevents entry of water and protects the seed from predators until conditions are right for germination. In nature, this may occur following a bushfire. Fire can be used in bushland remnants to promote germination of most wattles. However, care must be taken to avoid damage to other fire-sensitive species and juvenile plants. Cultivation can also be used to damage the seed coat and so encourage germination of wattles. Wattles may also be established by direct seeding of pre-treated seed (described below).

The seed of most wattles will require pre-treatment to damage the seed coat (dark black outer layer) for successful propagation. There are various options. The most widely used treatment for medium quantities of seed is placement in boiling or hot water (let stand till cool). This imitates the natural heating of a fire. Note that some species (and batches within a species) do not require heat treatment or are sensitive to prolonged heating. For example, Cavanagh[8] recommends 30secs at 100^{o}C for *Acacia terminalis*. A sample of each seed lot should be tested before treating the entire batch. Holding seed with tweezers and nicking the seed coat with a single-sided razor-blade is suitable for small quantities. Other

treatments include acid scarification (H_2So_4, 20 mins), microwaving (120 secs) and machine scarification[8].

Wattles are ideal for sunny positions. They will grow rapidly for a few years and slow down as the canopy and trunk develop. When the desired height has been reached, wattles can be pruned hard after flowering to keep them from becoming straggly and woody. Pruning will prolong the life of wattles[14].

What species to plant

Local native species are recommended. Check with the nearest indigenous nursery for species native to the area. Hint: search for indigenous nurseries on the internet. DON'T FORGET, WATTLES ARE ONLY PART OF THE UNDERSTOREY IN SOME AREAS.

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LAND FOR WILDLIFE

voluntary wildlife conservation

VICTORIA State Government | Environment, Land, Water and Planning

CONTENTS

A checklist of Victoria's wattles prepared by Land for Wildlife

A. x grayana	
A. acanthoclada	Harrow
A. acinacea	Gold-dust
A. aculeatissima	
A. alpina	Alpine
A. amoena	Boomerang
A. argyrophylla	
A. armata	A. paradoxa
A. aspera	Rough
A. ausfeldii	Ausfeld's
*A. baileyana	Cootamundra
A. bivenosa ssp wayi	A. ligulata
A. boormanii	Snowy River
A. botrycephala	A. terminalis
A. brachybotrya	Grey Mulga
A. brownei	
A. buxifolia	Box-leaf
A. calamifolia	Wallowa
A. cognata	Narrow-leaf, Bower
A. colletioides	Wait-a-while
A. dallachiana	Catkin
A. dawsonii	Poverty
A. dealbata	Silver
A. deanei	Deane's
A. deanii ssp deanei	
A. deanei ssp paucijuga	
A. decora	Western Silver
*A. decurrens	Early Black
A. difformis	
A. diffusa	A. genistifolia
A. doratoxylon	
*A. elata	Cedar
A. enterocarpa	Jumping Jack
A. falciformis	Hickory
A. farinosa	Mealy
A. flexifolia	Bent-leaf
A. floribunda	White Sallow
A. frigescens	Montane
A. genistifolia	Spreading

A. glandulicarpa	Hairy-pod
A. gunnii	
A. hakeoides	Hakea
A. hakeoides var angustifolia	A. williamsonii
A. halliana	
A. havilandii	Needle
A. howittii	Sticky
A. implexa	Lightwood
A. kettlewelliae	
A. kybeanensis	Kybean
A. lanigera	Woolly
A. leprosa	Cinnamon
A. ligulata	
A. lineata	Streaked
A. lineolata	
A. loderi	Nealie
A. longifolia	Sallow
A. longifolia var sophorae	A. sophorae
A. lucasii	Woolly-bear
A. maidenii	Maiden's
A. mearnsii	Late Black
A. melanoxylon	Blackwood
A. melvillei	
A. microcarpa	Manna
A. mitchellii	Mitchell's
A. montana	Mallee
A. montana var montana	
A. montana var psilocarpa	
A. mucronata	Variable Sallow
A. myrtifolia	Myrtle
A. nano-dealbata	Dwarf Silver
A. notabilis	
A. nyssophyla	
A. obliquinervia	Mountain Hickory
A. obtusifolia	
A. omalophylla	Yarran
A. osswaldii	Umbrella, Miljee
A. oxycedrus	Spike
A. paradoxa	Hedge

A. paucijuga	
A. pendula	Weeping Myall, Boree
A. penninervis	Hickory
A. phasmoides	Phantom
A. phlebophylla	Buffalo Sallow
A. pravissima	Ovens
A. pycnantha	Golden
A. retinodes	Wirilda
A. retinodes var. retinodes	
A. retinodes var. uncifolia	
A. rigens	Nealie
A. rubida	Red-stem
A. rupicola	Rock
A. salicina	Willow
*A. saligna	Golden Wreath
A. sclerophylla	Hard-leaf
A. siculiformis	Dagger
A. silvestris	Bodalla Silver, Red
A. sophorae	
A. sp. (Buchan)	
A. sp. aff. Kettlewelliae	
A. sp. aff. Papyrocarpa	
A. sp. aff. pendula	A. melvillei
A. spinescens	Spiny
A. stenophylla	Eumong
A. stricta	Hop
A. suaveolens	Sweet
A. subporosa	Bower
A. subtilinervis	
A. terminalis sensu Court	*A. elata
A. terminalis	Sunshine
A. trineura	Three-veined
A. triptera	Spur-wing
A. ulicifolia	Juniper
A. verticillata	Prickly Moses
A. verticillata var. latifolia	
A. verticillata var. ovoidea	
A. verticillata var. verticillata	
A. victoriae	Bramble
A. wilhelmiana	Dwarf Nealie

A. williamsonii	Whirrakee
A. alpina	Alpine
A. mearnsii	Black*
A. melanoxylon	Blackwood
A. amoena	Boomerang
A. cognata	Bower
A. buxifolia	Box-leaf*
A. victoriae	Bramble
A. kettlewelliae	Buffalo
A. aff kettlewelliae	
A. phlebophylla	Buffalo Sallow
A. leprosa	Cinnamon*
A.longifolia	Coast
A. silvestris	Cootamundra
A. doratoxylon	Currawong
A. siculiformis	Dagger
A. deanei	Deane's
ssp deanii	
ssp paucijuga	
A. lineolata	Dwarf Myall
A. wilhelmiana	Dwarf Nealie
A. decurrens	*Early Black*
A. stenophylla	Eumong
A. acinacea	Gold-dust
A. pycnantha	Golden*
A. saligna	*Golden Wreath
A. brachybotrya	Grey Mulga
A.glandulicarpa	Hairy-pod*
A. hakeoides	Hakea
A. sclerophylla	Hard-leaf
A. acanthoclada	Harrow
A. brownei	Heath
A. paradoxa	Hedge*
A. stricta	Hop
A. enterocarpa	Jumping-jack
A. ulicifolia	Juniper
A. kybeanensis	Kybean
A. implexa	Lightwood
A. maidenii	Maiden's
A. montana	Mallee

var montana	
var psilocarpa	
A. microcarpa	Manna
A. farinosa	Mealy
A. dawsonii	Mitta
A. myrtifolia	Myrtle
A. mucronata	Narrow-leaf*
A. rigens	Nealie
A. havilandii	Needle
A. pravissima	Ovens*
A. falciformis	Pale Hickory*
A. gunnii	Ploughshare
A. baileyana	*???Prickly Moses
A. nano-dealbata	Red (honey)
A. rubida	Red-stem
A. rupicola	Rock
A. aspera	Rough
A. lineata	Round-leaf
A. longfolia	Sallow
A. dealbata	Silver(Leadbeaters)*
A. ligulata	Small Cooba
A. boormanii	Snowy River
A. oxycedrus	Spike
A. genistifolia	Spreading
A. spinescens	Spring
A. triptera	Spur-wing
A. howittii	Sticky*
A. flexifolia	Streaked
A. suaveolens	Sweet*
A. obliquinervia	
A. aculeatissima	Thin-leaf
A. osswaldii	Umbrella(fodder)
A. verniciflua	Varnish*
A. colletioides	Wait-a-while
A. calamifolia	Wallowa
A. pendula	Weeping Myall(fodder)
A. decora	Western Silver
A. williamsonii	Whirrakee
A. floribunda	White Sallow

A. ausfeldii	Whipstick Cinnamon
A. salicina	Willow (fodder)
A. retinodes	Wirilda*
var retinodes var uncifolia	
A. lanigera	Woolly
A. lucasii	Woolly Bear
A. omalophylla	Yarran (fodder)
A. difformis	
A. frigescens	
* A. penninervis	
A. dallachiana	
A. argyrophylla	
A.aff papyrocarpa	
A. x grayana	
*A. elata	
A. halliana	
A. loderi	
A. melvillei	
A. mitchellii	
A. notabilis	
A. nyssophylla	
A. obtusifolia	
A. phasmoides	
A. sophorae	
A. sp (Buchan)	
A. subporosa	
A. subtilinervis	
A. terminalis	
A. trineura	
A. verticillata	
var longifolia	
var ovoidea	
varverticillata	

18. Old Trees For Wildlife

This Note explains why old trees are important to wildlife and what can be done to protect these values. It also considers the issue of building on existing vegetation versus revegetation. Which is best for wildlife?

Old trees are an inspiring part of Victoria's landscapes and many rural properties. They are also particularly important for wildlife conservation. Dieback (rural tree decline) and clearing is taking its toll on our stock of old trees. Stands of old trees are often referred to as 'old growth'. Old growth forest is now uncommon and so retention of all old trees is a priority for wildlife.

Why are big, old trees so valuable for the conservation of wildlife?

1. They are irreplaceable. Many of the large trees alive today are 200-800 years old or perhaps even older[1]. Such trees represent the vestiges of once-intact ecosystems and provide some sense of what the landscape was like before the arrival of Europeans. Trees planted now will need two centuries or more before they attain a similar form and position in the landscape[12]. However, estimates of rural tree decline suggest that most large trees on agricultural land will have died within 100 years[2,19], unless actions are taken to protect those trees now.

In many parts of the State the older trees needed by wildlife are now restricted to private land, roadsides and other refuges, having been cleared from public land many decades ago. These trees allow hollow-dependent wildlife species, such as Sugar Gliders, to persist in areas that would otherwise not support them.

2. Tree hollows only occur in mature trees. They provide essential refuge and breeding sites for many species of mammals and birds, as well as for many invertebrates, reptiles and frogs[9]. Thirty-seven per cent of Victorian mammals use hollows as nest sites or roost sites.

Thirty-nine per cent of forest and woodland bird species are hollow-nesters [4,9]. Useful hollows for wildlife only begin to form in eucalypts after about 100 years [1,9,12], subsequently deepening and enlarging with age. The number of hollows per tree also increases with tree age [1,12], providing alternative roost sites for bats and arboreal mammals that use a number of different roost sites within their home range [4,11].

Hollows large enough to provide nest sites or roost sites for large possums, cockatoos and owls generally only develop in trees aged 200 years or older [12], leading to the dependence of some of these species on remnant patches of 'old-growth' forest [10,14].

3. By virtue of size, old trees provide more food resources and nesting resources than younger trees[16]. One 300 year old Grey Box (*Eucalyptus microcarpa*) with a height of 20 m and trunk diameter of 1.5 m has a bark surface area of approximately 94 square metres. A 20 year old tree with a trunk diameter of 20 cm and height of 15 m has a bark surface area of just 9 square metres. An animal can therefore forage as profitably on the one large tree as on 10 smaller trees, at the same time decreasing the risk of predation by not having to travel so often from one tree to the next. Healthy, mature trees produce more nectar, foliage and fruits than young trees, which must spend much of their energy on growth in height. These highly productive nectar sources may be vital to the survival of some wildlife species, providing energy to nectar feeders (e.g. Regent Honeyeater) and species that rely on insects that are dependent on nectar (e.g. Brush-tailed Phascogale).

4. Litterfall is also positively correlated with tree size and tree age [20,3]. Litter is one of the key components of woodland and forest ecosystems [3,16,12]. The litter layer reduces the impact of water on soil, leading to more gradual run-off [7]. It gradually decomposes, providing a small, constant input of nutrients into the system 3. It supports a huge array of invertebrates, some of which spend their whole lives in the litter layer, others of which spend their larval lives there and their adult lives in the tree canopy [13,15]. Maintenance of the litter layer accordingly provides food, not only for decomposers and insect-eating animals on the ground, but also for arboreal insectivores[18]. The litter layer provides refuge and nest sites for many species of reptile, frog and bird. Loss of the litter layer may lead to widespread

declines in abundance of ground-dwelling species[18] (e.g. antechinus, nightjars).

5. Large trees drop large, rotten limbs. These limbs provide sustenance for decomposers, refuge for snakes, frogs, invertebrates, geckoes, lizards and mammals, cover from, and foraging areas for predators and perches for reptiles and birds that hunt by sallying and hawking.

What value do large trees have for landholders?

Large trees provide more shade, and in groups, provide more protection from inclement weather, than small trees. They provide a more stable microclimate, the soil beneath large trees being relatively cooler in summer and warmer in winter.

They are often prolific nectar producers and valued by apiarists.

When growing in a linear fashion along the edges of roads or paddocks, large trees will provide a more effective windbreak for stock and crops than smaller trees, particularly if some smaller trees or shrubs are also present[6].

Large trees can provide a ready source of young plants (seedlings) of local provenance without the costs of purchase or propagation, assuming that an area is fenced off from stock. Fencing off areas may also encourage regeneration of other native plant species and greater use of the area by wildlife.

Old trees have deep root systems and can tap into underground nutrients that are beyond the reach of pasture plants. These are then released at the soil surface as flowers, leaves, twigs, branches, bark, sap, pollen, nectar and water vapour.

The stature and form of large trees are appreciated by many people as an aesthetic and recreational attribute (e.g. as a good picnic or rest spot, somewhere to relax whilst fishing).

Old eucalypts often have very limited value as timber due to extensive deterioration of the wood. They are typically full of hollows and may contain cracked or rotten limbs. These other "attributes" outweigh their value as a source of timber which is much better provided by younger trees established as a woodlot.

Young trees are of smaller diameter, can be cut green (thus reducing chainsaw wear) and will split whilst drying, qualities which make them far better suited to firewood production.

Managing old trees.

Nearly all of the benefits attributed to large trees assume that we have a functioning ecosystem in which large trees are healthy, are producing viable seed and are part of an environment that contains other species of wildlife. For example, a healthy tree drops leaves, bark and sticks that fall and become the litter layer. This is gradually decomposed by a range of organisms that, in turn, support a wide array of insectivores and fungivores. These support larger predators, and so forth. For such a system to survive, it is vital to fence off old trees to protect them from stock. Stock faeces adds to soil nutrients and this has been linked to tree decline. Stock may ringbark old trees, particularly stringybark eucalypts and their trampling can compact the soil and prevent the germination of seed.

Stock trampling can cause damage to roots and alter the nature of the litter layer of leaves, twigs and branches.

Furthermore, the fenced-off area should extend beyond the canopy of the older trees, so that young plants are not competing directly with the old trees for light or water. Chemicals produced by the leaves of the mature tree may also inhibit seedling establishment beneath the tree.

In many instances, where mature trees are fenced off and protected from stock, some replanting will also be necessary to restore the understorey and ground layers of vegetation, to provide replacement young trees, or fill in gaps along streamside corridors and in remnant stands of vegetation. The most important action is the fencing off of the mature trees. Protection of these trees will increase their chances of living an extra 100 years, by which time the replacement trees will just be beginning to form their first hollow and attract their first bat or glider. Nest boxes may be used to provide temporary accommodation for wildlife in some circumstances but there are many unknown factors associated with their use (see LFW **Note No. 14**).

In summary, it is usually necessary to fence, revegetate (especially with understorey species) and connect. Throughout rural Victoria many old trees are dying from 'dieback' which may result from the combined effects of increased insect predation and other pathogens (e.g. cinnamon fungus), changed soil chemistry, salinity, exposure to extremes of weather, drought, old age and other factors. Dr Jill Landsberg of the CSIRO found that stock access beneath trees is important in determining the nutrient levels of foliage and insect attack at her NSW study sites[5]. She believes that increased nutrient levels in leaves at sites with stock access probably results from dung. Fenced sites showed lower nutrient levels and less insect damage. Fencing to exclude stock is the appropriate management response, although limited grazing may still be possible.

Retention or revegetation?

Vegetation is being re-established throughout Victoria for salinity control, stock shade and shelter, erosion control and as wildlife habitat. These plantings will not provide hollows for 100-200 years.

In many parts of the Victorian countryside all the trees have been removed. In such cases replanting is the only option for the restoration of wildlife habitats and revegetation of recharge areas and creek lines.

However, in some areas, remnants of the original native vegetation persist, often as scattered mature trees in paddocks. In such instances landholders have a choice between revegetation by replanting, revegetation through protection of mature trees (and seed fall from the trees), or a combination thereof. Which option will provide the best wildlife habitat?

Obviously, the choice will depend partly on the aim of the landholder and the presence or absence of vegetation at the target site. For instance, many saline areas and creek lines are denuded of vegetation. In such situations, control of rising groundwater and erosion will require planting many young trees and shrubs.

Where wildlife conservation is an important aim of revegetation and mature trees are present, the protection of those mature trees should be paramount. Indeed, it has been concluded that the retention and protection of stands of old trees (the larger the stand the better) is probably the single most important conservation action that can be taken on our own land, particularly where mature trees form a natural corridor and buffer along the edges of creeks[17].

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19. Woodlots And Wildlife

Many of Victoria's native trees have excellent qualities for fencing, construction, firewood and other uses. European settlers found them to be durable and strong, however the high demand for native timbers, coupled with the pressures to clear land for agriculture, led to the resource being rapidly depleted and today many areas are now treeless or reliant on off-farm supplies of timber. As a result of this timber removal, much wildlife relying on treed areas disappeared.

This Note explains the principles of how a woodlot could be established and managed to provide wood for personal use whilst also providing some wildlife habitat.

The advantages of a 'wildlife woodlot'

A woodlot need not be designed for wood production alone. It can also function as a shade and shelterbelt, recreational area, as an erosion and salinity control area and as wildlife habitat.

This Note is based upon the principle that these multiple returns may be of greater value than managing the woodlot for wood alone and that a healthier woodlot is likely to be sustainable in the long term with minimal landholder input. Together, these multiple benefits will probably offer greater return from the same area of land.

Wildlife, including birds, bats, mammals and predatory invertebrates that use the woodlot, will assist in maintaining its health by providing natural pest control.

Woodlots on a property with other areas of remnant vegetation that are managed principally for wildlife can have the additional benefit of reducing the need to harvest timber from those other areas. A woodlot on the property avoids the expense of driving to another location to gather wood and permit fees for collection (where applicable).

This is quite a different approach to the coppiced Sugar Gum plantations, used extensively in western Victoria, which provide minimal wildlife habitat.

Principles of a wildlife woodlot

- Local native plant species are used. These are not selected for any particular genetic traits.
- Monocultures are avoided. Diversity of species is encouraged.
- Native animals, including invertebrates, provide pest control. There is no use of chemical control.
- Some trees are left to reach old age and existing old trees may be incorporated into a new woodlot, if available. These are not harvested but are left to age, fall and decay, providing hollows for wildlife whilst standing and returning nutrients to the soil when fallen. Smaller branches may be removed if they pose a fire risk, although these are quick to mulch down.
- A selection of understorey species is included in the woodlot, including species that would naturally occur in association with the trees. Some plants are clumped to provide dense thickets for wildlife refuge.
- Ground litter is left to accumulate. Fire precautions are taken but the aim is to locate these out of the woodlot area. Fine litter is not left to accumulate near buildings.
- Fertilizers and supplementary watering are not required. Unnatural nutrient input to the woodlot is minimised although fallen eucalypt litter or branches from other fire-prone sites on the farm could be relocated to the woodlot.
- Young trees (10-40 years old) are harvested selectively or in small patches. Clearfelling large areas is avoided. Various age classes are represented.
- There is minimal disturbance to the woodlot when removing timber.
- Stock are mostly excluded. Other herbivores may also need to be excluded to permit natural regeneration.
- The woodlot may be able to act as a 'corridor' for wildlife species movement between intact remnants of native vegetation.

How to create a wildlife woodlot

Siting

A Whole Farm Plan for the property (see Garrett) will enable suitable areas to be identified. During the preparation of the Plan, potential other uses of the woodlot (e.g. recreation, wildlife habitat, shelter, erosion control) can be considered. They will in part determine its size and location. Suitable areas might be – beside watercourses, in erosion prone areas, salinity recharge areas on hillsides around fenced dams and adjacent to fence lines on the windward side of paddocks.

Points to consider:

- Local native plant species are adapted to particular sites in the landscape.
- Fencing is a major cost of establishment. This can be minimised by careful placement of the woodlot to take advantage of existing fences (within the framework of the Whole Farm Plan).
- Access for equipment used to harvest timber must be considered.

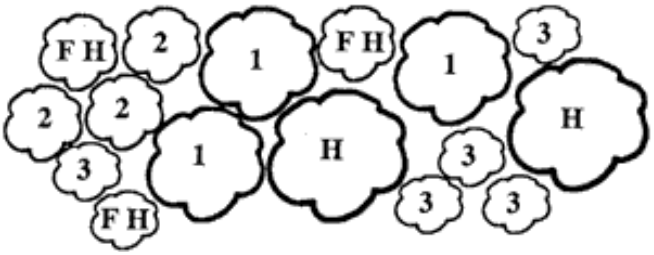
Area and shape

The total area required will be determined by the rate of harvesting, the number of useful trees per hectare and the age classes being maintained on the site. A proportion of

all age classes, and preferable a range of species, should be left to reach old age (future habitat trees, some with hollows). Mature trees will occupy a greater area than young trees and those being maintained for wildlife will be unproductive for wood. It is better to start off with a greater area under wood production than is likely to be needed and to reduce the area, if necessary, as the productivity of the site is evaluated.

Species selection

Local native species are recommended as they are adapted to local conditions. Each species has unique qualities that may be valued for different reasons (e.g. if harvesting firewood: heat production, ease of splitting, ignitability, quality of coals and number of sparks). Good native firewood species include Grey Box *Eucalyptus microcarpa,* Black Box E. *largiflorens*, Red Ironbark E. *sideroxylon*, Yellow Box E. *melliodora*, Red Box E. *polyanthemos*, Yellow Gum E. *leucoxylon*, River Red Gum E. *camaldulensis*, Blue Gum E. *globulus*, Red Stringybark E. *macroryncha*, Narrow-leaved Peppermint E. *radiata*, Messmate E. *obliqua*, Mountain Ash E. *regnans* and White Cypress Pine *Callitris columellaris*. CNR can provide information about local species suitable for firewood. Note that eucalypts of the subgenus symphyomyrtus (frequently smooth-barked eucalypts) form hollows more readily than subgenus monocalyptus. Some species are better nectar producers than others or of special importance to particular wildlife species (e.g. Red Ironbark).



Diagrammatic representation of a mixed age woodlot incorporating habitat trees (H), future habitat trees (FH) and various age classes of trees for harvesting (1,2,3). Note that understorey shrubs and ground cover have been omitted for clarity.]

A compact (round) shape will reduce the negative impacts of edges, including windthrow, impacts of adjacent land use and weed invasion from pasture. However, linear woodlots with long edges have the advantage of providing for 'edge' species, can provide habitat diversity and may be used to join more compact remnant areas.

Management

Site preparation and planting – a few points

As a general guide, on farmland, effective weed control will be the major factor in establishing the woodlot. Various options are available including herbicides, soil scalping and mouldboard ploughing. Plants can be established using natural regeneration (near existing remnants), direct seeding or planting. The warm, wet seasons (autumn, spring) are the time for planting to occur. Fertilizers and supplementary watering should not be necessary if

the site is well prepared and seasonal conditions are near average.

It may be best to establish the woodlot in patches over many years to ensure a range of age classes.

'Pioneer' understorey species, such as acacias, cassinias and native peas, can be used to provide shelter during the establishment phase.

Avoid areas close to buildings for fire safety (although a carefully managed native woodlot can be used to shield buildings (see Simpfendorfer)).

In most cases it will be necessary to securely fence areas being used as woodlots. This should be done prior to planting to ensure exclusion of livestock.

Harvesting wood

Minimal disturbance during harvesting will have less impact on wildlife and plant life and reduce the risk of weed invasion. Care should be taken to avoid the spread of diseases, such as cinnamon fungus, by cleaning all equipment prior to entering the woodlot. It may be necessary to harvest 'patches' to allow sufficient light and moisture to be available for regeneration. In corridor woodlots, selective felling may help to retain continuity.

What and when to harvest

Small diameter trees are ideal for firewood. If cut green, they are less risky to fell, create less disturbance, are more easily cut into lengths that can be stored and reduce wear on chainsaws. Green wood often splits whilst drying and so requires less axe work. Forward planning is needed to ensure sufficient drying time (which may take one to two years depending on the species). The advantage for wildlife is that old and dead habitat trees are retained and, if young trees are found to be an important component of the habitat, they can be replaced fairly quickly. Harvesting in summer, when soils are compact, is likely to reduce the effects of soil compaction and means that vehicles are less likely to carry soil on their wheels which may include undesirable weed seeds or microorganisms.

Old trees

Old trees are particularly valuable for wildlife. They can provide hollows for shelter and breeding, large areas of bark for insect-feeders such as treecreepers and abundant nectar flows (see LFW **Note 18** for details). Old trees are part of a naturally ageing forest. They produce abundant seed for natural regeneration and are more resistant to bushfire. As a general guide, three to ten hollow-bearing trees per hectare, with as many as thirty hollows, may be required to support a diverse wildlife population. Incorporate old trees into the woodlot design.

Weeds

Weed problems can be avoided by careful selection and screening of the seed/plants used to establish the woodlot (seek advice), minimal disturbance once established, immediate control of weeds once identified and regular monitoring.

Pest animals

Invertebrates may be a problem during establishment.

Their impact can be reduced by planting a diverse range of species in a reasonably large area and not using pesticides (which may kill helpful predators as well as the pests). Reducing soil fertility through soil scalping and avoidance of fertilizers may be an advantage in some areas as insect numbers have been correlated with the nutrient content of foliage (Landsberg et al, 1990).

Rabbits, foxes and other species may take advantage of the shelter of the woodlot. Increased control programs may be required. Effective techniques which minimise disturbance are available for the control of these species in bush areas (refer to Land for Wildlife News). Control of introduced species will benefit wildlife and assist regeneration. Remove only those fallen logs that are providing harbour in areas that cannot be treated by other means.

Fire

Firebreaks should be placed outside the woodlot area to reduce the risk of weed invasion through soil disturbance. Careful placement of the woodlot may offer protection from fire (Simpfendorfer, 1989), although understorey species may not be appropriate close to buildings as they may carry the fire into the canopy.

Natural litter, including fallen branches, leaves and twigs are an important component of the habitat for wildlife and predatory invertebrates. Leaf litter assists with controlling erosion and returns nutrients to the soil.

Livestock access

Livestock can concentrate nutrients, compact soils, eat seedlings and flowers (thereby preventing regeneration), ringbark trees and reduce the diversity of the vegetation which, for example, affects the quality of habitat for insectivorous birds and invertebrates. This substantially reduces the chance of natural pest control. Stock have been implicated in rural tree decline through redistribution of nutrients as dung to treed areas (Landsberg et al 1990), and in reduction of understorey habitat for insectivorous birds.

Stock should be excluded from woodlot areas at all times, except perhaps for short periods for protection from extreme weather, during drought or to reduce fire risk where other means are unavailable. In some instances, retaining stock access to areas can provide open conditions that suit particular species (e.g. Bush thick-knee, Grey- crowned Babbler) and carefully managed stocking may be appropriate so long as the vegetation does not deteriorate. Advice is available from Land for Wildlife extension officers. The ability of the vegetation to recover after these occasional episodes should be monitored.

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20. Shelterbelts And Wildlife

The value of shelterbelts in protecting crops and livestock is widely acknowledged. Reduced livestock death rates and higher birth rates, improved liveweight and wool gains, reduced heat and cold stress and higher crop yields have all been noted as potential economic gains (see Land for Wildlife **Note 10).** Environmental advantages include natural pest control, a more pleasant and visually appealing place in which to live, recreational opportunities and protection from the sun.

Less well known are the potential advantages afforded by shelterbelts, appropriately located and managed, in fire safety. A shelterbelt can reduce windspeed, the major weather factor in the rate of fire spread, deflect burning debris around the home and filter out sparks (Petris, 1992).

Suitably designed shelterbelts can also assist nature conservation and attract wildlife to a property. This Note considers those aspects of a shelterbelt that are most important to wildlife and includes some general information on design, location and management of shelterbelts.

Why select local native species?

The choice of local native species in preference to alternatives is a major factor in providing habitat for wildlife. Local native species offer a range of qualities that exotics and non-local natives do not. These are examined below and provide strong arguments for the use of local native species as opposed to traditional favourites such as cypresses and Sugar gums *Eucalyptus cladocalyx*.

- **Adapted to local conditions.** Local native plants are precisely 'tuned', through natural selection, to the soil types, seasons, climate and pests in the area of natural occurrence. Although conditions will have changed in some areas, as a result of overclearing and its consequences, local species should be tried before resorting to the nearest suitable alternative. Whilst introduced plant species may be free of natural diseases of their country of origin at present, they are susceptible to dramatic declines if a disease is introduced.
- **Permeability**. Shelterbelts need to be semi-permeable to wind such that wind speed is reduced significantly but that turbulence is not created. Some cypress trees are virtually impermeable to wind.
- Impermeable barriers can create substantial turbulence on the lee side which reduces the windbreak effectiveness and can even enhance wind effects. The chance of windthrow also increases with increasing impermeability to wind.
- In addition, mature cypress and pine trees usually exclude understorey plants. The gap between ground and lowest branches can be sufficient to allow wind to pass through unabated, or
- be channelled at higher speed, thus increasing the wind effects. In contrast, many natural plant communities include understorey shrubs which can be used to fill the gap that develops as trees age.
- Multiple-row native shelterbelts, using trees and shrubs of varying heights and ages, have been used to overcome this problem.
- **Evergreen/landscape character.** The vast majority of native species are evergreen. This is essential for a shelterbelt to provide wind resistance in all seasons. Use of local species helps to maintain the character of the local natural landscape giving each region its unique signature.
- **Durability/self-perpetuating**. Local species are able to survive most of the natural hazards, including fire, frost and drought, in their area of natural occurrence. Unlike conifers, which are easily killed by fire, many native species can resprout from buds, rootstock or seed after fire. Natural regeneration can maintain a native shelterbelt, if properly managed, and avoid re- establishment costs and long periods without shelter (see LFW **Note 16**).
- **Cost**. Techniques for establishing native plants, such as direct-seeding, permit native shelterbelts to be established at a fraction of the cost of nursery-grown plants. Introduced conifers are often planted as single row shelterbelts, resulting in shelterbelt failure when mature plants die, leaving a large gap. Replacements cannot be established due to competition from the mature conifers.

- **Labour**. Native plants usually require less follow up management during establishment. Supplementary watering is usually not necessary.
- **Wildlife and natural pest control**. Wildlife will be attracted to local native species and can provide natural pest control of agricultural pest species. For example, ibis feed on crickets, grasshoppers, beetle larvae and caterpillars, consuming about 200 grams of insects each per day. Bats may eat up to two thirds of their body weight in insects per night. Magpies consume scarabs, weevils and other pasture pests. Hence, wildlife and native invertebrates protect the shelterbelt by providing biological control of problem species (e.g. Christmas beetles, psyllids) directly through predation and by spreading parasites and diseases. Local native species can supplement the existing nature reserve network and attract wildlife to a property. Cypress and pine trees have value as habitat for very few native species. Local species provide the diversity of flowering times and continuous litterfall to which native wildlife is adapted. Native vegetation has a much higher diversity of invertebrate fauna than pine plantations (Ahern and Yen 1977)
- **Weed potential**. Many plants introduced from outside their natural range (e.g. *Pinus radiata*) may respond by rapidly colonising areas, such as natural bushland, in which they are not wanted. There are suitable local species that are non-invasive and can be used in place of potentially dangerous weeds. For example, Kurrajong *Brachychiton populneus* or Blackwood *Acacia melanoxylon* provide the same dense foliage and height as Sweet Pittosporum *Pittosporum undulatum* or Monterey pine *Pinus radiata* which are very serious environmental weeds (Carr et al 1992).
- **Wood**. Many Victorian eucalypts, and some other native species, produce excellent timber and firewood (Land for Wildlife Note 19, 1992). In comparison, cypress and many other exotic trees sometimes used in shelterbelts do not have the same utility.
- **Fire** "Traditionally, many shelterbelts have been planted with cypress trees. However, multiple rows of indigenous trees will often perform better as shelterbelt species. Many indigenous trees are often taller than cypresses, and subsequently provide more protection. Furthermore, most indigenous trees will also recover from fire, while cypresses are extremely susceptible to fire" (Petris, 1992).

There are a wide variety of local species from which to choose for establishing in a shelterbelt. Understorey species are also important.

General points on shelterbelt design

A shelterbelt should present a semi-permeable barrier to wind. Dense shelterbelts can be used near but not adjacent to buildings to provide maximum protection from wind and airborne debris (Petris 1992, Simpfendorfer 1989). Open shelterbelts are usually recommended for protection of fields and crops.

A shelterbelt should be long and continuous, as turbulence occurs around ends, and preferably joined to other shelterbelts, woodlots or areas of natural vegetation. This avoids turbulence and 'funnels'.

It should be sloped or contoured to reduce turbulence.

This can be achieved by placing smaller growing shrubs in front or species that will naturally contour, such as Melaleuca sp (subject to location). Continuous green foliage is required on the windward side of the shelterbelt extending from the ground level upwards.

Straight shelterbelts are not necessarily the best design. A shelterbelt along a meandering watercourse offers many pockets in which livestock can shelter, despite changes in wind direction. Refer to the references for more detail on shelterbelt design.

Wildlife aspects of shelterbelt design

Wider shelterbelts of mixed local native species, and shelterbelts that connect with larger areas of bushland, will be of greater benefit to wildlife than narrow strips of few species.

Shelterbelts need to be fenced to exclude livestock (other herbivores may also require exclusion, including rabbits, goats, horses, kangaroos and rabbits) but with optional access should the need

arise for fire control or to allow livestock to shelter during extreme weather.

Tall eucalypts and other trees can provide perches and nest sites for birds including birds of prey and magpies that attack agricultural pests. Dense or prickly shrubs offer refuge to many species. Leaf litter, rocks and logs provide habitat for reptiles, echidnas, antechinus, thick-knees, etc. Nectar-producing trees and shrubs provide food for many birds and some mammals.

Warning: avoid using environmental weeds in shelterbelts. Carr et al. (1992) list 584 plant taxa that have been recorded as weeds of native vegetation. Environmental weeds can reduce the habitat value of bushland areas for wildlife and pose a long-term threat to native vegetation. Some also pose a risk to cleared pasture.

The same wildlife principles apply to shelterbelts as to woodlots. These principles are outlined in Land for Wildlife Note 19 'Woodlots and wildlife' and include:

- use of a diverse range of local native species,
- avoidance of pesticides and fertilizers,
- leaving some trees to reach old age and develop hollows,
- retention of ground litter except near buildings,
- and minimal disturbance by noise, vehicle movement or cultivation.

Harvesting is undesirable in shelterbelts if it creates gaps in the vegetation. Selective logging may be suitable in some situations.

'Simple' shelterbelts of few species may attract Noisy Miners or other problem species.

Shelterbelt location - General points

Suitable sites for shelterbelts should be chosen as part of the development of a Whole Farm Plan for the property (see Garrett, 1991, Land for Wildlife Note 21).

Take advantage of naturally occurring shelterbelts, such as native vegetation along roadsides and streams. Protect these areas as a priority. They can provide excellent habitat for wildlife.

Shelterbelts on level ground should be oriented at right angles to prevailing winds.

On undulating sites, wind flows parallel with the ground rather than from one particular direction (Simpfendorfer 1989).

Shelterbelts on ridgetops give greatest deflection of wind in these situations but may be exposed to extreme winds. In windy situations, such as exposed hilltops, wider shelterbelts are preferable. Wide belts provide greater protection and allow species, protected deeper within the shelterbelt, to reach greater heights.

In gullies, shelterbelts can trap cold air drainage.

For fire protection, buildings should be sited more than 1.5 and less than 5 times the shelterbelt height from a dense shelterbelt (Simpfendorfer, 1989).

Open shelterbelts can reduce wind speed for a distance of up to 25 times their own height and are suitable for protecting stock and crops. To protect a large property a number of shelterbelts are needed. Multiple shelterbelts can significantly reduce windspeed compared to single shelterbelts (Simpfendorfer, 1989). Dense shelterbelts reduce wind speed on the windward side (by 2 to 3 heights) as well as on the leeward side (7 to 8 heights).

Crop yields may be decreased in the area adjacent to a shelterbelt due to competition between plants. This area can be used for a firebreak or lane-way.

Shelterbelt location and wildlife

Shelterbelts can act as corridors for wildlife movement if they connect with other areas of local native vegetation (see LFW Note 3). Consider the options for the property, discuss plans with neighbours and consult maps and aerial photographs to determine appropriate sites.

Plants within shelterbelts located on high quality, fertile sites may attain superior nectar flows and greater height than those on poor sites. This will benefit some species of wildlife.

Shelterbelts near noise or other forms of disturbance may be avoided by timid species.

Shelterbelt management

- Shelterbelts need to be managed to prevent weed infestation and to control pest animals such as rabbits, cats and foxes (see LFW Note 4 for other threats).
- Fences will need to be kept in good condition to prevent access by grazing animals.
- Leaf and twig litter (fine fuels) will need removal near buildings and other areas that need protection from fire.
- Occasional wildfires may burn the shelterbelt. If native species have been used (except rainforest species) this can be regarded as a natural event from which the plants are likely to recover. In fact, occasional wildfire can stimulate natural regeneration.
- Leave mistletoes as wildlife shelter and food.

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21. Eltham Copper Butterfly

Many Victorians will be familiar with the name Eltham Copper Butterfly, due to the significant publicity which has accompanied community efforts to ensure its survival in the urban environs of Eltham and Greensborough.

Map above : The Eltham Copper (Paralucia pyrodiscus lucida) Butterfly is only known from three general localities in Victoria. Source: Adapted from VBA 2019 and is a threatened species (Baker-Gabb 1991).

Eltham / Greensborough area - where about 10 sites exist across different tenure and management i.e. Parks Vic, Local Council and Private land.

Kiata & Salisbury areas in western Victoria - known from about 6 sites which includes Crown Land at Kiata and the Salisbury Bushland Reserve.

Castlemaine / Bendigo - about 5 sites near Castlemaine within National Park, Botanic Gardens & State Forest and 6 sites near Bendigo within National Park and one on private land.

Discovery of the Eltham Copper Butterfly in the Bendigo area only occurred as recently as December 2007 near Big Hill on the Melbourne side of Bendigo in the Greater Bendigo National Park. The population was found by studying the flowering of Bursaria. Ants, in the genus Notoncus were also present.

Although discovered only in 1938 at Eltham, a marked reduction in the abundance of the Eltham Copper was noted during the 1950's until, eventually, the sub-species was feared to have become extinct near Melbourne (New 1991).

The Eltham Copper Butterfly showing pattern on lower surface of wings. Its body length is 1cm and wingspan 2.5cms.

The Eltham Copper Butterfly showing colours on upper surface of wings.

However, the discovery in 1987 of several colonies at Eltham resulted in a call from local residents and naturalist groups for protection of the butterfly. This led to purchase of a small area of private land ("Diosma Road" site), otherwise destined for sub-division, and the securing of a government block ("Eucalyptus Road" site) also scheduled for sale.

Public fund-raising and policy initiatives ultimately saw the key parts of these properties reserved for the butterfly. Other lesser colonies still occur on community-owned land at a nearby linear reserve, as well as at Eltham Lower Park and at Yandell Reserve, Greensborough. Additional small colonies exist on private land in the surrounding urban area, three of these being adjacent or near to the established butterfly reserves, another two being more isolated.

Other colonies are known in regional locations at Bendigo, Castlemaine (south of Bendigo) and in the Kiata-Salisbury area (west of Dimboola). However, the public interest in the butterfly clearly springs from its situation in urban Eltham, where local residents, supported by the wider community, have vigorously expressed the view that they value the Eltham Copper as part of their urban environment.

Life of the Eltham Copper

The butterfly presents a fascinating example of co-operation between two very different insect groups, sharing a host plant. Its eggs are laid on plants of a spiny dwarfed form of Sweet Bursaria (*Bursaria spinosa*), at the bases of which nest ants of the genus *Notoncus*. The larvae (caterpillars) which hatch from the eggs are constantly tended by the ants, which accompany the larvae into the ant nest during daylight or during inclement weather (Vaughan 1988).

Sweet Bursaria, food plant of the Eltham Copper larva, and source of nectar for the butterfly, is easily recognised by its purse-like seed capsules.

The larva obtains both shelter and protection from the ants, while the ants probably harvest sugar and amino acid secretions from the larva. Larvae pupate in or near the ant nest, with adult emergence occurring from about late November to mid-January at Eltham. The adults feed on nectar of *Bursaria* flowers, and that of other species such as *Hakea spp*. A second wave of emergence occurs during March-April, possibly reflecting a December egg-laying. Alternatively, this second generation may overwinter as larvae until the next season, depending upon vegetation and climatic conditions during the summer months (Vaughan 1988).

Eggs of the Eltham Copper Butterfly laid near the base of a Sweet Bursaria plant a few centimetres above the ant nest. They may also be deposited amongst leaf litter.

At night, ants Notoncus enormis attend an Eltham Copper larva feeding on Sweet Bursaria.

The largest colony at Eltham, occupying only a few hundred square metres, contained 300-500 larvae when estimated directly by nocturnal counts. Adult Eltham Coppers are fast flyers, defending a territory of perhaps 20m radius and, although small, are exquisitely marked, with the male hind-wing bearing a distinctively sharp patch of bright copper scales (Vaughan 1988).

Benefits of butterflies to landholders

Landholders living in and around the haunts of the Eltham Copper may be interested to learn not only what they can do to benefit the butterfly, but what benefits they themselves might experience.

The continued presence of natural vegetation and specialised native butterfly species, such as the Eltham Copper, helps to reassure residents that urbanization and pollution have not overshadowed the natural features of the local environment. This perception can enhance the quality of urban community life. The Real Estate Institute of Victoria (REIV), as well as by individual agents, have advised that it can also improve property values. The REIV considers that flora and fauna conservation on a property "is often relied upon as a positive benefit, adding value to that particular property asset" (DCE, 1991). Grace (1988), in a socioeconomic valuation focussing on the Eltham Copper, argued that a 10% increase in market values of properties near Eltham Copper Butterfly colonies within 11 months of their discovery was due to "some positive force unique to Eltham area", not simply to market forces. Grace suggests this force to be the "proximity to areas of tranquillity and environmental significance".

Butterfly conservation has other potential spin-offs. The retention of butterfly reserves on sites otherwise destined for development may effectively reduce future pollution and congestion from traffic and people, even though the reserves might themselves attract numerous visitors. Intangible benefits include satisfaction for local residents in living close to, and having access to, wildlife areas, and knowing that their children will also have this option. Vicarious consumers (remote supporters of the butterfly's conservation) may also derive satisfaction and, clearly, the growing scarcity of natural bushland within Melbourne's suburbs works to enhance this satisfaction (Grace 1988).

The natural history of the Eltham Copper Butterfly also has great educational potential. Few people are unimpressed by the delicate and complex relationship between the butterflies, the ants, and the foodplants. The fact that local residents, with a little effort, can host this fascinating life-cycle on their own private land provides the community with a potential bonus

of experience, awareness and prestige.

Our outlook and future management

While much effort and funding has been expended to attain the current level of protection, the long-term survival of the "urban" Eltham Copper population is still considered highly dependent upon the adequacy of existing buffers around colonies and the ultimate effect of proximity to urban housing developments (New 1991).

New (1991) suggests that an increasing emphasis on wildlife resources in people's gardening practices, at the expense of neatness, is likely to accordingly influence local councils in their management of community-owned lands. Such practices may include deliberate planting of larval food plants and other attractant nectar plants as food supplies for adult butterflies. In the developing estates adjacent to butterfly reserves at Eltham, opportunities exist for landholders to retain at least small groves of native *Bursaria* and associated plants, and to protect these from garden sprays, trampling, grazing, weed invasion, unnatural drainage regimes, pollution and slashing. Protection should also currently be given from fire, although further studies may reveal the need for periodic burning to retain the natural elements of the butterfly habitat.

Residents with suitable habitat, especially in the Eltham- Greensborough area, are encouraged to apply for membership with Land for Wildlife or the Gardens For Wildlife program. These programs can offer sound advice on how to manage your potential butterfly habitat, with regular newsletters to keep you informed, and an attractive sign to display on your property, indicating your commitment to voluntary conservation.

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22. Farm Planning and Wildlife

This Note considers the wildlife aspects of property planning, with emphasis on farms, and should be used as a supplement to other texts describing the full integration of additional farm planning goals (see references page 8). This *Note* compliments LFW ***Note* 2 "22 ways to integrate wildlife conservation with farm management"**. Whole Farm Planning and Property Management Planning are other terms describing a holistic approach to farm planning.

Introduction

There is awareness in the community regarding the role of native vegetation in the sustainable management of private land. Protection of remnant vegetation and re-vegetation of selected areas with indigenous species offers the potential for long-term solutions to problems of land degradation. Native vegetation also provides habitat for wildlife species. Many landholders are now recognising the value and place of wildlife in a healthy rural environment and are looking for ways to encourage wildlife on their property. The key to conserving wildlife on farms is to maintain habitats that provide animals with the resources they need (food, shelter and nesting or breeding sites) and sufficient living space for viable populations. The purpose of this *Note* is to discuss ways in which wildlife and wildlife habitats can be integrated with sound farm management and production as part of the process of `Whole Farm Planning'. Three basic principles underlie this discussion, as follows:

(i) Conservation of native vegetation and wildlife offers a range of benefits to farm enterprises.

'Changes in bird species visiting a wheat and sheep property were recorded over a seven-year period as wildlife habitats were re-established. One hundred and six bird species were eventually recorded of which 67% were largely or exclusively insectivorous. (Anon. 1991)

'Studies suggest that in healthy eucalypt woodland birds may take about half of the insects produced (of the order of 30 kg per hectare per year). Small mammals, like sugar gliders, and predatory insects and spiders take a significant proportion of the rest. The average level of attack by insects and the frequency of outbreaks would be much higher without these natural predators.' (Ford).

Wildlife populations can make an important contribution to the sustainability of agricultural lands. As suggested above, many species are insectivorous and may play an important role in maintaining a balance in insect populations in farmland. For example, Australian Magpies feed in paddocks on the larvae of scarab beetles (e.g. cockchafers); ibis take large numbers of crickets and grasshoppers from pastures; honeyeaters, thornbills and pardalotes feed on insects that live on the foliage of trees, especially sap-sucking lerp and scale insects; Sugar Gliders take Christmas beetles and other invertebrates from tree foliage; and bats flying at night through farm woodlands consume moths, beetles and bugs. Research has shown that woodland suffering severe defoliation and dieback has only 10% of the birds of healthy woodland (Ford and Bell 1981). Wildlife may also aid dispersal of insect predators, diseases and parasites.

Native vegetation contributes to sustainable land management and farm production in other ways.

These include:

- protection of soils from erosion and nutrient losses.
- protection of water quality in streams.
- salinity control.
- timber for firewood, posts or commercial sale.
- shelter for stock and pastures.

There are other, less tangible, benefits from maintaining wildlife in the rural environment:

- the sights and sounds of wildlife, and the pleasure of encountering animals on a daily basis add to, and are part of, the quality of rural life in Australia; wildlife is a significant part of our heritage as Australians and a unique part of the heritage of each local district.
- natural vegetation contributes to a more pleasant farm landscape in which to live.
- properties with bushland habitat and wildlife are more attractive than those with bare paddocks, and so will often command higher real estate values.

- wildlife can be an important component of farm tourism (e.g. kangaroos in the back paddock, koalas in a gum tree).

(ii) Wildlife conservation on farms can make a valuable contribution to overall conservation goals.

'Emus and kangaroos on our arrival were plentiful in all parts of the district; also, the bustards in large flocks of from ten to twenty or forty, or perhaps more. The bustards now are scarce, and only met with in distant places.' (Captain Fyans 1853, in Middleton 1984).

'It is 45 years since they [native cats] were abundant in the Warrnambool district. I was offered a bonus of 1/2 d a scalp... to trap these native cats ... but I caught so many that the contract was ended.' (Unnamed correspondent 1934, in Seebeck 1984).

There have been marked changes to the wildlife of Victoria. 'Bustards' (Australian Bustard) and 'native cats' (Eastern Quoll) are among those species, once common in Victoria, that have long gone. However, many other species are still present, although some no longer occur in large areas of Victoria where once they were common. The major reasons for the decline of native species are the loss of habitats, degradation of remaining habitats, and the impacts of introduced species (e.g. Fox, Cat, Rabbit). With more than 60% of Victoria owned by private landholders (Woodgate and Black 1988), farm environments have a very important contribution to make to the goal of maintaining viable populations of all species throughout their range. In many districts this is simply not possible by relying solely on the few reserved areas such as National Parks or Flora and Fauna Reserves. It can only be achieved by a district-wide system of habitats that includes those on farms, as well as Crown lands such as streamsides, roadsides, and other small blocks.

All farms can play an important role in providing for a range of species (birds, mammals, reptiles, frogs, invertebrates) that are not necessarily regarded as rare or threatened. Experience has shown that the best way of conserving species is to maintain large populations, spread throughout their geographic range. However, in some districts, farm habitats are also important for the conservation of rare or threatened species. Victorian examples include native grasslands that support the Striped Legless Lizard and Plains Wanderer, wetlands that provide nesting sites for Brolga, and remnant coastal forests that are used by Rufous Bristlebirds. Without the assistance of private landholders, many species are likely to continue the process of decline, eventually ending in local extinction.

(iii) Wildlife and wildlife habitats can be integrated with sound farm management in practical ways.

'Shelter can increase livestock production by increasing the supply of pasture and by reducing environmental stress there seems little doubt that at least 10% of the farm can be profitably devoted to trees in the higher rainfall grazing areas of southern Australia'. (Bird 1990)

Many of the measures that protect or create habitats for wildlife can be developed and carried out as part of other farm activities (e.g. land protection, water supply, pasture production, etc). Some examples of farm activities that involve management of native vegetation and also provide the basic elements of habitat for wildlife are listed in Table 1.

Table 1. Farm activities with which wildlife habitats can be integrated

Farm activity	Habitat for wildlife
Provision of shade/shelter for stock	bush blocks, shelter belts, isolated trees or clusters in paddocks, roadside or laneway vegetation
Shelter for pastures	shelter belts
Provision and protection of water quality	streamside vegetation, protected wetlands, farm dams
Protection from erosion	vegetation along gullies, creeks, and steep slopes
Combat rising saline groundwater	vegetation in saline re-charge and discharge areas
Supply of firewood, posts etc	bush block, plantation, agroforestry plots
Fire protection	windbreaks, radiation shields, native grasses (low fuel)

Planning for wildlife should preferably be carried out in the initial stages of developing a Whole Farm Plan so that the greatest range of options can be considered, and there is the greatest potential for integrating wildlife plans with other farm

management activities. Successful integration of wildlife habitats into the Whole Farm Plan is dependent on the successful resolution of other farm issues - wildlife considerations should not be handled in isolation. This note can be used in conjunction with comprehensive texts on the subject of Farm Planning.

The following sections describe some stages in the incorporation of wildlife into a Whole Farm Plan.

- gathering information and taking stock of your property.
- developing and mapping specific plans for wildlife.
- management of wildlife habitats.
- monitoring wildlife on the farm.

Gathering information

An important first stage in incorporating wildlife into farm planning is to consider all relevant information. Three levels of information will be useful:

- information on the surrounding area in which the farm is located.
- information on your property.
- general information on wildlife, wildlife management, problem animals, and activities or issues that could affect wildlife conservation on the property.

(i) The surrounding area

Begin by taking an 'aerial view' of the property and its surroundings. Every property is part of a regional landscape - it does not stand alone. Land management and activities on one property will have consequences, of varying extent, for neighbouring properties. Wildlife conservation can be enhanced by careful planning in relation to habitats present on surrounding properties, on adjacent roadside reserves, streams or other Crown lands. Further, working together with neighbouring property owners (e.g. as part of a Landcare or Farm Trees group) has enormous potential for conservation by creating a co-ordinated *system of habitats* through the whole landscape.

When considering what can be done on your own property, it is worth considering some of the opportunities that are afforded by habitats nearby.

Large area of forest or woodland nearby

Nearby bushland can often provide insights into the natural forest types, the plant communities and plant species that formerly occurred in the area, and to which the local wildlife is adapted. This can be used as a guide for revegetation on your farm, and perhaps as a natural source of seed. Large bushland areas often act as a `reservoir' for wildlife populations, and an indicator of the local species that might be expected in the area and on your property. Maintaining or creating effective corridor links from the bushland to habitats on the farm will increase the likelihood of these species occurring on the farm.

River or stream passing through, or near, the property

Maintaining existing vegetation, or revegetating along the banks of streams, can contribute to the development of an overall stream corridor system which may extend for many kilometres. Streamside vegetation is a rich habitat for wildlife and it can be an effective corridor for many species, linking across and through numerous properties. Vegetation along stream banks also serves to reduce erosion and to protect water quality throughout the catchment, not just within one property. Where a stream passes nearby, but not through the property, there may be opportunities to link in with the stream corridor by revegetating seasonal drainage lines or gullies that feed into the stream.

Roadside vegetation adjacent to the property

In many districts, roadside vegetation forms extensive networks of remnant bushland, providing corridors across the landscape. It also acts as a habitat for many species of wildlife (e.g. birds, possums, gliders, lizards), especially where the roadside vegetation is wide. Linking bush blocks, shelter belts, or plantations on the farm with the roadside vegetation is an excellent way to join this existing corridor system, and to improve the connectivity of the wildlife habitats on the farm. Roadside vegetation also serves as a reminder of the local indigenous vegetation, and as a natural source of seed. Fencing a strip of paddock adjacent to roadside vegetation can be a cheap and effective means of natural revegetation that can include not only tree species, but local

understorey shrubs that are present on the road reserve.

Table 2. Habitats for wildlife that may be present on farms in Victoria

Remnants of natural habitat
Patches of remnant native vegetation (e.g. bush blocks, open woodlands) Isolated trees, clusters of trees or shrubs in paddocks
Native grasslands
Rocky areas (e.g. outcrops, 'stony rises') Wetlands (e.g. swamps, lakes), either seasonal or permanent
Rivers, creeks, intermittent water-courses
Mature trees (living or dead) with hollows
Fallen timber, logs and other tree litter
New or artificial habitats
Farm dams (and associated vegetation and islands)
Shelterbelts
Plantations
Farm gardens
Farm buildings and other structures
Lightly grazed pastures

(ii) On your property

The location of your property and its topography, climate, soil types and water regimes will influence the type of habitats that can be represented. However, every property has potential to develop wildlife habitats and to encourage wildlife to live on the farm. A useful first step is to make an inventory of those parts of the farm that presently provide habitat, or could do so in the future with appropriate management. Remnants of natural habitats will generally be of greatest value to wildlife. For example, woodlands or forests can be used by possums and gliders, forest birds, bats, small lizards and many other species; rocky outcrops are habitat for reptiles and some small mammals; wetlands are important for waterbirds, frogs, fish and aquatic invertebrates, and so on. New habitats, such as farm gardens and farm dams, will also be used by wildlife, notably birds. Clearly, the opportunities will differ between properties. The Table 2 sets out some possibilities; a close look around your property, or inspection of an aerial photograph or topographic map, could add further alternatives.

(iii) Sources of information and advice

There are numerous sources for obtaining information that can help in managing natural vegetation and planning for wildlife on your property (see below). A list of useful references, including guides for identifying wildlife, is provided at the end of the chapter. If you are a member of a group, it may be valuable to arrange an information day, with speakers or displays from some of the sources suggested below.

Land for Wildlife

Land for Wildlife is a program that provides encouragement and advice to private and community landholders who voluntarily conserve wildlife or integrate the conservation of wildlife with other objectives on their property. Free advice is given through a series of technical 'Notes', regular newsletters and events such as field days.

Victorian Biodiversity Atlas (VBA)

A list of wildlife recorded in your area can be obtained from the Atlas, a computer data base with over one million records. Breeding records, recent sightings, the occurrence of threatened species, and other details of distribution and abundance can be provided by visiting the Victorian Biodiversity Atlas website: https://www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

Neighbours

Neighbours may have information or experience to share on local wildlife and habitats, historical information, or solutions to problems. There may be opportunities to work co-operatively on projects that extend across several properties (e.g. establishing a wildlife corridor). Neighbours may also have concerns or suggestions about your plans that need to be discussed.

Local 'experts'

A tremendous resource. In most communities there are people with expert local knowledge of wildlife, vegetation, tree growing, seed collection, fencing techniques, etc.

Shires or Councils

Shire staff can give advice on any local government planning controls covering your area. There may be roadside assessment information available or a local conservation strategy. Some authorities employ a conservation officer or similar adviser.

Library

The local library will have books for identifying wildlife and may have reports on the flora and fauna of your district. Historical references may help to piece together the natural history of the area. Libraries are frequently points of contact for local groups. The librarian may be able to put you in touch with natural history groups or local experts.

Field Naturalists Clubs

Local branches of the Field Naturalists Club of Victoria have been established in most regions of Victoria. Individuals in such groups with a keen interest in natural history are often very willing to share their knowledge

Birdlife Australia

Birdlife Australia has several branches throughout Victoria, and members of these groups may also be a source of local knowledge. Enquiries to Birdlife Australia: https://birdlife.org.au/

Landcare groups

Members of Landcare groups usually have valuable local expertise and experience in many aspects of land management and vegetation establishment. They are generally property owners and understand the realities and practicalities of farm management. Contact your local Catchment Management Authority for advice.

Victorian Environment Friends Network

The Victorian Environment Friends Network exists to help represent the common interests of all Friends groups in Victoria. Their vision is protecting, restoring and enhancing the Victorian natural environment through community volunteer groups working for their special places and native species.

The Victorian Environment Friends Network is hosted by the Victorian National Parks Association, Level 3, 60 Leicester St, Carlton 3053.
Phone: 03 9375 7355
Email: friendsvic@hotmail.com

Consultants

A number of consultants provide services that may be relevant to your needs (e.g. habitat restoration, flora and fauna surveys). Substantial fees may apply.

Developing and mapping plans for wildlife

The following steps suggest a practical way of planning for wildlife as part of the preparation of a Whole Farm Plan. The key aim is to identify areas for the retention, restoration or re-establishment of habitats within which wildlife can live.

Firstly, identify and plot existing areas of wildlife habitat on a map or overlay of the property (a brightly coloured pen could be used). This might include a range of areas (see Table 2) such as a seasonal swamp, scattered trees in a back paddock, or a patch of bush, already known to be important to wildlife.

Then, identify and draw in potential areas of wildlife habitat. These are areas that could be further protected or restored, or where the re-establishment of habitats could begin. They may include, for example:

- expansion of existing bushland areas,
- corridor links between bushland habitats
- areas to be revegetated along gullies or streams,
- revegetation around the edges of a swamp or lake,
- revegetation adjacent to existing roadside vegetation.

Consider the surroundings of the property, and ask:

- How can existing or potential areas of habitat on the property be integrated with that in the surrounding landscape.
- Can links be developed with nearby bushland or with roadside vegetation?
- Are there streams, wetlands or bushland that extend across several properties?
- Can local bushland areas be used as a source of seed and a guide to which species to plant?

Examine other activities planned for the property and consider how these objectives can be integrated with your goals for wildlife conservation. For example, can plans for revegetating a saline or eroding gully be modified (e.g. by widening the revegetated strip) to create additional habitat for wildlife? Can local tree species and shrubs be used in shelter belts instead of exotics?

Work out priorities for developing wildlife habitats over the short term (e.g. 1-5 years) and the longer term. An achievable goal in the short term may be to build on the existing strengths of the property by protecting and enhancing those habitats already present. Examples could include: fencing an existing bushland area to protect tree regeneration or fencing a wetland. Different areas on the property will warrant different priorities for management (Table 3). In some areas, wildlife conservation will become the primary focus for management, while elsewhere it may be secondary to other considerations. To encourage a diversity of habitats and wildlife, try to ensure that each of the potential habitat types (e.g. woodland, wetlands, streams) that can be represented on the property appear in your Plan.

Table 3. Priorities for management of wildlife habitats on the farm

(i) Areas where wildlife conservation may be the primary aim of management
Remnant vegetation
Vegetation along creeks and rivers
Natural wetlands
Roadsides
Strategic corridors linking fragmented habitats
Older trees (live or dead) with hollows
Rocky areas with low agricultural potential
(ii) Areas where wildlife conservation could be integrated with other objectives
Saline recharge and discharge areas
Shelterbelts
Farm dams
Areas prone to erosion requiring revegetation
Agroforestry plots Homestead areas
Rough pastures
Vegetation established for shade and shelter
Vegetation established on driveways and laneways

Once you have some ideas on paper, it may help to get comments from others with similar plans, from neighbours, or from those with specialist knowledge of particular aspects. Staff of the Department of Environment, Land, Water and Planning may be able to assist. Incorporation of wildlife and wildlife habitats into Whole Farm Planning is

a new and developing concept, and there is much to be learned with regard to the most effective techniques and plans. Keeping records is important as it will help in sharing successes or solutions to problems with others at a later date. It is also likely that your plans will change and evolve over time as practical experience is gained.

Managing farm habitats for wildlife

Protecting and managing remnant bushland

Few native Australian animals survive solely in cleared farmland - most will only persist where there is natural vegetation. Consequently, the amount of remnant bushland and how it is managed are critical to the survival of wildlife in rural landscapes. Field studies suggest four key points for managing remnant vegetation as wildlife habitat:

- maximise the size of individual remnants ("the larger the better"), and the total area of remnant bushland.
- incorporate a diversity of vegetation communities, whenever possible.
- protect all layers of vegetation (e.g. tree canopy, tall shrubs, low shrubs, ground cover, logs, litter).
- maximise the connections between habitats supporting wildlife populations.

It is worth considering these four points, in turn.

(i) Size of the bushland is important

Fragmentation of bushland into progressively smaller and more isolated patches has implications for both the *number* of species and the *type* of species that remain. A consistent finding from many studies is that the larger the area the greater the number of species that it can support. Smaller patches of bushland (e.g. < 5 ha) at Naringal, in south- western Victoria, tended to have only the most common

species (e.g. Bush Rat, Common Ringtail Possum), while rarer species in this locality (e.g. Long-nosed Bandicoot, Red-necked Wallaby) are more likely to occur in larger blocks where there is a larger area to support a sparse population (Bennett 1987).

The size of bushland also influences the ability of species to withstand disturbance, such as drought or fire. For example, during the Ash Wednesday fires at Naringal, small blocks were often totally consumed, but there was a greater chance of an unburnt area remaining in a large block (e.g. along a creek line) as a refuge for animal populations.

(ii) Diversity of habitats encourages diversity of wildlife

Some species of animals (e.g. Echidna, Grey Shrike-thrush) are widespread in many forest types, but many species favour particular vegetation communities. Where a range of different types of habitat are present, it is more likely that a wide range of species will occur. For example, a combination of streamside vegetation with adjacent drier woodland or forest, will provide for those species that require moist habitats (e.g. frogs, waterbirds, etc.) as well as those more widespread in open and drier forest.

(iii) All layers of vegetation are important

Different species of animals live or forage in different layers of the vegetation. For example, in relation to mammals in bushland at Naringal East:

- Common Ringtail Possums and Koalas generally feed on foliage in the tree canopy layer.
- Sugar Gliders forage for insects and plant exudates both in the canopy and on the upper limbs and trunks of trees.
- Brown Antechinus forage for insects at ground level amongst logs and litter, and also above ground by climbing shrubs and trees.
- Long-nosed Potoroos live in dense undergrowth at ground level, feeding mainly on fungi that they dig from the litter and subsoil; and
- bats (e.g. Little Forest Eptesicus, Chocolate Wattled Bat) forage in open spaces amongst forests and woodlands for moths and beetles, and roost during the day in small tree holes.

A similar pattern can be described for forest birds, with different species foraging or living in different layers of the vegetation. For many lizards, frogs and invertebrates, the micro-habitats provided by logs, leaf litter and rocks at ground level are the most important.

Clearly, a tree layer alone is not enough if the full range of species is to be encouraged and conserved in remnant bushland. When shrub or ground layers are altered or destroyed, the species that live and depend on those habitats will also decline and disappear. For example, Long-nosed Potoroos do not survive in bushland areas that are heavily grazed by cattle, as the dense ground layer of shrubs and sedges in which they shelter is destroyed. Fencing all (or part) of a bushland area to protect understorey vegetation is an important investment for conservation.

(iv) Isolation creates problems

Populations of animals that are isolated are more likely to decline and disappear than those where regular movements can be made to and from nearby populations. For many species, such isolation can be reduced by maintaining or restoring corridors and 'stepping stones' of natural vegetation (see below).

Design and management of corridors for wildlife

Movement is a fundamental feature of animal life. Animals move to find food and shelter, and for breeding. Some species move seasonally to follow local changes in food availability, and others undertake long-distance migrations. Young animals generally disperse to establish their own home ranges after achieving independence. Fragmentation and isolation of natural habitats can make these movements difficult, or impossible, by imposing barriers of inhospitable land (e.g. open cleared paddocks).

The primary purpose of wildlife corridors is to improve and restore the connectivity between natural habitats, and in so doing to increase the survival of wildlife populations in isolated habitats. Different types of corridors which can be recognised include the following.

Natural corridors -

such as vegetation along creeks and rivers follow natural topographic contours. Such riparian vegetation may extend for many kilometres with minor tributaries and creeks joining with larger streams to make up an extensive connected network across a district.

Remnant corridors -

such as vegetation along roadsides or rail lines, are the result of clearing the adjoining vegetation. Roadside vegetation can be used by many species. For example, over a two-year period Middleton (1980) recorded 85 species of birds from a 2.5 km length of roadside in the Wimmera, and 30 species nested there. At Naringal, roadside vegetation was used by some 80% of the mammals in the area, and at least six species of small mammal lived in, and moved through, roadsides (Bennett 1988).

Planted corridors -

such as shelter belts, are those that have been deliberately created by humans. As yet little information is available on the values of such corridors to wildlife, but casual observations suggest that they are used by a range of birds.

Movements along corridors can occur in various ways. Large mobile mammals (e.g. wallabies) and many birds may move through a short corridor in a single movement. However, for many less-mobile species corridors will be most effective when they provide habitat in which animals can live, either in the short or long term.

Some practical principles in the design and management of corridors.

- Highest priority should be given to preserving or restoring natural corridors, such as gully lines, minor tributaries, and vegetation along creeks and rivers.
- Whenever possible, restore or build on to existing corridors of natural vegetation, rather than creating new corridors. These will already have components of natural ecological processes, such as soil micro- organisms, invertebrates, fungi, understorey plants etc, which will take longer to develop in new vegetation.
- Corridor width is important, and the wider the corridor the better. Compared with narrow strips, wide corridors provide greater variety of habitats, greater protection from disturbance along edges, and a larger area of habitat in which animals can live. Single lines of trees will have little value for most species; strips from 30 m to 100 m wide will be much more effective as a local corridor network.
- Corridors are most effective when they 'link up' with other larger habitats, with few or no gaps.
- Locally indigenous species of trees, shrubs and ground cover are the best plants to use when establishing new corridors, as it is to those that the local wildlife is adapted.
- Preserving (or establishing) a 'network' of corridors, wherever possible, will generally be more effective than a single corridor link.
- Patches or 'nodes' of bushland along a corridor can increase the area of corridor habitat and support more individuals.
- Fencing to prevent damage to understorey vegetation from grazing stock is probably the single most important, on-going management required for corridors (and other vegetation managed for wildlife).

Protecting streams as wildlife habitat

The value of creek and river environments as wildlife habitat is greatest when they are bordered on each side by natural vegetation. Water quality and the condition of the aquatic habitat are closely related to the presence of streamside vegetation. Vegetation provides shade, contributes nutrients, supplies invertebrates as food for fish, helps stabilise stream banks, and filters sediments and other runoff from surrounding areas. Stream habitats are used both by aquatic fauna (e.g. various fish, Platypus, Water Rat) and wetland fauna (e.g. herons, ducks, spoonbills, reed warbler), while forest wildlife occur in the creek side bushland The bushland along creeks and rivers is a rich habitat for wildlife because the moist environment and fertile alluvial soils contribute to high productivity. Riparian vegetation along streams frequently has high structural complexity (e.g. tall

canopy trees, several layers in the understorey, smooth-barked eucalypts with hanging bark, and tree hollows), that provides resources for a wide range of species. Further, the creekside habitat may extend as a continuous strip for kilometres, providing a large total area as well as connectivity for populations.

Measures that will enhance aquatic and streamside habitats for wildlife.

- Revegetating gullies and stream banks where vegetation has been cleared.
- Fencing to prevent grazing of vegetation and erosion of stream banks.
- Widening the overall strip of vegetation to provide a greater total area of habitat, and greater diversity of vegetation (e.g. riparian Manna Gum forest plus adjacent drier forest or woodland).
- Incorporating wider patches of habitat in the streamside corridor (e.g. at bends in a creek).
- Having a range of micro-habitats in the stream (e.g. deep pools, rocky riffles, submerged logs and snags).
- Preventing the run-off of chemicals, fertilisers and sediments into streams.

Tree-hollows for hollow-nesting wildlife

Many species of birds and mammals require tree hollows for diurnal shelter and for nesting and breeding. Some 36 species (20%) of common Victorian birds (33% of threatened bird species, Robinson 1991) are dependent on hollows for nesting. These species include parrots, owls, cockatoos, kingfishers and treecreepers. For many mammals, such as possums, gliders and small insectivorous bats, hollows are essential. Different species require hollows of different dimensions. The size of the hollow entrance is particularly important. For example, Sugar Gliders select hollows with an entrance diameter of approximately 3 cms; they are likely to be excluded by larger species (e.g. Brushtail Possums) from hollows with larger entrances. Species may also require a number of hollows within their home range, moving between these on an irregular basis.

As eucalypts generally do not develop hollows until at least 70-80 years of age, and there are many wildlife species potentially competing for hollows, it is not surprising that the availability of hollows can be a limiting factor for animal populations. This is particularly likely in forest areas dominated by regenerating trees where older trees are sparse or absent.

Practical measures to assist hollow-dependent wildlife.

- Protection of existing older, hollow-bearing trees (live or dead). These trees are likely to be used by a wide range of species when present in bushland amongst other trees, but isolated trees in paddocks are also used by a number of species (e.g. bats, Red-tailed Black Cockatoo).
- Leaving some older living trees (e.g. when felling timber for firewood, posts, etc.) to develop hollows over the next few decades. “Smooth-barked” eucalypts such as River Red Gum and Manna Gum tend to form hollows more readily than other species.

Nest boxes or artificial hollows can be provided for wildlife in some circumstances where natural hollows are in short supply. These can be a useful measure in localised areas and provide opportunities to view wildlife, but they should not be seen as a substitute for natural hollows in the environment. Little is known of the long-term use and value of nest boxes or artificial hollows to wildlife populations. A variety of designs have been used; several are described and illustrated in the Land for Wildlife Technical **Note No. 14 ‘Nest Boxes for Wildlife’**, and in a brochure prepared by the Bird Observers Club of Australia entitled ‘Nest Boxes for Australian Birds’ (1986, second edition).

Managing habitats for ground-dwelling animals

Habitats used by ground-dwelling animals are often the most easily disturbed on farms when areas are grazed, ploughed, or modified in other ways (e.g. logs burned). For ground-dwelling birds, mammals, reptiles and frogs to survive in farmland, food, shelter, refuge and breeding sites must be available.

Food:

Invertebrates (insects, spiders, worms, etc) play an important role in the breakdown of detritus and the recycling of nutrients in the natural environment. They also form the base of the food chain and are eaten by many species. Small lizards (e.g. Garden Skink, White’s Skink, Striped Legless Lizard), mammals

(Brown Antechinus, Fat-tailed Dunnart, Echidna) and birds (Superb Fairy-wren, Grey Shrike-thrush, Yellow-rumped Thornbill) all forage for invertebrates on the ground, or amongst leaf litter, grass tussocks and logs. Other species (e.g. Brown Thornbill, White-browed Scrub-wren, Yellow Robin) search for invertebrates amongst low shrubby foliage as well as on the ground. Some species (e.g. Long-nosed Potoroo, Bush Rat) feed on fungi in the litter and subsoil, and others (e.g. Swamp Rat) feed on stems and leaves of ground plants.

Shelter and refuge:

A variety of micro-habitats at ground level are used for shelter and refuge. Frogs and small lizards often shelter under or within logs, or under rocks or loose bark. Echidnas also take shelter under and within large logs. Small forest-dwelling mammals need thick vegetative cover (e.g. Bush Rat, Brown Antechinus, bandicoots); while the Fat-tailed Dunnart, living in open grasslands, shelters under rocks, logs, or posts. Small forest birds require shrubby low cover, while grassland birds (e.g. Richard's Pipit, Stubble Quail) shelter amongst long grass and tussocks.

Nest sites:

The habitats used for shelter and refuge are often the same ones used for breeding sites. For example, birds such as Superb Fairy-wren and Yellow-rumped Thornbill nest in low shrubs, while pipits and quail nest at ground level amongst grass.

The management required to provide these food, shelter and nesting requirements will vary between areas and habitat types. For example, in coastal forests where dense ground vegetation is the natural pattern, fencing to exclude stock is generally required to protect the ground layer component. Exclusion of stock will also be of benefit, but may not always be necessary in some open habitats (e.g. open grassy woodlands, stony rises) where numerous logs, rocks or other shelter persists and shrubs are typically sparse. Leaving logs and fallen branches (instead of "tidying up" under trees), and rocks on the ground will also be of benefit.

Wetland habitats

Wetland habitats occur on many farms, though a large number have been modified by changes in water regime or drainage and through removal of surrounding vegetation, especially as a result of grazing. A `wetland' may be an area of pasture that is seasonally covered by water, or a deeper, more permanent body of water. Both are important for wildlife. Re-instatement of natural water regimes, exclusion of stock (at least during sensitive periods) and restoration of natural vegetation around wetland areas will all contribute to improving this habitat for wildlife. Nutrient enrichment is also an important factor to consider. Fertiliser runoff, stock faeces and other sources of nutrients can reduce wetland quality and cause serious health risks. Other chemicals, such as herbicides, can also be detrimental to wetlands and their wildlife. Wetlands can contribute to the quality of water on a farm, to containment of water and flood mitigation and can be an attractive and pleasant feature with abundant plant and wildlife.

Revegetation and re-establishment of new habitats

On many properties, revegetation of selected areas will be a priority for the Whole Farm Plan. Often the primary objective will be to establish shelterbelts, prevent erosion, reduce salinity, or implement other land protection works. It will be beneficial to wildlife to revegetate areas so that they build onto, or link with, existing natural vegetation where components of natural ecological processes are already present (e.g. litter, invertebrates, soil fungi). Natural revegetation from existing trees or vegetation (e.g. adjacent bushland or roadside vegetation) can be an effective way to establish habitats and will usually be cheaper than planting seedlings.

Wherever possible, use locally indigenous plants or seed stock, appropriate to the location. These are the plants and vegetation types to which the local fauna is adapted. Be aware of plants that could become environmental weeds; for example, native species that are not locally indigenous and may proliferate.

A useful method of determining which plant species are suitable for your property is to visit remnant

areas of native vegetation in the district and select suitable plants, matching your location and soil type, from these remnants. Care must be taken to have the plants correctly identified to ensure that they are local native species. If you wish to purchase plants from a nursery, then choose one that stocks local native species or is prepared to grow seed you collect from local remnants. *Land for Wildlife* extension officers can help with contacts.

Strategies can be developed to attract particular species of wildlife and limit others by provision of suitable habitats including feeding, breeding and shelter requirements suited to the species. These strategies could be employed to encourage some wildlife species to frequent the home (e.g. honeyeaters) and discourage others (e.g. snakes).

However, it is always important to remember that species and their environment are inter-related and that an abundance of one species may be at the expense of others which may also have useful functions. Therefore, in most farm situations the aim should be to develop a diverse natural ecosystem of plants and animals including invertebrates.

Dealing with problems caused by wildlife

Particular species of native wildlife can, at times, cause genuine problems for farm enterprises. Usually this occurs when natural processes that regulate population numbers are disturbed. For example, numbers may increase when a natural predator is no longer present, or when an artificial food source allows an unnaturally high survival over critical times. Problems can also occur when a favoured food (e.g. a grain crop) is grown in close proximity to the species habitat.

Advice on dealing with problems caused by wildlife will vary, depending on the species concerned and the particular circumstances.

Monitoring wildlife on the farm

In the years following preparation and early implementation of a Whole Farm Plan, observations of the changes that take place on the property will be most rewarding. In addition to the pleasure gained from a growing list of species sighted on the property, monitoring can be used as a measure of the success of farm planning activities, and as a measure of the 'ecological health' of the property. It will also be a source of continuing education, as seasonal changes in wildlife populations, reproductive patterns, animal behaviour, and plant-animal interactions are noted. Monitoring can be carried out on a casual or a systematic basis, depending on the skills, enthusiasm, and needs of the property owner. Several suggestions are as follows:

Photopoints

Fixed photopoints are the simplest way to record changes in vegetation over time. Select a number of points and photograph at regular intervals (e.g. same time each year) from exactly the same location. An aerial view from the farm windmill, or a view looking straight down at some grassland might also be considered.

Farm diary

Making regular notes in a farm diary of birds, mammals, frogs or reptiles that are seen around the farm is a good way of recording observations. It is worth noting the date, the number seen and where they were. Records of breeding will be of particular interest. For example:

Koala - single animal in Red Gum, roadside near front gate, 2nd June 1992.

Brown Tree Frogs (2) and Striped Marsh Frog (1) calling at farm dam, 8/4/91

Blotched Bluetongue - one seen basking in sun, edge of shelterbelt, 10/11/91

New plant - found beside west paddock gate - sent for identification.

Over time, these records build up an invaluable picture of the range of species occurring on the farm, when they were present, and which habitats they use. The presence and spread of pest plants and animals, and the success and health of plant regeneration could also be noted.

Lists of wildlife species

A simple way of recording the species occurring on the property is to keep a list of those sighted, preferably noting dates and frequency of occurrence.

It will be surprising how many species, especially birds, will be recorded over time. Perhaps separate lists could be kept for different parts of the property, such as a list for those seen around the homestead, and a list for those seen in a bush patch. Local naturalists may be interested in assisting in this monitoring activity.

Standardised observations or censuses

Carrying out standardised observations of wildlife takes greater effort and discipline, but the quality of the information recorded is much greater. The important points are to make observations on each occasion at the same place, for about the same amount of time, using the same technique. Some examples could be:

- a regular (e.g. monthly) count of all waterbirds on a particular wetland;
- a regular count of all birds seen or heard while following the same track through a bushland area, or along a section of creek.
- a regular count of the species and numbers of frogs calling at a swamp.

Important questions to ask when considering the area surrounding your farm are:

- how can activities on this property contribute to developing a system of habitats throughout the wider area?
- what natural linkages are there between this property and other nearby habitats?
- are there opportunities for working co-operatively with other landholders on a catchment or regional basis?
- are there species of wildlife in the area that might conflict with other management aims?
- do the neighbours understand the improvements you would like to make, and why you wish to do so?

Useful questions to ask about your property include:

- what types of habitats are present on this property now?
- what types of vegetation will the soils on my property support?
- are there opportunities for using natural regeneration?
- which species, or types of wildlife, would I like to encourage on the property?
- what are the advantages and disadvantages of encouraging wildlife here?

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Identifying wildlife

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23. Edges – Their Effect on Vegetation and Wildlife

The "edge effect" is a term used to describe the various consequences, on vegetation and wildlife, that occur as a result of one type of vegetation sharing a border with another. These edges may be natural, such as forest grading into woodland, streamside vegetation passing through an arid zone, burnt and unburnt areas; or induced, such as pasture abutting forest or a road through a forest.

Edges may have a variety of effects on wildlife. For example, when thin, narrow strips of roadside vegetation and larger, square forest blocks in northern Victoria were compared, they shared only one common bird species, the Willie Wagtail (Bennett, 1993). This can be attributed to the large amount of edge habitat typical of roadsides and its consequences for the fauna of this habitat.

Managing edge effects can improve the quality and long- term viability of wildlife habitats.

What kind of changes occur at edges?

Depending on the aims of management, edges may have positive or negative effects on wildlife and property management.

Edges may affect wildlife through:

1. Micro-climatic changes

Solar radiation, humidity, air temperature, wind speed and soil temperature may all be altered along edges. This can have a dramatic impact on the vegetation and, ultimately, the wildlife. For example, new roadworks through bushland will increase sunlight and air temperature, which raises soil temperature and decreases soil moisture. This may prevent seeds of shade-tolerant species from germinating and favour other plant species (e.g. species which thrive with increased light). The increased exposure can stress vegetation leading to dieback through insect attack, parasites, wind damage or fungal attack. Rainforest species, which normally exist in a 'closed' environment, are particularly vulnerable.

2. Different inhabitants, edge species

Along with the altered pattern of vegetation, a change in wildlife can occur. Firstly, species that have particular habitat requirements (usually found in the interior or 'core', further away from the edge) may be lost from the area. For example, Long-nosed Bandicoots at Naringal in south- western Victoria survive only in larger remnants (Bennett, 1987). Secondly, 'vacancies' may be filled by species that have a wider tolerance range and the new edge may introduce species that would not normally be found in the core. Thirdly, aggressive edge-dwelling species, such as Noisy Miners and Bell Miners, may invade the habitat and displace prior inhabitants.

Edges provide habitat for species of wildlife that prefer edge habitats, and which are not all harmful. Many birds, such as parrots and cockatoos, will use edges for perching and nesting. Kangaroos and wallabies feed and move out along edges. Because edges are a meeting place between adjacent habitats, they are often rich in species (e.g. mixing of forest species, edge species and farmland species). Also, edges, especially where there is a scattered open 'buffer' type area, are often good places to see and experience wildlife.

3. An increase in pest animals

Pest animals such as foxes, cats and dogs tend to move and harbour along roads, tracks and cleared areas adjacent to or in bush areas. Edges, by providing improved access, can cause a decline in wildlife populations through predation and competition. Experimental and observational studies have shown that bird nests are more often preyed upon in edge habitats compared with core habitats (Andren & Anglestam, 1988; Wilcove, 1985). Platypus and quolls have suffered from predation by foxes moving along bush tracks, particularly beside rivers (LFW News, 1991).

4. Weed invasion

Edges can provide opportunities for the invasion of natural vegetation by weeds. Disturbance creates opportunities for weeds to establish. Weed seeds are spread by wind, water, animals, people (and their use of vehicles), soil, livestock and in agricultural products. These movements may be facilitated by edges.

5. Impacts from adjacent land-use

Edges are prone to many disturbances such as chemical and fertilizer drift from adjacent farmland, trampling and grazing by stock, fire escaping into habitat areas, recreational disturbance and littering. New tracks or clearing of vegetation may also change the hydrology of an area and cause erosion as water runs off compacted soil.

6. Noise and movement

An increase in traffic or human activities is not often considered. Many wildlife species rely on the seclusion of undisturbed habitat in order to breed successfully. For example, the Wedge-tailed Eagle has been known to abandon its nest due to disturbance (J. Robinson pers. comm.).

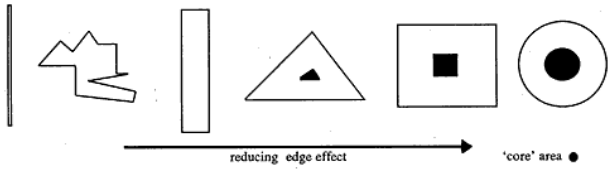
Edge effects are likely to be most influential on narrow strips or small areas of habitat. Consequently, they are an important issue in the management of corridors and small bush blocks. Larger areas are also vulnerable where disturbance, track construction and other activities create edges.

Larger bush blocks may benefit from retaining or managing edge habitats to meet other goals. For example, manipulation of shape, length and composition of edges is probably an effective way of managing for Eastern Grey Kangaroos - the more edge, the more kangaroos. Until the last decade or so, North American wildlife (game) managers actively managed edges in order to create ideal conditions for some game species.

How do edge effects vary with shape and size?

Generally speaking, the longer the edge, the larger the area disturbed. The more angular the edges, the greater the edge effect. Corners increase disturbance. Rounded edges and regular shapes minimise edge effects.

The smaller the area, the greater the risk of impact occurring throughout the vegetation, with the core habitat being destroyed.



How far do edge effects extend?

The 'depth' of the effect in habitat varies greatly with the length of the edge, the contrast in edge, the width of the habitat, the type of vegetation, the species of wildlife and the stability of the vegetation. One study showed that in terms of vegetation structure, the width of a forest edge was less than 13 metres, but based upon the distribution of birds' nests, the functional width of the edge ranged from 9 to 64 metres (Gates and Mosher, 1980).

It would be difficult to determine the exact extent of the "edge effect" in an area of private wildlife habitat. However, there are many actions landholders can take to prevent or diminish these effects in areas where edges are likely to have negative impacts.

Reducing the negative impact of edges.

1. Shortening edge lengths

The best way to reduce negative edge effects is to reduce the length of the edge. Rounded edges achieve this and also increase the 'core' size.

2. Modifying edge shapes

Edges can be modified by revegetation of areas, such as vehicle tracks, that penetrate existing vegetation.

3. Revegetation

Revegetation of degraded areas with local native species and planting a buffer zone around edges to increase the size of the habitat and its core can reduce edge effects. Buffer zones also have the effect of 'softening' the edges by reducing the contrast between land uses. The chances of success will be greatly increased if these areas are fenced off. Buffer plantings may be enhanced by selection of plant species that are tolerant of the stressful edge conditions - useful local species filling this role may be recognized along natural edges. Buffer plantings can reduce the influx of weed seeds from adjacent land use. Buffer plantings of non-invasive native species between remnant vegetation and pasture can moderate the effect of pasture species invading native vegetation remnants.

4. Fencing wildlife habitats

Uncontrolled grazing by stock is not compatible with sound native vegetation management. Fencing-off habitat areas, so that grazing stock cannot enter, may assist natural regeneration to occur (see LFW **Note 13**) and will reduce the impact of grazing on plant species.

5. Controlling weeds

Prevent weed invasion by limiting disturbance along edges, and avoid introducing potential weed seed carriers, such as stock feed and vehicles, to edges. Monitor edges for new species that may be weeds and effect control of any weeds promptly.

6. Re-routing tracks

Minimize the number and length of edges. Wherever possible, close off and revegetate tracks that dissect the habitat. Create new tracks and firebreaks outside the habitat area.

7. Using caution with chemicals

Care should be taken when using chemical sprays and fertilizers. Preferably use them well away from wildlife habitats. If this is unavoidable, take notice of wind direction to prevent drift and be aware that chemicals could runoff or leach through the soil into the habitat and cause extensive damage.

8. Removing rubbish

Garden clippings and other litter can introduce weeds and change the nutrient levels of the soil. Rubbish can also attract pest animals or cause injury to native wildlife. Refuse should be placed well away from habitat areas where it can be recycled, composted or placed in sealed storage prior to transport to an official refuse depot.

10. Locating a house away from habitat areas.

The noise, movement, soil disturbance, and other effects associated with human occupation, can be avoided by siting houses away from habitat areas. This will protect the habitat so that it can be enjoyed in its best condition.

11. Clumping revegetation areas.

Several landholders, each contributing a small amount of habitat, can increase the 'core' area by grouping their revegetation effort along common boundaries.

Monitoring edges

Habitat edges require regular monitoring. Look for:
- plants that have not been seen before;
- known weeds;
- diseased or unhealthy-looking plants;
- evidence of pest animals (cat faeces, tracks, wildlife remains)
- signs of erosion;
- litter.

Try recording your observations over time using a diary, fixed photographic points or other technique is recommended.

If action is required, seek advice on the most appropriate solutions, then proceed cautiously. The Department of Environment, Land, Water and Planning can offer advice for your particular property.

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24. Foxes – Options For Control

History of Introduction

The European Red Fox *Vulpes vulpes* was introduced into Australia during the 1860's and 1870's although it was not until the 1880's that the first viable population was released. One reason for this action was to recreate "the hunt" of old England for 'sporting' purposes.

The spread from these first releases around Melbourne was rapid. By 1917 sightings had been recorded in Kalgoorlie in Western Australia. The fox now ranges over two-thirds of the Australian continent in habitats as diverse as semi-desert through to rainforest and is known to be well established in the urban areas of capital cities.

Biology

The fox is an opportunistic feeder and, although being predominantly carnivorous, will vary its diet to include fruit, insects and carrion as the season and food supply permit. The diet in pastoral and agricultural areas is known to consist in large proportion of rabbits and mice. In bushland, native fauna such as possums, Brown Antechinus and Bush Rats are commonly consumed.

Foxes construct extensive burrows where cubs are born and reared. Rabbit warrens and Common Wombat burrows, hollow logs and other sites may also be used. Foxes breed once a year usually in late winter when three to five cubs are born.

The home range of foxes varies with habitat type, food availability and season. Foxes may range up to five sq km or more with densities of 1-12 per sq km.

Impacts of foxes on fauna and farm production

Since their introduction, foxes are thought to have had a substantial impact across the Australian continent through predation upon both native wildlife and introduced domestic animals. Apart from the Dingo and domestic dog, foxes are the largest terrestrial mammalian predator on the Australian mainland.

The Victorian fauna did not co-evolve with the fox. Therefore, susceptible species have not acquired adequate adaptations to avoid predation. Foxes are highly mobile, being capable of climbing the lower branches of trees and breaching tall fences.

Over 50 native species of animal have been recorded in the diet of the fox.

Many threatened species are preyed upon by foxes and foxes are thought to be a major factor in the decline of some of these. Threatened species in the diet of foxes include: Eastern Barred Bandicoot, Long-footed Potoroo, Broad-toothed Rat, Mountain Pygmy-possum, Brush-tailed Rock Wallaby, Broad-shelled Tortoise, Mallee fowl, Brolga, Hooded Plover and Little Tern.

The Eastern Barred Bandicoot (EBB) was previously widespread in Victoria and remains present in pastoral areas of Tasmania, where foxes are absent. Reintroduction of EBB in Victoria has been challenging, with successful examples having predator proof fencing or island locations. For example, on French Island where no foxes are present, a small colony of EBB was released in 2019 where the population remains stable. The remaining wild population near Hamilton in Victoria was relocated to the Hamilton Community Parklands, now protected by a predator proof fence and is showing signs of increasing numbers.

The fox has been implicated in the extinction of six mammal species in the Victorian Mallee.

A wide range of common species are also killed including the platypus (see LFW **Note 27**).

Some native fauna have low population densities and even low levels of fox predation on them may be significant to their continued survival.

Foxes can reduce recruitment of susceptible species. For example, foxes excavate and eat buried tortoise eggs and prey upon Brolga chicks. Further, foxes may compete with some native species (e.g. predatory birds, Tiger Quoll) for food resources.

Foxes may play a role in maintaining reservoirs of diseases harmful to wildlife and domestic animals such as distemper, parvovirus, canine hepatitis and heartworm. Foxes are also carriers of hydatid worms. Foxes with sarcoptic mange (scabies) are thought to be able to spread this disease into Common Wombat populations.

Foxes assist in the dispersal of some environmental weeds, such as Blackberries.

The fox in Europe is the main vector and reservoir host of rabies and is therefore seen as the main threat for potential spread of this disease should it ever be introduced into Australia. Rabies can seriously affect humans. This threat, of uncontrolled spread of rabies, was one of the main reasons for the fox being declared as vermin under the Vermin and Noxious Weeds Act 1958 thus requiring control by landholders.

The impact of the fox on the pastoral industry has not been thoroughly investigated. Research has suggested that the fox has been over-rated as a predator of otherwise viable lambs; however, in some instances large numbers of lamb deaths have been attributed to fox predation. Foxes also disturb and kill poultry.

However, there is hope of limiting the effects of foxes. Existing methods of fox control have proved successful in the recovery of some threatened mammal species. For example, a fox control program led to increased numbers of Numbats in Western Australia.

The main methods of control.

Fox control programs are most effective when they cover a large area so that fox populations will take longer to rebuild. This will usually involve a co-ordinated program with adjoining landholders operating at the same time and preferably more than once a year, ideally during Spring and Autumn. Co-operative approaches will also reduce the costs to individuals of fox control.

The planning and monitoring of fox control should be thorough. Expert advice can be valuable at this stage.

If fox control over the entire landscape is not feasible, then provision of some 'safe havens', subject to intensive control, for wildlife or domestic animals, may be an alternative.

Fox control may lead to an increase in rabbit numbers or feral cats. Therefore, control measures for a range of introduced species may need to operate in unison.

Potential off target poisoning of domestic dogs and wildlife must be considered and limits the range of techniques available for different situations. Larger properties generally have more options available to them than smaller properties located in areas with higher densities of human populations.

The main techniques are:

1. Poisoning:

Two main methods of poison baiting are available. The poison most commonly used is known as 1080 (ten eighty). Another option is the use of PAPP baits (Para-Amino-Propio-Phenone) and has improved success rates over 1080.

Use of poison baits is a restricted activity. Baits are only prepared and sold by authorised organisations. Landholders intending to lay baits must inform neighbours of their intention to do so and display signs indicating that poison has been laid on their land.

This is a legal requirement and is done to safeguard against the possibility of unintentional poisoning of domestic pets. Baits that are not taken must be collected. The use of non-poisoned baits (or 'free feed') to assess the potential impact on non-target species prior to a baiting campaign, is advisable and may be mandatory.

2. Shooting:

One method involves a number of shooters spacing themselves outside the bush or cover used by foxes and sending in dogs to chase the foxes out into the open toward the shooters. Small well-trained terrier-type dogs are preferable as they are less likely to threaten wildlife such as wallabies or kangaroos, which may use the same bush as cover.

Spotlighting is another method used with good results. A technique known as "whistling" for attracting foxes, particularly young cubs, toward the shooter is used successfully by some hunters. Spotlight shooting is biased toward taking yearling foxes and may not have the desired impact on more experienced foxes.

Landholders may be able to obtain the services of experienced shooters through local shooting organisations.

3. Fumigation:

Fumigants are also used for the control of foxes in their den. Extreme care should be taken when handling any fumigants (or other potentially dangerous chemicals). Manufacturers' instructions and warnings should be carefully observed.

4. Fencing:

The cost of erecting a high mesh fence capable of excluding foxes is not a practical solution for most situations. The electric fencing commonly found on farms is not adequate to exclude foxes as the spacings are too wide and the foxes have little difficulty in rapidly passing between the wires of an operating fence. A well designed and maintained electric fence with reduced distance between wire spacings will, however, give a high degree of control and should be a viable option to protect small reserves or vulnerable livestock.

5. Biological Control:

This method holds the hope of long-term future control of the fox population across the Australian continent. Research by the CSIRO Division of Wildlife and Ecology into immunosterilisation is being investigated as a viable method of fox control. Field application of biological control techniques, should they be successfully developed and socially acceptable, are unlikely to occur soon.

6. Fertility Control:

A range of fertility control chemicals are being assessed. These may provide a control option in areas where it is deemed unsafe or inappropriate to use poisoned baits.

7. Other methods:

- Foxes will use large stands of noxious weeds, such as blackberry and furze, for daytime shelter and to establish den sites. Removal of this cover will reduce the number of these sites.
- Environmental weed and pest animal (e.g. rabbit, grasshopper) control may reduce the availability of food for foxes and lead to lower population levels although it may also encourage a shift in prey selection toward native species or livestock.
- The use of treadle snares has proven to be effective in some instances to capture foxes.
- Other methods of control, such as trapping with oversize possum traps, have been trialled with little success in Gippsland. The use of steel-jawed traps for fox control is not target specific and is not recommended. A landholder using these traps may be in breach of the provisions of the *Prevention of Cruelty to Animals Act 1986.*
- Foxes are able to move more easily along tracks. Avoid placing tracks through native vegetation (see also **Note 23**).
- It is possible to reduce the number and effects of the fox population through the various control methods described. Long term control requires landholders within a district to adopt a group plan and co-ordinate their efforts on an ongoing basis.

Are there conflicts with protecting wildlife habitat?

Areas managed for wildlife may contain dense areas of vegetation or ground litter, including logs, that may provide refuge for foxes.

The methods outlined in this Note can be used effectively in bushland habitats without the need to make alterations to the habitat itself.

Foxes persist in highly modified habitats. For example, they survive on the docklands of Melbourne. Any attempt at habitat modification to reduce fox numbers will need to take into account the many benefits that native vegetation can provide such as shade and shelter for livestock, erosion control and wildlife habitat.

Avoiding negative impacts on wildlife

Whilst foxes are a major concern for wildlife, fox control measures may also adversely affect wildlife if not conducted properly. For example, the Tiger Quoll is a native carnivore that is likely to be susceptible to fox or cat control methods using poisoned baits. It is therefore very important that expert advice be sought and followed to prevent impacts on native species. Buried bait, free feeding and other techniques have been designed to prevent non-target species being affected.

References and Further Reading:

Flora and Fauna Guarantee Action Statement No. 44. 'Predation of Native Wildlife by the Introduced Red Fox' (and references listed therein).

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https://agriculture.vic.gov.au/biosecurity/pest-animals/priority-pest-animals/red-fox

25. Cats and wildlife – how you can protect both

Where is your cat at the moment? Could it be attacking wildlife or crossing a road? Is it safe from dogs? Is it identified so it can be returned to you if it gets lost? The information in this Note will help you to better protect your cat and wildlife.

Background

Cats are present throughout Victoria, as domestic pets, free-living strays, or as truly feral animals. Estimates in all these categories suggest that there are well over one million cats in the State.

Cats are obligate carnivores, that is, they must feed on animal protein. Each cat requires a minimum of 100-150g of protein each day, more if a female is nursing a litter. This means that an equivalent of at least seven small mammals, such as native Bush Rats, must be eaten each week by each cat.

Even cats that are well fed, apparently contented pets, will instinctively hunt and kill living creatures. An average of 32 wild animals may be killed by each pet cat every year. Each feral cat can kill many more. The potential impact on wildlife is enormous.

What impact do cats have on wildlife?

Cats are known to kill and eat more than 100 native Australian species of birds, 50 mammals, 50 reptiles, three frogs and numerous invertebrate animals. As more knowledge is obtained more animals continue to be added to the list.

Cats are a major threat to wildlife in the bush, where they are common and occur in most habitats, as well as in towns and cities. For example, in 1992, in response to a plague of native rats in south-west Queensland, where the endangered native Bilby survives, feral cat numbers were observed to be at high levels. T he Australian Army was called in to assist with control and, to the amazement of wildlife managers, shot 417 cats in four days within 20 km of the Bilby site. Up to six cats were shot out of a single tree in one day! Of interest is that the high cat numbers were on a cattle station on which dingo control was rigorous. Neighbouring stations, with more dingos, had less cats.

Cats can survive on water from prey in areas where drinking water is unavailable.

In Australia, cats (and dogs) have no natural predators. The hunting methods of cats are different to native predators, such as quolls, and so native wildlife has few inbuilt defences against cats.

Cats are most active at night, and especially at dusk and dawn. This coincides with the activity periods of much of our Australian wildlife, placing native animals at risk.

Cats kill prey of up to their own body size; most of Australia's endangered and vulnerable mammals are in this size category.

Cats can significantly control bird populations. Studies in South Australia indicate that domestic cats probably kill the 'standing crop' of birds, (i.e. the same number are killed as are produced each year).

Cats are significant predators on small mammals. In 15 months, one wildlife shelter in Melbourne received 272 native mammals with injuries that resulted from cat attacks; 242 of these were Common Ringtail Possums. Almost all died as a result of the attacks.

Cats have also been responsible for the death of at least 25% of all Sugar Gliders registered in the Victorian Wildlife database.

Cat's mouths can carry bacteria to which wildlife has little resistance, and wildlife that has been injured by cats usually dies - if not from injuries, then from infection.

Cats are the definitive host of the blood protozoan disease Toxoplasmosis which can affect wildlife, sheep and humans. It can cause unco-ordination, blindness, erratic movement and unnatural daytime activity. Toxoplasmosis is often fatal for infected wildlife. I t can have effects on reproduction (the disease can cause abortion in sheep and humans). Endangered Eastern Barred Bandicoots are at threat not only through direct predation by cats but from infection with the disease. It probably predisposes affected bandicoots to predation by cats or dogs and to road trauma.

Research into the reintroduction of rare mammals onto mainland Australia has found that, when foxes are controlled, cat numbers increase, continuing the attack on native species. Similarly, because rabbit is a significant part of feral cat diet in many (especially rural) areas, rabbit control without cat control may lead to increased predation on wildlife. Hence, an integrated pest animal control program is essential.

Cats also have an indirect impact on plant pollination by reducing numbers of native birds.

Although habitat alteration and hunting are also important factors, cats have been responsible for the extinction of over 30 species of birds around the world.

Cats have been the cause of decline and extinction of many bird species on a large number of islands including New Zealand, Macquarie Island, Socorro Island (Mexico), Ascension Island, the Kermadec group, Marion Island and many others. There are also records of mammals and reptiles being similarly affected - for example the endemic rodents of the Galapagos are now only found on islands without cats, and in Western Australia at least two species of now-endangered species of marsupial (Banded Hare-wallaby and Golden Bandicoot) have become extinct on the Monte Bello Islands due to cats.

Pet cats kill an average of 16 mammals, 8 birds and 8 reptiles every year. 900 000 pet cats by 32 wildlife each per year = 29 million wildlife.

Feral cats each need to eat the equivalent of seven native bush rats or ten native birds each week.
200 000 feral cats by 10 wildlife by 52 weeks = 104 million wildlife.

Stray cats in cities kill on average 5 wildlife each week.

300 000 cats by 5 wildlife by 52 weeks = 78 million wildlife.

GRAND TOTAL = 211 million wildlife killed by cats in

Victoria each year!

On farms

Toxoplasmosis in sheep, spread by cat faeces, can result in abortions, stillborn lambs, and a reduced lambing percentage. It is the most common cause of infectious abortions in sheep flocks in south-eastern Australia. Cats also carry the stock disease Sarcosporidiosis. Sarcocystis infection can result in carcase condemnation at the abattoir. Cats spread these diseases by contaminating pasture, hay and other animal foods with the parasite via their faeces. They in turn are contaminated by eating rodents, birds and wildlife which contain cysts of the parasite. Farmers who wish to avoid the risk to livestock of toxoplasmosis should not let cats near their pastures.

Pet cats - what can I do to protect my cat and wildlife?

Clearly, there is a need to act to reduce the impact of cats on wildlife and a range of measures are available that can also lead to safer living conditions for pet cats.

It may seem like a major change to the way you have viewed the life and entitlements of your pet cat to consider placing restrictions on it. Improving the care of your cat by limiting its behaviour is comparable to placing restrictions on children for their safety and to teach them to live alongside others.

The path to improved cat care can be direct or you may choose to improve control over time (see How else can I help protect wildlife?). You may choose not replace your cat when it dies or to change to a breed more suited to confinement at this time.

Why keep your cat confined?

By keeping your cat confined to your property at all times, and indoors or in a special enclosure or cattery between dusk and dawn, you will protect your cat and Victoria's wildlife better. Confining your cat will ensure its safety and well-being.

Cats not kept at home can be killed or injured - on roads, in fights, through disease or by acts of cruelty. They can catch feline AIDS from stray or feral cats. Wandering cats may mate and produce unwanted litters and are easily stolen. Why expose your cat to these dangers?

Cats are wonderful companions - they are affectionate and intelligent and they enjoy your company. Yet, in Melbourne alone, over 45 000 cats end up in animal shelters each year. Few have identification and only 1% are reclaimed by their owners. Most are humanely euthanised.

Is it cruel to confine my cat?

No - because suburban and rural environments pose too many risks to allow pet cats complete freedom. The average life span of a cat kept inside is 12 years. That of a cat allowed to roam at will is just three years.

If you provide all their needs, desexed cats are happy to live in a suitable enclosed area. Cats don't have an 'innate' need to roam - they need exercise and play as well as around 19 hours of sleep each day.

Many cats become better pets and live long, healthy and contented lives inside a house or flat, often for 24 hours a day.

How can I confine my cat?

Keep it inside (especially at night). Train your cat by feeding it inside before dusk and not letting it out before dawn.

Build a cattery

There are a great many options. Free-standing or attached enclosures can be constructed. Alternatively, use can be made of existing structures such as the garage or an unused aviary. Commercial cat enclosures are available. The diagram (below) provides some suggestions. If you wish to observe a cattery before building, contact a Land for Wildlife extension officer, local veterinarian or other contacts listed in this Note to see if they can assist you.

What are my cat's needs when enclosed?

Overnight - food, water, a litter tray and a warm, dry, draught-free sleeping area.

For longer periods - facilities for exercise, climbing, several resting places at various heights, and shelter from wind, sun, rain, cold and hot weather. A scratching and climbing pole is a must - up to 2.5m tall, with 2-3 perches. Provide cat toys (available at good pet shops) and help your cat to exercise daily by encouraging it to play, run and jump. Install window perches for your cat to sunbathe on, or a cat-door for access to an enclosed area outside.

The RSPCA and Cat Protection Society can provide more advice on confining your cat.

Why should I de-sex my cat?

Desexing your cat is one way you can show you care for it and wildlife. There are numerous benefits including:

- A desexed pet is easier to own and care for. Desexed male and female animals are less stressed by reproductive or territorial demands and make better pets. Many people say a desexed pet is more pleasurable to own. Cats won't wander or fight as much and are less noisy and odorous if desexed.
- A desexed pet does not tend to have the occasional unwelcome habits of entire animals, such as urinating on the carpet in the corner of the loungeroom.
- Desexing is better for your cat's health. Female cats can suffer physical and nutritional exhaustion if continually breeding.
- More desexed cats means fewer unwanted litters of kittens.
- Fewer strays also means more protection for humans, other companion animals, wildlife and the environment.
- Uncontrolled breeding results in large numbers of unwanted cats joining the stray and feral populations. Most suffer through disease and injury, and many prey on native wildlife to survive.

Are some cat breeds better suited to indoors?

Yes. The good old moggie, and many other long and short- haired breeds, like the Russian Blue, are happy being indoors at all times.

What can be done about feral cats?

Cats that belong to someone are legally recognised as chattels. It is illegal to harm or damage another person's belongings under common law. Therefore, if you wish to take action against cats on your property that are presumed feral, you must advise your neighbours in advance of your intention to control cats so that they can prevent their cat wandering onto your property. A means of permanently identifying cats would help solve this problem of ownership.

The feral cat in Victoria is now declared an established pest animal under the Catchment and Land Protection Act 1994. This will help to protect Victoria's at-risk biodiversity and give threatened species the best chance of survival.

The declaration only applies to specific areas of public land in Victoria. It is important that the feral cat declaration only applies to areas of public land where feral cat management is of high priority for the protection of biodiversity and minimises the risk to free-roaming domestic cats.

Feral cats have NOT been declared an established pest on private land, meaning farmers and other private landholders will not be required to control feral cats. Permission to hunt on public land does not extend to feral cats, unless conducted by accredited volunteer shooters engaged to participate in control programs.

Feral cats have a major impact on Victoria's biodiversity and are one of the most significant threats to our native wildlife. The declaration is an important milestone in protecting them.

Feral Cat information sheet
Copy and paste the following link into your web browser:
https://www.environment.vic.gov.au/__data/assets/word_doc/0031/329827/FINAL_Feral-cat-declaration-information-sheet_26.07.18.docx

Feral Cat declaration information sheet
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How else can I help protect wildlife?

Put bells on your cat's collar.
Bells do not stop cats killing wildlife - they only make a difference in one out of three attacks. Keeping your cat confined stops all cat attacks on wildlife.

Use a harness to walk your cat outside.
Train your cat to walk with a cat harness (dog leashes are not suitable) is easy and rewarding for you and your cat. Choose to not replace your cat when it dies.

This is a cheap option but has no effect in the short-term unless other control measures are adopted.

Answers to other commonly asked questions

Why put all this effort into cats when dogs, habitat destruction and foxes cause a greater impact?
Because cats DO kill millions of wild animals each year and contribute significantly to wildlife losses AND because this is a problem we can all do something about.

Aren't foxes more significant wildlife predators than cats?
Possibly. However, cat predation is a significant component of the overall toll on wildlife by introduced predators. When foxes are controlled feral cat numbers can build up and continue the damage caused by foxes. Action is also being taken against foxes (see LFW **Note 24**).

Haven't cat and native wildlife numbers reached a new equilibrium?
No. Overall, wildlife numbers and species diversity continue to decline, and cats are a significant contributor to this trend.

What native wildlife is most affected?
Small ground-nesting and feeding animals.

How can we protect wildlife that is active during the day?
Keep your cat confined during the day as well as at night.

I live 2km from the nearest patch of bush, so why do I have to confine or curfew my cat?
Wildlife is everywhere, and often those populations protected by parks and reserves depend on areas outside reserves for their future. Cats, especially males, can travel many kilometres if they are permitted to do so.

Are cats effective ratters and mousers?
No. Cats will kill some rats and mice (including native rodents) but are unlikely to eliminate these pests from an area. Rodents are a source of the disease toxoplasmosis (see page 1 and 2). Around the home and farm the presence of accessible food sources is a major attractant for pest rodents. Store grain in rodent-proof silos or cupboards, contain garbage and clean up any spills. Poisons, available in supermarkets, from Department of Agriculture offices and elsewhere, are an efficient short- term way of treating a localised rodent problem. Plagues of rodents are linked to environmental variables, not to the degree of cat predation.

Do cats control snakes?
No. Having a cat is no deterrent to snakes and cats can be killed by snakes. If you are concerned about snakes around your house, you can reduce your chance of encountering a snake by making the local environment less attractive for them; remove piles of rubbish and other shelter, keep grass near the house short and locate garden ponds (which attract frogs, a favourite food of snakes) away from children's play areas. **ALWAYS BE ALERT** in areas where snakes may occur.

Isn't a cattery just another word for a cage or a jail?
No. A well-designed cattery will provide all your cat's needs and protect it from the many dangers of living outside.

Don't catteries cost an arm and a leg?
No. Catteries can be as expensive or cheap as your design imagination. Low-cost catteries can be made using chicken wire and stakes.

What diseases is my cat exposed to while roaming?
Feline Acquired Immune Deficiency Syndrome (Feline AIDS), toxoplasmosis and others.

What is Toxoplasmosis?
Toxoplasmosis is a disease caused by the protozoan blood parasite Toxoplasma gondii. Cats are the definitive host, and intermediate hosts include many species of wildlife, and humans (see page 1). Affected cats do not show any visual external signs of the disease.

How adaptable are cats to being inside at night and at other times?
As adaptable as their owners. After a short adjustment period, cats are content to remain indoors. Often owners don't believe their cat will adjust happily and so do not proceed with training. Many cats become better pets and establish a new relationship with their owners when kept inside.

How often does a cat come 'in season'?
Cats may come into season six or eight times a year depending on whether they mate or fall pregnant. There is usually a short break in the breeding cycle in winter.

What is desexing?
Desexing is the surgical removal of a female animal's ovaries or a male animal's testicles. This results in permanent sterility for the animal. A desexed cat cannot reproduce.

Isn't it cruel to have a cat desexed?
No. It is cruel to subject your cat to unnecessary health problems associated with pregnancy. An entire cat kept inside will suffer frustration and may become neurotic. It is cruel not to desex your cat.

How much does desexing cost?
Costs vary and increase as pets get older and/or fatter. The RSPCA, through its immature animal desexing clinic, offers professional desexing at lower rates. For more information, call the RSPCA.

Who can desex animals? When is the best time to desex an animal?
Desexing is a surgical procedure performed by a registered veterinary surgeon. Females are best desexed at age 5 - 6 months and males age 6-8 months.

Will my pet cat get fat if it is desexed?
Not necessarily. A desexed animal will only get fat if it is fed too much and not given enough exercise. The calorie intake requirements of cats are lowered by desexing so do not over-feed your cat.

Shouldn't I allow my cat to have a litter before desexing it?
Desexing should be performed before full maturity is attained. Having a litter neither adds to, nor detracts from, a male or female cat's personality.

Why do we need registration as well as identification?
Registration will help you find your cat and others to return it if it gets lost. It also provides a way to offer incentives for owners to desex their animals by way of differential registration fees. Identification is necessary so that we can separate owned and unowned cats for control.

How can registered animals be identified?
By microchip implant, or tattoo and collar and tag. The microchip provides registration details and collar, and tag allows for visual identification.

What if I no longer want to keep my cat?
If owners find they are no longer able to keep their cat, they should seek to rehouse it themselves, or take it to an animal shelter for rehousing or humane euthanasia.

Confinement Options

1. Build a cattery
A-frame catteries provide for climbing and sunbathing at height. Adapt an aviary for your cat (available commercially) Connect to the house via a walkway from a window or a cat-door in the wall

2. Keep your cat inside with you
Then it can enjoy your company all the time!

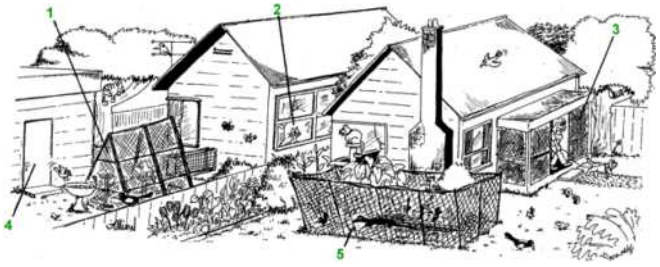
3. Enclose a section of your home
Enclose a verandah with chicken wire or flywire. Enclose the 'dead end' section of your garden between your house and the fence. Provide cat access via a window or cat-door.

4. Use the garage for overnight confinement.

5. Use a low-cost enclosure or exclosure
Build a 'floppy wire' fence from small gauge chicken wire and angle it in slightly to the centre to enclose a section of your backyard on a temporary or permanent basis. Provide all your cat's requirements inside. Build it in reverse and create an "exclosure" i.e. angle the wire outwards to keep cats out of your safe haven for wildlife.

6. Build a cat-proof boundary fence
Attach either small gauge chicken wire or aluminium flashing to the top of an existing fence and angle it into your property, or

Attach 'floppy' chicken wire to the top of your fence. Remember to secure any trees which may overhang the fence by either enclosing them with wire or erecting a 'cat barrier' at a suitable height up the tree.



26. Mistletoe and Wildlife – a positive view of a parasite

The unusual lifestyle of mistletoes

Mistletoes are partly parasitic flowering plants. There are twelve species (2 families, 6 genera) in Victoria all of which are native[1]. Mistletoes have co-evolved with the Australian flora and fauna and some extraordinary relationships have developed between this plant and other species[10,11].

Mistletoe is only partially parasitic on its host plant. It can produce its own energy through photosynthesis but must obtain mineral nutrients and water from its host. A wide range of species may be infected by mistletoe including eucalyptus, acacia, casuarina, banksia, members of the *Santalaceae* and *Myoporaceae* and introduced street trees.

Camouflage

Most mistletoes mimic their host plant to some extent, and some are virtually impossible to detect unless exposed by their flowers. Why do they 'hide'? The answer is unknown, but it may be that the mistletoe benefits by appearing to be part of the host which may have chemical and other defences against herbivores that the mistletoe does not.

For example, eucalypts contain high concentrations of toxins in their leaves that deter many animals from eating them.

Mistletoe and Wildlife

Mistletoes are a vital part of the web-of-life in Victorian ecosystems.

Nectar & flowers

Forty-one species of birds, mainly honeyeaters, have been recorded feeding at mistletoe flowers[10] and some species feed exclusively at mistletoe for periods of the year. In some areas, mistletoe flowers are a very important source of nectar for birds, particularly when nectar and manna production by other plants is at its lowest[10]. Mistletoe plants generally produce abundant flowers annually whilst many of their eucalypt hosts are irregular suppliers of nectar.

A wide geographic distribution and long flowering period in many species makes mistletoe an attractive resource for wildlife. Mistletoe is highly attractive to butterflies and moths and other invertebrates no doubt also use mistletoe as a source of nectar. Brush-tailed Possums and Yellow-bellied Gliders have been recorded feeding on *Amyema* flowers[10].

Fruits

The Mistletoe bird *Dicaeum hirundinaceum* and Painted Honeyeater *Grantiella picta* are dependent on the fruits of mistletoe for their survival[9,10]. Though quite common, Mistletoe birds are inconspicuous and rarely seen by untrained observers. They are effective dispersal agents for mistletoe because, although the fruits are eaten, the seed and its sticky coating pass through the bird undigested. Seeds pass out in the droppings and some are deposited on tree branches where their sticky coating helps them to attach and grow. Mistletoe birds are credited with perching sideways on branches thus facilitating placement of the seed. Painted Honeyeaters, classified rare in Victoria, feed largely on mistletoe berries and nest only where they are common. In their search for mistletoe berries, they migrate to the ironbark forests of northern Victoria in spring. Olive-backed Oriole, Little Lorikeet, Silvereye, and various honeyeaters may be partially dependent on mistletoe berries[4]. In all, 33 bird species have been recorded feeding on mistletoe berries but the behaviour and digestive process of most does not aid mistletoe dispersal[10]. Mistletoe fruits were also eaten by aborigines[11].

Foliage

The dense foliage of a mistletoe plant offers concealment, and some bird species take advantage of this attribute as a secure nest or perching site (e.g. Regent Honeyeater). The haustorium provides a secure platform on which nests can be constructed. Ringtail Possums sometimes use mistletoe clumps for daytime shelter. Brushtail Possums eat the leaves.

Many butterflies have developed a unique association with mistletoe. Larvae of the Azure Butterflies (*Ogyris spp*) and Jezabels (*Delias spp*) rely on mistletoe as their food source. For example, Imperial White Butterfly *Delias harpalyce* caterpillars feed exclusively on mistletoe which they defoliate before pupating. Genoveva Azure *Ogyris genoveva* caterpillars feed at night on Box Mistletoe where they are attended by ants. The ants escort the caterpillars to their nest for daytime shelter and receive sugary secretions as reward from the caterpillars[8].

Concerns about mistletoe

Mistletoe can be a conspicuous feature in trees, especially when the host plant foliage is of a different colour or if the host is deciduous. Where mistletoe is prolific, it is often highly visible. Tree death frequently coincides with heavy infestations of mistletoe, however, this observation may simply be a symptom of the problem rather than its cause.

Some landholders have expressed concern about the potential effects of mistletoe on its host plant and are apprehensive about the effects of mistletoe on trees retained or planted for various purposes around a property.

In 1904 mistletoe was declared a noxious weed in Victoria and up to the 1950s was manually removed from thousands of acres in some Victorian forests. This treatment proved ineffective because mistletoe rapidly re-invades, and labour costs quickly outstrip any benefits.

Mistletoe as an indicator

Mistletoes obtain water, minerals and nutrients from their hosts but produce their own energy by photosynthesis.

Their long association with native plants, on which they are dependent, suggests that the relationship is not one in which the mistletoe has complete dominance under natural conditions. For example, it is not unusual to find a mistletoe plant dead on a living tree, although the reasons for this (e.g. old age, natural resistance of the host, less resistance to bushfire) are not always clear. Overseas, host resistance to mistletoe has been demonstrated[4].

Healthy stands of native species could be expected to have defences against mistletoe. Some may even have a mutually beneficial relationship with it although there is no evidence of this in the literature. Alternative flowering times between host and parasite could advantageously attract insectivores, gleaners and other species that benefit the host.

Severe infestations of mistletoe are often associated with stressed or ageing plants or disrupted plant communities. Changes to the nutrient status of soils, soil compaction, salinity and cultivation, fertilizer use, partial clearing leading to forest trees being isolated in paddocks, changed water supply, fungal attack and insect predation may stress vegetation. Parasites, including mistletoe, and pathogens are likely to increase in these situations.

Heatwole and Lowman[6] conclude that 'trees heavily infested with mistletoe may be killed directly by them; but probably more often they die as a result of a combination of stresses, one of which is mistletoe.'

Therefore, increasing infestations of mistletoe might actually be a useful indicator of unhealthy or unnatural conditions requiring remedial action.

Information relevant to control

Mistletoes affect their host plant through competition for water, nutrients and light.

They vary in their degree of host specificity; some only infest one or two species of host plant. The susceptibility of the host to infection also varies[3], even within a species.

Mistletoes are more common in open forests with higher light penetration, such as the box and ironbark forests of northern Victoria. They tend to occur high in the canopy on northward-facing aspects or high exposed branches (dense trees), in intact forests. In disturbed situations, retention of lower limbs on host plants leads to a greater surface area with sufficient light for mistletoe growth.

In forests, mistletoe is rarely observed to be as prolific as it is on many isolated trees a short distance from the forest edge.

Explanations for reports of increased mistletoe numbers have included the suggestions that additional light favours mistletoe growth and/or more frequent visits from Mistletoe birds, that reduced water stress favours mistletoe, that fire regimes (mistletoes may be killed by low intensity fires whilst eucalypts can survive) and lower numbers of Brushtail Possums (millions were taken for their skins in the 1930s) favour mistletoe.

In Victoria, germinating mistletoe seeds can only penetrate young branches with thin bark and so have no impact on the quality of timber production, although they may slow the rate of growth and reduce flowering, fruit and seed production of the host plant. The host branch usually dies beyond the point of mistletoe attachment thus enabling access to sunlight by the parasite.

Mistletoes have a limited life span (about 20-30 years[7]) that is much shorter than that of a eucalypt host (over 150 years).

Mistletoes can rapidly re-infest host plants after removal if the causes of infestation are unchanged[3].

Natural predators of mistletoes include butterfly larvae (see above), at least one weevil, longicorn beetles, moths and wasps[3,6]. Brushtail Possums (and probably Ringtails) eat the foliage. Little is known of potential pathogens but unexplained deaths of mistletoe do occur. All the above contribute to natural means of biological control of mistletoe in natural systems.

Whilst host eucalypts will control their water use in dry periods, mistletoes do not reduce their water loss significantly. Large infestations of mistletoe have been associated with locations near watercourses and dams.

Mistletoes apparently lack the dormant buds which allow their eucalypt hosts to resprout after fire[4], have thin bark and so are probably fire sensitive[12].

Mistletoe distribution is limited by climate. For example, few mistletoes occur in open alpine environments.

Soil nutrient status may affect the distribution of mistletoe although this is unconfirmed.

Buloke Mistletoe *Amyema linophyllum*, Golden Mistletoe *Notothixos subaureus* and Jointed Mistletoe *Korthalsella rubra* are listed as rare or threatened plants in Victoria[5].

Mistletoe control

Given the importance of mistletoe in the Victorian environment, the first issue to address is whether or not any control is desirable. In most cases, it will be best if mistletoe is left to perform its valuable functions.

Since the cause of problems associated with mistletoe appears to be related to an 'unhealthy' environment, a long- term solution is to try to create an environment on a property, and in the surrounding landscape, which is more 'ecologically healthy' and hence where 'tree stress' is reduced. Some steps that can be taken are to fence off remnant native vegetation, restore areas by encouraging the growth of native understorey plants and native groundcovers. Regeneration of surrounding trees will eventually shade some of the mistletoes on isolated trees and may help their recovery. Leaving ground cover such as leaves, branches and logs will assist animals that make use of this habitat and may assist invertebrates that defoliate mistletoe. Fencing off reasonably large circular areas of native vegetation and taking care with agricultural practices (e.g. keeping fertilizers away from native vegetation) will assist. Connecting small remnants with larger ones using corridors of native vegetation can restore natural movement patterns including those of birds that eat mistletoe fruits but do not aid dispersal, thus potentially reducing recruitment.

If you are particularly concerned about the fate of an individual favourite tree then manual removal of mistletoe (usually the branch on which the mistletoe occurs) is an option, if combined with measures to address the cause of the infestation. Take care to remove all outgrowths of the mistletoe (particularly Creeping Mistletoe which has long outgrowths which attach to the host) or it may reshoot.

Of course, this technique may be very difficult and dangerous depending on the location of the mistletoe. The cost of control must be evaluated against the benefits. Re- infestation is likely within a short time. Mistletoe is sensitive to heat and can be killed using a blowtorch (beware of fire risk)[4].

Foliar application of chemicals can be used to kill mistletoe[4,7]. The injection of a chemical into the trunk of a mistletoe-infested eucalypt has been suggested as a control option, however, this remedy does not target the cause of the infestation and involves the risk that the dosage will either fail to kill the mistletoe or will kill the host plant. The experience of the operator is one factor in determining whether such an operation is likely to succeed. There are also environmental and health risks associated with the chemicals used.

Revegetation, especially by natural regeneration, whilst not guaranteeing the survival of an individual tree, is a way of continuing to provide the significant benefits associated with native vegetation on a property (e.g. for shade of livestock) and is probably the most effective solution for landholders. Selection of a native species or variety that is resistant to mistletoe attack may be necessary when isolated trees are required.

This Note has attempted to evaluate the role of mistletoe in the Victorian environment so that a balanced approach to control can be achieved. Overseas, mistletoes have a prominent place in many cultures. For example, they had mythological significance to the Gauls in pre-Roman England and play a traditional role in English Christmas celebrations.

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27. Platypus – Helping them in the wild

Where are Platypus found?

Platypus (*Ornithorhynchus anatinus*) live only in Australia. They are widespread and common residents of permanent streams, rivers and lakes in Tasmania, Victoria, New South Wales, and Queensland to as far north as Cooktown.

Platypus may also use temporary or man-made water bodies, particularly when these are linked directly to streams or rivers. In Victoria, platypus have been sighted in recent times in 26 of the 31 river systems in the State, occupying much the same area as before European settlement. However, their distribution has been reduced in the Melbourne metropolitan area, presumably because of disturbance and water pollution. Platypus have probably also declined in the Murray River downstream of Echuca, and may have disappeared from the Portland Coast, parts of the Wimmera River system, and Tidal River on Wilson's Promontory (Grant, 1992).

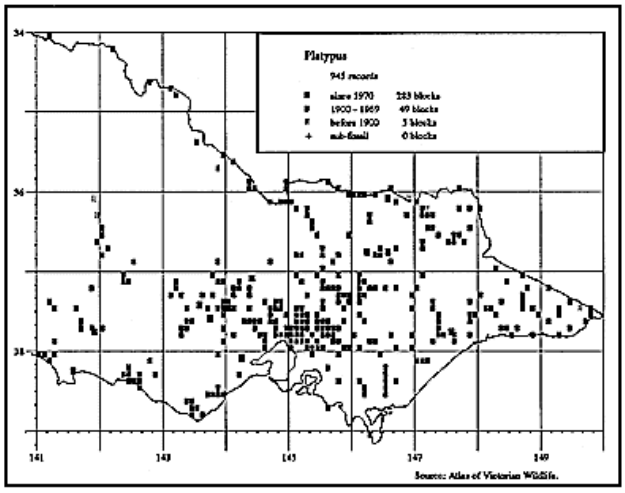

Figure 1. Distribution of the platypus in Victoria

Although reasonably abundant, platypus are not often seen because of their quiet, retiring nature and largely nocturnal habits. Platypus are most often observed near dawn or dusk in unpolluted stream pools or sections of river. When alarmed, platypus will 'splash-dive' - make a loud single or double splashing noise with their body and tail as they dive abruptly.

Other facts about Platypus

Along with two species of echidna, platypus are the only mammals to lay eggs. Platypus breed from August to October; a female lays 1-3 eggs, which are incubated between her belly and curled-up tail. The eggs are 15-18 millimetres long and have a parchment-like shell, like those of snakes and lizards (Griffiths, 1978). After hatching, the young are fed milk for about 4 months, and first enter the water in January to March. When grown, male platypus measure an average 50 centimetres in total length (bill tip to tail tip) and weigh 1200-2600 grams. Adult females are smaller, measuring an average 44 centimetres in total length and weighing 600-1600 grams.

Platypus consume 15-30% of their body weight in food each day. Their diet includes a wide variety of freshwater invertebrates: shrimps and crayfish (yabbies), water bugs and diving beetles, worms and mussels, and immature dragonflies, mayflies, true flies and caddis flies (Faragher et al., 1979). They also dine on tadpoles and small frogs and fish. Platypus keep their eyes and ears tightly closed underwater. To detect prey, platypus bills are equipped with electroreceptors which apparently can sense the tiny electric currents created when many of their prey species move - for example, when a yabby flicks its tail (Scheich et al., 1986). Platypus have cheek pouches in which food items are stored as the animals forage underwater. When their cheek pouches are full or they need to breathe (platypus can remain underwater for only 5-10 minutes at a time without drowning), the animals return to the surface to 'chew' their food with the rough grinding pads they have instead of teeth.

Platypus spend up to 17 hours a day asleep in a burrow (Serena, in press). There are two types of platypus burrows: 'nursery burrows' (which provide shelter for a mother and her offspring) and 'camping burrows' (all other burrows).

Camping burrows are quite short (1-3 metres long). The entrances are usually difficult to spot, being located underwater or just at the water surface, often beneath a fallen log or undercut bank or stump. An adult will use several different camping burrows and may occasionally share a burrow with another grown platypus, though males and females both tend to be solitary in their habits (Serena, in press). Nursery burrows are 3-15 metres long, with one or more oval entrances located well above the waterline. It may be that nursery burrows are placed relatively high up along a bank in order to help protect young platypus from drowning in floods. Platypus have strong claws on their front feet and are well suited to digging - it has been calculated that the animals can complete one metre of tunnel in about two hours.

The home ranges of adult female platypus overlap those of other grown females as well as males, so several different individuals may occupy a given stretch of stream or river. For example, surveys conducted over a four-year period indicated that 3-5 platypus typically made use of any given point along a relatively small stream in the Yarra Valley (Badger Creek). Adult males were recorded to move more than 6 kilometres along this stream in a single night, while females travelled up to nearly 2 kilometres in a night.

Information on the sex and age of platypus can be gained by examining the appearance of a spur located on the inner ankle of the hind foot. From the time they leave the nursery burrow, young male platypus are equipped with conspicuous cone-shaped spurs, about 1 cm long. Initially the spurs are covered in a white chalky layer, which chips away entirely by the age of about 9 months to reveal the curved, amber-coloured true spur. Young female platypus have tiny (1-2 millimetres long) white or brown spurs, which are shed by the age of about 8-10 months, leaving only a small pit to mark the spot (Grant, 1989). Male spurs are hollow and connected to a poison gland in the thigh. The glands start producing poison when males become mature (at the age of two years) and produce the greatest amount of poison during the breeding season. It is therefore believed that males use their spurs as weapons when competing for breeding territories or females.

People who are spurred when handling an angry or frightened male platypus typically experience severe pain and swelling, although the poison is not considered to be life-threatening to humans.

Threats to platypus

Platypus have been recorded to live to the age of at least 13 years in the wild, though most individuals die at a much younger age. Some mortality may result from flooding, although floods can also benefit platypus by expanding the size of the area available to the animals for foraging.

Severe drought probably kills many individuals, by eliminating their habitat and increasing their vulnerability to predators as water levels drop.

Animals that are known or believed to kill platypus include foxes, domestic dogs and cats, goannas, Murray cod, carpet pythons and wedge-tailed eagles (Grant, 1989; Land for Wildlife News, 1991). It has also been suggested that predation by crocodiles may contribute to the lack of platypus on Cape York Peninsula, Queensland. Platypus are very susceptible to drowning in some types of fishing nets, including weighted gill nets and completely submerged drum and fyke nets (unless the latter are fitted with mesh exclusion panels). Platypus may also suffer severe injuries or die as the result of encounters with rubbish and litter dumped by humans (Land for Wildlife News, 1992). For example, one unfortunate platypus found dying on the banks of Lake Learmonth (near Ballarat) had a loop of nylon fishing line caught around his body - the line had gradually sawn through the animal's muscle and ribs, opening up the lung cavity. Another platypus was recently found starving near Benalla with a section of PVC pipe caught around her neck. Besides interfering with feeding, the rough edges of the pipe had caused deep lacerations where they rubbed against the animal's body. Chemical pollutants that enter freshwater systems through runoff from storm water drains or nearby land - such as oils, paints, solvents, and pesticides - can harm platypus by fouling their fur or poisoning the small animals on which they feed.

What you can do to help platypus

1. Help to build awareness of the fact that platypus are likely to be living in local streams and stream-fed lakes. Platypus are sometimes observed even in highly disturbed water bodies, such as the metropolitan section of the Yarra River. It is important that people realise that their actions can have a real impact, for better or worse, on the long-term survival of platypus populations in their area.

2. Whenever possible, retain logs, stumps and snags that occur in and along water courses. These provide good sites for platypus burrows and important habitat for the small aquatic invertebrates eaten by platypus. Deep pools (including those that form at creek and river bends) and backwaters are also important places for platypus to find food. Man-made ponds are most likely to be used by platypus if there is a suitable channel (holding at least a few centimetres of water) linking the pond to the nearest natural water body.

3. Work to maintain and improve the quality of native vegetation growing along water courses. In Victoria, it has been estimated that streamside vegetation is in poor condition along 65% of the length of streams in cleared areas. Over 25,000 kilometres of stream courses are either actively gullying or vulnerable to erosion because of soil compaction and loss of vegetation cover (Land for Wildlife **Note 10**).

4. Although platypus are basically aquatic animals, they require stable banks for secure burrow sites. In addition, erosion and consequent siltation can reduce or eliminate the platypus food supply when populations of smaller freshwater organisms decline. Streamside vegetation is also vital to platypus in providing protective cover from predators. To improve the quality of habitat along water courses, limit stock access with fencing, encourage native plants to regenerate, control weeds, and encourage a layer of ground litter to develop (Land for Wildlife **Note 8**). Besides helping platypus and many other wildlife species, such activities will improve water quality, reduce flooding and benefit recreational fishing (Land for Wildlife **Note 3**).

5. Avoid placing walking paths or vehicle tracks along the edge of water courses - they facilitate access by predators such as foxes, and can also contribute to erosion of stream and riverbanks.

6. To reduce the risk of contaminating freshwater systems, avoid applying pesticides, herbicides or other chemicals near streams and other water bodies.

7. Help to build awareness of the fact that platypus can be badly injured or killed by litter and rubbish left by humans. Be particularly careful to dispose properly of sharp or jagged objects and materials in which an animal could get caught or tangled, such as fishing line.

8. Don't get rid of leftover waste chemicals by tipping them down the sink or into a storm water drain. Instead, ring your local shire office, Melbourne Water or the Environment Protection Authority for advice on the most appropriate way to dispose of waste chemicals in your area.

9. If you think you have found an illegal fishing net, please report it to your local council or Department of Environment, Land, Water and Planning office. However, don't disturb or try to damage the net - in one recent case, a drum net that had been set by fish researchers in a manner that was harmless to platypus became a lethal trap after it was tossed into a deep pool by well-meaning but misguided bushwalkers.

10. Don't let your pets wander unsupervised at night - this will help safeguard the welfare of your pets as well as wildlife! Domestic dogs and cats are both potentially predators on platypus, particularly on farms or in suburban areas. Young, inexperienced platypus and platypus living in shallow streams are especially at risk.

11. Platypus normally spend their entire lives in or within a few metres of water. However, orphaned or naturally dispersing juveniles, or adults which have been displaced from their homes by catastrophic events, may sometimes be found in completely inappropriate places. If you find an injured or displaced platypus, contact the Veterinary Department staff at Healesville Sanctuary or Melbourne Zoo as soon as possible for advice.

If a platypus needs to be held overnight before being released back into the wild or transferred to the care of an experienced wildlife veterinarian, the animal should be kept in a quiet, dark, secure location (such as a sturdy closed cardboard box placed in a quiet room) away from people and household pets. To reduce stress to the animal, handle it as little as possible.

There is no need to encourage the platypus to eat, drink or swim - in fact, all these actions can be very harmful, especially if the animal is sick or weak.

12. Encourage and actively support local Landcare groups to improve the environmental quality of the landscape surrounding streams and rivers.

References and further reading

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28. Management of shallow freshwater wetlands for wildlife

This Note briefly considers the management issues associated with maintaining the natural values of small semi-permanent wetlands on private land, however, much of the information is also relevant to other wetlands.

Other *Land for Wildlife* Notes on related topics are **Note 15 'Wildlife and farm dams'**, which provides information on the management of small artificial wetlands, and **Note 22 'Whole Farm Planning and wildlife'**. Further information can be gained from the references listed at the end of the text.

It is important to recognise that, whilst many of the larger wetlands are in public ownership the smaller, more numerous, often seasonal, wetlands are mostly privately owned. Many of these have been drained or altered from their natural state. Shallow wetlands provide wildlife habitat that differs from that provided by deep permanent wetlands.

What are the wildlife values of shallow wetlands?

Seasonal drying imposes particular conditions on the plants and animals which are resident in shallow wetlands and means that larger wildlife species are only visitors, although they may breed. The vegetation is dominated by annual species or species which use bulbs or fleshy roots to survive drying. Invertebrate species have resistant eggs or lie dormant in the substrate, as do most frogs. Without connections to permanent water, fish are usually absent.

When flooded by winter rains, nutrients released from plant material, broken down over summer or by inundation, stimulate plant and invertebrate growth and breeding of frogs. Birds which have adapted to exploit these conditions include Black Duck and Grey Teal which eat both plant material and invertebrates, and Black- winged Stilt, ibises and White-faced Heron which eat invertebrates.

Shallow wetlands offer respite to tadpoles from predators, such as fish, that inhabit more permanent waters.

Reptiles and amphibians associated with wetlands have a fixed dependence on the wetland, year-round, in contrast to most birds. Carpet Snakes, which have declined in Victoria, take refuge in the live and dead River Red Gums and Black Box associated with wetlands in northern Victoria.

Shallow wetlands are important breeding habitat for many water birds. Some species both nest and raise their young (e.g. Black Swan, Black-winged Stilts, Brolga and Purple Swamphen) at shallow wetlands. The amount of vegetation remaining from the previous inundation, together with new growth, is important in determining how long after flooding these species will nest, as large amounts of material are used by some species for nest construction (e.g. swans) while others build their nest above the water in emergent vegetation (e.g. swamphens). Other waterbirds nest nearby in tree hollows (e.g. Australian Shelduck, Maned Duck) or dense vegetation (e.g. Black Duck, Australasian Shoveler) and newly-hatched young move to the wetland. Again, the amount of vegetation is important because it provides protection from predation for young birds as well as food.

It should be remembered that some species which nest on more permanent wetlands (e.g. Great Egret, Little Pied Cormorant, Rufous Night Heron, Yellow-billed Spoonbill) or, indeed, in trees away from water (e.g. White-faced Heron) rely on seasonally inundated wetlands for food which they may carry for many kilometres back to feed their young.

Where vegetation is sparse or low along the shoreline, Black-fronted Plovers and Red-kneed Dotterels nest on the ground and migratory waders (e.g. Sharp-tailed Sandpiper, Latham's Snipe), which do not breed in Australia, may be seen feeding.

Are there other values?

Wetlands may provide landholders with a wide range of other benefits including improved water quality (due to natural filtration), flood mitigation, erosion protection, nature conservation, study and education, recreation (bird- watching, duck-hunting, fishing), tourism, nutrient cycling/pollution control,

landscape values, control of pasture pests by wetland birds, aquaculture opportunities and firebreaks (Oates, 1993; DCE & OOE, 1992). Farmers recognise wetlands as a valuable source of water (for stock and fire protection) and as a source of 'green-pick' in summer.

Threats

Briefly, the processes which may threaten wetlands are: drainage, dredging and land-filling, some agricultural practices (particularly cropping and inappropriate grazing regimes), water supply and regulation, salination, soil erosion and sedimentation, clearing, waste assimilation and nutrient input, plant and animal pests, some forestry practices (especially those resulting in siltation), over- fishing, excessive recreational use, fire and activities associated with mining and extractive industries.

While some of the threats to wetlands can be tackled on an individual property, many require a group approach to obtain changes in the whole catchment.

Wetland diversity

There are a great variety of natural wetland types in Victoria. Variation in landscape position, geology, salinity, depth, size, and vegetation are some of the attributes that contribute to this diversity. There can be large variation across relatively short distances. Wetlands also vary in their management history and degree of degradation. It is therefore difficult to provide prescriptions that will cover the great range of wetlands encountered across Victoria. The following management considerations are applicable to a wide range of wetlands and should be used as a guide only to the potential issues and management solutions that may be applied in specific instances.

Management considerations

The overall aim of wetland management for wildlife is to promote a natural system in which natural processes operate and in which the elements necessary to sustain life (soil, water and nutrients), are maintained in a healthy state.

Planning

Planning is essential if the full potential value of the wetland is to be attained (refer to **Note 22** Whole Farm Planning). The first step in managing wetlands on a property is to prepare a management plan that considers your aims, issues and management actions.

Since individual wetlands are part of the broader landscape, which could include other wetlands, hollow-bearing trees and extensive catchment areas, it may be necessary (and is advisable) to work in unison with other landholders to protect the wetland catchment. A network of wetlands throughout the area will usually have higher wildlife value than one isolated wetland. Several small wetlands are likely to support a greater variety and number of species than a single wetland. The Victorian Wetlands Database may be able to assist in locating wetlands in your area and aerial photos can also be used.

The plan should allow for buffer zones around wetlands to protect the wetland against outside disturbances and address issues such as fencing, grazing regimes, weed control, tree planting and impacts of other activities (e.g. sedimentation following cultivation in the catchment, fertilizer or spray drift, etc.).

In most areas of management, a passive approach, allowing natural processes to 'manage' the wetland, is usually preferable to intervention. Careful prior investigation of the potential consequences of active management is essential.

In the following text, potential management actions are shown in boxes.

Water level

Natural fluctuations in water level are a feature of all wetlands and, for shallow wetlands, are responsible for the dramatic seasonal changes which occur. The timing (season), duration and frequency of water level changes are all important in determining the nature of the wetland. Remember that it may be normal for a shallow wetland to contain no water for up to six months of each year.

A drop in water level may influence flowering and seed set or offer opportunities for regeneration. Differences in the depth of water, frequency and time of immersion influence what plant communities are present and the area they occupy. Water depth influences the availability of food, some species being able to exploit foods at greater depths (e.g. swans can eat aquatic vegetation to the depth of their neck length whilst Blue-billed Duck will dive for food). Periodic floods may control invasive plants (native and introduced), bring earthworms to the surface (providing a food supply) or allow fish and other aquatic life to take advantage of newly inundated areas. Nest sites may be flooded, and breeding affected. Wetland animals take advantage of food sources released by rising water levels. Breeding cycles may be activated by water level changes. Unnatural fluctuations may disrupt any of these processes.

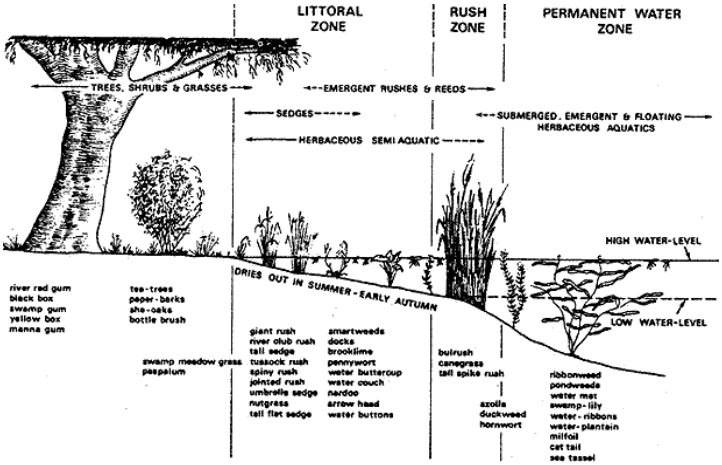
Drying enhances decomposition of plant material contained in the wetland and encourages high productivity of vegetation and animals when the wetland refills with water. Some invertebrates require drying and reflooding for reproduction.

Longer periods of inundation do not necessarily improve wetland values and can be harmful. For example, if inundation lasts more than 12 months, productivity will be lower in the second year. River Red Gum (Eucalyptus camaldulensis) and Black Box (E. largiflorens) may be killed by more than four years continuous flooding (Briggs, 1988).

Briggs (1988) comments that wetlands need to remain flooded for at least 4-6 months in the year to allow for successful reproduction of waterbirds. This reproductive sequence involves pair formation, nest construction, incubation, brood rearing and fledging of young.

Seed-bearing plants, when flooded in autumn, may attract large flocks of waterbirds, especially ducks. Rice growers often (unintentionally) create excellent habitat for ducks which can cause extensive damage to the crop.

A natural regime of water level fluctuations is usually the appropriate aim of management. In south-eastern Australia, temporary wetlands are usually dry in summer and refill in winter or spring, however, considerable annual variation occurs, depending on rainfall patterns. Wetlands that have been drained can be restored by blocking the drain with suitable material which may include an outlet device/regulator (if some degree of continued water level control is required). Attention may have to be given to the sources of water in the wetland catchment if the natural regime is to be reinstated. In most instances, the zonation patterns of natural wetland vegetation can be used as a guide to the extent and duration of wetland flooding. For example, River Red Gums, reeds and sedges fringe many Victorian wetlands and represent the outermost margin that is above water at most times. Low herbs or floating-leaved plants may occupy the zone that undergoes regular fluctuations and submerged plants, such as stoneworts and water milfoils, the deeper sections that are rarely dry. Of course, deeper sections are often not present in shallow seasonal wetlands so species sensitive to prolonged inundation (e.g. River Red Gums) may occur throughout. Refer to DCE & OOE, (1992b) for a method of determining wetland boundaries.



The extent and duration of wetland flooding is indicated by the distribution of wetland species

Water turbidity & sedimentation

Water quality is affected by human activities within the wetland catchment and by natural events such as storms, wind and rainfall.

Water turbidity influences the efficiency of visual predators and can change the nature of the bottom vegetation and food sources for wildlife.

Sedimentation of the wetland reduces its volume, can smother plants and affect animals (e.g. cover fish spawning sites) and reduce light penetration. Nutrients and toxins bound to sediments washed into the wetland may affect plant and animal populations.

Establishment of a suitable level of plant cover in the wetland catchment, and particularly around the wetland, will limit erosion as a source of sediment. Leaf litter is also beneficial in reducing the impact of rainfall as a cause of erosion. Reducing the stocking rate or changing the pasture composition may be necessary. Soil disturbance should be avoided, particularly near to the wetland. Disturbance by livestock can be avoided through fencing or de-stocking during sensitive periods (especially whenever soils are soft). A sediment trap, consisting of a well-vegetated depression, can be installed above the wetland, if this will not interfere with other values.

Salinization

Salinization of the wetland may occur with changes in catchment hydrology. Changing salinity levels have dramatic effects on plant and animal life with salt-intolerant species disappearing and being replaced by salt-tolerant species. Within the catchment, revegetation of groundwater re- charge areas will help to control or prevent salinization of wetlands.

Private companies offer water-quality monitoring services, if required.

Wave action

Wave action can affect the shoreline profile (and hence plant communities) and may lead to erosion of banks and siltation. Wave action is most noticeable in permanent wetlands with a large surface area.

Control is achieved by establishing binding native vegetation along the shoreline. Reducing grazing levels to retain vegetation cover in dry periods is also very useful.

Light and temperature

Light is required for plant growth. Temperature influences the amount of dissolved oxygen which, in turn, influences the rate of plant decomposition and the activity of wetland lifeforms. High light penetration, suitable nutrient loads, calm water and warm temperatures favour algal blooms which can be toxic and, in any case, reduce light available to submerged plants. Shade from trees affects the distribution of annual plants in the wetland and can reduce water temperature. For example, water temperature affects physiological processes such as spawning, hatching, feeding, growth and migration of fish.

Use local natural wetlands as a guide for planting. Avoid creating conditions favourable to blue-green 'algae', by paying attention to the input of nutrients to the wetland, especially sources of nitrogen and phosphorus (see Land for Wildlife News Vol. 2, No. 2, p 3). The EPA (Environment Protection Authority) can assist with identification and management of blue-green algae.

Nutrients/toxins

Changes in the level of nutrients can have a major impact on the plant community and significant increases can eliminate plants that are adapted to low levels of nutrients or that are shaded by the increased phytoplankton growth. Excessive plant growth leads to lower water movement and reduced dissolved oxygen which is required by aquatic life. Nutrient changes may favour exotic plants which can displace native species and so change the nature of the wetland.

Chemicals may be harmful to aquatic life: fish may be killed by chemicals such as ammonia, pesticides and phenols and crustaceans by copper from fungicide sprays. Human consumption of fish may be dangerous, as a result of accumulated toxins.

Sources of nutrients include fertilizer, manure, sediment and effluent (e.g. from dairies, leaking septic tanks, some household detergents or old garbage dumps). Nutrient levels may change naturally, for example, as a result of colonisation by a flock of birds. Toxins may be used for agricultural, other commercial or household purposes on the property or further afield. Extreme events, such as floods, must be considered in planning for effective protection of the wetland, as these may cause nutrients or toxins to be mobilised.

Carefully consider fertilizer input to pastures (close to wetlands) create a buffer zone of dense low plant cover (local native reeds, sedges, grasses) surrounding the wetland, manage grazing and promote natural recycling of stock faeces in pasture. Avoid the use of toxic chemicals wherever possible, use according to manufacturer's instructions and return unused portions to approved disposal agents (your council will probably be able to advise of the procedure in your area).

Problem plants/animals

Some 149 environmental weeds of herb-dominated freshwater wetlands and 42 of shrub-dominated freshwater wetlands have been identified (Carr et al, 1992). Environmental weeds affect the vegetation of wetlands and this affects animal communities (Carr et al, 1992; Loyn & French, 1991). For example, native wetland plants can be displaced by introduced competitors.

Prevent or reduce the rate of weed invasion by reducing the level of disturbance to soils and plant communities (e.g. cultivation, livestock, vehicular movement), excessive fires and frequent unnatural flooding or drying regimes. Avoid introducing sources of weed seeds (e.g. livestock feed cut from wetlands that contain weeds). Reduce the 'edge' between wetland and other land use by increasing the buffer area around the wetland and keeping vehicle tracks well away (20 metres) from wetland margins.

Fire, flooding and digging by native animals are examples of natural forms of disturbance that may favour weed invasion. It is generally not advisable to alter these natural processes in order to attempt control. Flooding may exclude plant species that might otherwise invade the wetland.

Many chemical weedicides are unsuitable for use near wetlands as they are transported by water and can easily enter the food chain. Frogs, fish and invertebrates are particularly vulnerable to chemicals.

Avoid the use of chemical controls near wetlands and follow manufacturer's instructions carefully to avoid contamination of wetland areas. Alternative techniques include manual removal, mowing, overlay and overplanting (see LFW News Vol. 1, No. 10).

Wetlands that are fenced and providing cover for native animals may also provide habitat for unwanted species such as rabbits and foxes.

A vermin control program for the wetland should be incorporated into the management plan for vermin throughout the property/area (refer to Land for Wildlife **Note 24 - Foxes - options for control in wildlife habitat**, Land for Wildlife News Vol.1 No. 8 p 5, Vol. 2, No. 2, p3).

Swamp Rats may occupy dense vegetation around wetland margins and can be responsible for chewing bark of young trees and shrubs (especially in late winter).

Modifying the habitat by keeping long grass off the site (by mowing, limited grazing) during establishment of the plantation can prevent this problem (Temby 1992).

Grazing & trampling

Grazing by native herbivores is a natural process in many wetland types and may be necessary to maintain diversity. Overgrazing is damaging to wetlands. Some wetlands, such as alpine bogs and tidal marshes do not tolerate any grazing by livestock without sustaining damage.

Grazing may damage wetlands by changing vegetation, soil and hydrological processes. Livestock can selectively graze palatable species, trample plants, pugg soils, increase nutrient levels through addition of faeces, advantage weeds through soil disturbance and remove seed-heads and flowers. Weed seeds can be introduced with stock

feed or with faeces. Vegetation needed for nesting and cover from predators may be removed. On the other hand, well- managed grazing can maintain open areas preferred by some waterfowl and reduce the dominance of some prolific plant species, allowing others to survive.

The impact of grazing will vary according to the timing (season and duration) and the type of stock. Cattle readily enter water to graze emergent plants; however, sheep are less likely to enter water, cannot graze in deep water and are less likely to be grazed on wet sites due to the dangers of contracting footrot or liver fluke. The stocking rate, the plant community being grazed, the presence and numbers of native and exotic grazers and prevailing climatic conditions also play a part in determining the impact of grazing.

Grazing should be managed to minimise damage by restricting access to all or part of the wetland (particularly in areas with sensitive or rare species) using appropriate fencing. Alternatively, if cessation of grazing is not possible, restrict the duration, timing and number of livestock to a level where wetland values are maintained, and damage minimised. The period when soils are dry, seeds have fallen, and breeding is absent may be suitable for grazing. The exact number of stock that can be grazed and the impact they will have on different wetland types can only be determined by experiment and observation. It is better to underestimate the number of stock than overestimate. Pigs and goats are destructive feeders and should not be permitted access to wetlands. Where livestock access is prevented, and the wetland was used for livestock watering, then water might be pumped or siphoned to a trough. If limited access to the wetland is permitted, then the effect of livestock on this reduced area will increase if livestock numbers are not reduced. Gravel ramps may need to be built at access points to avoid damage. Access for native animals must also be taken into account. Standard cattle and sheep fences will not prevent access by kangaroos and their relatives (qv LFW **Note 29**).

Fire

Fire can be a frequent event in wetlands (CNR, 1993). Seasonal wetlands may dry out sufficiently during summer to burn. Many of the plants in these wetlands are adapted to survive fire by such means as re-shooting from underground rootstocks or rapid re-colonisation from soil-stored seed. Wetlands that rarely dry out may be damaged by fire. Unseasonal fires can be harmful to wetland plants and animals. Fire can be particularly damaging to wetlands on peaty soils as the peat, if sufficiently dry, can be consumed by the fire. Fire can remove food, nesting materials and cover needed to shelter from predators. Ash from fire may contribute a substantial quantity of nutrients to the wetland. Following fire, sedimentation may increase along with water temperature, as a result of less vegetation cover. Frequent fires may favour weed invasions. Fire may increase wetland plant diversity by reducing the dominance of vigorous species.

As a management tool, fire may be used to remove dense above-ground vegetation from an area of a wetland for re- vegetation purposes. Your local council or the CFA may be consulted about the safe use of fire for vegetation management, including if and when it should be used. If fire is used, always allow room for errors and insufficient knowledge by burning only a portion of the wetland at any one time and, of course, always take note of fire restrictions.

Soil disturbance, changes to surface drainage and loss of vegetation cover should be minimised by limiting the extent of the fire and, as far as possible, limiting vehicle movement to outside the wetland boundary.

If a firebreak is considered necessary, it should be situated at least 20 metres from the wetland and preferably in an area that does not affect native vegetation. Strip grazing, as a means of creating a firebreak, is preferable to cultivation (CNR, 1993).

Vehicle access

Vehicles should avoid wetlands, particularly whenever the soil is damp.

Vegetation

The wildlife values of shallow wetlands have been discussed previously in this Note. Wildlife is dependent on the type and quality of vegetation.

Aim to create a natural diversity of plant species and wildlife habitats. As a general rule, use local wetlands, in natural condition and of similar type, as a guide to wetland management and what to plant, being careful to identify each species beforehand to ensure it is native and not a potential problem.

A greater diversity of habitats will maximise the diversity of wildlife species. Size, diversity of marginal and submerged vegetation, irregularity of edges, variation in the rate of water flow and the extent of open water are some of the variables that add to the diversity of wetlands.

Transplanting and establishment from seed are simple, effective and cheap means of revegetating a wetland if native plants have disappeared. Plants will also establish from propagules washed into the wetland or brought in on the body of waterbirds. The references given at the end of this Note may assist with species identification. Some nurseries specialise in wetland plants and may be willing to propagate local seeds or cuttings that you collect (Ask a Land for Wildlife extension officer for contacts).

Monitoring

Monitoring the health of the wetland can provide valuable management information. Simple sampling techniques can be used to provide information on a range of variables. Others may require expert analysis.

Indicators of water quality include turbidity, suspended solids, conductivity, pH and nutrients. Biological indicators such as macroinvertebrates, fish, birds, vegetation and rare species can also be monitored to obtain information on the health of the wetland. If you intend to monitor a wetland yourself, it is wise to seek advice initially about setting up standards and consistency.

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29. Fencing wildlife habitats

Scope of this Note

This Note provides advice only on the erection and operation of fences as they relate to wildlife concerns. Fencing construction is well covered elsewhere, however, some suggestions are made for fencing in difficult situations and for reducing costs. A comprehensive reference list of publications on fence construction is provided for your guidance (see references). The Department of Environment, Land, Water and Planning, Department of Agriculture, Catchment Management Authorities, neighbours, responsible fencing contractors or fencing distributors may also be able to offer advice on the construction aspects of fencing.

How do fences help wildlife and landholders?

Fencing habitat areas is one of the most effective steps that can be taken to protect native vegetation, the wildlife dependent on it and the benefits it offers to a property including shade and shelter for livestock, and erosion prevention.

Fences are used as a barrier to the movement of animals. They can be an effective barrier to livestock and may also be a barrier to the movement of other animals including vermin and wildlife.

Trees are at risk from browsing of the bark by livestock.

By exclusion of livestock, fences protect native vegetation and the soil surface from browsing and trampling respectively. Some of the impacts livestock can have on native vegetation are removal of flowers and seed heads, compaction of soil, spread of weeds, destruction of leaf and twig litter and prevention of natural regeneration.

A fence around native bushland ensures that livestock dung remains in the paddock where it is useful as fertilizer. This prevents accumulation under shade trees in native vegetation which may contribute to tree dieback (Landsberg, 1990, LFW News Vol.1, No.8, p10). Natural regeneration as a result of careful fence placement is the cheapest means of obtaining revegetation. Fences protect understorey plants which are vital to many insectivorous birds.

Fences serve many other useful functions for land managers. They help to prevent erosion, permit controlled use of different land systems, protect vegetation used to shelter livestock, reduce the risk of livestock death in dangerous areas and reduce the time spent on transfer of stock around a property. Thus, fences are a basic tool in the effective management of a property.

The Fences Act

The Fences Act 1968 sets out the legal framework relating to dividing land including vermin-proof fences. For example, it specifies who is liable for the cost and construction of fences and how disputes are to be settled. A copy of The Fences Act may be obtained through some libraries, or look it up on the internet.

Effective placement

The first step in determining where to place fences is to prepare a Property Management Plan (Whole Farm Plan) for the property. Consideration must be given to the most effective use of fences to achieve the separation of different land classes (e.g. rocky areas vs alluvial flats), efficient livestock movement (laneways, paddock exits), control of livestock mating and land protection (gullies, rivers and

streams, dams etc.) including vegetation protection (bush areas, areas for regeneration or planting). Design factors that reduce the cost of labour spent on supervision and mustering should be considered and evaluated.

The usual technique is to draw up a plan of the features and issues of the property and then compare the existing layout with an 'ideal' situation, with the aim of working toward the new layout over time as finances and labour permit. It is often best to draw up the ideal situation first before comparing it with the existing layout so that the plan for the future is free of pre-existing constraints (ref Garrett, B.K., 1993, LFW **Note 22**).

Priorities

In terms of wildlife habitat, priority should be given to protecting existing remnants of the original native vegetation (select those in the best condition based on the quality of understorey) or consolidating existing remnants through expansion of their area and connections to nearby remnants. Larger areas should be fenced before small, isolated remnants which have lower long-term viability. Streams should also be given high priority, particularly areas with wide vegetation frontages. These, and other areas with fertile soils, will provide high-quality wildlife habitat.

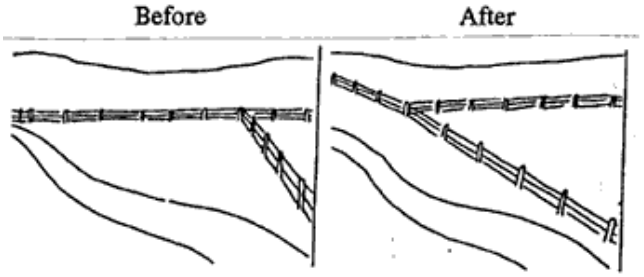
Other priority areas may be sites of rare or locally uncommon species. The least well represented habitats in the area/on the property should also have a high priority.

Wetlands and rocky areas are often unsuitable for agriculture but high in wildlife values and should be fenced. A stand of dead trees, which provide important wildlife breeding and roosting sites, may need to be protected by fencing.

New plantings and new wildlife corridors have a lower priority than consolidating remnants but are still important considerations and the fencing plan should allow for revegetation. Areas with potential for natural regeneration should be considered as these will be more cost-effective than revegetating using tube-stock. Opportunities for working in with neighbours should also be discussed.

Aim to protect or create a system of habitat patches and corridors by protecting remnants and creating further habitat in areas where it will benefit the property and wildlife. If possible, allow for at least some large patches of habitat.

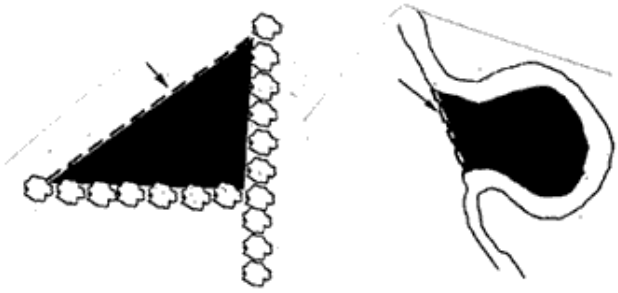
Some specific suggestions for fence placement to permit regeneration and expand habitat areas, at minimal cost, are shown below.



1. *Re-alignment of existing fences when they are due for replacement can offer scope to protect areas for rehabilitation with local native vegetation.*

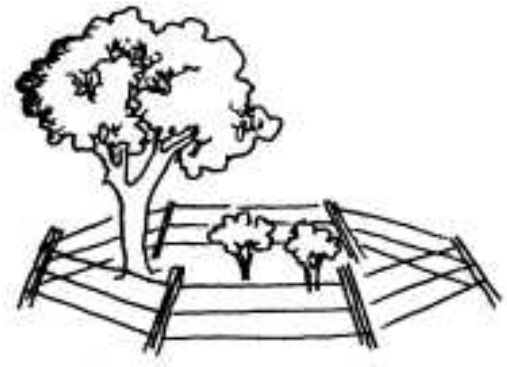
2. Double fencing is widely practiced in Victoria. It has the added advantage of eliminating the need to take down and dispose of the old fence in some situations. This method offers an opportunity to connect isolated patches of habitat with corridors. Particularly valuable when the adjacent area (e.g. roadside) has good remnants of the native flora which can be used as a source of natural seed fall.

3. Fencing paddock corners, especially in areas with



good roadside remnants of the native vegetation can be cheap and may substantially increase the size of a habitat patch. Dotted line = fence position.

4. A fence across the bend in a river offers protection to a large area, whilst requiring a minimum of fence. Note that, to reduce the risk of fence damage by floodwaters, fences should run in the direction of stream flow wherever possible (Dole, 1985).



5. The major advantage of a circular design is that it eliminates the need for strainer posts. Also, more habitat is away from the edge between pasture and bush than with linear designs, thus offering greater protection from the outside environment.

6. Fencing beside remnant trees, rather than beneath them (where seedlings may be suppressed), can allow for natural regeneration.

Type of fence

The type of fence required will be dependent on the type on animal(s) being excluded and on the situation. Conventional or electric fencing can be used. Electric fences may be cheaper but require regular maintenance. Standard farm fences will not exclude wildlife although they may hamper some species (e.g. emus). Consequently, they do not pose the same risk to wildlife as some electric fences that effectively form a broad-scale barrier to wildlife movement.

Total exclusion of grazing animals, especially rabbits, may be necessary to achieve revegetation and this may require more elaborate fencing such as wire netting or other measures such as fumigation or warren-ripping (see LFW News Vol. 1, No. 8, p5).

Whilst access tracks are usually necessary to permit maintenance, consideration should be given to their potential role in the dispersal of weeds, which may threaten the habitat or adjacent crops, and their potential for erosion.

When to fence

Fences can be constructed at any time of the year. Fencing in winter has the advantage of moist, easily worked soils and precedes summer seed fall which could be used for regeneration. If areas are to be planted in autumn or spring, then prior fencing in summer or winter is usually necessary to protect plants from livestock.

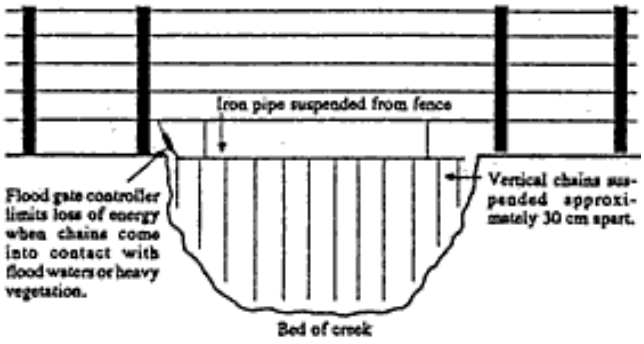
Difficult situations

Rivers and streams

To reduce the risk of damage to fences during floods, fences should be located well away from the main flow. This will also benefit erosion protection and wildlife by increasing the area being revegetated. Twenty metres on either side is a desirable minimum width but may be impractical in some farming situations.

A two-wire electric fence, with livestock access 'chutes' (gravel ramps), protects the stream environment and livestock from drowning. An even better option might be total exclusion and provision of water in troughs.

Another important consideration in fencing eroded streambanks is to allow for streambank re-stabilisation. Steep-sided eroded banks will eventually attain a sloping stable grade that is wider than the current stream width.



A variety of fencing techniques, such as floodgates can be used where watercourses occur.

Wetlands

By ensuring that the wetland is surrounded by an adequate buffer, the problems associated with fencing across a wetland are avoided.

Rocky areas

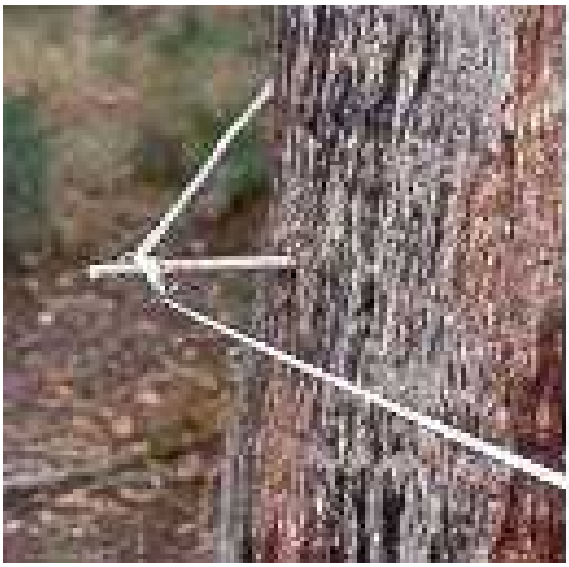
Go around rocky areas where possible. The advice of local contractors or fence manufacturers (who may have extension staff willing to help with advice) should be sought in these situations. Where a suitable hole is unable to be dug, solutions, such as drilling into the rock and securing the post with a bolted plate, or setting it in concrete, can be used. Both of these methods limit the strain that can be placed on the fence.

Cheaper alternatives

Fencing is a major capital cost to any landholder. Whilst expenditure on quality fencing is a worthwhile investment, it may be necessary to seek alternative, cheaper solutions, at least in the short term. Electric fencing offers considerable scope for reducing fencing costs. Some suggestions are given here that can be applied to protect remnant bushland from livestock.

A tree has been used as a corner post for an electric fence erected to protect native vegetation. A steel pin avoids the need to circle the tree with wire which may eventually kill it or create a hazard if the tree is ever sawn.

An insulated wooden stake rests against this remnant tree, taking the strain of the wire off the tree and saving the cost of a corner post.



A fibreglass rod insulates an electric wire from the tree and can be used as an alternative to the ceramic insulator shown above.

A log section has been used to anchor a corner in a single- strand electric fence.

Other tips: Recycle old fence posts to span gaps between trees. Use live trees as posts but be sure to insulate the tree from live wires using polypipe. Don't circle trees with wire, as this may kill the tree and create a hazard if the tree is sawn and wire has become buried in the wood. Don't cut off the tops of dead trees to use the stump as a strainer as this will significantly reduce the number of dead trees available for wildlife breeding and shelter.

How to get water to stock

Troughs or access ramps ("chutes") can be provided to permit access to water on watercourses, wetlands and dams that have been excluded from livestock by fencing. Troughs are preferred as they permit total protection of the habitat. Where the trough can be positioned downhill from the water source, water can be siphoned to the trough. To obtain water from most wetlands and streams will require a pump. Inexpensive pumps, such as hydraulic ram pumps which operate on the force of the fall of water in a stream, may enable cheap delivery of water to the trough. The costs of establishing a trough system should be evaluated against the potential loss of stock through drowning, cost of erosion control, loss of shade and shelter and loss of wildlife if exclusion is not practised. Access via chutes to the watercourse may offer an alternative but must take account of the concentration of activity as a result of the reduced area. Thus, some form of reinforcement of the bank, such as gravel, will need to be provided.

Weed control

Opportunities for weeds to establish in native vegetation will be reduced once stock are excluded. However, particularly were there has been a history of major soil disturbance or in situations where native vegetation is being established on introduced pasture grasses, weeds may proliferate in the absence of grazing. This possibility should be anticipated, and a control program prepared. Disturbance resulting from vehicles, people movement or digging should be minimised during construction, to avoid weed establishment. Land protection staff of the Department of Environment, Land, Water and Planning may be able to assist with preparing a weed control strategy. In some cases, it may be necessary to allow limited short-term grazing to resume, in order to control weeds. In other cases it will be worthwhile establishing local native ground-cover vegetation at the time of fencing, in order to prevent weed infestation (see LFW News Vol. 1, No. 10

Environmental weed control - check your options). Changes to the nature of the ground-layer vegetation following fencing may have negative (as well as positive) effects on wildlife. For example, Grey-crowned Babblers and Bush Thick-knees, which forage amongst leaf-litter and fallen branches, will be discouraged if a dense understorey of grasses or shrubs develops.

Problems for wildlife

Fencing can have negative impacts on wildlife, if not properly designed. For example, on a large scale, wildlife exclusion fences can form a barrier to wildlife movement. Movement is an essential part of maintaining the health of wildlife populations (see LFW **Note No. 3 Creating habitat corridors for wildlife**).

A Squirrel Glider which has died as a result of being snagged on a barbed wire fence.

Electric fences may cause the death of wildlife. For example, kangaroos may become caught in the wires of an electric fence and be killed by the current.

Electric fences with live wires placed low to the ground may kill animals, such as echidnas and snakes (Lund and De Silva, 1985). The echidna responds to the electric shock by raising its quills and can remain stuck in the fence until killed by the current. Sugar Gliders may land on the top wire of an electric fence and steady themselves by holding on to the next wire down. When shocked they cling on tighter and may perish (Lund & De Silva, 1985). Koalas may also be killed when they attempt to climb electric fences. A more frequent hazard for gliding possums and birds is getting snagged on barbed wire on conventional fences. Livestock may also be killed, especially horned animals which become stuck in an electric fence.

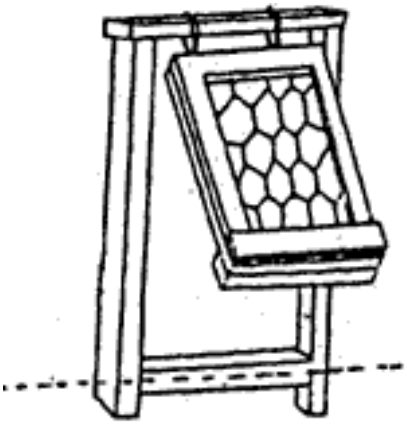
The solution is to select wire spacings that avoid killing wildlife and to use plain wire wherever possible. Electric fencing has reduced the need to use barbed wire in fencing and is more effective at containing cattle. Large-scale fencing to exclude wildlife may be inappropriate and should consider the movement needs of wildlife.

Solving problems caused by wildlife

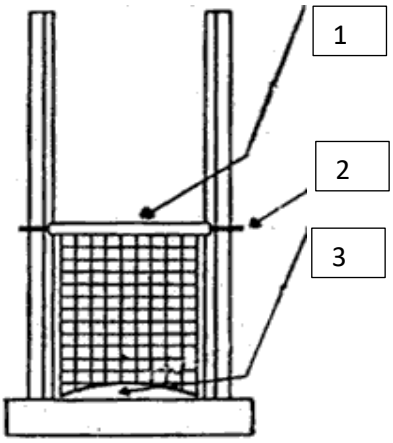
Exclusion by fencing can be an effective means of solving problems caused by wildlife (Temby, 1992). If one has regard for potential problems for wildlife (see 'Problems for wildlife'), fences can be designed to reduce damage by wildlife to existing fences and to exclude wildlife from areas where their activities are incompatible with other land use.

Structures

Wombat damage to rabbit-proof fences may be avoided by the installation of a simple gate. In an existing fence, wombat passages should be progressively closed until the wombats are using only a few openings. This may take several weeks. At the remaining openings, install a wombat gate (as described) and leave each open until the wombats are freely using them. Finally, close the gate and monitor subsequent use. Don't forget that juvenile wombats will have less capacity to open the gate. Alternatively, a two-wire electric fence with live wires at 15 and 30cm can be used to exclude wombats.



Materials for Wombat gate: Door frame of 75x25mm timber with heavy mesh or use single sheet of heavy marine ply, metal or other material 600mm high and 400mm wide.



Kangaroo Gate
Note: Dimensions may need to be modified for individual situations.

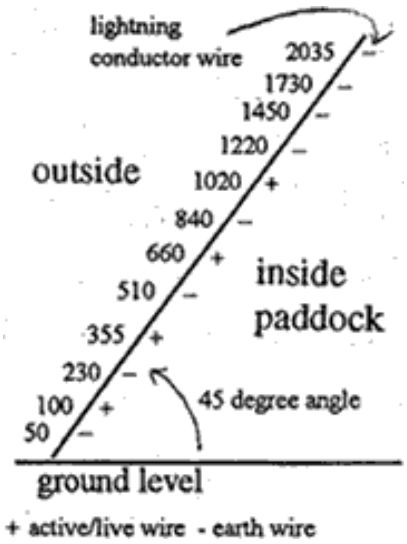
Guide for the Kangaroo Gate diagram:

1. *10mm internal diameter pipe welded to mesh.*
2. *5.7mm rod through posts and pipe.*
3. *4mm x 5cm mesh. Min. 50cm high, 45cm wide. 8mm rod welded to mesh to form 10cm gap.*

Install the gate where kangaroos regularly breach the existing fence.

Source: Farmnote No. 71/90, WA Dep't of Agriculture & Beckmann, 1990.

A similar gate can be installed for kangaroos (see Beckmann, 1990).



A sloping electric fence designed to exclude kangaroos. Wire spacings in millimetres. Post length of 2.13 metre. This fence may be appropriate for exclusion of wildlife from valuable enterprises, such as crops, if which wildlife damage has been costed as considerable. As a broad-scale barrier, it may be harmful to wildlife. Modified, from Temby 1992, by reducing spacings of lowest wires by 50mm to reduce the chance of echidna deaths.

Some Do's and Don'ts

- Do consider the range of wildlife species in your area and how they might be affected by fencing.
- Do determine your priorities for fencing and prepare a property plan.
- Do seek advice - from the Department of Environment, Land, Water and Planning, Department of Agriculture, your local Catchment Management Authority, local contractors and distributors, etc.
- Don't create hazards or broad-scale barriers for wildlife.

Protected by fencing, an eroded stream is being revegetated. Fencing is a positive contribution to landcare and improved environmental management with potential savings for landholders.

Discarded materials

Unused and old fencing materials may create a hazard for wildlife, as well as for humans and machinery. Dispose of these materials thoughtfully.

References and further reading.

Please Note: Agnotes referred below to may no-longer be available.

Agnote 2316/83 (1983) Electric fences for vermin and wildlife: fencing design. Department of Agriculture and Rural Affairs

Agnote 1880/82 (1982) Electric fencing. Department of Agriculture and Rural Affairs

Agnote 1844/82 (1982) Hints on erecting fences. Department of Agriculture and Rural Affairs.

Agnote 4116/89 (1989) Fencing wires. Department of Agriculture and Rural Affairs.

Boord, C.T. & Parker, J.K.D. (1981) Electric fencing: how to erect and operate electric fences. Agbulletin AB2. Department of Agriculture - Victoria.

Farmnote No. 32/89 Simple electric fencing to protect bush areas on farms. Agdex 723. Western Australian Department of Agriculture.

Other references:

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Bishop, A.H. (1977) Farm fence construction. Department of Agriculture, Victoria.

Dole, D. (1985) Fencing the floodplain - a few methods and a lot of problems in Proceedings of the River Management Association May 17, 1985.

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Land for Wildlife Note No. 22, January 1993. Farm planning and wildlife. Department of Conservation and Natural Resources.

Lund, R. & De Silva, S. (1985) Fencing to allow for the behaviour and movement of animals in Gallagher 2nd world wildlife power fencing seminar, Dubbo, NSW, Australia, 15 & 16 November 1985.

Temby, I. (1992) A guide to living with wildlife: how to prevent and control wildlife damage in Victoria. Department of Conservation and Environment, Victoria.

30. Including wildlife in Landcare actions

General principles

This Note provides a range of general ideas and principles for including wildlife habitat with Landcare planning. More detailed information on property planning is given in **Note 22 *'Farm planning and wildlife'***. This Note takes a landscape level view of wildlife needs and planning.

Providing for wildlife can involve some simple steps that will add value to your property, whether your interest is in the advantages of natural pest control, in adding interest to your property for your own enjoyment or for resale value, or in making a contribution to the conservation of our unique native animals. Many solutions to land degradation involve protecting vegetation or revegetating areas. It is therefore possible to build in wildlife benefits at the same time, at minimal extra cost, to make best use of these areas, by following a few principles, as outlined in this Note.

Protect the best remnants first

The most valuable wildlife habitats are those that remain in a natural or semi-natural condition. These areas have special value because they may retain many of the species and interactions that make up the web-of-life for that natural ecosystem. Understorey plants, soil microflora and invertebrates may be present in remnants but will be absent, at least initially, from areas in which vegetation has been re-established. Logs, fallen branches and leaves, and rocks are important habitat components that may remain in remnants.

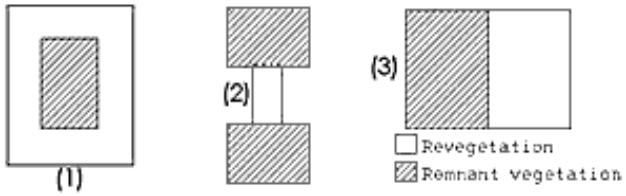
Remnants can often be substantially improved by fencing to exclude livestock (see Note 29 'Fencing wildlife habitat') or expanded by relatively cheap means, such as natural regeneration (see **Note 13 'Natural regeneration: principles and practice'** & **16 'Natural regeneration: case studies on the farm'**).

Revegetation options

Revegetation is a way of improving farm habitats for wildlife and contributing to land protection at the same time.

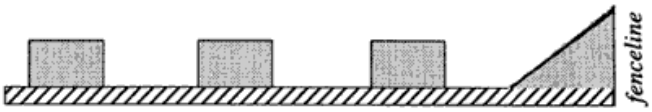
Existing remnants

These few simple guidelines, for revegetation of existing remnants, will improve your revegetation efforts.



There are three main ways in which revegetation can be used to improve the conservation value of existing remnants of native vegetation in agricultural areas. (1) a buffer zone to protect the existing remnant from edge effects (see **Note 23 'Edges: their effect on vegetation and wildlife'**. (2) corridors to provide continuity of habitat. (3) additional habitat to increase the effective size of the remnant and maximise opportunities for natural regeneration of trees and understorey plants[1].

Many remnants on private land are small in size. This makes them vulnerable to disturbances from outside the remnant, such as windthrow during storms, invasion by weeds and rabbits, drift from fertilizers and noise and movement. Small remnants will attract wildlife species that like edge environments, such as Noisy Miners, but will not provide for species that avoid edges, such as Pink Robin, Gilbert's Whistler and Long-nosed Bandicoot. Noisy Miners are aggressive and may expel other species.



Long narrow corridors can be improved by added blocks of vegetation scattered along their length, such as at fence corners. An additional benefit is improved protection for livestock.

Cleared land

Revegetating areas near to existing remnants will improve the chances of natural recolonisation of the area by the great variety of organisms that occur in a natural plant community.

Blocks of habitat are generally better than narrow strips. Within the Landcare area, it may be possible to identify some sites where substantial blocks of local native vegetation could be provided.

In summary, for most properties it will be best to PROTECT, REGENERATE then REVEGETATE.

Species selection

Selection of plant species used in revegetation work is all important. Native animals rely on local native plants. Whenever possible, use local native plants in all revegetation work. Wildlife will make some use of other species, but, because they do not form part of a natural system they will not be as effective in providing habitat and rarely provide long-term prospects for the animals that make use of them.

Native plant species have many admirable qualities that make them suitable for land protection, including the ability to flourish under local conditions and in the variety of local environments, the ability to self-perpetuate and, for the majority of species, ability to survive bushfire. Many species provide excellent wood for a range of uses including firewood, building and furniture (see ***Note 20 'Shelterbelts and wildlife'*** for further detail). These qualities translate into lower costs of establishment and maintenance, and resilience. Local species are a good choice for many other Landcare goals, such as soil stabilisation, as well as for wildlife.

To determine the plant species that are natural to your area, look for a remnant area of native vegetation in good condition. The nearer the remnant to your site, the better.

It is important that the site is similar to that which you will be revegetating, as soil, local climate conditions and other factors influence where native plants will grow.

Exotic plants, and Australian plants from distant areas, can cause serious problems for wildlife, their habitats and other activities on private land. For example, some plant species invade natural bushland (these are known as environmental weeds) and can change its character so that some wildlife species that would normally occur are unable to survive. The Grey-crowned Babbler, a medium-sized bird that lives in groups and feeds amongst leaf and twig litter and on the trunks of large box eucalypts, may have its feeding habitat destroyed when tall-growing dense weeds, such as St John's Wort, invade a site. Note that some native Australian plants are also invasive weeds outside their usual range. A list of known environmental weeds is available from Land for Wildlife.

There is no need to preferentially select species that have 'special' wildlife characteristics, such as high nectar production. The majority of local species will, in some way, contribute to the habitat resources used by native wildlife. It is more important to achieve a balance that is self-perpetuating and similar to the natural situation.

Integration

For native vegetation to have long-term value as wildlife habitat, and for it to make a valuable contribution to a property, it must be considered alongside the many other factors that influence property management and be fully integrated into the range of activities carried out on the property.

Fire safety, use of exotic plants, pest animal control, water supply and other management issues will have implications for wildlife habitat. The aim is to seek ways in which all the necessary goals for the property can be achieved harmoniously (see Land for Wildlife ***Note 4 'Wildlife management considerations on private land – a summary').***

There are many activities that, whilst of no immediate value to wildlife in themselves, will help to protect the remnant habitats that do exist and upon which wildlife depend in the long-term. Examples include controlling erosion in gullies to prevent siltation of wetland and stream habitats and creating woodlots to avoid taking wood from bushland. Important natural processes, such as the cycling of water, nutrients and energy, will need to be maintained in a healthy state for habitats to persist. The whole range of Landcare activities contribute to a healthy property and wildlife will benefit from and contribute to this.

Integration can only be achieved by careful planning and adjustment to the way in which properties are managed. A special planning committee could be formed to look at ways of improving the integration of wildlife values across the Landcare area. This could be a special project of the Landcare group or the topic of discussion for one or two monthly meetings.

No doubt, there will be many issues identified where there appears to be a conflict in managing to achieve a truly integrated system that allows for wildlife and other objectives. For example, will more bushland habitat harbour more pest animals? Having these issues raised at group meetings, at which expert advice can be sought, can help to find solutions.

A patchwork landscape

The 'patchiness' of the landscape contributes to the range of habitats that are available for wildlife to live within. Patchiness is relevant because natural habitats are themselves a mosaic of different ages, floristics (type, number and distribution of plants), structures, etc. Important components of a patchwork landscape include the range of habitats, diversity of plants, habitat age, history, structure and changes over time.

Habitat diversity

Different animals live in different habitats. Therefore, the greater the range of habitats managed for their wildlife values, the greater the range of species that can be represented.

Examples of habitats that may occur in a Landcare area include dry forest on upper slopes, tall forests along streams or rivers, lakes, shallow wetlands, scattered woodland in paddocks, plantations, farm gardens, etc.

Species diversity

A wide range of plant species potentially provides a wide range of resources for wildlife. The natural diversity of species in the area is the best guide. For this reason, it is valuable in revegetation or regeneration to include trees, shrubs, grasses, ground covers, climbers and parasites, such as mistletoe, where these are natural. Artificially enhancing diversity by planting additional species from beyond the area, is not necessary and is likely to have adverse effects.

Changes in habitats over time

Some wildlife species only occupy a habitat during a stage in its development. For example, the Silky Mouse prefers mallee-heathlands during the early years after a fire. At this time, there is a high diversity of fruiting plants which provide ample food supplies and support breeding year-round. In contrast, hollow-dwelling wildlife such as Sugar Gliders, Eastern Rosellas and Chestnut-rumped Thornbills, need access to trees aged at least 70 years, which is the minimum for hollow development.

Habitats, and the resources they provide, also change on a seasonal basis. For example, most plant species do not flower at the same time across their entire range. The varied sequence of flowering enables honeyeaters, and other flower feeders, to follow the pattern of flowering of plants and ensures an on-going supply of food over a long period of time.

History

The history of the vegetation may also contribute to its patchiness and its quality and value as a wildlife habitat. For example, some areas may have a history of regular burning whilst others may have been unburnt for many decades. The history of management may be important in deciding which areas are most valuable for wildlife. Areas that have

been frequently or extensively disturbed are likely to have less value for wildlife; they will be more prone to weed invasion and harder to manage.

Structure

Understorey and ground cover plants are also important parts of habitat for many species of wildlife. The great variety of features in a habitat support its range of wildlife species. Some species may need tree hollows for shelter, but feed amongst the bark, twigs and leaves of the forest floor. Species that are related to each other may use separate parts of a habitat, such as the three thornbills, in the example below, which feed at different heights in the vegetation. Within the same species, some individuals may differ in their use of the habitat. For example, male golden whistlers feed higher in the tree canopy than females.

Three species of thornbills can occur at the same site by feeding in different parts of the habitat. Striated Thornbills spend most of their time in the tree canopy gleaning insects off gum leaves, Brown Thornbills feed in understorey plants, particularly from leaves, whilst Buff-rumped Thornbills prefer bark surfaces at all levels and leaf, twig and bark debris on the ground.

Site quality

All sites are not the same to wildlife. As you would expect, more fertile sites with mild climates often provide superior habitat. So, for example, whilst koalas might be found on drier slopes, their preference is for the foliage of eucalypts growing on fertile soils, such as often occur along streamsides. It has been observed that, at some sites, productivity by plants important to some wildlife, is maintained even when stressful conditions prevail, such as drought. For example, the plants, particularly eucalypts, at these sites may maintain nectar production, which sustains nectar-feeding birds and mammals, until conditions are more favourable.

Keep it healthy, not 'tidy'

Many landholders now realise that a 'tidy' property, on which all fallen plant debris is raked or burnt, where dead trees are unquestioningly removed, and so on, does not equate to a well-managed property. Not only are the leaves, bark, twigs and branches that fall valuable habitat for wildlife, they are stores of nutrients that can be recycled to the soil and provide protection against erosion. Dead trees provide roosts for insect-eating bats, which help control agricultural pest species while not causing any damage to crops or livestock. Logs, branches, twigs, leaves and rocks provide shelter for lizards, frogs and many invertebrates which may also be predators on species that cause problems.

Legitimate concerns regarding harbour for vermin can be addressed by using alternative methods of control (see Land for Wildlife ***Notes 24 'Foxes - options for control in wildlife habitat'*** and ***31 'Rabbit control in wildlife habitat'***). Plant debris should not be allowed to accumulate where it may present a risk to humans in the event of a fire or other disaster. However, there are many areas where fallen plant material can be left as a valuable contribution to wildlife habitat and the soil. Identify them for your Landcare area. It is extremely important that these features are retained in bushland areas, where safe to do so.

Checklist

Does your plan:

- Provide some wildlife habitat in each land class/area/zone, across the landscape?
- Give priority to the most natural remnants?
- Include some wide corridor links?
- Enlarge on blocks of native vegetation?
- Include some large blocks of vegetation?
- Include: streams, gullies, drainage lines, wetlands, sites with high natural fertility?
- Consider using local native species in each revegetation area?
- Represent the range of habitat features that occur naturally including: provision for understorey and ground cover vegetation; retention of fallen logs, branches, twigs, leaves, and rocks?
- Include vegetation in a range of age classes?
- Give priority to areas with big old trees?
- Protect dead trees?
- Overall, have you set up a process to integrate wildlife with other property uses?

Add value to Landcare efforts by building in wildlife values from the beginning

*(see **Notes 9 'What your property can do for you'** & **10 'How wildlife habitats can benefit your property'**).*

As a general rule, put your effort into the best remnants first.

The 'rule-of-thumb' is, the wider the corridor and the larger the block, the better for nature conservation.

Streams, gullies, drainage lines and wetlands are important, both as a focus for Landcare activities and as valuable habitat sites for wildlife.

Remnants of native vegetation, retaining their natural diversity of ground flora, should be high priority for management.

Aim to achieve self-perpetuating ecosystems.

Integrating wildlife habitat with other property uses can help you achieve all the things you want your property to be such as a wonderful place to relax and enjoy a family picnic.

Wildlife considerations should be integrated into all activities on the property, in the Landcare area and the catchment.

Aim to make your restored bushland and revegetation as diverse as the local nature.

If a range of vegetation age classes are represented in habitat areas throughout the Landcare area, then this will cater for a wider range of wildlife species. Areas with large old plants are particularly valuable as they are the most difficult to replace.

Ensure habitats are represented across the landscape and not just clumped in one area.

Be aware of the history of management of the vegetation when assessing its priority for action.

Aim to represent the range of habitat features that occur naturally.

Understorey and ground cover vegetation are important. Not all sites are the same to wildlife. High value sites, such as along watercourses, can be important locations to retain or re-establish wildlife habitat.

To cater for the variety of needs of different wildlife species, consider including a range of sites, some with naturally high fertility, in revegetation plans. Since creek sides and gullies may be prone to erosion, fencing of these often-fertile areas can combine wildlife and other land management goals.

Bush Thick-knees shelter amongst fallen branches left as habitat by this landholder. In appropriate places, fallen plant material benefits a property through soil enrichment and provision of habitat.

Wildlife habitat can be incorporated into a Property Management Plan by adding a wildlife habitat overlay to an aerial photo-based plan (see Dixon, 1994, p 1-9). This layer must then be integrated with other layers to achieve an overall plan for the area. The example below is for a landscape near Woodend and illustrates the type of landscape level features that should be identified (see ***Note 22*** for property level features).

Need more help?

As well as the references listed below, there are many other sources of local information that may be of assistance, including your regional Catchment Management Authority or local council.

References and further reading:

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1Hobbs, R.J., (1993). Can revegetation assist in the conservation of biodiversity in agricultural areas? Pacific Conservation Biology, 1: 29-38.

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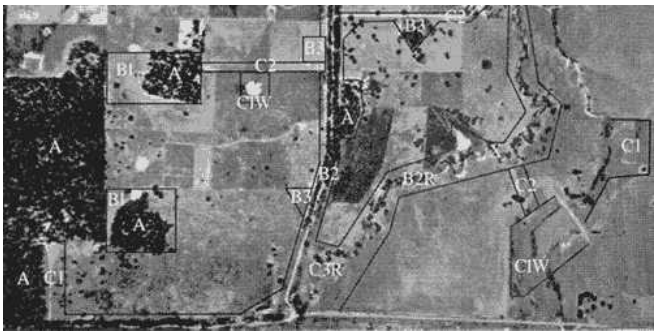
O'Connell, M.A., and Noss, R.F., (1992). Private land management for biodiversity conservation. Environmental Management, 16: 435-50.

Examples only. Remember, wildlife considerations must be integrated into the whole landscape. The lines identify key areas for habitat.

Best remnants - top priority for management/fencing A Natural Regeneration - blocks, corridors, nodes. B1, B2, B3

Revegetation - blocks, corridors, nodes. C1, C2, C3

Threatened/locally significant species X
Wetland/Riparian W/R



Above: Aerial photographs are good source of information and show the relative locations of remnant vegetation. Google Maps provides satellite images across Victoria – insert your property address for maps relevant to your location.

31. Rabbit control in wildlife habitat

Introduction

The introduced rabbit *Oryctolagus cuniculus* has a major impact upon native vegetation, crops and pasture in agricultural areas. Bushland areas, particularly those in which logs and undergrowth are retained, can provide harbour for rabbits and may be perceived by some landholders as undesirable for this reason. However, a wide range of techniques is available for effective rabbit control in vegetation whether it is retained specifically as wildlife habitat or to prevent land degradation. Given the importance of both these aims, rabbit control in bushland will play a role on all properties.

This Note gives an overview of the techniques and issues involved in rabbit control. Read the section titled 'Further Information' in this pamphlet for additional sources of advice. A brochure specific to urban areas is available (see references).

In addition to traditional techniques, the CSIRO and Australian Animal Health Laboratory are searching for alternative methods of control, such as fertility control and more effective biological control, to help reduce rabbit populations. Spanish Fleas have been introduced as a new carrier of the myxoma virus in drier areas. These are potential solutions for the future. But real options exist right now for rabbit control.

Problems caused by rabbits

The problems associated with rabbits extend beyond those of agricultural production. Rabbits eat many species of native plants, selecting particular species over others. This can prevent natural regeneration in bushland areas, destroy seed production, facilitate erosion, deny or reduce native wildlife species' food supplies, create soil disturbance and allow invasion by bushland weeds. It can also change the nature of the vegetation, as unfavoured species expand into areas previously occupied by those preferred by rabbits and may lead to plant and animal extinction or reduction in numbers. Rabbits can ringbark young trees and be a serious menace to revegetation projects.

The ensuing land degradation will affect the health of habitat areas. Rabbits in bushland may encourage permanent populations of cats and foxes which also impact on native fauna. They are thus of major concern to landholders protecting native vegetation.

One doe rabbit can produce 30-35 young in a season. As rabbits become sexually mature in 3-4 months, her own young may begin breeding in the same season. It follows that each rabbit killed during the non-breeding period avoids having to kill 30 or more times as many following breeding.

Aiming to keep the bush healthy

Understorey vegetation, rocks and logs provide wildlife habitat. Removal of these essential components of an ecosystem can lead to reduced numbers of wildlife and subsequent problems with increased insect attack and dieback. The aim in areas managed for their value as wildlife habitat must be to use techniques that are non- destructive to the habitat.

Preparation

It is important to decide initially whether rabbits are threatening the vegetation and to ensure that any treatment undertaken is less harmful than the rabbits themselves. Assessment through on-ground night and day inspections is an essential part of managing rabbits. Daytime inspections will reveal the extent of damage to vegetation, soil stability and enable mapping of features such as warren and burrow locations, inaccessible areas and wildlife. Night inspections (by spotlight) will reveal rabbit numbers, where rabbits are feeding (for poisoning), age classes and susceptible wildlife.

Group action

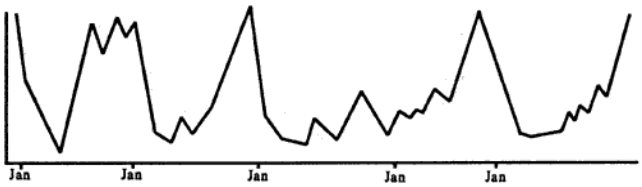
Whilst the individual efforts of single landholders are commendable and an example to others, effective rabbit control will only be achieved if neighbours band together as a group to tackle rabbits.

This is because rabbits can rapidly reinvade controlled areas from adjacent uncontrolled ones. Hence, your involvement in a Landcare or similar group will be necessary to manage rabbits effectively and joining, or starting a group in your area, is highly recommended.

Control options

Numerous mechanical and chemical methods are available for the control of rabbits. However, they are most effectively used in combination.

Rabbit warrens afford protection from predators and are important in the social structure of the rabbit population. Destroying the warren is critical to reducing the rabbit population.



Rabbit populations fluctuate seasonally with peak numbers occurring in the spring breeding season. Aim to reduce rabbit numbers in the base population (bottom of the trough) so that there are fewer breeding individuals.

Fumigation - autumn/winter

Fumigation tablets (Gastoxin and Phostoxin), which liberate poisonous gas on contact with moisture, are available from stock and station agents. A tablet is placed deep inside each warren entrance before the entrance is filled with soil and the soil stamped down to seal in the gas. A muzzled dog can first be used to scout the area and flush rabbits underground. Pressure fumigators are also widely used. 'Larvacide' (chloropicrin) gas, and smoke as a tracer, is pumped through the warren by the fumigator. These techniques involve minimal disturbance to bushland areas. Fumigation should be followed by warren destruction. Note that wildlife may be living in rabbit burrows. Check for signs before fumigating or use live-capture traps instead.

Warren ripping and wool plugs - autumn/winter (moist soils)

A ripper, pulled behind a tractor, can be used to destroy the rabbit warren complex. The tractor driver is usually accompanied by an assistant who locates warrens, temporarily removes obstacles, such as logs, and shovels in entrances that cannot be reached by the ripper. This method is generally unsuitable for natural bushland areas in which the ground flora cannot be disturbed and may facilitate weed invasion amongst native vegetation, causing serious control problems. Ripping is usually carried out two to three days after fumigation. Ripped areas will need to be revegetated to prevent erosion.

An alternative technique under trial involves the use of wool plugs rammed into warren openings. Fumigation tablets are placed into the warren before it is plugged. This technique, if successful, will avoid the problems associated with disturbance in native vegetation and could be valuable in rocky areas.

Poisoning - summer/autumn

Clean (free of weed seeds) oat grain or diced carrots may be laid in trails or broadcast with a bait layer designed for this purpose. Several 'free-feeds' without poison are followed by one including sodium monoflouroacetate (compound 1080, pronounced 'ten eighty', poison) or pindone (which is recommended for built-up areas and other areas where dogs may be affected by secondary poisoning after eating rabbit carcasses). Poisoning should be timed to occur when rabbits are least territorial and when other foods are scarce (summer). Care must always be exercised in the use of poisons, to avoid potential impacts on wildlife, livestock and other domestic animals.

Coloured dyes are used to minimise uptake by birds and, in areas with larger macropods, a bait station (cage excluding species larger than rabbits) can be used. This method is useful in reducing the rabbit population peaks. It is suited to cleared land adjoining a bushland area.

Shooting

Shooting the rabbits remaining, after these other methods have reduced numbers, is proving to be one of the best techniques in maintaining low numbers. It is cheap, encourages night inspection and is target-specific, thereby avoiding any impact on wildlife. Cats and foxes can be controlled at the same time.

Fencing

Rabbit-proof fencing is another option. However, as rabbits are able to gain access through even a small hole in the fence, this method is frequently ineffective in practice. Rabbit control needs to be undertaken across the landscape in an ongoing way, in cooperation with neighbours.

Fencing does not achieve this goal. Another problem with exclusion fencing is restricting wildlife movement. For example, echidnas will not be able to pass through rabbit netting and this can have undesirable consequences (see ***Note 3 'Creating habitat corridors for wildlife'***).

Combining treatments

Cooke (1981) found that combined treatments were more effective than individual methods in controlling rabbits in roadside remnants of native vegetation in South Australia. This study also found that effective rabbit control could be economically justified in terms of increased crop yields in adjacent paddocks. Complete crop protection was achieved in the study. Effective rabbit control in the first instance meant that less intensive follow-up treatments could be employed in future years. Unless a large percentage of rabbits are killed (90%) then the rabbit population will very rapidly return to its original size.

Once rabbit numbers are reduced, they must be kept low. A flare-up once in five years can set regeneration back to its starting point. Continuous low numbers can only be achieved by a carefully planned and faithfully exercised program of regular surveillance and treatment of rabbits.

Avoiding harm to wildlife

Rabbit control can have potential negative impacts, as well as those positive aspects mentioned earlier, on wildlife. Non-target species may be poisoned if poisons are used improperly, fences can create barriers, disturbance can allow weeds to invade and so on. Careful planning and care can minimise negative effects which are considerably outweighed by the positive benefits of reduced rabbit numbers.

Other side effects

A side effect of a successful rabbit control program in bushland can be the appearance of environmental weeds brought in by the rabbits or other vectors. Weeds take advantage of disturbance, such as around warrens. They may have previously been kept invisibly low by constant rabbit browsing. An integrated campaign of rabbit and weed control combined with revegetation by native plant species can prevent this problem. With fewer rabbits available, there may be a temporary increase in fox and feral cat predation on native wildlife but in the medium-term fewer rabbits means fewer feral cats and foxes.

Concern has been expressed about the potential effects of rabbit control on birds of prey, particularly Wedge-tailed Eagles. When myxomatosis was first introduced it achieved a 99.9% mortality rate without causing an apparent effect on eagle populations through loss of food supply. Also, with the reduction in rabbit numbers, alternative prey are likely to become available, such as native bandicoots. Based on toxicity estimates, a Wedge-tailed Eagle would have to consume 7.5kg of poisoned rabbit at one sitting to be killed by 1080. This is 2.5 times the average weight of the bird. However, care needs to be taken to remove poisoned rabbits, as specified in the guidelines for using 1080 poison, to avoid secondary poisoning of wildlife through consumption of dead carcasses.

Hares

Unlike rabbits, hares do not build warrens, resting instead in a shallow depression called a 'form', and are solitary animals. Hares prefer grassland and open woodland habitats. Although not considered a major pest of pastures, they may cause considerable damage to trees and vines due to their habit of stripping bark and nipping off the top of seedlings. Hares are not susceptible to myxomatosis nor do they readily take poisoned baits.

The main method of control, in open country, is shooting. Seedlings can be protected by plastic guards. In direct- seeded plantations, landholders have used a range of deterrents including handfuls of blood and bone scattered among the seedling lines; a mixture of five fresh eggs, 600ml of water and 150ml of acrylic resin or paint sprayed onto the trees; salt licks placed at 20-50m intervals; or fat with 15-20% kerosene rubbed onto the trunks.

The rewards

Once rabbits have been controlled, the health of bushland areas can be dramatically improved. Understorey vegetation may return, and natural regeneration can occur. Flowers will no longer be eaten before they can set seed. Working against rabbits is a job for those interested in bushland and wildlife as much as for those seeking to improve pastures or crop yields.

References

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Information leaflet - 'Rabbit control: Trail baiting with 1080.' Department of Conservation, Forests and Lands, Victoria.

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32. The value of understorey vegetation

Introduction

Winter is the time of the year when many parts of the Victorian bush are flooded with various shades of yellow from the blooms of wattles. The white flowers of Cassinia (Dogwood) are characteristic of the summer period while in spring, the bush is often a mosaic of different colours. It is the various types of understorey plants that help create these familiar impressions of different seasons in the Victorian landscape.

This Note gives a general description of the important role understorey plants play in the natural ecosystem as well as its value to farmers and other private landholders. In addition, the decline of understorey in rural environments is discussed and various methods of protecting and restoring the understorey layer are mentioned.

What is understorey vegetation?

The understorey includes the herbs, grasses, shrubs, mosses, lichens and small trees that occupy the vegetation layers (strata) below the canopy of taller trees. Some habitats have mixtures of these plants, whilst others, such as grassy woodlands, have mostly grasses and no shrubs. There can be an enormous difference in the diversity of species between the understorey and overstorey layers. Valley grassy forests of northeast Victoria may have four species of eucalypts and between 70 to 100 species of plants in the understorey.[1] Thus, understorey vegetation represents over 90% of the biodiversity of the vegetation and a large proportion of the ecosystem.

The disappearing layer

Because they are an obvious feature on the landscape, declines of eucalypts in rural areas of Victoria have received more attention than the loss of any other type of vegetation. Aborigines, followed by Europeans, recognized the value of understorey vegetation as sources of medicinal plants, food, building materials and shelter. This view changed as environments were modified and the 'scrub' stood in the way of change.

Vast tracts of vegetation and understorey were cleared in order to establish pastures of introduced grasses. Understoreys had to compete with newly introduced weeds, survive frequent fires, chemicals and withstand the effects of new kinds of hard-hoofed domestic, and feral animals. These changes also had their effects on the pollinators and animal dispersers of understorey plants. It is not surprising that many bushland remnants, on private land, that are unfenced have lost their understorey and that roadsides and similar refuges are the remaining haunts of many understorey species.

As farming perspectives and management have shifted to recognise the need for environmentally sustainable development (ESD), and farm enterprises diversified, it is time to recognise the potential role that understorey vegetation can have in contributing to ESD, healthier environments and producer options.

Understorey plants represent some 90% of the plant biodiversity of native vegetation. Their impact on wildlife species is similar in magnitude.

The values of understorey vegetation

Understorey vegetation plays a very important role in maintaining a balance in natural ecosystems. Its value to land managers is often underestimated, as it can contribute to economic, social and environmental goals, both in the short and long term.

Many of the symptoms of dieback, such as leaf loss, increased numbers of aggressive communal birds, such as Noisy Miners, and large populations of pest insects, can be traced to loss of understorey as one potential cause.

Natural pest control

The understorey layer provides habitat for predators which can assist in natural pest control. For example, more than ten wasp species parasitise the larvae of leaf-eating beetles such as Christmas Beetles. The adult wasps feed on nectar and protein from native trees and shrubs, such as Burgan and wattles. Lack of understorey species has decreased nectar sources and consequently the wasps cannot survive in these cleared areas. The larvae and adults of other beetles and flies also feed on Christmas Beetle grubs but require shelter by day in leaf and bark litter and do not thrive in open cleared pastures.[2]

The understorey layer needs to be composed of a sufficient range of species to allow many different insects to complete all stages of their life cycle: egg, larva, pupa, adult.
The reduction of understorey has also reduced the number of insectivorous birds that feed on various insect pests. Thornbills eat small beetles, ants and caterpillars, as do robins and fairy-wrens. Cuckoos are well known predators of hairy caterpillars, including stinging cup-moth larvae and even sawfly larvae. Mammals, such as bandicoots and gliders, also feed on various insects and their larvae.[3] Studies in the Mallee have shown that wattles along fence lines harbour predators that significantly reduce pests in wheat crops. A study of Noisy Miners, native birds that band together and exclude small insectivorous birds, indicates that Miner colonies are smaller where there is understorey vegetation present.

Wildlife habitat

Trees provide simple ecosystems supporting relatively few species. Understorey plants add a large variety and diversity of habitats for many of our wildlife species, such as gliders, lizards, small bush birds and invertebrates.

Fairy-wrens build their nests in prickly dense shrubs. After the young wrens leave the nest, they spend another week hiding in the dense understorey. Some lizards prey on the insects that live in understorey vegetation. Frogs often hide in leaf debris or on fern fronds whilst tadpoles avoid predators beneath bankside vegetation.

Honeyeaters feed on nectar from flowers of understorey species, as do many types of insects such as butterflies, wasps and ants. Even the much-maligned bracken provides valuable habitat for birds such as Brown Thornbill and White-browed Scrub wren. Powerful Owls roost by day in tall dense understorey shrubs such as Blackwood Acacia melanoxylon. Several thornbill species can co-exist in the same location because they have different feeding patterns. Brown Thornbills feed largely in the understorey whilst related species utilise the tree canopy or ground layer.

Protecting and enriching the soil

The understorey layer is vitally important to the stability of the soil surface. The presence of an understorey, along with leaf debris, softens the impact of rainfall and reduces runoff both by acting as a physical barrier to surface water and by contributing to soil porosity. Understorey plants are a source of organic material that sustains living organisms in the soil. They also act as a thermal insulator and protect the soil from extremes of heat and cold as well as from strong winds.[4]

Trees alone are often insufficient to control streambank erosion

The understorey often includes species, such as wattles and casuarinas, that contribute to soil fertility. These plants support microorganisms, in nodules on their roots, which fix nitrogen from air in the soil, converting it to a form that can be taken up by other plants. Through leaf fall and death of the plants, the nutrients are returned to the soil. The addition of organic material to the soil in the form of humus also provides for a healthier soil.[5]

Biodiversity and genetic resources

Conservation of biological diversity is a foundation of ecologically sustainable development.[6] Biodiversity enables us to undertake selective breeding programs, for example, to create new medicines and crops. It enables plants and animals to develop natural resistance to disease and to survive environmental change. Biodiversity increases our options - to find solutions to management problems such as increased salinity, to look for new agricultural products and to fight increasing resistance to traditional medicines by infectious diseases. Biodiversity is directly reliant on maintaining the genetic resources of the whole ecosystem and the processes which sustain it, including understorey plants.

The retention of vegetation is imperative if we are to preserve our flora and fauna and attempt to slow down or even halt the processes of human-induced extinction. For a diversity of animals there must be a diversity of vegetation - different foliage types, qualities of light, a range of heights and sizes. A variety of plant forms and species must be present in order that an ecosystem can be sustained. Maintaining the genetic species diversity provides a buffer against climate change, allowing evolution and adaptation to a more rapidly changing environment.

Understorey plants may provide valuable genetic resources that could be used in scientific and technological research and that have the potential to be developed into commercial products such as new crops.

Shade and shelter for stock and crops

Native vegetation can be used to provide shelter to protect stock and crops from exposure to extreme weather. Although most landholders plant trees, more benefits come from using a variety of vegetation including shrubs and groundcovers. Studies by CSIRO have shown that shelter supplied by vegetation can reduce lambing losses by up to 50% and death by exposure of newly shorn sheep.[7] Studies have also shown that access to shelter can increase wool production, milk production and liveweight gains. A five-year study at Armidale, New South Wales, showed that sheep on sheltered plots produced 35% more wool and 6kg more liveweight than those without shelter.[7] Many studies have shown that crop yield increases when wind breaks are established. Shrubs should be included in shelterbelts to avoid gaps beneath trees that may cause a large wind tunnel effect (see ***Note 20 'Shelterbelts and Wildlife'***).

Other values

As sources of honey and pollen, the understorey plants are often vital to beekeepers. Low trees and shrubs can be important sources of emergency feed for stock. Be aware that some species are poisonous. The potential value of various understorey species as fodder feed has yet to be properly researched. The beauty of understorey species, particularly when in flower, can add to the landscape appeal of the area for social activities, such as picnics, as well as providing a more pleasant working environment. This in turn can be reflected in improved land values and increased tourism[5]. Understorey plants, such as Blackwood Acacia melanoxylon, are valued for their timber qualities. They have potential in horticulture because many are attractive, to humans and wildlife, and are at eye level. In cities, shrubs avoid the problems associated with trees, such as branch fall and interference with powerlines.

What you can do to retain or re-establish these values

The re-establishment of the understorey vegetation is an important step in the reinstatement of a healthy ecosystem. Improved management or re-establishment of understorey species may help entice the return of wildlife by providing food, shelter and breeding sites. 'Tidying up' a property by removing these essential habitats will lead to a loss of wildlife.

Conserve what remains

If you are fortunate enough to have understorey still present on your property, then there are a number of ways to conserve it. Identify areas of remaining understorey, such as in paddocks that have a history of low intensity disturbance, along roadside verges, on hilltops and beside creek lines. If stock are present, fencing, to prevent access to areas where understorey is to be retained, should be a high priority. Stock may destroy the understorey by browsing, trampling, soil

compaction and via nutrient build up from manure (see Land for Wildlife ***Note 29*** for details). Weed and pest animal control are important actions. See LFW ***Notes 13 'Natural regeneration - principles and practice'*** and ***31 'Rabbit control in wildlife habitat'.***

Encourage the return of understorey

If the understorey vegetation only recently disappeared from your property, there may still be a seed bank in the soil. Again fencing, an ecologically appropriate burning regime, pest animal and weed control will encourage the return of understorey species. Alternatively, select areas of your property, close to understorey remnants, manage to encourage regeneration, and wait for natural dispersal to occur.

Planting or direct seeding

Direct seeding is easier, cheaper and quicker than planting out (ask for the Land for Wildlife News Vol. 1 No. 9 supplement on direct seeding). Hand broadcasting may be appropriate in degraded habitat when use of machinery is inappropriate. Plant local species to avoid non-local natives becoming weeds.

In some circumstances, planting may be the only appropriate method to use. You can grow your own seedlings or ask a local nursery to propagate your local seed.

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33. Natural regeneration - case studies in bushland

This Note looks at some case histories of natural regeneration in bushland remnants. Note 13 'Natural regeneration: principles and practice' and Note 16 'Natural Regeneration - case studies on the farm' should be used in conjunction with this Note.

The advantages

Natural regeneration in bushland has many advantages over natural regeneration in farm areas, however, both have important roles to play in restoring wildlife habitat on private land. The advantages of natural regeneration in bushland include:

· a larger degree of protection from climatic factors such as harsh sun and wind.

· a larger, more diverse, seed bank already in the soil, allowing a greater variety of trees, shrubs, grasses, herbs and groundcovers to appear.

· the presence of natural predators such as birds and gliders that help control the extent of insect attack.

· soil conditions which may be more favourable for seed germination and seedling growth. Germination in exposed areas may be impaired by compacted, unstable soils.

A number of factors, both natural and artificial, are believed to be involved in the process of encouraging natural regeneration in bushland.

The issues

The removal or reduction of livestock can encourage natural regeneration to occur by decreasing the grazing and browsing pressure on mature and seedling plants. The heavy hooves of stock, including cattle, horses, sheep and goats, can compact soil and destroy soil structure. These soil changes may prevent or restrict germination. The dung of these animals may also introduce weed species and increase soil fertility, favouring competitive weed species.

Weed control may help initiate natural regeneration by removing competition. Weeds can be very efficient at occupying spaces, particularly those that have been disturbed, and using up available resources such as nutrients, light and water. They can successfully outcompete native species in the 'race' to grow and colonise.

Pest animal control may be an important factor to consider when encouraging natural regeneration in your remnant bush. The most effective approach is to produce a control program and to involve your neighbours in the program. Refer to LFW ***Notes 24, 25*** and ***31***. Care must be taken to minimise **disturbance** to bush areas and their wildlife. For example, ripping a rabbit warren may not be appropriate. Invertebrates may consume young seedlings when they are most vulnerable.

Fire may be used as an ecological tool for encouraging natural regeneration. It has played an important role in determining the composition and structure of much of Australia's vegetation. However, its occurrence in remnant vegetation is now often lacking. Fire can stimulate regeneration by removing competitive weed species, triggering seed release, stimulating flowering, breaking seed dormancy and cracking open hard seed cases. Many native plants have mechanisms to regenerate after fire. Rainforest can be damaged by fire. **Smoke** from fire can also trigger germination in some species and flowering in others. However, burning too frequently or at the wrong time can simplify understorey and cause local extinctions of plants and animals.

Microhabitats such as leaf litter, logs, crevices in rocks and depressions in the ground can supply small, protected areas where seeds have a greater chance of germinating. Stable temperatures, increased moisture content, correct humidity and protection from the wind are important for seeds during germination and for the survival of small seedlings. Moss and lichen mats may also assist seedling establishment by providing a sheltered 'nursery' for seeds. Moss and lichen are important for their ability to bind bare ground, maintain soil moisture, provide a stratum in which seeds can germinate and to provide important habitat for many invertebrates.

The variability in seasons can play a vital role in determining when and at what rate natural regeneration occurs. Most seed germination occurs in autumn and spring when conditions are at their best. Natural regeneration may be more successful in 'good years' with above average rainfall when the soil is warm. Unfortunately, these conditions also encourage an increase in weed seed germination. Germination may fail to occur in a vegetation community during a **drought** and a **flood** may kill seedlings. However, some species, such as River Red Gum, respond to flooding which may initiate large-scale regeneration.

Succession plays an important role in the regeneration of vegetation**. Pioneer species** (the first colonisers) can include plants such as peas, dogwoods and wattles. These plants occupy an area very quickly and create an environment that is more favourable to other plants, such as eucalypts.

Wind and insects are essential for **pollination** and **seed and spore dispersal**. Pollinators such as butterflies, wasps and native bees, allow flowers to become fertilised and, consequently, to set seed. Attract pollinators to your bush by maintaining a diversity of habitats including flowering plants.

The relationship between plant species is important in the regeneration of some native species. For example, Cherry Ballarts (Exocarpos cupressiformis) seem to be partially **dependent** on various species ranging from native grasses to wattles. Their roots parasitize roots of other plants from which they obtain valuable nutrients.

Wildlife plays an important role in the processes of natural regeneration. Seeds may germinate after they pass through the **digestive system** of many species of birds and are passed out in their droppings. Attracting these birds back to your bush by encouraging diversity of habitats may assist regeneration. **Perches** have a role in seed dispersal by encouraging birds to stop, at which point they may produce droppings that may contain seeds. Ants can also play a beneficial role in **seed dispersal** and germination. Some seeds even produce ant attracting structures. By carrying the seeds around or taking them down their tunnels or other cavities in the soil, ants aid the dispersal and germination of a large number of Australian plants. However, some ants may take up to 100% of the year's crop of seed for food and nest building and this may prevent germination. Light raking of the soil during seed fall may hide sufficient seed from ants that consume seed. This **disturbance** action is usually carried out by native animals such as bandicoots, Lyrebirds and Mallee Fowl.

However, many of these species are lacking from remnants, and light raking of the soil may replace this action. Attracting these animals back to your remnant is important action you could take in trying to return the balance of the bush. Seed dispersal can also be aided by wildlife by acting as a **vector** for movement. Spiky seeds can get caught in fur, skin and feathers. Attracting **natural predators** that feed on herbivores (grubs, caterpillars, crickets etc.) can help reduce attacks on seedlings as well as mature plants.

Case Histories

Case 1: David & Jean Edwards, "The Springs", McKillop (Mt. Evelyn). WET FOREST.

Method: "Bradley" method (i.e. weeding from the most intact areas towards more weedy areas) followed by selective replanting with indigenous, local provenance species. Bush mulching, allowing plants to seed and regenerate. Annual walk-and-weed to retain good areas where birds drop unwanted seeds (especially berries).

The property has springs which are the source of one of the tributaries of the Stringybark Creek. It includes a southerly slope which has probably **never been grazed** and is in good condition with mature Messmates (Eucalyptus obliqua) and Narrow-leaved Peppermints (Eucalyptus radiata), a sparse middle storey and small shrubs, grasses and herbaceous plants. Common Bird-orchids occur on several of the informal tracks. The sparse middle-storey is probably due to the slope not being **burnt** for a very long time - probably not since the 1920s.

At the time of purchase, in 1971, parts of the gully were covered with impenetrable mounds of blackberry up to ten metres long. A **weed control program** was initiated by spraying with accurate equipment at the optimum time of the year (between

flowering and berry formation - usually between Christmas and New Year). This allowed the wet gully, with its Scented Paperbark (Melaleuca squarrosa), Red-fruited Saw-sedge (Gahnia sieberiana), Rush (Juncus procerus) and Coral Fern, to flourish. Annual spot- spraying across the property has maintained control.

On the south side of the creek, some mature Narrow-leafed Peppermints died following a Bell Miner (bird) -Psyllid (insect) infestation in 1981. This demonstrates a tip in the balance of **natural predators** and herbivores. The death of these trees opened up the forest to more light and allowed the growth of pioneer species such as Dogwood (*Cassinia aculeata)* as well as more flowering plants like Austral Bluebell *(Wahlenbergia gracilis)* and Creamy Candles *(Stackhousia monogyna).*

A similar result follows the deliberate removal of environmental weeds such as Pittosporum undulatum. David controls this species by frill-cutting and poisoning ("frill" bark with tomahawk and fill "cups" with herbicide). As it dies, in situ, and gradually drops its leaves, the **ground layer** and shrubs increase through natural regeneration.

Part of the steep gully was deliberately burnt with a hot fire on Anzac Day 1988. This converted a species-poor understorey to a riot of colour and diversity with wattles, Golden Bush-pea *(Pultenaea gunnii)* and numerous small flowering plants and creepers. Silver Wattle (Acacia dealbata) has since become dominant.

Every three or four years there is a big seed set on Cherry Ballarts *(Exocarpus cupressiformis)* and they grow, clustering around the Silver Wattles, which on this property, they seem to be **dependent** on. Jean successfully transplanted a very small Cherry Ballart and a young Silver Wattle a couple of metres apart into a cleared area.

Smaller understorey plants take much longer to establish, possibly because of **competition** from the grasses, or possibly because there is not such a great seed source nearby. Where small clumps of Rough Coprosma (Coprosma hirtella) and Tasman Flax-lily occurred, these have expanded. Some plantings from local stock has been done and some of these are now starting to self-seed and regenerate.

Another interesting form of natural regeneration which has occurred on the property over the last twenty years is the spread of tree ferns (mainly *Cyathea australis* but some *Dicksonia antartica*). This is possibly due to the **spread of spores** by wind and perhaps other vectors. In 1971 the tree ferns were confined to a thin line along the creek.

Over time they have appeared in clumps in the gully above the springs. Where there was formerly an infestation of Holly *(Ilex aquifolium)* covering a couple of acres on the moist south-facing slope, and these have been removed, tree-ferns have taken their place in the wetter places.

And what are the pleasures and rewards of restoring the quality of bushland? Yellow-tailed Black Cockatoos which regularly fly low over the property in flocks of up to forty birds are now feeding on the hakea and banksia seed; rosellas feed on the Burgans; White's Thrush (Australian Ground Thrush) is seen occasionally in the damper, more dense parts of the property, as are antechinus; an Eastern Whipbird calls occasionally from the gully and many Swordgrass Brown and other butterflies enliven the summer months.

Case 2: Won Wron State Forest, South Gippsland. HEATHY WOODLAND.

Method: Fuel reduction burn resulting in regeneration of a greater variety of species.

Won Wron State Forest was burnt in a fuel reduction fire in autumn 1992. Three different sites were observed, and the response was different depending on the fire **intensity**.

The first site was a heathy woodland, and the fire was **hotter than anticipated with partial crowning**. This encouraged species, such as eucalypts and banksias, to resprout and species with hard seeds, such as wattles, to germinate and regenerate. Another fire in the next couple of years could be detrimental to many species **because many have not reached the age where they produce quantities of seed.** By November 1993, when the photo was taken, the Grass-trees had flowered and the sedges were regenerating from rhizomes (underground stems). There was epicormic growth on the eucalypts.

The second site was a stringybark forest which experienced an **intense crown fire**. This encouraged a mass of eucalypt regeneration from seed. The intensity of the fire on the forest floor also led to the germination of soil-stored seed including peas and heath. In fact, the regeneration was so vigorous that 70-80% of the soil surface was covered in 18 months after the fire.

The third site had a **cooler fire** which meant there was no eucalypt regeneration from seed or epicormic growth. The fire was hot enough to kill most shrubs. Species afforded some soil protection, such as orchids and tuberous lilies, were advantaged.

Native grasses, shrubs and trees started to regenerate once stock was removed from this property.

Case 3: Engerbretson's property at Heathcote Junction. GRASSY WOODLAND.

Method: Removal of livestock.

When this property was first purchased by the Engerbretson family, there was no obvious ground flora due to **grazing** by stock. When horse and cattle grazing was removed from this bushland, native tussock grasses returned from rootstock. Trees and shrubs also started to regenerate. The resulting understorey is excellent wildlife habitat, it is visually attractive and now the family has a lovely place to go for a picnic. The chances of soil loss through erosion is also minimised.

Case 4: After Ash Wednesday fires. HEATHLAND, DRY FOREST.

On 16 February 1983, various sites within Victoria were burnt by 180 fires, eight of these being major wildfires. The ability of the flora and fauna to re-establish itself was incredible and the following photos, taken 8-10 months after the day, demonstrate this remarkable regeneration of the bushland.

Buds shooting from beneath the bark (epicormic shoots) of eucalypts after defoliation by fire.

Red Beaks (Lyperanthus nigricans) are orchids that are dependent on summer fires to initiate flowering

Case 5: Tongalong Ridge, Barmah State Forest. DRY WOODLAND.

Method: Exclusion of grazing by introduced animals and native kangaroos.

The lack of regeneration of understorey and ground plants was evident in most of the higher 'box woodland ridges' in Barmah State Forest, a situation that is quite common in the box woodlands of the northern plains. Shrubs, such as bulokes and wattles, and some native grasses tend to be palatable and disappear when **grazing** pressure is high. The only chance these species may get to regenerate is exclusion of grazers, introduced and native. Once established, native grazers, such as kangaroos, may be allowed to enter the ecosystem once again.

Plot outside exclusion area showing very little regeneration. Notice the wattles are grazed and the lack of grasses.

In the summer of 1992/1993 a large exclusion plot was created at Tongalong Ridge to protect an area of Box/Buloke grassy woodland, using fencing that excluded kangaroos, rabbits, hares and cattle. Another plot was marked which did not contain any fencing and was used for comparisons. Within a couple of years there was an incredible increase in the overall level of vascular plant material in the exclusion plot. Surveys (quadrats) done in early 1995 indicated the most evident changes were increases in the abundance of shrubs, grasses and herbs. These surveys need to be repeated in spring to pick up any differences in the annual plants. Perennial native grasses regenerated from seed and basal stock and as a result, out-competed some of the weeds such as Patersons Curse. Buloke (Allocasuarina luehmannii) regenerated by suckering, from seed and by resprouting from basal stock that had been grazed for more than fifty years[1].

Exclusion site showing regeneration of plants and general increase in biomass (plant matter)

There was also a significant difference in the diversity and abundance of moss species. There were about 12-15 species in the exclusion plot and about 6 species in the non-exclusion zone. Stock camps and areas of intense grazing had as low as 1-2 species. However, even though the diversity was reduced, many mosses are adapted to colonise bare ground and the number of individual plants in the non-exclusion plot was higher[2].

Lack of ground flora in non-exclusion plot

Native grasses in exclusion plot

In this case there was enough seed and rootstock present for regeneration of most species to occur. In some cases, there may not be a bank of seed available and subsequent planting of shrubs, grasses

and herbs may need to occur. In many circumstances, a weed control program may also have to occur to give the local plants a head start in regenerating. Experiment with different techniques. For example, pick up some of the organic matter from around the base of a bush or tree, which is growing in nearby less disturbed areas, dry it for a month, place it in your exclusion plot and burn it. With any luck, particularly if the season is good, seeds will be triggered to germinate.

And, most importantly, be patient! If you don't get results this year, you might next year.

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34. Dieback lessons : learning how to manage sustainability

Background

Dieback is a term used to describe the death of vegetation - vegetation that is 'dying back'. All plants have a lifespan and, eventually, individuals will die. This is quite natural. However, it is less common for large patches of plants to die at once. It is therefore with great alarm that, in recent decades, extensive landscape-wide death of native vegetation has been observed, particularly in heavily cleared rural environments.

Dieback can occur in two ways - as a natural event caused by natural processes or as an unnatural event caused by ecosystem dysfunction. This Note concentrates on the latter of these two processes as this is the major cause of dieback affecting natural vegetation across private land in Victoria.

Why be concerned? Rural dieback is a symptom of a wider illness affecting our land systems. Things aren't as healthy as they should be. We're not just losing a few trees, though this is significant in itself, but underlying this are changes in hydrology, salinity, the build-up of pest insect populations and other factors. Our loss includes the shade for livestock, the wildlife and the panoramic Australian eucalypt-dominated landscapes. We can make decisions now that will shape what the future outcomes will be like, but this will only occur if plans are turned into action. The history of concern about dieback goes back to last century. On-ground management changes are needed to address the problems associated with dieback.

How urgent is the situation? By comparing trees visible in aerial photographs in 1971 and 1993, covering 3300 ha of pastoral land in north-east Victoria, it has been calculated that in just 22 years 28% of the living trees have died[1]. If this rate continues, it will take just 77 years for all remaining trees to die.

There is still a great deal to learn about dieback. This Note is based on studies conducted into dieback. However, the exact causes of dieback in any particular instance may be quite complex, may vary from site to site, are likely to be inter-related and can be very difficult to determine. It has been necessary to make informed judgements, or best guesses, about many of the issues due to the lack of sufficient research. Please take this into account when using the material. Landholders are encouraged to use the information in this Note to undertake their own trials and explore approaches to dealing with dieback locally. An exciting challenge for this generation of landholders!

The aim of the Note is to develop practical ways for landholders to think about solving dieback problems, and tackling land management issues in general, and to encourage action.

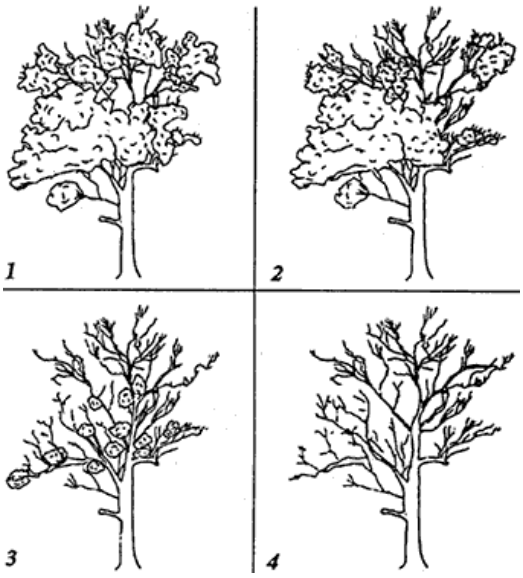
The key messages are that we must manage our environment in an integrated way if we want to achieve the most benefits from it and that it is an option for us to shape what the future environment in each region will be like - these are processes that humans can determine, at least to some degree. Complacency toward dieback may occur when vegetation appears to recover, presumably due to improved conditions (e.g. a drought may kill beetle scarabs and reduce defoliation in subsequent years)[3]. Dieback must be treated as a complex problem requiring long-term solutions.

Symptoms

The following symptoms typify dieback-affected vegetation.

Loss of vigour

Typically, the first sign of dieback is loss of vigour. Plants become more and more unhealthy, and reproduction may be affected. For example, all seed produced may be sterile. Rapid death may follow, such as in healthy vegetation affected by Cinnamon Fungus (*Phytophthora cinnamomi*), but often there are episodes of recovery, presumably as conditions improve for a time.



Stages of eucalypt dieback. 1. branch tips die, 2. extensive defoliation, 3. epicormic regrowth 4. tree death. Note that dieback in other plants may have different symptoms. Drawings by Stephen Platt.

Crown death

The uppermost small branches of trees and shrubs may die. Gradually this may extend to most of the crown. Intermittently, in good seasons, there may be recovery of vegetation, often from epicormic buds concealed beneath the bark of eucalypts, leading to clumps of healthy foliage amidst dead limbs.

Mistletoe infestation

Trees may become infested with parasites and diseases as they lose health. For example, tens of mistletoe plants may infest a single eucalypt or wattle. This is not a typical event in healthy native vegetation[2] and is probably a symptom of dieback.

Insect infestation and defoliation

The other commonly observed phenomenon is massive attacks by defoliating insects. For example, the entire foliage of trees may be consumed by species of beetles. Also, Swamp Paperbark (Melaleuca ericifolia) dieback in Rhyll Swamp, Phillip Island, coincided with defoliation by native Paperbark Sawfly caterpillars (Pterygophorus sp.) but the cause was not determined[8].

Large psyllid infestations, often attended by a colonial native species of bird, either Noisy or Bell Miner, are another indicator of unhealthy eucalypts.

Psyllids are small insects (about 1-2mm long) that live on eucalypt leaves. The insect shelters beneath a covering, called a lerp, that is usually white and may be fan shaped or variously adorned with hairs or other protuberances.

Psyllid, under its lerp shelter, on a eucalypt leaf. Large numbers of psyllids may be an indicator of declining tree health. Photo:P. Atkinson

Causes of dieback

There may be one or more causes of dieback in any particular situation. The following processes are all potential candidates for causing dieback. Not all have been confirmed as causes due to insufficient research but are regarded as probable causes by persons qualified to make such judgements[3]. They have been split into primary and secondary causes by the author because, whilst many causes are now operating, they may not have been the original cause of dieback. Several factors influencing dieback may act together, complicating management solutions.

Primary causes

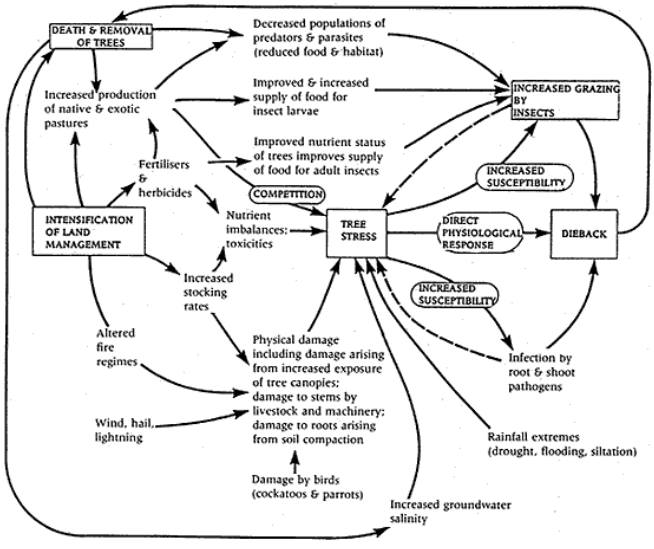
Landscape clearance, and consequent ecosystem dysfunction, is believed to be the primary cause of rural dieback. Plants that were once fully integrated into a continuous forest or woodland, that are now standing isolated in a sea of introduced plants subject to completely different conditions, could be expected to be under extreme stress.

The obvious solution, though by no means an easy task, is to restore ecosystem function or at least those parts of the ecosystem that are necessary to ensure that as many benefits as possible can be maintained. This subject is considered later in this Note.

Simple monitoring techniques allow a deeper *understanding of what is causing dieback. In this example, a tree branch has been bagged to exclude defoliating insects but allow light and air to enter. The result indicates that the tree is healthy and renders unlikely as explanations some potential causes of dieback such as old age, salting or nutrient deficiency. Photo: J. Landsberg*

Secondary causes

Once the natural ecosystem is placed out-of-balance by massive clearance, other factors come into play. They relate to both human land management and to unusual fluctuations in otherwise natural phenomena. In each of the following descriptions, it is the aim to indicate methods of monitoring or testing what is going on locally and also to suggest some of the potential remedial actions that might be taken. Please note that the actions must be used as an integrated package.



Possible relationships between factors contributing to dieback. From: Wylie, F.R. and Landsberg, J. (1990).

The diagram indicates some of the probable linkages between the factors contributing to dieback

Insect attack

Beetles (especially Christmas Beetles), psyllids and phasmids are often involved. Some insect infestation of vegetation is normal and necessary for maintenance of insect-eating birds and other animals. In healthy vegetation, insect numbers are usually controlled by birds and other natural predators, or climate. Healthy plants are able to defend against a degree of insect attack, but large numbers of insects can overcome these mechanisms. Insects may have benefited from increased pasture (beetle larval habitat), use of fertilizers (enriched food) and loss of natural predators. Monitor by exclusion bags over branches, leaf counts of insect numbers or defoliation, mapping the distribution of Noisy or Bell Miner colonies (psyllid harvesters - the feeding activity of these Miners is actually an advantage to psyllids), other small birds (psyllid feeders which are excluded by Miners), bats and Sugar Gliders (beetle feeders). Actions 1-6, 9-12.

Salinization, waterlogging, Cinnamon Fungus

Sites, particularly those that are low in the landscape, may be affected by rising salinity, waterlogging or a fungal pathogen that attacks plant roots. Monitoring includes test wells to determine salinity levels and water depth and soil and plant tissue analysis to look for pathogens. **Actions 7-9.**

Nutrient enrichment

Particularly where stock camp under the shelter of trees and in areas where fertilizers and other chemicals are used. Also, from improper disposal of nutrient rich sources such as dairy and household effluent. Monitoring may include soil and water tests for nutrients and tracking nutrient disposal from source to outlet. **Actions 2,6.**

Pathogens

Some fungi, which are normally not a problem in healthy eucalypts, may spread in defoliated trees and can play a role in dieback. Observe stem sections for cankers (dead wood surrounded by live wood). **Action 7**. The role of Cinnamon Fungus is referred to above.

Senescence

An ageing population of plants will obviously include a greater proportion of unhealthy and dying individuals. Monitoring could include looking at the response when exclusion bags are placed over defoliated branches (to look for healthy regrowth in absence of insects, no regrowth might indicate a plant has no capacity to recuperate), counting the number of saplings (to indicate recruitment of future generations) and per cent of seed germination. **Actions 5, 9, 11.**

Grazing of bark

This affects stringybark eucalypts in particular. Obvious signs of bark loss at or below breast height indicate this as a likely problem if livestock are present. **Action 5.**

Livestock can certainly play a role in dieback. These trees have been girdled by livestock. They are likely to die.

Drought

Severe droughts may be a contributing cause of dieback. They may also be involved in recovery from dieback where pest insect populations are affected.

Soil acidification

Occurs as a result of fertilizer use. A problem for pasture as well as native vegetation. Simple soil test kits are available to monitor acidity. Compare unhealthy sites with healthy ones. **Action 3**.

Airborne salt

Can affect vegetation within range of coastal winds (approx. 15 km). Monitoring may take the form of sampling vegetation to check for salts or comparing salt pruning of shoots on more and less exposed areas (leeward side of larger blocks of vegetation). **Actions 3, 9**.

Nutritional disorders

Practices associated with agriculture may have affected the availability of some essential plant nutrients. Soil tests can detect nutrient deficiencies. **Actions 2, 6.**

Deterioration of soil structure

Compaction by livestock and loss of soil conditioning organisms through application of chemicals, fertilizers and ploughing, may be a factor in dieback. Monitoring might involve testing soil penetration at healthy and unhealthy sites using a steel rod or taking equal quantity of soil samples from a number of sites and laying them on paper to count the number and diversity of soil organisms that emerge. **Actions 2, 5, 8, 12.**

Mistletoe

Mistletoe infestation at levels experienced by isolated trees in paddocks may cause the death of the tree but mistletoe infestation is probably not an initial cause of dieback. Parasites, such as mistletoe are likely to become prolific when the natural defences of a plant are reduced due to ill health2. **Actions 1-12.**

Loss of natural predators

Loss of birds, reptiles, mammals and predatory insects may be an important factor in dieback, permitting defoliating insect populations to spiral out of control. This may be helped along by Miner colonies which harvest psyllids and exclude other small birds which feed on them5 . Compare small bird populations in healthy and unhealthy areas, map the distribution and score the diversity of understorey species. **Actions 1, 3-5, 10-12.**

Altered fire regimes

Has been associated with dieback. Comparing sites which have been burnt with those unburnt may help determine if this is a likely factor. Alternatively, investigating the response of an area after burning may indicate its use as a management technique. **Action 11**.

Damage by livestock, machinery, herbicides and other agricultural chemicals

All these factors can be detrimental to plant health and may be responsible for localised occurrences of dieback. Monitoring may involve comparing the areas potentially damaged with areas that could not have been. **Actions 2,5**.

Flooding, hail, wind, frost, lightning

May cause local incidence of dieback.

Actions

How can such a complex issue be solved?

The first point to note is that whilst some dieback issues are very local (e.g. ringbarking) most occur at a landscape scale and so working with neighbours is necessary to find solutions, including Landcare groups.

The second point is that tackling dieback is as fundamental as addressing water quality, salinity and other catchment issues that affect the local human population and its environment. Many of the actions necessary are possible to achieve, particularly if every person contributes. Of course, there are barriers such as financial costs involved and physical capacity to carry out the work. Assistance on both of these issues is available through various incentive scheme, grant programs and philanthropic trusts and via government employment programs. Ask your local Land for Wildlife extension officer to identify sources of assistance. Many of the resources are available locally and this is another reason to work with neighbours, as much of the equipment and ideas can potentially come from local sources.

Thirdly, a great deal can be learnt by setting up a monitoring program. Test actions and follow the response of the vegetation. For example, photograph areas at regular intervals following treatment.

Reinstate natural processes to the maximum extent possible.

This may involve:

1. restoring understorey vegetation (e.g. Black Wattle provides essential winter food for Sugar Gliders which eat Christmas Beetles). Include a diverse array of local native species in your revegetation efforts to build in as many natural links as possible (LFW ***Note 32 'The value of understorey vegetation'***).

2. minimizing fertilizer and chemical use. Where used, they should be kept away from native vegetation and water bodies. Safer storage and disposal of chemicals.

3. creating blocks of vegetation, rather than narrow strips, and linking areas of vegetation with corridors. Blocks are less affected by edge effects[6].

4. retaining live and dead trees with hollows as wildlife habitat (LFW ***Note 6 'Wildlife needs natural tree hollows'***).

5. fencing to exclude livestock (LFW ***Note 29 'Fencing wildlife habitat'***).

6. managing nutrient disposal (contact the Department of Agriculture, Energy and Minerals).

7. quarantining areas infected by Cinnamon Fungus[7].

8. controlling salinity and erosion through revegetation.

9. revegetating areas of land.

10. controlling predators of wildlife (cat, fox). Artificial manipulation of predator populations using nest boxes or feeding supplements may be a short-term response. (LFW ***Notes 24 - fox, 25 - cats, 31- rabbits, 14 - nest boxes***).

11. reinstating natural fire regimes

12. leaving leaves, twigs and branches where they fall in selected areas managed for dieback control and wildlife habitat.

13. and other measures that address the primary

cause or potential for secondary causes to start up or continue operating. Taking greater care to avoid direct damage to vegetation (e.g. as caused by vehicle movements) is also important.

As a general rule, begin with protecting what is still healthy first.

While it may not be possible to save an individual tree or other plant affected by dieback, due to the poor state of its health, it may be possible to preserve the benefits by allowing it to regenerate by fencing the area and other means (refer Land for Wildlife ***Notes 13 'Natural regeneration - principles and practice'*** and ***16 'Natural regeneration - case studies on the farm'***).

In many situations, going back to the original forces operating in an ecosystem is not an option due to the extraordinary extent of changes that have occurred.

Alternatively, you can choose species selected to withstand the new regimes, which may include exotic species but should not include species which have the potential to invade native vegetation (environmental weeds). A list of environmental weeds is available from Land for Wildlife extension officers. If this choice is selected, then many values associated with local species will be lost.

What will happen if nothing is done?

We can guess that a new balance in the ecosystem will be achieved. However, this new balance may not include as many benefits for humans as the previous one. Saline unproductive land, increased management inputs, reduced water quality, less wildlife and so on are likely.

Tackling dieback is part of an overall need to manage land more sustainably. Your contribution today will benefit many future generations of people who live on, and rely on, the land.

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35. Encountering wildlife without feeding

Introduction

Feeding wildlife is an exceptionally popular activity and most people will have done it at some time. But is it a good idea? This Note looks at the pros and cons of feeding wildlife so that you can make better decisions about your own actions.

The main reason people feed wildlife is to have a close encounter with a wild animal. This Note also looks at how close encounters can be obtained without harming wildlife or posing a risk to humans.

Feeding wildlife - issues

There are a number of convincing arguments against feeding wild animals. They include:

- potential dependence on fluctuating food sources supplied by humans, rather than natural sources.
- inadequate dietary balance.
- alteration to the community structure of the animal population, due to increased resources, with potential consequences for other species of plants and animals.
- the potential for transmission of diseases or harmful chemicals as a result of contamination of the food or feeding location or direct transmission between animals at the feeding station. The feeding station may also act as a focus for predators.
- potential conflicts arising between human social and economic needs, and wildlife, including human disease transmission.

Case studies

Choughs and orchids

White-winged Choughs live in eucalypt forests and woodlands, in colonial groups of 2-20 individuals, where their main natural food source is invertebrates. Choughs are large native birds and are an important part of natural ecosystems. They have a lot of character and many landholders enjoy their company.

To the north of Melbourne, Chough numbers have apparently increased as a result of regular feeding with bread supplied by local landholders. When not being supplied with food from our larder, Choughs seek natural foods. Because Choughs are very systematic feeders, working together to locate food items, they can cause considerable disturbance to the bush. One food item that can be severely affected is orchids. The Choughs dig up the orchid tubers, systematically excavating complete colonies. This probably happens in nature to some extent. However, the artificially high numbers of Choughs, and acquired taste for high starch foods, such a bread supplied by people, is having major unnatural consequences for orchid populations in the foothill areas north of Melbourne and perhaps elsewhere. One particularly rare species of orchid has had to be placed in an enclosure to exclude Choughs. The problem is not the Choughs but the imbalance in their numbers brought about by feeding. Choughs *would* benefit from a healthier ground layer of twigs and leaves in which to forage for insect prey.

Sulphur-crested Cockatoos and house damage

Sulphur-crested Cockatoos can cause considerable damage to timber houses, in particular western red cedar window and door frames. Cockatoo beaks grow continuously, and regular use is probably important to maintaining beak condition. In the wild, cockatoos have often been observed to bite off twigs and small branches from the trees they are resting in. Cockatoos also excavate holes in the wood of trees in search of wood-boring grubs and enlarge nest hollow entrances using their strong beaks. These activities might help explain why cockatoos like to chew wood.

A common factor, which indirectly contributes to the damage caused by cockatoos to houses, is the provision of food by the victim or a near neighbour which attracts the birds to the area.

Crimson Rosellas

A brilliantly coloured bird, the Crimson Rosella is exquisite to look at and readily becomes tame enough, when fed regularly, to alight on humans. In

the wild, wattle and eucalypt seeds form a major part of the diet. At regular feeding sites, large numbers of rosellas may congregate in anticipation of food being provided. These groups typically include a lot of immature individuals which are naturally abandoned by their parents as they become independent.

Problems encountered by artificially fed birds include irregular supply (e.g. a lower number of holiday-makers at parks in winter leaves a reduced food supply), an unbalanced diet of seeds they would not encounter in the wild, and the flocking of starlings with rosellas. Starlings are introduced birds that compete with native wildlife for breeding hollows and can benefit from food left for native bird species.

Red Wattlebirds and beri-beri

Red Wattlebirds are raucous birds common in the dryer forests of Victoria and the suburbs of Melbourne. Occasionally, these birds have been found on the ground convulsing, always in winter months. Frequently, this symptom is followed by death. It has been suggested that the most probable cause of these deaths is thiamine deficiency. Such a disease, in humans, causes the nerve disease beri beri which is characterised by pain and paralysis of the extremities and accompanied by severe emaciation or swelling.

Red Wattlebirds collect their energy requirements from nectar, manna, honeydew or psyllids (sap-sucking insects) which are high in carbohydrates but low in protein. Like all honeyeaters, they require a supplement of insects which supply essential proteins. Red Wattlebirds 'hawk' a number of insects, big enough to supply the needs of this large bird and worth the energy expenditure, from the air each day for this reason. During winter there is a marked deficiency of large insects in Melbourne and so Red Wattlebirds normally migrate to northern Victoria where milder winters support more large insects.

Dr. David Paton, of Adelaide University, has suggested that development of the Melbourne suburbs, which has included planting many nectar-producing shrubs and trees (e.g. Western Australian eucalypts, such as Eucalyptus caesia, red-flowering Yellow Gum E. leucoxylon var. rosea, Red Ironbark E. sideroxylon and banksias) may have encouraged Red Wattlebirds to remain in Melbourne over winter. Sugar solutions supplied in bird feeders by humans may have also contributed to the reluctance of Red Wattlebirds to head north on their usual migration. Dr. Paton has estimated that a Red Wattlebird would need to consume about 500 small insects per day to obtain the same protein (and thiamine) as is available from large insects during warmer months. This would be a major drain on the time and energy needed to collect and defend major carbohydrate sources (nectar producing plants, such as eucalypts).

So, the birds that remain behind may suffer from inadequate intake of thiamine and suffer the effects of beri beri.

Seed bells

Commercial seed bells are widely available. However, many questions remain unanswered about their potential effect on wild bird populations. What are the levels of pesticides in seed bell grain? What effect does indiscriminate artificial feeding have on wild bird populations? What other ingredients are consumed by birds using seed bells? Wood glues are used to bind the seed together in some bells. Are viable weed seeds present in seed bells that might be spread by birds?

Artificial feeding has the potential to disrupt the dietary balance of natural populations, attract predators, disrupt social behaviour and spread disease. Increased numbers of animals may affect other species in the area.

Kookaburras and minced meat

In nature, Kookaburra families vigorously defend areas of bushland against rival kookaburras. When confronted with their own reflection in a house window they may attack it, thinking it to be another individual. In one extreme case, ten windows were broken. Often the birds are first attracted by the landholder's food offerings. Minced meat, the food usually proffered, is not the same as natural dietary items.

Kangaroos

Kangaroos live in social groups and in the wild consume coarse native grasses and forbs. They are readily attracted to food offerings by humans. Complications that arise include attacks by males, asserting dominance on humans as they vie for female attention during the breeding season (kicks by the hind feet can cause serious injury), physical abnormalities, such as extended toenail growth due to insufficient movement over hard surfaces, and increased incidence of the disease lumpy jaw which is caused by infection by several organisms entering the jaw around a tooth or via the gums. The main visual symptom of lumpy jaw is an open decaying wound around the jaw area. The common name is derived from the response to infection whereby additional layers of bone are laid down around the infected area.

For the above reasons, and in the best interest of wildlife, Land for Wildlife recommends against the feeding of wildlife. However, in instances where it does occur, irregular feeding is preferable to regular feeding and quality foodstuffs from natural sources are better than manufactured products of unknown origin.

Weaning animals off human food sources

For wild animals that are partially dependent on food supplied by humans, it is best to reduce the supply over a period of time, thus forcing the animals to rely on natural sources whilst not causing an immediate food shortage. Wildlife that has been raised in captivity may be entirely dependent on human food sources and expert advice should be sought as to whether release to the wild is an option and legal. Sick or injured animals should be taken to a Wildlife Shelter where experienced carers can look after the animal.

How to encounter native wildlife without regular feeding

There are steps that you can take to increase your chances of encountering native wildlife without the need for regular feeding.

Habitat management

You can improve the management of habitat in the area that you visit to view wildlife. For example, by maintaining a healthy understorey and leaf and twig litter layer and eliminating weeds.

Near the home or viewing area, you may increase the wildlife visiting by planting local native food plants that provide nectar, fruits, different foraging substrates (e.g. bark types) and a shallow source of water for birds away from vegetation that could conceal predators. Old feathers, natural fibres (wool) and short stems of dried grass can be used to attract birds in the breeding season. Place them in a tree or shrub fork, away from potential danger from predators, near a place from where you can observe the animal whilst remaining concealed. A few nest boxes can be added to increase the chance of seeing hollow-nesting and roosting species near your home (see Land for Wildlife ***Note 14 'Nest boxes for wildlife'***).

Understanding wildlife

Increasing your knowledge of wildlife will help you to locate and view species. Become familiar with the habitats that animals use, their patterns of activity, where they breed, shelter and feed. Waterholes are often good observation points.

Learn how to determine which animals are in the area by looking for tracks and traces left by animals passing by and listening for the noises they make. For the more determined, remotely operated cameras and hides can be used to view wildlife with minimal disturbance. Some excellent audio tapes and videos are available, but nothing beats learning from an experienced naturalist or researcher. Fortunately, there are many naturalist clubs available in Victoria.

Learning about wildlife and searching for it in the wild, though less predictable than feeding, adds to the adventure of encountering wildlife. Alternatively, some species can be viewed at close hand in captivity (see 'zoos, sanctuaries and animal parks' in the Yellow Pages telephone directory).

Avoiding danger

Although most of our wildlife is harmless, close encounters with some species in the wild poses a degree of risk. Care should be taken whenever you are in bushland areas where the presence of dangerous wildlife may go undetected. Sturdy, protective clothing should be worn, and first aid materials kept close at hand. Animals of unknown capacity should be regarded as dangerous until better information is obtained and are best avoided. Attempting to kill the animal increases the risk substantially. Avoidance is a better solution. Close contact with animals during the breeding season should be avoided. Wildlife is more likely to be aggressive at this time and you are more likely to cause disturbance and stress to the animals or their young. Wildlife faeces should not be handled due to potential contamination by disease-causing organisms.

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36. Victoria's native freshwater fish

Unlike most other vertebrates, fish and their habitats remain largely unseen and are a hidden, but important component of the natural environment. Their general biology and ecological requirements remain a mystery to most people, while degradation of their habitat, and other threats they face, usually pass unnoticed. Any harmful actions that occur within a catchment may have a profound effect on the aquatic environment, and its fish populations.

Because angling is a major recreational activity in Victoria, most of the interest and research that exists on freshwater fish tends to focus on the larger angling species. However, the smaller native fish are just as important.

Forty-five species of essentially freshwater native fish have been described in Victoria, ranging from the Murray Cod, which can grow to over one hundred kilograms and is highly prized as an angling species, to the smaller galaxias, some of which reach a maximum size of just 40 mm. Most native fish are migratory, many requiring access to an estuary or the sea as part of their life cycle. They are dependent on a system with clean water and quality habitat that will supply shelter, food, breeding sites and other habitat requirements.

Three species of native freshwater fish, which are likely to be found on private land, are profiled in this Note, as well as a discussion of threats to fish and their environments and what you can do to help conserve native fish on your property.

Tupong Pseudaphritis urvillii

Tupong Pseudaphritis urvillii

Features: Small to medium-size (to 360 mm), slender fish, flathead like appearance; tubular body; somewhat compressed posteriorly; eyes set close together, almost on top of the head.

Habitat: In a variety of estuarine and riverine situations. In streams, prefers areas of slow-flowing water and is normally found amongst debris and leaf litter, or under logs and overhanging banks.

Biological notes: Males found in environments close to or under estuarine influence. Females migrate downstream towards estuary to breed. They are generalised carnivores, taking a wide range of bottom-dwelling (benthic) organisms, such as insects, worms and small fish. Status is widespread/common.

River Blackfish Gadopsis marmoratus

River Blackfish Gadopsis marmoratus

Features: Small to moderate size (to 600mm), dark, mottled, slimy fish with elongate tapering body; single long dorsal fin.

Habitat: Preferred habitat is clear, well oxygenated, flowing streams with abundant cover such as timber debris, rocks and undercut banks. Also occurs in slow-flowing lowland rivers, coastal and inland lakes.

Biological notes: Are secretive, benthic fish, which are not migratory and deposit eggs in hollow logs and rock cavities. Is predominately a carnivorous bottom feeder, particularly on insect larvae. Status is indeterminate and declining in its abundance and its range.

Southern Pigmy Perch Nannoperca australis

Southern Pigmy Perch Nannoperca australis

Features: Small (to 75mm), oblong, moderately compressed fish with large head; brownish-green body; darker dorsally; two horizontal bands of brown-black spots occur along the body.

Habitat: Prefers shady, weedy, slow-flowing or still waters, such as small creeks and backwaters of large rivers, as well as dams, lakes and billabongs. Prefers weedy aquatic vegetation.

Biological notes: Spawn in response to rising water temperatures from late winter to early spring. Eggs are randomly scattered over the bottom, loosely adhering to rocks and vegetation. A carnivorous fish, feeding on a variety of invertebrates. Status is common/ widespread.

How do I know if I have native fish on my property?

Besides angling, there are other less destructive methods to monitor fish on your property. If the water in your stream, river or wetland is clear, you might be lucky, if you sit quietly on the bank, to actually catch sight of native fish. They might be coaxed out by throwing breadcrumbs or worms into the water. This should only be done occasionally to observe the fish and not as a way of feeding the fish. At night, a spotlight can be used to catch sight of nocturnal species, such as eels and blackfish. However, these techniques make identification difficult. Dip netting using a hand net, may allow you to catch fish.

What type of habitat do native freshwater fish require?

Water quality

Clean water, containing no pollutants or high levels of sediment or nutrients, is vital for a heathy stream environment. Oxygen dissolved in the water is the 'air supply' for fish and is vital for fish to survive. Fish also require stable temperatures which influence physiological and behavioural responses, with each species having an optimal range. Salinity and pH (acidity) also have effects on fish populations.

Flow regime

Fish and other biota of Victoria's streams are adapted to natural flow regimes which are influenced by seasonal rainfall. Flooding can act as a trigger for some species to migrate and or spawn. Reduced flooding also reduces the chance to flush sediment and areas of poor water quality.

Nutrient sources

Fish are dependent on the flow of nutrients through the food chain. Organic material (leaves, branches, bark) from native riparian vegetation is very important at the beginning of the food chain, which in turn is processed by microbes in the water, then by various invertebrates, which then become food for fish.

Habitat structure

The number and diversity of fish is usually related to the quality of the habitat. Fish require habitats that may provide territories, nutrients, shade, and spawning sites, as well as shelter from fast flowing water, or predators and competitors. Instream objects such as logs, rocks, aquatic vegetation and leaf and twig litter are important in providing habitat. Native riparian (streamside) vegetation is essential for a continuous supply of instream habitats and nutrients, for stabilising banks and acting as a filter of sediments and agricultural chemicals, fertilizers and waste.

What are the threats to native freshwater fish and what are the solutions?

Riparian (streamside) vegetation removal

Riparian vegetation is vital to the functioning of stream ecosystems. One of the main threats to streams is the removal of this native vegetation. Replacement with exotic species can also be detrimental to fish and other aquatic fauna. For example, deciduous trees, such as willows, alter the timing, quality and consistency of the nutrient supply. The leaves fall all at once, not continuously, as in Australian evergreens such as eucalypts. Willows can also impede flow by 'choking' small streams (see LFW News Vol 2 No.3).

Solution: Maintain and enhance streamside vegetation by fencing from stock and by weed control. Revegetate with indigenous natives including trees, shrubs and groundcovers.

Habitat removal

The removal of instream habitat by de-snagging and general clearing has been widespread in Victoria and is detrimental to species such as Blackfish which is dependent on instream objects for habitat and spawning sites. Channelization removes all instream habitat for fish. Recent studies indicate that there is no scientific basis behind the removal of snags for the control of flooding.

Solution: Removal of instream habitats should be avoided. Trees and logs should be left as they are, and if missing from the stream, add some logs and branches. Avoid channelization.

Sedimentation

Sedimentation can occur from poor land management practices, such as extensive clearance of native vegetation or insufficient retention of pasture cover and overgrazing. It can also occur during dam and road construction, from unmade roads and cattle access points. The blanketing of substrate by sediment can lead to a decrease in usable habitat and unsuccessful attachment and smothering of fish eggs, while high levels of suspended solids in streams may be lethal to fish eggs, larvae and sometimes, even adults.

Solution: The broad strategy is to decrease erosion and prevent sediment reaching the stream by maintaining vegetation cover on all land, particularly along streamsides. Silt traps can be used during road construction and cattle access to streams should be restricted. Riparian vegetation can act as a filter zone.

Reduced water quality

Toxic spills, such as from farm chemicals, can create lethal situations while use of sprays in farm activities and effluent discharge can slowly decimate fish populations. Low level water release from impoundments can reduce water temperatures dramatically and decreases oxygen content.

Solution: Wise use and storage of farm chemicals. Riparian vegetation zones will help filter runoff from surrounding areas.

Barriers to fish passage

Fish passage problems are primarily a result of dams, weirs, drop structures, causeways and road crossings which physically block upstream movement.

Solution: Causeways and road crossings should be designed to avoid abrupt drops. Rocks and logs can be built up next to vertical drops to act as a 'fish ladder'.

Introduced species

There are thirteen species of introduced fish in Victoria. Many of these prey and compete with native fish. Species such as carp can also increase turbidity and destroy aquatic plant beds.

Solution: Avoid introducing non-native species to your dams, wetlands and streams. Provide hiding places for native fish.

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Bill O'Connor (CNR - FFB), Steve Saddlier (NRRI) and Tarmo Raadik (CNR - FFB) contributed to this Note.

37. How can I help white-bellied Sea Eagles on private land

White-bellied Sea-Eagles on private land

Very few properties in Victoria can boast that they are home to the White-bellied Sea-Eagle, one of our truly majestic wildlife species. Those that do have a unique and valuable attraction.

Since about half the nest sites in Victoria occur on private land, private landholders can make a significant contribution to the protection of the White-bellied Sea- Eagle. This Note provides a brief overview of the species, its habitat requirements and threats to its survival.

About the White-bellied Sea-Eagle

The White-bellied Sea-Eagle *(Haliaeetus leucogaster)* is one of Victoria's largest and most distinctive birds. It is a bird of prey with a white body, around 800 mm long (females are slightly larger than males), broad greyish wings and a short pale wedge-shaped tail with a white tip. Juveniles are speckled in appearance. A detailed description of the appearance of birds from juvenile plumage to adulthood is provided in Marchant and Higgins (1993). Juvenile and immature White-bellied Sea-Eagles can be confused with Wedge-tailed Eagles *(Aquila audax).* Full adult plumage is acquired at three and a half years.

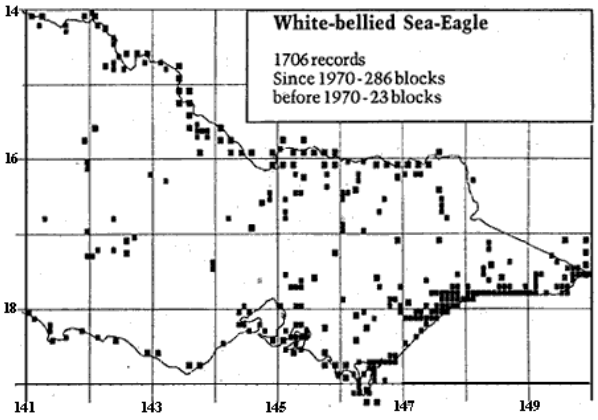
White-bellied Sea-Eagles are generally seen alone or in pairs, although they may occasionally congregate where food is abundant. The species is an opportunistic carnivore feeding on birds, mammals, fish, reptiles and carrion. Birds often have favoured roosts on prominent trees and soar in large circles with wings upswept during flight. When hunting, they may hover and dive close to the water. Pairs may hunt together and often harass other bird species to steal their food.

Sea-Eagles usually form pairs for life and once a home range has been established, will remain in this general area. Although we don't know how long they live, some large raptor species (of similar size to White-bellied Sea-Eagles) can survive up to 25 years in the wild.

This poses a particular problem. A long-lived species may continue to appear plentiful long after its production of offspring has declined. Thus, monitoring the success of clutches is important to determine how well White-bellied Sea-Eagles are surviving changes to their environment.

Where do they live?

These magnificent birds occur along the coastline of Australia and also range inland over large rivers and wetlands. In Victoria, they are most common between Gabo Island, in far East Gippsland, and Wilson's Promontory. Populations also exist along the Murray and Goulburn Rivers, and there are scattered records across the State. Inland records are usually associated with impoundments (dams) that have plenty of large trees in surrounding country. Birds favour forested coasts and forested margins of inland waterways.



Distribution of the White-bellied Sea-Eagle in Victoria. Source: Atlas of Victorian Wildlife, CNR.

Breeding areas are traditional, and several nests may be used in one area. Nests are usually found near water, in tall live or dead trees or on remote coastal cliffs. River Red Gum Eucalyptus camaldulensis, Forest Red Gum E. tereticornis and Southern Mahogany E. botryoides are commonly used as nest trees. On islands free of predators, nests may be close to the ground in shrubs or rocky platforms. These birds rarely use artificial structures as nest sites.

Like the Wedge-tailed Eagle, the White-bellied Sea-Eagle builds very large nests. Nests can be very conspicuous being made of sticks lined with leaves and, as new material is added, can become very large. They can be used for years in succession. One or two whitish-yellow eggs are produced usually between April and August, but the timing of breeding can vary.

The White-bellied Sea-Eagle fishing.

Are they in trouble?

The White-bellied Sea-Eagle is considered to be rare in Victoria and is listed under the Flora and Fauna Guarantee Act 1988 as a threatened species and is also protected under the Wildlife Act 1975. The total Victorian population may be only 100 breeding pairs, with about 25 pairs around the Gippsland Lakes, 25 pairs around Corner Inlet and a further 50 pairs scattered across the State. It is likely that the species has never occurred in large numbers.

Habitat destruction is probably the most significant threat to the White-bellied Sea-Eagle, resulting in the loss of nesting sites and causing birds to nest in less suitable areas. Decline of the species over much of its coastal range could be presumed because of the widespread clearing of coastal forests for agriculture and urban expansion.

Reduced fish populations due to commercial exploitation and pollution may have had an effect on Sea-Eagle numbers.

Birds are very sensitive to disturbance by humans, particularly during the breeding season and can desert nests and young.

Although the significance of other threats to the species is unknown, they may include direct or indirect poisoning during control programs for foxes and rabbits, deliberate shooting, eggshell thinning because of the past use of DDT, and food chain contamination by heavy metals. 1080 baiting attempts to minimise risks to non- target species, and since raptors are not highly susceptible to 1080 poison, this threat may not be high.

Contamination of food sources by poisons, such as mercury, needs investigation since this has been found to cause declines in other species of Sea-Eagle overseas.

Historically, this species, like other large birds of prey, such as Wedge-tailed Eagles, has been viewed in some rural areas as a predator of livestock. The species has also been viewed unfavourably by some fishers. It is very unlikely that the species could be considered a significant predator to either livestock or fish due to its low numbers. Shooting of White-bellied Sea-Eagles is both illegal and unjustified.

What can you do?

Retaining and restoring habitat on your land will not only benefit the White-bellied Sea-Eagle, but many other species of flora and fauna, as well as your property. Fencing-off trees will protect them from stock damage and also encourage regeneration. Protecting and enhancing vegetation can also provide shelter for stock and reverse problems such as soil erosion and salinity. Riparian habitat along rivers is an important refuge for many species of flora and fauna. Fencing off trees along rivers can not only protect many species of birds, mammals, fish, amphibians and invertebrates, but also improve the condition of waterways and quality of water in them.

By keeping your distance from nest trees during the breeding season, you can give the birds the best chance for successful breeding. These beautiful birds are also more likely to keep returning to your property to breed, year after year.

Sticks are used in nest construction and it is important that a supply is available in the general area.

By carrying out 1080 poisoning programs according to guidelines and using chemicals responsibly, the possible threat to species such as the White-bellied Sea- Eagle can be minimised.

Studying White-bellied Sea-Eagles

There have been few studies carried out on the White- bellied Sea-Eagle in Victoria. We need to gain a better understanding of whether birds are breeding successfully, what their habitat needs are and what activities threaten them. As private landholders, your help could be invaluable. By recording details about where nests are found, whether the birds breed successfully each year as well as any interesting historical, ecological and behavioural details, we will improve our understanding of how this majestic bird is faring. You can also help to identify threats and their importance to the species' survival. This improved knowledge will aid in identifying the best ways to protect birds and their nests.

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38. The value of dead wood to wildlife and agriculture

Those dead trees and branches in paddocks and amongst bushland could have more value than many landholders realise. The temptation to turn them into firewood has led to their loss from many areas of Victoria. However, it is worth considering their considerable range of values before taking steps to remove dead wood from a property.

The value of dead wood

Dead wood provides:

- an excellent roost site for bats. Bats are insect eaters and look for food over paddocks as well as amongst trees that form the basis of woodlots and shelterbelts and which contribute to agricultural production. Bats consume many agricultural pest species, such as the Rutherglen Bug, thereby reducing the need for less desirable chemical controls. A study of the Lesser Long-eared Bat in northern Victoria found that, of the roost sites found within trees, over 75 per cent were in dead trees and others were in dead sections of living trees. This may be related to the different insulating qualities of dead wood. A dead tree or branch can thus indirectly contribute to natural pest control and, consequently, reduce reliance on expensive pesticides.

- perching sites for birds of prey, and other species which pounce on ground-dwelling prey, such as robins and Cuckoo Shrikes, which help to keep agricultural pest species in check. For example, the major component of the Wedge-tailed Eagle's diet consists of rabbit, a major agricultural and wildlife habitat threat. At night, owls may be found using dead trees or branches, whether in a forest or more open situation, as observation points for hunting.

- sources of the largest hollows which are used by black cockatoos, large owls, sugar gliders and other wildlife species. Eighty-five per cent of the endangered, Red-tailed Black Cockatoo's nest sites, in western Victoria, were in dead River Red Gums. Large old trees have features that young trees do not (see ***Note 18 'Old trees for wildlife'*** for more detail) and dead trees are often the last representatives, in many districts, of the largest trees.

- important sources of insects for insect-eating birds. Decaying wood and flaking bark are particularly rich sites for insects and birds take advantage of this. For example, sittellas spend a third of their time looking for prey on dead branches rather than live ones. This sets them apart from tree-creepers which prefer to feed on living surfaces. More insect-eating birds around a property helps keep insect numbers low, reduces reliance on potentially dangerous chemical controls, and assists with protecting the health of bushland used for shade, shelter or to prevent land degradation.

Dead trees and branches on private land are very important resources for wildlife. They provide habitat for insect-eating species and that's good

- nest sites. Some bird species place their nest solely or primarily on dead branches. For example, sittellas are obligate dead wood nesters and require vertical dead branches for breeding.

Flycatchers and Cuckoo Shrikes nest most often on horizontal dead branches. Dead branches are often associated with hollows and hollow development. Mammals (including bats), birds, reptiles, amphibians and invertebrates use hollows. Dead branches may be habitat in themselves for a number of invertebrate species. Twigs are an important nesting material being used by a wide variety of species, including eagles. Cuckoos use dead branches for singing, an important part of courtship prior to breeding.

- a source of lichen and cobweb that is used by birds in nest construction. Fantails, Cuckoo Shrikes, robins, sittellas, thornbills, warblers, and many honeyeaters use spider web either as an agent to attach the nest or to bind the other nest materials. Lichens and cobweb are most abundant on dead wood.

- the immediate source of soil nutrients. The decay of dead plant material is the major source of soil nutrients. The return of nutrients to the soil is essential if it is to remain productive. Removal of dead plant material from a bushland remnant is like eroding the capital on a long-term investment. Eventually, the bush will be depleted of nutrients.

- supplies of logs, branches and twigs that provide important habitat for ground-dwelling wildlife such as Bush Stone-curlew, nightjars, reptiles and small native mammals and in-stream habitat for fish and invertebrates. For example, the Murray Cod, an extraordinary native fish and important angling species, spawns in hollow logs.

- cache sites for butcherbirds. Butcherbirds wedge food in a tree fork or on a spike and tear their prey apart, the feet being too small to hold it down in the manner of a hawk. The butcherbird's name is derived from this habit. Food includes insects, mice, reptiles, birds, including nestlings, and plant material.

Biologists call our big old trees ‘veterans’ because they’ve been around a long time and developed a unique character that is particularly valuable for wildlife. When they die, many of these values are retained. A dead tree remains standing for about 50 years before falling where it continues to supply habitat for ground-dwelling species of small mammal and reptiles, and continues to rot, supplying food to animals inhabiting the soil and plants.

Are dead trees good firewood sources?

As firewood, dead trees have the advantage of being immediately useable but what about the disadvantages? They are often hollow or rotting making the effort of felling them worthless and adding to the danger. Dead wood is extremely hard to cut and can quickly blunt a chain-saw blade or axe. Large dead trees may take hundreds of years to replace naturally. Felling large dead trees for firewood is an unsustainable activity on most properties.

The solution to personal firewood supply

The solution to firewood supply for your own use is to establish a woodlot so that old dead trees can be retained for their wildlife and other values and quality wood is available for your own use. The advantages of growing trees specifically as firewood are numerous. The trees can be harvested when of an appropriate size for easy handling (say 20 cm diameter), the wood is cut green so that it is easy on your chain saw, when drying it often splits (depending on species) allowing for straightforward axe work and there is little risk of your effort being wasted on a hollow plant. What’s more, natural areas can be protected.

If you don’t have a woodlot, and need a source of wood whilst one develops, then living trees of small diameter are the best choice for firewood. They have the advantages described above and, most importantly, they are easier to replace than big old dead trees which may be hundreds of years old.

Cutting green timber means that you will need to plan ahead one to two years to allow the wood to dry out. The shrinkage caused by drying the wood is what leads to splitting and helps with axe work. Planning ahead also has the advantage of ensuring that wood will be available in future years.

A 1995 study of firewood use in Victoria concluded that more firewood comes from private land than public land, that over half the volume of firewood used is collected by households directly and not via the market and that firewood consumption, by volume, is roughly equal to sawlog and pulp production combined. Because of the small area of private land that is treed, the impact of collection on private land habitats is probably far greater than for public land.

Alternative sources of firewood include recycled timber from fencing, tip sites, and industry; timber discarded by tree loppers, and sawmill off-cuts. Solar heating can reduce the need for timber.

Thus, the decisions of private landholders about long-term supply of firewood is important in determining the quality of habitat available to wildlife on private land.

What about supply for commercial purposes?

Commercial firewood suppliers may be interested in removing large dead trees because they don't need to wait for the wood to dry before being sold. For the landholder, this means getting a once only cash return for irreplaceable trees. If you are interested in commercial growing of timber, why not set up as a regular and reliable supplier by establishing a woodlot or agroforest. This could be an aim of your Landcare group. In this way your return can be an on-going supplement to income from other sources.

Safety issues

Dead trees and branches can pose a risk to public safety, as can live trees and branches. The risk of tree or branch fall increases in extreme weather conditions, such as during storms.

Where pedestrian traffic is high it may be wise to reduce the risk to people by removal of the tree or branch or by using suitable restraints. In other areas of the property, where the main aim is to retain wildlife habitat, suitable safety warnings, that apply to any venture in bushland, should be given.

A tidy farm?

It is important to recognise that a well-managed farm may very well have a healthy ground layer of logs, branches, twigs, leaves and shrubs in appropriate areas. The practice of 'tidying up' a farm by removing logs and branches, whilst still appropriate in some areas, such as where they interfere with agricultural machinery or in fire breaks, is also recognised as being incompatible with the objective of sustainability.

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39. Creating an environmental weed strategy

What are environmental weeds?

Environmental weeds are plants that invade native ecosystems and adversely affect the survival of indigenous flora and fauna. Environmental weed invasion is among the most serious conservation and land management problems in Victoria.[1]

Environmental weeds may compete with indigenous plants for factors such as nutrients, moisture and light. They can prevent natural regeneration, reduce wildlife habitat, change the movement of water, increase soil erosion, introduce poisons into the soil or poison animals, change fire behaviour and may introduce foreign genes into local plant populations. As a consequence, environmental weeds can have a large effect on the health and survival of indigenous plants and animals.

Prevention is better than the cure

Environmental weeds should be treated as a symptom of a problem, not just the cause. You should continually inspect your property (and even your neighbours) and be alert to new weeds. Action should be taken to prevent these weeds spreading. Preventing new invasions of weeds is very important and is cheaper and more successful than eradicating weeds once established. Prevent the invasion of weeds by minimising disturbance of soil, avoiding importing foreign soil, disposing of garden clippings via council services or by incineration, keeping tools, equipment, footwear and vehicles clean of weed seeds or fragments, by removing stock and stock feed from bushland, avoiding fertiliser drift near your bushland, using local native species and avoid planting potential environmental weeds in your garden. Educating others about the threat of weeds to biodiversity is another step to preventing the spread of weeds.

Why create a weed strategy?

Most environmental weed management on private land (and public land) consists of going out and spraying something or pulling it out of the ground, often at an ad hoc level.

Very little thought is given to planning an attack which would give the most effective and efficient control.

A lot of time and money can be wasted. To be effective, environmental weed management should be integrated in your management approach and ecological consequences should be considered.

A strategy can help the landholder make day-to-day and long-term decisions and to allocate limited resources to achieve set tasks efficiently and effectively.

Steps in developing a strategy

Step 1 Recognition of the problem

Step 2 Determining the situation

Step 3 Consultation

Step 4 Goals and objectives

Step 5 Management planning and priorities Step 6 obtaining funding and resources Step 7 action - on the ground

Step 8 Monitoring and recording

Step 9 Review

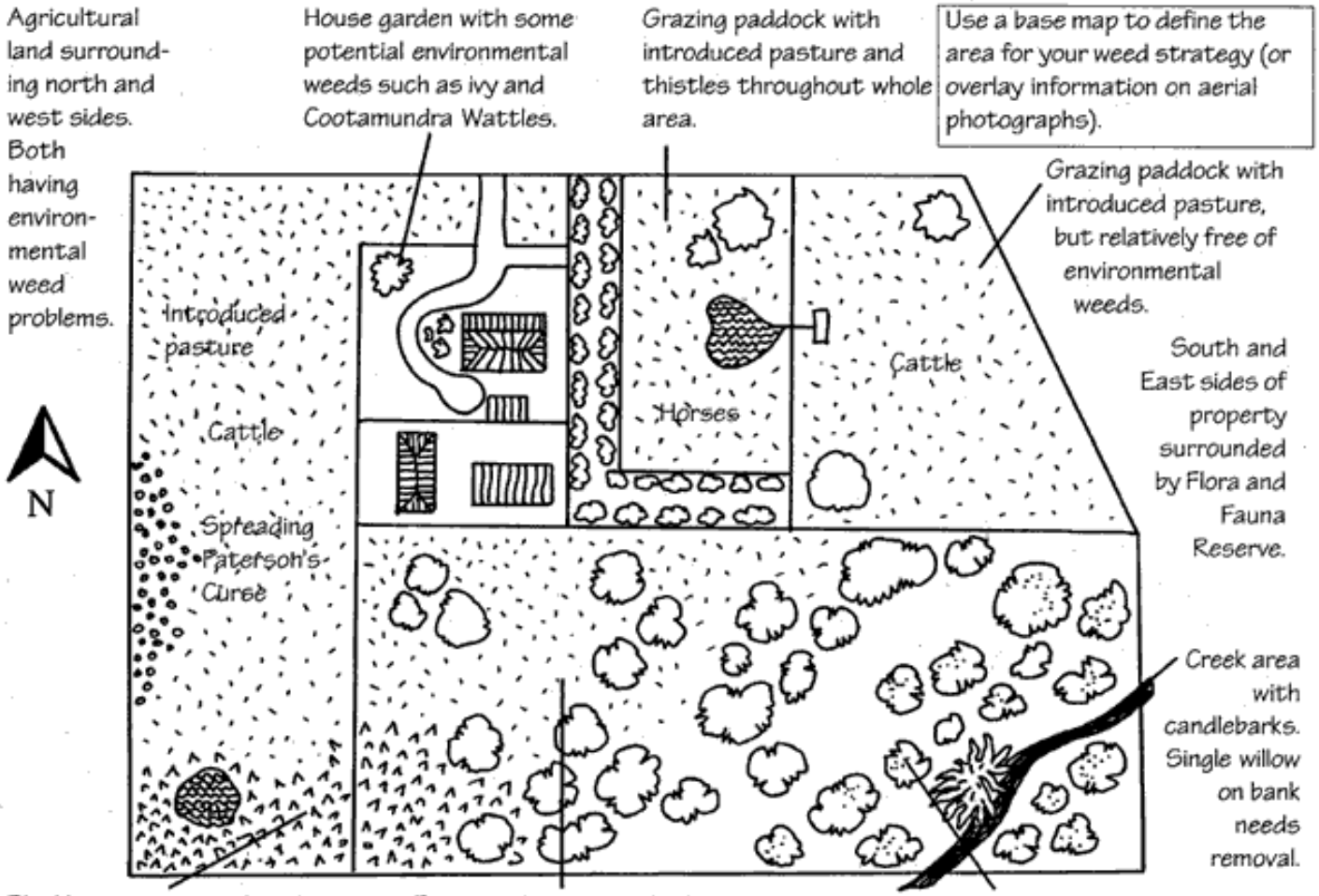
Step 10 Sharing information

Step 11 Ongoing commitment

Step 1: Recognition of the problem

The most important step in dealing with environmental weeds is to realise that there is a problem, and that something should be done. Monitor the changes you observe on your property and after some time you will become aware of any problems with weeds. If you need further assistance, refer to the organisations and contacts and the list of references at the end of this note.

Figure 1: Example of a simple sketch map that can be used in preparing an environmental weed strategy.



Step 2: Determining the situation

Collecting information

It is your choice as to how much detail you wish to collect. You may wish to just put information on a simple map, or to do just a written report or both.

Define the planning area

Identify the geographic area of concern and map it. At this stage, you should decide whether you should look at the area within your fence line, at a Landcare group level or at a catchment area.

You can decide if you would like to draw your own base map, use an existing topographic map or consider overlaying information over aerial photographs.

Who is responsible?

If you are looking beyond your fence line, identify who owns and manages the land/water and all the people who use that area.

Environmental information

Environmental weeds - list all weeds found on the site and collate as much information about each species. If you are not sure about the identification of weeds, seek advice from local naturalists or send specimens to the Herbarium at the Royal Botanic Gardens, or use the references listed at the end of this note.

The following points should be noted:

- weed distribution and abundance (map if possible). Plant lists, including weeds, can be obtained from your local council or Catchment Management Authority.
- is it declared noxious? - legal requirements.
- ecological and biological information such as life history, tolerance to light, response to fire, habitat preferences, rate of spread and mechanisms for dispersal. For example, being aware of the life history of thistles, Ragwort or Paterson's Curse will allow you to direct your energies towards removing these plants at the rosette stage, rather than the upright stage (easier, cheaper and far less herbicide, if any, is used).
- impact on the ecosystem such as changes to structure and composition of invaded communities, changes to hydrological, light and fire regimes, plant interactions, competition and recruitment, and plant and animal interactions including pest animals (e.g. the use of blackberries by wrens and foxes).
- known management options such as prevention methods, treatment techniques, best time for control, best integrated management strategy, follow up and replacement indigenous plants.

Pest animals

List all pest animals and their population levels. Foxes spread blackberry seeds in their droppings while rabbits create disturbed areas suitable for weed invasion.

Fire history

Record (map if possible) the fire frequency, location and intensity of all types of fires, whether wildfire or management fires. Fire is a disturbance that can encourage weeds or treat them.

Indigenous flora and fauna

List the flora and fauna and map vegetation communities if possible.

Significant species and communities

List any important species and communities, with conservation ratings (e.g. rare) and map if possible.

Surrounding land / water use

Think about what happens on the land and water bodies around or in your site and what problems could occur. Map these.

Built structures and modified sites

Map these since these are all prime weed sites, eg roads, drains, stockyards, water troughs, gates. Is there adequate access to the sites?

Other values or features

Map waterways, wetlands, geological features, etc.

Financial situation

Look at your current budget and availability of external funding or sponsorship.

Human resource situation

Consider who can help you; no-one, your family, the community, volunteers (Australian Trust for Conservation Volunteers, Volunteers in Conservation), government staff, contractors, consultants and employment schemes (LEAP, prisoners etc). It is important to consider if you are fit enough to do the job yourself.

Physical resources

List tools and equipment, herbicides in store (check use- by-dates), mulch sources and supply of indigenous plants to replace weeds.

Step 3: Consultation

Consult widely. The more people you talk to, the more information and ideas you will have. You may wish to talk to neighbours, community groups, interest groups, government officers (federal, state and local), neighbouring land managers (eg National Parks), agencies, organisations and utilities (water boards, companies supplying gas, electricity or telephones, Regional Catchment and Land Protection Boards etc), CFA and schools.

Step 4: Goals and objectives

Setting goals will help you determine why and how you are going to tackle an environmental weed problem. You may like to set 5 or 10 year goals (e.g. to control all weeds in my forest patch in 10 years'

time). Objectives outline how you are going to reach this goal (e.g. to stop stock grazing in forest, to control weeds around the edge of the forest).

Step 5: Management planning and priorities (planning what you want to do)

Determine the management approach

The next step is to decide which management approach you wish to take. Most weed management in the past, has been treatment based, usually in the form of treating individual weeds or infected areas with herbicide or manual removal or both, without carrying out follow-up works or rehabilitation. This approach usually gives a short-term solution and is based on treating the symptom and not the cause.

The preferred management approach is a strategic and integrated one which takes into consideration the dynamics of the ecosystem you are working with. Look at the 'big picture' and consider all issues related to its management.

Integrate other management programs with your approach, such as pest animals, fire and recreation and utilise as many treatment methods as possible. Consider the ecological effects of your management and how removing weeds will affect wildlife. For example, it may be better to drill and fill with herbicide weeds such as boxthorn, rather than cut them down, so that the structure can remain as wildlife habitat. Think about why this weed is growing here and how the natural balance of the ecosystem has been affected.

What are you going to do first?

There are a number of things to consider when determining management priorities.

Consider:

- the background information you have gathered including maps, lists, observations
- which are the most threatening environmental weeds (ie those that are invasive, have a high impact on the environment, have a rapid rate of spread)?
- which are your highest priority sites (sites you may need to attend first that have a high biological significance)? Refer to Land for Wildlife ***Note No. 40 How healthy is your bushland?***

To help you decide on your priorities, it is also important to:

- eliminate potentially threatening weeds before or as they expand
- eliminate potentially threatening environmental weeds where action is likely to be successful
- control environmental weeds in small infestations before they have produced seed or other propagules
- control environmental weeds in areas of high conservation value.
- contain known environmental weeds by securing/protecting uninfested areas

Design appropriate actions

The following principles, techniques and options will help you determine your plan of action.

Basic management principles

- Prevention and early intervention will reduce considerable future costs.
- Identify the cause(s) of the problem. Weeds are usually a symptom of another problem such as burning practices, grazing or planting invasive species in gardens.
- Consider what the wildlife will use when you remove weeds. It may be appropriate to remove the weeds and replace with appropriate indigenous plants at the same time.
- Are your actions benefiting the ecosystem? Using large amounts of herbicides may be harmful to some species, such as frogs. Your actions may be causing more harm than good, even though they make you feel better because you are doing something visible.
- Look beyond boundaries. Weeds don't distinguish between fences and other management boundaries.

- Start at the top of your best habitat. Start treatment at the top of a catchment to avoid reinfestation of lower areas through seed roll (gravity) and by being washed down slopes and watercourses.

- Hygiene is important. Remember to keep your tools, vehicles, boots and clothing clean of weed seeds, etc.

- Minimise site disturbance (particularly soil) which will reduce the opportunity for more weeds to establish at the site.

- Work from most intact habitat since prevention of degradation is cheaper than eventual rehabilitation.

Treatment options

Options for treatment will not be discussed in this Note. However, you can find out about this from various contacts and agencies such as:

- Catchment Management Authorities
- local government environmental officers
- chemical companies
- books and brochures

You can choose from a variety of techniques such as slashing, mowing, hand-pulling, grazing, chemical control, scalping, fire, heat, smothering, moisture, and nutrient manipulation. See references and contacts.

Determine timelines

How long are you going to take to reach your goals? Develop a weed calendar which includes flowering times and times for best treatment. This will help you determine what to do each month and when attention should be given to the priority species. Relate this to flowering/seeding times of indigenous plants, to make decisions on timing for activities such as burning and slashing.

Prepare your management plan

Write down your plans of action, as simply as you like, and make sure everyone involved has access to this plan.

Write down your goals and objectives, record priority actions, dates of action, results and follow up. Make sure you include actions such as rehabilitation and any maps and tables you have produced in your plan. Keep all the information that you researched together with your management plan or make sure it is filed away for future reference.

Step 6: Obtaining funding and resources

Identify funding sources and when making your application, use your management plan or strategy to support your case. Contact your local Land for Wildlife Extension officer for more information. Land for Wildlife News 3:2 p 8-9 lists various incentives and grants.

Primary producers can make taxation claims for expenses relating to activities that contribute to the control of land degradation, including the control of weed pests (Section 75D of the Income Tax Assessment Act, seek advice from your tax agent).

Step 7: Action on the ground

Implement treatments

There are various ways to implement the treatments; by yourself, with your family, your neighbours, your Landcare group, contractors such as herbicide applicators or volunteers. Volunteers are valuable allies in the fight against environmental weeds.

Rehabilitate the site

There is the chance that, once you remove an environmental weed from natural vegetation, that it may be replaced by the same or different species. By encouraging the site to rehabilitate naturally or revegetating with plants grown from local seed stock, this problem may be avoided. Rehabilitation can also replace habitat and food that the weeds provided for wildlife, e.g. Gang Gang Cockatoos eating Hawthorn berries. Replace blackberries, which can be protective habitat for wrens and other wildlife, with prickly hakeas or wattles. Rehabilitation should be occurring continuously through your strategy and not just at the end.

Step 8: Monitoring and recording

It is a good idea to monitor environmental weeds before, during and after your strategy has been carried out. This information will help you determine success and to plan future management actions and priorities. Use photo points, keep records and maps of work done, successes and failures. Land for Wildlife News Vol. 3, No. 3 has an article on how to monitor your property.

Step 9: Review

Incorporate any new information you have in your management plan. Learn from success and failures and incorporate new technology when appropriate. You may need to modify your plan over time. If you decide that you do not have enough background information, take the time to do further research, assessment, and monitoring.

Step 10: Sharing information

Now you have increased your knowledge of weed management in your area, you may like to share this information with other people. Use your Landcare group to network, write articles in its newsletter, conduct local field days or workshops. The more information we share, the less people will "reinvent the wheel".

Step 11: Ongoing commitment

Environmental weeds will always be around and so it is important to maintain your interest and motivation. Approach your neighbours and explain the weed management strategy and that their interest and commitment can also help improve the health of the catchment.

Conclusion

Once you have worked through this process you will understand the importance of a strategic approach to environmental weed management, where ecological considerations are also considered. Remember to treat the cause, not just the symptom.

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This strategy has been adapted from Environmental weed management handbook for Victoria (prototype). This project has been carried out by Kate Blood, NRE, with the financial assistance of the Aust. Nature Conservation Agency(ANCA) under their Save the Bush program.

Illustrations by Alexis Beckett.

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CONTENTS

40. How healthy is your bushland

A self-guided assessment to recognising high quality wildlife habitat

Providing the best possible habitat for native wildlife on your property requires a good understanding of its living requirements. This understanding makes it possible to make informed judgements about what changes will improve the habitat areas you are managing.

Habitat condition is vital if the full natural range of species are to inhabit the area, to maintain its long-term health and for it to fully contribute to the value you get from your property.

So, how healthy is the habitat at present on your property? This information sheet provides an introduction to some important habitat components and is intended to prompt questions which are answered in more detail in other Land for Wildlife Notes.

The aim of habitat management for nature conservation is not only to maintain the species present in the habitat but also the processes that make the habitat function such as nutrient cycling, pollination and seedling establishment and its long-term future in the landscape.

While this Note won't tell you what to do about any problems identified, it can be used as a summary of the current situation of your remnant. The symbol - has been included to remind you to record actions you may wish to take to rectify any deficiencies. The term bushland is used to cover all native vegetation types.

It is preferable that you stand in or near your bushland while thinking about the contents of this information sheet.

1.What surrounding landscape?

The management activities carried out in surrounding areas will affect the quality of your habitat. For example, if the adjoining land is cleared and sown to pasture it is more likely that the habitat will be affected by edge effects, such as windthrow and weed invasion (an aerial photograph will help identity the surrounding features). Adjoining bush may act as a buffer or offer potential for vegetation corridors.

Is your bush surrounded by:

- cleared land/pasture or crop?
- weed sources?
- remnants of native vegetation?
- bush on most or all sides?
- a buffer against weed invasion, wind, etc?
- low in the catchment? (if low, may suffer from salinity, etc)

2. How large? /how well connected?

Larger blocks of vegetation can harbour a wider range of species and are more resilient to external factors. Wildlife corridors can assist movement and act as habitat in themselves. Rehabilitating the surrounding area, creating buffer zones and corridors are potential corrective actions.

Is your bushland:

- 0-1 hectares?
- 1-5 hectares?
- Greater than 5 hectares?
- Connected to habitat >30ha by corridors wide enough to provide habitat in themselves?

3. What shape? /How much edge? /How much core habitat ?

Remnant blocks of vegetation with a circular shape are less likely to suffer disturbance from the surrounding landscape such as weed invasion, the effects of predators, and climatic extremes than narrow linear or irregular bush blocks. Circular shapes have less edge (see LFW ***Note 23***). Also, shyer species require the safer, more stable conditions deep inside the bush.

- Is your bushland:
- Circular in shape?
- Rectangular in shape?
- Irregular in shape with many indents?

4. How natural?

Most vegetation types consist of several 'storeys' or layers. Often, wildlife species make use of resources from several of these layers. For example, using tree hollows for nesting whilst also needing food resources from shrubs or grasses nearer the ground. Note that vegetation types, such as grasslands and heaths, are naturally treeless and require management to maintain the diversity of grasses and many small forbs present. The presence of cryptogamic mats (lichen and moss) depends on the vegetation type. Shrubs can be an indicator of habitat health (e.g. no shrubs - grazing too heavy, only spiny shrubs - grazing too heavy, many shrubs - a good sign). Management actions could include restricting grazing animals, revegetation or use of fire to promote regeneration. (Refer to LFW ***Notes 32 & 13***).

(a) Indigenous (local native) vegetation layers present include:

- Tree canopy
- Tall shrubs
- Low shrubs, ferns, etc.
- Native grasses
- Wildflowers
- Ground layer of leaves, twigs and branches
- Soil moss and lichen layer present

(b) Is the vegetation replacing itself?

Long-lived vegetation may appear healthy but can in fact be living on borrowed time if seedlings are not surviving to replace parent plants. On the other hand, if flowers are setting seed and seedlings appearing, it is a good indicator of many ecosystem processes still operating (e.g. pollinators must be present). Look for seedlings in autumn or spring. See LFW ***Note 22*** for monitoring suggestions.

(c) Natural regeneration is occurring in:

- tree species
- shrubby species
- native ground covers

(d) Evidence of ecological function

- seed set pollination
- regeneration (post fire)
- variety of native invertebrates present

(d) Habitat features present/species diversity

A wider range of habitat features, or different types of vegetation will provide for a greater range of species. For example, if suitable tree hollows are present, hollow-nesting species may remain to roost or breed rather than just pass through. Of course, one bit of bush may not have all the features listed here. A variety of vegetation densities will allow a greater range of species to find food and nesting sites. Naturally fertile areas may support more wildlife. Compare your bush with similar types in your district.

Habitat components include:

- tree hollows for nesting
- hollow logs for ground dwelling animals
- native grasses
- rocky areas (for lizards, etc)
- big old trees (see LFW ***Note 18***)
- native mistletoes
- flowering plants producing nectar throughout year
- a variety of habitat types (e.g. woodland/ heathland, creek line/slope)
- a variety of vegetation densities
- some areas of naturally high fertility (e.g. deep, rich soils)
- stream systems
- wetland systems
- unusual habitat type(s) for the area

5. Disturbances/threats

Environmental influences like soil disturbance, grazing, fire, weed invasion, isolation, and feral animals influence vegetation and wildlife.

- Are rare/locally uncommon species stable/increasing?

(a) evidence of feral predators

(Feral animals can have severe effects on native animal populations through directly eating wildlife, competing for food supplies or destroying habitat).

Is your habitat affected by?

- foxes? (look for scats)

- cats? (domestic or feral) Sand patches can be used to detect tracks
- dogs?

(b) evidence of competitors
(see Land for Wildlife ***Notes 24, 25, 31***).

- many weed species present
- rabbits
- livestock grazing
- introduced honeybees (occupying tree hollows/taking nectar)
- other introduced grazing animals (e.g. goats, pigs, etc.)

(c) evidence of unbalanced ecosystems

- tree dieback occurring (see LFW ***Note 34***)
- excessive mistletoe infestation (see LFW ***Note 26,*** See LFW ***Note 34***.)
- repeated excessive defoliation by insects
- loss of nitrogen fixing wattles and peas
- evidence of excessive disease (e.g. Such as wombat mange)
- wildlife populations declining

(d) other threats

- fertilizer drift from adjacent paddocks
- soil disturbance/compaction
- disturbance by passers-by/machinery
- nutrient input from animal faeces, sewage, runoff from adjacent land
- garden waste dumping
- earthworks, stock camps

6. Management history?

Previous management sets today's scene and can limit your options. For example, a prior history of logging may mean that few very large trees with hollows remain. Coppiced, thin trees lacking hollows may indicate prior firewood collection. Single aged plants indicate a prior disturbance at one point in time.

- evidence of unsustainable livestock grazing
- or livestock excluded by fencing for many years
- abnormal fire regime
- or natural fire regime maintained
- evidence of soil disturbance (e.g. very weedy patches present)
- or soil profiles intact
- evidence of extensive firewood collection
- drainage alterations to wetlands/stream flows

Record what you know of the management history (attach additional information):

7. Future plans

Having completed this general assessment, consider what improvements to the habitat you can practically achieve. They might include putting up a fence, planning to put in a vegetation corridor or start a pest control program. Your local Land for Wildlife Extension Officer is available to help you. Revise your actions and add to your activities' calendar/diary.

Intended management actions (attach additional information):

Further reading

- Anon. How good is that patch of bush? Information sheet No. 4. Australian Nature Conservation Agency & NSW National Parks and Wildlife Service.
- Keane, J., Bushland restoration: Action for the environment by the community, Mt Lofty Ranges Conservation group, Aldgate, S.A.
- All Land for Wildlife Notes.

The following images provide examples of vegetation in various levels of "health".

Unhealthy grassland remnant. Note how many of the inter-tussock wildflowers are missing. Weeds are often very common, making up 30% or more of the species.

Unhealthy coastal vegetation. A weed, Bridal Creeper, has invaded this stand of paperbarks. Death of the canopy allows light to enter. Isolated stands can be attacked by salt-laden winds. Unhealthy coastal vegetation

Healthy woodland remnant. Open branched trees with numerous scattered shrubs and forbs. Leaf and bark layer present. Old trees with hollows retained.

Unhealthy forest and woodland remnants. Leaf and twig layer is missing. Understorey shrubs and grasses have been removed by grazing. Damage to tree bark by livestock is evident. Little or no regeneration. Surrounded by open paddocks. Dieback is usually evident. No vegetation corridors to nearby remnants.

Healthy grassland remnant. Generally tussocky with plenty of spaces occupied by wildflowers and rarely some small shrubs

Healthy forest remnant. Trees with interlocking branches. A lack of coppiced trees indicates that the area is unlikely to have been harvested for firewood. Trees with hollows. Scattered shrubs and forbs. Evidence of ground-dwelling species.

High quality coastal vegetation. Ground layer of bracken fern and sedges intact. No evidence of deaths due to the fungus Phytophthora. Part of an extensive tract of connected vegetation.

41. Management of grasslands of the Victorian volcanic plains

This Note provides an overview of some important management considerations of native grasslands on private land, particularly grasslands that occur on the basalt (volcanic) plains of southern Victoria. Readers should note that there is a great deal of information about grasslands that remains unknown, and this Note should be read with that knowledge in mind.

Recognition

Native grasslands include a whole range of species as well as the most obvious grasses. Not all grasslands are the same. This means that, to conserve their inherent variation, we need to protect grasslands across their distribution. Typically, a grassland community includes dominant, usually tussock-forming, long-lived grasses in association with other plant species, especially of the daisy, pea, lily, rush, and orchid families of plants, of which a number may be annuals. Trees are often present but, at the time of European settlement, extensive areas were 'treeless' (with few, but usually some, plants of tree size, especially where water was abundant or lightly trees. Typical grasses include Kangaroo (Themeda triandra), Wallaby (Rytidosperma spp.), Spear (Austrostipa spp.) and Tussock (Poa spp.) [see LFW News Vol. I, No.6, p3}.

Native grasslands were once extensive but have been mainly displaced by agricultural 'grasslands' of exotic species through cultivation, grazing, weed competition and so on. Most native grassland remnants are confined to refugia, such as paddock corners, steep swamp margins, rocky areas, lambing paddocks, old cemeteries, roadsides, railways, escarpments, steep creek lines, locations where machinery access has been difficult and similar locations where they have escaped destruction. In a few cases, conservative management by landholders has saved the grassland community and left them with a rare asset.

Status

Because these grasslands typically occupy fertile sites on flat country they have been severely affected by settlement and agriculture and are now extremely rare. You are indeed fortunate if you have a native grassland remnant, as less than 0.2 % of the original area in Victoria remains in an intact and diverse condition.

Potential economic values

The economic values of native grasses are being increasingly recognised. Some species have high protein levels, they are hardy and drought tolerant and some continue to produce green growth into summer when introduced species have declined. Grasslands offer a genetic resource of plants that are adapted to the agricultural zones and may yield future crops or species of horticultural or medicinal value. Perennial grasses are suggested as a partial solution to soil acidity and a method for controlling grasshopper numbers through planting in egg-laying sites (north facing hillsides). Native grasslands provide habitat for native predators of agricultural pests such as Red-legged Earth Mite. The grasslands were used extensively by aborigines and bush tucker species, including the staple Yam Daisy, may offer scope for ecotourism restaurant ventures. Native grasslands are unique and rare.

Notable species

Several grassland species have become well known including the most endangered mammal in Victoria, the Eastern Barred Bandicoot (many of the extinct Victorian mammals occurred in grassland and woodland habitats). Australian Bustard, Eastern Quoll (extinct in Victoria), Plains-wanderer, Striped Legless Lizard and Button Wrinklewort are also well-known threatened species. Unfortunately, there are many other lesser-known grassland species that are threatened including over 125 plant species. It's worth noting that wetlands on the volcanic plains, such as in the Lake Bolac-Willaura area, are significant habitats supporting many waterbirds.

Ecology and Management Considerations

General

Precautionary management - As a rule of management, always test and evaluate your management regime before applying it to the entire area. Establish reference areas. Take time to learn about how your grassland operates. If your grassland is in good condition, practice conservative management by maintaining existing management until new methods prove their value.

Adaptive management – involves setting up alternative management options and evaluating results against controls.

As a rule of thumb, be guided by what you would expect to be the natural process/recent history and try to maintain or re-establish it.

Grasslands tend to occur on soils with relatively high fertility and can support a relatively frequent fire regime. Sites with lower fertility tend to support heathlands or dry forests. Trees and shrubs become more common as water availability increases. Many grassland plants can survive extreme periods of hot and dry.

Grassland communities vary throughout the year and between years in response to the prevailing environment. Species can easily be overlooked. Continue to survey your grassland in different seasons and over many years.

Soil and Water

Soil profiles (see LFW News Vol. 1, No. 6, p7).

The flat nature of much of the volcanic plain is very deceptive. Underneath the ground there can be enormous variation.

On the basalt plain, soils began as solid rock formed from a lava flow from one of the many extinct volcanoes dotting the plains. Water has penetrated the rock and weathered it to varying degrees. Where water lies for a long time, the soils tend to be black, alkaline and deep, often underlain by white kaolin clays over dissected columnar basalt bedrock.

Rises tend to have shallow red soils with columns of rock, showing as exposed rock, at their peaks. These rocks protect plants from close grazing.
Rock crevices are important as perennial plants can, if they survive a risky childhood, establish roots in the cracks which act as reservoirs of water during dry periods. Loose rocks on the surface act as homes for a range of animals such as Blue-tongue Lizards, Fat-tailed Dunnarts, Marsh Frogs and Striped Legless Lizard.

Basalt soils are highly variable. Red soils tend to be acidic whilst black soils are usually alkaline. Within short distances soils may vary incredibly. Grey sticky (when wet) clays often surround depressions that seasonally fill with water. Adjacent to these may be loamy red soils. On rises soils may be shallow and skeletal (poorly formed). Plants respond to these conditions.

Soil cracking may be severe in summer causing roots to be ripped apart, even though many species have strong rope-like roots. It allows water to enter the soil profile and resupplying underground reservoirs and permitting animals, including Striped Legless Lizards, to escape fire.

Possible management responses: Avoid using fertilizers which will promote weeds and change soil chemistry to the disadvantage of the natural ecology including soil fungi and invertebrates. Addition of soil modifiers, such as gypsum, also usually leads to loss of native grassland species. Avoid soil disturbance which encourages weed invasion. Return rocks from rock fences to the rises where they naturally occur (check first with your council that they aren't of any heritage value).

Flowering, pollination and seed set

Flowering typically occurs from late winter/early spring to early summer with different species peaking in sequence according to genetic factors. Fire and other environmental variables may be a trigger for some species. For example, ethylene gas produced by a fire can be important in triggering flowering in orchids. Some species may not flower, or even appear above ground, in adverse seasons.

Native bees, beetles, butterflies, wasps and flies are important pollen vectors as are, no doubt, many other invertebrates. Wind is also important, especially for grasses, whilst birds and mammals are less significant compared to other plant communities. Large dense populations of flowering species may attract more pollinators and have greater seed set than small populations or scattered plants.

Possible management implications: Avoid management, such as soil compaction and use of chemical insecticides that may be harmful to pollinators.

Seed set occurs following the onset of summer.

January- February is the main seed collection time for the area immediately west of Melbourne.

Recruitment/revegetation

Very little is known about this most important aspect of grassland ecology. Perennial species may live for long periods (decades) and so successful recruitment events may be at lengthy intervals, probably when a form of disturbance, such as fire, physical removal or death due to drought or age, creates a space (gap) in the grassland mosaic and frees the resources needed for establishment; there is good seed set and follow up rains. On the other hand, annual species typically occupy the spaces between tussocks and use the seasonal opportunities, when water is plentiful, to complete their life cycle. Soil stored seed is another factor. Successful germination and recruitment probably normally occurs at the autumn break (April). Soil crusts (mosses, lichens) may be important as microsites for seedling establishment.

Possible management responses: Planting should be undertaken in autumn with minimal soil disturbance or spring (heavy soils). It is critical that plants are placed in a habitat comparable to where they would naturally occur. Determine this by looking at the location (soil type, slope, height, etc) of remnant populations of the same species and plant in the same site. Transplanting small quantities of soil crusts to previously disturbed areas may be valuable.

Anticipate substantial mortality due to seasonal factors and competition with established plants. Try multiple plantings, in clusters, in less competitive sites (e.g. where a tussock has died or where shallow soils prevent tussock competition). Make sure biomass is controlled in subsequent years or seedlings may be outcompeted.

Fungal associations

Some grassland plants have mycorrhizal fungi associated with their root system (e.g. orchids). The fungi are essential to the plant's health, allowing it to obtain otherwise unavailable nutrients.

Possible management implications: Transplanting or propagating individual plants without the associated presence of, and conditions for, the fungus may be unsuccessful. Soil collected when the fungus is active can be introduced to the site or pot.

Grazing

Without biomass removal by fire, grazing or slashing, grasses can dominate a site and exclude other species through accumulation of prior years' leaf litter. Kangaroo Grass may die from self-shading. Thus, some form of biomass reduction is usually essential. Grasslands are adapted to grazing by native herbivores. However, many species are not well adapted to sustained grazing by large populations of introduced livestock. Palatable herbs are particularly vulnerable. Soil crusts may be destroyed, and soil compaction can affect recruitment, soil fungi, etc. However, since most private land grasslands will have been subject to grazing for lengthy periods, it is likely that grazing will continue to be a labour management tool.

Possible management responses: Maintain grazing regime and trial practical alternatives such as burning, particularly when re-establishing palatable species. Create grazing exclusion plots to monitor effects of grazing, restrict the timing of grazing to after seed fall and prior to soil wetting (i.e. late summer when soils are hard and dry). It is extremely important to monitor biomass levels.

Excluding livestock without replacing grazing with a viable alternative, such as fire, is likely to be counterproductive. Consider pulse grazing. Many stock graze at one time, forcing consumption of less palatable species and so removing excess biomass.

Fire

Fire is an important management tool for grasslands. An alternative form of management to maintain an open structure to the vegetation is grazing and mowing followed by raking which are alternatives if fire cannot be used. Most grassland species tolerate and even thrive with frequent fires (possibly every 1-3 years). Naturally, fires would have been most common in summer, normally after seed set (February - March) and when soil cracks are available as a refuge for animals. However, aboriginal patterns of burning are unknown and may be significant. Underground tubers, dense tussocks with protected buds, resistant seeds and other mechanisms are used by plants to survive fire. Grassland fires may be fast and intense when there is a large quantity dry fuels.

Possible management responses: Consider the use of regular fires to maintain the diversity of plant species and remove biomass. Seek advice on options for controlling weeds using fire (see below). Do not attempt to undertake an ecological burn without first consulting the local fire authority (CFA), NRE, council and weather bureau to obtain advice on safety, weather conditions and restrictions. Prepare a fire plan first.

Introduced species (see LFW Notes 24, 25, 31, 39).

Even a good quality grassland site may have up to one third introduced species. Typically, in more disturbed sites, half the species will be introduced. Weeds are a major grassland management issue.

Possible management responses: Avoid/minimise soil disturbance. Hand weeding, spot spraying with herbicides. Create 'sterile' edges around remnants perhaps using an infertile crop species. Always replace weeds with natives.

Research indicates that over 50% cover of Kangaroo Grass is a greater deterrent to competing weeds such as Chilean Needle Grass.

It is yet to be determined whether fire can be used effectively against grassland weeds. Typical approaches involve setting the fire regime so that it has a greater effect on the biology of introduced species than on natives. Unless specific advice is available, time fires to occur as close to the natural fire season as possible within the limitations of fire season restrictions, preferably after seed set and fall. Fire can also be used to remove weed masses (e.g. Rye Grass mats) at other times. Be extremely careful to avoid transporting and introducing weed seeds in hay, clothing, mud on vehicles, etc. (e.g. Wear gumboots in summer! It'll save your socks).

Monitoring

The following techniques are suggested as a minimum.

Photo points - vertical (ideally stereo) photos and oblique at a range of sites.

Herbarium- a collection of pressed and dried specimens with details.

Exclusion plots - fenced plots to monitor the impact of grazing. Miniature plots may be used to exclude introduced invertebrates.

Testing soil-stored seed- collecting a quantity of surface soil (top few centimetres) which is watered and grown on till plants can be identified.

Mapping records- aerial photos make an excellent base. Draw areas burnt, sites of transplants, etc. onto clear overlays.

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42. Phytophthora root disease

Phytophthora root disease, also known as Cinnamon Fungus, is a very serious disease that destroys many of our native plants. The disease is caused by a microscopic pathogen that lives in the soil and in plant roots. It causes symptoms similar to drought stress. The following is a description of the disease, how its effects habitat and steps you can take to minimise its spread.

What is Phytophthora root disease?

Phytophthora root disease is Phytophthora cinnamomi which belongs to a large group of plant pathogens that cause serious devastation to ecosystems worldwide. This group of pathogens derive their name from the Greek words for "plant destroyer" (Phyto -phthora).

Phytophthora cinnamomi was first described on cinnamon trees in Sumatra in the 1920s (Erwin and Ribeiro 1996). Hence, it is commonly called Cinnamon Fungus. Since then, it has spread throughout the world and now impacts on native forest, horticultural industries, and agricultural crops worldwide. The disease is well known in Western Australia as the cause of jarrah dieback (Shea and Tippett 1989).

P. cinnamomi can seriously destroy wildlife habitat. Most levels of habitat such as tree canopy and shrub layers can be altered by this pathogen. In turn this can reduce breeding, feeding and shelter sites for many fauna species. Loss of canopy layer can lead to the loss of bird species that feed in this zone, such as Striated Thornbills, Weebills, lorikeets and honeyeaters. Even if a plant species is not infected by the pathogen, the lost canopy layer may lead to less than favourable conditions for them. For example, fern species may be lost because of the increased exposure. This in turn may lead to the loss of fauna species reliant on shady and moist habitats, such as frogs, worms, and other invertebrates.

What does it do?

P. cinnamomi is primarily a root and collar rot pathogen. The pathogen penetrates the roots of plants, causing the death of root cells. As root cells are killed by the pathogen, the plant begins to suffer from a reduction in water uptake. As a result, the plant starts to show symptoms similar to those of drought stress. These include yellowing of the leaves and wilting, followed by leaf loss. Leaf loss can often lead to the death of branches, which may be shed by the tree. This leaf loss is usually from outer branches and is generally referred to as "dieback" – the "dying back" of leaves from the branches. Dieback may be followed by death of the plant. In some cases, death is rapid, occurring within six months of the original infection.

The rapidity of death and the extent of disease seen in areas affected by P. cinnamomi depends on the interaction of three factors – the pathogen itself, the plant host, and the environment. Each factor will be described further below, but it must be remembered that none of these factors acts in isolation – all factors affect each other to produce disease of varying degrees of severity.

Figure 1 Phytophora cinnamomi causing a mass collapse of Jarrah in Western Australia

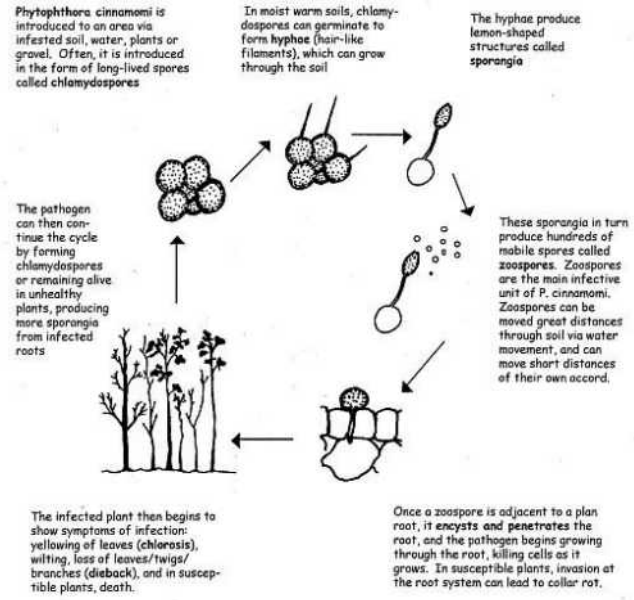
The pathogen

P. cinnamomi has a life cycle that equips it well to cause disease and also makes it difficult to control. The pathogen is often introduced into an area in the form of chlamydospores, either in infested soil, gravel, or infected plants. These chlamydospores are capable of surviving in gravel for up to five years, although their survival depends greatly on how many microbes are present. Chlamydospores can be parasitised by soil microbes, reducing their survival.

When introduced into an area, chlamydospores germinate to produce hyphae, a hair-like growth that can grow through the soil. Under warm, wet conditions, this mycelium can produce a structure called a sporangium, which in turn produces mobile spores called zoospores. These zoospores are the main infective propagule of the pathogen. Zoospores can move a short distance of their own accord, but usually spread great distances when carried in water moving through soil or drainage channels. This water movement carries the zoospores into new, uninfested areas, where they can cause disease. When the zoospores are carried close to a host root, they are attracted to the root by chemicals produced by the root. The zoospores then infect the root.

Once a plant is infected, the infected root can, under warm, wet conditions, produce more zoospores (spreading disease further) or infect nearby roots if the pathogen grows through the soil. In a susceptible host, under favourable environmental conditions, the pathogen can move through the root system and cause collar rot.

Figure 2 The disease cycle of Cinnamon fungus



The disease cycle of Cinnamon Fungus *Phytophthora cinnamomi*. Adapted from Marks, G.C. & Smith, I.W. (1991) and Griffith-Jones (2001)

Phytophthora cinnamomi. Adapted from Marks, G.C. and Smith I.W. (1991) and Griffith-Jones (2001).

Figure 3. Compare the healthy strand of Austral Grass Trees (above) with infected area (below).

The environment

The environment, as mentioned in the previous section, plays a significant role in disease development. The environment affects the activity of the pathogen, the production of spores, the spread of spores, and the response of the infected plant. In some areas of Australia, the pathogen is present in the soil but does not cause significant disease because low soil temperature inhibits activity of the pathogen.

In other areas of Australia, the soil itself suppresses disease (Broadbent and Baker 1974a, b).
P. cinnamomi can be suppressed by the activity of other soil microbes, such as fungi and bacteria. In areas with high levels of organic matter – such as rainforests – the microbial population in the soil may inhibit activity of P. cinnamomi suppressing disease development. Unfortunately, significant areas of Australia have poor soils that are low in organic

matter and therefore are not able to suppress the disease.

In addition, many areas of Australia have shallow soils that are poorly drained. These soils waterlog rapidly in spring, resulting in increased disease as the pathogen produces large numbers of mobile spores. In contrast, well-drained soils generally have lower disease incidence, as the pathogen has less free water available and cannot spread as far.

Because it requires warm, wet conditions, the peak season in Victoria for populations of the pathogen and for disease spread is spring, and to a lesser extent, autumn. In winter, the soil is often too cold for the pathogen to be active. Over summer, soil is usually too dry for the pathogen to spread and infect although the dry summer conditions can lead to the death of infected plants that are already suffering from reduced water uptake.

The plant host

Plant responses, both between species and within species, to infection by P. cinnamomi range from resistance to high susceptibility. There are few truly resistant plants – P. cinnamomi is capable of infecting roots of most species – but some plants are able to contain the pathogen once it has penetrated the root and prevent it from invading the rest of the root system and plant collar. Other plants, such as grasses and sedges, are able to rapidly produce new roots to replace those infected by the pathogen and so are able to withstand infection.

Moderately susceptible species are species that withstand infection as long as the environment favours the plant and not the pathogen. Many plants tolerate dry conditions well, and as long as the environment remains dry, these plants may withstand infection. When the environment becomes waterlogged, the pathogen is favoured, and the plant becomes ill. Many moderately susceptible species can show symptoms when the environment favours the pathogen but recover when the environment no longer favours the pathogen.

Highly susceptible species are those that have no resistance to the pathogen. These plants are often used as indicator species, as they are generally the first to show symptoms of infection when an area becomes infected with P. cinnamomi. An example is the Austral Grass Tree (Xanthorrhoea australis), which when infected, rapidly yellows, wilts, and eventually collapses. In areas containing this species, the death of these plants is often spectacular and highly indicative of infection by P. cinnamomi.

How do I know if I have P. cinnamomi?

The symptoms of infection have been described – yellowing of leaves, wilting, loss of leaves, dying back of branches. In some cases, these symptoms will move through an area in a "front" – there will be a clearly defined line between healthy vegetation and dying vegetation. In other areas, there will be a mosaic pattern, with individual plants becoming infected. Over time, an area infested with the pathogen will change as susceptible plants die out and are replaced by resistant species, especially grasses and sedges.

However, as the symptoms resemble the effects of drought stress, it can be difficult to tell if you have an area infested with P. cinnamomi. The only way of being certain is having your soil tested for the presence of the pathogen. See page 4 for details on where you can get your soil tested.

How can I protect my land from this threat?

The best protection comes from knowledge and prevention. Understanding the disease is important, as it makes you aware of how the disease can be spread and how it behaves. Understanding what factors affect disease is important in understanding what can be done to prevent it.

Basically, the pathogen can be spread into a new area by the introduction of infested soil and/or infected plants, or movement of water containing zoospores from nearby infested areas. When purchasing plants from nurseries, select those businesses that have an understanding of the pathogen, and that take steps to prevent the infection of their stock. Ask questions – ask what your nursery does about this pathogen. If the answer is, "Nothing," you know what your response should be. Always buy from a reputable nursery that has a good understanding of plant hygiene.

If you are concerned that soil from nearby areas may be a risk, introduce sanitation methods. When moving from an infected area into an uninfected area, scrub boots with a disinfectant, making sure to remove all soil from the shoe. In Victoria, the disinfectant Phytoclean (Avis Chemicals) is registered for this purpose. Be aware of your surroundings – if you find yourself in an infested area, carry a spray bottle with disinfectant in it, and when leaving the area, spray your shoes with it.

Minimise moving stock from infected areas into non infected areas. Soil containing the pathogen may be carried in hooves.

Also, take steps, if necessary, to clean equipment when moving between infected and uninfected areas – any soil clinging to the underside, wheels, or side of the vehicle could be carrying spores of the pathogen. This may even involve cleaning your tent pegs after camping. Be aware of the movement of soil.

Soil/Gravel to be used in gardens, driveways and roads of pathogen free areas should be tested before introduction to your property. When planning roads/tracks ensure that culverts do not direct water flow into areas containing susceptible species. Similar precautions should be undertaken when constructing dams/lakes etc where water outflows may result in waterlogging.

What if I already have the pathogen on my land?

There is no known way to eradicate P. cinnamomi from areas already infested. The best option, if you already have the pathogen, is to be aware of how it spreads, and limit the potential for further spread (see previous section). A program of testing will help delineate the distribution of the pathogen on your land and enable quarantine and hygiene measures to be implemented as appropriate. Where walking tracks are to be constructed through infested areas, consider using tanbark on the tracks to prevent the pick-up of soil on shoes. Board walks may be considered in very wet areas.

Other research underway is investigating the use of fungicides to control the disease. Promising results are being obtained with low concentration foliage sprays with phosphonate on native species.

In horticulture and forestry, breeding for resistance to P. cinnamomi has produced a number of lines of plants tolerant to the pathogen. Encouraging the regeneration of native plants in infested areas (eg by regeneration burn) may produce some individuals that are tolerant of the disease. Alternatively, planting of known tolerant species, that are locally indigenous, may help provide a vegetation structure for wildlife.

However, it is far better where possible to prevent spread of the pathogen into new areas. In the case of Phytophthora root disease, the old saying "prevention is better than the cure" certainly applies.

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Where can I get my soil tested?

The Department of Agriculture - Crop Health Services, Knoxfield, (03) 9210 9356 or (03) 9210 9222.

43. Photographic monitoring of vegetation

Introduction

All managers need to keep records, so that they can assess how they are doing, and adjust management if necessary. Records of things like stocking rates, fertiliser application and of course cash flow, are a necessary part of managing a farming business. But the records of how the land itself is coping with management are not always taken, because they are less easy to quantify. To do this, it is advisable to monitor, that is, to observe and keep a record of change in something over time. The results of monitoring can be used to evaluate performance.

Monitoring is the process of undertaking periodical assessments or surveys, recording results, and periodically comparing and evaluating them to determine the effectiveness of actions or the progress of the projects. How frequently this is done, and in what form, will vary according to what is being measured and the purpose of the monitoring.

Monitoring is important for two main reasons: it provides feedback on the effectiveness of management actions and hence whether these actions need to be modified and it enables the determination of whether natural resources are stable, improving, or declining. So that this can be done, the records need to be consistent, comparable, and easily interpreted by any interested person.

Why should we monitor vegetation?

As land managers, it is necessary to understand how and why the land and its vegetation is behaving over time, and the human memory is not as accurate as we would like to think!

Monitoring can help to:

- Record change over time
- Relate these changes to climate/ environment/management events
- Document the effect of management actions
- Document the extent and severity of (and then recovery after) extreme events eg flood, fire, frost or hailstorm.
- Develop a benchmark against which future performance can be measured
- Use the information gained to determine management actions
- Show up a problem when it is still small
- Support funding applications – and then demonstrate how the grants are being used

Which all adds up to developing a better understanding of cause and effect in managing vegetation.

For monitoring vegetation, either remnant vegetation or revegetation sites, a simple yet very useful method is to take a series of photographs, called 'photo point monitoring'.

What is Photo point Monitoring?

A snapshot is a record of a particular site at a particular time. Any picture tells a story, but to get a good monitoring photo takes a little bit more thought.

Photos are best used for monitoring relatively slow changes to vegetation. They build up into a valuable record to hand onto new owners, or to the next generation. Evidence of good management may be useful when dealing with financial institutions! What photos do not do is give exact details of species and sites, so precise notes to go with photos.

When to use Photo points

Use photo points to take the guesswork out of recalling how the country used to look. Use photo points to monitor events such as:

- Fencing to remove stock
- Fire
- Storm events- flood/wind/hail/frost
- Weed control
- Feral animal (eg rabbit) control
- Revegetation - both direct seeding and planting

- Effect of landcare works
- Changes in the water table
- Wind and water erosion

Setting up the Photo point

Which site/s to choose?

The aim of doing photo monitoring is to use the photographs as an easy method of comparison to record change over time so, when you take the initial photo, have clear in your mind what change you expect, eg saline area revegetated, weeds replaced by native vegetation etc.

Your photo site needs to illustrate a distinct feature, for example:

- Exact location of Phytophthora Dieback front
- Boundary between burnt/unburnt vegetation
- Extent of salt/waterlogging/erosion/weed/rabbit affected area
- Good example of particular vegetation community
- The growth and health of one particular representative plant
- Direct seeding of revegetation site
- Strand line on flood bank

The location should be carefully chosen to illustrate that ONE FEATURE. The more specific the photo is, the easier will be the interpretation of a sequence of photos.

Choose a recognisable site

You, and perhaps somebody else, will need to return to the site in future years, therefore, the site must be clearly recognisable. Either use a particular tree, fence post or range of hills for a guide or, better still, mark the site with stakes. If appropriate, locate the site fairly close to a track for ease of access.

Set it up so that the view from the camera to the point of interest is uncluttered – remember, young tree/shrub vegetation will get taller as it grows.

Note site on map

Locate the site on the main map you are using so that future observers can easily return. Locate the position and direction of view of each photo on a mud map (or overlay on an aerial photo), especially if you are taking more than one picture in a particular piece of bushland.

Mark the site

If using a fence post, rock or tree as a marker, it should be identified in some way – paint is the most long-lasting (but remember that smooth-barked eucalypts shed their bark, so marks on a tree trunk are not permanent).

If the site is on private land, or away from interference by vandals, permanent marker posts can be used. Place two posts (eg star pickets) 10m apart in the direction the photo is to be taken, the first is the camera post, the second the sighter post.

Mark the sighter post with a code number that is specific to that site. An aluminium tag could be used for a label, but it must be firmly fixed, so that it cannot be removed - by ravens for example. Paint could be used on a fence post or star picket, or waterproof marker pen on a dropper.

If vandalism is a possibility, put a small marker peg close to the large one. These probably will not be removed and so help in relocating the exact site of the photo.

Take the Photo

As an option you can lean a data board against the sighter post. The easiest to use is a clipboard with paper on which is written the site number and date.

The writing needs to be large enough to be read on the developed photo. Some cameras have the capability of recording the date on the photograph. For monitoring photographs, this can be useful, as long as it does not detract from an important feature of the photo.

Use a camera with a standard lens, 50mm or 55mm, as this is closest to the image as seen by human eyes. Do not use a wide angle or a telephoto lens, as this alters the perspective of the photo and makes it difficult to repeat.

Sometimes an elevated position, eg standing on the back of a utility, can give the best results, especially if you wish to show understorey density. Try to choose a clear, sunny day for photography, as this will give good shadow patterns for estimating the density of woodland cover, for example. It is best to have the sun at an angle to the photograph; directly in front of, or directly behind the photographer is not advisable as it will reduce the amount of detail the photograph can show.

What to record in your field notebook?

When you start taking the sequence of photos for a particular site, or a specific project, start by recording:

- Date, time, weather
- Location (perhaps use a GPS)
- Direction (try to use a compass for a precise reading)
- Management history of the site, eg when cleared, when fenced, when planted, last fire, when gravel extraction ceased, etc.
- Reason for taking that photo
- Slope, aspect, soil type, soil condition, eg litter layer, algal crusts etc.
- Erosion, salinity, stock pads, ringbarking or other grazing damage
- List dominant plants
- Note any relevant fauna information
- Photographer
- Take the original photo out into the field to try to help align the future photos.

Photo points in bushland habitat

If you wish to show changes in bushland, it is very useful to make a tracing of the photo and annotate it with plant species information and notes of the specific feature you wish to monitor.

Photo points in revegetation projects

These should be specifically related to the planting or seeding plan for that project so that they can show eg:

- Growth rate of a particular species
- Effectiveness of a particular weed control treatment
- Change at soil type boundary, etc.

Again, a tracing of the photo with notes attached may be useful. Annotate the drawing with information such as year planted, preparation works and species lists.

Using photos for evaluating projects

To use photo points for evaluation, it is necessary to systematically compare the elements shown in the photographs with performance against the objectives of the project. To do this properly, the photos need to be combined with quantitative (measured) information taken at the time of photography and recorded in the field notebook. For example:

- Count the number of surviving seedlings
- List the species of plants appearing after fires
- Record the number of bird species.

References

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