The importance of paddock trees for regional conservation in agricultural landscapes

A discussion paper for consideration by the Riverina Highlands Regional Vegetation Committee

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Philip Gibbons
Miles Boak

New South Wales National Parks and Wildlife Service
Southern Directorate

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Summary

Isolated trees and small patches of trees – paddock trees – perform a number of ecosystem services:

- *they provide habitat to a range of fauna in the Riverina Highlands, including several species listed on the NSW Threatened Species Conservation Act and species acknowledged to be in decline throughout the wheat-sheep belt;*
- *these trees contribute to the viability of wildlife populations in agricultural landscapes by maintaining connectivity between larger patches of remnant vegetation;*
- *they contribute to salinity mitigation;*
- *in riparian areas they are important for mitigating erosion;*
- *they help recycle nutrients leached beyond the pasture root zone;*
- *they provide shade to stock and are an important component of the visual landscape.*

Tree-cover within grazed and cultivated paddocks in the Riverina Highlands will gradually diminish unless there are changes to land use practices. This is because paddock trees will senesce with time - often accelerated by factors associated with dieback – and will not be replaced because recruitment does not typically occur in these environments. Estimates of annual mortality among paddock trees suggest that this resource may be lost within 40 years.

Using satellite (SPOT) imagery with a 10m resolution for a 30,000ha sample of the Riverina Highlands around Holbrook, we examined the contribution to total tree cover made by paddock trees. Woody native vegetation covered 12% of the study area. Overall, clumps of trees up to 0.1ha (approximately 1-5 trees) represented 9% of total tree cover and patches up to 1ha represented 33% of total tree cover.

When assessed in isolation, paddock trees appear to have little value for conservation. In the regional context however, paddock trees are important for the conservation of some vegetation communities. For woodland dominated by E. blakelyi/E. melliodora, *8% occurred as patches <0.04ha (1-2 trees), 16% as patches <0.1ha (1-5 trees), 42% as patches <0.5ha, 55% as patches <1ha and 79% as patches <5ha. A similar pattern occurred for communities dominated by* Eucalyptus macrorhyncha/E. polyanthemos, E. macrorhyncha/E. goniocalyx *and* E. albens.

If patches containing 1-5 paddock trees are not protected and recruited, the community dominated by E. blakelyi/E. melliodora *will be reduced from 6.7% to 5.7% of its predicted pre-1750 distribution within the study area. If patches <1ha are not protected and recruited then this community will be reduced to 3.1% of its predicted pre-1750 distribution. The figures are similar for woodland dominated by* E. macrorhyncha/E. polyanthemos, E. macrorhyncha/E. goniocalyx *and* E. albens.

Thus, by not protecting and promoting regeneration among paddock trees, it will be difficult to achieve a net gain in selected vegetation communities – a stated objective in the draft Riverina Highlands Regional Vegetation Management Plan.

To reduce the rate at which paddock trees are lost from the landscape requires measures to reduce clearing and dieback. Dieback among paddock trees can be reduced through a number of measures, such as managing stock movements and minimising herbicide drift.

Measures that can be implemented to encourage recruitment among paddock trees in grazed and cultivated areas include: periodic reductions to stocking rates within paddocks; temporary fencing around paddock trees; and permanent fencing around paddock trees. Regeneration events need only be applied to a paddock or stand once every 50-100 years. The potential increase to tree-cover that can be achieved across the landscape using these techniques greatly exceeds that which can be achieved by planting alone.

Introduction

Under present land-use practices, tree cover provided by isolated and small clumps of trees (paddock trees) in grazed or cultivated paddocks within the Riverina Highlands will be lost over time.

There are three reasons for this:

(1) These trees have a maximum life-span of around 500 years (Banks 1997) and will therefore naturally senesce with time.

(2) Premature mortality among paddock trees - or dieback - often occurs as a result of factors including salinity (Kimber 1981), the interaction between increased nutrient loads and insect attack (Landsberg *et al.* 1990), soil compaction (Yates and Hobbs 1997), altered flooding regimes (Reid and Landsberg 2000) and windthrow.

(3) Such trees are cleared for a number of purposes such as plantation establishment, firewood collection and some forms of cultivation.

The loss of paddock trees has been measured at 2.5-11% per annum in different agricultural landscapes in Australia (Reid and Landsberg 2000). At this rate, the paddock-tree resource will be lost in a period of 9-40 years.

There is a general absence of eucalypt regeneration in cultivated or intensively grazed landscapes (Wilson 1990), so paddock trees are not replaced when they are lost. This scenario has given rise to the description of paddock trees as 'the living dead'.

To date, there has been no holistic approach to management of paddock trees because their contribution to biodiversity conservation and other ecosystem services is often undervalued. Further, vegetation mapping is undertaken at a scale such that their contribution to total tree-cover in the landscape has not been measured.

In this discussion paper we review the value of paddock trees – particularly in terms of biodiversity conservation. We also quantify the contribution of paddock trees to total tree-cover in the Riverina Highlands. Options for appropriate management of this resource are discussed.

Relevant conservation principles

Two overarching notions are relevant when assessing the importance of paddock trees for biodiversity conservation: (1) connectivity; and (2) comprehensiveness, adequacy and representativeness.

Connectivity

Metapopulation theory underpins the basis for contemporary assessment of population viability - or extinction risk - for organisms in fragmented landscapes (Hanski and Gilpin 1991, Lindenmayer and Possingham 1994). This theory is based on observations that animal populations generally occur as a set of sub-populations embedded within a matrix of sub-optimal habitat. The matrix is important for maintenance of the metapopulation (all sub-populations together) because it enables exchange, or dispersal, of organisms or their genetic material between sub-populations. This is important for maintaining sufficient genetic diversity within a sub-population and enables sub-populations to be recolonised in the event of periodic perturbations, such as drought, fire or disease.

In agricultural landscapes, there is an increased risk of extinction among the remaining wildlife populations within remnant patches of vegetation when the matrix, or area between these patches, forms a barrier to movement. For example, there have been observations of small bush birds such as the Hooded Robin, Silvereye and Diamond Firetail disappearing permanently from remnants in the wheat-sheep belt after major droughts have caused mortality (Reid 1999). The inability of these patches to be recolonised has been blamed for these species' permanent, localised loss (Reid 1999).

However, agricultural landscapes generally contain some level of tree-cover between the larger remnants. There are many species with the capacity to feed and move through paddocks via the crowns of these scattered trees. McIntyre and Barrett (1992) suggested that native vegetation in agricultural landscapes functions as a continuum for many organisms and therefore the distinction between remnant patches and scattered trees is an artificial one. Indeed, Bennett and Ford (1997) found that total tree cover in the landscape was a significant variable influencing bird species richness in northern

Victoria - not just the contribution made by vegetation in larger remnants.

Comprehensiveness adequacy and representativeness

The guiding principles used to assess forests in the Comprehensive Regional Assessment (CRA) process throughout Australia were: comprehensiveness, adequacy and representativeness (Commonwealth of Australia 1997). The Native Vegetation Advisory Council considered these principles relevant for preparation of Regional Vegetation Management Plans for NSW (Native Vegetation Advisory Council 1999). Among other things, these principles recognise that effective conservation requires the protection of sufficient examples of every vegetation community in every region. In the absence of better information, vegetation communities are considered to be one of the better surrogates for biological variation, and therefore the representation of sufficient, good examples of each vegetation community in a conservation strategy is seen to be a positive step towards biodiversity conservation.

Contributions by paddock trees to conservation

Use of paddock trees by fauna

Most studies of fauna in agricultural landscapes have focused on larger patches of remnant vegetation, because they support larger populations of most species. However, there is a range of studies that provide us with an indication of the value of paddock trees for biodiversity.

In Victoria, Loyn and Middleton (1991) detected 24 more bird species in agricultural areas that contained scattered trees, compared with agricultural areas containing no trees. A similar result was found in northern Victoria where approximately four birds per hectare were detected in open grassland, 11 per ha in areas with scattered trees, 17 per ha in remnants <5ha and 12 per ha in remnants >30ha (A. Bennett pers. comm. cited in Reid and Landsberg 2000). Birds detected in paddock trees are not only the common and widespread species. Hill et al's (1997) observations of birds using isolated trees in South Australia included the Jacky Winter, Brown Treecreeper and Diamond Firetail. Each of these species is considered to be declining in the wheat-sheep belt of NSW (Reid 1999).

Some of the migratory birds that visit the Riverina Highlands seasonally have been observed using isolated trees. These include species listed on the NSW Threatened Species Conservation (TSC) Act, such as the Superb Parrot and Regent Honeyeater. Some of the preferred tree species for these birds (e.g. *E. melliodora*) occur predominantly in areas that have been cleared for agriculture and therefore tend to be the dominant paddock-tree species.

Use of the paddock-matrix by insectivorous bats has been noted in a number of Australian studies. Law *et al.* (1999) detected nine species in five paddock sites located in the Riverina Highlands (*Chalinolobus morio, C. gouldii, Vespadelus regulus, V. darlingtoni, V. vulturnus, Falsistrellus tasmaniensis, Miniopterus schreibersii, Mormopterus planiceps, Nyctinomus australis*). Two of these species (*F. tasmaniensis* and *M. schreibersii*) are listed as Vulnerable in the TSC Act. In a study from Victoria, an isloated tree contained an extremely large roosting colony of *F. tasmaniensis* (Parnaby and Cherry 1992).

Law et al. (2000) undertook a study comparing fauna in scattered trees and different-sized patches in areas to be converted to plantations in North East NSW. Two of the arboreal species recorded (the Brush-tailed Phascogale and Squirrel Glider) were listed as Vulnerable on the TSC Act. This species occurs in the Riverina Highlands.

Paddock trees also represent a source of woody debris important for a range of invertebrate and vertebrate species. Reid and Landsberg (2000) quoted figures from an unpublished study that found 210 lizards per ha in areas with scattered trees, but 1500 lizards per ha in areas where the litter and woody debris under scattered trees were not removed. Trees on floodplains are an important source of woody debris for some native fish species such as the Golden Perch (McNally et al. 2000).

Resources provided by native paddock trees not provided by pine plantations

The replacement of paddock trees by pine plantations is an important issue in the Riverina Highlands. Pines provide a number of ecosystem services also provided by paddock trees (see next section). In terms of biodiversity, pine plantations support a number of native species, particularly where there is a dense understorey of blackberries. In studies undertaken in the Tumut region, pine plantations supported a number of mammal and bird species including the Eastern Yellow Robin, Yellow-tailed Black Cockatoo, White-throated Treecreeper, White-browed Scrubwren, Brown Antechinus Common Ringtail Possum, Swamp Wallaby, Common Wombat and Brushtail Possum, although abundance was often less in pines compared with remnant native vegetation (Lindenmayer et al. 1999). However, pines do not provide habitat to many of the typical woodland species, including virtually all of those listed as declining by Reid (1999), possibly because they lack many of the dietary items that occur in stands of eucalypts (Suckling et al. 1976). For example, pine plantation do not provide the nectar resources required by the migratory bird species, many of which are listed on the TSC Act, and Radiata Pine does not readily develop hollows. Also, the value of pines as a conduit for movements by declining bird species that occur in the Riverina Highlands has not been established.

Other ecosystem services provided by paddock trees

Paddock trees perform a number of other ecosystem functions (Reid and Landsberg 2000):

- Isolated and widely-spaced trees have a greater root volume per tree than trees in stands and therefore have the potential to intercept and pump considerable volumes of subsurface water, thus reducing salinity risk.
- Scattered trees reduce wind velocity at ground level and therefore slow the spread of grass fires.
- Trees among pastures recycle nutrients leached beyond the pasture root zone.
- Trees reduce erosion potential, especially in gullies and on stream banks.
- Favourable conditions for some native understorey species (e.g. *Microlaena stipoides* and *Poa sieberiana*) occur where there is some tree-cover.
- The vertebrate fauna supported by paddock trees help control invertebrate populations.

Paddock trees in the Riverina Highlands

Using SPOT satellite imagery for the study area and a Geographical Information System (GIS), we examined the relative contribution of single paddock trees and small clumps of trees to total native tree-cover in the western portion of the Riverina Highlands, viz. the Holbrook 1:25,000 mapsheet – an area of 30,808 ha (Figure 1). It is important to note that the quality of native vegetation is not distinguished between remnants and non-woody vegetation that may occur in the study area. Also, non-woody vegetation (e.g. grasslands) is not identified.

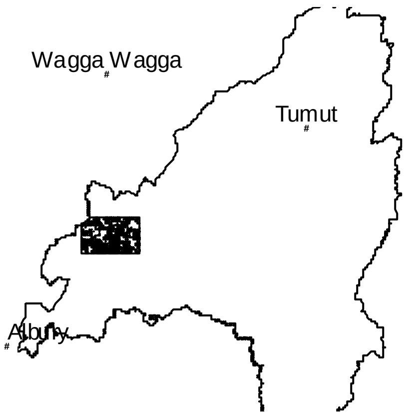

***Figure* 1. The Riverina Highlands Vegetation Committee boundary and the 1:25,000 Holbrook mapsheet used as the study area in this project.**

Total native tree-cover for the Holbrook mapsheet was estimated to be 3,768ha. That is, 12% of the area contained native tree-cover. It is important to note that this estimate of tree-cover is higher than the 3,407ha for the same area as mapped by Maguire et al. (2000) as part of the Southern Comprehensive Regional Assessment (CRA). The difference reflects to the resolution of the satellite imagery used to identify woody vegetation. The SPOT imagery has a resolution of 10mx10m and thus is likely to capture most isolated trees, small patches and narrow linear strips, such as roadsides (Figure 2).

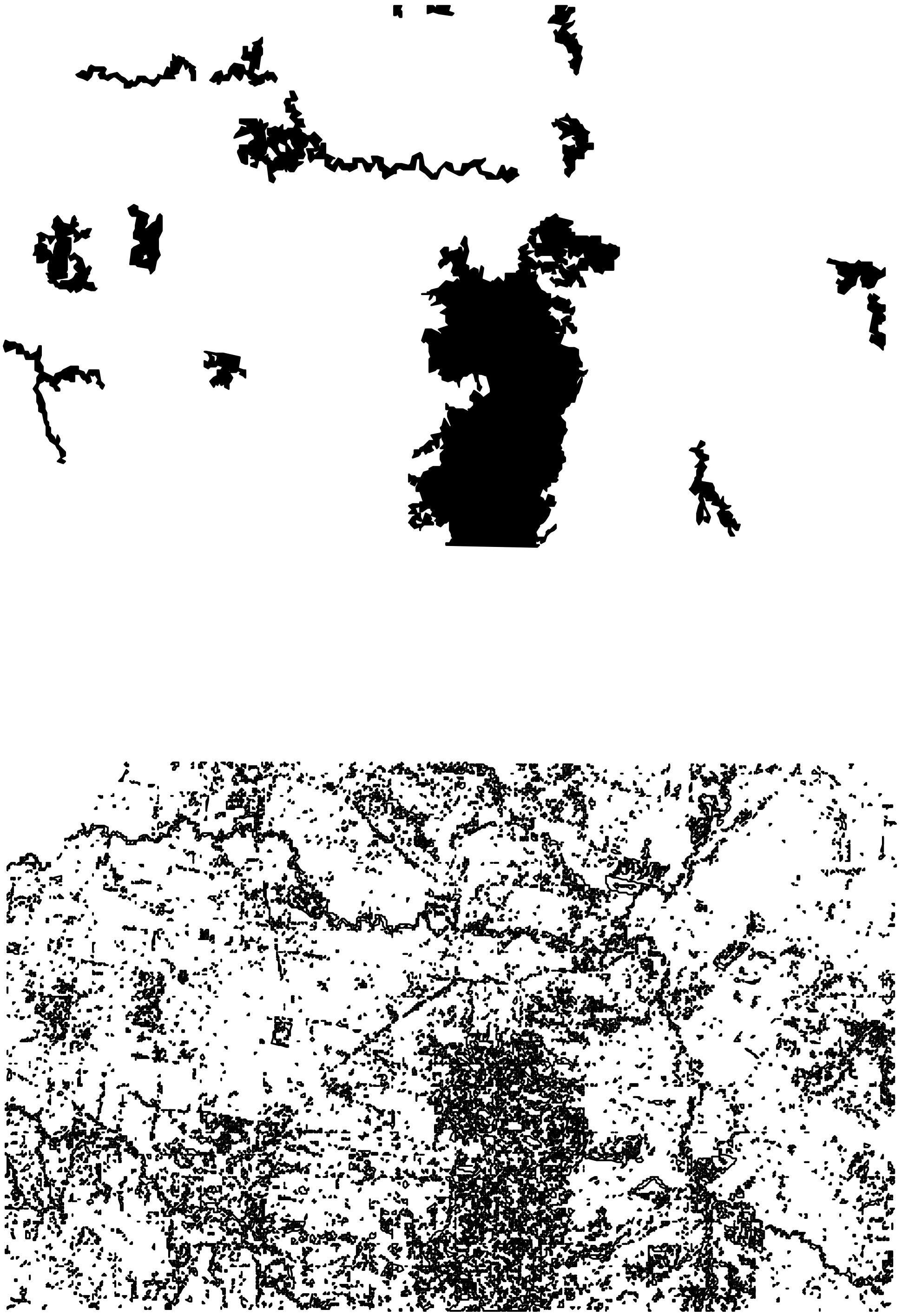

***Figure* 2. Comparison between woody vegetation mapped in CRA process (top) with woody vegetation derived from SPOT imagery (bottom). We estimated that tree-cover occurred over 12% of the study area.**

There were relatively more small patches of native vegetation (including isolated trees) than there were larger patches of native vegetation (Figure 3). These data indicated that there were only 18 patches of native vegetation >10ha in the study area, compared with 12,680 patches <0.1ha (around 1-5 mature trees per patch). There was only one patch of native woody vegetation with an area >50ha.

Together, single trees and clumps of trees up to 0.1ha (around 1-5 mature trees) accounted for 9% of the total tree-cover in the study area. Together, clumps of trees up to 1ha accounted for 33% of the total native tree-cover in the study area. Clumps of trees up to 10ha accounted for 57% of total tree cover in the study area, with the balance (43%) occurring in patches >10ha (Figure 4).

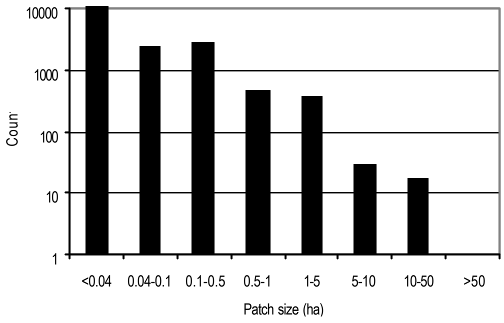

***Figure* 3. Counts of different patch-sizes of woody vegetation. Patches <0.04ha are likely to contain 1-2 mature trees. Patches up to 0.1ha are likely to contain up to 5 mature trees. There was one patch >50ha.**

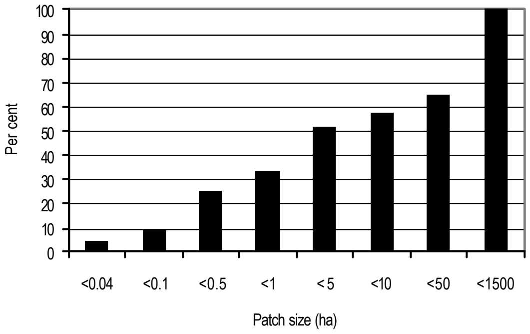

***Figure* 4. Cumulative total area of tree-cover contributed by different patches in the study area.**

Changes to tree-cover in the landscape when patches <0.1 ha (1-5 trees) and patches <1ha are removed are simulated in Figure 5. This illustrates not only the degree to which vegetation cover is reduced under these scenarios, but also the decreased level of connectivity that results. The mean distance between patches across the study area increased from 247m to 267m when patches <0.04ha were removed, to 294m when patches <0.1ha were removed and to 451m when patches <0.5ha were removed.

We examined the patch-size distribution for each vegetation type separately by overlaying our tree-cover layer with the pre-1750 layer developed for the Riverina Highlands as part of the Southern Comprehensive Regional Assessment (Maguire et al. 2000). The patch-size distribution of vegetation in the study area varied considerably between vegetation types. It is important to note that all areas for vegetation communities reported here are based on tree-cover within the predicted distribution of the vegetation types, irrespective of condition.

***Figure* 5. Total tree cover in the landscape (top), tree cover in the landscape with patches <0.1ha (1-5 trees) removed (middle) and tree cover in the landscape with patches <1ha removed (bottom).**

Vegetation dominated by *E. dwyeri/Acacia doratoxylon* was predicted to occupy an area of 1345ha within the study area. This type dominated the larger patches of remnant vegetation (*viz*. the drier ridges), with only a small proportion occurring as scattered paddock trees (Figure 6). Only 0.5% of the mapped extent of this community occurred in patches <50ha, with the remaining 99.5% in one patch >50ha.

Vegetation dominated by *E. macrorhyncha/E. polyanthemos* or *E. macrorhyncha/E. goniocalyx* had a different patch-size distribution. Most of these vegetation types occurred in patches between 0.1-0.5 ha (29.5%) and 1-5ha (30.1%) (Figure 6). Overall, 8% of these vegetation types occurred in patches up to 0.04ha (1-2 trees), 17% occurred in patches up to 0.1ha (1-5 trees), 46% occurred in patches up to 0.5ha, 61% in patches up to 1ha and 91% in patches up to 5 ha.

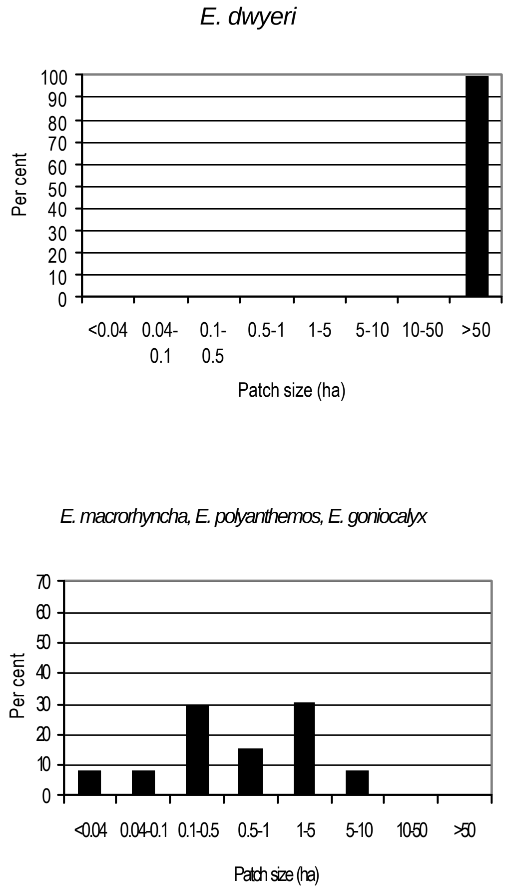

***Figure* 6. The contribution of different patch sizes to the total area of the communities dominated by *E. dwyeri/Acacia doratoxylon* (top) and *E. macrorhyncha/E. goniocalyx, E. macrorhyncha* in the study area.**

For the *E. blakelyi/E. melliodora* community, the majority of the mapped extent (1431ha) occurred in patches between 0.1-0.5ha (25%) and patches 1-5ha (24%) (Figure 7). For this community, 8% occurred as patches <0.04ha (1-2 trees), 16% as patches <0.1ha (1-5 trees), 42% in patches <0.5ha, 55% as patches <1ha, 79% in patches <5ha, and 84% in patches <10ha.

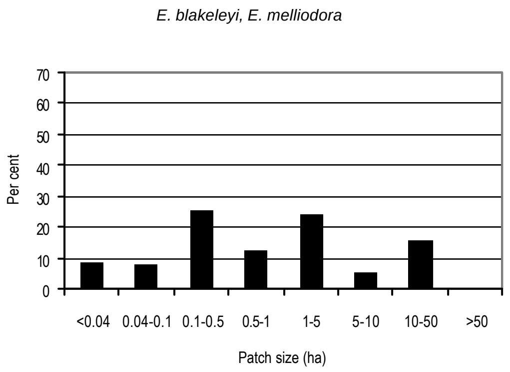

***Figure* 7. The contribution of different patch sizes to the total area of the community dominated by *E. blakelyi and/or E. melliodora* in the study area.**

A similar pattern occurred for the community dominated by *E. albens*, which was predicted to occur over 121ha. Most of this vegetation type occurred in patches between 0.1-0.5ha (Figure 8). Ten per cent of this vegetation type occurred as patches <0.04ha, 21% as patches <0.1ha, 59% as patches <0.5ha and 77% as patches <1ha.

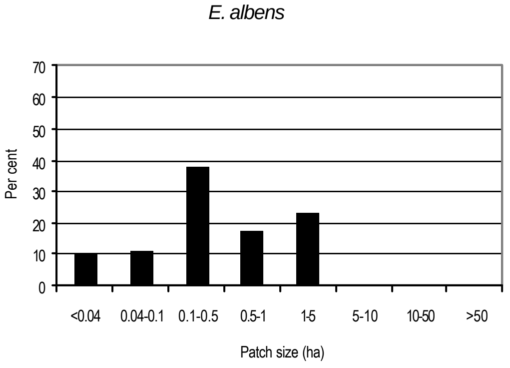

***Figure* 8. The contribution of different patch sizes to the total area of the community dominated by *E. albens* in the study area.**

A different pattern occurred for riparian woodland dominated by *E. camaldulensis*. This vegetation type covered a predicted area of 83ha. The majority of the remnant vegetation of this type (72%) occurred in four linear patches >10ha (Figure 9). Isolated, and smaller patches of trees up to 0.1ha only accounted for 3% of the extant area of this vegetation type, with patches <1ha accounting for 15%.

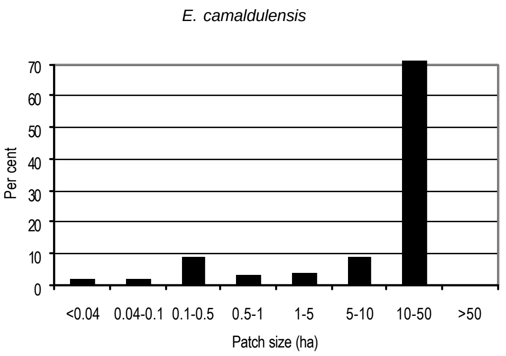

***Figure* 9. The contribution of different patch sizes to the total area of the community dominated by *E. camaldulensis* in the study area.**

Error associated with the data

We manually checked the accuracy of our woody vegetation layer by visually comparing woody vegetation on the SPOT image with the polygons of woody vegetation derived from the same image using Arcview™. This was done for 10, 1km^2 plots located randomly in the study area. Typically, the presence or absence of tree canopies was obvious when the SPOT image was enlarged. Overall, our layer for the 10km^2 sample estimated there to be 243ha of woody vegetation. After manually deleting or adding polygons to tree crowns judged to be incorrectly classified, we estimated total woody vegetation cover over this same area to be 225ha. This manual classification suggested that we overestimated woody vegetation cover by 9%. The error varied in different parts of the landscape. The assignment of woody vegetation appeared to be most accurate on partially cleared hilly terrain. In the continuous areas of native vegetation within the hilly parts of the study area, woody vegetation was underestimated. The procedure often classified cropped paddocks in the flatter, well-watered parts of the landscape as woody vegetation. Therefore, some of the vegetation types on the alluvial parts of the landscape were overestimated. A further source of error would be attributable to non-native woodland cover, e.g. around homesteads, in windbreaks and within the township of Holbrook. There were no pine plantations within the study area to contribute to this.

Discussion

Individual trees and smaller clumps of trees up to 0.5ha represented 42-59% of remnant woody vegetation for communities of the lower slopes and plains dominated by the tree species *E. blakelyi*, *E. blakelyi/E. melliodora,* *E. albens* and *E. macrorhyncha/E. polyanthemos/E. goniocalyx*. Where these isolated trees, scattered trees and clumps occur in grazed or cultivated land, this tree-cover will be progressively lost because of the general absence of recruitment in these environments.

Without change to the way these patches and isolated trees are managed will undermine the ability to reach vegetation targets nominated for these vegetation communities in the Draft Riverina Highlands Regional Vegetation Management Plan.

For example, 6.7% of the predicted pre-1750 extent of the community dominated by *E. blakelyi/E. melliodora* occurred within the Holbrook 1:25,000 mapsheet (this estimate includes all remnant woody vegetation in these communities as mapped using SPOT imagery, irrespective of condition). Should patches containing approximately 1-5 trees (<0.1ha) in the study area be lost from the landscape, this vegetation type will be reduced to 5.7% of its predicted pre-1750 distribution. Should patches up to 1ha be lost from the landscape, this vegetation type will be reduced to 3.1% of its predicted pre-1750 extent.

For the community dominated by *E. albens*, the loss of trees in patches <0.1ha will reduce the predicted pre-1750 extent of this community within the study area from 8.4% to 6.6% and the loss of patches <1ha will reduce this vegetation type to 2.0% of is pre-1750 distribution.

For the communities dominated by *E. macrorhyncha/E. polyanthemos*/*E. goniocalyx*, the loss of trees in patches <0.1ha would reduce them from 5.9% to 4.9% of their predicted pre-1750 distribution and losing patches <1ha would reduce them to 2.3% of their predicted pre-1750 distribution within the study area.

We expect these patterns to generally hold across the Riverina Highlands, except perhaps for communities dominated by *E. macrorhyncha*, which may occur in generally larger patches than suggested here. Conserving the isolated trees and smaller patches is therefore critical for achieving the stated objective of the Draft Riverina Highlands Regional Vegetation Management Plan, i.e. net vegetation gain in the vegetation communities of the lower slopes and plains such as *E. blakelyi*, *E. melliodora* and *E. albens*.

According to the principles recommended by the Native Vegetation Advisory Committee for Regional Vegetation Committees, the best examples of a vegetation type should be given priority for protection. The smaller clumps and isolated trees represent a large proportion of much that remains of certain vegetation types in the Riverina Highlands. Although the structure and understorey floristics in these smaller patches will be highly modified, they are nevertheless some of the best relative examples of remnant vegetation for these types, given the degree to which many of these vegetation types have been cleared. For the highly cleared communities, it could be argued that all remaining vegetation of these types, regardless of condition, is important for their conservation.

Rehabilitation efforts for these woodland communities should be focused where there is existing tree cover, unless there is a specific reason for new vegetation to be established in a certain location (e.g. riparian areas). This is because understorey characteristics approaching natural conditions can be achieved in a matter of years. Species such as grasses, forbs and wattles can reach functional maturity within 1-10 years. However, trees do not reach functional maturity, that is, they do not supply large quantities of seed, nectar and hollows for decades. For example, hollows suitable for fauna do not occur in the majority of eucalypts until they are upward of 150-200 years old (Gibbons et al. 2000).

The loss of paddock trees will also remove deep rooted perennial vegetation from a large proportion of the Riverina Highlands. As demonstrated in Figure 5, the removal of isolated trees and patches <1ha from the landscape leaves large areas without woody vegetation, predominantly in the lowland areas, which are also the areas with potential to be sites of salt discharge.

Further, the loss of patches smaller than 1ha would severely reduce the degree to which the larger patches of vegetation are connected across the landscape (Figure 5), thus increasing fragmentation and potentially reducing the viability of populations of those species that can move through habitat provided by scattered trees.

As discussed previously, the principles of comprehensiveness, adequacy and representativeness suggest that all vegetation communities across the landscape should be sampled in a conservation network. This is important in the Riverina Highlands because the lowland vegetation types dominated by species such as *E. blakelyi, E. melliodora, E. camaldulensis* and *E. albens* represent habitat for some species that are generally not found in the drier vegetation types dominated by species such as *E. dwyeri.* These include species such as the Squirrel Glider and Regent Honeyeater. Failure to arrest decline among paddock trees will undermine the ability to meet the conservation objectives of comprehensiveness, adequacy and representativeness in the Riverina Highlands.

The paddock-tree resource, i.e. isolated trees and small clumps of trees in agricultural areas, therefore provide a number of ecosystem services in the Riverina Highlands. The loss of this resource will have a number of negative conservation implications. Without changes to landuse that reduce the rate of dieback, limit clearing and promote recruitment among paddock trees, then this resource will be largely lost. Such measures are particularly necessary among the most extensively cleared vegetation types in the region (viz. *E. blakelyi/ E. melliodora, E. albens* and *E. macrorhyncha/E. polyanthemos/E. goniocalyx* communities).

Conclusions

1. Paddock trees (i.e. isolated trees and smaller patches of trees) perform a number of ecosystem services.
2. Because they are typically highly modified examples of native vegetation, paddock trees will always appear to have little value if assessed in isolation. Their true value for conservation can only be assessed in the regional context.
3. Paddock trees were important for the conservation of those vegetation communities within the Riverina Highlands that were highly cleared. Failure to protect and perpetuate paddock trees in these vegetation communities will undermine the ability to achieve the conservation objectives of comprehensiveness, adequacy and representativeness in this region.
4. The rate of dieback among paddock trees must be reduced to protect this resource. Reid and Landsberg (2000) provided a number of recommendations to reduce dieback among paddock trees:

- provide buffer plantings around isolated trees
- avoid fertilising in the vicinity of trees
- avoid excessive nutrient build-up in the vicinity of paddock trees by managing stock movements
- avoid herbicide drift to paddock trees
- provide conditions for increasing numbers of insect-eating birds and bats.

5. Conditions suitable for eucalypt regeneration must be created for the paddock-tree resource to be perpetuated. Eucalypt regeneration can be achieved by spelling one paddock at a time at a stocking rate sufficiently low enough to achieve regeneration, preferentially timed with years favourable for recruitment. Eucalypt regeneration has been achieved by temporarily reducing stocking rates by approximately one third in unfertilized pastures (data from Reid and Landsberg 2000). Alternatively, trees or patches can be temporarily fenced to prevent grazing or cultivation. Fertilizer input should also be reduced where regeneration is targeted. The identification of demonstration areas in which eucalypt regeneration has been achieved may help define the specific conditions required to obtain regeneration. A regeneration event as seldom as every 50-100 years would be sufficient to perpetuate eucalypts provided mortality is kept to a minimum.

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