Molonglo River Reserve Procedures Manual: Monitoring Vegetation and Habitat Condition

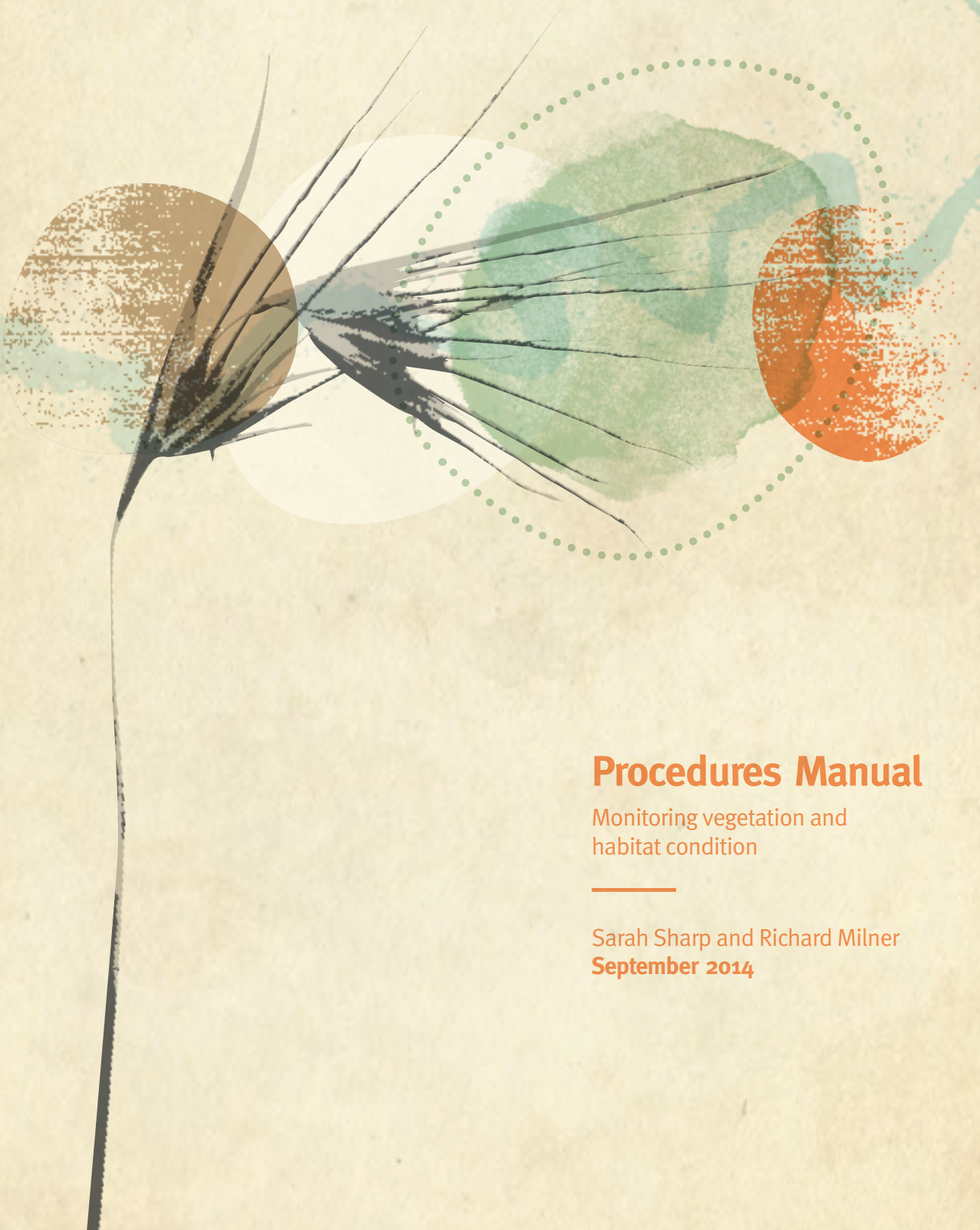
Technical Report · April 2015

2 authors, including:

Richard N C Milner
ACT Government
19 PUBLICATIONS **221** CITATIONS

SEE PROFILE

MOLONGLO RIVER RESERVE



Procedures Manual

Monitoring vegetation and habitat condition

Sarah Sharp and Richard Milner

September 2014

Acknowledgments

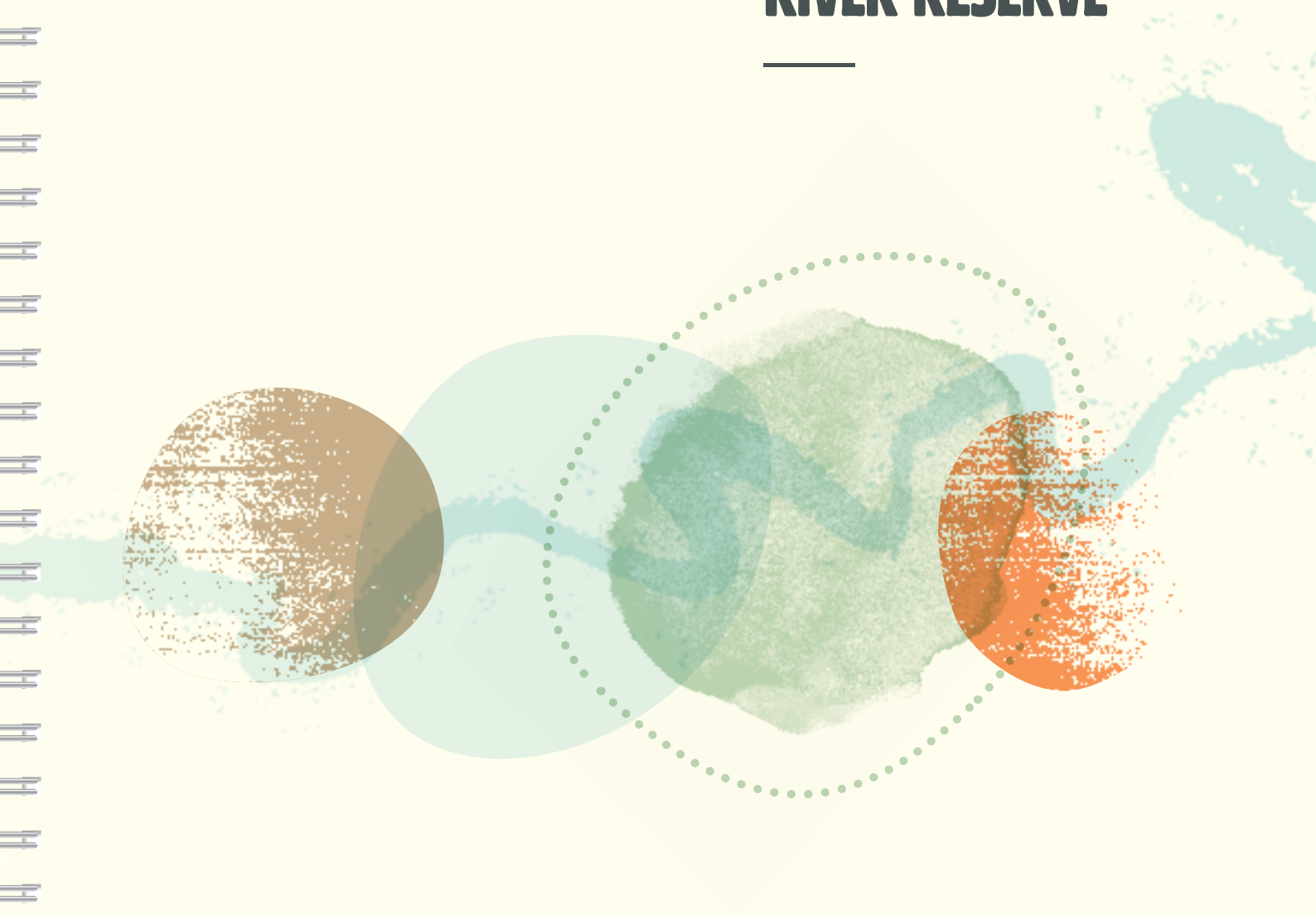
Development of this Procedures Manual for the Molonglo River Reserve was facilitated by the provision of advice and assistance by many people and organisations. Particular thanks for comments, suggestions and review of draft content go to Dr Keith McDougall (Office of Environment and Heritage, NSW Government), Dr Michael Mulvaney and Dr Murray Evans (Conservation, Planning and research ACT Government).

Image attribution: Richard Milner: Page 5 Pink-tailed Worm-lizard, David Wong: Page 6–7: Pink-tailed Worm-lizard Sarah Ryan: Page 10–11, 16–17, 22–23, 28, 31, 37, 41 & 45 Molonglo River Corridor; Geoffrey Dabb: Page 21 Red-browed Finch; Page 26–27 Superb Parrot & Page 56 Brown Treecreeper; PCS Image Library: Page 34.

Enquiries: Phone Canberra Connect on 13 22 81

Website: www.tams.act.gov.au

MOLONGLO RIVER RESERVE



Procedures Manual

Monitoring vegetation and habitat condition

Sarah Sharp and Richard Milner

September 2014

CONTENTS

Tables

Figures

1. INTRODUCTION

1.1 Condition Monitoring of Matters of National Environmental Significance in Molonglo

The Procedures Manual presents the core monitoring program designed to meet monitoring requirements identified in the Molonglo Valley Plan for the Protection of Matters of National Environmental Significance (the NES Plan; ACTPLA 2011) that relate to condition of Box-Gum Woodland and Natural Temperate Grassland and of habitat for Pink-tailed Worm-lizard, Superb Parrot and Swift Parrot, as follows:

> 'The monitoring regime will take into account and track the ecological condition of Box-Gum Woodland, Natural Temperate Grassland and the Pink-tailed Worm-lizard habitat against the objectives for management' (ACTPLA 2011, p.38).
>
> 'Ecological condition for Box-Gum Woodland and Natural Temperate Grassland will be measured using a peer reviewed, repeatable and scientifically robust methodology for examining and comparing the condition of woodland, derived grassland patches and grassland patches over time' (ACTPLA 2011, p. 20, 27).
>
> 'Ecological condition of Pink-tailed Worm-lizard habitat will be measured using the criteria described in Osborne and Wong 2010' (ACTPLA 2011, p. 29).
>
> 'Construction Environmental Management Plans will include appropriate monitoring and reporting' (ACTPLA 2011, p. 34).
>
> 'Mechanisms will be established to monitor, evaluate, and annually report on progress to achieve objectives for management, including how management actions will be adjusted to account for new information' (ACTPLA 2011, p. 37).
>
> 'Establish benchmark data and monitor rehabilitation success using scientifically credited performance measurements already adopted by regional leaders in rehabilitation assurance' (ACTPLA 2011, p. 39).
>
> 'Annually monitor the condition of the Box-Gum Woodland patches I, L, M and P.... to ensure that fuel hazard management is not negatively impacting the Box-Gum Woodland values' (ACTPLA 2011, p. 25).

Specific monitoring programs are being developed for monitoring populations of two of the three identified MNES species, Pink-tailed Worm-lizard and Superb Parrot. These are presented in separate publications (Milner and Osborne in prep.; CPR 2011, unpublished).

The identification of what is monitored and how it is monitored depends on why the monitoring is being undertaken. The methods identified in this manual are based on Sharp and Gould (2014), except where separately referenced. Data collected using these methods allow for assessment of benchmark condition based on Biobanking Assessment (DECCW 2011), assessment of Floristic Value Score (Rehwinkel 2007) and assessment against criteria for determining the occurrence of nationally listed endangered ecological communities. The data enable statistical analysis of change in selected attributes over time. Because the methods selected for monitoring condition of vegetation and habitat are consistent with measurements that are used elsewhere in ACT and NSW comparison with other data sets are possible.

1.1.1 Peer review

The methods described in this procedures manual have been reviewed by Dr Keith McDougall (Office of Environment and Heritage, Queanbeyan) and Dr Michael Mulvaney and Dr Murray Evans (Conservation Planning and Research, Environment and Planning Directorate). Their advice has been incorporated into the manual.

1.2 Other monitoring in Molonglo

Sharp et al. (in prep) also identifies monitoring of non MNES that may be undertaken to assist in management of other important matters in the Molonglo:

- Relative effectiveness of different management techniques to achieve biomass control (e.g. for fire fuel management or to increase species diversity).
- Effectiveness of weed control, undertaken in accordance with the ACT Weed Strategy (DECCEW 2009).
- Effectiveness of pest control, undertaken in accordance with ACT Pest Animal Management Strategy (ESD 2012).
- Monitoring impacts on species listed as threatened under ACT legislation, and other Special Protection Status species, for example the Little Eagle, Rainbow Bee-eater and Pale Pomaderris.
- Monitoring by community volunteers using standard programs, including frogs (Frogwatch), aquatic invertebrates (Waterwatch), birds (Canberra Ornithologists Group) and vegetation condition (Vegwatch).
- Specialised surveys and monitoring of particular species groups, including bats, reptiles or mammals.

While methods in this manual may also be appropriate to measure attributes to undertake these monitoring programs, they will require specific programs that determine where, why and how they will be undertaken, including replication and controls (see Section 2.1). Information on other monitoring programs that could be applied in Molonglo is in Section 3.4. Operational Plans identify what monitoring may be relevant within each management area (see Section 2.3) to measure changes caused by management on habitat, vegetation or species, as well as for MNES.

1.3 Objectives

Monitoring of vegetation condition and habitat of MNES in the Molonglo Conservation Areas will be undertaken for the following reasons, where appropriate.

1. To ascertain whether offset sites continue to meet, or improve towards meeting, criteria to represent the critically endangered BGW or endangered NTG under Commonwealth legislation (the EPBC Act).
2. To measure change in condition of vegetation within offset sites against benchmark condition in endangered ecological communities.
3. To measure changes in habitat and vegetation condition against application of management actions and use this information, if necessary, to modify management.
4. To measure changes to specified indicators against application of management actions and use this information, if necessary, to modify management.

Lower rural setting

1.4 Performance targets

Performance targets include:

1. That the patch continues to meet the definition of the endangered community (White Box – Yellow Box – Blakely's Red Gum Grassy Woodland; Natural Temperate Grassland of the Southern Tablelands)
2. That the patch retains or increases condition for each attribute defined in the benchmark scores (DECCW 2011) against the vegetation community benchmark and against the plot and site baseline measured in 2012/13 (Eco Logical Australia 2013) and/or initial monitoring.
3. That a patch continues to retain or improve habitat important for the support of key threatened species.
4. That patches identified for restoration increase in diversity and cover of native plant species and habitat features, and retain or increase diversity of native fauna (especially birds).

Pink-tailed Worm-lizard

2. METHODS

2.1 Methods used for assessing or monitoring the condition of a site

Vegetation and habitat attributes are measured at three spatial levels: the vegetation zone, plots and transects. The choice of which one to use depends on the information that is being collected. The plot survey method is used to measure species diversity, structural diversity and habitat features. Transects are used to measure vegetation at points along a line, and are useful to measure the frequency of a species or group of species that is present. Particular species that occur within the site are measured within a vegetation zone.

How to apply these methods is outlined in detail as part of the instructions for measuring each indicator.

2.1.1 Vegetation zone

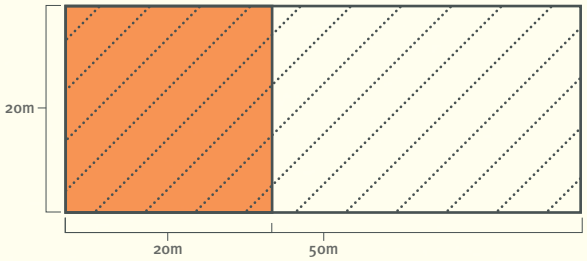
A vegetation zone is an area that does not have a defined size or shape, but indicates the area in which the vegetation species composition, structure and condition is relatively homogenous. Several attributes are measured within the vegetation zones.

2.1.2 Plots

The plot survey is used to collect quantitative data for comparing sites and vegetation communities. The plot size to be used is 0.1 ha, usually measured within a 20 x 50 m plot, consistent with national, NSW and ACT recommended standards (Hnatiuk et al. 2009; DECCW 2011; CPR 2012). If a vegetation zone is long and narrow (such as along a roadside or along a riverbank) the shape may be modified but not the size (e.g. a 100 m x 10 m plot may be more practical). Plants taller than 2 m are measured in the entire 0.1 ha plot, and plants smaller than 2 m are measured in a 0.04 ha sub-plot (usually 20 x 20 m) (Figure 1). If a site only contains vegetation less than 2 m only the 0.04 ha plot is established. In the Molonglo each plot is placed so that the 50 m length is running N–S, independent of slope.

Figure 1. The recommended shape and layout of a 0.1 ha plot.

The 20 m x 20 m sub-plot (0.04 ha) is used to measure abundance of all species less than 2 m tall.



2.1.3 Transects

Transects are linear (although they may not be a straight line), and provide fixed points to determine changes to vegetation and other features. This method is used to provide a quantitative measure of plant frequency, which is equated to cover. Two ways of measuring along transects are used:

1. Point-intercept transect: Along a tape at set intervals a plant species (or plant group) and other features such as rocks, bare ground or litter are recorded if they touch a narrow wire (Figure 2). More than one feature that is being recorded may touch the wire. If so, they are both recorded. The number of times a particular feature is recorded is summed to provide a frequency score of that feature. This method is used in the Manual to measure groundstorey cover (Recording Sheet 3), which is the relative cover of groundlayer species and other ground cover (rocks, bare ground and litter).

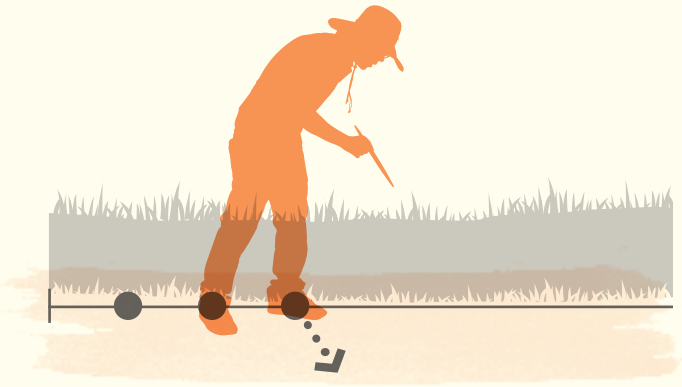
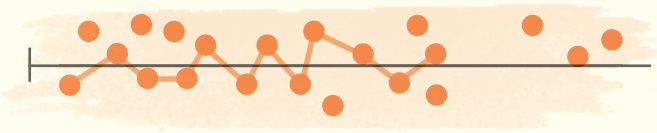


Figure 2. Recording along a point-intercept transect. Record what the wire is touching at set one metre intervals along the tape. It may be more than one feature. Record 100 measurements to provide adequate measurements for estimation of cover.

2. Zig-zag transect: This measurement is used to measure cover of woody species: in the mid-stratum (1 – 2 m tall) and upper stratum (› 2 m tall) tall (Recording sheet 4). Lay a tape out through the length of the plot commencing at 10 m along the 20 m side of the plot. Undertake the first measurement at the edge of the crown canopy of the woody plant that is closest to the transect line. Measure the width of the crown. Commence from the other side of the crown and measure the distance to the next tree that is towards or across the transect (crown gap). If crowns overlap the crown gap has a negative value (e.g. if two crowns overlap by 3 m the gap is -3). Measure the width of that crown. Estimate the percent foliage cover for each plant measured. Continue to do this for twelve sets of measurements (where possible), even if this continues outside the plot.

Figure 3. Recording along a zigzag transect.

Percentage foliage cover may be estimated using reference diagrams (see Section 4.3), or alternatively, there is an app for android smartphones that will photograph cover from beneath, and estimate projective foliage cover. This method is likely to be much more accurate than estimation from diagrams. HabitApp is designed for aiding habitat assessment in the field, providing a simple way to measure the leaf coverage provided by the surrounding tree canopy. https://play.google.com/store/apps/details?id=com.scrufster.habitapp



2.2 Statistical validity of data

2.2.1 Variability of values measured

Monitoring is used to show a trend in improvement, decline or no change for the variables measured. However, it is important when interpreting the data to take into account that not all changes in the measurements are going to be caused by the changes in management that were applied. Other important factors include:

a. The condition of the sites prior to monitoring

b. The seasonal conditions when the sites were monitored

c. The time since management was applied when the sites were monitored

d. Inherent differences between sites

Variability within sites: A site (a remnant or one or more vegetation units) may be small or large, contain a high diversity of habitat across the site (such as rocky areas, patches of trees in an otherwise treeless landscape, or wetlands) or may be very uniform in terms of vegetation structure and plant composition. Attributes measured across an entire site (e.g. a species list) does not allow *statistical* comparisons to be made of those attributes between sites because the data are not comparable.

Seasonal conditions affect plants. Most herbaceous species in grasslands and woodlands are perennial (i.e they flower and produce seed more than once in their lifetime), but many die back to rootstock after seeding. In dry seasons these individual plants may remain dormant, may be smaller than usual, or may go through their reproductive process (and die back) very quickly. Therefore results from wet or dry seasons may differ in terms of the number of species seen, the number of plants recorded and plant cover. Different herbaceous plants will be perceptible at different times of the year. Therefore monitoring needs to be undertaken within about a four week window each year – ideally in late spring when the flowering and ability to identify plants is at a maximum. It is not valid to compare a species list from spring with one from late summer or autumn.

Causes of Change: Even if management actions are likely to be causing change, the nature of the change occurring may vary considerably, and each component that changes may influence change on another component. For example a reduction in kangaroo abundance may influence rabbit abundance and plant growth. However, these changes may have another cause such as climatic conditions. If a site is burned, the result may be an increase in plant growth, changes in species composition (such as increased weeds) and plant cover, but as with the kangaroo example, changes might be also the result of seasonal conditions. Caution must be exercised when drawing conclusions on causes of change.

Overcoming variability

Variability is overcome by measuring multiple sets of data within sites and measuring the variability, so that the average and range of any attribute can be identified. Replication of plots where management is undertaken and in sites that are otherwise similar, but the management is not applied (controls) assists in determining whether changes that are measured in the attributes are caused by management or other factors (such as seasonal conditions).

2.2.2 Proposed statistical analysis

The existing data from the baseline condition assessment (Eco Logical Australia 2013) was used to identify how the monitoring data could be analysed. The variability of the data was very high, and consequently the numbers of plots estimated to be required to account for the variability of the individual attributes was extremely high, and essentially unpractical. However, as a number of attributes are measured that collectively provide a score of the condition in the vegetation and habitat (based on Biometrics; DECCW 2011) it was advised to undertake ordination analyses to determine the change in condition of the sites (Dr Keith McDougall, pers. comm., September 2013). This analysis allows the identification of:

a. the relative power of the different attributes in causing changes in condition;

b. the 'distance' between each plots, and change in space of each plot over time; and

c. change in single attributes over time within sites and plots.

The methods to be applied to analyse the data were used to determine the layout of the plots and the number of replicate plots required. Statistical analysis using ordination is possible without increasing the replication of plots beyond the number measured in the baseline study (see Table 1), which was based on the recommendations in DECCW (2011). Basically the more plots per site, the smaller the error, however this needs to be balanced against resources and practicality.

2.3 Number of plots to measure

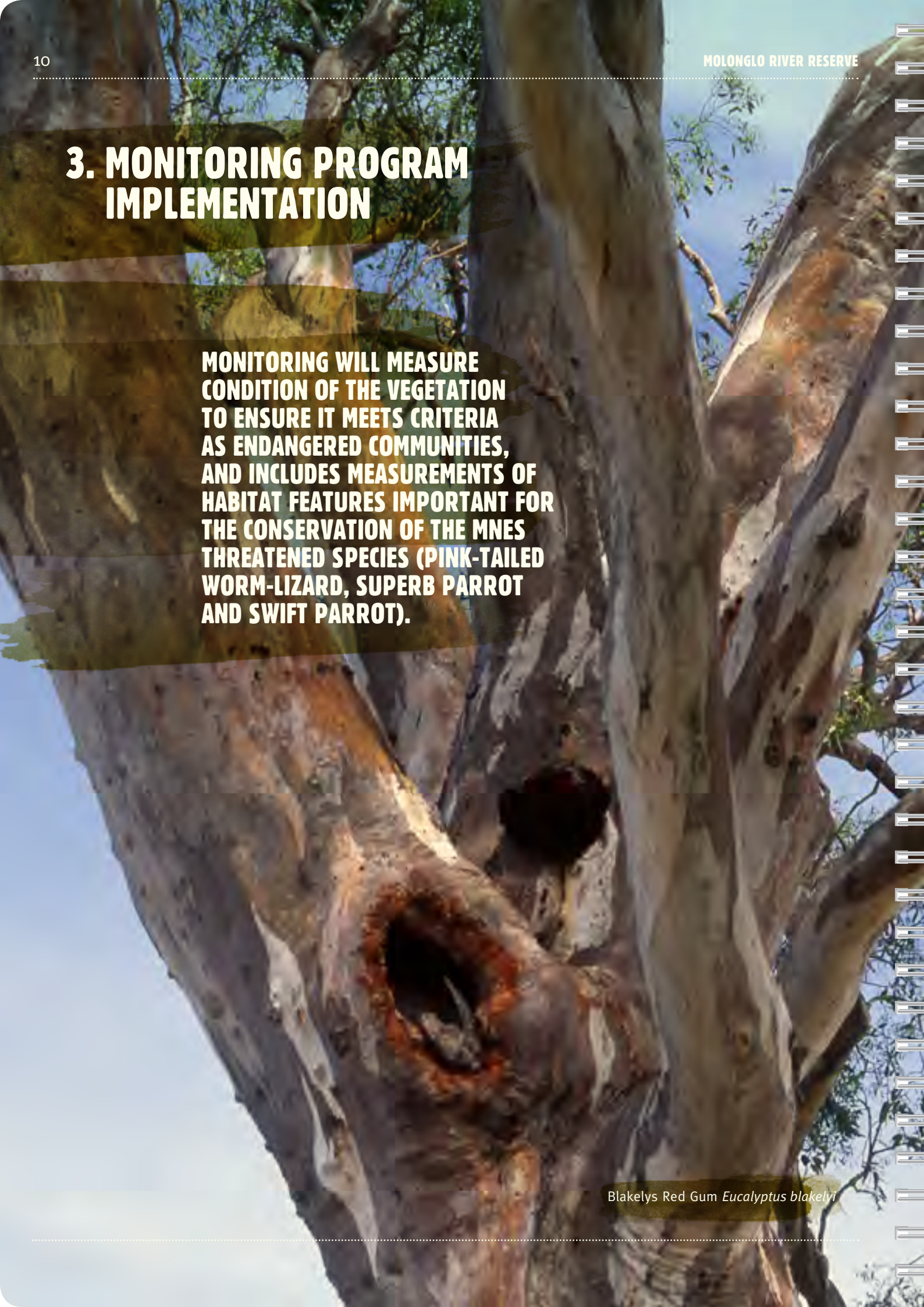
The number of plots to measure for Molonglo is in Table 1, and are based on DECCW (2011).

Table 1. Recommended minimum number of plots to be established to counter variability across sites.

Size of vegetation zone	Number of plots and transects
›0 - ‹ 4 ha	2
4 to ‹ 20 ha	4
20 – ‹50 ha	5
›50 ha	6

3. MONITORING PROGRAM IMPLEMENTATION

MONITORING WILL MEASURE CONDITION OF THE VEGETATION TO ENSURE IT MEETS CRITERIA AS ENDANGERED COMMUNITIES, AND INCLUDES MEASUREMENTS OF HABITAT FEATURES IMPORTANT FOR THE CONSERVATION OF THE MNES THREATENED SPECIES (PINK-TAILED WORM-LIZARD, SUPERB PARROT AND SWIFT PARROT).



Blakelys Red Gum *Eucalyptus blakelyi*

3.1 Attributes to monitor

Key attributes to monitor vegetation and habitat condition are listed in Table 2, against the objectives to be met. In addtion to measuring condition of the vegetation to ensure it meets criteria as endangered communities, the monitoring includes measurements of habitat features important for the conservation of the MNES threatened species (Pink-tailed Worm-lizard, Superb Parrot and Swift Parrot). Methods used to monitor Pink-tailed Worm-lizard and Superb Parrot population abundance and distribution are included in separate publications (Milner and Osborne in prep.; CPR 2011). Swift Parrot will not be monitored directly due to the species' variable use of the landscape each season (see Sharp et al., in prep.).

A short description of each indicator that is measured and information on what can be achieved using these indicators is in Section 3.2. The recording sheets used in the field to measure the attributes are in Section 7. The methods used to measure the attributes, and the attributes measured, are compatible with those monitored by ACT Government's Conservation Planning and Research unit. Attributes that may be monitored for matters that are not covered in the NES Plan are identified in Section 3.4. Further information about what monitoring may be relevant is to be included in Management Area Operational Plans.

Explanations of how to calculate the benchmark scores, criteria for whether a site contains the listed Box-Gum Woodland or Natural Temperate Grassland ecosystems and floristic scores are provided in Section 5.

In addition to the above, other data collected using condition monitoring sheets 1, 3, 4 and 7 that assist with management decisions and actions include:

- Annual exotic cover (transect)
- Bare ground cover (transect)
- Exotic over-storey cover (transect)
- Exotic mid-storey cover (transect)
- Revegetation success (transect)

Table 2. Key attributes to monitor in Molonglo for Matters of National Environmental Significance. Attributes for assessing vegetation condition are those used for scoring benchmarks against vegetation type and against site condition and are based on DECCW (2011). Attributes used for assessing floristic score is based on Rehwinkel 2007, as applied in the ACT by Conservation Planning and Research.

Site Attribute	Recording Sheet	Scoring Benchmarks	BGW, NTG EEC listing	Floristic score (BGW, NTG, PTWL habitat)	Threatened species habitat	Key attribute to trigger management intervention
Native plant species richness (plot)	2	Yes	Yes			
Native over-storey cover (transect)	4	Yes	Yes		Superb Parrot PTWL	
Native mid-storey cover (transect)	4	Yes	Yes		Superb Parrot PTWL	
No. important species (BGW) present	2		Yes			
No. PTWL habitat species present	2				PTWL	
Native groundcover (grasses) (transect)	3	Yes			PTWL	
Native groundcover (shrubs < 1 m tall) (transect)	3	Yes			PTWL	
Native groundcover (other) (transect)	3	Yes			PTWL	
Exotic plant cover (percentage of groundcover and mid-storey cover) (transect)	3	Yes			PTWL	Yes
Annual exotic plant cover (transect)	3					Yes
Bare ground (transect)	3					Yes
Number of trees with hollows (plot)	5	Yes			Superb Parrot	
Proportion of overstorey species occurring as regeneration (zone)	5	Yes				
Total length of fallen logs (plot)	5	Yes				
Proportion of native species in the groundlayer (transect)	3		Yes (BGW, NTG)		PTWL	
Native plant species diversity and abundance (plot)	2		Yes (BGW)	Yes	PTWL	
Biomass	6				PTWL	Yes
Disturbance to rocks	3				PTWL	Yes

3.2 Methods used to measure vegetation condition

It is recommended that condition monitoring is undertaken annually in spring. It is important that all attributes are measured annually, as the ordination requires data from all measurements. Note: measurements for upper-storey and mid-storey cover, number of trees with hollows, total length of fallen timber and native regeneration will be taken biennially and assumed to remain unchanged in non-monitored years.

The methodology recommended for assessing and monitoring aspects of vegetation and habitat condition is based on Sharp and Gould (2014). The methods are consistent with survey and monitoring methods used by ACT Government ecologists for assessing vegetation composition, structure and condition and are also consistent with measures used to monitor against benchmarks for vegetation communities in NSW (DECCW 2011).

Photopoint monitoring is undertaken at every plot that is monitored and every time that it is measured. Photopoint monitoring associated with the monitoring helps to interpret the data collected. A selected corner of the plot provides the fixed point from which to take photos (ideally facing south with the sun behind).

3.2.1 Plant Species Diversity

Modified from Indicator 1 in Sharp and Gould 2014.

The cover-abundance using the Braun-Blanquet scale is estimated for all species that occur within a plot either 0.1 ha (species greater than 2m tall) or 0.04 ha (species less than 2m tall) in size. Any herbaceous species with abundance less than 5 specimens in the plot are identified to help calculate the floristic score (Rehwinkel 2007). The data provides information on whether native species or exotic species richness is increasing or decreasing, and whether there are changes in the species that are found over time.

3.2.2 Plant Species Cover

Indicator 4 in Sharp and Gould (2014).

Species cover is measured at three strata:

1. Groundlayer species less than 1m high: species in groups (native grasses, native shrubs ‹ 1m tall, other native species, annual exotic grass and forbs and perennial exotic grasses and forbs) is estimated using frequency as a surrogate for cover, measured at 100 points along a point-intercept transect. In addition bare ground, rocks, cryptogams and litter are also recorded. Changes in the frequency indicate how the site is responding to environmental changes and human intervention.

2. Upper-storey species: total cover of species over 2 m tall is measured as a percentage of the 0.1 ha plot (and beyond, if required, to measure 12 upper storey species). Native and exotic species are measured separately. The cover of species › 2 tall, are measured along a zig-zag transect through the plot (DECCW 2011), estimating projective foliage cover using diagrams, or using the HabitApp on an android phone https://play.google.com/store/apps/details?id=com.scrufster.habitapp

3. Mid-storey species: total cover of species between 1 m and 2 m tall is measured as a percentage of the 0.1 ha plot. Native and exotic species are measured separately. An average is taken from 12 specimens, along a zig-zag transect. Projective foliage cover is taken to be 100%, unless clearly not so, in which case an estimate of projective foliage cover is taken from ground height, either estimating or using the HabitApp .

3.2.3 Condition of Native Trees and Shrubs

This is modified from Indicator 3 in Sharp and Gould (2014).

1. **Regeneration**:
   a. Within the 0.1 ha plot the number of plants at each life stage present for each species is counted. The measure is used to identify the species that are regenerating, the range of different age classes present for each species and the amount of regeneration occurring within each age class.
   b. Proportion of native tree species regenerating in the vegetation zone: the proportion of total number of tree species that are regenerating within the vegetation zone is calculated (DECCW 2011).
2. **Length of fallen timber** in a 0.1 ha plot: total length of timber that falls within the plot that is greater than 10 cm diameter and longer than 0.5 m in length (DECCW 2011).
3. **Number of trees with hollows** in a 0.1 ha plot: the total number of trees that contain hollows that are more than 1 m off the ground, where the entrance wider than 5 cm with evident depth are counted (DECCW 2011).
4. **Pink-tailed Worm-lizard habitat:** Disturbance to rocks: Number of dislodged rocks in PTWL habitat in 0.04 ha plot.

3.2.4 Biomass

Estimation of biomass cover allows for comparison of biomass over time within one site and between sites. It can be used to help make management decisions about when to control biomass (e.g. burning, slashing and grazing) or when to remove biomass control (e.g. kangaroo population control). Scientists at La Trobe University in conjunction with Parks Victoria have developed a technique that provides a rapid field assessment of biomass using golf balls. The method will be trialled across a variety of grassland vegetation types (incl. BGW, NTG, derived grassland and native pasture) within the Molonglo and compared against dry herbage mass.

3.3 Methods used to monitor other MNES in Molonglo

3.3.1 Revegetation Success

Revegetation success is measured within the revegetated patch. Measures of the survival and health of plantings in the area indicates the success of the revegetation program, and can be used to identify if particular species have established better than others, whether follow-up is required or whether the conditions in which the revegetation was undertaken were optimal or not. Note: final methods to be used will be discussed with Greening Australia to be compatible with work undertaken at restoration sites.

3.3.2 Pink-tailed Worm-lizard habitat

PTWL habitat condition will be monitored as part of both the vegetation condition monitoring program and the below 'low-impact' PTWL population/detectability monitoring program. Specific parameters for PTWL habitat have been incorporated into the standardised vegetation condition assessment (see Table 2 for key habitat attributes measured).

Methods to monitor Pink-tailed Worm-lizard populations or detectability that do not impact their habitat (rocks and ant colonies) are currently under investigation and will be provided in a separate report (Milner and Osborne in prep.).

3.3.3 Superb Parrot habitat

Superb Parrot habitat condition will be monitored as part of the vegetation condition monitoring program. Specific parameters for Superb Parrot habitat have been incorporated into the standardised vegetation condition assessment (see Table 2 for key habitat attributes measured).

A baseline survey of the known and potential nesting trees in the Molonglo River Reserve (incl. Kama), the Arboretum Woodland Conservation Area, NES Patches H and C and Spring Valley (Eco Logical 2014) has been completed. Annual surveys of known and potential nesting trees should be carried out to confirm if they are being used for breeding by Superb Parrots. A more comprehensive survey of breeding activity should be undertaken every five years, and include areas outside the Molonglo River Reserve such as Central Molonglo. Methods used should be consistent with Davey (2011).

3.4 Other monitoring programs

Other existing or potential monitoring programs are not explained in detail in this manual.

3.4.1 Existing monitoring programs in Molonglo include:

Fish monitoring in the Molonglo River (CPR, unpublished data)

Vegetation monitoring in Kama (CPR, unpublished data)

Bird monitoring in Kama by Canberra ornithologists Group (COG) (Bounds et al., 2010, Taws et al. 2012)

3.4.2 Community monitoring programs that may be included:

Waterwatch is part of a national community water quality monitoring program that brings people together from all parts of the community to raise awareness, educate, monitor, restore and protect waterways. Through Waterwatch the water quality of local creeks, wetlands, lake, rivers and stormwater drains is regularly monitored. The program is facilitated by an officer within the Environment and Sustainability Directorate, and there are coordinators within each of the catchment groups. http://www.act.waterwatch.org.au.

Vegwatch monitoring program has been established to provide data on the condition of bushland sites across the region using methods that are consistent and robust. Because the same methods are used across all the sites the results can be used to compare change over time within particular sites as well as over multiple sites within the region, significantly increasing the value and strength of individual studies. The program also encourages the participation and increase in knowledge and understanding of processes occurring in bushland of volunteers and landholders who traditionally have not been involved in the extension step of their on-ground work – that of quantitatively measuring and analysis of the results of their labour http://www.molonglocatchment.com.au.

Bird abundance or distribution, using methods consistent with those used by Canberra Ornithologists Group (www.cog.org.au). The 2-hectare area search method recommended by Birds Australia is used by COG, as it is readily repeatable, given an accurate coordinate for the centre of the site. The two hectare area should be similar habitat throughout. Two hectares equates to 200 m x 100 m, 140 m x 140 m, or approximately 80 m radius circle. There are a number of protocols for this survey type including duration (20 minutes) and data recording that are available from the COG website.

Frogwatch, as used nationally and currently co-ordinated locally by Ginninderra Catchment Group, is undertaken by volunteers at sites across the ACT and region. Monitoring is based on the recording of frog calls (eg. by use of the tape recorder or iPhone) and these recorded calls are used to provide an estimate of the number of frogs calling. This is done in simple categories of relative abundance. Calls are checked by the Frog Watch officer. A simple list of habitat variables is also recorded. Training is provided annually for new participants and the monitoring is undertaken in the third week of October annually. The program complements more detailed monitoring undertaken by various research institutions and the ACT Government. (Note: sites selected for frog watch generally need to be reasonably accessible to the public at the night. It may not be practical to locate sites in more remote parts of the reserve such as in the lower Molonglo Gorge because of the lack of ready access). http://www.ginninderralandcare.org.au/frogwatch

3.4.3 Other monitoring programs that could be incorporated to answer particular questions

Distribution and abundance of species

This is used to measure change in distribution and abundance of desirable or undesirable species (Sharp and Gould 2014). If a particular species occurs within a small area (a patch) it is possible to measure the entire population, in terms of distribution by mapping it, and in terms of abundance by counting each plant present. This is useful for monitoring changes to discrete populations of weeds or uncommon or threatened species.

Riparian condition

The Rapid Appraisal of Riparian Condition (RARC) Version 2 (Jansen *et al.* 2005) or other preferred methods may be used to measure riparian condition.

Landscape Function

The Plan of Management for the Molonglo River Park (Ryan in prep.) identifies that landscape function is a key process to be retained. LFA provides a rapid, consistent assessment of soil health and biophysical soil processes across a widely variable set of sites that is repeatable and consistent (Tongway and Hindley 2004). The method involves assessing and scoring indicators of soil surface condition, which results in three indices of landscape function: stability, infiltration and nutrient cycling (Tongway and Hindley 2004). The technique has been used to compare the condition in terms of landscape function of 36 nature reserves in the ACT (Sharp 2011), and is also being used to monitor condition in a more intensive way at Mt Painter Nature Reserve (Tongway and Ludwig 2011). The technique can be compared over time in one site, for example to determine the impact of control burning on soil function (Sharp 2011) or impacts on soil condition of formal or informal access tracks in the Lower Molonglo Corridor, or can be used to compare the condition of a range of sites within a single time period. The method is accompanied by detailed information on how to collect the data, spreadsheets for data entry that internally analyse the data, and information on how to interpret the data and it is available on a CD (Tongway and Hindley 2004).

Remote sensing

Remotely sensed information may be used to measure gross changes to the landscapes through existing remote sensing or low altitude oblique aerial photography (Johnston *et al.* 2009). Changes that can be detected using this technique include track establishment or damage, erosion, vegetation disturbance or changes to vegetation structure. It is recommended that low altitude oblique aerial photography be obtained every five years over the Corridor and Box-Gum woodland patches and analysed to review disturbances to vegetation, development of unofficial tracks, condition of tracks and open space.

4. UNDERTAKING CONDITION MONITORING IN MOLONGLO

DEVELOPING AN APPROACH TO A LOW IMPACT MONITORING METHOD.

Pink-tailed Worm-lizard population monitoring

4.1 Number of plots to measure in vegetation zones

The number of plots per management zone is included in the Molonglo monitoring program (Table 3). The number and placement of these plots represent the minimum required to meet the requirements for determining whether changes have occurred to MNES, as specified in the NES Plan (ACTPLA 2011).

Table 3. Number of plots to monitor in Molonglo management zones

Management Zones	Patches/areas	Veg type	Size (ha)	No. plots monitoring	Total/ zone
River Corridor Reserve	K1	BGW (derived grassland)^	33.2	3	
	K2	Degraded NTG	10.2	2	
	Q, R	BGW (derived grassland)^	8.5	3	
	S	BGW (derived grassland)^	5.6	2	
	D1	BGW	17.2	3	
	D2	Degraded BGW	2.3	2	
	T (Misery Point)	BGW (derived grassland)^	6.4	4	
	T1 (Barrer Hill)	BGW	4.5	2	21
Kama Nature Reserve	A1, A2	NTG	36.6	4	
	O1	BGW	12.0	2	
	B1, B2, B3*	BGW	106.0	6	12
Arboretum	N2	BGW	7.8	2	
	N1, N3	Degraded BGW	13.3	4	
	GG1	BGW	43.9	4	
	GG2**	BGW	3.7	2	12
Spring Valley Farm	I	BGW	20.7	3	
	L	BGW	2.2	2	
	M1	BGW	6.7	2	
	P1	BGW	7.8	3	
	P3***	Pine forest	1.7	2	10-12
William Hovell Drive	C	BGW	6.9	2	
	H	Degraded BGW	8.6	2	4
Total plots					59-61

^ Areas mapped under the NES Plan as BGW (derived grassland) are now considered to contain areas of Purple Wire-grass – Wattle Mat-rush dry tussock grassland (NTG r8).
The association has not been previously identified in the ACT (Sharp et al. 2013).

* Number of plots for the Patch has been increased from four in 2013 to six in 2014.

** Number of plots for the Patch has been increased from one in 2013 to two in 2014.

*** With the removal and control of pines in P3, it is expected that there will be extensive natural regeneration and that the site should be monitored. No monitoring was undertaken in 2013.

4.2 Frequency of monitoring

Plant species diversity, herbaceous plant cover and biomass will be monitored annually until 2017.

Upper-storey cover, mid-storey cover, native regeneration, number of trees with hollows and total length of fallen timber will be monitored every two years (2013, 2015and 2017) until 2017.

The monitoring program (incl. monitoring frequency and number of attributes and plots monitored) will be reviewed in 2017/18 to ensure the objectives of the program are being reached, as well as ensuring the program is sustainable in the long-term.

4.3 Instructions for undertaking monitoring

Plot Establishment and Description

Reference: Sharp and Gould (2014)

You will be:

- Setting up plots to measure the vegetation attributes and to establish permanent markers.
- Describing them to provide background information to assist in interpretation of the data.
- The description will need to be done so that you can easily re-locate them, and that someone not familiar with the plots will be able to find them

Timing: any time before undertaking assessment monitoring or when undertaking the first set of monitoring

Method used: Plots and transects

Instructions

1. Assessment sites should be at least 10 metres away from the area boundary, as this zone is likely to be more disturbed. This may not always be possible. For monitoring programs choose sites that can be easily re-located.
2. In an area that contains woody vegetation over 2 m tall – undertake the measurements within a 0.1 ha plot, generally 20 x 50 m plot. In an area that contains grassland, sedgeland or low shrubland - undertake the measurements within a 0.04 ha plot, usually 20 m x 20 m. Where plots of these dimensions do not fit, for example, in a long and narrow area such as adjacent to the river, another shape plot may be used (e.g. 10 x 100 m or 10 x 40 m).
3. Establish the plots. See Section 3.3 for a guide to how many plots and transects should be established according to the size and variability of the vegetation zone. Plots should be representative of the vegetation zone (e.g. plots should not be placed in high quality sites if the vegetation zone is in overall poor condition).
4. Establish the plots with the 50 m length running N-S.
5. Mark out the sites.
6. Mark the location of the monitoring plot on your map and take GPS readings for each plot (starting at the SW corner).
7. Take photos to identify where the plot is located. By convention the SW corner is identified as point 1. For each plot or transect that you establish, fill out the Plot Location recording sheet and the Plot Description recording sheet. Provide enough detail that someone else would be able to locate the site without assistance.
8. Give a relative abundance score on the plot description sheet, as follows:
   - Abundant– species occurs in an almost continuous manner or over more than approximately 50% of the area;
   - Common – species encountered commonly i.e. without having to search for it, but not distributed continuously, covering between approximately 5 and 50% of the area.
   - Occasional – four or more plants and/or less than 5% of the area, not encountered frequently.
   - Rare – isolated, very infrequent, one to three plants.
9. Take this sheet and photos with you each time you monitor to make it easy to re-locate the monitoring site. On subsequent visits, insert a description of elements, such as obvious disturbance, changes, condition of the vegetation etc.

1. Photopoint Monitoring

Reference: Sharp and Gould (2014)

Photopoints are a simple and effective way to record change. A photopoint is simply a fixed point from where photos can be regularly taken. Photopoint monitoring may be used on its own to retain a visual record over time of particular parts of your site. It is only descriptive, but it is useful to have several areas within a site that photopoint monitoring is undertaken regularly and consistently.

Photopoint monitoring should also be undertaken at every plot that is monitored and every time that it is measured. Photopoint monitoring associated with the monitoring helps to interpret the data collected. A selected corner of the plot provides the fixed point from which to take photos.

You will be recording:

- The exact location and at the same scale over a period of time to observe how it changes

Timing: If possible, repeat photographs should be taken at the same time of the year, similar time of day and under similar light conditions.

Method used: Specific photo monitoring points

Instructions

1. Take photographs at set locations at the same time of the year and day on a regular basis. If possible take the photo with the sun behind (i.e. generally looking to the south).
2. At a defined point in front of the point at which the photo is to be taken, hammer in a "sighter" post. Attach a card to the sighter post with the date and name of the plot. This will help with record keeping. Write down the distance of the sighter post from the point from which the photo is taken. Try to minimise the amount of trampling between the camera post and the sighter post.
3. The 'sighter' post should be placed along the direct line of sight to the centre of the assessment site (along the diagonal).
4. Record the location of the photopoint, and the distance and compass bearing of the sighter post from the camera post. Use this information to find the exact point in future monitoring. There are smartphone apps that contain compasses.
5. In some situations the best 'sightline' for the photopoint is not towards the centre of the monitoring site, e.g. a large bush is 2m away and blocks the camera view in that direction. If this is the case, choose a line of sight that is more appropriate. Be sure to note the angle/ bearing on the sheet.
6. Record the height of the camera above ground on the data sheet and ensure you use the same height each time you take a photograph in the future (e.g., "taken at eye level, 1.5 m high").
7. Take the photo with the middle of the frame focussing on the top of the sighter post and take the photo in normal mode. Ensure the sign indicating the date and site number is visible before setting up the sighter post for the first time. Take a photo each time in the same way: landscape or portrait, and focus on the same point, so that each time the same details are in the photo.
8. Complete the Photopoint Monitoring sheet.
9. Take a photograph from your photopoint each time you monitor or at the least once a year. Each time, fill out the subsequent monitoring description sheet.

2. Plant Species Diversity

Reference: modified from Indicator 1, Sharp and Gould (2014)

You will be measuring:

- The number of different species present in the plot,
- The abundance of these species in classes (not quantitative, comparative only)
- The number of native compared to introduced species in the plot.

Timing and frequency: mid October to mid November, annually, at the same time each year

Method used: 0.1 ha plot (usually 20 x 50m) or 0.04 ha plot (usually 20 x 20m) if all vegetation is less than 2 m in height

Instructions

1. A 0.1 ha plot (usually 20 x 50 m) is used for surveying species taller than 2 metres. Species smaller than 2 m in height are measured in a 0.04 ha sub-plot (usually 20 x 20 m). If there are no species present over 2 m, then set up a 0.04 m plot. In narrow sites a different shape plot may be used, but retain the sizes as 0.1 and 0.04 ha for compatibility with other studies.
2. Traverse each area in a systematic way, and record each different species that you find;
   a. Record all species over 2 m tall within the entire 0.1 ha plot.
   b. Record all other species up to 2 m tall within a 0.04 ha plot.

3. Estimate a relative cover estimate:

5: › 75% cover	4: 51–75% cover	3: 26–50% cover	2: 5–25% cover	1: ‹ 5% cover and numerous	+: ‹ 5% cover and infrequent	r: ‹ 5% cover and less than 5 specimens

Canopy cover/abundance rating table:

Criteria	Cover Class	Examples of cover in 0.04 ha plot
Less than 5% cover, single plant (shrub or tree) or less than 5 individual plants (herbaceous species)	'r	5%: 20 m² = 1 x 20 m; 4 x 5 m
Less than 5% cover, few plants (shrub or tree) or less than 15 individual plants (herbaceous species)	'+	5%: 20 m² = 1 x 20 m; 4 x 5 m
Less than 5% cover, plentiful	1	5%: 20 m² = 1 x 20 m; 4 x 5 m
Any number of individuals covering 5 – 25% of the area	2	25%: 100 m² = 5 x 20 m; 10 x 10 m
Any number of individuals covering 26 – 50% of the area	3	50%: 200 m² = 10 x 20 m
Any number of individuals covering 51 – 75% of the area	4	75%: 300m² = 15 x 20 m
Any number of individuals covering 76 - 100% of the area	5	


Red-browed Finch

3. Plant Species Cover: Groundcover

Reference: Indicator 4, Sharp and Gould (2014)

This indicator is used to measure changes in abundance of species groups in the groundlayer (plants less than 1 m tall), midstorey (plants between 1 and 2 m tall) and upperstorey. It provides an insight into how species groups are responding to management interventions.

At the same time, measure the disturbance to rocks in Pink-tailed Worm-lizard habitat.

You will be measuring:

- Abundance of groups of herbaceous species
- Proportion of native to introduced herbaceous species
- Structural diversity of the groundlayer
- Proportion of the groundlayer containing non-vegetative material
- The abundance of a particular species against other groups (if necessary)
- Rock disturbance (PTWL habitat)

Timing and frequency: mid October to mid November, annually, at the same time each year

Method used: 2 transects within the plot

Instructions

Use this to calculate cover for all groundcover, including species less than 1 m in height. Take 100 measurements along two 50m transect running the SW-NW and SE-NE plot edge.

1. At each metre interval place the point of the fine wire directly adjacent to the tape. Record what is touched as a tally. If you 'hit' two or more species groups or attributes at one point, mark it as a hit for each group.
2. If touching a stem that appears to be dead, but is still attached to the plant, count it as that plant. If the stem is detached, count it as litter.
3. If touching a plant and also bare ground that is clearly visible through the plants, record both. If the bare ground is not clearly visible through the plant, do not record it (effectively the bare ground is protected by the plant).
4. To calculate percentage cover for each group or species, add up the number of hits (tallies) for each group (F), divide by the total number of measurements made (P) and multiply by 100. For example, if you have a tally of 24 from 100 points that were measured, the percentage cover is (12/100)x100 = 24%. Note that the total percentage cover may be over 100% due to overlapping plants.

2. Pink-tailed Worm-lizard habitat

- Count the number of dislodged rocks in a 0.04 ha plot. The measure is used to monitor habitat disturbance.

4. Plant Species Cover: overstorey and midstorey (native and exotic species)

Reference: Hnatiuk et al. (2009)

You will be measuring:

- Projective foliage cover of native woody species above 2 m in height
- Projective foliage cover of exotic woody species above 2 m in height
- Projective foliage cover of native woody species between 1 and 2 m in height
- Projective foliage cover of exotic woody species between 1 and 2 m in height

Timing and frequency: every two years, any time of the year, unless exotic species are deciduous

Method: Along a zigzag transect within the plot and extending out to measure 12 woody plants in each category

Field procedure

1. A 50 x 20 m plot is used as the basis to measure woody plant species cover.
2. The mid and upper strata are measured separately (mid strata 1 – 2 m tall; upper strata › 2m tall), and also grouped by origin (indigenous native or introduced, including native introduced species).
3. Lay a tape out through the length of the plot commencing at 10 m along the 20 m side of the plot.

4. Undertake the first measurement at the edge of the crown canopy of the native woody species >2 m tall that is closest to the transect line.
   - Measure the width of the crown.
   - Commence from the other side of the crown and measure the distance to the next tree that is towards or across the transect (crown gap). If crowns overlap the crown gap has a negative value (e.g. if two crowns overlap by 3 m the gap is -3).
   - Measure the width of that crown. This measure assumes that crown cover is an approximate circle. Where crowns significantly deviate from this, measure then average the longest and shortest diameters.
   - Estimate the percent foliage cover for each plant measured
     a) using the photos demonstrating projective foliage cover (see below), or
     b) calculate the cover on the basis of a photo taken of the canopy overhead. The app is available at https://play.google.com/store/apps/details?id=com.scrufster.habitapp. To take a measurement, use HabitApp to take a photo with your camera, or alternatively, open a photo from the gallery. You will then see the photo on the left, and a black and white version on the right. By moving the Cut-off slider until the right-hand image best represents the left, you can obtain an accurate measurement of the coverage.
   - Continue to do this for twelve sets of measurements (where possible), even if this continues outside the plot.

5. Use the same method to measure cover for the midstorey (1–2 m tall) and for introduced species in the upper and mid strata. Assume that the projective foliage cover for most shrubs less than 2 m is 100%.

6. Calculate crown cover and percent foliage cover by estimation:
   a. Calculate the mean crown gap, mean crown width and mean percentage foliage cover for each stratum and origin.
   b. Calculate the crown separation ratio (CSR) (mean gap between crowns/mean crown width).
   c. Calculate the crown cover percentage using the following relationship:

$$\text{CROWN COVER (\%)} = \frac{K}{(1+ CSR)^2}$$

where K = 80.6 for samples taken along a zigzag transect.

   d. Calculate the percent foliage cover = crown cover percent *mean percent foliage cover.

7. Calculate the average percent foliage cover in each plot for each group of species.

These photos assist with estimates of percent foliage cover (Hnatiuk et al., 2009, p85). Rows show similar crown types for different leaf sizes (large to small, left to right). Acacia phyllodes are in the right-hand row. Most Australian woody plants are in the range 40–70%.

40%

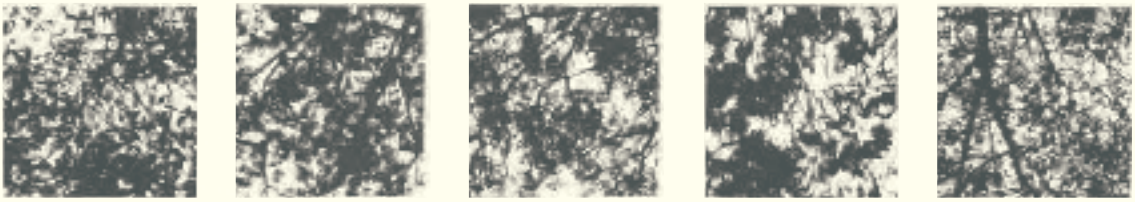
45%

50%

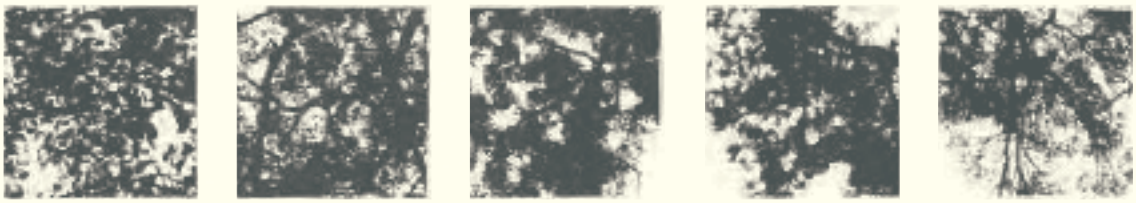
55%

60%

65%



70%



5. Condition of Native Trees and Shrubs

Reference: Indicator 3 in Sharp and Gould (2014)

Method used: 0.1 ha (e.g. 20 m x 50 m) plot and vegetation zone. This indicator is not used for monitoring in grasslands.

Measure every second year, at any time of the year.

Instructions

1. Regeneration and tree health in the vegetation zone

1. Write down the names of all the native trees that are in the vegetation zone. There are likely to be more species than are present in the plot.
2. Identify if there is regeneration of any of these species within the vegetation zone (i.e where there are young trees with diameter less than 5 cm at 1.2 m height).
3. Calculate the proportion regenerating: number of species regenerating/total number of species present multiplied by 100.
4. Identify the health of the trees of each species in the vegetation zone.

1. Very good | **2.** Good | **3.** Moderate | **4.** Poor | **5.** Very poor

2. Regeneration in the plot

1. Write the names of all the main tree and shrub species that are present on the plot. If Indicator 1 has been undertaken you will already have this list. Place a (P) next to plants you know have been planted.
2. For each species record the number of plants that are within each regenerative stage. If there are more than 10 plants, record in classes of ten (11-20; 21-30; etc).
3. For unknown species, write down your own name-description, e.g. narrow-leaved rough bark tree, on the score sheet. Use the Unknown Species Identification sheet to record their details so you can get these plants identified later.

	Regenerative stages for trees	Regenerative stages of shrubs
Seedlings	<1m for Eucalypts, may be multi-stemmed	have not flowered
Juveniles and/or saplings	Have not flowered, fruited, no buds or nuts, usually spindly, one main trunk with little side branching, and where the trunk is less than 5 cm in diameter at 1.2 m.	
Young	May have flowered and fruited but have not attained maximum size or adult shape	
Mature	Flowering, fruiting, full size, typical adult shape	have flowered
Very old mature	Most have lost branches or the main trunk, may have hollows, mostly very broad, gnarled	
Senescent	Dead or dying, with many branches with few leaves or small branches	dead or dying

Superb Parrot *Polytelis swainsonii*

3. Length of fallen timber in the plot

- Measure the total length of timber (include entire length, not the distance from one end to the other) that falls within the plot that is greater than 10 cm diameter and longer than 0.5 m in length. Use each cell to write down the lengths as you go, or else add them up cumulatively in your head.

4. Number of trees with hollows in the plot

- Count the total number of trees that contain hollows that are more than 1 m off the ground, where the entrance is wider than 5 cm with evident depth.

6. Biomass (to be trialled in 2014)

Reference: Morgan J. (in prep).

Method used: 10 x 1m² quadrats within each 0.1 ha plot.

Measure every year in spring and prior to final decisions about biomass reduction.

Instructions

1. Within the plot randomly select 10 locations (they don't need to be the same each year) to place the quadrat.
2. Drop 18 golf balls from a 1.3 m height into the quadrat
3. Score each ball as follows:

- ›90% of the ball is visible: score 1
- 33 – 90% of the ball is visible: score 0.5
- ‹33% of the ball is visible: score 0.

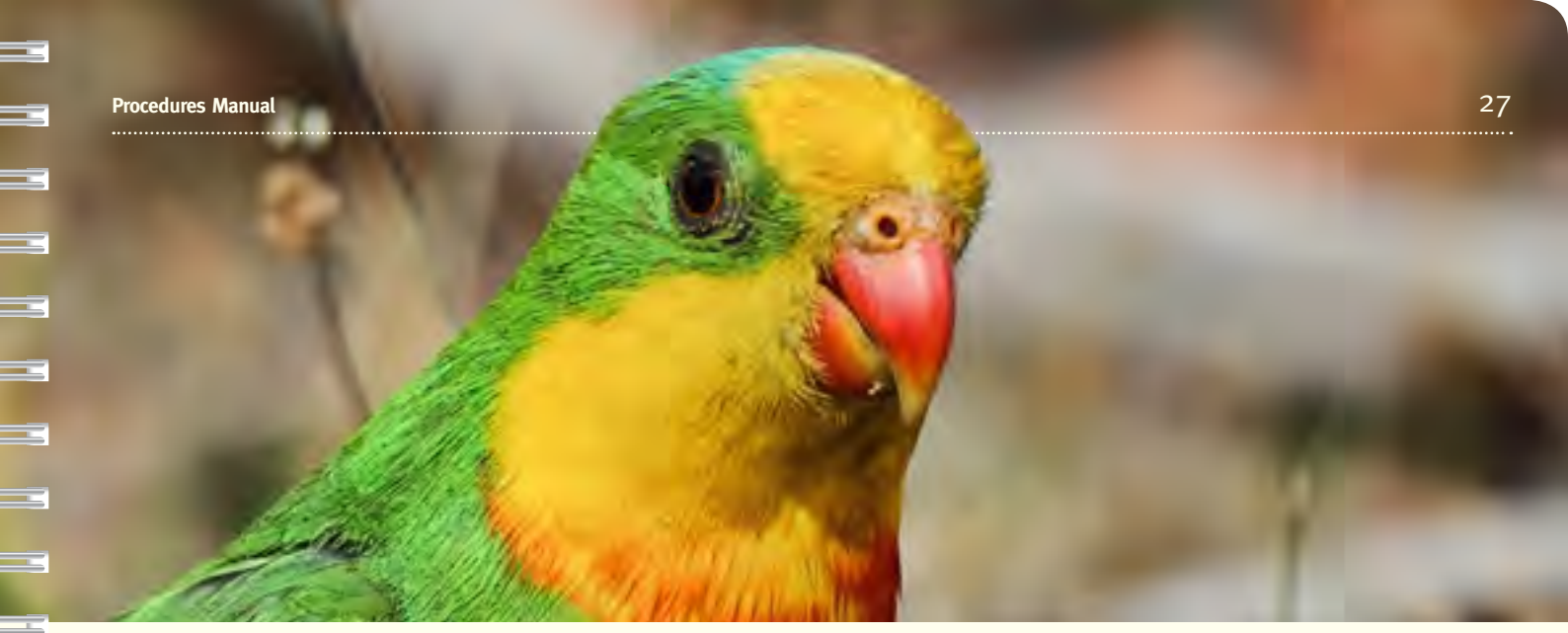
4. Take a photo to provide a reference for the score.
5. Calculate the average score for the plot
6. Identify the vegetation type
7. Calculate the biomass level: low (15-18), medium (6-14), high (0-5).

High biomass grassland scores (0-5) indicate that disturbance/biomass management maybe required (e.g. grazing, slashing or burning).

Medium biomass grassland scores (6-14) indicate that **no** disturbance/biomass management is required but the grassland should be monitored for thickening.

Low biomass grassland scores (15-18) indicate that disturbance/biomass management is not required and stock should be removed, if present, and no slashing or burning should be undertaken.

In this example, the total visibility score is 11.5 (out of 18). The golf balls in the blue circles have been scored as 1, the golf balls in the green circles have been scored as 0.5, and the golf balls in the pink circles have been scored as 0 (Morgan J. in prep).



7. Revegetation Success

Reference: Indicator 8 in Sharp and Gould (2014)

Monitoring the survival of revegetation is important to understand whether the revegetation itself is successful and whether it is contributing to ecosystem health. This indicator is most suitable for monitoring the success of tubestock planting. It is less suitable for direct seeding or herbaceous species, as after a short time it is not possible to discriminate between these and existing plants. In these cases it might be better to use Indicator 1 - Herbaceous Species Cover to measure the change in the cover and diversity of groups of species.

This indicator can provide a 'snapshot' of revegetation success at one point in time, or can be carried out over many years to indicate growth rates and survival. It can provide valuable information on species survival and which species do well at a particular site. It can also alert you to problems affecting the health of the plants.

If there are a large number of plantings - measure in several plots.

You will be measuring:

- The survival rate of each species or of the total species planted over time, and
- Change in height and cover of the surviving species

Timing and frequency: once a year or once every two years, when the species planted are easiest to identify

Method used: 0.04 ha plots (20 x 20 m or other shape depending on the shape of the revegetation area), or the size of the revegetation plot if feasible

Instructions

1. If possible obtain a list of the species that were planted. This will help identification, especially while the plants are small.
2. Choose and mark your site as per the standard procedure outlined in the Plot Location Recording Sheet. Take at least one photo according to the Photopoint Monitoring Sheet.
3. For a small revegetation project count all species.
4. For a large revegetation project count survival in subsets. At least 20 plants of each species should be counted to get an accurate estimation for the entire population.
5. Estimate overall survival rate and patchiness of surviving plants.
6. Count the tubestock plantings according to their health and survival by species if possible or by growth form.
7. Calculate the survival rate of each species by dividing the number of living plants by the total for that species then times by 100.
8. Calculate the average height and approximate cover of the surviving species in the plot.

5. INTERPRETING THE DATA

Varied sittella
Daphoenositta chrysoptera

5.1. Definition of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and derived native grasslands

EPBC Act: Box-Gum Woodland is listed as a Critically Endangered Ecological Community (CEEC) under the Commonwealth EPBC Act and as an Endangered Ecological Community (EEC) under the ACT NC Act.

The CEEC listed under the EPBC Act must meet the following criteria:

a. Have White Box, Yellow Box and/or Blakely's Red Gum as the most common species currently or in the past; AND

b. Have a predominantly native understorey AND EITHER

- Be greater than 0.1 ha in size and contain at least 12 native, non-grass understorey species (including forbs, shrubs and ferns), including at least one important species (as defined in the declaration, listed in Table 4);

OR

- Be greater than 2 ha in size and natural regeneration of the overstorey species, OR at least 20 mature trees (greater than 125 cm circumference at 130 cm height) per hectare.

NC Act: The definition accepted by the ACT Flora and Fauna Committee for the community listed under the NC Act is less quantitative:

> Yellow Box/Red Gum Grassy Woodland is an open woodland community in which either or both of Yellow Box *Eucalyptus melliodora* and Blakely's Red Gum *E. blakelyi* are usually present and commonly dominant or co-dominant. Apple Box E. *bridgesiana* is a frequent associate. The trees form an open canopy above a species-rich understorey of native tussock grasses, herbs and scattered shrubs. The combination results in a variegated mosaic of vegetation patches with features that are transitional between forest and grassland, and the community is frequently interspersed with these other vegetation types.

In practice, the definition under the EPBC Act is used to identify whether a site meets the definition under the NC Act.

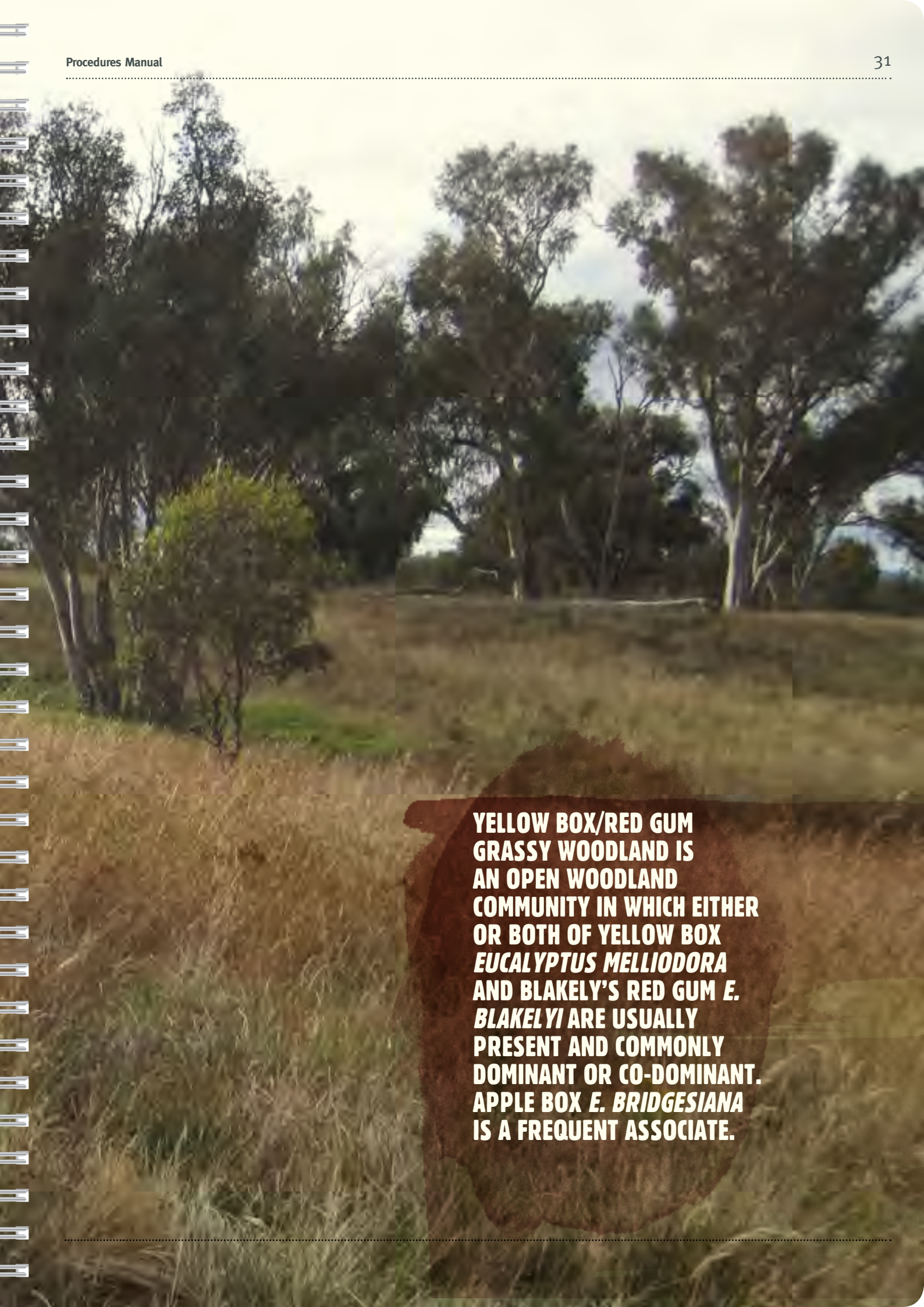
5.1.1 Important species for Box-Gum Grassy Woodland

The species list (Table 4) comprises the species identified as 'Important' in Box-Gum Grassy Woodland and are used to assess the presence of Box-Gum Woodland under the EPBC listing (SEWPAC 2012a). No such list exists for the national listing of Natural Temperate Grassland in the Southern Tablelands (SEWPAC 2012b), but many of these species are also endemic to NTG. The list is presented here in full, but some of the species are not known to occur in the ACT. This list also requires revision, due to the presence of species that cannot be regarded as important, e.g. Burgan, *Kunzea ericoides*.

Table 4. Important species for Box-Gum Grassy Woodland

Species	Common Name	Gr. Form
Cheilanthes distans	Bristly Cloak Fern	Fern
Dichanthium sericeum	Queensland Blue-grass	Grass
Dichelachne crinita	Longhair Plumegrass	Grass
Dichelachne hirtella	Slender Plumegrass	Grass
Dichelachne inaequiglumis	Plume Grass	Grass
Dichelachne micrantha	Short-hair Plumegrass	Grass
Dichelachne parva	Plume Grass	Grass
Dichelachne rara	Plume Grass	Grass
Rytidosperma pallidum	Silvertop Wallaby Grass, Redanther Wallaby Grass	Grass
Sorghum leiocladum	Wild Sorghum	Grass
Themeda triandra	Kangaroo Grass	Grass
Tripogon loliiformis	Fiveminute Grass	Grass
Ajuga australis	Australian Bugle, Austral Bugle	Herb
Alternanthera nana	Hairy Joyweed, Downy Pigweed	Herb
Ammobium alatum	Tall Ammobium	Herb
Ammobium craspedioides	Yass Daisy	Herb
Arachnorchis spp.	Spider Orchids	Herb
Arthropodium milleflorum	Vanilla-lily, Pale Vanilla-lily	Herb
Arthropodium minus	Small Vanilla Lily	Herb
Asperula conferta	Common Woodruff	Herb
Asperula scoparia	Prickly Woodruff	Herb
Brachyscome aculeata	Hill Daisy	Herb

Species	Common Name	Gr. Form
Brachyscome decipiens	Field Daisy	Herb
Brachyscome diversifolia	Large-headed Daisy	Herb
Brachyscome graminea	Grass Dairy	Herb
Brachyscome heterodonta	Lobe-seed Daisy	Herb
Brachyscome multifida	Cut-leaved Daisy	Herb
Brachyscome rigidula	Leafy Daisy	Herb
Brachyscome scapigera	Tufted Daisy	Herb
Brachyscome spathulata	Spoon Daisy	Herb
Brunonia australis	Pincushion, Blue Pincushion	Herb
Bulbine bulbosa	Bulbine Lily, Native Onion, Native Leek, Golden Lily	Herb
Bulbine glauca	Rock Lily	Herb
Burchardia umbellata	Milkmaids	Herb
Caesia calliantha	Blue Grass-Lily	Herb
Calocephalus citreus	Lemon Beautyheads	Herb
Calochilus robertsonii	Purplish Beard Orchid	Herb
Calotis cuneifolia	Purple Burr-daisy	Herb
Calotis glandulosa	Mauve Burr-daisy	Herb
Calotis lappulacea	Yellow Burr-daisy, Yellow Daisy-burr	Herb
Calotis scabiosifolia	Rough Burr-daisy	Herb
Centella asiatica	Pennywort	Herb



YELLOW BOX/RED GUM GRASSY WOODLAND IS AN OPEN WOODLAND COMMUNITY IN WHICH EITHER OR BOTH OF YELLOW BOX *EUCALYPTUS MELLIODORA* AND BLAKELY'S RED GUM *E. BLAKELYI* ARE USUALLY PRESENT AND COMMONLY DOMINANT OR CO-DOMINANT. APPLE BOX *E. BRIDGESIANA* IS A FREQUENT ASSOCIATE.

Species	Common Name	Gr. Form
Chrysocephalum apiculatum	Yellow Buttons, Common Everlasting	Herb
Chrysocephalum semipapposum	Clustered Everlasting, Yellow Buttons	Herb
Craspedia canens	Billy Buttons, Grey Billybuttons	Herb
Craspedia variabilis	Billy Buttons	Herb
Cullen microcephalum	Dusky Scurf-pea, Mountain Psoralea	Herb
Cullen tenax	Emu-foot, Emu Grass, Tough Scurf-pea	Herb
Daucus glochidiatus	Australian Carrot, Native Carrot, Austral Carrot	Herb
Desmodium brachypodum	Large Tick-trefoil	Herb
Desmodium varians	Slender Tick-trefoil	Herb
Dianella longifolia	Smooth Flax Lily	Herb
Dianella revoluta	Blueberry Lily, Black-Anther Flax Lily, Spreading Flax Lily	Herb
Dichopogon fimbriatus	Chocolate Lily, Nodding Chocolate Lily	Herb
Dipodium punctatum	Hyacinth Orchid, Pink Hyacinth Orchid	Herb
Diuris aequalis	Buttercup Doubletail	Herb
Diuris behrii	Golden Cowslips	Herb
Diuris chryseopsis	Common Golden Moths	Herb
Diuris dendrobioides	Long-tail Purple Diuris, Wedge Diuris	Herb
Diuris maculata	Leopard Orchid, Nanny Goats, Leopard Diuris, Spotted Doubletail	Herb

Species	Common Name	Gr. Form
Diuris monticola	Highland Golden Moths	Herb
Diuris ochroma	Pale Golden Moths	Herb
Diuris pedunculata	Small Snake Orchid, Two-leaved Golden Moths, Golden Moths, Cowslip Orchid, Snake Orchid	Herb
Diuris punctata	Purple Donkey-orchid, Purple Double-tails, Purple Diuris, Purple Cowslip, Dotted Double-tails	Herb
Diuris semilunulata	Donkey-ears	Herb
Diuris sulphurea	Tiger Orchid, Hornet Orchid	Herb
Eriochilus cucullatus	Parson's Bands	Herb
Eryngium ovinum	Blue Devil	Herb
Eryngium vesiculosum	Prostrate Blue Devil, Prickfoot	Herb
Galium gaudichaudii	Rough Bedstraw	Herb
Gastrodia sesamoides	Cinnamon Bells, Potato Orchid	Herb
Genoplesium	Midge Orchids	Herb
Geranium antrorsum	Antrorse Geranium	Herb
Geranium graniticola	Granite Cranesbill	Herb
Glossodia major	Wax-lip Orchid, Parson-in-the-pulpit	Herb
Glycine clandestina	Twining Glycine	Herb
Glycine tabacina	Glycine Pea, Variable Glycine	Herb
Goodenia hederacea	Forest Goodenia, Ivy Goodenia	Herb
Goodenia pinnatifida	Scrambled Eggs, Cut-leaf Goodenia	Herb
Gratiola nana	Creeping Brooklime	Herb

Species	Common Name	Gr. Form
Gratiola pedunculata	Brooklime	Herb
Gratiola peruviana	Austral Brooklime	Herb
Hymenochilus bicolor	Bicolor Greenhood	Herb
Hymenochilus cycnocephalus	Swan Greenhood	Herb
Hymenochilus muticus	Midget Greenhood, Blunt Greenhood, Dwarf Greenhood	Herb
Hypericum gramineum	Small St John's Wort	Herb
Hypericum japonicum	Small St John's Wort, Matted St John's Wort	Herb
Isoetopsis graminifolia	Grass Cushion	Herb
Kennedia prostrata	Running Postman, Scarlet Running Pea, Scarlet Coral-pea	Herb
Lagenophora stipitata	Blue-bottle Daisy, Common Lagenophora	Herb
Laxmannia gracilis	Slender Wire-Lily	Herb
Leptorhynchos elongatus	Lanky Buttons, Hairy Buttons	Herb
Leptorhynchos squamatus	Scaly Buttons	Herb
Leucochrysum albicans	Hoary Sunray	Herb
Linum marginale	Wild Flax, Native Flax	Herb
Lotus australis	Austral Trefoil, Australian Trefoil	Herb
Microseris lanceolata	Yam Daisy, Murnong	Herb
Microtis parviflora	Slender Onion-orchid	Herb
Microtis unifolia	Common Onion-orchid, Onion-orchid	Herb

Species	Common Name	Gr. Form
Ophioglossum lusitanicum	Adder's Tongue	Herb
Oreomyrrhis eriopoda	Australian Carraway	Herb
Pelargonium australe	Native Storks-bill, Austral Storks-bill, Wild Geranium	Herb
Pelargonium inodorum	Scentless Storks-bill	Herb
Pelargonium rodneyanum	Magenta Storks-bill	Herb
Plantago gaudichaudii	Narrow-leaf Native Plantain, Narrow Plantain	Herb
Plantago varia	Variable Plantain, Small Plantain, Sago-weed	Herb
Podolepis hieracioides	Tall Copper-wire Daisy	Herb
Podolepis jaceoides	Showy Copper-wire Daisy	Herb
Polygala japonica	Dwarf Milkwort	Herb
Poranthera microphylla	Small Poranthera, Small-leaved Poranthera	Herb
Prasophyllum petilum	Tarengo Leek Orchid	Herb
Ptilotus erubescens	Hairy Tails, Hairy Heads	Herb
Ranunculus lappaceus	Common Buttercup, Australian Buttercup	Herb
Rhodanthe anthemoides	White Sunray, Chamomile Sunray	Herb
Rumex dumosus	Wiry Dock	Herb
Rutidosis leiolepis	Monaro Golden Daisy	Herb
Rutidosis leptorhynchoides	Button Wrinklewort	Herb
Rutidosis multiflora	Small Wrinklewort	Herb

Yellow Buttons
Chrysocephalum apiculatum

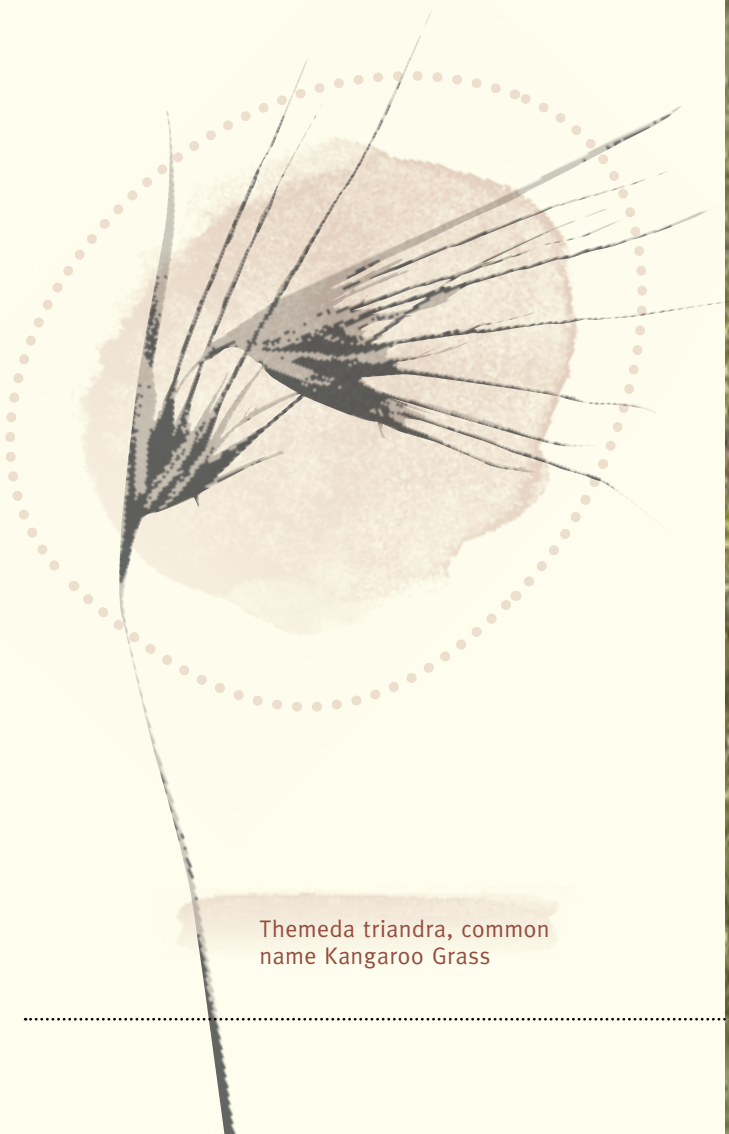
Species	Common Name	Gr. Form
Scleranthus biflorus	Spiny Mat-plant, Knawel, Cushion-bush, Two-flowered Knawel	Herb
Sebaea ovata	Yellow Centaury	Herb
Sida corrugata	Corrugated Sida	Herb
Solenogyne dominii	Smooth Solenogyne	Herb
Solenogyne gunnii	Hairy Solenogyne	Herb
Spiranthes sinensis	Austral Ladies' Tresses	Herb
Stackhousia monogyna	Creamy Candles, Creamy Stackhousia	Herb
Stellaria filiformis	Thread Starwort	Herb
Stuartina hamata	Crooked Cudweed, Hooked Cudweed	Herb
Stuartina muelleri	Spoon Cudweed	Herb
Stylidium graminifolium	Grass Triggerplant	Herb
Stypandra glauca	Nodding Blue Lily	Herb
Swainsona behriana	Behr's Swainson-pea	Herb
Swainsona monticola	Moutain Swainson-pea	Herb
Swainsona oroboides	Variable Swainson-pea	Herb
Swainsona queenslandica	Smooth Darling Pea	Herb
Swainsona recta	Mountain Swainson-pea, Small Purple-pea	Herb
Swainsona reticulata	Kneed Swainson-pea	Herb
Swainsona sericea	Silky Swainson-pea	Herb
Thelymitra ixioides	Spotted Sun-orchid, Dotted Sun-orchid	Herb

Species	Common Name	Gr. Form
Thelymitra malvina	Mauve-tuft Sun-orchid, Mauve-tufted sun orchid	Herb
Thelymitra pauciflora	Slender Sun-orchid, Few-flowered Sun-orchid	Herb
Thelymitra rubra	Pink Sun-orchid, Salmon Sun-orchid, Red Sun-orchid	Herb
Thesium australe	Austral toadflax, Austral Toad-flax, Australian Toadflax	Herb
Thysanotus patersonii	Twining Fringe-lily	Herb
Thysanotus tuberosus	Common Fringe-lily	Herb
Tricoryne elatior	Yellow Rush-lily, Yellow Autumn-lily	Herb
Triptilodiscus pygmaeus	Austral Sunray	Herb
Velleia montana	Velleia	Herb
Velleia paradoxa	Spur Velleia	Herb
Veronica gracilis	Slender Speedwell	Herb
Viola betonicifolia	Showy Violet, Arrow-head Violet, Native Violet, Purple Violet	Herb
Wurmbea dioica	Early Nancy	Herb
Zornia dyctiocarpa	Zornia	Herb
Acacia dawsonii	Poverty Wattle, Dawson's Wattle, Mitta Wattle	Shrub
Acacia decora	Western Silver Wattle, Showy Wattle, Western Golden Wattle, Pretty Wattle	Shrub
Acacia genistifolia	Spreading Wattle, Early Wattle, Wild Irishman	Shrub
Astroloma humifusum	Native Cranberry, Cranberry Heath	Shrub

Species	Common Name	Gr. Form
Bossiaea buxifolia	Box-leaved Bitter-pea	Shrub
Bossiaea prostrata	Creeping Bossiaea, Prostrate Bitter-pea	Shrub
Bossiaea riparia	River Leafless Bossiaea	Shrub
Daviesia genistifolia	Spiny Bitter-pea, Broom Bitter-pea	Shrub
Daviesia latifolia	Hop Bitter-pea	Shrub
Daviesia leptophylla	Narrow-leaf Bitter-pea	Shrub
Daviesia mimosoides	Narrow-leaf Bitter-pea	Shrub
Daviesia ulicifolia	Gorse Bitter-pea	Shrub
Dillwynia cinerascens	Grey Parrot-pea	Shrub
Dillwynia glaucula	Michelago Parrot-pea	Shrub
Dillwynia prostrata	Matted Parrot-pea	Shrub
Dillwynia retorta	Heathy Parrot-pea	Shrub
Dillwynia sericea	Showy Parrot-pea	Shrub
Discaria pubescens	Australian Anchor-plant	Shrub
Dodonaea procumbens	Trailing Hop-bush	Shrub
Exocarpos strictus	Pale Ballart, Pale-fruit Ballart, Dwarf Cherry	Shrub
Gompholobium huegelii	Pale Wedge-pea	Shrub
Grevillea iaspicula	Wee Jasper Grevillea	Shrub
Grevillea lanigera	Woolly Grevillea	Shrub
Grevillea ramosissima	Fan Grevillea, Branching Grevillea, Prickly Parsley Bush	Shrub
Grevillea rosmarinifolia	Rosemary Grevillea	Shrub

Species	Common Name	Gr. Form
Grevillea wilkinsonii	Tumut Grevillea	Shrub
Hakea microcarpa	Small-fruit Hakea, Small-fruited Needlebush	Shrub
Hardenbergia violacea	False Sarsparilla, Purple Coral-pea, Native Lilac	Shrub
Hibbertia calycina	Lesser Guinea-flower	Shrub
Hibbertia obtusifolia	Hoary Guinea-flower	Shrub
Hibbertia riparia	Stream Guinea-flower, Erect Guinea-flower	Shrub
Hovea linearis	Creeping Hovea	Shrub
Indigofera adesmiifolia	Tick Indigo, Leafless Indigo, Broad-leaved Indigo	Shrub
Indigofera australis	Austral Indigo, Australian Indigo, Native Indigo, Hill Indigo	Shrub
Kunzea parvifolia	Violet Kunzea, Tickbush	Shrub
Lespedeza juncea	Perennial Lespedeza	Shrub
Leucopogon fletcheri	Pendant Beard Heath	Shrub
Leucopogon fraseri	Beard Heath	Shrub
Leucopogon virgatus	Common Beard Heath	Shrub
Mirbelia oxylobioides	Mountain Mirbelia	Shrub
Muehlenbeckia tuggeranong	Tuggeranong Lignum	Shrub
Pimelea curviflora	Curved Rice-flower	Shrub
Pimelea glauca	Shrubby Rice-flower	Shrub
Pimelea pauciflora	Poison Pimelea, Poison Rice-flower	Shrub
Pultenaea fasciculata	Bush-pea	Shrub

Species	Common Name	Gr. Form
Pultenaea microphylla	Spreading Bush-pea	Shrub
Pultenaea procumbens	Heathy Bush-pea	Shrub
Pultenaea spinosa	Bush-pea	Shrub
Pultenaea subspicata	Low Bush-pea	Shrub
Rulingia prostrata	Dwarf Kerrawang	Shrub
Templetonia stenophylla	Leafy Templetonia, Leafy Mallee-pea	Shrub
Exocarpos cupressiformis	Cherry Ballart, Native Cherry, Wild Cherry, Cherry Wood	Shrub /Tree
Jacksonia scoparia	Winged Broom-pea, Dogwood, Broom	Shrub /Tree
Kunzea ericoides	Burgan, Kanuka	Shrub /Tree



Themeda triandra, common name Kangaroo Grass

5.2 Definition of Natural Temperate Grassland

EPBC Act: Natural temperate grassland is grassy vegetation dominated by moderately tall (25–50 cm) to tall (50–100 cm), dense to open tussock grasses in the genera *Rytidosperma*, *Austrostipa*, *Bothriochloa*, *Poa* and *Themeda*. Up to 70% of all plant species may be forbs (i.e. herbaceous, non-grassy/non-grass-like plants). The community may be treeless or contain up to 10% [projective foliage] cover of trees, shrubs or sedges. It occurs within the geographical region of the Southern Tablelands of NSW and the ACT at altitudes between 560 metres in central and northern parts of its distribution and 1200 metres in the south, in valleys influenced by cold air drainage and in broad plains (Endangered Species Scientific Subcommittee 2000).

NC Act: Natural Temperate Grassland is a native ecological community that is dominated by native species of perennial grasses. There is also a diversity of other native herbaceous plants (forbs) present. An important characteristic of the community is that it is naturally treeless, or has less than 10% projective foliage cover of trees, shrubs and sedges in its tallest stratum. In the ACT natural temperate grassland occurs up to an altitude of 625 m.

5.3 Scoring vegetation condition in the ACT.

5.3.1 Benchmarking

Gibbons et al (2009) describes the methodology for assessing native vegetation in the ACT. For monitoring, this same methodology is used to score condition over time. The total scores and attribute values can be compared between years and sites.

The methodology takes 10 parameters and for each gives a score ranging from 0 – 3, depending on the condition of the parameter at the site under investigation (Table 5). If the parameter is in a condition that is close to that of Benchmark or little disturbed sites it will score 3, while if it is a long way from the benchmark condition it will score 0. For example, the native plant diversity benchmark score (measured within a 20 x 20m quadrat) for ACT Box –Gum woodland is 35 species. Thus a site with 30-50 species in a 20x 20m area will score 3, while if only 10 species are found it will score 1, while it will score 0 if only a couple of natives are present.

The ten parameters are collected from either 20m x 20m plots or 20m x 50m plots. Areas under consideration are divided up into ACT classification vegetation zones that are of roughly the same condition. The Gibbons methodology has a guide to the number of plots that should be collected per zone but generally it is 2 or 3, but goes up to 10 in zones that are 1000s of hectares and down to 1 in zones of a few hectares (Table 1).

The site data collected for each of the ten condition attributes is then compared against benchmarks or alternatively comparisons can be made between time and between plot data. Benchmarks represent the range of variability for the condition attribute in relatively unmodified examples of the same vegetation type. Each condition attribute is allocated a score from 0-3 (0=low, 1=moderate, 2=high, 3=very high) based on the difference between its measured value and its benchmark.

The following equation determines the score applying to the attribute against the benchmark value.

$$S_c = \frac{\{\sum(a_v w_v)\} + 5[(a_a a_g) + (a_b a_i) + (a_h a_j) + (a_c a_k)] \times 100}{c}$$

where

S_c

is the current Site Value score of the vegetation zone

a_v

is the attribute score for the vth site attribute (a-j) as defined

w_v

is the weighting for the vth site attribute (a-j) as defined

a_k

is equal to $(a_d + a_e + a_f)/3$, the average score for attributes d, e, f

c

is the maximum score that can be obtained given all attributes a-j being at benchmark for the vegetation type (maximum score of 480 for non-grassland communities and 142.5 for grasslands).

Table 5. Attribute contributions to the site value.

	Site attribute (field assessment method)	Site attribute score (see notes below) 0	1	2	3	Weighting of attribute score
(a)	Native plant species richness (plot)	0	›0–‹50% of benchmark	50–‹100% of benchmark	benchmark	25
(b)	Native over-storey cover (transect)	0–10% or ›200% of benchmark	›10–‹50% or ›150–200% of benchmark	50–‹100% or ›100–150% of benchmark	within benchmark	10
(c)	Native mid-storey cover (transect)	0–10% or ›200% of benchmark	›10–‹50% or ›150–200% of benchmark	50–‹100% or ›100–150% of benchmark	within benchmark	10
(d)	Native ground cover (grasses) (transect)	0–10% or ›200% of benchmark	›10–‹50% or ›150–200% of benchmark	50–‹100% or ›100–150% of benchmark	within benchmark	2.5
(e)	Native ground cover (shrubs) (transect)	0–10% or ›200% of benchmark	›10–‹50% or ›150–200% of benchmark	50–‹100% or ›100–150% of benchmark	within benchmark	2.5
(f)	Native ground cover (other) (transect)	0– 0% or ›200% of benchmark	›10–‹50% or ›150–200% of benchmark	50–‹100% or ›100–150% of benchmark	within benchmark	2.5
(g)	Exotic plant cover (calculated as percentage of total ground and mid-storey cover) (transect)	›66%	›33–66%	›5–33%	0–5%	12.5
(h)	Number of trees with hollows (plot)	0 (unless benchmark includes 0)	›0–‹50% of benchmark	50–‹100% of benchmark	benchmark	20
(i)	Proportion of over-storey species occurring as regeneration (entire zone)	0	›0–‹50%	50–‹100%	100%	5
(j)	Total length of fallen logs › 10 cm diameter (plot)	0–10% of benchmark	›10–‹50% of benchmark	50–‹100% of benchmark	benchmark	10

The term 'within *benchmark*' means a measurement that is within (and including) the range of measurement identified as the *benchmark* for that vegetation type. The term '‹ *benchmark*' means a measurement that is less than the minimum measurement in the *benchmark* range. The term '› *benchmark*' means a measurement that is greater than the maximum measurement in the *benchmark* range.

Benchmark scores for communities in Molonglo

The monitored status of the community is compared against attribute benchmarks, site benchmarks, reference sites and management targets to gauge management progress and effectiveness. Benchmarks (ESDD, unpublished data, March 2013) for vegetation communities that occur in Molonglo are presented in the below table. While changes in site and attribute scores (categorical data) provide an overall assessment of change, statistically such data cannot be used to analyse change, and thus measures of continuous data are included to enable analyses that allow for comprehensive assessment of impacts against management targets.

Benchmark values for the Vegetation Communities present in the Molonglo Corridor. Benchmark values are based on results of extensive surveys of data in the Vegetation Types in the ACT (ESDD, unpublished data, March 2013). Benchmark values are not available for all vegetation types identified in Molonglo.

Vegetation Community	Richness indigenous plant species (no.of spp)	Native over-storey cover (% PFC)	Native Mid-storey cover) (% PFC)	Native ground cover (grasses) (% PFC)	Native ground cover (shrubs) (% PFC)	Native ground cover (other) (% PFC)	Number of large trees	Total length of fallen logs (m)
River She-oak Dry Riparian Forest	15[4]	20–50	1–35	2–50	0–6	5–20[2,4]	5[2,4]	50[2,4]
Black Cypress Pine – Brittle Gum Tall Dry Open Forest	39[4]	18–42	4–41	10–32	4–2[4]	3–22[4]	2[4]	40[4]
Red Stringybark – Scribbly Gum Tall Dry Forest	29[4]	20–36	2–10	14–40	6–22	4–15[2,4]	3[2,4]	60[2,4]
Blakely's Red Gum – Yellow Box Grassy Woodland	**354**	**11–32**	**0–12.5**	**23–63**	**0–4.5**	**8–16.5[4]**	**5[2,4]**	**35[2,4]**
Snow Gum Grassy Woodland	22[4]	14–25	0–14	20–70	0–20	10–33[4]	2[4]	100[4]
Apple Box – Broad-leaved Peppermint Shrubby Woodland	30[4]	20–40	1–18	18–50	0–20	7–17[4]	4[4]	40[4]
River Bottlebrush – Burgan Rocky Riparian Shrubland	25[4]	0–1	20–55	2–40	17–40	3–14[4]	0[4]	2[4]
Kangaroo Grass – Wallaby-grass Moist Tussock Grassland	**10[1]**	**0–1**	**0**	**40–55**	**0**	**3–8[1]**	**0 N/A**	**0 N/A**
River Tussock - Kangaroo Grass Wet Tussock Grassland	16[2]	0–1	0	30–80	0–5	5–40[2]	0 N/A	0 N/A
Tableland Wetland Fringing Aquatic Vegetation	20[2,3]	0–1	4–13	25–75	0–2	10–50[2,3]	0[2,3]	3[2,3]
Tableland Riparian Floating and Submerged Vegetation	20[2,3]	0–1	4–13	25–75	0–2	10–50[2,3]	0[2,3]	3[2,3]

Key Cover: Percent Foliage Cover
EEC: Ecologically Endangered Community
No. large trees: (Circumference >= 150cm @ 1m above ground OR hollow >= 5cm wide @ >=1m above ground)
Total length of fallen logs: greater than or equal to 10cm diameter and greater than or equal to 0.5m long

Sources of data
1 PCL kangaroo monitoring data
2 NSW BioBanking
3 Expert opinion
4 Survey of ACT sites

Sticky Everlasting *Xerochrysum viscosum*

5.3.2 Floristic value scoring for natural grassland and other grass-dominated communities

Floristic scores are based on weightings that have been applied to species that occur in natural grasslands. The weighting is related to the rarity of species based on analyses of species data from surveys undertaken on over 650 sites containing grassland or grassy woodland in the South-Eastern Highlands. The method enables a quantitative and comparative score to be developed for each plot and applied to sites.

This method relies on three groupings of species, referred to as:

Common or increaser species;

Significance Level 1: Moderately significant species are encountered less frequently, and known to occur in less disturbed sites; and

Significance Level 2: Highly significant species are the rarest of the grassy ecosystems species, are known to occur in the least disturbed site and have the highest significance weighting.

How this is applied is currently under revision. However the data collected in the monitoring enables this score to be applied.

Applying the score

Spreadsheets are available from Conservation Planning and Research to automatically calculate floristic scores. In this spreadsheet there are lists of species that occur in each sub-region. Each species has a score based on its level of significance in each sub-region. Alternatively, the scores can be calculated by hand using Table 6 and the table of the scores for each species identified by level of significance (common, significance level 1 or significance level 2; Rehwinkel 2007).

The species in a plot are listed and the abundance of each species if less than 5 specimens are present is recorded. Their weighting is applied for each species based on their indicator level, but reduced if less than 5 specimens are present. Note: weighting for Kangaroo Grass and River Tussock changes according to the cover of the species in the site (Table 6).

Table 6. Weightings

Criteria	2007 scores	Proposed scores	Final score after review...
Significance level 2 spp. >4 specimens	3	3	
Significance level 2 spp. 1–4 specimens	1	1	
Significance level 1 spp. >4 specimens	1	1	
Significance level 1 spp. 1–4 specimens	0	0.3	
Common spp. >4 specimens	0	0.3	
Common spp. 1–4 specimens	0	0.1	
Kangaroo Grass cover >25%	3	3	
Kangaroo Grass cover <25%	1	1	
River Tussock cover >25%	3	3	
River Tussock cover <25%	0	1	

5.3.3 Condition of Pink-tailed Worm-lizard habitat

A checklist of groundlayer plants that are indicative of lower levels of disturbance in PTWL habitat.

These species therefore may be found in association with less-disturbed Pink-tailed Worm-lizard habitat (Table 8_2 Sharp et al, in prep.)

Grasses/graminoids

Aristida ramosa
Cymbopogon refractus
Poa sieberiana
Sorghum leiocladum
Themeda australis
Dianella revoluta
Dianella sp.
Lomandra bracteata
Lomandra filiformis
Lomandra longifolia
Lomandra multiflora
Lomandra sp.
Luzula sp.

Forbs

Acrotriche serrulata
Ajuga australis
Asperula conferta
Asplenium flabellifolium
Astroloma humifusum
Bulbine bulbosa
Cheilanthes distans
Cheilanthes sieberi
Chrysocephalum apiculatum
Desmodium varians
Epilobium billardierianum
Eryngium rostratum
Galium gaudichaudii
Glycine clandestina
Glycine tabacina
Gonocarpus tetragynus
Goodenia hederacea
Helichrysum scorpioides
Hydrocotyle laxiflora
Isoetopsis graminifolia
Leptorhynchos squamatus
Lissanthe strigosa
Luzula sp.
Opercularia hispida
Plantago varia
Polygala japonica
Poranthera microphylla
Stackhousia monogyna
Stellaria pungens
Stypandra glauca
Tricoryne elatior
Triptilodiscus pygmaeus
Velleia paradoxa
Viola betonicifolia
Wurmbea dioica

Low or procumbent shrubs

Acrotriche serrulata
Astroloma humifusum
Brachyloma daphnoides
Cryptandra amara
Dillwynia retorta
Dillwynia sericea
Hibbertia riparia
Hovea heterophylla
Leucopogon sp
Lissanthe strigosa
Melichrus urceolatus
Mirbelia oxylobioides
Monotoca scoparia
Pultenaea procumbens
Phyllanthus hirtellus
Pimelea curviflora

6. REFERENCES

Blakelys Red Gum *Eucalyptus blakelyi*

ACT Planning and Land Authority (ACTPLA) (2011). The Molonglo Valley Plan for the Protection of Matters of National Environmental Significance (the NES Plan), September 2011

Bounds J., Taws N. and Cunningham R. (2010). A statistical analysis of trends in occupancy rates of woodland birds in the ACT, December 1998 to December 2008: the ten-year data analysis. *Canberra Bird Notes,* 35 (3) December 2010.

Conservation Planning and Research (2011). Survey guidelines for Superb Parrot. Unpublished report.

Conservation Planning and Research (2012). Survey guidelines for determining lowland vegetation classification and condition in the ACT. Unpublished report.

Davey C. (2011). Distribution, abundance and breeding status of Superb Parrot (*Polytelis swainsonii*) during the 2010-2011 breeding season, Gungahlin, ACT. Prepared for the COG 10 May 2011.

Department of Environment, Climate Change and Water (2011). Operational Manual for BioMetric 3.1.

Department of the Environment, Climate Change, Energy and Water (2009). ACT Weeds Strategy 2009-2019 Policy: Natural Environment April 2009.

Eco Logical Australia (2013). Molonglo Valley Vegetation Survey. Baseline Condition Assessment. Report to Territory and Municipal Services.

Eco Logical Australia (2014). Molonglo NES Plan Superb Parrot Survey: Baseline Survey 2013. Report to Territory and Municipal Services.

Environment and Sustainable Development (2012). ACT Pest Management Strategy 2012-2022.

Gibbons P., Briggs S.V., Ayers D.A., Seddon J., Doyle S., Cosier P., McElhinny C., Pelly V. and Roberts K. (2009). An operational method to assess impacts of land clearing on terrestrial biodiversity. *Ecolocial Indicators,* 9, 26-40.

Hnatiuk R.J., Thackway R. and Walker J. (2009). Vegetation. In, Australian Soil and Land Survey Field Handbook, 3rd Edition. Edited by the National Committee on Soil and Terrain. CSIRO, Collingwood, Vic.

Jansen A., Robertson A., Thompson L. and Wilson A. (2005). Rapid Appraisal of Riparian Condition Version 2. River and Riparian Land Management Technical Guideline. Number 4A, Ocober 2005. Land and Water Australia, Canberra.

Johnston L., Skinner S., Ishiyama L. and Sharp S. (2009). Survey of vegetation and habitat in key riparian zones: Murrumbidgee River, ACT. Technical Report 22. Environment and Sustainable Development Directorate, Canberra.

Milner R.N.C. and Osborne W. (*in prep*) A low-impact monitoring technique for Pink-tailed Worm-lizards.

Morgan J. (*in prep*) Biomass management in native grasslands.

Rehwinkel R. (2007). A method to assess grassy ecosystem sites: using floristic information to assess a site's quality. NSW Department of Environment and Climate Change, unpublished report to the Natural Temperate Grassland National Recovery Team.

Ryan S. (*in prep*). Molonglo River Reserve Draft Plan of Management. Prepared for Territory and Municipal Services.

SEWPAC (2012a) SPRAT Profile for White Box – Yellow Box – Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands. http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity

SEWPAC (2012b) SPRAT Profile for Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory. http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=14.

Sharp S. (2011). Landscape function in Canberra Nature Park and impacts of threatening processes on landscape function. Appendix G, in Cooper, M. Report on Canberra Nature Park (nature reserves); Molonglo River Corridor (nature reserves) and Googong Foreshores Investigation. Office of the Commissioner for Sustainability and the Environment, Canberra.

Sharp S. and Gould L. (2014). ACT Region Vegwatch Manual: Vegetation and habitat condition assessment and monitoring for community. Molonglo Catchment Group, Canberra.

Sharp S., Osborne W., Rehwinkel R. and Wong D., 2013. Incidence of a previously unidentified Natural Temperate Grassland type in the Lower Molonglo Valley and possibly elsewhere in ACT. Unpublished note to Conservation, Planning and Research, ACT Government.

Sharp S., Osborne W., Taws, N. and ngh environmental (in prep). Molonglo Conservation Areas Ecological Management Guidelines. Report to Territory and Municipal Services.

Taws N., Bounds J., Rowell A. and Cunningham R. (2012). An analysis of bird occupancy and habitat changes at six woodland locations – 2003 and 2010. Canberra Bird Notes 37 (2), June 2012.

Tongway D.J. and Hindley N.L. (2004). Landscape Function Analysis, Procedures for monitoring and assessing landscapes. CSIRO, Canberra.

Tongway D.J. and Ludwig J.A. (2011). *Restoring Disturbed Landscapes: putting principles into practice*. Island Press, Washington.

Waterwatch: http://www.act.waterwatch.org.au.

Vegwatch: http://www.molonglocatchment.com.au

7. RECORDING SHEETS

Showy Parrot-pea *Dillwynia sericea*

1. Field equipment required

Field equipment	To establish permanent plots	Condition Monitoring
Map of the site with vegetation zones identified	Yes	Yes
Camera	Yes	Yes
Pens, pencils, rubbers, clipboard	Yes	Yes
2 x 50 m tapes and 2 x 20 m tapes or ropes marked at 20 and 50 m	Yes	Yes
4 tent pegs and 6 flags	Yes	Yes
Permanent markers	Yes	
Compass, GPS	Yes	Yes
Sighter post		Yes
Plastic bags and ID tags for specimens		Yes
Point wire (4 mm thick)		Yes
Field guides		Yes
Recording sheets	Plot Description, Plot Location, Photopoint Monitoring	Copies of the Plot Description, Plot Location and Photopoint Monitoring sheets for relocation of plots. Recording sheets 1 – 6 as required.

The maps in Appendix B show the location of the management zones, patches within these and the location of the monitoring plots within these.

2. Recording sheets

1. Photopoint monitoring (add description onto existing sheet)
2. Plant species diversity
3. Plant species cover: groundcover
4. Plant species cover: overstorey and midstorey
5. Condition of native trees and shrubs
6. Biomass (one sheet per vegetation unit)
7. Revegetation success (one sheet per revegetation location)

Plot Location	
Location	**Plot ID**
Date established	**Surveyors**
Assessment Site set-up by	
Directions to get to plot	
Plot dimensions, orientation	
Map or GPS Reference of Permanent Stakes at each corner	**SW:** Easting: ..... Northing: ..... **NW:** Easting: ..... Northing: ..... **NE:** Easting: ..... Northing: ..... **SE:** Easting: ..... Northing: .....
GPS Datum: circle appropriate	WGS84 AGD66 AGD84 GDA94

Sketch of area showing location of assessment site and location of corner pegs

Attach photos

Plot Description

Date	**Location**	**Plot ID**
Surveyor	**Recorder**	**Photo #**
Land use		
Slope %	**Elevation**	**Aspect**
Landform element	Ridge or crest; Hilltop; Upper slope; Lower slope; Flat; Valley Floor; Drainage Line; Riparian zone	
Structural formation	***Natural grassland:*** Isolated or no trees ***Sedgeland:*** Isolated or no trees ***Woodland*** Trees canopies separated ***Closed Forest:*** tree canopy overlapping ***Secondary grassland*** Trees cleared ***Shrubland:*** Isolated or no trees ***Open Forest:*** tree canopy touching ***Waterbody:*** Isolated or no trees, permanently or occasionally containing water	
Dominant tree and shrub species (list)		
Dominant herbaceous species (list)		
Height of the groundlayer (use the sighter post)		
Regeneration present	Seedlings; Saplings; Immature trees; Mature trees; Very old mature trees; Senescent trees	
Tree health (circle): **1.** Very good **2.** Good **3.** Moderate **4.** Poor **5.** Very poor		
Planting: Yes/No	Local Native ( ); Non Local Native ( ); Exotic ( ) Trees ( ); Shrubs ( ); Grasses ( ); Forbs (wildflowers) ( )	
Significant weeds (circle and indicate Abundant, Common, Occasional, Rare)	Serrated Tussock ( ); African Lovegrass ( ); Chilean Needlegrass ( ); St John's Wort ( ) Blackberry ( ); Woody weeds ( ); Other	
Plot disturbance (indicate Low, Medium, High)	Soil disturbance ( ); Recent clearing ( ); Dumping ( ); Artificial drainage ( ); Salinity ( )	
Erosion (indicate Low, Medium, High)	Sheet ( ); Rill ( ); Gully ( ); Streambank ( )	
Plot management (circle)	Weed control; Ploughing; Mowing; Recent fire; Grazing	
Grazers (circle)	Cattle; Sheep; Horses; Kangaroos; Rabbits; Other	
Description of plot in your own words: condition, particular habitat features, weediness, disturbance etc		
Description on subsequent visits		
Description on subsequent visits		
Description on subsequent visits		

1. Photopoint Monitoring

Date	**Location**
Plot ID	**Photographer**
Plot corner or GPS location of camera post:	
Direction of photo, compass bearing:	
Height of camera post:	Photo #
Height of sighter post:	
Distance of sighter post from camera post:	
Time of day:	Weather conditions:

Photo – insert your initial photo here for reference for future monitoring

On each subsequent time, record the following:

Date	Monitoring site number:
Time of day	Weather conditions:
Description of the area at the time of the photo	

Insert Photos

2. Plant Species Diversity

Location **Plot** **Surveyor** **Date**

No. refers to page in Grassland Flora.

Acaena novae-zelandiae 136		*Cymbonotus lawsonianus 88*		**Hypochaeris glabra 86*		*Poa labillardierei 12*	
Acaena ovina 136		*Cymbopogon refractus*		**Hypochaeris radicata 86*		*Poa sieberiana 12*	
**Acetosella vulgaris 124*		**Cynodon dactylon 34*		*Hypoxis hygrometrica 62*		**Polygonum aviculare*	
Acrotriche serrulata		*Cynoglossum suaveolens*		*Indigofera adesmiifolia*		*Pultenaea procumbens 142*	
**Aira sp. 46*		**Cynosurus echinatus*		*Indigofera australis*		**Rosa rubiginosa*	
Alternanthera nana		**Cyperus eragrostis*		*Isotoma fluviatilis 102*		**Rubus fruticosa*	
Amyema sp.		**Dactylis glomerata 44*		*Juncus sp. (native) 48*		*Rumex brownii 124*	
**Anagallis arvensis*		*Daucus glochidiatus 138*		*Kunzea ericoides*		**Rumex crispus*	
Anthosachne scaber		*Daviesia genistifolia 142*		*Lachnagrostis filiformis*		*Rytidosperma pallidum 18*	
**Arctotheca calendula 88*		*Daviesia leptophylla 142*		**Lactuca serriola*		*Rytidosperma spp 16*	
Aristida ramosa 34		*Daviesia mimosoides*		**Lepidium africanum*		**Salvia verbenaca 106*	
Arthropodium fimbriatum 58		*Desmodium varians 112*		*Leptospermum sp.*		*Schoenus apogon 52*	
Arthropodium minus 58		*Dianella revoluta 56*		*Lepidosperma laterale*		*Scleranthus biflorus 132*	
Asperula conferta 92		*Dichelachne sp. 26*		*Leptorhynchos squamatus 80*		*Sebaea ovata*	
Astroloma humifusum 140		*Dichondra repens 134*		*Leucopogon fletcheri*		*Senecio sp. (native)*	
Austrostipa bigeniculata 14		*Dillwynia sericea*		**Ligustrum sp.*		**Silene gallica*	
Austrostipa densiflora 14		*Drosera peltata 92*		**Linaria pelisserana 104*		*Solanum cinereum*	
Austrostipa scabra 14		**Echium plantagineum 106*		*Lissanthe strigosa 140*		**Solanum nigrum*	
**Avena sp.*		**Echium vulgare 106*		**Lolium perenne 44*		*Solenogyne dominii 130*	
Bossiaea buxifolia 142		*Einadia nutans*		**Lolium rigidum 44*		**Sonchus asper (Sow thistle)*	
Bothriochloa macra 24		*Eleocharis acuta*		*Lomandra bracteata 54*		*Sorghum leiocladum 38*	
Brachychiton populneum		**Eleusine tristachya*		*Lomandra filiformis 54*		**Spergularia rubra*	
Brachyloma daphnoides 140		*Elymus scaber 20*		*Lomandra filiformis coriacea*		*Stackhousia monogyna 90*	
Bracteantha viscosa 84		*Enneapogon nigricans 32*		*Lomandra longifolia 54*		*Stellaria pungens*	
**Briza maxima 46*		*Epilobium billardiereanum 120*		*Lomandra multiflora 54*		**Taraxacum sect. Ruderallia*	
**Briza minor 46*		*Eragrostis brownii*		*Luzula densiflora 50*		*Thelymitra sp.*	
**Bromus sp. 1 46*		**Eragrostis curvula 42*		**Lycium ferocissimum*		*Themeda triandra 10*	
Bromus sp. 2		**Erodium cicutarium 104*		*Lythrum hyssopifolia*			
Bulbine bulbosa 62		*Erodium crinitum 104*		**Malva parviflora*		**Species > 2 m: 0.1 ha plot**	
Bursaria spinosa		*Eryngium ovinum 108*		**Marrubium vulgare*		**Acacia baileyana 124*	
Calotis lappulacea 98		*Euchiton sp. (native) 130*		*Melichrus urceolatus 140*		*Acacia dealbata*	
Carex appressa 52		**Festuca arundinacea 44*		*Microlaena stipoides 22*		*Acacia genistifolia*	
Carex breviculmis 52		*Galium gaudichaudii 92*		*Microseris lanceolata 86*		*Acacia implexa*	
Carex inversa 52		**Gamochaeta sp 130*		*Microtis unifolia 64*		*Acacia mearnsii*	
**Carthamus lanatus (Saffron)*		*Geranium retrorsum 118*		**Modiola caroliniana*		*Acacia melanoxylon*	
Cassinia longifolia		*Geranium solanderi 118*		**Moenchia erecta*		*Acacia parramattensis*	
Cassinia quinquefaria		*Glycine clandestina 112*		**Myosotis discolor*		*Acacia rubida*	
**Celtis australis*		*Glycine tabacina 112*		**Nassella neesiana 40*		*Allocasuarina verticillata*	
**Centaurium erythraea 122*		*Gonocarpus tetragynus 124*		**Nassella trichotoma 40*		**Crataegus monogyna*	
**Cerastium glomeratum*		*Goodenia hederacea 70*		**Onopordum acanthium (Sc)*		*Dodonea viscosa*	
Chamaesyce drummondii		*Goodenia obtusifolia*		*Opercularia hispida*		*Eucalyptus blakelyi 146*	
Cheilanthes austrotenuifolia 138		*Goodenia pinnatifida 70*		*Ophioglossum lusitanicum*		*Eucalyptus bridgesiana 148*	
Chenopodium pumilio		*Grevillea alpina?*		**Orobanche minor*		*Eucalyptus dives 148*	
Chloris truncata 34		*Haloragis heterophylla 134*		*Oxalis perennans 116*		*Eucalyptus macrorhyncha148*	
**Chondrilla juncea*		*Hardenbergia violacea*		*Panicum effusum 28*		*Eucalyptus mannifera 146*	
Chrysocephalum apiculatum 74		*Hibbertia obtusifolia 144*		**Parentucellia latifolia 122*		*Eucalyptus melliodora 146*	
Chrysocephalum semipapposum		*Hibbertia riparia 144*		**Paronychia brasiliana*		*Eucalyptus nortonii 148*	
**Cirsium vulgare (Spear)*		**Hirschfeldia incana*		**Paspalum dilatatum*		*Eucalyptus pauciflora 148*	
Clematis leptophylla		**Holcus lanatus 42*		*Persicaria prostrata*		*Eucalyptus polyanthemos 146*	
Convolvulus angustissimus 120		**Hordeum (Critesion) sp. 46*		**Petrorhagia nanteuilii 120*		*Eucalyptus rossii 146*	
**Conyza sp.*		*Hovea heterophylla114*		**Phalaris aquatica 44*		*Eucalyptus rubida 148*	
Craspedia variabilis 82		*Hydrocotyle laxiflora 134*		*Pimelia curviflora 90*		*Exocarpus cupressiformis*	
Crassula sieberana		*Hypericum gramineum*		**Plantago lanceolata 128*		**Prunus sp.*	
Cryptandra amara 140		**Hypericum perforatum*		*Plantago varia 128*		**Pyracantha sp.*	

3. Plant Species Cover: Groundcover

Date	Location	Plot ID
Surveyor		

1. Groundcover	Tally over 100 points: Total no of points measured (P):	Frequency (F)	% cover (F/P)x100
Cryptogams (mosses, lichens, fungi and/or algae) tally only if bare ground			
Bare Earth			
Rocks			
Litter/Dead Vegetation			
Annual introduced grass and forbs			
Perennial introduced grasses, forbs and shrubs < 1m			
Native grasses			
Native shrubs < 1 m tall			
Other native ground stratum species			

In Pink-tailed Worm-lizard habitat

Within 0.04 ha plot: count the number of dislodged rocks within the plot.

No. dislodged rocks	

4. Plant Species Cover Woody Vegetation Cover

Date	Location	Veg Zone, plot #
Surveyor	Recorder	

Upper Stratum; Native › 2m tall

Plot	1	2	3	4	5	6	7	8	9	10	11	12	Mean
Crown width													
Crown gap													
% foliage cover													

Mid Stratum: Native 1–2 m tall

Plot	1	2	3	4	5	6	7	8	9	10	11	12	Mean
Crown width													
Crown gap													
% foliage cover													

Upper Stratum: Exotic (including Australian exotic) › 2m tall

Plot	1	2	3	4	5	6	7	8	9	10	11	12	Mean
Crown width													
Crown gap													
% foliage cover													

Mid Stratum: exotic (including Australian Exotic) 1 – 2 m tall

Plot	1	2	3	4	5	6	7	8	9	10	11	12	Mean
Crown width													
Crown gap													
% foliage cover													

5. Condition of Native Trees and Shrubs Recording Sheet

Date	Location	Plot ID
Surveyor		

1. Regeneration and tree health in the vegetation zone

Tree species present in zone	Regenerating?	Health
Number regenerating		
Proportion regenerating		

2. Regeneration in the plot

Species Name	Seedling (trees and shrubs)	Sapling/ Juvenile (trees)	Young Adult (trees)	Mature Adult (trees and shrubs	Very old mature trees	Senescent (trees and shrubs)	Age groups present
	Number	Number	Number	Number	Number	Number	Number

3. Length of fallen timber

Use the cells to write down amounts as you go, and then sum the whole:

4. Number of trees with hollows

Within 0.1 ha plot: count the number of hollows in trees where the trunk is within the plot; include hollows more than 1 m off ground and greater than 5 cm diameter where the entrance can be seen and the hollow appears to have depth.

No. trees with hollows	

6. Biomass

Drop 18 golf balls into a 1m² quadrat. If more than 90% of a ball is visible, score 1; if less than 33% is visible, score 0; if between 33%-90% is visible, score 0.5. Take a photo of each quadrat as a record of the score.

Repeat this ten times in each plot.

Date	**Location**		**Plot ID**
Surveyor	**Photo #**		

Quadrat	Score			Total	Photograph #
	1 (>90%)	0.5 (33-90%)	0 (<33%)		
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
Average					

Reference: Morgan in prep.

7. Revegetation Success Recording Sheet

Date	Location	Veg Zone, plot #
Surveyor	Recorder	Photo #

Estimation of survival rate of revegetation overall	≤10%	11-20%	21-40%	41–60%	61-80%	80%+
Survival patchiness of revegetation overall	Uniform	Slightly Patchy	Very Patchy			

Species	Alive, healthy	Alive, stressed	Dead	Average height of surviving plants for each species	Approximate cover of surviving plants for each species
Total					
Total percentage alive (alive/alive + dead)*100					

APPENDIX A. MAPS

Brown Treecreeper
Climacteris picumnus

Molonglo River Park
Condition monitoring plots (2013)

N

0 80 160 240 320
Metres

ACT Government
Chief Minister, Treasury and Economic Development

Prepared by: Richard Milner, ACT Parks and Conservation Service, Canberra Nature Park, PO Box 158 Canberra ACT 2601. | **Printed:** 02/09/2014 | Aerial Photography 2012

Kama
Condition monitoring plots (2013)

N

0 50 100 150 200
Metres

1:10,023 When printed at A4
Map Grid of Australia 1994, Geocentric Datum Australia

ACT Government
Chief Minister, Treasury and Economic Development

Prepared by: Richard Milner, ACT Parks and Conservation Service, Canberra Nature Park, PO Box 158 Canberra ACT 2601. | **Printed:** 02/09/2014 | Aerial Photography 2012

Arboretum and William Hovell Conservation Area

Condition monitoring plots (2013)

N

0 75 150 225 300
Metres

1:13,782 When printed at A4
Map Grid of Australia 1994, Geocentric Datum Australia

ACT Government
Chief Minister, Treasury and Economic Development

Prepared by: Richard Milner, ACT Parks and Conservation Service, Canberra Nature Park, PO Box 158 Canberra ACT 2601. | **Printed:** 02/09/2014 | Aerial Photography 2012

Spring Valley Conservation Area
Condition monitoring plots (2013)

N

0 40 80 120 160
Metres

1:7,517 When printed at A4
Map Grid of Australia 1994, Geocentric Datum Australia

ACT Government
Chief Minister, Treasury and Economic Development

Prepared by: Richard Milner, ACT Parks and Conservation Service, Canberra Nature Park, PO Box 158 Canberra ACT 2601. | **Printed:** 02/09/2014 | Aerial Photography 2012

ACT Government
Territory and Municipal Services

THE RIVER RESERVE IS OUR TREASURED 'FRONT YARD'

Twitter

Facebook

13 22 81

molonglo@act.gov.au

GPO Box 000
Canberra ACT 2601