Managing natural assets on farms:

Shelterbelts

Well-managed and diverse native shelterbelts can have productivity benefits for cropping and grazing enterprises while supporting hundreds of species of birds, mammals, invertebrates, frogs and reptiles. This management guide details the science behind shelterbelts and outlines how to create effective shelterbelts on farms.

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Introduction

Planting native shelterbelts on farms is a significant act of land stewardship, one that also delivers demonstrated productivity and biodiversity benefits.

Shelterbelts are generally linear strips of vegetation, intended to provide shelter, shade and wind breaks. They can be a strip of newly planted trees and shrubs, or can involve the restoration of existing remnant vegetation. Shelterbelts can also incorporate other landscape features such as paddock trees, farm dams, creeks and rocky outcrops.

All forms of shelterbelts can significantly improve on-farm biodiversity and deliver productivity benefits to livestock, crops and pastures.

About 85% of the original woodland vegetation has been lost across southeast Australia, and in some regions just 3% remains, predominantly on farms. Planting shelterbelts is one way to help restore this native vegetation cover.

Australian research indicates that the total amount of native vegetation across a property or the broader landscape is more important than the size of individual patches or plantings. Even small shelterbelts can make a worthwhile contribution to biodiversity.[1]

Livestock and wool productivity gains, increases in crop and pasture production, more pollinators, and reductions in costly crop and pasture pests, such as red-legged earth mites, have all been associated with the introduction of shelterbelts on farms.

Photo: Suzannah Macbeth

"In the paddocks where we have shelter from the trees, we put stock into lamb, and you have a much higher percentage surviving because it's sheltered. If lambing rates increase over five or ten years, then that's a significant result. You also have much better protection of your pastures because you don't lose topsoil."

Bimbi Turner, 'Silverdale', Yass, NSW

Planting along a creekline. Photo: Eleanor Lang

The science of shelterbelts

The productivity benefits of shelterbelts on farms in Australia is well-demonstrated, while two decades of scientific work by Sustainable Farms highlights the co-benefits for biodiversity.

BENEFITS: Livestock productivity and welfare

Shelterbelts create microclimates – reducing windspeed and windchill and creating shade.

- Shelter that reduces windspeed by 50% can reduce energy losses of shorn sheep by 20% and increase liveweight gains by as much as 40%.[2]
- Shelterbelts are particularly important for protection of vulnerable stock such as lambs, with one study in southeast Australia showing effective shelterbelts reduced lamb losses by 50% (Figure 2).[3]
- Shade from shelterbelts can alleviate heat stress in cattle — improving milk yields and liveweight gains.[3]

Heat loss (chill index) in lambs is a function of wind speed and air temperature. Even at 9°C, in moderately strong winds (around 30km/hr), heat loss exceeds the critical value of 1100 (Figure 2). Reducing wind speed by 50% (to about 15km/hr) reduces heat loss to safer levels.

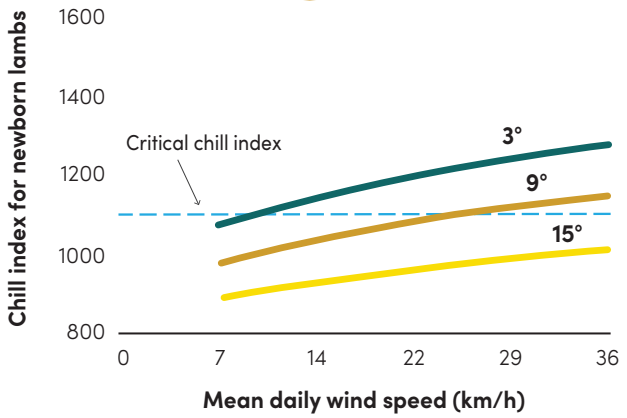


FIGURE 2. The effect of wind on heat loss from newborn lambs at 3, 9 and 15 degrees.[3]

Shelterbelts can provide effective protection from wind for a horizontal distance of at least 12, and up to 20, times the shelterbelt's height. They can reduce windspeeds by up to 70%, and moderate maximum and minimum temperatures (Figure 1).[4]

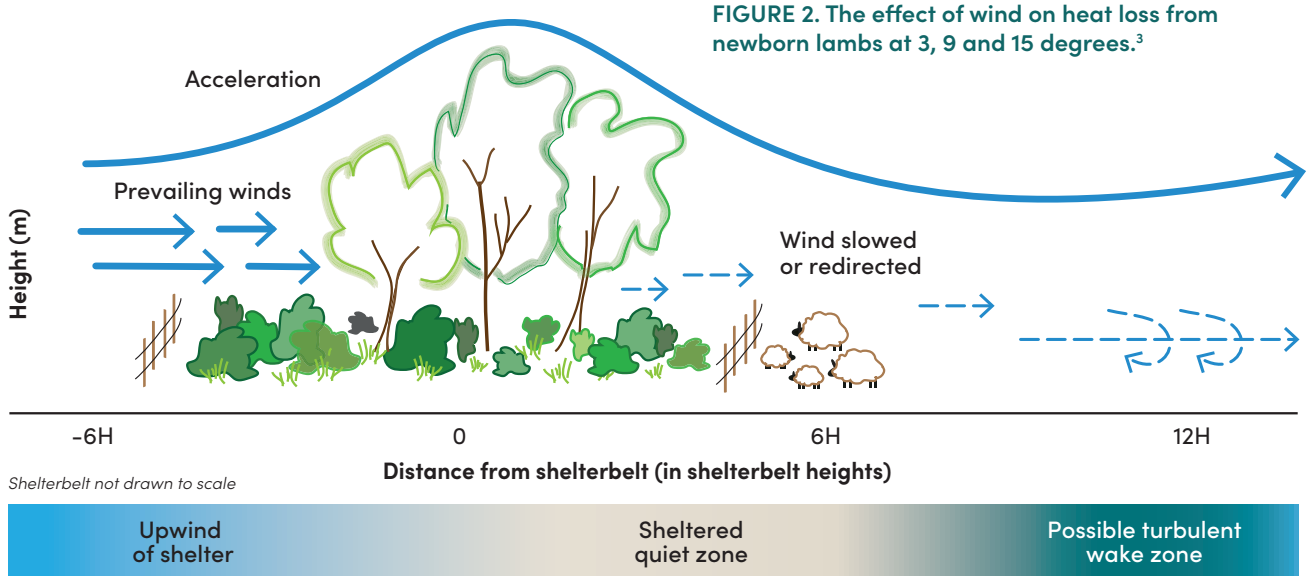


FIGURE 1. The effect of a shelterbelt on wind.[5] Planting dense shrubs and grasses helps maximise wind protection, while tall trees closer to the eastern and southern edges of a shelterbelt help maximise shade.

BENEFITS: Crop and pasture growth

Shelterbelts reduce wind damage, evapotranspiration and spray drift, while providing habitat for beneficial invertebrates that offer valuable pollination and pest control benefits.

- Planting of 10% of cropping areas with shelterbelts or tree clusters could reduce windspeed by 50%, reducing soil erosion and enhancing productivity.[6]
- Productivity increases of 8% (pastures[7]) and 22–47% (wheat, oats and lupins[6]) have been attributed to shelterbelts.
- Shelterbelts with ground cover provide habitat for a diversity of beneficial organisms that suppress pest numbers in adjacent pastures.[8]
- Areas of native vegetation close to pastures and crops support greater numbers of pollinator species, which may act as insurance against potential declines of the European honey bee.[9]

Competition for soil moisture can reduce productivity of crops and pastures close to the shelterbelt, but the gains in productivity beyond this competition zone exceed the production losses (Figure 3).[6,7]

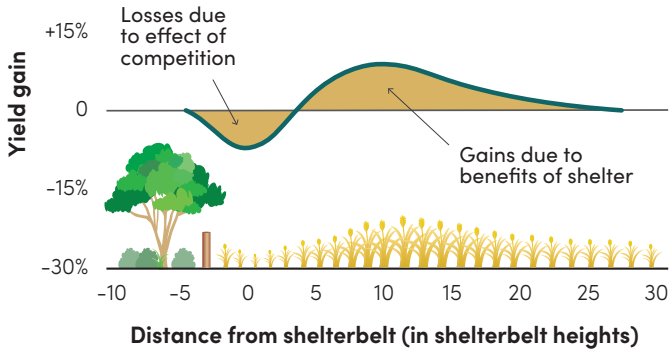


FIGURE 3. The effect of a shelterbelt on crop yields[5]

BENEFITS: Carbon storage

Shelterbelts are one mechanism by which farmers can increase carbon storage and play a significant role in climate change mitigation.

- Tree planting is an important means of increasing carbon storage in soil and vegetation. Plantings such as shelterbelts are an effective means of long-term carbon storage.[10]
- Shelterbelts can restore degraded soils, slowing carbon release.[11]
- Water infiltration doubles in planted revegetation sites that are 11–20 years old, compared to pastures and younger plantings.[7] Increased soil moisture is beneficial for carbon-capturing microbes.[12]
- Government and industry funding schemes that enable farmers to benefit financially from increased carbon storage already exist, and continue to be developed.

Studies show that trees can contribute to more than 20 positive ecosystem services on farms.[13]

Photo: Suzannah Macbeth

"I think it is vitally important that we pay attention to establishing replacement vegetation that is properly planned into the operation of the farm so that it will be there for the long term. I have noticed the crops on the lee side of the plantings often do better, as they are more sheltered from the prevailing winds. And we have noticed that in summer, the stock really enjoy the shade that is provided by these shelterbelts."

Derek Schoen, 'Killeneen', Corowa, NSW

BENEFITS: Biodiversity and conservation

The original box-gum grassy woodlands that once covered south-eastern Australia were rich in plant and animal diversity. Today only a fraction of the original woodlands remain, predominantly on farms. By enhancing these remnants or planting new native shelterbelts, farmers can invest in a farm's natural assets while supporting the conservation of native plants and animals. In turn, this increases amenity value and boosts the mental health and wellbeing of those living and working on the land.

- More native vegetation means greater biodiversity: doubling the amount of vegetation can treble the number of bird species at a landscape level and double the number of species at farm level.[14]
- Some bird species colonise shelterbelts in preference to more open remnant woodland. These birds include the brown treecreeper, sacred kingfisher, speckled warbler, hooded robin, crested shrike-tit, jacky winter, scarlet robin and rufous whistler.
- Diversity of bird species is higher at the intersections between linear shelterbelt plantings than elsewhere in those plantings.[15] While larger block plantings are generally preferable (see Figure 4, page 8), if space is limited then intersecting narrower plantings can offer similar value for birds.
- Noisy miners are an aggressive native bird that can drive away other native birds. They are less likely to occur in landscapes with more vegetation cover, and this is especially the case where the area of vegetation includes a shrub layer.[16] Native shelterbelts with a midstorey of shrubs and bushes are thus particularly important for small woodland birds that are otherwise driven away by noisy miners.

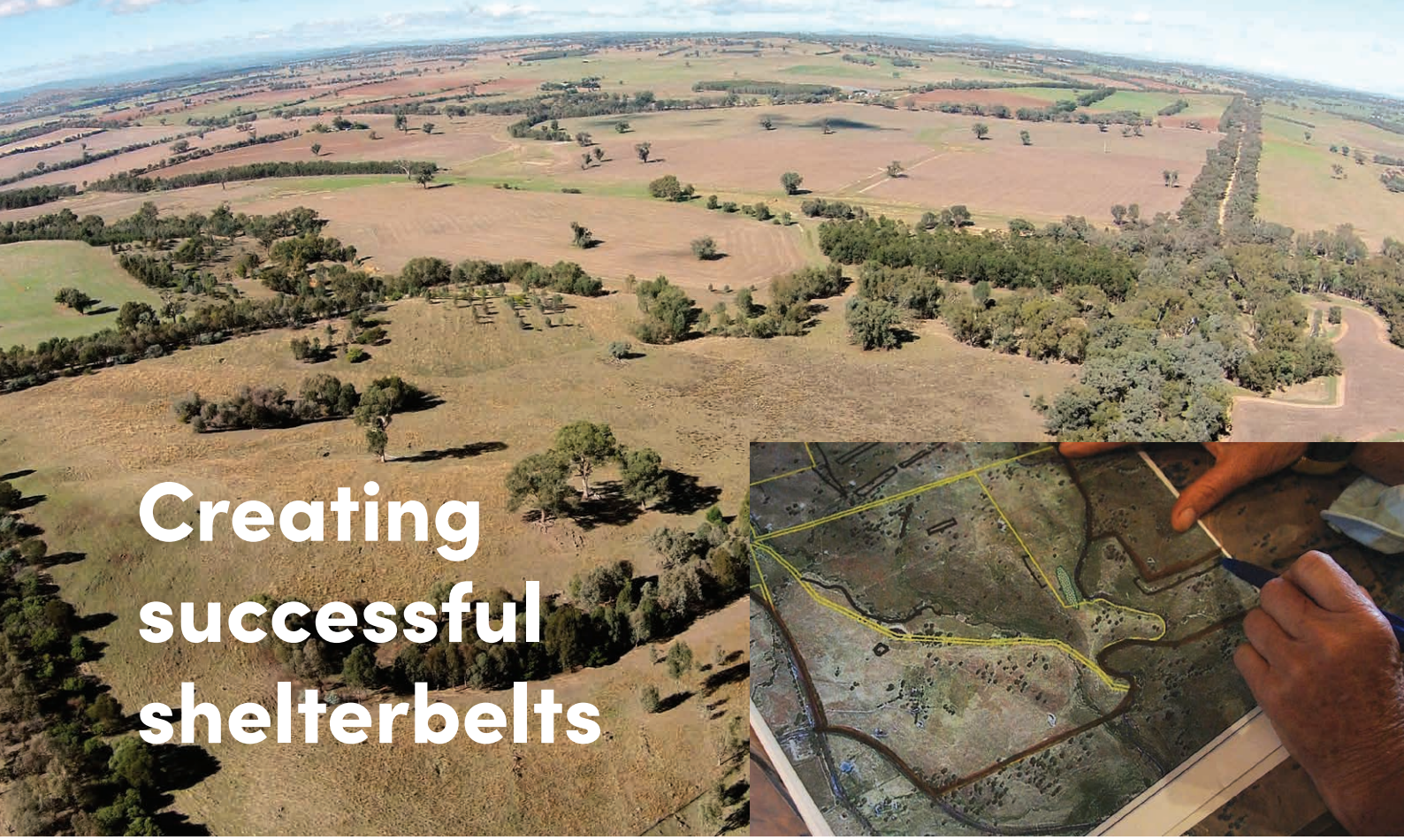
Digging mammals like echidnas, wombats, bandicoots, bilbies and bettongs play a major role in soil health. These mammals can shift 3.6 tonnes of soil per kilo of body mass every year. In the process, they bury organic matter, reduce combustible material on the ground, enable water infiltration and enhance growth of fungi.

TOP: Flame robin Photo: David Jenkins
MIDDLE : Boulenger's skink Photo: Damien Esquerre
BOTTOM: Short-beaked echidna Photo: Suzannah Macbeth

"I was moving stock the other day and I came across a flock of zebra finches. Ten years ago, we didn't see any. When you never used to see them and you've got a flock of about seventy of them and they're flitting around on the ground in front of you, well that's a bit of fun. If you just observe what's going on around you, it's quite extraordinary what you'll see."

John Hopkins, 'Allawah', Illabo, NSW

Photo: Natasha Fijn



Creating successful shelterbelts

The first step in establishing a shelterbelt is to determine its main purpose or function. Are you seeking summer shade for livestock, or a windbreak for soil erosion control and lamb shelter? Or are you primarily interested in boosting biodiversity and developing corridors for local wildlife?

1. Plan

Complete a whole-of-farm plan to identify existing vegetation and natural assets, and highlight areas vulnerable to wind exposure or erosion and those needing shade.

2. Consider location

Integrate shelterbelts with other natural assets such as existing paddock trees, remnant vegetation, fallen logs, farm dams and rocky outcrops to create corridors of native habitat for movement of native mammals, reptiles, birds and invertebrates across the landscape.

Incorporating paddock trees into shelterbelts helps protect paddock trees from damage by stock and from exposure. It also provides a 150-year head start on shelterbelt biodiversity, as the old growth represented by paddock trees provides habitat that cannot immediately be replicated in a new planting (e.g. for the white-plumed honeyeater and white-browed wood swallow).[1] Shelterbelts planted along natural waterways will reduce soil erosion and improve water quality, benefiting biodiversity and productivity.

3. Go wide

Wider shelterbelts slow wind more effectively and generate greater biodiversity. A minimum width of 30 metres is recommended, but smaller shelterbelts can still be valuable. If limited by how wide the shelterbelt can be, intersecting narrower belts can provide more biodiversity than separate lines of plantings. Fencing is the principal cost of a shelterbelt so wider shelterbelts also have the advantage of lowering fencing costs per unit area planted.

4. Fence to restrict grazing

Shelterbelts must be fenced to exclude livestock, enabling new plantings to grow and natural regeneration to occur. Grazing also compromises the biodiversity value of replanted areas through trampling and removal of vegetation. Reptiles are particularly affected. Intense grazing can lower breeding success of some species of birds, such as superb fairy wrens, due to habitat simplification.[17]

Ensure gates are incorporated in shelterbelt fences to allow access for firefighting and for weed and pest control.

5. Prepare

Competition from weeds can cause new plantings to fail. Crash grazing up to a year before planting can reduce the weed seed bank. In some cases, it may be necessary to use other means of control following grazing.

Several months before planting, deep rip compacted soil to 40–60cm to break up subsoil and create fissures for water infiltration and root growth. Check with your local Landcare group for advice targeted to your area.

6. Plant natives

Native species provide the best habitat for wildlife and can survive local conditions which may include drought and fire. Match the characteristics of the site (geology, soils, climate, aspect and elevation) with local species best adapted to the site, and plant a variety of species to provide greater resilience against pests and diseases.[18] Consider planting rare local plant species to maintain their populations. Consult your local Landcare group for more detailed advice.

7. Create complexity

Ideally, a shelterbelt should include a canopy of tall trees such as eucalypts, a midstorey of shrubs (including wattles) and a ground layer of low shrubs, forbs and native grasses. As a rule, plant three times as many shrubs as trees.

Denser areas of shrubs towards the edge of the shelterbelt provide an effective windbreak while planting taller trees towards eastern and southern edges of the shelterbelt will provide the most effective shade (see Figure 1).

8. Ensure permeability

Shelterbelts need to be permeable (porous) to the wind. Porosity can be judged visually, and should ideally be between 20-35%.[5] The goal is to filter and redirect wind, rather than to block it completely, which can cause turbulence and erosion.

Shelterbelts should ideally be a minimum of 30 metres wide and contain a mix of trees, midstorey shrubs and a ground layer of low shrubs, forbs and native grasses. Photo: Bindi Vanzella

Aim for diversity

A healthy, resilient shelterbelt capable of supporting biodiversity on a farm will have both floristic diversity (a range of plant species) and structural diversity (different vegetation layers, plants of varying ages, fallen timber).

Greater species diversity is generally a good indication of an ecosystem's health and resilience. Healthy areas of box-gum grassy woodlands can support between 60 and 110 plant species. Therefore, when planting a shelterbelt, include a variety of locally-indigenous species of trees, shrubs and ground covers such as native grasses and forbs.

More floral diversity will ensure that suitable niches and resources are provided for many different fauna species. Taller wattles in the midstorey, for example, will benefit some bird species (e.g. white-plumed honeyeater) and provide small birds with refuge from predators and noisy miners, while low shrubs benefit other species such as grey fantails.[1]

Integrating fallen timber into shelterbelts provides further structural diversity and supports more species of birds and reptiles.[19] Because shelterbelts initially lack the fallen timber common in remnant woodlands, timber can be manually added (for example, a log that's in the way of machinery in a paddock can be dragged into a shelterbelt).

Photo: Suzannah Macbeth

ABOVE (from L–R): Yellow rumped thornbill, yellow-footed antechinus, olive legless lizard. Photos: Damien Esquerre, David Smith, Damian Michael

Designing shelterbelts and plantings to benefit wildlife

During the planning stage when you are deciding where to locate shelterbelts or other plantings on your farm, there are a few simple decisions you can make that could have a big impact on how effective the shelterbelts are for supporting wildlife. Sustainable Farms research shows that simply changing the shape or location of a planting can help maximise biodiversity benefits without needing to increase the overall area planted (see below).

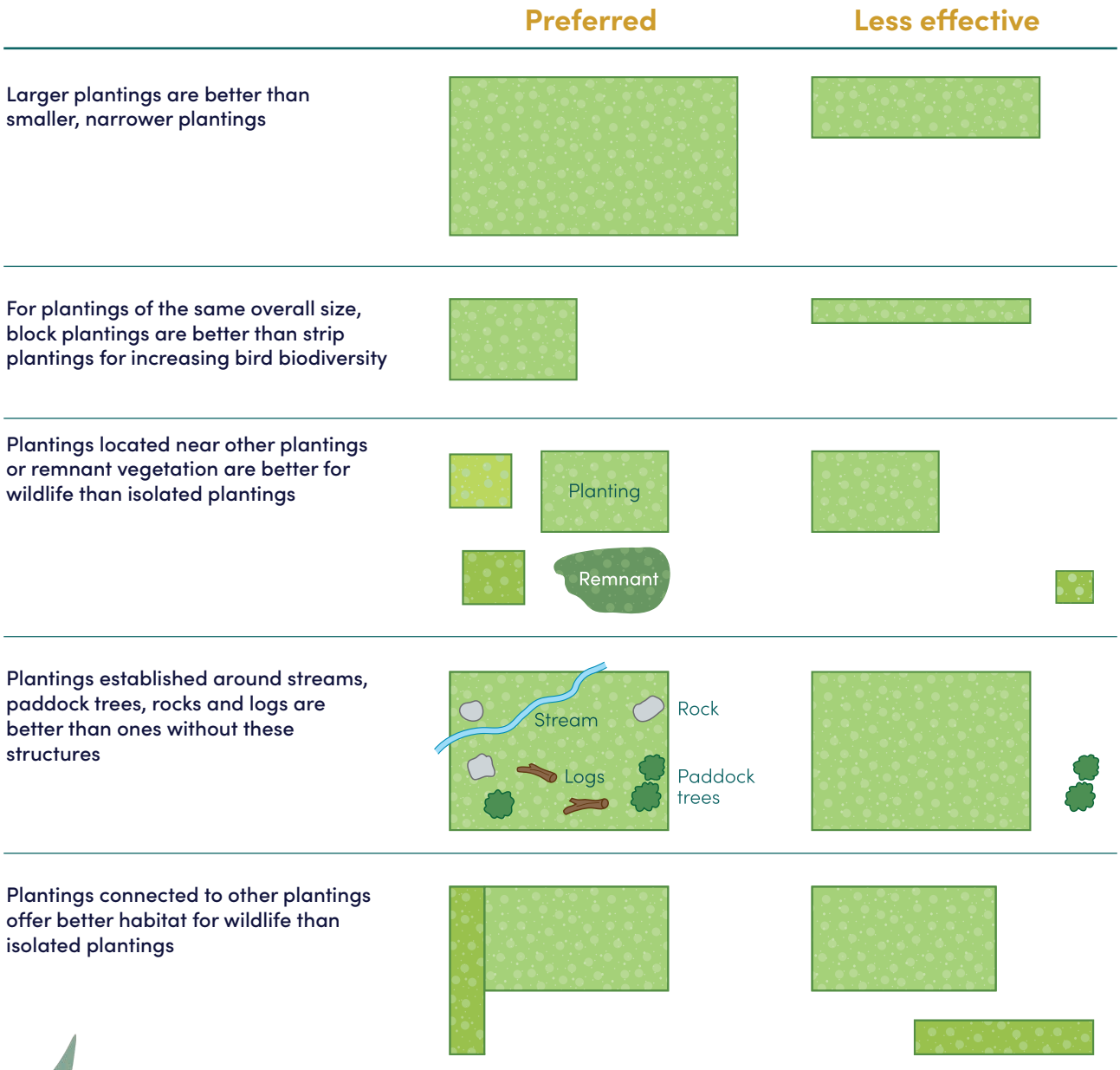


FIGURE 4. Key features of a planting that are better for wildlife.[20]

Planning for future timber or fodder needs

A carefully planned shelterbelt with a variety of plants included for specific purposes can provide the opportunity for firewood, fodder or agroforestry benefits down the track.

Multipurpose design from the outset can provide an opportunity for farmers to benefit, while still ensuring the shelterbelt provides the necessary shade, shelter and wildlife habitat.

Considerations for multipurpose shelterbelts:

- At the time of planting include some extra plants – perhaps an additional row of trees – that will be suitable for firewood in the future. Firewood is usually harvested from fallen timber, removing an important resource for native animals. Growing trees that are specifically designed for future firewood avoids this loss.
- Some perennial Australian shrubs are suitable for fodder and can be included in a shelterbelt planting to provide out-of-season feed for stock, while also providing shelter and shade, controlling dryland salinity and wind erosion, and improving biodiversity.[21]
- Agroforestry plantings can provide a way to revegetate large areas and create a future income source, and should ideally be integrated with or connected to shelterbelts. Research shows that such plantings convey benefits to adjacent agriculture well in advance of future harvest income.[22]

Mixed-species agroforestry planting on a farm near Holbrook.
Photo: Suzannah Macbeth

- By incorporating a diversity of native understory species into agroforestry plantings, they can play a role in supporting ecosystems through providing animal habitat or protecting areas of native plant habitat.[5]

Managing fire risk

Shelterbelts and other plantings bring a range of benefits to a farm, many of which are increasingly important in a changing climate. In many rural landscapes, where grass fires can be a particular risk, wind can be an important driver of fire behaviour and the ability of shelterbelts to check those speeds can be critical.

The following elements should be considered when designing and managing shelterbelts in the context of grass fire risk on farms:[18,20]

- Shelterbelts that are placed perpendicular to prevailing winds can help slow spread of grass fires.
- Caution should be given to shelterbelts that run up a hill, because fire travels faster up slopes.
- Shelterbelts must be dense enough to effectively slow wind speeds, but should have a degree of porosity. Shelterbelts that are too dense can divert winds, while gaps can create wind tunnels.
- Ensure that planted areas not only have gates, but they are wide enough for access by emergency vehicles and have sufficient space between rows or along fencelines to allow vehicle movement.
- Avoid establishing native vegetation too close to homesteads and other built infrastructure.
- Plant locally-native species, and consult your local fire authority for guidance on location, arrangement and choice of species to reduce fire risk. Establish native grasses in the understorey as these are summer-growing, so they remain green and less flammable throughout summer.
- Management of understorey weeds is important in shelterbelts. Depending on the age of the trees and shrubs, brief controlled grazing or chemical forms of control may be appropriate.

Note: Every fire is different and will be influenced by a range of factors, so this information should be considered as very general guidance in relation to grass fires only.

Managing existing shelterbelts

The initial investment in a shelterbelt will return increasing benefits over time, but some ongoing management is required to maximise results. Older shelterbelts may show signs of decline such as dead trees or collapsed fences, but rejuvenating these older shelterbelts is extremely worthwhile.

Maintain fences

Fencing shelterbelts to control grazing is essential for maintaining shelterbelt effectiveness in the long term. Grazing of an established shelterbelt will likely reduce ground cover and limit the growth of shrubs, reducing the shelterbelt's effectiveness as a windbreak and for wildlife habitat.

Repairing fences can also be an opportunity to widen older, narrow shelterbelts and add extra rows of trees and shrubs, boosting the provision of shade, shelter, habitat for wildlife and other benefits.

Keep dead trees and fallen timber

One of the reasons older shelterbelts are more valuable for wildlife is the presence of older, larger trees, including dead trees which provide habitat, and fallen timber that can help reduce erosion and protect new seedlings as they germinate.

Dead trees and fallen timber are often harvested for firewood, removing this valuable resource from a shelterbelt. If you hope to harvest firewood from your shelterbelt in future, consider planting extra trees for this purpose.

Add new plants

For younger shelterbelts, replacing young plants that die due to dry conditions may be required in the first few years after planting. For established shelterbelts of sufficient width with a mix of suitable species, natural regeneration should occur, but in some cases additional planting can be needed to provide the next generation of shrubs and trees and maintain appropriate plant density.

Some old shelterbelts are comprised entirely of trees and lack the midstorey species required for shelter and habitat. Underplanting with shrub species such as wattles can be an extremely effective way of boosting the function of these shelterbelts.

Control pests and weeds

Shelterbelts and other plantings can provide focal points from which to conduct targeted pest control efforts, such as for foxes. While some landholders worry that shelterbelts may attract pests, most farmers find that their initial concerns are outweighed by the other, observed benefits of shelterbelts in the landscape.

Weeds should be monitored and controlled, particularly in young shelterbelts. Over time, accumulated litter from trees and shrubs, as well as ground covers such as grasses and forbs, will likely reduce the opportunity for weeds to establish.[18]

Frequently asked questions

What species should I plant?

Native species are best because they are adapted to local conditions and will support native wildlife. Local Landcare groups can advise on local trees, shrubs and forbs. See also the Sustainable Farms planting guide in our *Powerful Pollinators* brochure.

What plant spacings should I use?

To be an effective windbreak, a shelterbelt needs a reasonably dense layer of shrubs and trees. For biodiversity purposes, less dense plantings are adequate provided shrubs are included. Natural box-gum grassy woodlands are typically quite open with 30–40 trees/ha. Local Landcare groups can advise on preparing a planting plan.

How do I achieve the best outcomes for farm productivity?

The main benefits of shelterbelts for animal and crop production are wind protection on the leeward side of the planting and shade on the southern or eastern sides. An effective shelterbelt can reduce windspeeds to a distance up to 20 times the height of the shelterbelt (see Figure 1). Careful planning is required to ensure that a mix of shrubs and trees provides an effective wind barrier; gaps can create wind tunnels. Tall trees such as eucalypts or she-oaks planted towards the southern or eastern sides of the shelterbelt will create the longest shadow.

Will my shelterbelt encourage foxes?

Foxes can use shelterbelts to den in so increased areas of native vegetation could theoretically increase fox numbers. Foxes are believed to be responsible for 1-3% of healthy lamb deaths but the benefits of shelterbelts for lamb survival rates more than offset this (see Figure 2), and fox control is a key part of most operations regardless of the presence of shelterbelts. To be effective, fox control must remove 70% of the population and be co-ordinated at a district scale as foxes are highly mobile and will move into any 'vacuum' created by localised culling.

What kind of wildlife can I expect to see when I complete my shelterbelt?

Native insects, mammals, reptiles and birds will discover the resources in your shelterbelt soon after it is planted. Many small woodland birds, including many that are vulnerable or of conservation concern, prefer planted areas rather than old growth woodland. These 'planting specialists' include speckled warbler, weebill, yellow-rumped thornbill, southern whiteface, rufous whistler, scarlet robin, red-capped robin, flame robin, hooded robin and diamond firetail.

As the shelterbelt grows, its characteristics will change and the assemblages of animals using it will also change. Farmers can use the *BirdCast* tool to predict what birds might use woodland areas on their farm, and to understand how bird occupancy might change under a range of scenarios.

ABOVE (from top left): rufous whistler (Patrick Kavanagh); marbled gecko (David Smith); scarlet robin (Daniel Florance); squirrel glider (Katherine Tuft); yellow-tailed black cockatoo (Damien Esquerre); yellow-rumped thornbill (Patrick Kavanagh); fringed heath-blue butterflies (M.G. Jefferies); superb fairy-wren (Damien Esquerre); blotched blue tongue lizard (Damien Esquerre)

Further information:

- ***Natural Asset Farming*, by David Lindenmayer, Suzannah Macbeth, David Smith and Michelle Young.[20]**
- **For additional information on shelterbelts: SustainableFarms.org.au/info/shelterbelts**
- **To order or download the *Powerful Pollinators* planting guide: SustainableFarms.org.au/info/pollinators**
- **To use the BirdCast tool: SustainableFarms.org.au/birdcast**
- **To connect with local advice on planting: contact your local Landcare group, Local Land Services or Catchment Management Authority**
- **For access to additional resources, references and published research: SustainableFarms.org.au or contact us directly**

Photo: Suzannah Macbeth

"I see investing in shelterbelts as investing in the capital of the property. There is no doubt of the benefits they provide to the livestock and the birds. We have also noticed we no longer have issues with redlegged earth mite."

Paul Graham, 'Bongongo', Adjungbilly, NSW

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Sustainable Farms Brochure 1.2 (2022). Cover photos by Dave Smith, Suzannah Macbeth and Amber Croft.

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