How much habitat is enough?

Planning for wildlife conservation in rural landscapes

Native animals are a distinctive part of the heritage of rural Australia. A sustainable environment is one in which the sights and sounds of Australia's extraordinary wildlife will continue to be present and add to the quality of life for generations to come.

But what is happening to wildlife in rural landscapes? What kinds of changes occur as native vegetation is cleared from the landscape? Are we losing particular species from rural landscapes? Are some species more sensitive to change than others? How much native vegetation is needed for wildlife populations to survive and thrive?

Wildlife in rural landscapes

From L-R above:

Banjo Frogs live around farm dams and wetlands.

Spotted Pardalote, a widespread woodland-dependent bird.

Common Dunnarts are very rare in dry forests and woodlands.

Eastern Rosella, an iconic Australian bird.

'All native vegetation is important as habitat for native wildlife.'

When viewed from above, rural landscapes are visible as mosaics of cleared agricultural land and remnant native vegetation. Landscape elements such as patches and strips of native vegetation, agricultural land, wetlands and streams, and human settlements, together form a complex environment that supports many species of wildlife. Different types of native species live in different parts of the mosaic.

Agricultural elements in the mosaic include pasture, crops, vineyards, and irrigation channels. ***Farmland*** species survive in these agricultural areas: Richard's Pipits flit daintily to fence-posts from grassy paddocks; Olive Legless Lizards wriggle between grass tussocks in native pastures; and the 'pobble-bonk' of Banjo Frogs bubbles out from reedy farm dams.

Native vegetation occurs along roadsides and streams, as scattered trees in farmland, or as patches, from small fragments up to large bushland reserves. *Woodland-associated* species live in native vegetation but also use cleared land. Eastern Rosellas and Red-rumped Parrots often nest in trees along roadsides but frequently forage in grassy farmland; Lesser Long-eared Bats roost by day in tree hollows and at night forage widely around scattered trees in farmland.

Many animals live almost exclusively in native vegetation, rarely venturing onto cleared land. These ***woodland-dependent*** species often have specific habitat requirements: White-browed Babblers need shrubby undergrowth in which to build their domed nests; Squirrel Gliders move effortlessly from tree to tree in search of food, and Spotted Pardalotes forage amongst the canopy foliage.

Many species live permanently in rural landscapes, some are seasonal migrants, others pass through briefly, yet each benefits from using the mosaic. But landscapes are always changing – native vegetation is cleared, new crops sown, wetlands drained, land subdivided and houses built. Ultimately, the diversity and abundance of native wildlife depends on the amount, type and arrangement of native vegetation in the landscape.

Wildlife species use rural land mosaics in different ways.

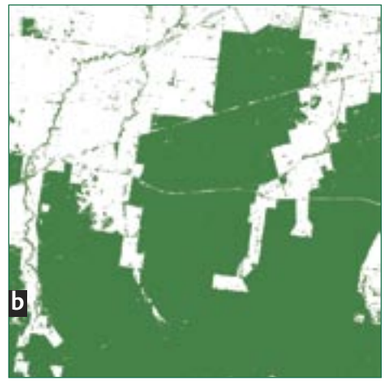
Rural landscapes are mosaics that extend over kilometres and consist of different types of landscape elements. These landscapes are vital for wildlife conservation because agricultural land-uses have replaced the natural habitat of many native species across vast areas of southern Australia.

A landscape view

In a recent study, researchers at Deakin University investigated the effects of landscape change on wildlife in 'whole landscapes' in northern Victoria. Why study whole landscapes?

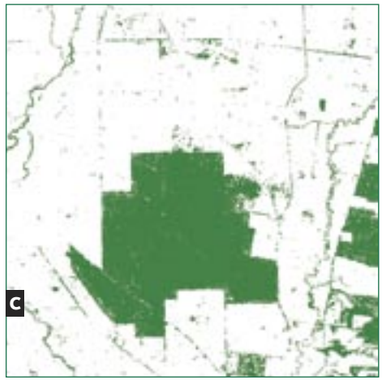
- For most species, single patches of bush are not enough for viable populations to survive in the long term; they need networks of habitat through the landscape.
- Many species use the whole landscape, moving between landscape elements on a daily, seasonal or irregular basis.
- The land use surrounding remnants of native vegetation influences the species capable of using that remnant.
- The 'landscape' is the most appropriate scale for planning the management and restoration of rural environments.

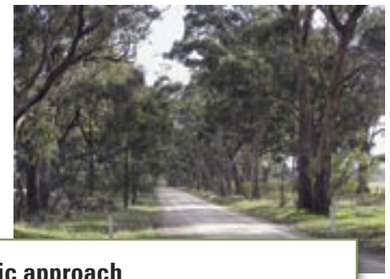
Native wildlife were surveyed in 24 'landscapes,' each 10 x 10 km in size. These were selected to sample a range in native vegetation cover from 2% to 60% of the landscape. In half, native vegetation was *aggregated* in one or a few large blocks, while in the others it was *dispersed* through the landscape in smaller remnants, linear strips and paddock trees. Birds and mammals were systematically surveyed at 10 sites in each landscape, with survey sites located in small and large patches, roadsides, streamside vegetation and scattered trees in farmland.



Landscapes were chosen to represent different *amounts* and different *configurations* (aggregated or dispersed) of native vegetation in the landscape.

Tree cover is shown as green:
a) 4% cover; b) 60% cover;
c) aggregated configuration (20% cover) and d) dispersed configuration (19% cover).





Landscape ecology – an holistic approach

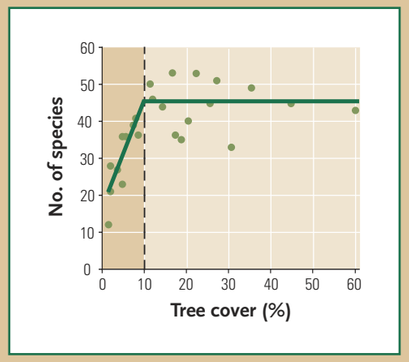
Landscape ecology is a scientific discipline that offers valuable insights for conservation and land management. It is concerned with understanding the interaction between landscape structure, living organisms (plants, animals, fungi) and ecological processes.
Landscape *structure* refers to the types of landscape elements; the size, shape and amount of each, and their pattern of distribution across the landscape. Landscape *function* refers to the interactions between parts of the landscape, such as flows of water and nutrients, movements of animals and people, and transfer of energy. Landscapes *change* in structure through time, and this results in changes in landscape function.

Thresholds of change

Native animals require native vegetation as habitat to survive in rural landscapes. How is the native fauna affected as the amount of vegetation in the landscape decreases?

Surveys showed that the number of species present *(species richness)* fell as native vegetation cover in the study landscapes decreased. This was especially true for woodland-dependent birds, which ranged from 12 to 53 species per landscape. Landscapes with more than 25% cover contained twice as many species as landscapes with less than 5% cover. Similarly, the average number of native mammals, excluding bats, in landscapes with less than 5% cover was 5.5, compared with 8 species detected in landscapes with more than 25% cover.

Is the decline in species richness directly proportional to native vegetation cover or is the relationship more complex? The results for woodland-dependent birds showed strong evidence for a discontinuity or 'threshold response' in the relationship at around 10% vegetation cover in the landscape. As the amount of tree cover decreased from 60% to around 10%, there was little change in the trend for species richness. Below 10% cover the number of woodland-dependent species decreased dramatically and continued to fall as vegetation cover decreased.



The relationship between the number of woodland bird species and tree cover in the study landscapes. The green line represents the 'average' number of woodland species per landscape, and the vertical line indicates the 'threshold' at which dramatic change in species richness occurs.

The number of woodland-dependent bird species decreases as the amount of native vegetation in the landscape declines. Below a 'threshold' level, there is a rapid loss of species as the bird community 'crashes'.

What is a landscape 'threshold'?

In nature, few relationships show constant change in one attribute in response to change in another. Sometimes there are points or zones at which dramatic change occurs in one attribute in response to a small additional change in one or more influential factors. That is, there is a *discontinuity* in the response of the ecological condition at a *threshold* value of the influential factor.

'Landscape thresholds' are values at which small changes in landscape structure (such as vegetation cover) produce abrupt changes in an ecological condition (e.g. species occurrence, richness). This may represent points at which there is a major change or breakdown in natural systems. An understanding of landscape thresholds offers insights for land management. It informs us about ecological limits and precautions needed to prevent excessive disturbance and degradation of the natural environment.

How do individual species respond?

Results from the study landscapes showed that different species have different *types of responses* to landscape change. Three examples are illustrated here.

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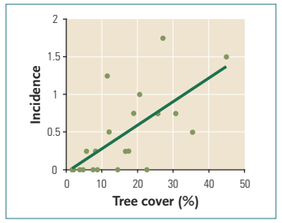
Linear response

e.g. Little Lorikeet (left), Crimson Rosella, Swift Parrot, Olive-backed Oriole

What's happening? The *rate* of population decline is constant as tree cover decreases. These species move easily across the landscape, and so isolation does not exacerbate the impacts of habitat loss. Population size is therefore limited by the total amount of native vegetation in the landscape.

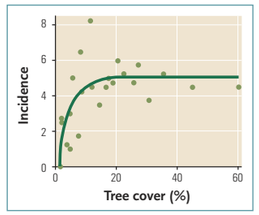


Incidence of the Little Lorikeet versus tree cover. The line represents the 'average' incidence for the corresponding amount of cover.

Curvilinear response

e.g. Grey Shrike-thrush (left), Yellow Robin, Crested Shrike-tit, Black-chinned Honeyeater, Rufous Whistler

What's happening? These species have difficulty crossing large gaps between patches of habitat. As tree cover decreases, isolation effects compound habitat loss and the *rate* of population decline increases. The amount of tree cover at which isolation effects commence depends on the individual species' sensitivity to habitat fragmentation.

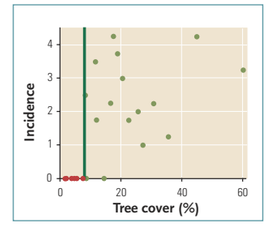


Incidence of the Grey Shrike-thrush versus tree cover.

Step-threshold response

e.g. Yellow-tufted Honeyeater (left), Red-capped Robin, Gilbert's Whistler, White-browed Babbler, Diamond Firetail

What's happening? These species occur only in landscapes above a threshold level of tree cover. Above the threshold, population size is not closely related to tree cover. Many of these species are 'large patch specialists': landscapes below the threshold do not include a patch that meets their minimum size requirements.



Incidence of the Yellow-tufted Honeyeater versus tree cover. This species was not detected in landscapes below their tree cover threshold (green line).

Wildlife species respond to changes in native vegetation cover in the landscape in a number of different ways.

Species on the edge

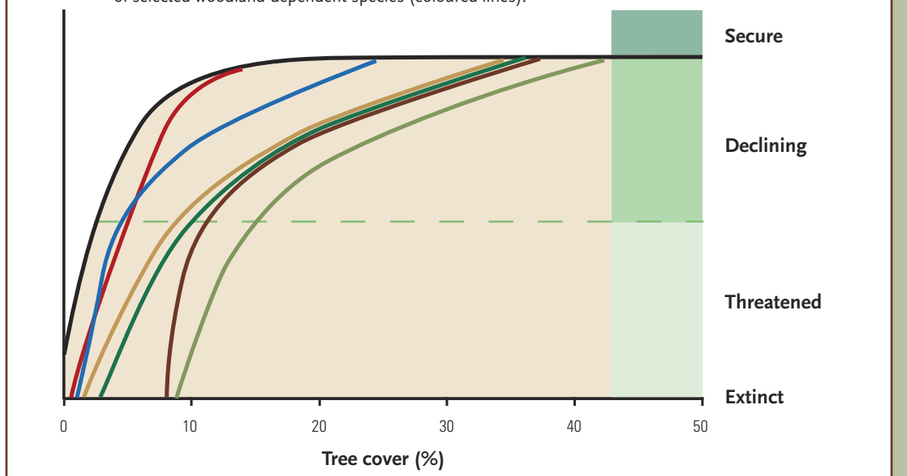
We value native wildlife in our rural landscapes. But how secure are these species? Often, species may be *present* in a landscape but their populations are not *viable* – they are not large enough for long-term survival. This point is illustrated (right) by combining data from two sources. The black line depicts the decline in the number of species present as tree cover decreases. The coloured lines represent the decline in the incidence of six woodland-dependent birds.

Species are considered 'secure' when their incidence is >75% of the maximum expected for that species. We considered species to be 'declining' once they are below the 75% criterion. Note that the total number of species does not fall appreciably until many species are 'threatened' (<50% of maximum expected incidence) and their trajectory of decline has dropped sharply. Once in this phase, there is little time remaining for remedial action.

Species richness may remain unchanged even though many species are declining. It is only when species become locally extinct that species richness falls. If we react only to a decline in species richness (e.g. at around 10% cover), it will be too late for many species that have already become threatened.

The amount of vegetation cover in the landscape required for resilient, sustainable populations differs between species. There is no simple, universal 'answer' to the amount of native vegetation required for biodiversity conservation.

Relationship between species richness (black line) and incidence of selected woodland-dependent species (coloured lines).



Isolation

Many native animals are unable or unwilling to move across cleared land. Isolation effects occur when continuous habitat is fragmented into separate patches. Isolation effects stem from the inability of individuals to reach isolated habitat, either to establish new populations in 'empty' patches, or 'rescue' existing populations that are in decline. The consequence is that in fragmented landscapes populations will decline more rapidly than expected from habitat loss alone because some habitats become inaccessible. The severity of isolation effects will depend on the distance between suitable habitats and the ability of the species to move through the land mosaic.

Incidence of wildlife

The incidence of a species in a landscape was measured by dividing the number of times it was detected at a site by the number of surveys conducted at that site. This fraction was added together for all sites in the landscape to give the 'incidence' for the species. Incidence can be interpreted as the average number of sites out of ten at which the species is expected to be present in the landscape on any given day. Incidence, therefore, was used as a surrogate for population size.

Changes in ecological processes

The occurrence of Box Mistletoe in rural landscapes involves a complex interaction between the mistletoe plant, the host tree and a dispersal vector, usually the Mistletoebird. The Mistletoebird feeds on the fleshy fruit of the mistletoe plant, and moves to another potential host tree where it deposits the seeds via its droppings on small branches. New mistletoe plants then grow and the cycle continues.

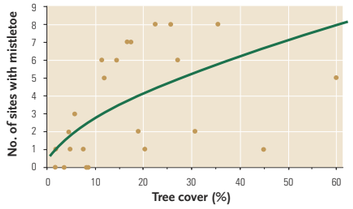
Many animals are involved in ecological processes essential to maintaining healthy ecosystems: for example, pollination of plants, recycling of organic material, regulation of foliage-feeding invertebrates, parasite-host relationships and seed dispersal. How are these types of processes and interactions affected by change in rural landscapes?

Mistletoes provide a fascinating example of an ecological process. These native plants are often seen growing on trees in woodlands and farmland. Surveys showed that Box Mistletoe, the most common species in this area, was patchy in distribution but more common in landscapes with greater tree cover. Within landscapes, distribution was strongly influenced by the arrangement of vegetation. Box Mistletoe occurred in woodland patches, in roadside vegetation and in scattered trees in farmland, but was sensitive to isolation from large blocks of native vegetation.

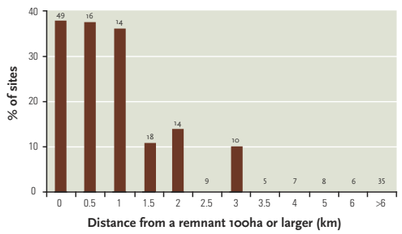
Changes in native vegetation cover affect ecological processes that maintain healthy ecosystems.

Ecological benefits of mistletoe

Mistletoe provides many benefits for native wildlife. Their dense clumps of foliage make ideal nest sites for many birds, and by increasing the rate of hollow formation in trees they help provide further nesting sites for birds and mammals. They are an important food source for many birds, mammals and insects (e.g. butterflies), offering a smorgasbord of delights: nectar, fruit and foliage. Mistletoes are a significant part of biodiversity in their own right, and include several threatened species.



The frequency of occurrence of Box Mistletoe increases with increasing tree cover in the landscape.

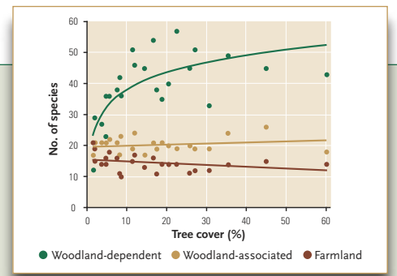


Mistletoe was not recorded at sites more than 3 km from a large block (>100 ha) of native vegetation. Number of sites surveyed is shown above columns.

Changing communities

There is a change in *species composition* (the mix of species present) at the landscape level associated with changes in land-use. The proportion of woodland-dependent birds in the avifauna decreases as tree cover decreases and other land-uses (e.g. cropping, grazing) occupy more of the landscape. The number of farmland and woodland-associated species remains steady but they make up a greater *proportion* of the bird community in more production-orientated landscapes.

A similar situation occurs with mammals. Generalist species such as the Common Brushtail Possum are common in farming-dominated landscapes but habitat specialists such as the Yellow-footed Antechinus and Sugar Glider become less common. The *proportion* of introduced mammals (e.g. Red Fox, Cat, Brown Hare) increases as native vegetation in the landscape decreases – not because there are more species of introduced mammals but because of the decline in native species.



The species composition of wildlife communities depends on the dominant land-uses and the amount of native vegetation in the landscape.

Planning for the future

A major challenge is to determine how much native vegetation is required for wildlife to thrive in rural landscapes. There is no "correct" or universal answer because different species prosper in different environments: the type and arrangement of native vegetation in the landscape, as well as land use, landform, climate and biogeography all influence species composition. Perhaps the question we should be asking is 'what will happen to the native fauna in *this landscape* if we manage it in *this way*?'

a. This rural landscape has less than 5% native vegetation cover. The native fauna in this landscape are in trouble: it is highly modified and dominated by farmland species (e.g. Australian Magpie, Galah, Crested Pigeon) although woodland-associated species (e.g. Eastern Rosella, Willie Wagtail, Laughing Kookaburra) occur along roadsides and creeks, in small remnants and among scattered trees. Even in very low-cover landscapes such as this, some woodland-dependent species survive. Some may be widespread (e.g. Musk Lorikeet, Grey Shrike-thrush) but most occur in small and dwindling numbers (e.g. Sacred Kingfisher, Weebill). Only hardy mammals, such as the Common Ringtail Possum and Eastern Grey Kangaroo are common here. Five percent cover is not enough to support viable populations of most species and to sustain ecological processes.

b. Native vegetation cover in this landscape is 10-15%. The prospects for native wildlife are brighter in this scenario. Woodland-dependent species are likely to occur here in greater diversity and abundance. Mammals such as the Short-beaked Echidna and Yellow-footed Antechinus are probably secure, and birds like the Brown Treecreeper and Black-chinned Honeyeater are more prevalent. The abundance of patch edges and diversity of patch sizes creates a varied landscape, one favoured by edge-dwellers such as the Jacky Winter and Mistletoebird. Some habitat-sensitive species occur here but in smaller populations than before the landscape was modified (e.g. Hooded Robin, White-browed Babbler). This landscape is likely to support a high diversity of native species but their future sustainability is not assured. This scenario serves as an intermediate goal for restoration of very low-cover landscapes.

c. Landscapes with 30-35% native vegetation cover are relatively healthy: they support resilient faunal populations more capable of withstanding environmental fluctuations. Ecological processes are less disprupted and woodland-dependent species are expected to outnumber farmland and woodland-associated species. Many species that are uncommon in lower-cover landscapes (e.g. Eastern Yellow Robin, Gilbert's Whistler, Swift Parrot, Sugar Glider) occur in greater numbers in landscapes like this, greatly improving their chance of long-term survival. Large blocks of habitat are a key feature of these landscapes. They harbour area-sensitive species, such as the Crested Bellbird, Speckled Warbler and Brush-tailed Phascogale, which are unlikely to occur in landscapes with less native vegetation. The conservation value of large habitat blocks depends on their integrity or 'completeness', which must be preserved from degrading land-uses or fragmentation into small blocks.

Making a difference

Many benefits flow from managing rural landscapes in an ecologically sensitive way. Not only will retention and restoration of native vegetation help to sustain resilient populations of native fauna, it will also promote landscapes that are more robust to environmental shocks (e.g. low rainfall, floods, fire), buffer degrading processes (e.g. salinity, soil acidity and erosion, weed invasion), enhance sustainable agricultural production, and contribute to the emotional and spiritual well-being of people.

We have a choice about the types of rural landscapes we want in the future. How much habitat is enough? That depends on how much of our natural heritage we are willing to lose. Our research shows that the woodland bird community collapses below 10% cover – we must aim higher than this. In mosaics with 10-20% cover, many species are in decline but this is enough habitat to support sustainable populations of some species. However, to support most species present in woodland regions in southern Australia, an average of 30-35% native vegetation cover is necessary. It is not practical to have uniform cover of 30-35% on all farms and landscapes, but we need to ensure that areas with high vegetation cover are regularly interspersed among those where native vegetation has been heavily cleared.

Effective actions to protect and conserve Australia's distinctive wildlife can be undertaken at many levels – for single blocks of bushland, the farm property, the landscape scale and across entire regions. Every property contributes to the land mosaic on which native flora and fauna depend for survival. It is the actions of many individual land managers that together determine the shape of present landscapes and the pattern they will take in the future.

Individual actions ***do*** make a difference in rural landscapes:

- *Protecting* patches of native vegetation, especially key parts of the landscape such as streamside vegetation, scarce vegetation types and large blocks of habitat.
- *Tying together* the landscape by maintaining natural vegetation along creeks and streams, protecting remnant 'corridors' and 'stepping stones' of bushland, and building on to existing blocks of bush.
- *Increasing* the total amount of habitat for wildlife by natural regeneration and strategic revegetation.

Further information

Department of Sustainability and Environment (DSE)
Customer Service Centre: 136 186
Web: www.dse.vic.gov.au

Victorian Catchment Management Council (VCMC)
(03) 9412 5045
Web: www.vcmc.vic.gov.au
Includes links to all regional CMAs.

Land and Water Australia (LWA)
(02) 6263 6000
Web: www.lwa.gov.au

Greening Australia Victoria Inc. (GAV)
(03) 9450 5300
Web: www.greeningaustralia.org.au

Trust for Nature (TFN)
(03) 9670 9933
Web: www.tfn.org.au

World Wildlife Fund (WWF), including Threatened Species Network (TSN)
(03) 9853 7244 or 1800 032 551
Web: www.wwf.org.au

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