Threatened Species Recovery Hub

National Environmental Science Programme






A practical guide for conservation planning using the General Ecosystem Model for Southern Australian Woodlands

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Acknowledgement of Country

Much of this work was conducted on the unceded land of the Wathaurung, Boonwurrung and Woiwurrung peoples; we acknowledge the Traditional custodians of these lands and their long and enduring connection to Country. Field data were collected from across the south of the continent, including the Traditional Lands of the Taungurong, Yorta Yorta, Djadjawurung, Kamilaroi, Wiradjuri, Nyaki Nyaki, and Balardung peoples.

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Cover image:
Top left: A grassy woodland roadside remnant in an 'Exemplar' state. Image: Libby Rumpff
Top middle: A billabong in a remnant grey box woodland. Image: Megan Good
Top right: A 'transformed' woodland landscape. Image: Libby Rumpff
Bottom left: A 'thicket' woodland condition state. Image: Libby Rumpff
*Bottom middle: Obligate-seeder gimlet (*Eucalyptus salubris*) woodland, with a chenopod shrubby understorey. Image: Carl Gosper*
*Bottom right: Obligate-seeder gimlet (*Eucalyptus salubris*) woodland, with a sclerophyll shrubby understorey. Image: Carl Gosperr*

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Navigating the guide

Step 1: Choose a woodland type

In order to navigate this guide, the first step is to align your focal woodland community with the most appropriate woodland type, because the threats and management guidance might vary. Click on a woodland type to find a description, the current listed woodland communities, common threats and drivers, and possible transition states.

- Floodplain and riparian
- Shrubby/Obligate seeder
- Grassy

Step 2: Set landscape goals

Click here to find a description of the condition states. Deciding where to focus management efforts requires consideration of the proportion of the landscape in each condition state and constraints (access, resources).

Step 3: Identify site-scale goals and risks

From each starting condition state, identify the possible transitions towards a goal state. Look at the possible pathways towards more degraded states and think about what transition risks you might face.

Step 4: Create conservation plans for each condition state

Click on your starting condition state below to find a description of the state, the key threats, suggested monitoring attributes, transitions to avoid, and management guidance (decision trees) for your condition state goal.

- Exemplar
- Simplified 1
- Simplified 2
- Simplified 3
- Simplified 4
- Overstorey and Midstorey Thicket
- Thicket
- Transformed

Step 5: Assess fauna habitat attributes and landscape processes

Fauna are integral to a fully functioning woodland ecosystem and they are often influenced by landscape processes. Ensuring key habitat attributes are reinstated or protected should form part of any conservation advice or management plan for all woodland sites. Click here to find management considerations for fauna; these apply to all condition states.

Step 6: Monitoring and adaptive management

Management actions will be implemented in different ways, depending on context and available resources. Uncertainty about management effectiveness is often high, and trialling different actions via adaptive management may be necessary. Monitoring of vegetation, threats, habitat attributes, and key faunal indicators is critical to understanding if interventions are effective, and if not, why.

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Floodplain and Riparian Woodlands

Description:

Woodlands that occur in regularly or occasionally inundated land; floodplains, the banks of waterways and fringing wetlands. Eucalypt overstorey with an understorey dominated by grasses, rushes, sedges and low shrubs.

Common threats:

Vegetation clearing, soil disturbance, livestock grazing, below-average rainfall, altered flood regimes, cropping, tree mortality, dense regeneration events.

Common positive drivers:

Revegetation, grazing management, ecological thinning, above-average rainfall, restored flood regimes, recruitment events, weed control.

Possible transitions:

Experts in Floodplain and Riparian woodlands considered 26 transitions likely or very likely. In terms of positive conservation outcomes, the only transitions experts considered likely were from Simplified 1 to Exemplar, and Thicket to Simplified 2. No change in condition state was also considered likely.

Example listed ecological communities:

- Gippsland Red Gum (*Eucalyptus tereticornis* subsp. *mediana*) Grassy Woodland and Associated Native Grassland
- Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregion

Image: Megan Good

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Shrubby/Obligate seeder woodlands

Description:

Woodlands with an overstorey of obligate seeding (killed by fire) *Eucalyptus spp*, with an understorey dominated by shrubs, and little grass cover.

Common threats:

Vegetation clearing, soil disturbance, livestock grazing, below-average rainfall, altered flood regimes, cropping, tree mortality, salinity.

Common positive drivers:

Revegetation, grazing management, ecological thinning, above-average rainfall, ecological burning, recruitment events, weed control.

Possible transitions:

Experts in Shrubby and Obligate Seeder Woodlands considered 18 transitions likely or very likely. Of these transitions, only six may yield positive conservation outcomes: from Transformed, Overstorey Thicket, or Overstorey and Midstorey Thicket states.

Example listed ecological communities:

- Plains mallee box woodlands of the Murray Darling Depression, Riverina and Naracoorte Coastal Plain Bioregions
- Eucalypt Woodlands of the Western Australian Wheatbelt
- New England Peppermint (*Eucalyptus nova-anglica*) Grassy Woodlands
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
- Illawarra and South Coast Lowland Forest and Woodland
- Eucalyptus ovata Forest and Woodland in Tasmania
- Kangaroo Island Narrow-leaved Mallee *Eucalyptus cneorifolia*) Woodland
- Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia
- Western Sydney Dry Rainforest and Moist Woodland on Shale

Image: Carl Gosper

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Grassy woodlands

Description:

Eucalypt dominated overstorey with a predominantly herbaceous understorey and scattered shrubs in the midstorey. Generally occurring on productive lowlands and gentle slopes.

Common threats:

Fragmentation, vegetation clearing, soil disturbance, livestock grazing, below-average rainfall, altered fire regimes, cropping, tree mortality, dense regeneration events.

Common positive drivers:

Revegetation, grazing management, ecological thinning, above-average rainfall, ecological burning, biomass control, small mammals, creating habitat, recruitment event, weed control.

Possible transitions:

Experts in Grassy woodlands considered 28 transitions likely. The only likely transitions that may result in conservation gains are from the Simplified 1 to Exemplar, Thicket states, and between Transformed and Simplified 4. It was considered likely that each of the vegetation condition states would remain in the same conditions.

Example listed ecological communities:

- Plains mallee box woodlands of the Murray Darling Depression, Riverina and Naracoorte Coastal Plain Bioregions
- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands of South-eastern Australia
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland
- Grassy Eucalypt Woodland of the Victorian Volcanic Plain
- Lowland Grassy Woodland in the South East Corner Bioregion
- Eucalypt Woodlands of the Western Australian Wheatbelt
- Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregion
- New England Peppermint (*Eucalyptus nova-anglica*) Grassy Woodlands
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
- Illawarra and South Coast Lowland Forest and Woodland
- Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia

Image: Libby Rumpff

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Exemplar

Description: The best of the best, but not necessarily pre-1788. All vegetation strata are intact; understorey species richness is high and includes disturbance-sensitive species; low weed cover; soil is stable and has a natural nutrient balance

Example: remnants or reserves

Simplified 1

Description: Overstorey is mostly intact; mid/understorey is depleted in both richness and cover; understorey flora is primarily native; soil nutrient levels are natural, or close to natural

Example: travelling stock reserve

Simplified 4

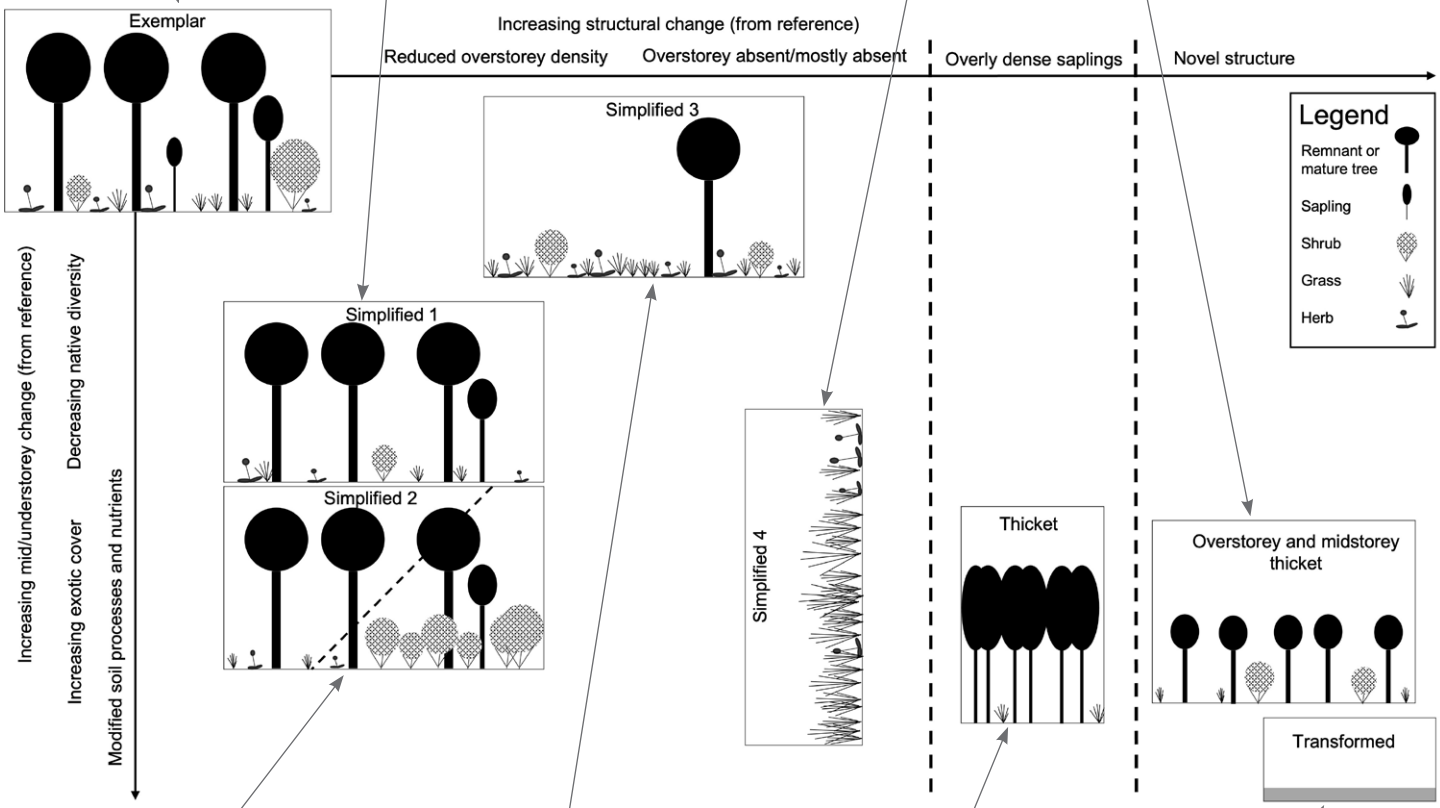
Description: Overstorey is depleted or absent; midstorey is absent or depleted; understorey is depleted in native species richness and cover

Example: native pasture, grazing land

Overstorey and Midstorey Thicket

Description: Few to no mature trees; high density of shrubs and tree saplings; higher shrub and tree richness compared to Overstorey Thicket; understorey may be dominated by natives or exotics; low native understorey richness

Example: revegetated sites



Simplified 2

Description: Overstorey is mostly intact; mid/understorey is depleted in richness; midstorey can be elevated in cover; exotic annual herbs present and may be prevalent; altered soil processes

Example: road reserve

Simplified 3

Description: Overstorey mostly absent; midstorey depleted but understorey remains mostly intact

Example: derived native pasture

Thicket

Description: Overly dense overstorey; very low understorey species richness, low under/mid storey cover; understorey may be dominated by natives of exotics; soil stability may be compromised

Example: destocked pasture

Transformed

Description: Very low to no vegetation cover in the mid and understorey; overstorey absent or low, dead or dying, no recruitment, soil is saline, acidic, or highly nutrified

Example: exotic pasture, salinized area, cropland

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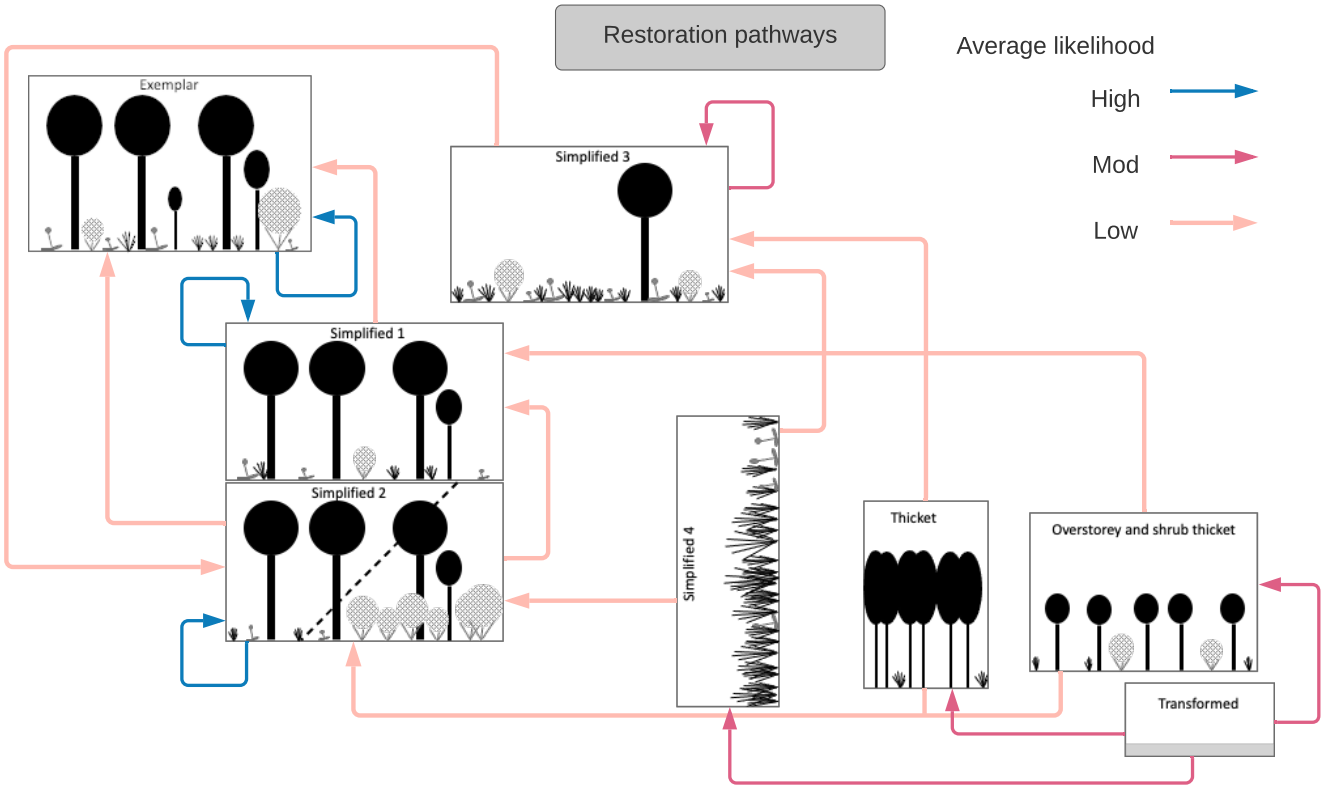
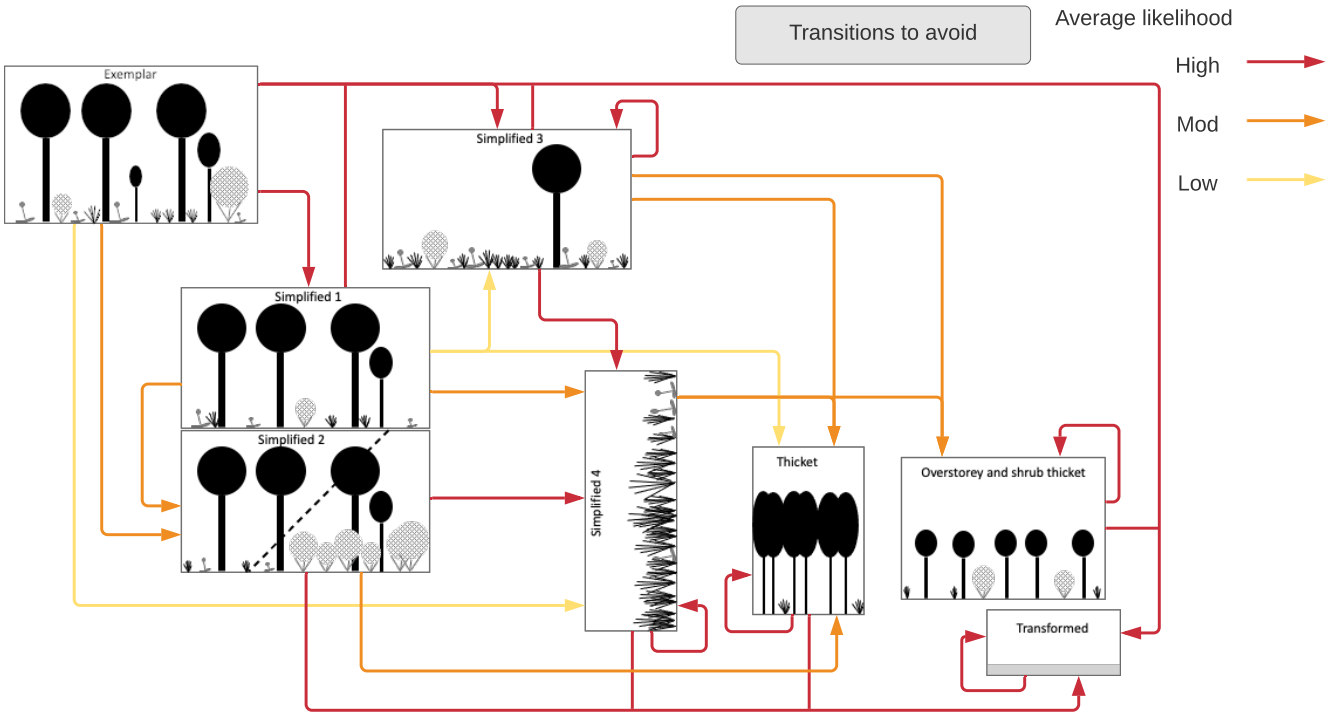
Where do you want to go? Identifying site-scale goals and transition risks





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Exemplar woodlands

Description:

All vegetation strata are intact; understorey species richness is high and includes disturbance-sensitive species; low weed cover; soil is stable and has a natural nutrient balance.

Occurrence:

Very uncommon – Uncommon

Land use:

Remnants or reserves

Threats:

Fragmentation, weed invasion, vegetation clearing, tree mortality, altered flooding

Variables to watch:

- Shrub/midstorey cover
- Tree density
- Richness and diversity of understorey species
- Exotic understorey cover

How to maintain

Likelihood: Possible (see figure below)

How? The Exemplar state mostly exists in isolated remnants. Conserving this state requires regular and frequent monitoring and then intervention if the understorey diversity declines, or recruits are being heavily browsed. In Floodplain/Riparian woodlands it may be also necessary to control weeds if there is a flood event that is followed by adequate rainfall.

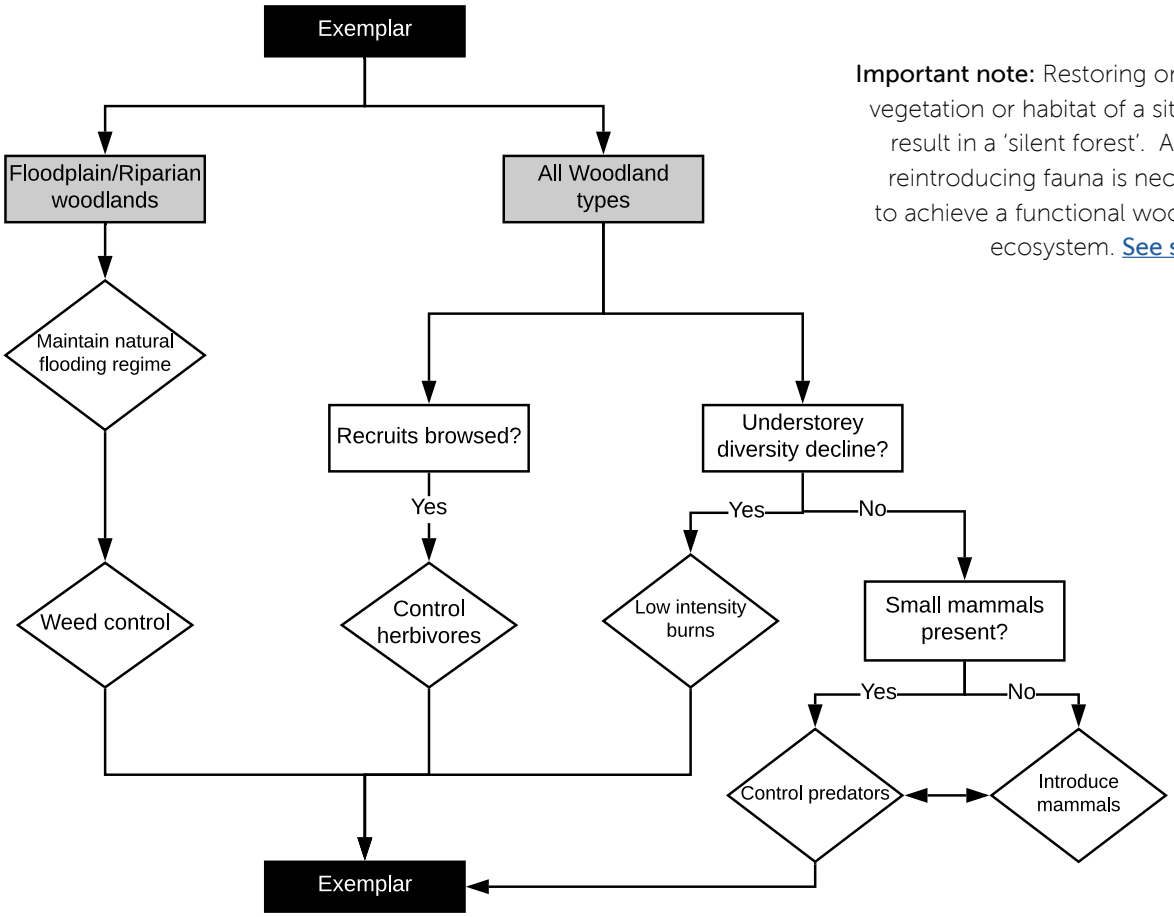
Transitions to avoid:

End state: Simplified 1

Likelihood: Very likely

How? Changes in the disturbance regimes, especially if drought is also involved. Similarly, Exemplar is considered likely to transition to Simplified 1 over long timescales due to fragmentation and associated reductions in geneflow and recruitment.

Indicators: Reduction in shrub/midstorey cover, reduction in tree density, reduction in richness and diversity of understorey species, increase in exotic understorey cover.



Important note: Restoring only the vegetation or habitat of a site may result in a 'silent forest'. Actively reintroducing fauna is necessary to achieve a functional woodland ecosystem. See step 5.

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Simplified 1 woodlands

Description:

The overstorey is mostly intact; mid/understorey is depleted in both richness and cover; understorey flora is primarily native; and soil nutrient levels are natural, or close to natural.

Occurrence:

Uncommon

Land use:

Travelling stock reserves, or areas that have not been subject to continuous disturbance

Threats:

Grazing and agricultural interventions, altered flood or fire regimes

Variables to watch:

- Native understorey cover
- Exotic understorey cover
- Tree density/mortality

How to maintain

Likelihood: Very likely

How? It is possible that vegetation will remain in a Simplified 1 state with no intervention, or if low intensity periodic/rotational grazing is retained, and grazing by native or feral herbivores is kept at a low level.

How to restore

Target state: Exemplar (see figure below)

Likelihood: Very unlikely

How? Livestock removal (allows for passive regeneration). In floodplain and riparian woodlands, reinstate a natural flood regime.

Indicators: Increased shrub abundance and native understorey diversity.

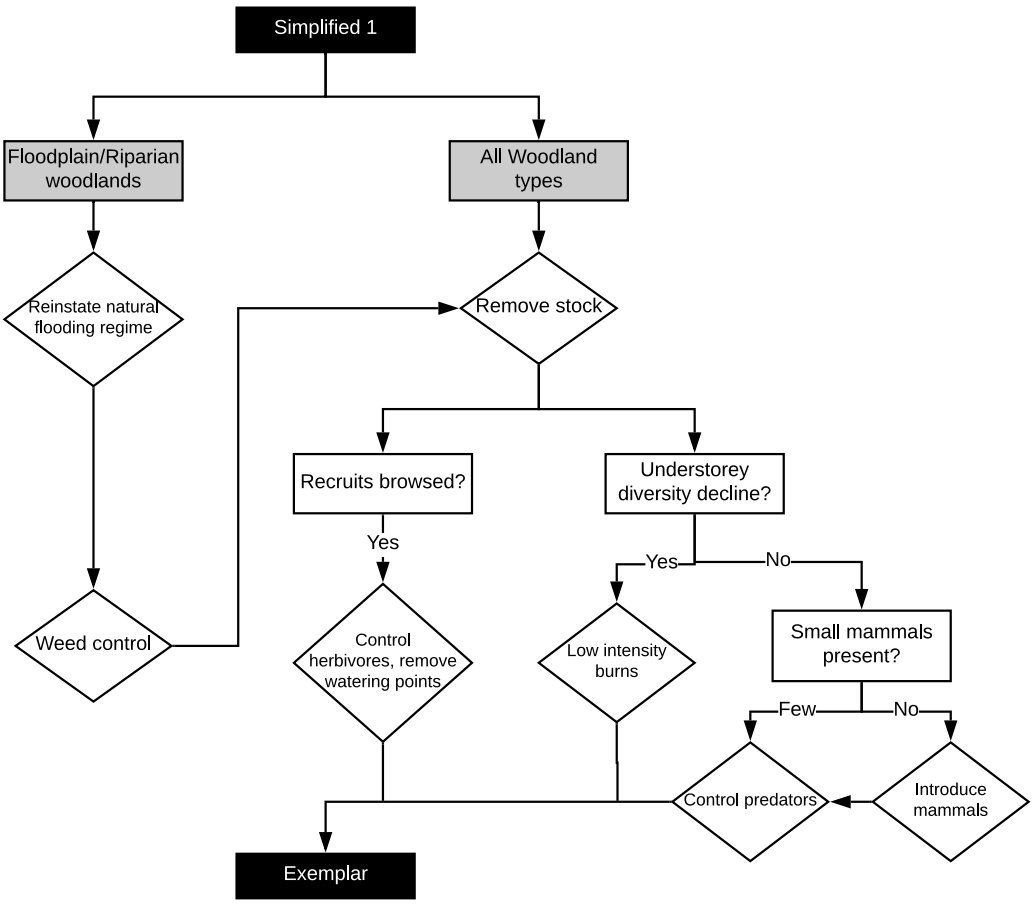
Transitions to avoid:

End state: Simplified 2

Likelihood: Likely

How? Likely to occur due to agricultural interventions, or through benign neglect. In Floodplain and Riparian woodlands, this transition can occur via flood events that bring exotic propagules, or altered flood regimes.

Indicators: Reduced native understorey and increased exotic understorey cover, reduced tree density.



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Simplified 2 woodlands

Description:

Overstorey is mostly intact; mid/understorey is depleted in richness; midstorey can be elevated in cover; exotic annual herbs present and may be prevalent; altered soil processes.

Occurrence:

Common (Grassy woodlands), neither common or uncommon (Shrubby woodlands), uncommon (Floodplain woodlands).

Land use:

Road reserve

Threats:

Clearing

Variables to watch:

- Native understorey cover and diversity
- Exotic understorey cover
- Tree density/mortality

How to maintain

Likelihood: Very likely

How? The Simplified 2 state is likely to remain stable if there is no active management intervention, or if low intensity or rotational grazing is retained, and grazing by native or feral herbivores is moderate to low. If the site is stocked it may be important to reduce the number of stock or remove stock completely in drought conditions.

Target state: Simplified 1 (see figure below)

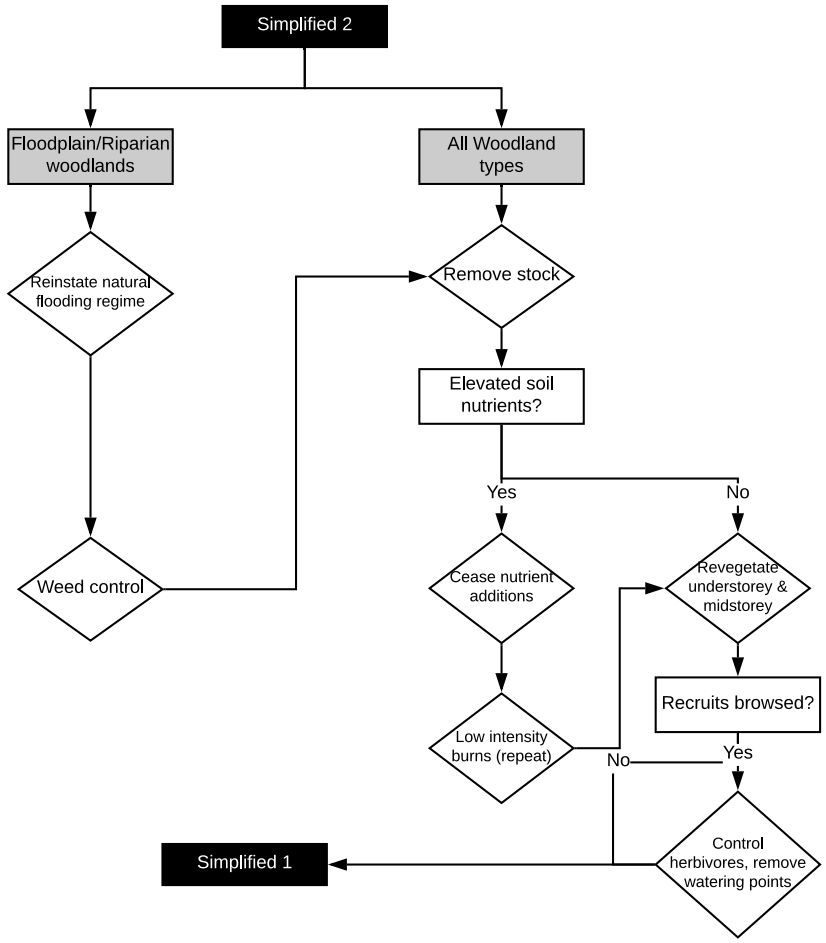
Likelihood: Very unlikely

How? Intensive intervention, including removal of stock, cessation of nutrient additions, ecological burning, and revegetation of the under- and midstorey. In Floodplain and Riparian woodlands reinstating a natural flood regime (or a single flood event) with follow up weed control can also encourage this transition.

Indicators: Increased native understorey cover and diversity, decreased exotic understorey cover and increased tree density.

Transitions to avoid:

Negative transitions are not common unless there are deliberate mass disturbance interventions such as clearing.



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Simplified 3 woodlands

Description:

Overstorey mostly absent; midstorey depleted but understorey remains mostly intact.

Occurrence:

Uncommon

Land use:

Grazing land, derived native pasture

Threats:

Dense regeneration, weed invasion

Variables to watch:

- Tree and shrub seedling density
- Exotic species cover
- Overstorey tree health

How to maintain

Likelihood: Very likely

How? Monitor to detect dense regrowth, declines in understorey diversity and increases in weed cover and intervene where necessary. If dense regrowth of woody species occurs, manual ecological thinning is recommended at the seedling stage. If understorey diversity is declining, it may be due to dominance of particular species or increases in weed cover, in which case management via biomass or weed control should be implemented.

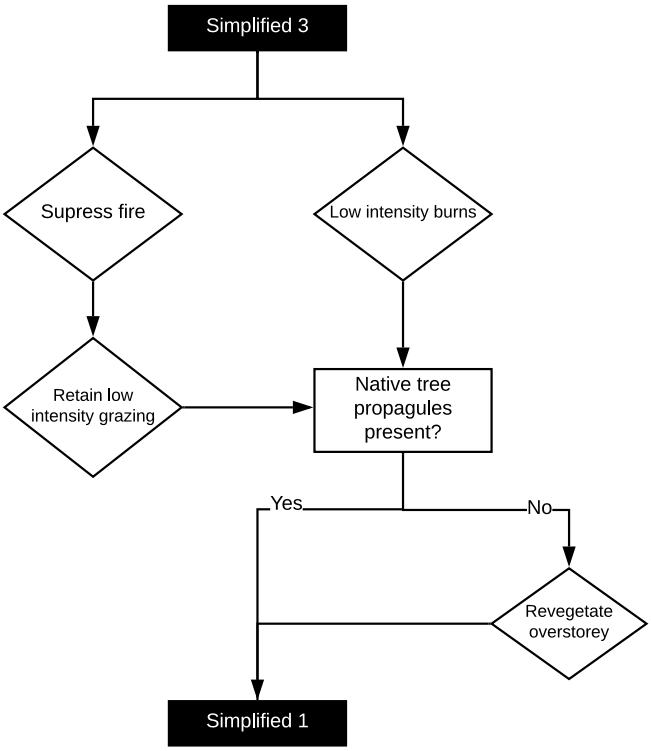
How to restore

Target state: Simplified 1 (see figure below)

Likelihood: Very unlikely

How? This transition is thought to be possible either through passive regeneration or active tree planting after low intensity ecological burns, or with fire suppression and grazing at low intensity.

Indicators: Increased shrub cover and increased richness and diversity of native understorey.



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Simplified 3 woodlands (continued)

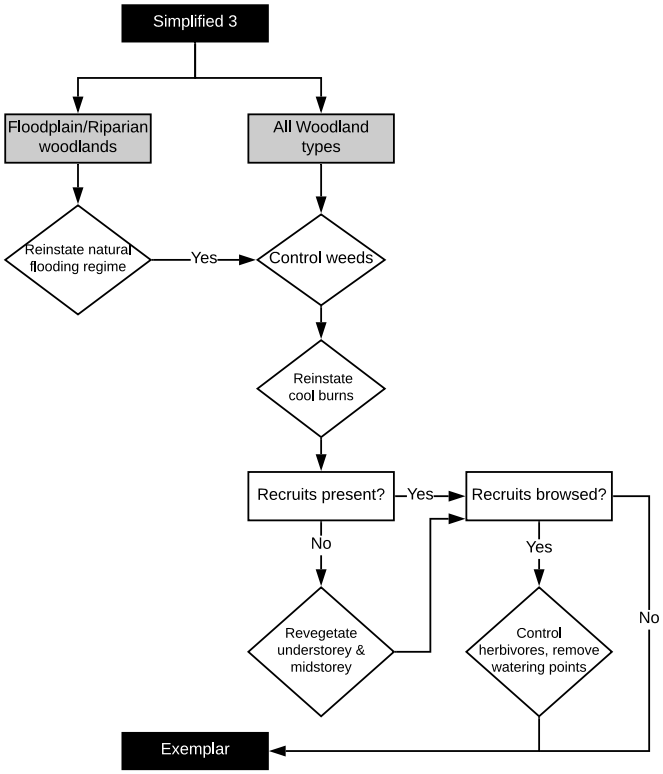
How to restore

Target state: Exemplar (see figure below)

Likelihood: Very unlikely

How? This transition could be achieved with multiple interventions; by reinstating flood regimes (for floodplain woodlands), managing the weed cover and reinstating cool burns, and where relevant, managing herbivore pressure and either revegetating or allowing for passive regeneration.

Indicators: Increased shrub cover, decreased exotic cover and increased richness and diversity of native understorey.



Transitions to avoid:

End state: Thicket

Likelihood: Likely (floodplains and grassy), unlikely (shrubby)

How? Can occur when revegetation efforts result in inappropriate high density of trees (without mortality). Alternatively, dense tree regeneration can occur with the presence of sufficient native propagules, following soil disturbance (i.e. ripping) or after a reduction in grazing pressure, typically with above average rainfall. In the case of Floodplain and Riparian woodlands, dense regeneration may follow a flood event. Where dense regrowth is detected, ecological thinning is recommended at the seedling stage.

Indicators: Increased tree density

End state: Overstorey and midstorey thicket

Likelihood: Likely

How? As with transition to Thicket, but with the addition of shrubs in revegetation or regeneration at high density.

Indicators: Increased shrub cover and tree density

End state: Simplified 4

Likelihood: Very likely

How? This transition can be caused by heavy grazing pressure (either by stock or native and feral herbivores) and resultant degradation of biophysical processes. The transition may also occur due to prolonged drought or, in the case of Floodplain and Riparian woodlands, a flood that brings an abundance of exotic propagules. If grazing by native and feral herbivores is observed to be impeding recruitment and causing declines in understorey condition, culling or removing water points are recommended.

Indicators: Decreased tree density, increased exotic cover.

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Simplified 4 woodlands

Description:

Overstorey is depleted or absent; midstorey is absent or depleted; understorey is depleted in native species richness and cover.

Occurrence:

Common (grassy woodlands), uncommon (shrubby and floodplain woodlands)

Land use:

Native pasture, grazing land

Threats:

Drought and inappropriate grazing management

Variables to watch:

- Tree health
- Exotic species cover
- Soil health and stability

How to maintain

Likelihood: Very likely

How? Retain current land management and/or land use (retain current grazing pressure).

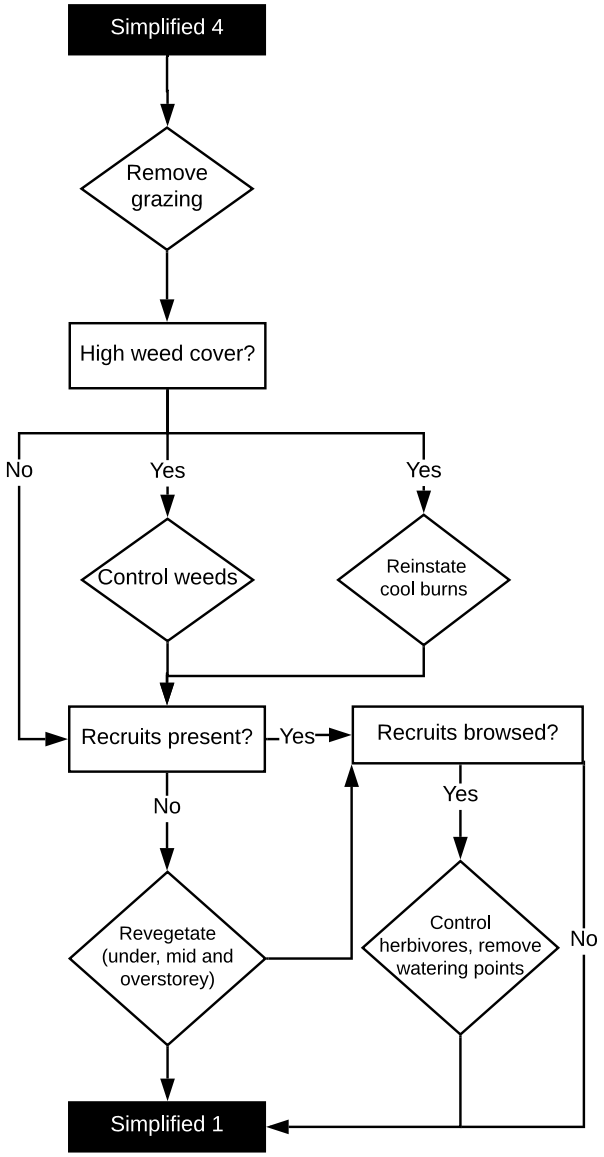
How to restore

Target state: Simplified 1 (see figure below)

Likelihood: Very unlikely

How? This transition could be achieved if grazing is removed, weed cover is managed via herbicide or cool burning (if relevant) and the vegetation is allowed to regenerate (if propagules are present) or replanted. If herbivores are acting to prevent understorey regeneration, grazing control (i..e culling, watering point removal) is required.

Indicators: Increased mature tree density, increased non-plant ground cover, increased diversity of native understorey, reduced exotic understorey cover.



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Simplified 4 woodlands (continued)

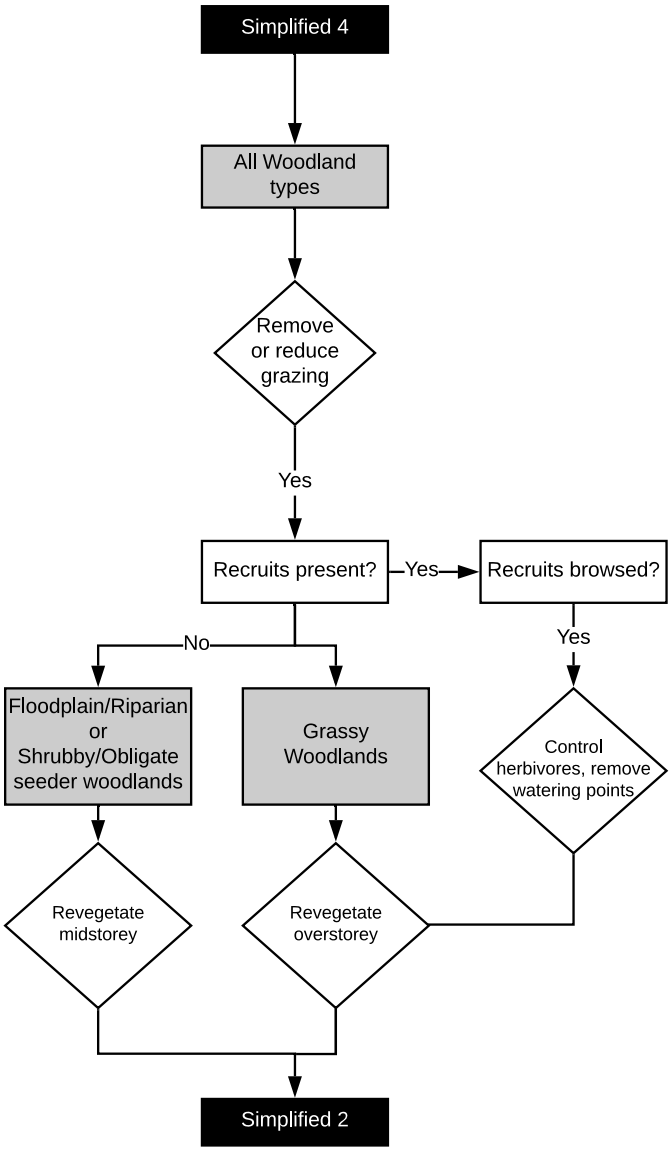
How to restore

Target state: Simplified 2 (see figure below)

Likelihood: Very unlikely

How? This transition could be achieved by removing grazing and revegetating the overstorey and, for Floodplain and Riparian woodlands and Shrubby and Obligate Seeder woodlands, revegetating the midstorey. Alternatively, in the presence of native propagules and sufficient rainfall, removing grazing may be sufficient to allow regeneration.

Indicators: Increased mature tree density, non-plant ground cover, increased diversity of native understorey.



Transitions to avoid:

End state: Thicket

Likelihood: Likely (floodplains and grassy), unlikely (shrubby)

How? Can occur when revegetation efforts result in inappropriate high density of trees (without mortality). Alternatively, dense tree regeneration can occur with the presence of sufficient native propagules, following soil disturbance (i.e. ripping) or after a reduction in grazing pressure, typically with above average rainfall. In the case of Floodplain and Riparian woodlands, dense regeneration may follow a flood event. Where dense regrowth is detected, ecological thinning is recommended at the seedling stage.

Indicators: Increased tree density

End state: Overstorey and midstorey thicket

Likelihood: Likely

How? As with transition to Thicket, but with the addition of shrubs in revegetation or regeneration at high density.

Indicators: Increased shrub cover and tree density

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Overstorey and Midstorey Thicket woodlands

Description:

Few to no mature trees; high density of shrubs and tree saplings; higher shrub and tree richness compared to Thicket; understorey may be dominated by native or exotic species; low native understorey richness.

Occurrence:

Common (Grassy woodlands), very uncommon (shrubby and floodplain woodlands)

Land use:

Revegetated sites

Variables to watch:

- Tree and shrub density
- Exotic species cover
- Soil stability

How to maintain

Likelihood: Very likely

How? Retain current land management and/or land use.

How to restore

Target state: Simplified 1 (see figure below left)

Likelihood: Very unlikely

How? Ecological- and self-thinning of the mid- and overstorey vegetation and revegetation of the understorey can facilitate this transition.

Indicators: Reduction in tree and shrub density, increase in native understorey cover and richness, reduction in exotic understorey cover.

Target state: Simplified 2 (see figure below right)

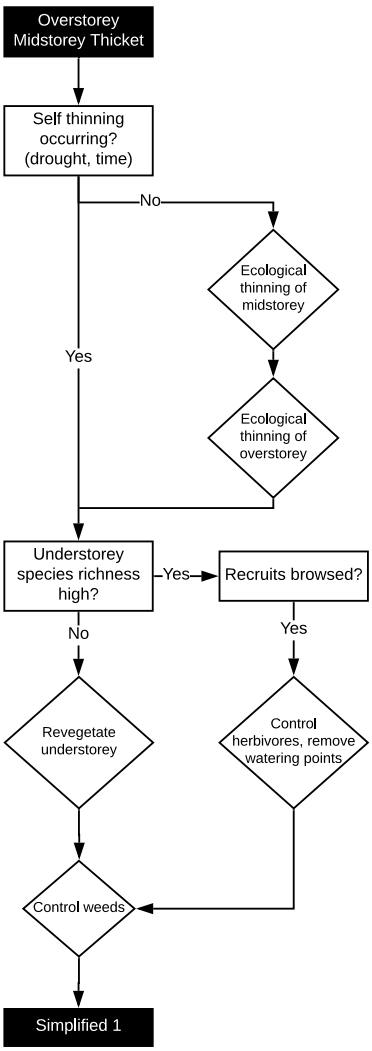
Likelihood: Very unlikely

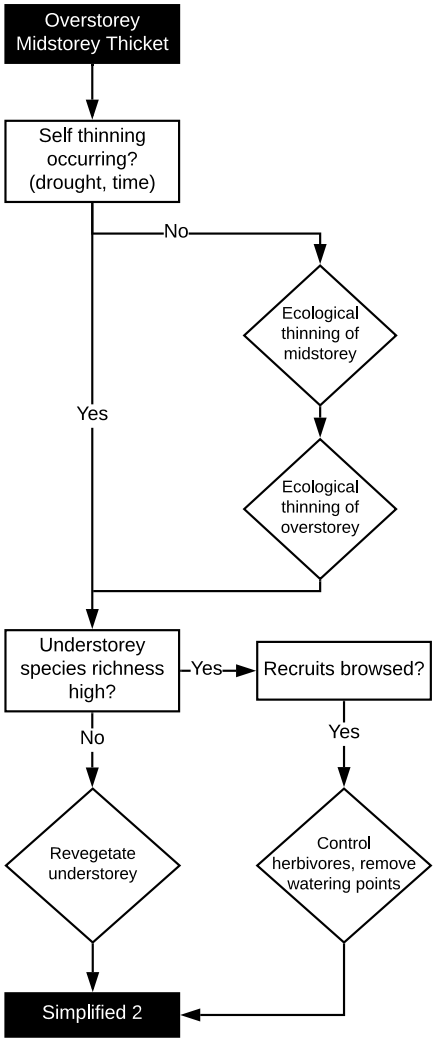
How? As for Simplified 1 transition but with less effort controlling weeds and grazing pressure.

Indicators: Reduction in tree and shrub density.

Transitions to avoid:

Without active intervention no transitions are likely.





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Thicket woodlands

Description:

Overly dense overstorey; very low understorey species richness; low under/midstorey cover; understorey many be dominated by natives or exotics; soil stability may be compromised.

Occurrence:

Common (Floodplain woodlands), uncommon (Grassy woodlands), very uncommon (shrubby woodlands)

Land use:

Destocked pasture, new reserves

Variables to watch:

- Tree and shrub density
- Exotic species cover
- Soil stability

How to maintain

Likelihood: Very likely

How? No active intervention

How to restore

Target state: Simplified 1 (see figure below left)

Likelihood: Very unlikely

How? This transition could be achieved with a combination of the ecological- or self-thinning and planting in conjunction with weed control.

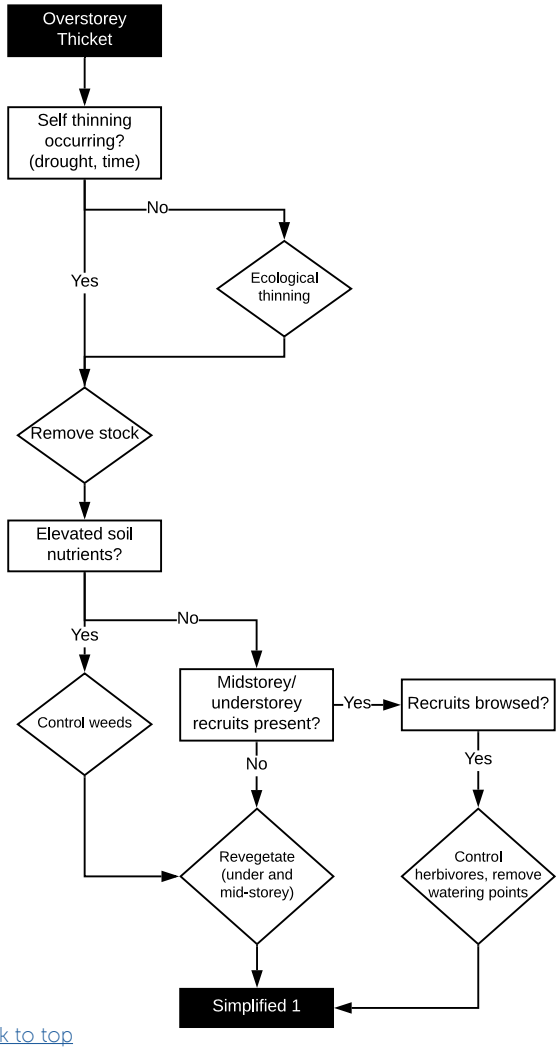
Indicators: Decreased sapling density and increased native understorey cover.

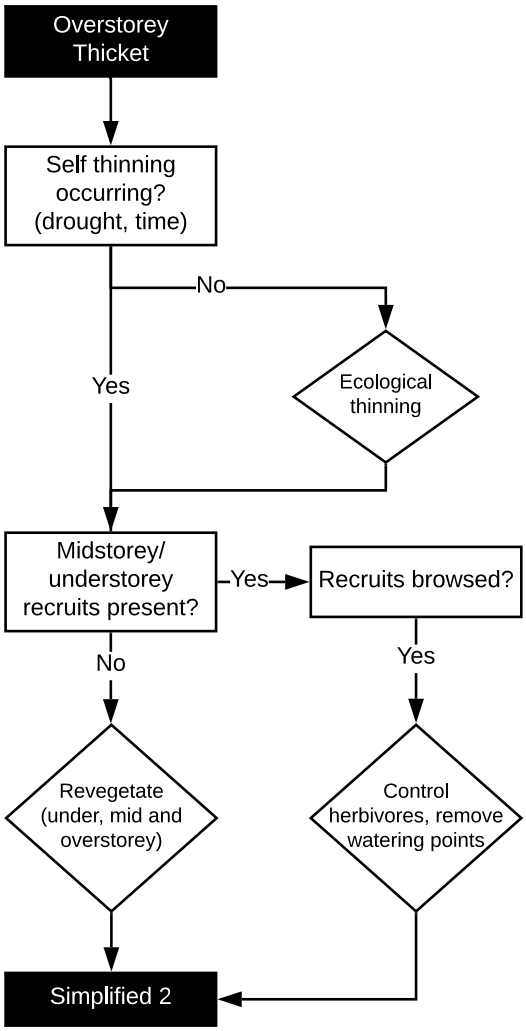
Target state: Simplified 2 (see figure below right)

Likelihood: Very unlikely

How? As with the transition to Simplified 1 but with less effort to control weeds.

Indicators: Decreased sapling density and increased native and/or exotic understorey cover.





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Transformed woodlands

Description:

Very low to no vegetation cover in the mid and understorey; overstorey absent or low, dead or dying; no recruitment, soil may be saline, acidic or highly nutrified.

Occurrence:

Very common

Land use:

Exotic pasture, salinized land, crops, urban areas

Variables to watch:

- Tree health
- Exotic species cover
- Soil health and stability

How to maintain

Likelihood: Very likely

How? No active intervention

How to restore

Target state: Novel ecosystem

Likelihood: Possible

How? In cases where sites have become saline or highly acidic it may be impossible to restore any approximation of woodland vegetation in 100 years or longer. In this case, replanting with any (preferably native) species that are able to tolerate these conditions is recommended to attempt restoration of some ecosystem function.

Indicators: Any increase in vegetation cover or soil stability.

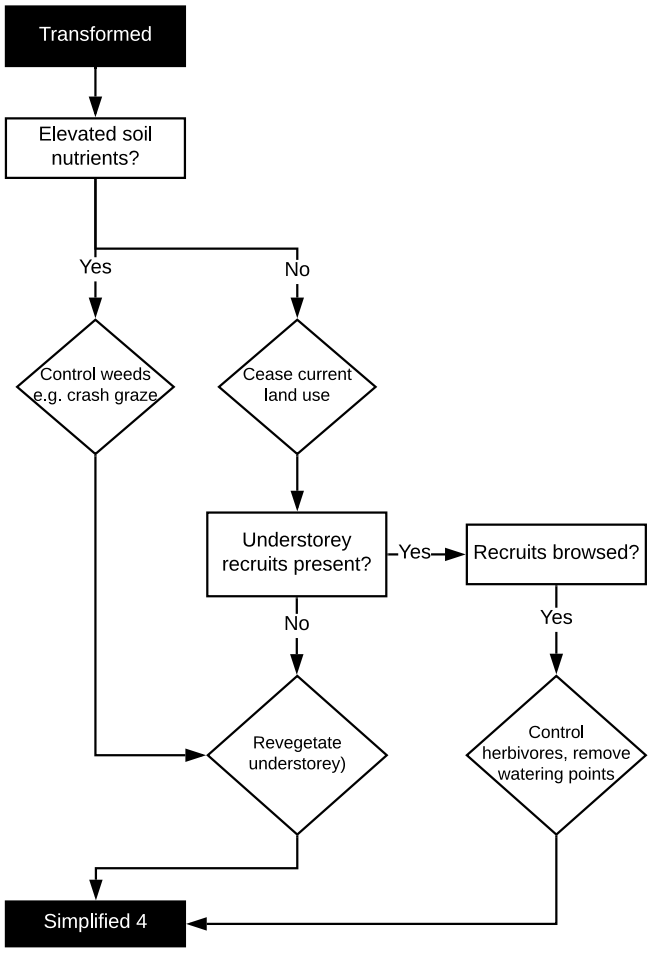
How to restore

Target state: Simplified 4 (see figure below)

Likelihood: Possible

How? If soil nutrients are not substantially elevated, adequate grazing and cessation of current landuse along with either passive regeneration (if propagules are present) or revegetation can result in a transition from the Transformed to Simplified 4 state. Herbivore control may be required. If soil nutrients are elevated, crash-grazing may be necessary to remove some of the nutrients.

Indicators: Any increase in vegetation cover and increase in soil health.



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Transformed woodlands (continued)

How to restore

Target state: Thicket or Overstorey and Midstorey Thicket (see figure below)

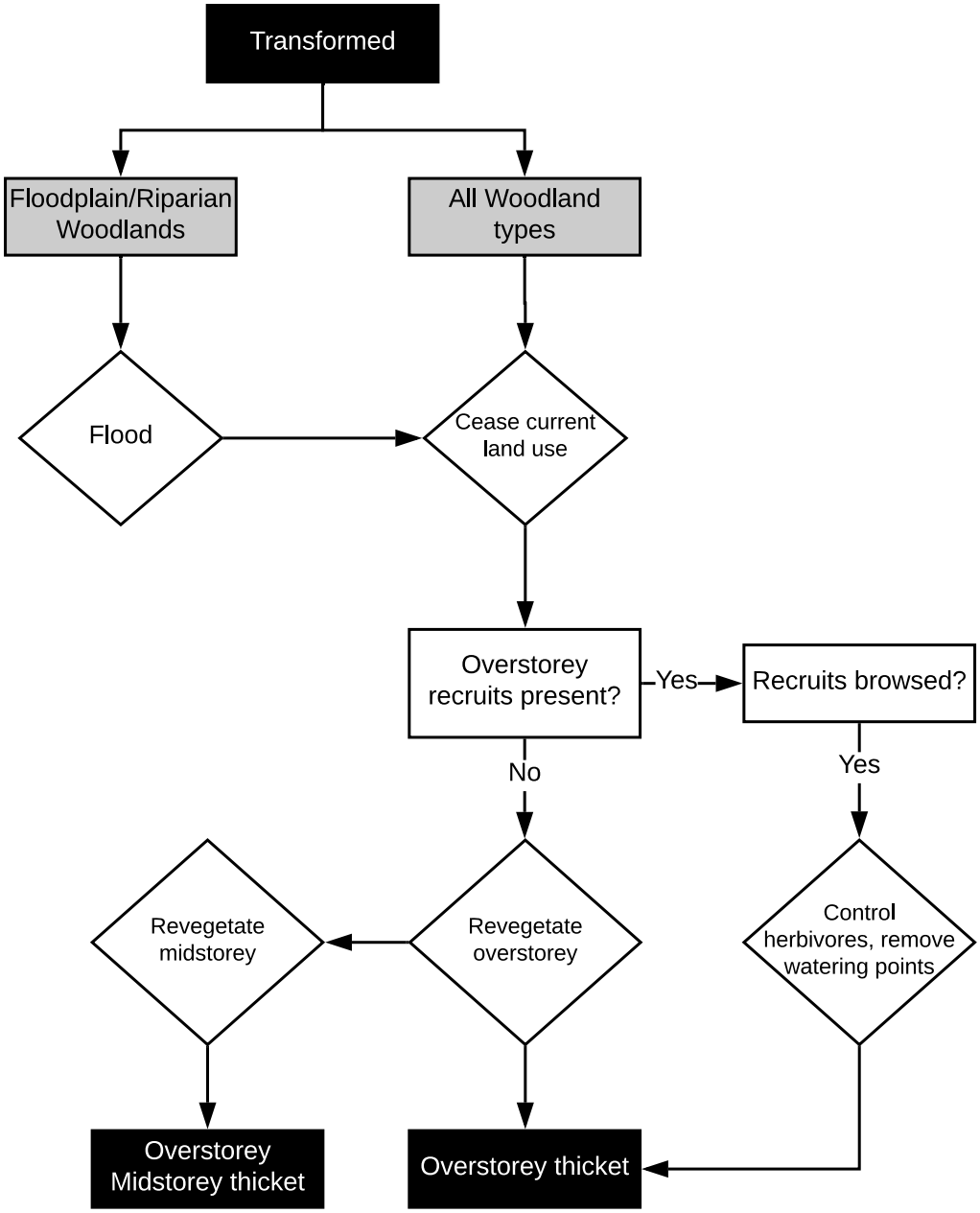
Likelihood: Likely

How? Cease current landuse and revegetate with overstorey species (at high density). This transition may also occur if sufficient seed propagules are available, and with a flood (in the case of Floodplain woodlands). To transition to Overstorey and Midstorey Thicket condition, regeneration (or replanting at high density) of the midstorey is necessary.

Indicators: Increase in tree and/or shrub density.

Transitions to avoid:

Without active intervention no transitions are likely.



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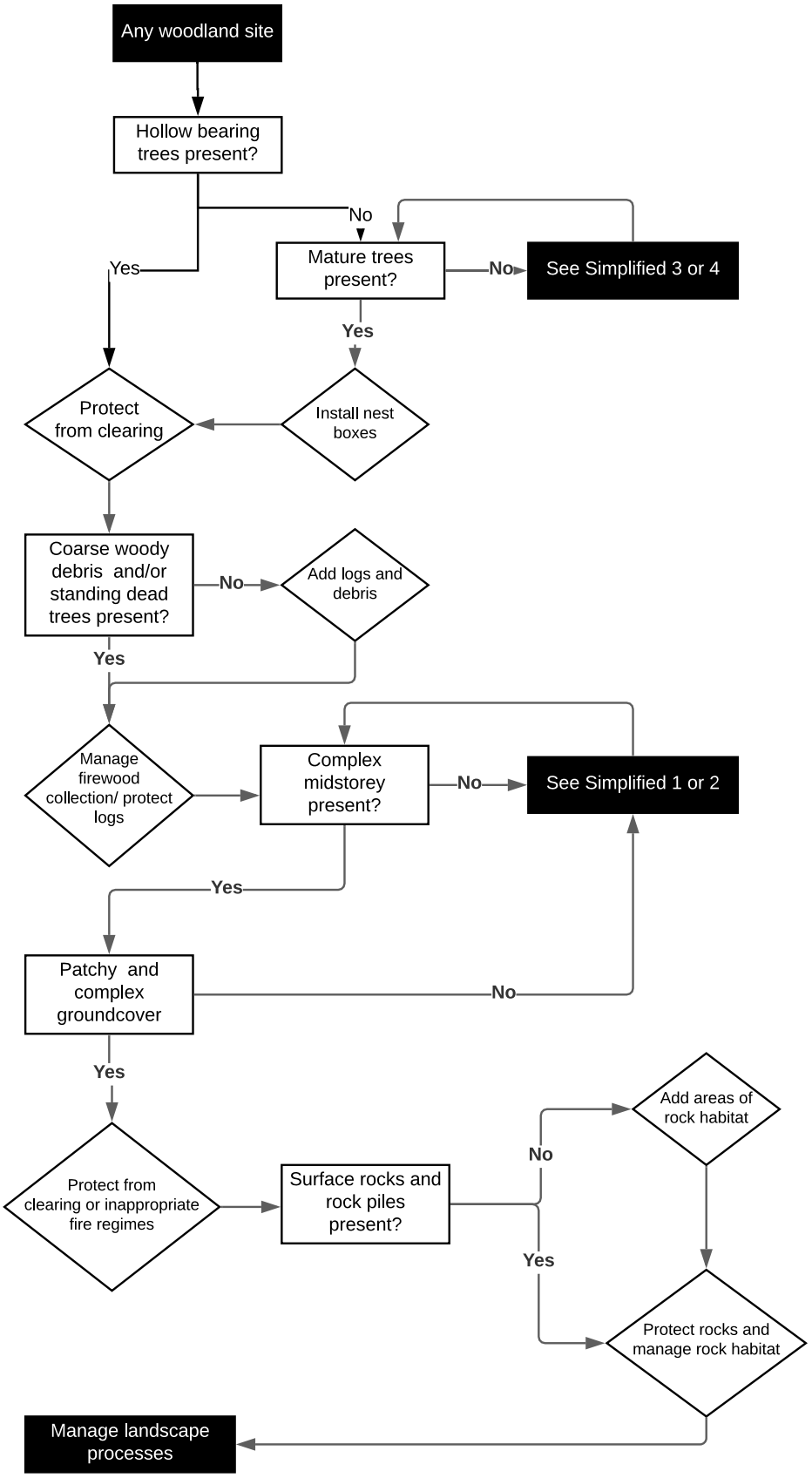
Fauna habitat assessment

How to use:

Fauna is integral to a fully functioning woodland ecosystem. Ensuring key habitat attributes are reinstated or protected should form part of any conservation advice or management plan for all woodland sites. This decision tree can be used to assess the presence or absence of key habitat attributes in any site, and should be used in conjunction with the Condition State specific management recommendations as well as the Landscape Management fact sheet.



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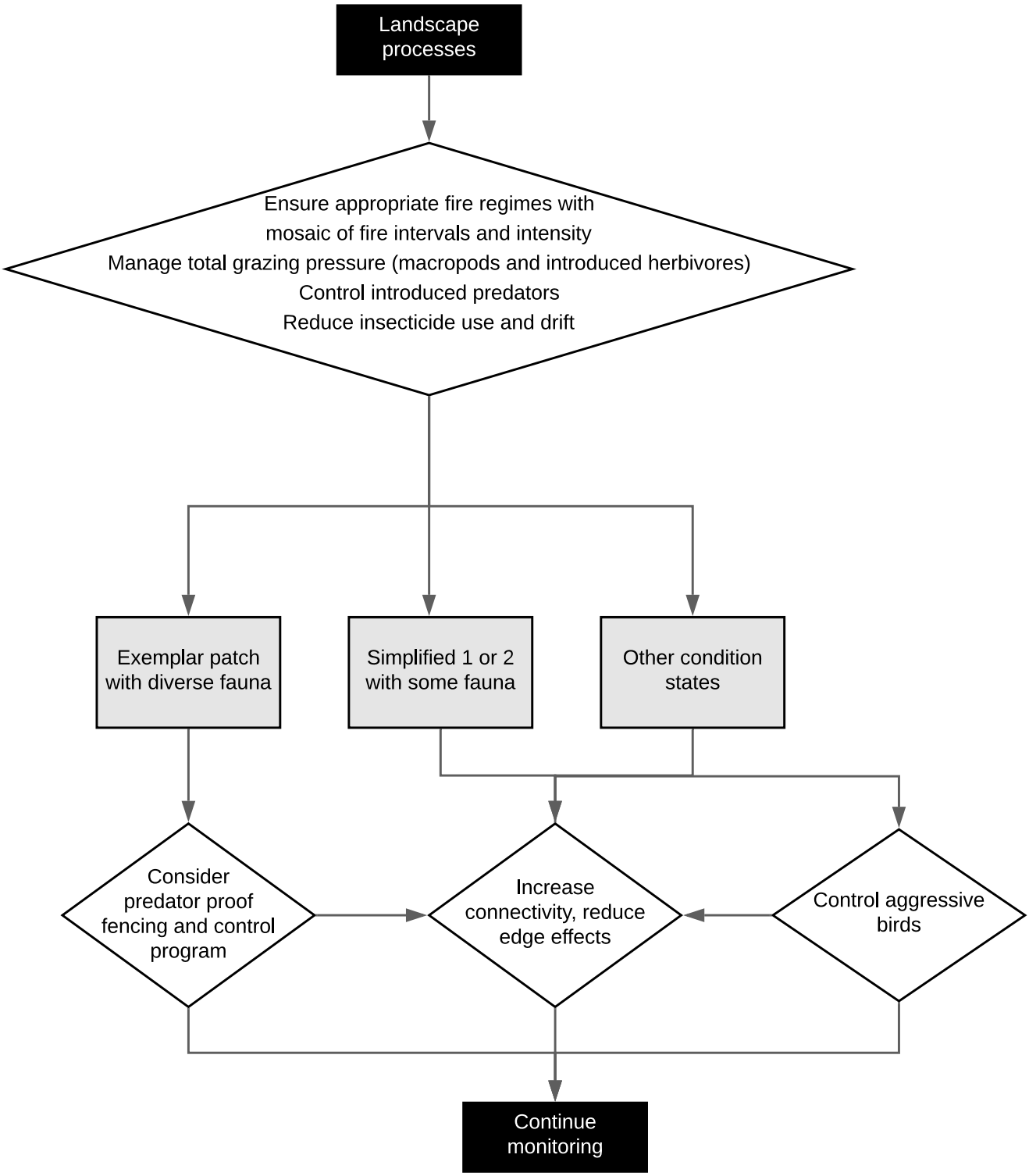
Landscape management

Why landscape?

Processes acting at the landscape scale will affect any site scale management interventions. This is not a comprehensive list of landscape management interventions, but an attempt to highlight important threats and actions to consider beyond the site scale.



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Further information:
http://www.nespthreatenedspecies.edu.au

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Threatened Species Recovery Hub

National Environmental Science Programme