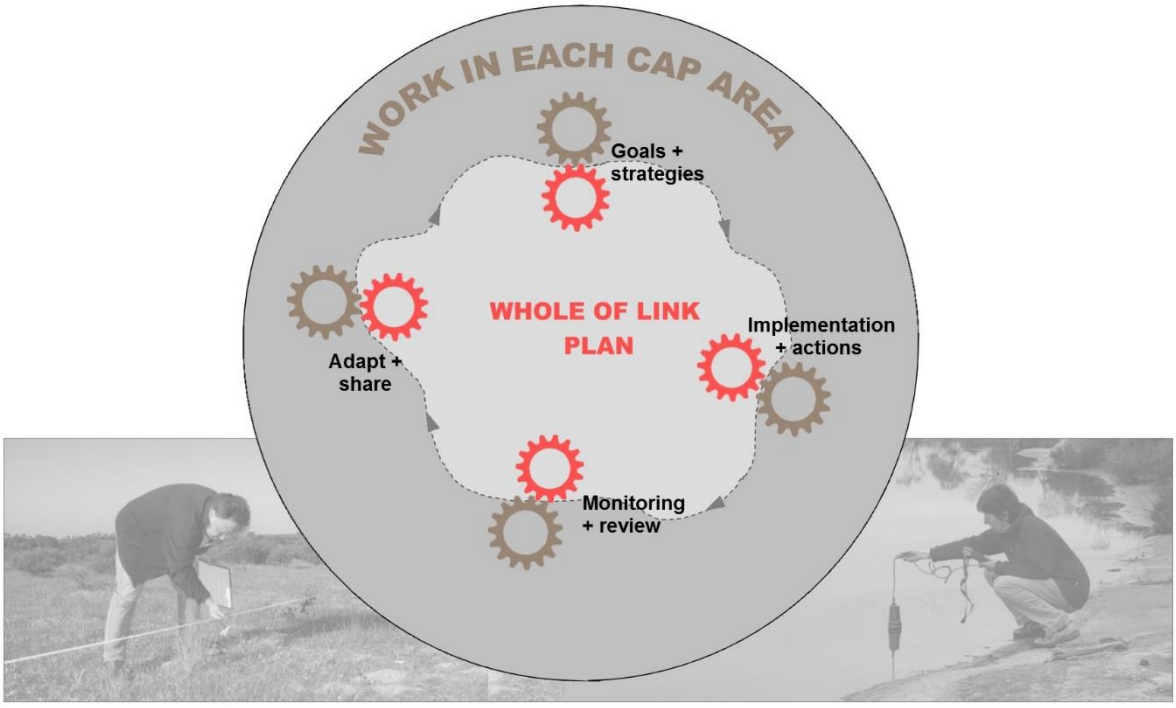
Gondwana Link

MONITORING GUIDE



Version 0.5

Version 0.5: This version draws from numerous discussions, workshops and planning sessions over the past decade, along with an extensive review of the published literature and the approaches adopted by colleagues in other large landscape programs. While a complete document, and ready for use providing additional guidance to work underway, it will be subject to extensive review by collaborating groups and scientific peers during the remainder of 2015. This version has a focus on the Central Zone of Gondwana Link. We expect Version 1.0 to be a substantially improved document that better covers all of Gondwana Link.

Acknowledgements

The hard yards of drawing this document together, and wrestling with the many nuances of what ecological resilience and function mean over this particular large landscape, has been admirably undertaken by Paula Deegan and Amanda Keesing, drawing on the efforts and thoughts of a wide range of groups and individuals. We give special thanks to Angela Sanders and Nic Dunlop for their assistance on the theory and practicalities of monitoring.

This project is supported by South Coast NRM, through funding from the Australian Government's National Landcare Programme.

Authorisation

This Version 0.5 document is authorised by the Chief Executive Officer, Gondwana Link Ltd, who accepts any responsibility for errors and misinterpretations.

Citation

This document may be cited as:
Gondwana Link Ltd (2015) *Gondwana Link Monitoring Guide Version 0.5.* Gondwana Link Ltd., Albany, WA.

Table of Contents

1 Introduction

The Gondwana Link program has developed since 2002 as a collaborative venture underpinned by a cohesive, focused and strategic approach to on-ground achievement through the endeavours of a wide spectrum of organisations and individuals.

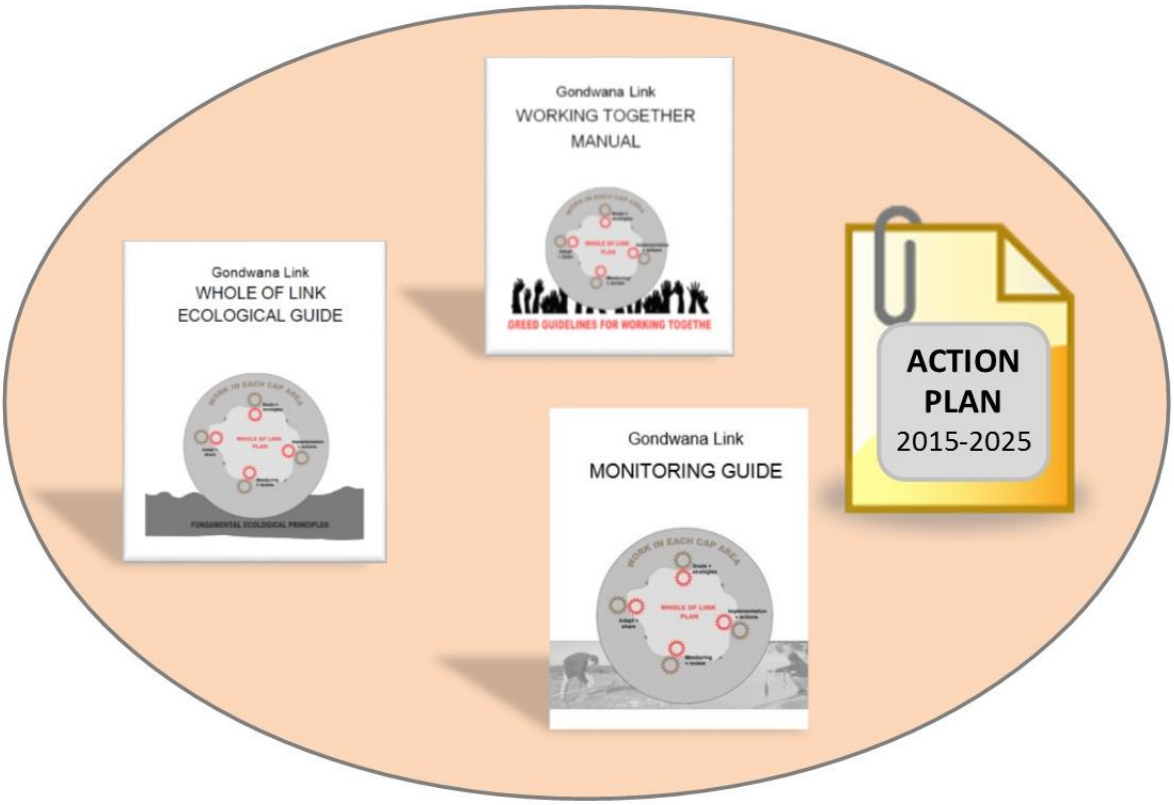
It is now moving into an exciting new organisational phase, with a more formal and inclusive structure, a guide that enables ecological outcomes to be measured across the Link, and a strategic approach aimed at substantially achieving the vision by 2025.

The ongoing program will be informed by four inter-related compilations of guidance and information currently being compiled:

- the Ecological Guide;
- this Monitoring Guide (when extended for the Whole of Link);
- a Working Together Guide; and
- a Strategic Guide which outlines key action steps (in preparation).

These four guiding documents are based on the experience to date and the on-ground plans and work programs being undertaken, plus the best ecological and business advice we can find. They are published as current versions, and will undergo constant revision and adaption as the work progresses, as the groups undertaking the work review and adjust their programs, and as new perspectives emerge into the ecological science underpinning life in our special part of the ancient Gondwanaland.

Whole of Link Framework



1.1 About this Guide

This Guide has been prepared by Gondwana Link Ltd to assist its member groups and supporters. It has been developed to:

- clearly define whole of link goals so we adopt the most effective strategies;
- improve the synergy between area based Conservation Action Plans (CAPs) and whole of Gondwana Link goals; and
- determine how we measure and share progress synergistically between whole of link scale and area scale monitoring.

The Guide will remain a dynamic document, with regular review and adaptation of objectives and strategies and communication of these between all the groups participating in Gondwana Link.

1.1.1 Some important context

While the Guide provides initial overall guidance, it is but an early outline. During 2015 there will be substantial additional work and dialogue across member groups, key scientists and involved organisations. We anticipate the production of successive updated and revised versions, in line with the adaptive management approach we take.

In particular, as actions to implement the Gondwana Link vision proceed, we expect to be able to progressively refine and quantify objectives for protection and restoration of native vegetation, and for management of the threats to them.

1.1.2 The process we are following

Various parts of this guide have been developed in discussion across member groups and key informants, in general terms as area CAPs have been developed since 2004, and through more specific monitoring discussions since 2012. Now all 'the bits' have been brought together as Version 0.5 it is being circulated to Gondwana Link member organisations. Below is what we have done and anticipate happening next.

Timing	**Step**
2004-15	Ongoing development and revision of Conservation Action Plans across the Link.
June 2014	First version of the Gondwana Link Whole of Link Ecological Guide prepared and circulated for comment.
July 2014	Gathering of all Gondwana Link groups where groups presented on their various programs and discussed the meshing with whole of Link scale work and plans.
Oct 2014	Workshop to discuss CAP development, standardised terminology and guidelines and the benefits to groups of their adoption.
Feb 2015	Commenced workshops on CAPs, standards and monitoring plan development.
June 2015	Preparation of the Monitoring Guide version 0.5.
July-Dec 2015	*Additional workshops on CAPs, standards and monitoring plan development*
Dec 2015	*Version 1.0*

Note: Either the CEO of GLL or any of the member groups may initiate a Board decision on whether a review of this Guide or a specific aspect of this Guide is needed by recommending this to the Board, along with a clear case for the change. Significant dialogue across groups is likely before any significant changes are made.

1.2 The Vision

The Gondwana Link program is guided by the long term Vision for the ecological health of the broad region, and by guiding principles for the way in which we work (see Gondwana Link Working Together Guide).

> *'Reconnected country, from the wet forests of the far south west to the woodland and mallee bordering the Nullarbor, in which ecosystem function and biodiversity are restored and maintained.'*

This vision for Gondwana Link was developed in 2002 and usefully started the process of imagining a better ecological future and the steps necessary to achieve that future. Several of the groups and individuals that have become involved with the program have done so on the strength of the vision.

The vision has been well enough understood to encourage buy-in to Gondwana Link. Part of the function of this Guide is to support monitoring and evaluation that tracks progress towards achieving the vision, which assists groups understand and document the outcomes they are achieving, and which enables the collective achievement across Zones and the Whole of Link to be understood and documented.

2 Objectives

The ***objective of this document*** is to develop the Monitoring Guide for use by Gondwana Link groups at the Whole of Link, Zone and Conservation Action Plan scales.

The ***objectives for the monitoring*** within Gondwana Link are defined by the questions that we need to answer in order to show that we are achieving the Gondwana Link Vision. These are dealt with again in Section 4.1 but generally fall into three main groups, that are in turn defined by their audiences:

- ECOLOGICAL CHANGE: What do the groups need to know to be sure that they are making a difference to the viability of ecosystems within Gondwana Link?
- EEFFECTIVENESS: What do Gondwana Link Ltd and its member groups need to know about the effectiveness of the structure, planning and strategies being used to achieve those ecological changes?
- CREDIBILITY: What do funders and external supporters need to know to assure them that investment in Gondwana Link is worthwhile, and that further investment will be similarly worthwhile?

As with most aspects of the Gondwana Link program, we learn by doing and we don't follow a "command and control" model. This Monitoring Guide will grow and evolve in response to what we learn individually and collectively, at a speed and scale largely dependent on the effort put into the required actions.

And that may vary. In developing this Guide, a constant source of concern, particularly to the local area-based groups, was the difficulty in planning for the medium to long term with their current funding streams and the increasing uncertainty over directions being taken with public funding programs. That issue is being tackled through separate documents and programs, but does interact closely with improved ability to document what is being achieved.

3 Common issues with monitoring

Despite the effort put into current systems for monitoring conservation work, most organisations still find it difficult to answer key questions on the effectiveness of their conservation efforts. While recognising that some of the problems are due to the fact that ecosystems and their functions are complex and that the complexities increase as more jurisdictions and scales come into the equation, there are some additional common issues that recur:

- Lack of a clearly stated purpose (what are we monitoring to demonstrate progress in achieving?)
- Inefficient/ineffective indicators are tracked
- Poor study design or inefficient/ineffective methods
- Data is gathered but never collated and analysed or shared
- Data is analysed but not interpreted relative to objectives
- Data is analysed and interpreted but not relayed to managers
- Data proves useful at the project level but the lessons learned are never shared with broader audiences
- Data is collected relevant to activity but not outcomes
- High risk or high leverage strategies or projects are inadequately measured so key lessons are not learnt or shared
- Tried and tested strategies or projects, or low investment level actions, expend too much effort on complex monitoring
- Resources are inadequate to conduct useful monitoring at the appropriate scale
- Resources are expended on developing comprehensive monitoring systems that are discontinued within a relatively short time as government/organizational priorities change and/or expertise is lost from the project.

We will try to avoid as many of these issues as we can by:

- Ensuring that we have clearly defined outcomes by planning through the Open Standards approach (and other processes as appropriate)
- Using standard methodologies and indicators where possible and sharing data
- Considering low-cost, qualitative options that are practically achievable
- Considering less frequent monitoring visits rather than no monitoring
- Using data from other organisations or programs whenever possible
- Using monitoring approaches that members of local groups can readily carry out, on their own and by engaging other local people & volunteers in monitoring efforts, such as through “citizen science” type projects
- Where it is considered useful, collaborating with research organisations on scientifically rigorous experimental designs as long as it is consistent with the next point
- Not monitoring anything that we can’t or won’t do anything about.

4 Background to the Guide

4.1 Why Gondwana Link needs a Monitoring Guide

A Monitoring Guide is needed simply to:

- Make sure we are heading in the right direction at all scales
- Support learning and adapting as we go
- Make sure we are making the connections across scales and levels
- Make sure we are not making assumptions that are highly risky or untrue

- Make sure we are able to assess how effective we are in reaching conservation outcomes, and
- Present a convincing case to those we rely on for funding or other support that their investment is worthwhile.

4.2 Whole of Gondwana Link Plan and Gathering

In July 2014, the "What's Happening" gathering in the Porongurup Range saw representatives of many of the groups involved gather to review the previous 12 years of effort and to start mapping out directions for the next 10-12 years.

Two "overarching" organisational strategies were proposed (emphasis added):

- Achieving an exponential increase in funding available for on-ground works to build on the initial foundation achieved, ***using measurable outcomes*** to demonstrate value for money and maintain core focus against 'mission creep'.
- Strengthen permanency by broadening institutional support across Government policy mechanisms, institutional structures and regional cultures, ***using measurable outcomes*** to demonstrate relevance with the accepted societal goals of sustainability and to maintain core focus and ecological effectiveness against 'mission creep'.

Ensuring that we can measure outcomes has required the development of clearer goals at whole of link and local area CAP scales, plus development of clear links between the scales to allow a "roll-up" of measures where possible. The first version of the Gondwana Link Whole of Link Plan outlined an initial framework for this, and has been the basis of subsequent discussions across a range of groups and expert individuals.

4.3 Open Standards for the Practice of Conservation (OS)

Open Standards is a tool that attempts to do at a global scale what we are trying to do at the Gondwana Link scale: provide support and guidance to achieve more effective and measurable conservation outcomes, and to "(*s)hare our results respectfully, honestly, and transparently to facilitate learning*" (Conservation Measures Partnership, 2013).

One of the strengths of Open Standards is that it brings together common concepts, terminologies and approaches in a framework that is not an exact recipe to be followed, but a guide to achieving better conservation outcomes. It builds on standard terminologies developed and used by the IUCN, and categorised according to scales at which conservation actions happen. This allows translation between different regions and jurisdictions so that conservation priorities and progress can be compared at different scales.

The Open Standards is an adaptive management framework based on a cyclical process of plan-implement-adapt-learn–share (see diagram to right). The monitoring plans at all scales (WOL, zone and area plans) are being developed through the OS/CAP process, which has a firm base in conservation measures.

4.4 Action scales in Gondwana Link – from CAPs to WOL

Across Gondwana Link there are now eight Conservation Action Plans (CAPs) which follow the Open Standards guidance, and are completed to at least first iteration stage. The earliest start on a CAP was in the Fitz-Stirling area and that has now been through a few revolutions of the project cycle. Most other CAPS are at a far earlier stage and require some review and evaluation according to the capacity of the groups responsible for them.

What was not available as the CAPs began was a clear articulation of the specific Whole of Link (WOL) outcomes needed for the Vision to be achieved. The principle of "every action to be of value in its own right", together with the expectation of the whole being greater than the parts has been sufficient so far for good works to happen and good people to become involved.

With this growth in planning from the ground up, in 2013/14 Gondwana Link Ltd began to focus on a WOL plan and the process to support its implementation. That work is continuing, but it has used the Open Standards process to articulate the underlying assumption behind the Gondwana Link program. Our logic is shown in the Results Chain diagram below (Figure 1), and the relationship of the different scales is shown in Figure 2.

The Zone level was introduced because of the three distinct climatic/geographic/land use zones across Gondwana Link, which may share some characteristics but have very different strategy needs: the south west forests, the central fragmented (agricultural) zone, and the Great Western Woodlands.

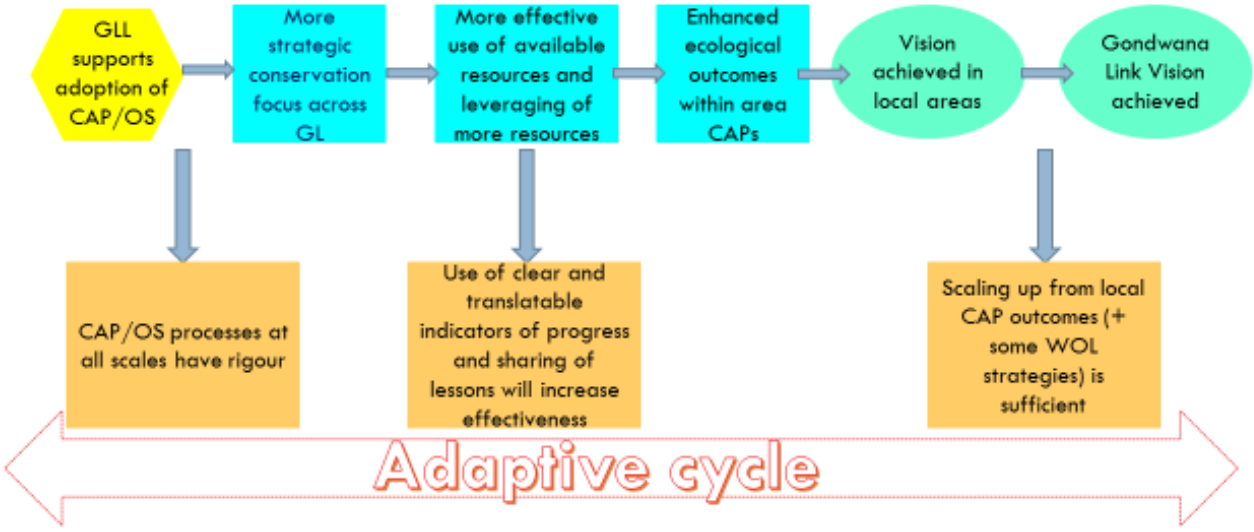


Figure 1: Results Chain for the Gondwana Link strategy of developing CAPs across different areas, based largely on socially-defined and sometimes "flexi" boundaries, in which many of the on-ground projects take place. The orange boxes identify some of the major assumptions underlying the results chain.

Figure 2: Relationship between the three scales of planning. The monitoring guide is mainly concerned with the relationship between the aspects common to the different scales (the areas in green) and how we use measures across those scales.

Translating measures across scales requires that we use common terminology. In the same way that the Open Standards framework adopts the IUCN lexicology for Targets, Threats and Strategies, we have taken those lexicons and used them to develop additional 'Gondwana Link' levels so that we can "roll up" our measures appropriately.

5 Open Standards based development of monitoring plans

The supporting software[1] for the Open Standards process supports a provisional monitoring plan based on information developed at three stages in the planning process:

- Defining Targets and rating Target Viability
- Defining and assessing Critical Threats
- Developing Strategies (Strategies = Objectives + Strategic Actions + Action Steps) and testing them through the development of Results Chains (similar to Program Logic Frames)

Many indicators may have been identified during the development of Targets, Threats and Strategies. Results Chains are a very useful tool for identifying the critical points at which monitoring may be essential. Figure 3 shows the development of measures in relation to the targets, threats and strategies.

[1] The Nature Conservancy's original CAP process was supported by the CAP Workbook, an Excel-based spreadsheet still in use but no longer technically supported by The Nature Conservancy. Miradi is a software system developed by the Conservation Measures Partnership specifically to support the Open Standards. See www.miradi.org. Across Gondwana Link the plans produced by either software are still termed 'Conservation Action Plans'.

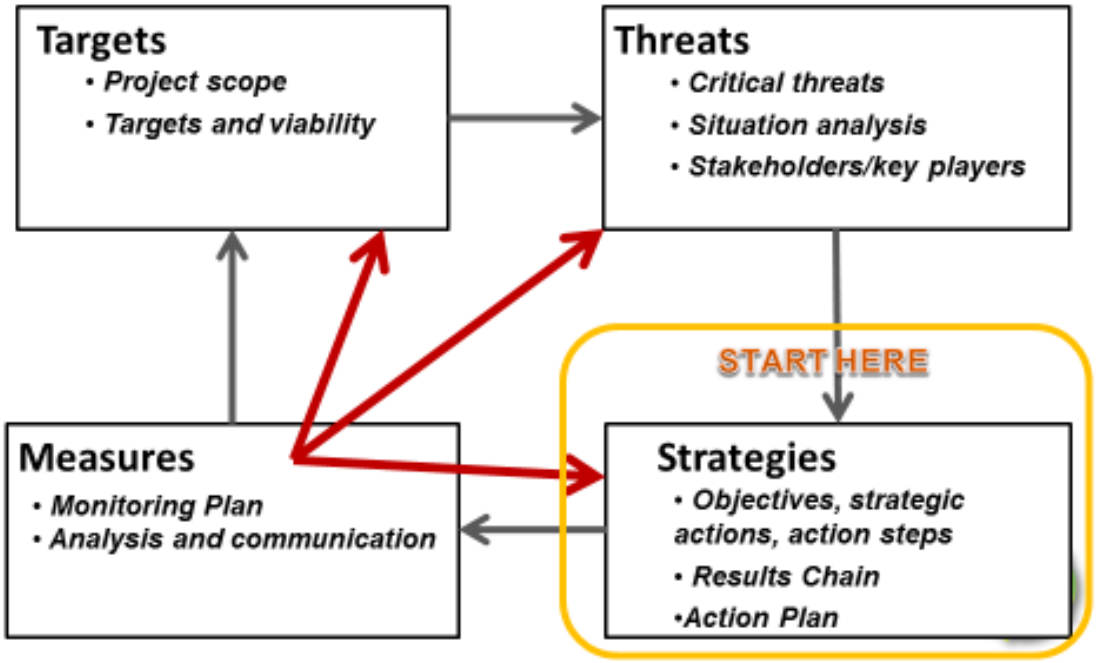


Figure 3: The Open Standards process uses Indicators to develop ratings for Target Viability and Threats. Results Chains identify Interim Objectives that may also need to be measured. In developing a Monitoring Plan, the Open Standards encourages you to start with the indicators you have already identified and confirmed in your results chains.

5.1 Indicators of Target Viability

The Viability of Conservation Targets is assessed by:

1. Identifying Key Ecological Attributes (KEAs). A KEA is an aspect of a target's biology or ecology that if present, defines a healthy target and if missing or altered, would lead to the outright loss or extreme degradation of that target over time. KEAs are generally related to size (e.g. extent or population), condition (e.g. reproductive ability, species richness) or landscape context (e.g. fire regime, connectivity).
2. Choosing one or more Indicators of each KEA. For example, for a Target that is a particular vegetation system, the KEA may be the amount of that system, and an Indicator could be the current extent as a percentage of the original or pre-European settlement.
3. Assigning the Indicator ratings across 4 categories, Poor, Fair, Good and Very Good. For the example given above the ratings may be defined as Poor = <10% of pre-European extent, Fair = 10-30%, Good = 31-60%, and Very Good = >61%. Best available information should be used in assigning the Ratings values and the source and level of uncertainty noted.
4. Based on current assessment of the Indicator (e.g. current extent c.f. original), that KEA for the Target is then given the appropriate Current Rating. The overall Target Viability is based on the Ratings for all KEAs for that Target.

5.2 Linking Targets across scales

The ability to "roll up" Target Viability ratings across scales, or to make valid comparisons between CAPs, depends on being able to translate the measures across scales or geographies. To allow this, we have defined some standard terminologies and Indicators to use at the three scales. These are expanded in Appendix 1, but an example of how the rolling up occurs is given below:

	SCALE		
	CAP	Zone	WOL
TARGET	Wandoo woodlands	Eucalypt woodlands and forests	(Ecological functions that underpin the Zone and CAP Targets)*
KEA 1	Fire regime	Fire regime	Fire regime
Indicator 1	Extent, frequency of fires in defined period	Extent, frequency of fires in defined period	Extent, frequency of fires in defined period
KEA 2	Extent	Extent	Extent
Indicator 2	% of pre-European extent	% of pre-European extent	% of pre-European extent
KEA 3	Vegetation Condition	Vegetation Condition	Vegetation Condition
Indicator 3	Structure, Crown condition, Species Composition	% of woodlands and forest Target in each category (Poor-Very Good) in CAPs	% of woodlands and forest Target in each category (Poor-Very Good) in CAPs

* The Ecological functions from the WOL plan include Natural biological and physical heterogeneity; Hydrological processes; Trophic interactions; Wildlife populations and movements; Evolutionary processes; Natural disturbance regimes. We have an additional Target in the WOL called "Living with country" which deals with broad human-ecosystem interactions and culture.

Thus, by using standard terminologies for Target KEAs, standard Indicators for them, standard methodologies for their measurement, and consistent ratings categories (see Appendix 1), we can have a degree of confidence that, for example:

- Wandoo woodland described as in Fair condition in Lindesay Link is in a similar condition to a Wandoo woodland described as in Fair condition in Ranges Link.
- The individual CAP ratings for all the woodland or forest vegetation systems can be rolled together to develop broader indicators at Zone and WOL levels based on the proportion of the Targets within the different Viability ratings.

Achieving Viability Ratings of Good to Very Good for all Targets are our primary Goals. This is how we measure ***Status***.

5.3 Rating Threats across scales

When the KEAs of Targets are missing or altered, they are ***Stresses*** (e.g. loss of species or loss of extent of a system). The ***Source*** of those stresses are direct ***Threats*** (e.g. predators causing loss of species; clearing causing loss of system extent).

Threats are rated by assessing three main factors:

- the ***scope*** of the Threat (how much of the Target is affected now or is likely to be in 10 years under current management)
- the ***severity*** of the Threat (how severely the Target is now impacted or is likely to be in 10 years under current management)
- the ***reversibility*** of the Threat (can the impacts be feasibly reversed)

To improve Target Viability, Threat ratings need to be reduced. In most cases, the Threat ratings have been developed by a peer group assessment, and repetition of this at intervals can be used to monitor trends in reducing or increasing Threats ***if the ratings are assessed with sufficient objectivity.*** In practice, this is not always the case but some Threats can be more reliably estimated. Fire as a Threat can be assessed quantitatively for example as a proportion of Target extent with more than a specified departure from ecologically based fire regimes (as long as the required fire regime is adequately defined and information on actual fire history is available).

Using consistent terminology to define Threats will assist in rolling up ratings and comparing ratings across CAPs and across scales. The current terminology recommended for Gondwana Link (and based on the IUCN higher level definitions) is in Appendix 2.

As the ongoing implementation and revision of CAPs progress, more specific definitions of the scope, severity and reversibility of the Threats and quantitative indicators identified in CAP areas will be developed.

6 Using Results Chains to develop the Monitoring Plan

6.1 Results Chains

Results Chains show a series of "if…then…" statements about RESULTS/OUTCOMES.

They are not a series of activity steps (Activities or Actions/Action steps are included within the Strategy).

A Results Chain is a diagram of a series of causal (or "if…then") statements. For example, ***if*** we remove all the rabbits from this catchment ***then*** the native plants will regenerate. The Results Chain focuses on the achievement of results, not activities. eg **Result** = regeneration; **activity** = removal of rabbits.

A Results Chain is made with statements that can be shown to be true, i.e they can be measured.

Results chains

- Show our thinking / logic
- Provide a way for teams to agree on what needs to be achieved
- Identify where there is uncertainty about the impacts of a strategy
- Clarify where we need to be monitoring
- Show progress toward long-term goals
- Make **implicit** assumptions **explicit** (i.e articulate the causal links)

A good Results Chain will include all the critical monitoring needs and is thus a good place to begin developing the Monitoring Plan. It also helps to identify the three main foci of monitoring:

> Implementation: Are we carrying out the actions needed to implement our plan?
> Effectiveness: Are our actions having their intended impact?
> Status: How is Target Viability progressing? How are Threats to Targets changing? Is the capacity to improve conservation increasing?

Below is a generic results chain (figure 4) and an example of a simple results chain for an Integrated rabbit, cat and fox control strategy (figure 5). Appendix 3 gives aditional examples of results chains.

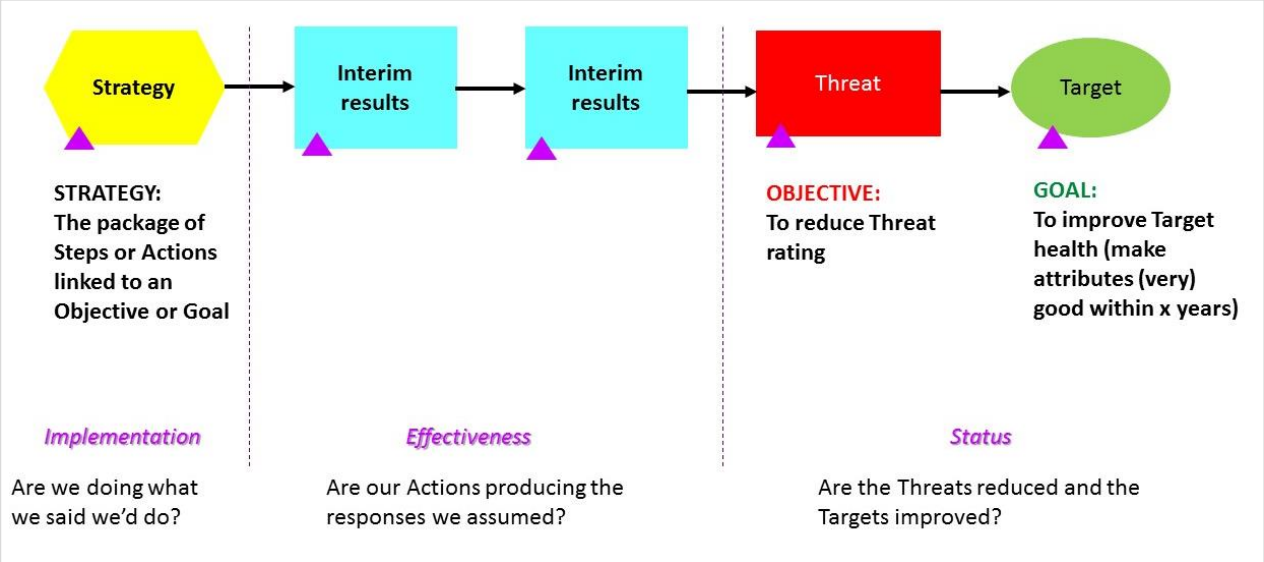


Figure 4: Generic Results Chain showing the components. Purple triangles represent Indicators.

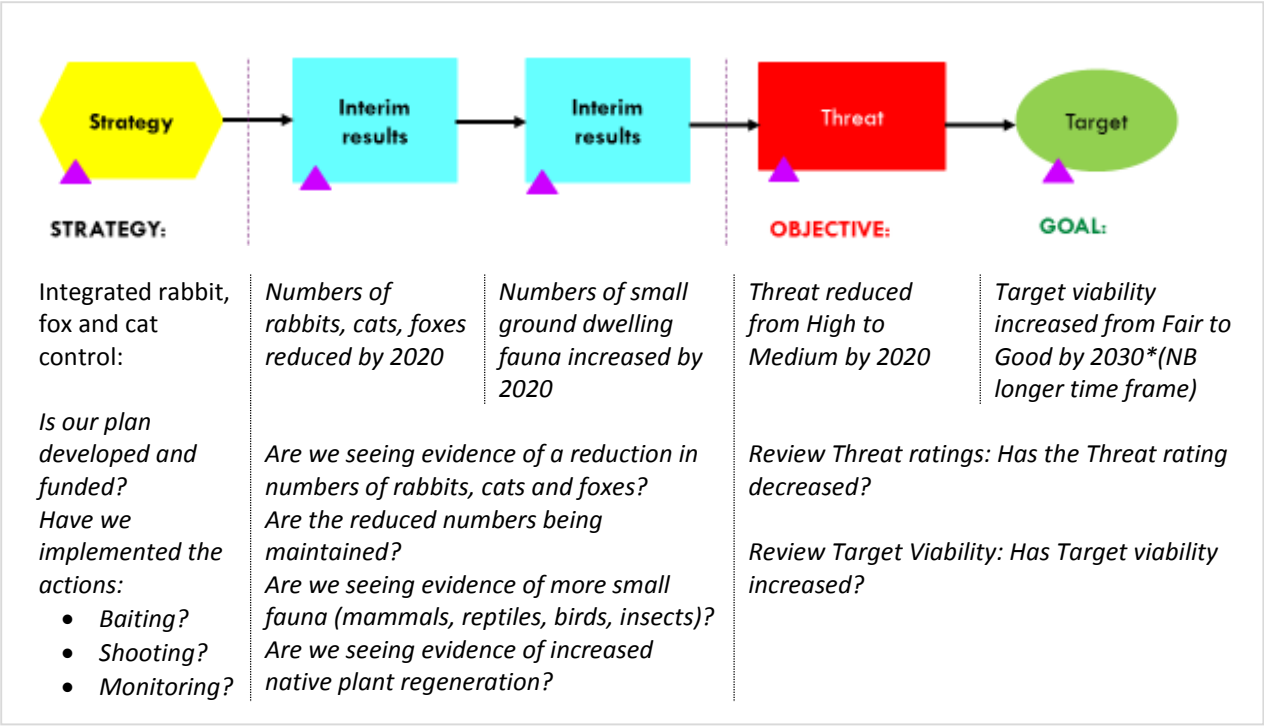


Figure 5: Example of a Results Chain for an Integrated rabbit, cat and fox control strategy.

It is sometimes useful to include Feedback mechanisms in Results Chains (see generic examples in Appendix 3). These link the monitoring outcome to a response that will be taken.

It should also be remembered that the Results Chain and the rest of the OS process provide guidance, they don't make the decisions. If there are points in the chain where the "if…then" relationship is solid enough not to need comprehensive monitoring (eg weeds are sprayed -> weeds are controlled) then a simple follow up assessment may be sufficient (e.g. check sprayed area after a certain period to ensure all weeds are knocked down; if not, re-spray). *The team decides* – but make sure you document your reasoning, even if it is just in a few key points.

6.2 Components of the Monitoring Plan

The monitoring plan is based on the questions we need to answer, which can generally be grouped under:

- Implementation: Are we carrying out the actions needed to implement our plan?
- Effectiveness: Are our actions having their intended impact?
- Status: How is Target Viability progressing? How are Threats to Targets changing? Is the capacity to improve conservation increasing?

Dividing the monitoring plan into these three categories will usually make it easier to identify:

- What data is needed to answer the question
- How frequently the data is needed
- Who needs the data and in what format
- What analysis or further interpretation of the data will be needed
- Who needs the interpreted data and in what format
- What responses will be made to the data and who is responsible for making the decision to respond

Table 1 below shows how a simple results chain provides the basis for identifying the monitoring required, and how the frequency of analysing and interpreting the data varies along the chain. By developing Results Chains for each of the major strategies employed across Gondwana Link, the monitoring template can be populated. The effort and resources committed to each item will depend on:

- the resources being spent to implement the strategy
- the risks associated with the strategy
- the leverage value of the strategy
- the level of confidence in the assumptions underlying the causal links.

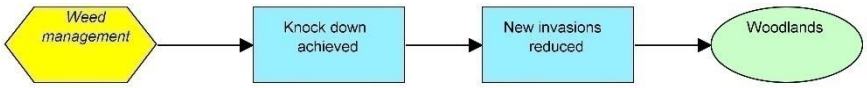
	Implementation	Effectiveness	Status
			
What question are we asking?	Every year – are we using the plan?	Every 1-3 years: are the strategies working?	Every 5-10 years: Are our Targets improving? Threats decreasing?
Analyse data	Landholders taking part Funding received Area treated	Follow up required Decrease in density, extent of weeds Native plants re-establishing	Is woodland health (species composition) improving?
Reflect and interpret data	Not enough staffing Travel costs too high Herbicide resistance	Good results on some weeds Outbreaks still occurring	Some woodlands recovering, others going backwards – need for additional expertise?
Adapt	New strategy? More resourcing of current strategy?	Move on to new area Try different weed treatment	Keep monitoring

Table 1: This table shows how a simple results chain provides the basis for identifying the monitoring required.

6.3 Monitoring Implementation

This is usually a straightforward checklist of Strategies (or Actions) completed, but should also include regular (annual) review of the Strategies part of the plan to ensure that all the critical components are there and are still current. Critical components are:

- Clear objectives (SMART: Specific, Measurable, Actionable, Realistic, Timebound)
- Well defined Strategies
- A clear workplan identifying who is responsible for what actions, when and how they will be done
- The budget required – funds, people, equipment and other resources

When the required Strategies and Actions are clear, the collection of data can be very quick and all can be assigned to one of the categories in the following Table (Figure 6). The pie chart is a quick and visual way of illustrating progress on the implementation of the whole plan. These can be easily rolled up across Zones and the Whole of Link as necessary, and help to identify what issues are consistently occurring across the CAP areas.

Scheduled for Future Implementation: Activity is not yet started
Major Issues: Ongoing, but has major issues that need attention
Minor Issues: Ongoing, but has minor issues that need attention
On Track: Ongoing, generally on track
Completed: Successfully accomplished
Abandoned: No longer relevant or useful

Figure 6: Proposed assessment scoring for Implementation monitoring.

6.4 Monitoring Effectiveness

This is where a good Results Chain really helps! Monitoring Effectiveness is done to make sure you are progressing in the right direction at an adequate pace to be confident that the Threat and Target Status will change, even though that change may be decades away. The Objectives and Indicators that we develop for our Interim Outcomes (the Effectiveness part of the Results Chain) are often used as project milestones.

Scheduling when to analyse and interpret Effectiveness Indicators requires balancing two needs: early detection of trends so that changes can be made rapidly to Strategies if required; and detection of true progress towards a Status change, free of too much "noise" introduced by other factors (often climate related: a very dry season, very wet conditions, etc).

The review frequency may vary for different Effectiveness Indicators, but at a minimum do a team review every 3 years and determine whether any require more detailed analysis.

If the review of different Effectiveness Indicators is staggered, monitoring can occur annually on different Indicators: i.e. you can have an annual program which on different years is monitoring different effectiveness Indicators.

6.5 Monitoring Status

The status of Targets is measured through the KEAs and their indicators. The status changes when we shift these indicators sufficiently to move the Target Viability from one rating to a higher one. Similarly, Threat ratings will shift downwards when we significantly decrease the scope or severity of the Threat. These changes will generally be slow to effect and to detect – hence the need for some good Effectiveness measures to know if we are headed in the right direction.

The standard list of KEAs and Indicators is very minimalist but if collected consistently, recorded and analysed it can provide enough for most management needs. It can also be supplemented or verified by additional monitoring or site-specific scientific studies if project collaborators can be encouraged

to do this. These can be provided through research organisations, but also through collaboration with organisations such as Birdlife Australia, the Wildflower Society and WA Naturalists. Citizen Science projects can also enlist the “Grey Nomads”, schools and other volunteers – but organising volunteers can be extremely time consuming, so best to work with groups who already do this regularly.

As mentioned previously, to date Threat ratings have perhaps been too subjectively applied and we need a greater degree of objectivity in their assessment in order to roll up ratings across zones. As the implementation and evaluation of CAPs progresses, more specific definitions of the scope, severity and reversibility of Threats identified in CAP areas will be developed, with quantitative indicators where possible.

You need to be clear on your audience for your status reporting. If the end product of the Status monitoring needs to be communicated in a peer-reviewed science journal, then perhaps there is the need to get a scientist to set it up and supervise the monitoring.

While we have indicated that Status monitoring should be reviewed every 5-10 years, for many of our Targets and Threats the changes due to our interventions may take many decades – or in the case of restoring a vegetation system probably centuries. So we need to have some good news milestones along the way!

Status monitoring may be beyond the abilities or expertise of groups. To assist, Gondwana Link is bringing together a monitoring advisory group that gives assistance to all groups across the link in determining status changes from their monitoring results.

6.6 Putting it together – Monitoring Plan outline

Two suggested templates follow. These templates can be completed for each major Strategy. Combined they constitute the complete Monitoring Plan.

These templates have been provided as not all groups are comfortable working directly in Miradi. Please note that this information can be input directly into the Miradi software.

	Implementation	**Effectiveness**	**Status**
What question/s do we need to answer?	*Are we using the plan?* *Do we have all the critical components of the plan that we need?* *Clear objectives (SMART: Specific, Measurable, Actionable, Realistic, Timebound);* *Well defined Strategies;* *A clear workplan identifying who is responsible for what actions, when and how they will be done;* *The budget required – funds, people, equipment and other resources*	*Do we have a reliable Results Chain with Interim Outcomes and Indicators?* *Are the Strategies producing the intended outcomes we expected?*	*Are the Targets getting healthier?* *Are the Threats being reduced?*
What indicators are we using?	*Checklist against workplan*	*Refer to Results Chain*	*Refer to Target Viability Table.* *Refer to Threats Rating Table.*
When is data collected?	*Monthly?* *Quarterly?*	*See methodology for specific indicators (also influenced by Interim Objectives)*	*See methodology for specific indicators*
Who collects data?			
How is data stored?			
When is data analysed?			
Who analyses and interprets the data?			
Who needs to know the outcome?			
How is it reported?			
Is there a clear response process?			
Who is responsible for adapting the plan if it is needed?			

For each Strategy, the following template can be used for developing the detail of the Monitoring Plan. Once again note that this data can be entered directly in the Miradi software.

Strategy:								
Indicator	Method	Priority*	Frequency	Location	Who	Progress	Cost/year	Source of funds

*Suggested Priority Rating:

Critical – Because of the nature of the Strategy, or the risks associated with it not succeeding, or the high leverage that can be obtained by demonstrating its effectiveness

Required – Identified as a key indicator because it directly feeds back to management actions, or is included in status ratings; may be a funder requirement (try to avoid having funder requirements override logical monitoring already identified!), part of an on-going commitment, or

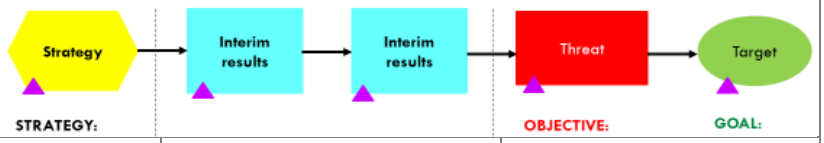
Desirable – would be good to do if resources became available or a 3rd party emerged who could do it.

7 Evaluation and adaptation

Monitoring is done to inform how we manage the things that are of concern, and to confirm for ourselves and for others that we are making the changes needed to achieve both the local objectives and Gondwana Link's overall vision. As the previous sections have illustrated, all monitoring is related to answering specific questions; answering them helps us to make our strategies and plans more effective, and to improve overall standards and practices within the conservation community.

Monitoring is often thought of as gathering data, but as outlined in the Table in Section 6.2 (reproduced in modified form below), this is just the first step. Design of what data is worth collecting, analysis of the data (what is it telling us?), reflection and interpretation of the data (are there other factors influencing the results of the monitoring or the way that strategies were implemented?), and adaptation (of the actions or of the plan based on the data) are all essential parts of the monitoring process.

Often, the failure to complete these steps is because they are not addressed at the start of the planning/project phase, so no one is responsible for doing it, the methods of analysis have not been considered, the potential responses to the analysis have not been considered, and subsequently funding and resourcing these actions have not been considered.

	Implementation	**Effectiveness**	**Status**
			
What question/s are we asking?	Are we using the plan?	Are the strategies working?	Are our Targets improving? Threats decreasing?
Analyse data	Look at the Action Plan and decide if all Actions are on track	Look at interim objectives and indicators: are your assumptions holding true?	Analysis method should be defined when you choose the indicators.
How often?	Probably every year (when developing work plans is a good time)	Depends on indicator but every 1-3 years usually works	Depends on indicators, but every 5-10 years may be OK
Who is responsible?	Probably the operations coordinator	Maybe the project team?	Maybe specialist help needed?
Reflect and interpret data: Do you know who is responsible for this step? Who else needs to be involved?	What is influencing any actions not on track? Are there actions that need more/less effort? Any redundant? Any missing?	Are the results supporting your assumptions in the results chains? If not, why not? Is the data interpretation frequency adequate?	Are there other factors influencing target health and threat ratings that haven't been accounted for in your plan? Is your situation analysis still valid?

Adapt Do you know who is responsible for this step? Who else needs to be involved?	Adapt the work plan (and maybe the budget). Make sure all responsibilities are clear.	Adapt the results chains if necessary. Look at other parts of the plan to see if they need review.	Are the threats and targets still valid? Are the goals and objectives still valid?
Document, communicate (*see next step*)	Who needs to know? In what format do they need the information?	Who needs to know? In what format do they need the information?	Who needs to know? In what format do they need the information?

With monitoring results in hand the group needs to periodically review their CAP and adjust it as required. This is best undertaken by a small group from the CAP team but may require some external expertise. In undertaking the Evaluation and Adaptation step, also consider the review of the CAP *process* itself (i.e. *is the plan adequate for what we are trying to achieve? Is the plan being updated as we learn and advance our implementation?).* A fairly simple way to evaluate the process is to use the ***CAP Self-Assessment Tool*** (Refer to CAP for Gondwana Link – Standards and Guidance.pdf).

One last message: don't forget how frustrating it is for someone coming in to a new position and not being able to trace back to find out what is going on! DOCUMENT the changes that are made, date them and note why changes were made and who made them. It will save tears!

8 Communicating shared learnings

Communicating can be with:

- your group and in your area;
- other CAP groups;
- Gondwana Link Ltd who will be involved in "rolling up" data from the CAP scales to the WOL and zone scales; and
- donors and funders of all types.

You might also want to target some other wider audiences, to help other groups learn from your experiences.

Your audience will dictate the level of detail and type of communication. These can vary from full detailed reports to simple one page snapshots with pie charts and colour indications of progress.

Sharing lessons learned is an essential part of the CAP process. Others can learn from your successes and mistakes, short cut 'reinventing of the wheel', increase efficiency and reduce waste of resources. Gondwana Link Ltd plan to have annual/bi-annual forums for sharing. During these forums there will be sessions for review of the plans at area, zone and WOL scales. In addition, if groups are interested, we can have an internal Facebook or another informal information sharing mechanism.

One of the best places for sharing may be Miradi Share where potentially each group can load their Miradi conservation plan giving others permission to view. Miradi files include contact details so others can talk directly to each other. We are exploring the best ways that Gondwana Link members can access and use Miradi Share and to "roll up" plans to give zone and WOL reports.

If the data and lessons learned are to be utilised in zone and WOL reporting, it will need regular inputs of data to shared Miradi files, and Gondwana Link Ltd is pursuing ways to facilitate this, including working through licensing and training issues, as well as developing simple customised reporting from Miradi to meet a range of communication needs.

Having reviewed the planning work undertaken to date and developed standardised terminologies, Gondwana Link Ltd will now be focused on further developing and supporting application of the Monitoring Protocols. This will include regular (annual to bi-annual) review of how the CAPs are working together at area, zone and WOL scales, and developing a peer support and review group to help stimulate ongoing review and adaptation.

9 Reporting to different groups and funders

At all scales (area, zone and WOL) the groups leading their respective CAPs are implementing them through a range of different projects, with funding from different sources. Project funders generally have specific reporting requirements, which can range from simple verbal reports and onsite visits, through ongoing relationships with key donors, to the quite detailed output reporting required with public funding. Groups also have their own internal management and reporting processes, and with multiple groups involved in an integrated program there can be quite a complex and time consuming tangle of reporting needs.

Fortunately the Miradi software can provide reports suited to a number of formats and can be enhanced to enable rapid “roll up” of multiple project reports within an integrated program. One leading group involved in Gondwana Link which has multiple project funders, Bush Heritage Australia, has already had good success from modifying its internal reporting templates and procedures to simplify reporting. We encourage all groups to consider doing similar.

As noted in Section 8, we will be pursuing the Miradi Share license arrangements to enable Gondwana Link Ltd and member groups to share their plans and aggregate information and results at different scales. Pending some further discussions with colleagues in mid to late 2015, we also expect to gain the capacity to program the export formats from Miradi to enable us to prepare reporting templates for specific purposes.

9.1 Miradi and MERI

Projects funded by the Commonwealth Government, either directly or through NRM regional groups, are generally required to prepare reports consistent with a Monitoring, Evaluation, Reporting and Improvement (MERI) Framework. Some concern has previously been expressed that MERI and Open Standards required very different reporting approaches, but we don’t believe this to be the case. In fact, the program logic that underpins MERI is very similar in its structure to the Results Chain logic used in Open Standards, and the Miradi tool enables groups working on Commonwealth funded projects to quite readily prepare project reports using Miradi. We understand this is already happening in a number of programs in Australia using the Open Standards process, including some of the Healthy Country Plans across northern Australia and in specific NRM regions in the Northern Territory and South Australia.

Gondwana Link is making this next stage a major focus in 2015-16.

10 Methodologies

It is difficult to provide a definitive list of monitoring methods. Just as the landscape and habitats vary across the link so do the methods required to assess them. As groups develop their monitoring plans and investigate, adopt or adapt methods we will document new methodologies in this living document and encourage all participating groups to be part of this on-going conversation. Additionally Gondwana Link Ltd are working with others not directly involved in CAPs to develop methods we can use. Initially, unless capacity is substantially changed, CAP monitoring plans will address a select number of high priority issues so there is time to develop methodologies for additional work. **The whole basis for our work is that we continually learn, improve and adapt, and that includes improving and adapting our monitoring methodologies.**

Appendix 1 lists Key Ecological Attributes (KEA), their Indicators and suggested methods to measure changes in the Indicator. Appendix 2 lists standard threats and the suggested methodologies to assess changes in the threat status. These 'generic' monitoring protocols may be useful in themselves or with adaptation to a particular environment or requirement. For example when monitoring vegetation condition through assessing crown density we suggest using a modified wandoo crown decline methodology. Each group will need to review and modify the method if necessary for the dominant vegetation type they are assessing (and share those methods across CAP areas where the target vegetation types are the same).

Some monitoring is most efficiently undertaken across the entire Link, presumably by Gondwana Link Ltd (GLL), who then make the results for each CAP area available to the relevant groups. For example a commonly used KEA of a vegetation system may be 'connectivity'. GLL plan to undertake a patch analysis across the link and report on changes in connectivity in each CAP area to the relevant group.

The following are analyses that GLL plans to undertake at the WOL scale, with the results reported to relevant groups for area and zone CAPS. Because of the relatively long time scale for changes in functional vegetation cover to occur, most of these analyses will be undertaken only every 5 years.

Key Ecological Attribute	Indicator	Method
Fire regime	Fire regime: frequency and area burned	Analysis of burn data
Connectivity	Patch analysis	Patch analysis of perennial vegetation and native vegetation extent data
Extent of habitat/community remaining	% of pre-European extent	Analysis of pre-European and current extent
Catchment native vegetation/perennial cover	% of native vegetation and/or perennial cover in catchment	Spatial analysis of native vegetation and/or perennial cover

11 References

Conservation Measures Partnership (2013). *Open Standards for the Practice of Conservation. Version 3.0.* www.conservationmeasures.org.

Gondwana Link Ltd. (2014) *CAP for Gondwana Link – Standards and Guidelines.* http://www.gondwanalink.org/links/default.aspx

Barrett, S., Comer, S., McQuoid, N., Porter, M., Tiller, C. & Utber, D. (2009). Identification and Conservation of Fire Sensitive Ecosystems and Species of the South Coast Natural Resource Management Region. Department of Conservation and Land Management, South Coast Region, Western Australia. (search online and download from SCNRM – unable to supply a direct link)

Casson, N., Downes, S. and Harris, A. (2009). Native Vegetation Condition Assessment and Monitoring Manual for Western Australia. http://www.dpaw.wa.gov.au/images/documents/plants-animals/monitoring/native_vegetation_condition_manual_full.pdf

Cook, B. A., Janicke, G. & Maughan, J. (2008). Ecological values of waterways in the South Coast Region, Western Australia. Report No CENRM079, Centre of Excellence in Natural Resource Management, University of Western Australia. Report prepared for the Department of Water. (http://www.rivercare.southcoastwa.org.au/resources/pubs/lr/report.pdf

12 APPENDIX 1. Key Ecological Attributes

Key Ecological Attributes: *Terrestrial Systems*

	Key Attribute	Indicator	Poor	Fair	Good	Very Good
Landscape Context	**Fire regime**	Fire regime: frequency and area burned *(Assessed through spatial analysis annually-5 yearly)*		Not enough/ too much fire on too little/ too much area	Fire regime may be altered, but is maintaining reasonably "Good" condition and structure	Close to historical fire return interval and area burned
	Connectivity	Patch analysis (Patch size; distance between; perimeter/area rations) *(Assessed through spatial analysis annually-5 yearly)*	Highly fragmented (metric TBD)	Fragmented but still some large, though possibly isolated blocks (TBD)	May be altered but maintains high degree of connectivity (TBD)	Close to original
Condition	**General vegetation structure and composition**	(For woodlands and forests) Crown condition *(Based on modified Wandoo crown condition assessment tool)*	Most in poorest condition rating	Some to most lower condition ratings	Most vegetation in high condition rating	Most in highest condition rating
	General vegetation structure and composition	Structure *(Presence/absence of expected structural components)*	One or more strata absent from most sites	One stratum missing or poorly regenerating, or degraded	Strata present at most sites; may be some loss or degradation but retains regenerative capacity	All strata present and in good condition

	Key Attribute	Indicator	Poor	Fair	Good	Very Good
	General vegetation structure and composition	Species composition *(Proportion of native to non-native species in ground cover)*	More than 50% non-native species	20-50% non-native species	Native species dominant, few non-natives (<20%)	Native species dominant, occasional aliens
	Presence & abundance of characteristic animal species	Bird activity and species richness *(BHA or BA methodologies)*	Almost exclusively common species	A number of sensitive species are declining	Most sensitive species &/or nested targets in healthy numbers	Rare species and nested targets in healthy numbers
	Presence & abundance of "indicator" or focal species (eg. A characteristic species found in good quality habitat)	Presence/ abundance of a particular species (eg Tree creeper in Wandoo woodland)	Indicator species seriously declining or absent	Indicator species likely to be declining slowly	Indicator species generally stable or increasing in abundance	
Size	**Extent of habitat/ community remaining**	% of pre-European extent *(Assessed through spatial analysis annually-5 yearly)*	Serious habitat depletion <10%?	Substantial habitat depletion 10-50%?	Minor habitat depletion 51-80%?	Close to pre-European extent; minimal loss >80%?

Key Ecological Attributes: *Wetland and Riparian Systems*

	KEA	Indicator	Poor	Fair	Good	Very Good
Landscape Context	**Catchment native vegetation / perennial cover**	% of native vegetation and/or perennial cover in catchment *(Assessed through spatial analysis annually-5 yearly)*	<30%	<60%	60-80%	>80%
Condition	**Bank stability & integrity**	% of stream with expected abundance & diversity of important habitat components	Most reaches have highly modified bank characteristics	Some reaches have highly modified bank characteristics	Bank condition generally intact	
	Instream habitat diversity	% of stream with expected abundance & diversity of important habitat components (snags, biotopes - pools, riffles, runs, instream vegetation)		Some reaches have lower than expected instream habitat abundance and diversity	Most reaches have minimum expected instream habitat abundance and diversity	
Size	**Extent and condition of riparian vegetation**	Width and continuity of riparian vegetation	Riparian vegetation absent or in poor condition across most of waterway	Riparian vegetation absent or in poor condition across some of waterway	Riparian vegetation present and in good condition across most of waterway	

Note:

Select **no more** than five attributes for a target. Three may be enough (one each for Size, Condition, Landscape Context)

Some attributes may be unsuitable for particular targets chosen due to limited information. Consider whether it will be possible to determine this within 3-5 years or choose another attribute that can be measured.

13 APPENDIX 2. Standardised Threats and suggested monitoring methods

A hierarchy of standardised terminology for threats operating at different scales was developed by the IUCN and is utilised in the Open Standards for the Practice of Conservation. We first adapted the IUCN threat list for Gondwana Link in October 2014, and here provide an updated list which provides standard threat nomenclature for the area, zone and WOL scales as well as suggested methods for assessing threat status. By using this terminology, we can be more assured that the different CAPs are assessing similar threats, and hence we can "roll up" assessments across the larger Gondwana Link area.

> **Remember**: Threats are the ***source*** of stress. Be clear about the ***stress*** versus the source of stress. Stresses are the inverse/opposite of Key Ecological Attributes (see the Key Attributes table in Appendix 1 for suggested stresses associated with standard attributes). As an example:

Stress	**Source of stress (threat)**
Predation	Foxes, cats
Fragmentation	Clearing; clearing paddock trees; residential or commercial development; mining and quarrying; roads and infrastructure
Competition for hollows	Fires, clearing of old trees; introduced bees, aggressive bird species

The table below is the Gondwana Link standardised threats and suggested monitoring methods.

IUCN Standard classification	WOL and zone nomenclature	Area CAP scale nomenclature	Includes	Potential impacts (major)	Proposed indicators
1. Residential and commercial development	1. Residential and Commercial development	**Development (residential and commercial)**	Housing and urban areas, commercial and industrial areas, tourism & recreation developments with a substantial footprint.	Direct loss of ecosystems, degradation of ecosystems through fragmentation and edge effects, changed hydrology.	• Annual/5 yearly assessment of area of native vegetation lost to residential and commercial development. • Number of significant safeguards included in statutory instruments, including planning policies and development conditions. **Method:** WOL spatial analysis
2. Agriculture and aquaculture	2 Agriculture	**(Use the categories in this column below: these will be aggregated up at WOL scale)**	Current (not historical) impacts from agriculture, including on-going hydrological change, loss of further native vegetation (including paddock trees); impacts of grazing on native systems in agricultural areas. Nutrient and chemical drift and erosion and sedimentation are grouped under Pollution (see 9 below)	See below	See below
2.1 Annual and perennial non-timber crops					

IUCN Standard classification	WOL and zone nomenclature	Area CAP scale nomenclature	Includes	Potential impacts (major)	Proposed indicators
	2.1.1 Annual cropping	**Annual production systems**	Areas under annual crops or pastures	On-going hydrological impacts	Change in area (annual/5 yearly) under annual crops **Method:** Spatial analysis of land use mapping
	2.1.2 Stubble burning	**Stubble burning; Windrow, logs burning**	Burning of stubble or other on-farm burning that contributes to wildfires or burning of remnants	Contributing to wildfire ignition; burning remnants on farms	Area of native vegetation lost from fires started from stubble burns **Method:** Fire mapping analysis
	2.1.3 Poor grazing practices	**Poor grazing practices**	Stock in bush and riparian areas; lack of paddock tree recruitment NB nutrient and soil loss issues see 9 below.	Degradation of natural ecosystems; loss of niche habitats (eg paddock trees) that support birds, bats, insects	Change in areas protected from grazing **Method:** Area fenced
	2.1.4 Loss of native vegetation	**Loss of native vegetation; Clearing of paddock trees;**	The replacement of natural ecosystems with agricultural land uses, including cropping, viticulture, horticulture and grazing**. NB This is NOT for historic clearing (impacts are accounted for in your target viability assessments) but relates to new clearing for agriculture.**	Direct loss of ecosystems, degradation of ecosystems through fragmentation and edge effects, changed hydrology.	Areas of native vegetation lost; Areas placed under conservation management or restored; Paddock trees lost or planted **Method:** WOL spatial analysis of remnant vegetation and tenure datasets
2.2 Wood & pulp plantations	2.2 Plantations	**Plantations**	Stands of trees planted for timber, fibre or carbon outside of natural forests and woodlands, often with non-native species	Direct loss of ecosystems, degradation of ecosystems through edge effects, changed hydrology.	• Area of plantation • Area/proportion of plantations contributing to meeting CAP goals (TBD) **Method:** Analyse land use mapping (NB indicator to be further developed

IUCN Standard classification	WOL and zone nomenclature	Area CAP scale nomenclature	Includes	Potential impacts (major)	Proposed indicators
					through specific CAPs to define where, how and what sort of plantations help to meet CAP objectives, and in what circumstances plantations might represent a threat to biodiversity objectives)
2.3 Livestock farming and ranching	2.3 Pastoralism	**Pastoralism**	Domestic or semi-domesticated animals allowed to roam in the wild and supported by natural habitats.	Degradation of ecosystems	• Area being used for pastoralism • Proportion of pastoral area contributing to CAP goals (TBD) **Method:** Analyse land use mapping, Rangeland condition
2.4 Marine and freshwater aquaculture	2.4 Freshwater aquaculture				
3. Energy production and mining					
3.2 Mining & quarrying	3.2 Mining and quarrying	**Mining and quarrying**	Producing minerals and rocks. NB See below - effluents produced by mine-sites go under 9.	Direct loss of ecosystems, degradation of ecosystems through edge effects, changed hydrology.	• Area occupied by mining operations (mine-sites and infrastructure) • Effective legislative and policy controls on environmental impacts of mining activity, including rehabilitation **Method:** analyse tenements/mines data from Dept Mines and Petroleum
	Mining exploration	**Mining exploration**	Exploring for minerals, rocks, oil or gas.	Direct loss of ecosystems, degradation of ecosystems through edge effects.	Area affected by mining exploration (site disturbance including tracks) **Method:** TBD. Keren Raiter's PhD (2016) may give an insight.

IUCN Standard classification	WOL and zone nomenclature	Area CAP scale nomenclature	Includes	Potential impacts (major)	Proposed indicators
4. Transportation and service corridors	4. Transportation and service corridors	**Transportation and service corridors**	Includes roads, railways, pipelines, powerlines	Direct loss of ecosystems, degradation of ecosystems through edge effects, changed hydrology.	(Change in) area of infrastructure **Method:** mapping of transport routes, remnant vegetation changes
5. Biological resource use					
5.1 Hunting & collecting terrestrial animals	Harvesting or collecting of native plants or animals	**Harvesting, collecting of [name the resource]**	Collecting plants, seeds, animals or other components of ecosystems for commercial or other human uses and may be legal or illegal (eg poaching of nests; taking of orchids; removal of granite rocks)	Loss of species or degradation of ecosystems through over-harvesting or disturbance associated with collection.	Trend in activity as determined in CAP **Method:** TBD. Possibly through DPaW licences (NB Not identified as a threat in current CAPs)
5.1.3 Persecution/control	Control of native species (planned or inadvertent detrimental impacts)	**Shooting cockatoos**	Shooting of cockatoo species; by-kill of native species through baiting; impacts of barrier fences on native species.	Loss of species or populations	Trend in activity as determined in CAP **Method:** TBD
		By-kill of native species through baiting programs		Loss of species or populations.	Trend in activity as determined in CAP **Method:** TBD

IUCN Standard classification	WOL and zone nomenclature	Area CAP scale nomenclature	Includes	Potential impacts (major)	Proposed indicators
		Barrier fences		Restricted wildlife movement (loss of functional connectivity); loss of individuals through direct impact of fence.	Length, area affected Native species killed **Method:** TBD**.** Counts of animals killed
5.3 Logging & wood harvesting	5.3 Logging and wood harvesting (from native systems)	**Logging, wood harvesting**	Logging for timber or firewood, firewood collection	Direct loss of ecosystems, degradation of ecosystems through edge effects, changed hydrology.	Trend in area, intensity of activity as determined in CAP **Method:** Analysis of remnant vegetation mapping for logging of native forests **Method:** Surveys for change in vegetation condition and disturbance regimes including number of dead standing trees, number fallen trees for impact of firewood collection
6. Human intrusions and disturbance					
6.1 Recreational activities	6.1 Recreational activities	**Recreation activities (may be sub-lists for specific activities)**	Inappropriate 4WD and off road bike activity; trampling of sensitive species; destruction of vegetation or removal of ground cover for firewood.	Degradation of ecosystems	Trend in area, intensity of activity as determined in CAP **Method:** surveys for change in vegetation condition and disturbance regimes
7. Natural system modifications					

IUCN Standard classification	WOL and zone nomenclature	Area CAP scale nomenclature	Includes	Potential impacts (major)	Proposed indicators
7.1 Fire & fire suppression	7.1 Fire & fire suppression	**Fire and (some) fire suppression activities**	Extensive wildfires (from natural or deliberate ignition); too frequent prescribed burning; detrimental impacts of fire suppression activities, such as back burns escaping or intensifying burning; bulldozer lines and tracks not being restored post-fire.	Direct loss and degradation of ecosystems; loss of fire sensitive species over time.	• Area burnt under wildfire annually/5 yearly • Area disturbed for management (tracks, bulldozer lines) **Method:** analysis of fire mapping and fire infrastructure
7.2 Dams & water management/use	7.2 Dams & water management/use	**Water extraction**	Extraction of water from rivers and aquifers for public or private use	Direct loss and degradation of ecosystems; altered hydrology	Trend in area, intensity of activity as determined in CAP **Method:** Dept of Water data/analyses
		Dams	Public or private dams	Changes in hydrology, changes in animal distribution; change in feral animal distribution	Trend in area, intensity of activity as determined in CAP **Method:** Dept of Water data/analyses
7.3 Other ecosystem modifications					
	Salinity and other hydrological modifications (NB mostly through (historical) land clearing)	**Salinity and other hydrological modifications (through (mostly historical) land clearing)**	Dryland salinity, groundwater rise, due to broadscale clearing	Direct loss and degradation of ecosystems; altered hydrology	Trends in areas affected by salinity; groundwater levels **Method:** Changes in salinity mapping, NDVI vegetation condition mapping

IUCN Standard classification	WOL and zone nomenclature	Area CAP scale nomenclature	Includes	Potential impacts (major)	Proposed indicators
8. Invasive & other problematic species & genes					
8.1 Invasive non-native alien species	Invasive non-native animal species: predators	**Can be grouped or as individual species (will need to be able to aggregate at WOL level)**	Introduced predators: foxes, cats, dogs, pigs, kookaburras, bees	Direct loss of species through predation and displacement	Trends in distribution and severity of impact **Method:** TBD but likely involve tracks, scats, spotlighting and camera traps. Current d databases are inadequate and need to be improved to develop baselines then assess trends over time
	Invasive non-native animal species: herbivores	**Can be grouped or as individual species (will need to be able to aggregate at WOL level)**	Introduced predators and herbivores: foxes, cats, rabbits, camels, dogs, goats, donkeys, pigs, starlings, kookaburras, bees	Direct loss of species through displacement; loss or degradation of ecosystems through grazing & browsing; trampling, destruction of water points	Trends in distribution and severity of impact **Method:** as above
	Invasive non-native plant species	**Weeds**	Weeds	Direct loss and degradation of ecosystems; altered fire regimes	Trends in distribution and severity of impact **Method:** Opportunist and structured site surveys using techniques including 'drive by mapping (map start and end of infestation from moving vehicle) to transects and quadrat methods
	Invasive non-native pathogens	**Phytophthora cinnamomi (and/or other plant pathogens)**	Diseases including Phytophthora cinnamomi	Direct loss of species and degradation of ecosystems; altered fire regimes	Trends in distribution and severity of impact **Method:** Pc mapping based on the current SCNRM mapping

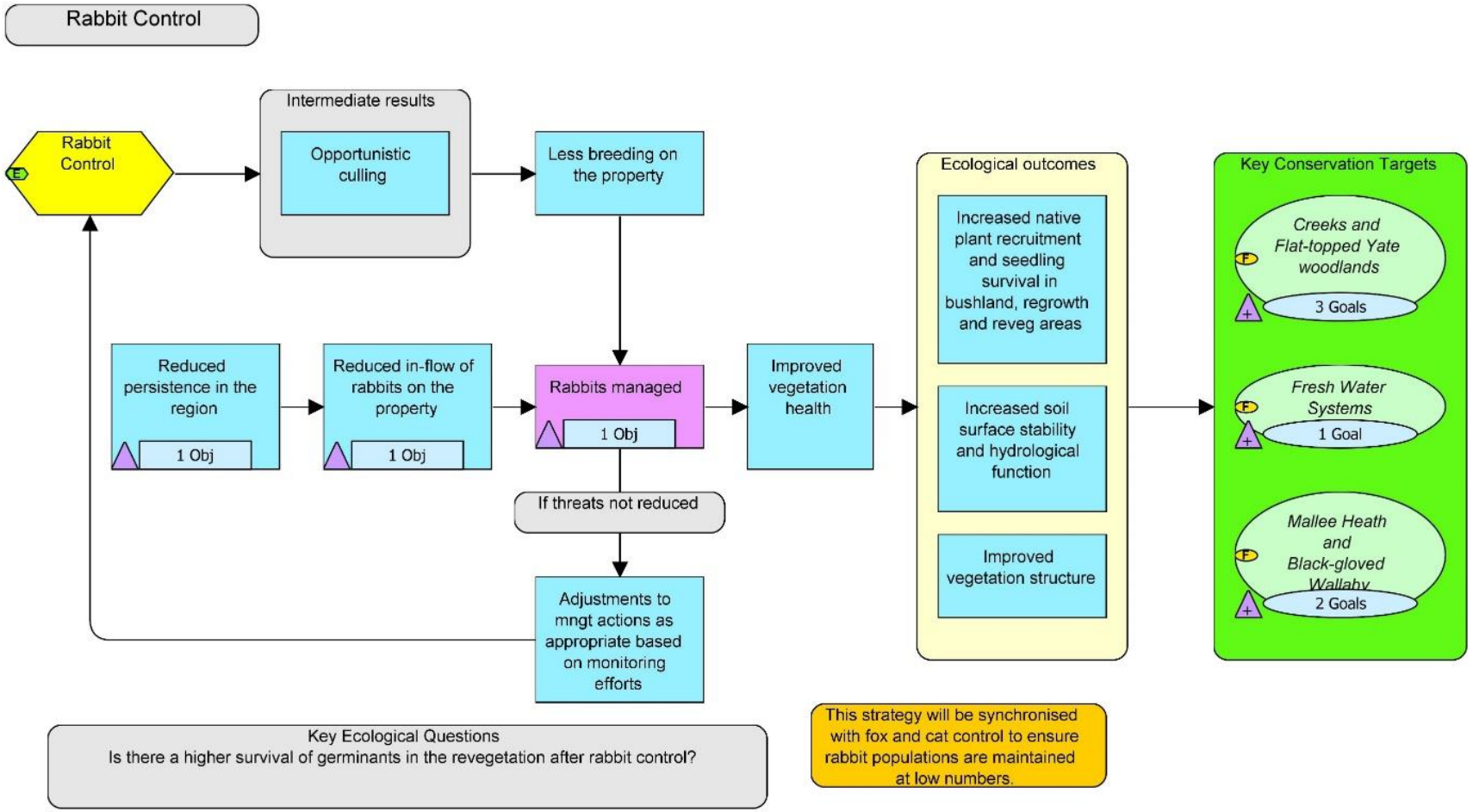
IUCN Standard classification	WOL and zone nomenclature	Area CAP scale nomenclature	Includes	Potential impacts (major)	Proposed indicators
		Chytrid fungus (frogs) (and/or other animal diseases)	Chytrid fungus, other	Direct loss of species and degradation of ecosystems	Trends in distribution and severity of impact **Method:** TBD
8.2 Problematic native species	8.2 Problematic native species	**Problem native species (or name them)**	Over grazing by kangaroos or other native herbivores; nest or other habitat displacement by opportunistic native species	Loss or degradation of ecosystems through grazing & browsing; site degradation; displacement of other species	Trends in severity of impact **Method:** TBD but likely involve tracks, scats, spotlighting and camera traps.. Inadequate databases need to be supplemented to develop baselines then assess trends over time
8.3 Introduced genetic material	8.3 Introduced genetic material	**Non local provenance**	Use of genetic material from other regions in restoration	Genetic loss of local species, genomes; potential impacts of insects and lower organisms	Uptake of and compliance with restoration standards **Method:** monitor uptake and compliance with Restoration Standards
9. Pollution					
9.1 Household sewage & urban waste water	9.1 Household sewage & urban waste water				
9.2 Industrial & military effluents	9.2 Industrial effluents				
9.3 Agricultural & forestry effluents	9.3 Agricultural & forestry effluents				
9.3.1 Nutrient loads	9.3.1 Nutrient loads from agriculture or forestry	**Nutrients**	Nutrient loadings in streams, wetlands; Nutrient loading to edges of native vegetation patches	Direct loss of species and degradation of ecosystems	Trend in area, intensity of activity as determined in CAP **Method:** Liaise with Dept of Water regarding water quality monitoring at designated sites

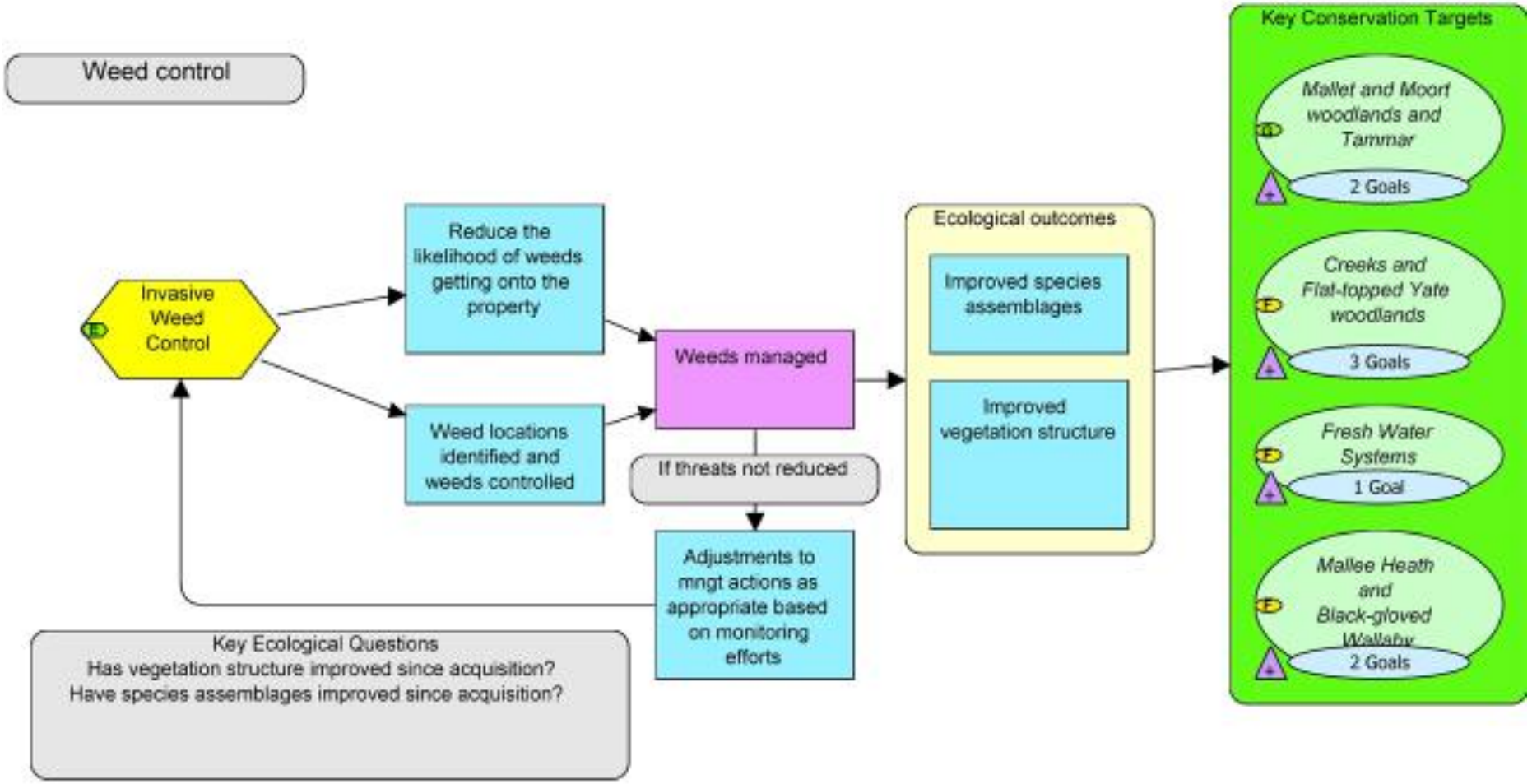
IUCN Standard classification	WOL and zone nomenclature	Area CAP scale nomenclature	Includes	Potential impacts (major)	Proposed indicators
9.3.2 Soil erosion, sedimentation	9.3.2 Soil erosion, sedimentation from agriculture or forestry	**Soil erosion and sedimentation**	Soil and sediment loss	Direct loss of species and degradation of ecosystems	Trend in area, intensity of activity as determined in CAP **Method:** refer to DAFWA
9.3.3 Herbicides, pesticides	9.3.3 Herbicides, pesticides	**Herbicides and pesticides**	Spray drift, indiscriminate use in agriculture, roadside maintenance, infrastructure services	Direct loss of species and degradation of ecosystems	Trend in area, intensity of activity as determined in CAP **Method:** Note vegetation deaths on roadsides, fencelines, correlate with spraying activity, wind direction and wind speed
9.4 Garbage and solid waste	9.4 Garbage and solid waste	**Rubbish**	Rubbish, litter, landfill sites	Aesthetic; impacts on local wildlife (ingestion, trapping)	Trend in area, intensity of activity as determined in CAP **Method:** opportunistic sightings
11. Climate change and severe weather	11. Climate change & severe weather	**Climate change and severe weather**	Habitat shifting and alteration, droughts, temperature extremes, storms and flooding	Loss of suitable habitat; loss of species or populations	Trends in severity of impact **Method:** BOM annual statistics

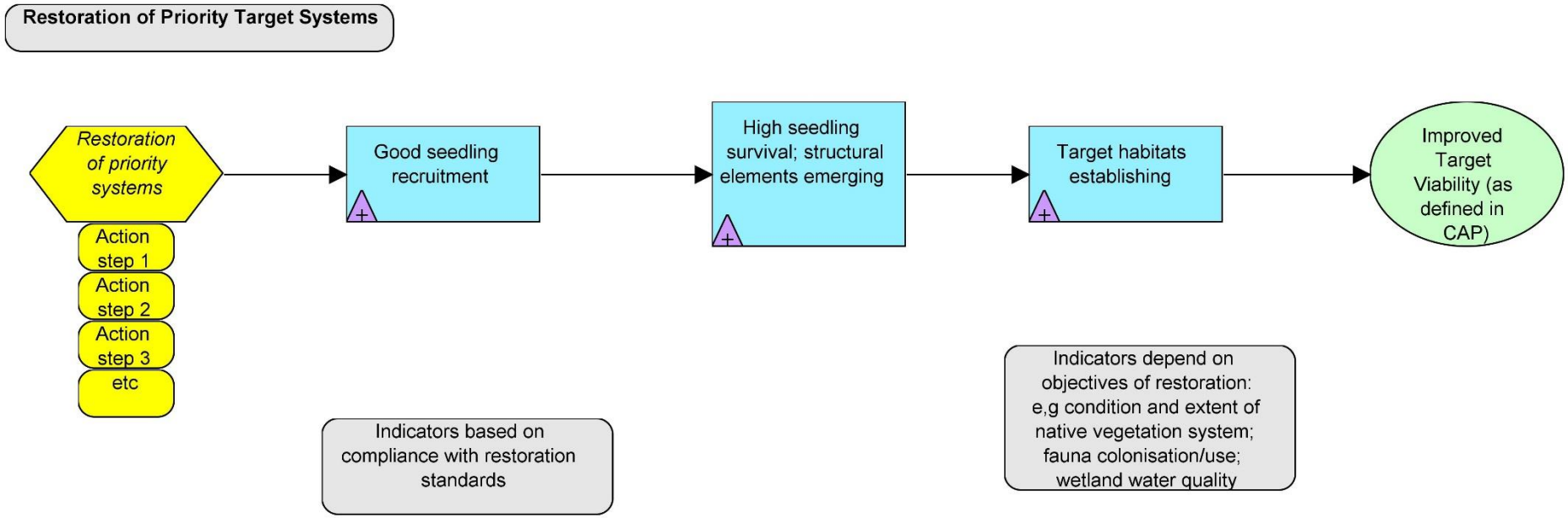
14 APPENDIX 3. Examples of Results Chains

NOTE: Results Chains show a series of "if…then…" statements about RESULTS/OUTCOMES.

They are not a series of activity steps (Activities or Actions/Action steps are included within the Strategy).




Weed control
Invasive Weed Control
Reduce the likelihood of weeds getting onto the property
Weed locations identified and weeds controlled
Weeds managed
If threats not reduced
Adjustments to mngt actions as appropriate based on monitoring efforts
Key Ecological Questions
Has vegetation structure improved since acquisition?
Have species assemblages improved since acquisition?
Ecological outcomes
Improved species assemblages
Improved vegetation structure
Key Conservation Targets
Mallet and Moort woodlands and Tammar
2 Goals
Creeks and Flat-topped Yate woodlands
3 Goals
Fresh Water Systems
1 Goal
Mallee Heath and Black-gloved Wallaby
2 Goals


Restoration of Priority Target Systems
Restoration of priority systems
Action step 1
Action step 2
Action step 3
etc
Good seedling recruitment
High seedling survival; structural elements emerging
Target habitats establishing
Improved Target Viability (as defined in CAP)
Indicators based on compliance with restoration standards
Indicators depend on objectives of restoration: e,g condition and extent of native vegetation system; fauna colonisation/use; wetland water quality

15 APPENDIX 4. Collation of standard methodologies

Appendix 1 lists some 'standard' or often used Target Key Ecological Attributes (KEAs), their suggested Indicators and methods of indicator assessment. In this Appendix the methods of KEA indicator assessment currently available are provided.

In the literature there are usually a number of methods to undertake the required assessments. Some of the methods we recommend (below) have been produced specifically for ecological assessments in Gondwana Link so they are regionally relevant. We are keen to keep assessments as simple as possible while ensuring the relevant information can be gathered with high confidence that it is accurate and useful. We prefer simple methods that do not rely on high levels of skills, can be undertaken by volunteers as well as project staff and don't require too much expensive, specialised equipment.

It should be noted that some of the assessments can be undertaken at the Whole of Link or Zone scales then the relevant information provided to the area CAP groups. Gondwana Link Ltd will undertake to have these WOL/Zone assessments done and share the resulting data.

15.1 Spatial analysis of fire frequency and area burned

KEA	Indicator	Poor	Fair	Good	Very Good
Fire regime	Fire regime: frequency and area burned *(Assessed through spatial analysis annually-5 yearly)*		Not enough/ too much fire on too little/ too much area	Fire regime may be altered, but is maintaining reasonably "Good" condition and structure	Close to historical fire return interval and area burned

We note that it may be difficult to know what historical fire return intervals were. Advice from a good fire ecologist may be the best bet. There are also some locally relevant references such as Barrett et al.

This analysis will be undertaken at WOL/Zone scale using fire data available through DPaW.

15.2 Spatial patch analysis

KEA	Indicator	Poor	Fair	Good	Very Good
Connectivity	Patch analysis (Patch size; distance between; perimeter/area rations) *(Assessed through spatial analysis 5 yearly)*	Highly fragmented (metric TBD)	Fragmented but still some large, though possibly isolated blocks (TBD)	May be altered but maintains high degree of connectivity (TBD)	Close to original

This analysis will be undertaken at WOL/Zone scale using patch analysis software and remnant vegetation data.

15.3 Crown condition of woodlands and forests

KEA	Indicator	Poor	Fair	Good	Very Good
General vegetation structure and composition	(For woodlands and forests) Crown condition *(Based on modified Wandoo crown condition assessment tool)*	Most in poorest condition rating	Some to most lower condition ratings	Most vegetation in high condition rating	Most in highest condition rating

Crown decline may be a good indicator of the health of the major structural species of a vegetation system. Crown decline occurs across all major vegetation types and is a relatively easy way to regularly assess change in vegetation system health.

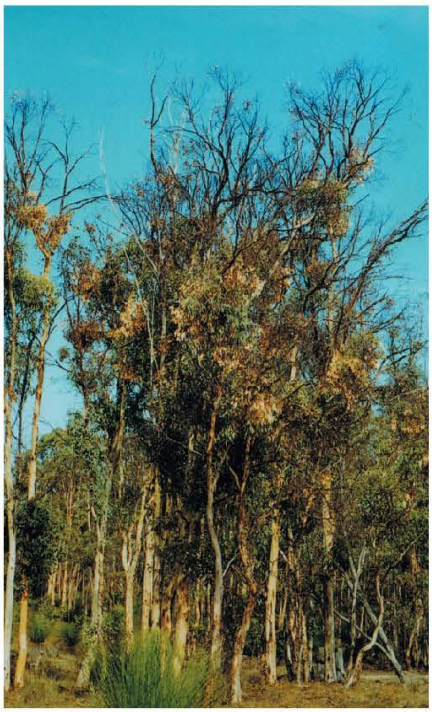
The wandoo crown decline method was developed by the Wandoo Recovery Group in 2005 (Department of Conservation and Land Management. Surveying wandoo crown decline: A guide for assessors. Information booklet produced by Wandoo Recovery Group, CALM).

Similar crown density analysis methodologies can be developed for other woodland and forest types. For example Angela Sanders, Bush Heritage Australia, developed a Yate crown assessment for the Fitz-Stirling by modifying the Wandoo crown assessment. We recommend that you develop a photographic or diagrammatic guide to crown density as well as a Diameter at Breast Height (DBH) reference system. Angela measured the DBH of 100 yate trees in the Fitz-Stirling area then developed the DBH classification for the reference system. The same species in different areas may require a different DBH reference system.

Diagrams for the visual estimation of percentage cover can be found in Appendix 5.

Wandoo Recovery GROUP

Surveying wandoo crown decline A guide for assessors



A declining stand of wandoo trees.

Introduction

Wandoo crown decline has been observed in many areas throughout the trees' natural range, which extends over the drier parts of the south west of Western Australia.

Although the reasons for the decline are unclear, a number of factors including reduced soil moisture, salinity and possibly changed fire regimes are seen as potential contributors. Wood boring and crown defoliating insects are also likely to be causes, but are thought to be secondary.

Though possibly secondary in nature, the wood boring and crown defoliating insects are thought to cause the 'flagging' which identifies the initial stages of wandoo crown decline. The upper and outer leaves in the tree crown brown and start to die off. The tree responds by sending up epicormic shoots along the lower branches. These epicormic shoots may also die, resulting in progressive downward movement of the tree crown and redistribution of the canopy. Over several years there can be a noticeable decline in the tree canopy, sometimes culminating in the death of the tree.

This guide describes a simple survey procedure for assessing wandoo crown decline. The survey is based on assessment of individual trees within a woodland block or along a road verge.

Purpose of the surveys

These surveys will help to develop understanding of the geographic extent and severity of wandoo decline, and its progression over time. The widespread and ongoing use of a common assessment procedure will provide information that is locally informative, but also substantially contributes to knowledge of the decline. The data will be collated by the Wandoo Recovery Group and made available for research and monitoring.

Community groups, land managers, students and researchers are encouraged to adopt this survey procedure as a simple addition to their investigations of wandoo decline and to compile and communicate the results.

We stress the importance of consistency in the methodology and timing of survey, so please follow the instructions contained in this guide as accurately as possible. Multiple copies of the survey sheet will be needed. File all information in a safe place for future reference. Please forward copies of your completed surveys to the Wandoo Recovery Group (see address at the end of the guide).

Assessment of crown decline stage

Wandoo crown decline can progress through a number of stages, including periods of short-term recovery.

Large, old trees commonly bear the scars from fire and wind damage. These and a range of other damaging events that can make the identification of the stage of decline difficult.

The line drawings are generalisations of a single decline event in wandoo. Not all trees observed will fall clearly into this classification scale.

Your understanding of these factors, together with careful analysis of each tree, will enable valid assessments of the crown condition to be produced from the survey.

Your guide to completing the survey

Equipment

You will need:

- this guide,
- a 50-metre tape,
- a GPS,
- surveyor's tape,
- a pencil or pen,
- an eraser and
- survey sheets and line drawings.

Survey procedure

Time of year

- To assess progression of decline accurately, surveys should be taken three times a year in March/April; August/September; December/January and repeated annually as close as possible to the previous survey date e.g. 15th day of the month.
- If it is only possible to survey once a year, then do this in March/April, when active decline (flagging) is most prevalent.

Overview

Have sufficient copies of the survey sheets and crown decline line drawings to conduct the survey. Two people working together would require one copy of the line drawings and one survey sheet per 100-metre transect.

Select, measure and mark the start/finish of the transect using coloured tape. Accurately record the length and location of the transect using GPS reference points or measure the distance and bearing from a mapped feature. You need to be able to find this survey transect again.

For each tree:

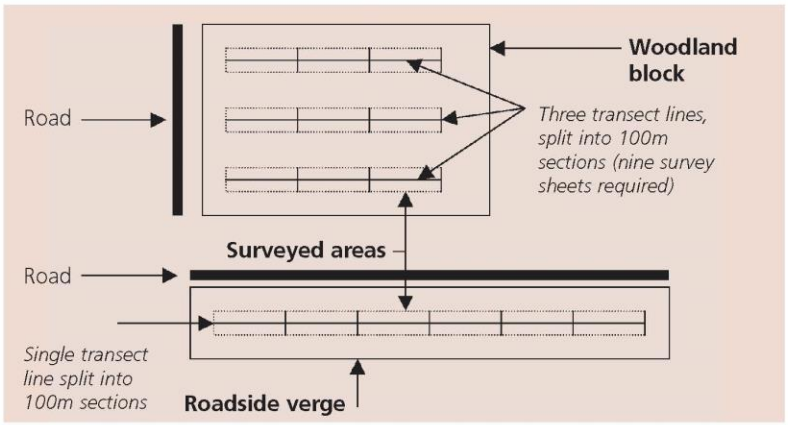
- estimate the tree diameter;
- assess the crown decline stage;
- assess the amount of flagging in the crown;

Suitable and fun for everyone. Mark and record the start/finish of the transect line, then assess each tree.

- place a tick in the appropriate box; and
- once the transect is complete, count the ticks and summarise for each column and row.

Site layout

1) Measure the transect line as close to 100 metres as possible. Mark the start and finish of the line with coloured surveyor's tape so the transect can be found again.
2) Draw a map on the back of the survey sheet showing orientation and location of the transect line.
3) Assess each tree growing 10 metres either side of the transect line and record the assessment on the survey sheet (using a tally system in the appropriate boxes).
4) The transect line can be extended in 100 metre increments. Use a new survey sheet for every 100-metre section.
5) If possible, repeat this process a minimum of three times to gain a random coverage of the site. See two examples below:



Tree species

6) Assessment of different species (e.g. wandoo, powderbark, jarrah, flooded gum, etc.) **must** be recorded on separate survey sheets and the tree species clearly indicated at the top of the sheet.

- Be aware that powderbark and wandoo look similar but are unrelated and must be recorded separately. Powderbark trunks will leave a flesh-coloured powdery film on your hand if rubbed.

Tree diameter

7) Measure or estimate the diameter of the tree at a point 1.3 metres above ground level (at chest height). A rod/stick with marked measurements from 0 to 50 centimetres can be placed horizontally against the trunk to estimate diameter.

8) Exclude or avoid lumps, bumps and scars on the trunk.

9) If the trunk is burnt out, scarred or hollowed, estimate what the diameter of the whole tree would have been.

10) If the tree is multi-stemmed, count as one tree and measure the largest stem.

Measuring tree diameter (1.3m from the ground).

Crown decline stage

11) Determine the crown decline stage for each tree by comparing the tree with the line drawings and descriptions C1 to C6.

12) Ignore old dead branches.

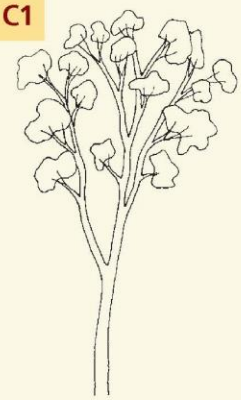
13) The density of leaves in wandoo crowns varies widely. Do not consider leaf density in making these assessments.

14) The drawn sequence may not adequately or fully describe all decline. Pick the drawing that best represents the stage of decline.

Example of C4 with epicormic clusters.

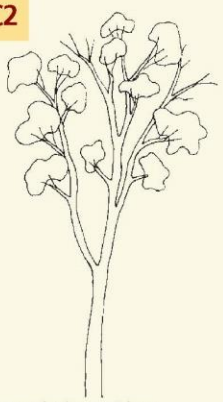
Crown decline stages

C1



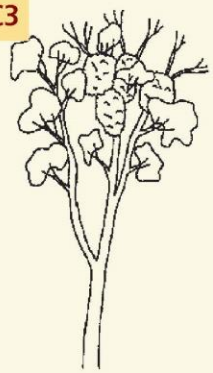
No decline, typical scruffy but healthy crown. No dead branches or a few dead branches low in the canopy.

C2



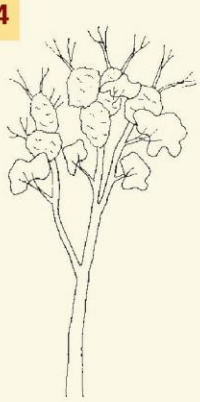
Some decline evident. Some terminal foliage (leaves at tips of branches) absent; some dead branches in upper part of canopy.

C3



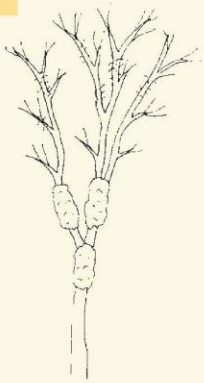
Most terminal foliage absent. Most foliage is epicormic (new shoots sprouting along lower branches); dead branches emergent from canopy.

C4



All terminal foliage absent. Growth of epicormic clusters, dead branches emergent from the canopy.

C5



Death of initial epicormic clusters. New epicormic foliage evident further down stems.

C6

Dead tree

Death of tree. No green foliage.

Current flagging

15) Estimate the proportion of the leaves in the crown that are 'flags' (yellowing or browning off and appear to be dying) at the time of the assessment. Walk around the tree when estimating proportions to see the whole canopy.

16) Does flagging make up:

- 0% (no flagging leaves)
- < 20% (less than a fifth of the leaves on the crown)
- 20%–50% (between a fifth and a half of the leaves on the crown)
- 50%–100% (more than half of the leaves in the crown)

Recording

17) For each tree, mark the box on the survey sheet based on the tree's
a) diameter,
b) crown decline stage, and
c) percentage of the leaves in the crown that are flagging.

Use a tally system within each box.

Summarising the results

18) Tally the marks in each row and column, and enter the sum in the totals rows and columns.

- Calculate the percentage of trees in each of the crown decline stages. Divide the totals for each row by the total number of trees assessed, then multiply by 100.
- Calculate the percentage of trees in each of the diameter classes. Divide the totals for each column by the total number of trees assessed, then multiply by 100.
- These values can be used to compare the structure of stands of trees on different sites and to compare the impact of the disease on different sites.

Initial flagging (less than 20%).

Moderate flagging (20%–50%).

Photographic record

19) Photos of a single reference tree will help to provide an accurate picture of the decline process. Ensure that photos are taken from the same reference point with the date recorded.

Additional observations

20) We encourage people to do their own wandoo watching outside the regular survey periods. Please note other observations such as when flagging/decline was first noticed; unseasonal climatic conditions; fire; severe insect activity; or human impact.

Return the survey sheets

21) Return the completed survey sheets by mail to:
Wandoo Recovery Group
Department of Conservation and Land Management
PO Box 1167
Bentley Delivery Centre
Bentley WA 6983

Acknowledgments

This document was prepared by Kim Whitford, Allan Wills and Liz Manning and brings together contributions from several sources. The survey procedure is based on the work of Allan Wills, and ideas and comments from Frank Batini, Roger Underwood and members of the Wandoo Recovery Group.

References

- White, P, Manning, E. 2005. Wondering about Wandoo. *LANDSCOPE*, Vol.20, No. 3, pp 17-21.
- Wills, A., 2005. Crown decline in Wandoo: Observations from Wundabiniring Brook 1999-2005. Unpublished report, Department of Conservation and Land Management, Perth.
- WRG Bulletins No 1 (2004); and 2 (2005). Department of Conservation and Land Management, Perth.

For more information or training on how to use this guide, contact the Wandoo Recovery Group's Executive Officer, Liz Manning, on 0427 441 482.

2005300-09-200

Yate crown condition methodology

This methodology was developed by Angela Sanders of Bush Heritage Australia, by modifying the Wandoo crown decline methodology. It has been provided as an example only of a crown density methodology for a different vegetation system. This methodology has an associated photographic guide to give examples of the different crown conditions classifications.

- Quadrats (20m x 100m) are established on sites of interest. Crown condition is assessed over the full 20m x 100m quadrat.
- Mark all dead and living Yate with a >3cm Diameter at Breast Height (DBH) within the quadrat with flagging tape. Measure the diameter of all the Yate at chest height to the nearest centimeter (pull the tape tight). Don't measure re-sprouting fallen trees. If there are multiple re-sprouted trunks originating from a dead trunk only record the largest diameter trunk but use the whole canopy for the health assessment.
- Determine the crown condition stage by comparing it with the photographs below.
- Record the crown condition in the appropriate box for each tree based on its diameter. Remove the flagging tape as each tree is completed.

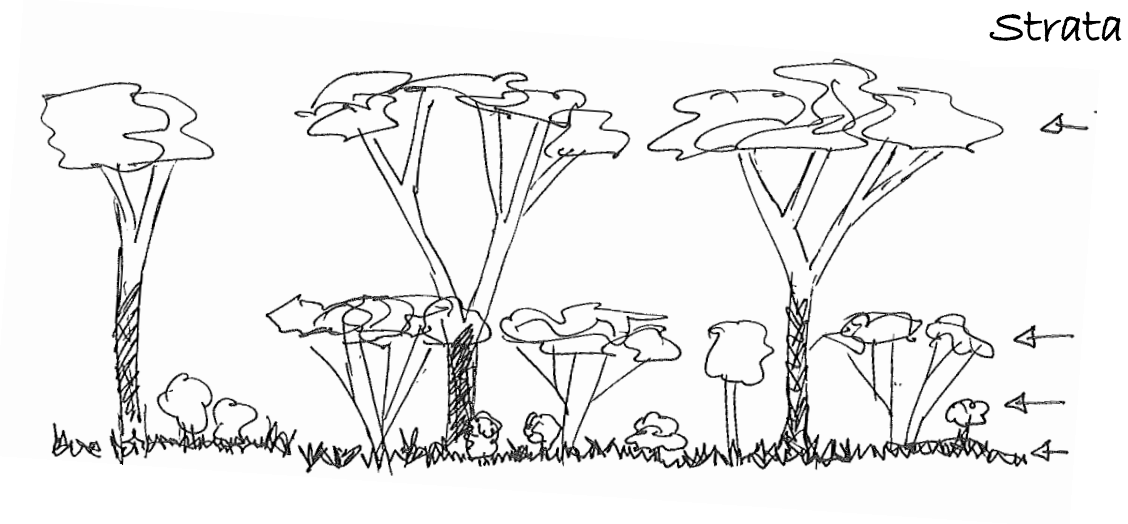
Yate Crown Condition data sheet			
Crown Condition	**Diameter 3-16cm (a)**	**Diameter 17-25cm (b)**	**Diameter > 26cm (c)**
C1 No decline			
C2 <25% foliage absent			
C3 30%-50% foliage absent			
C4 75% foliage absent			
C5 95% foliage absent			
C6 Dead tree			

15.4 Presence and absence of expected structural components

KEA	Indicator	Poor	Fair	Good	Very Good
General vegetation structure and composition	Structure *(Presence/absence of expected structural components)*	One or more strata absent from most sites	One stratum missing or poorly regenerating, or degraded	Strata present at most sites; may be some loss or degradation but retains regenerative capacity	All strata present and in good condition

The number of strata or layers expected in different vegetation types varies but often changes in condition are reflected by the loss of one or more of these strata. Often a decline in vegetation condition is seen as the loss of overstorey or understory strata. This method is to assess the number of strata and their condition at your sites against the known number of strata/condition expected for that vegetation type. The expected number of strata/condition are determined using a very good condition reference site.

- Select a reference site for your vegetation type. Choose a site in a patch of bush in very good condition. If in doubt you could ask a botanist to select an appropriate reference site.
- Assess the number of structural strata and their condition in the reference site using the methodology outlined below.
- Check for the structural strata/condition at your assessment sites using the same methodology.
- You will need to determine the frequency at which you check your sites. As the assessment does not take long check annually then decide if you can decrease the frequency.
- This quick assessment can usually be undertaken in conjunction with other work.
- Use photo monitoring to visually compare past and present vegetation condition.



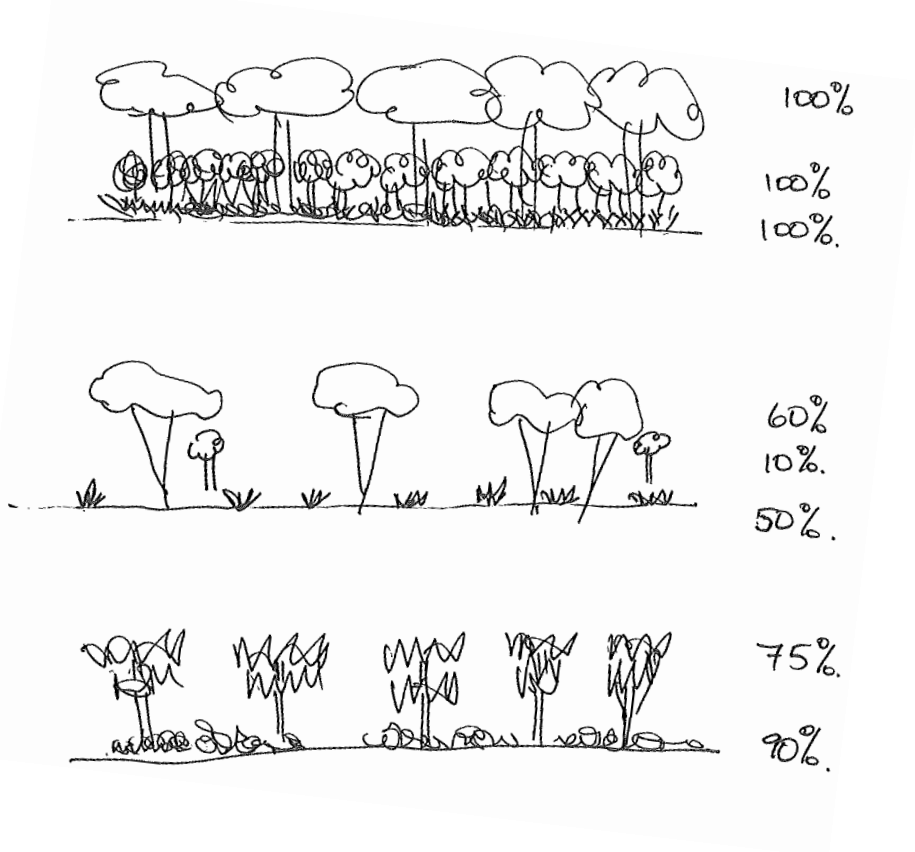
Most vegetation types won't have all; some (eg moort woodlands) may naturally only have one).

Parameters to assess number of strata and their condition.

Parameters to measure	Notes
Number of layers (strata)	Refer to the diagram and notes below.
Tallest layer:	This will be the dominant eucalypt layer in woodlands and forests, but may be a shrub layer in heaths or shrublands.
density (% cover) of layer	Refer to following information
canopy condition	Refer to Wandoo assessment notes for how to assess for tree layers
recruitment	Evidence of seedlings, young saplings (number/density); fruits/seeds on plants
Next layer:	
density (% cover) of layer	Refer to following information
(canopy) condition	(Refer to Wandoo assessment notes for how to assess for tree layers); for shrub layers indicate whether main species are healthy or in decline
recruitment	Evidence of seedlings, young saplings (number/density); fruits/seeds on plants
Next layer:	
density (% cover) of layer	Refer to following information
condition	Refer to Wandoo assessment notes for how to assess for tree layers; for shrub layers indicate whether main species are healthy or in decline
recruitment	Evidence of seedlings, young saplings (number/density); fruits/seeds on plants
Next layer:	
density (% cover) of layer	Refer to following information
condition	Refer to Wandoo assessment notes for how to assess for tree layers; for shrub layers indicate whether main species are healthy or in decline
recruitment	Evidence of seedlings, young saplings (number/density); fruits/seeds on plants
Litter cover:	
Coarse woody debris	Refer to Appendix 5 for how to assess cover
Leaf litter	Refer to Appendix 5 for how to assess cover
Non-native plant cover	Refer to Appendix 5 for how to assess cover
Other observations	Include relevant observations with any of these assessments. For example, you may be assessing a tree layer as having poor canopy cover but it has heaps of tree hollows that are being used by fauna – note here. Shrub or other layers may be healthy where they remain, but areas of disturbance are removing some areas – note the cause and impacts if known , etc.
Photo point monitoring	Make sure you take photos – see Appendix 6.

Density (%cover) of strata (layer)

Imagine taking a cross section of your vegetation and looking at the profile. Assess each strata for the density of the cover (0-100%). Imagine looking at the dripline of the plants and what percentage of the ground it would cover.



The table below (from Casson et al) provides a mechanism of rating the structural condition of your vegetation survey site when compared to your very good condition reference site.

Order of priority (Semi-sequential & independent)	**POOR**	**FAIR**	**GOOD**	**VERY GOOD**
Structure of vegetation	Widespread loss of layers.	One or more layers missing or frequently & repeatedly removed.	All layers present, but some may be sparse or discontinuous.	All layers present.
Plant composition.	Many species missing.	Several species diminished/missing.	One or more species diminished	Full range of native species present.
Disturbance &/or weeds (Converse is soil seed bank integrity)	High level <> Extensive area (consolidated) <> Repeated/ongoing (frequent)	Mod/high level <> Growing area (melding) <> Intermittent (sporadic)	Moderate level <> Limited area (scattered) <> Single incidence (infrequent)	Low level
Recruitment	No seedlings <> No saplings	Scarce or no seedlings <> Scarce or no saplings	A few species have isolated seedlings <> A few species have isolated saplings	Several species have several <> Several species have several saplings

15.5 Proportion of native to non-native species in ground cover

KEA	Indicator	Poor	Fair	Good	Very Good
General vegetation structure and composition	Species composition *(Proportion of native to non-native species in ground cover)*	More than 50% non-native species	20-50% non-native species	Native species dominant, few non-natives (<20%)	Native species dominant, occasional aliens

This is a simple visual assessment which involves looking at sites and using the pictures in Appendix 5 to determine the proportion (%) of native to non-native ground cover. Undertake annually at the same time of year. Suggested sites are 50 x 10 m.

15.6 Bird activity and species richness

KEA	Indicator	Poor	Fair	Good	Very Good
Presence & abundance of characteristic animal species	Bird activity and species richness *(BHA or BA methodologies)*	Almost exclusively common species	A number of sensitive species are declining	Most sensitive species &/or nested targets in healthy numbers	Rare species and nested targets in healthy numbers

Methodologies for bird activity and species richness assessment are still being determined. Bush Heritage Australia has been using 'Bird Minutes' to determine species present and their level of activity during the spring breeding season. The CCWA Citizen Science program is using mist netting and other techniques to determine bird species present and species residency. Both assessment methods require a high degree of training for implementation and are therefore of limited use across Gondwana Link. Work is being undertaken to develop methodologies that are simpler and can be undertaken by volunteers with minimal training. It is hoped that in the long term we will have a suitable methodology which allows us to analyse the bird functional guilds. We will then be able to compare species that are present within each functional guild of birds at survey sites against the expected species that use reference sites of bush in very good condition. Stay tuned!

15.7 Vegetation condition assessment by presence/absence of an indicator species.

KEA	Indicator	Poor	Fair	Good	Very Good
Presence & abundance of "indicator" or focal species (eg. A characteristic species found in good quality habitat)	Presence/ abundance of a particular species (eg Tree creeper in Wandoo woodland)	Indicator species seriously declining or absent	Indicator species likely to be declining slowly	Indicator species generally stable or increasing in abundance	

This methodology is under discussion and will be completed in the near future. The underlying assumption is that vegetation of a particular types in very good condition has certain species present. The species which act as 'very good condition' indicators are being confirmed. The draft list appears below.

Vegetation type	**Indicator the vegetation is in good condition**
Wandoo/Salmon Gum woodland	Rufous treecreeper
Mallee with sparse understorey	Malleefowl
Mallee/heath	Southern Scrub Robin, Shy Heathwren
Jarrah/Marri Forest	Golden Whister

15.8 Spatial analysis of pre-European extent

KEA	Indicator	Poor	Fair	Good	Very Good
Extent of habitat/ community remaining	% of pre-European extent *(Assessed through spatial analysis annually-5 yearly)*	Serious habitat depletion <10%?	Substantial habitat depletion 10-50%?	Minor habitat depletion 51-80%?	Close to pre-European extent; minimal loss >80%?

This analysis will be undertaken at WOL/Zone scale using pre-European and remnant vegetation data.

15.9 Analysis of catchment cover

KEA	Indicator	Poor	Fair	Good	Very Good
Catchment native vegetation / perennial cover	% of native vegetation and/or perennial cover in catchment *(Assessed through spatial analysis annually-5 yearly)*	<30%	<60%	60-80%	>80%

This analysis will be undertaken at WOL/Zone scale using remnant vegetation and revegetation data.

15.10 Riparian assessment

KEA	Indicator	Poor	Fair	Good	Very Good
Bank stability & integrity	% of stream with expected abundance & diversity of important habitat components	Most reaches have highly modified bank characteristics	Some reaches have highly modified bank characteristics	Bank condition generally intact	
Instream habitat diversity	% of stream with expected abundance & diversity of important habitat components (snags, biotopes - pools, riffles, runs, instream vegetation)		Some reaches have lower than expected instream habitat abundance and diversity	Most reaches have minimum expected instream habitat abundance and diversity	
Extent and condition of riparian vegetation	Width and continuity of riparian vegetation	Riparian vegetation absent or in poor condition across most of waterway	Riparian vegetation absent or in poor condition across some of waterway	Riparian vegetation present and in good condition across most of waterway	

Pen-Scott method of assessing riparian vegetation and stream condition has been used successfully on many south coast rivers. (Jansen et al 2003) (Price & Lovett (1999)) (Lovett & Price (1999)) (W & R Comm (1999)) (W & R Comm 2000) (W & R Comm 2002) (W & R Comm 2002). This assessment uses a “Stream Condition Index" which incorporates Foreshore Condition Assessments (predominantly reflects weeds and erosion, ranked as A-D) with "Environmental Condition" (which incorporates

Floodway and Bank vegetation, verge vegetation, stream cover, bank stability and erosion and in-stream habitat diversity. A combined numerical score is thus assigned to each length of creek.

The Pen-Scott method can be found at http://www.water.wa.gov.au/PublicationStore/11183.pdf

Water quality assessment

A simple water quality assessment can be done using inexpensive equipment to test for pH, salinity and temperature. To assess dissolved oxygen, turbidity, conductivity and other qualities an expensive water quality meter is required and some expertise in its use and maintenance.

The creek systems west of the Stirling Range are largely saline and there is little ongoing monitoring of their basic water quality. Regular basic water quality assessment would build a basic knowledge base on the changes these creeks undergo from season to season, year to year. This baseline knowledge will assist in assessing when a waterway is healthy versus un-healthy.

Salinity

When we measure the salinity of water, we look at how much dissolved salt is in the water, or the concentration of salt in the water.

Concentration is the amount (by weight) of salt in water and can be expressed in parts per million (ppm). Here are the classes of water:

- Fresh water - less than 1,000 ppm (0.1%)
- Slightly saline water - From 1,000 ppm to 3,000 ppm (0.1 – 0.3%)
- Moderately saline water - From 3,000 ppm to 10,000 ppm (0.3 – 1.0%)
- Highly saline water - From 10,000 ppm to 35,000 ppm (1.0 – 3.5%)

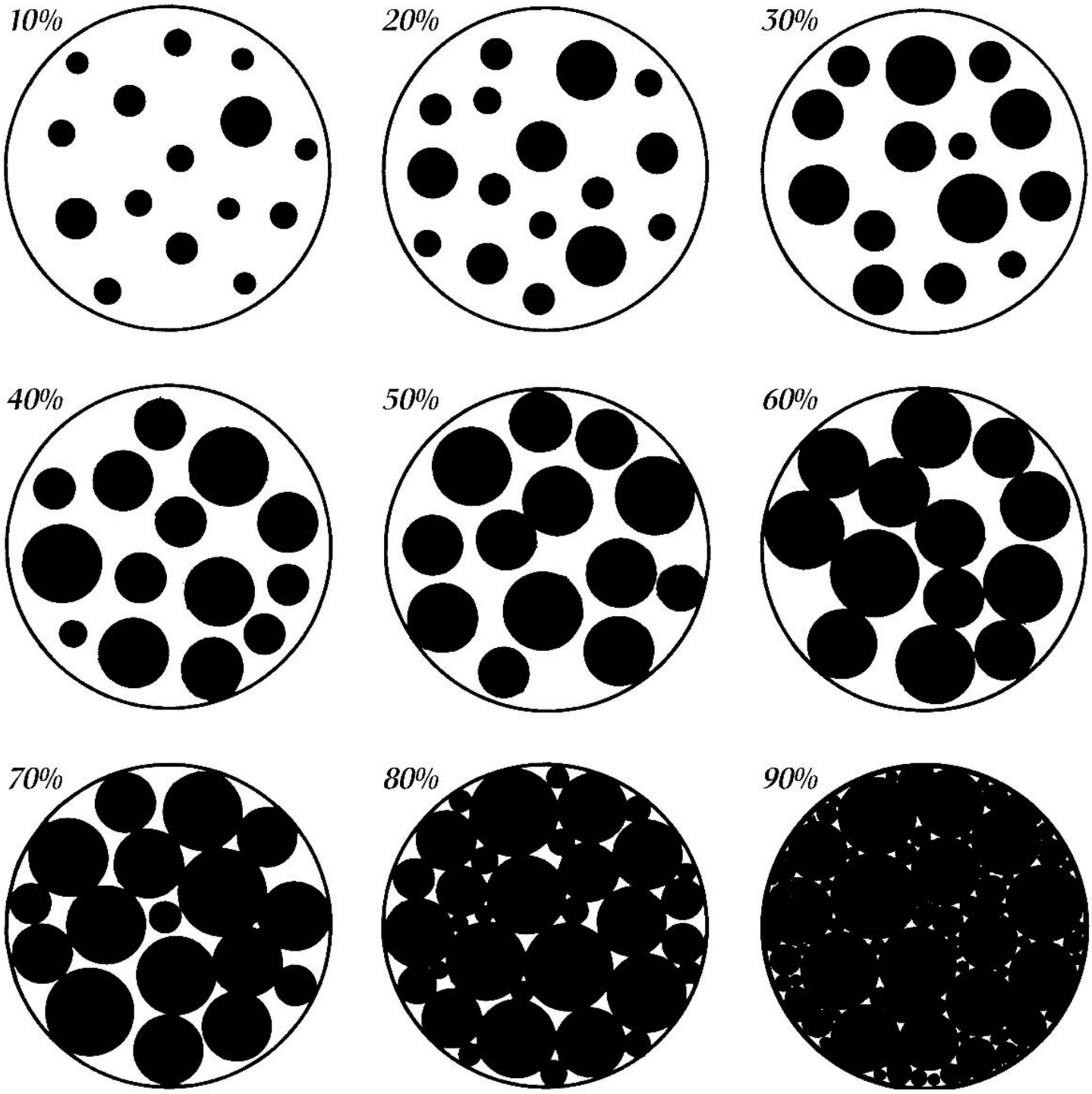
Ocean water has a salinity that is approximately 35,000 ppm.

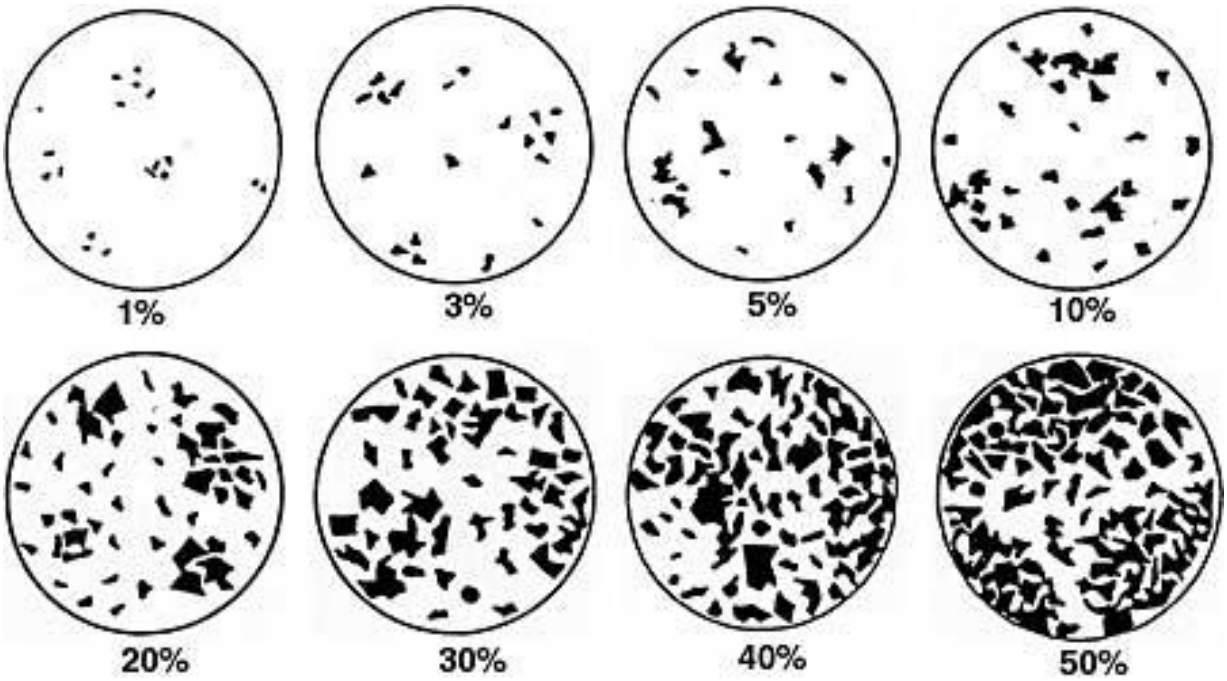
For information on the ecological values of waterways in the south coast region of Western Australia see Cook et al. (2008).

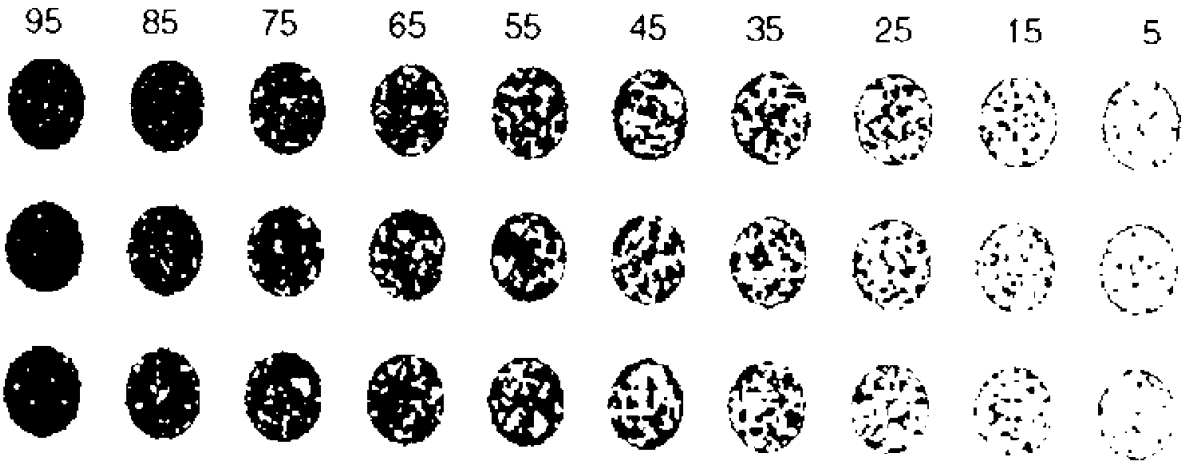
16 APPENDIX 5. Visual estimates of percentage cover

These reference figures can help to estimate:

- % canopy cover
- % low vegetation cover
- % weeds versus native species

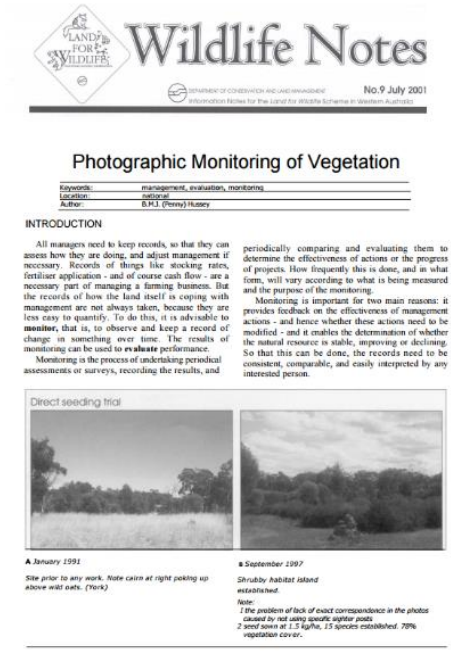



1%
3%
5%
10%
20%
30%
40%
50%


95
85
75
65
55
45
35
25
15
5

17 APPENDIX 6. Photo monitoring

Instead of reinventing the wheel we have recommended two existing photo monitoring methodologies. Note that some people set up a photo monitoring point then take 4 photos on the compass points (N, S, E and W) to make the most of the opportunity. Warning, plants can grow fast – take care selecting your photo points or in the future you may find yourself taking a photo of a bunch of leaves and nothing else.



Wildlife Notes

No.9 July 2001

Photographic Monitoring of Vegetation

Keywords: management, evaluation, monitoring
Location: national
Author: B.H.J. (Penny) Hussey

INTRODUCTION

All managers need to keep records, so that they can assess how they are doing, and adjust management if necessary. Records of things like stocking rates, fertiliser application - and of course cash flow - are a necessary part of managing a farming business. But the records of how the land itself is coping with management are not always taken, because they are less easy to quantify. To do this, it is advisable to **monitor**, that is, to observe and keep a record of change in something over time. The results of monitoring can be used to **evaluate** performance.

Monitoring is the process of undertaking periodical assessments or surveys, recording the results, and periodically comparing and evaluating them to determine the effectiveness of actions or the progress of projects. How frequently this is done, and in what form, will vary according to what is being measured and the purpose of the monitoring.

Monitoring is important for two main reasons: it provides feedback on the effectiveness of management actions - and hence whether these actions need to be modified - and it enables the determination of whether the natural resource is stable, improving or declining. So that this can be done, the records need to be consistent, comparable, and easily interpreted by any interested person.

Direct seeding trial

A January 1991

Site prior to any work. Note cairn at right poking up above wild oats. (York)

B September 1997

Shrubby habitat island established.

Note:
1 the problem of lack of exact correspondence in the photos caused by not using specific sighter posts
2 seed sown at 1.5 kg/ha, 15 species established. 70% vegetation cover.

http://www.dpaw.wa.gov.au/images/documents/conservation-management/off-road-conservation/LFW/Photographic_Monitoring_of_Vegetation.pdf

Photopoint Monitoring

FACT SHEET

WHAT IS PHOTOPOINT MONITORING ?

Photopoint monitoring is a simple, fast and inexpensive technique to record and monitor visual changes in the natural environment over time. It involves taking a series of images of a fixed area or subject at regular time intervals, which can then be compared to show physical change at a given location.

Consistency is critical to the success of photopoint monitoring. Photos must be taken at the same location, with the same camera direction angle, focus points and preferably camera settings at each time point, for an effective permanent visual record of environmental change.

Photopoint monitoring is most effective only when its strengths as a method match the objectives of the study, in terms of the nature and magnitude of the change that is expected to occur. When considering using photopoint, you need to be clear about the appropriateness, capabilities and limitations of the method.

Appropriateness

Photopoint monitoring is a useful technique for recording the effectiveness of on-ground management actions at the site scale (10m–100m) and is most appropriate when used to capture environmental changes which are visible to the eye. Photopoint monitoring may be best used to support other monitoring efforts aimed to quantify environmental change.

The photo series can detect change in condition due to:

- Weed growth/management
- Grazing pressure/management
- Feral animal impacts/management
- Erosion impacts/management
- Recreational or human impacts/management
- Revegetation
- Reintroduction of native animals
- Regeneration
- Dieback

One picture is worth a thousand words

Capabilities

- Low measurement error and variation
- Requires minimal training
- Readily obtainable equipment
- Low impact on monitoring site
- Provides a standardised and precisely replicable result that can be achieved by different people at different points in time
- Generally, it can be conducted by one person, however two people may be preferable due to safety considerations and transporting of equipment
- Complements quantitative monitoring techniques/data i.e. vegetation condition monitoring and species survival counts
- Potential to store data electronically and link to site records and/or GIS maps/data point
- Photos provide a permanent visual record of site conditions that transcends periodic changes in staff and expertise
- Photos may be a more effective communication/extension tool when dealing with the public and decision makers than highly quantitative charts, tables and graphs

Limitations

- Will only detect changes large enough to be seen by the eye from the camera position
- Is a qualitative rather than quantitative monitoring technique. These limitations can be overcome if additional quantitative techniques are applied, such as counts *(see Appendix 1)*
- May not provide any evidence of cause of change in the variable of interest
- External effects, such as light may make detection of changes more difficult. Extreme wind and rain also present challenges
- Cannot be used in dense woody vegetation as branches and foliage obscure camera field of view.
- Overtime representation of objects may be restricted by the size and number of fields of view or photopoint markers can become obscured by vegetation, or lost due to soil erosion or vandalism
- Results will almost always be relative to the site where they are taken and comparison between sites may be limited
- Interpretation requires collection of 'metadata', e.g. date, time, plant species names
- Changes in operators or technology/equipment may affect results. This can be avoided by following a set method.

http://www.nrmsouth.org.au/wp-content/uploads/2014/08/Photo-Monitoring-Fact-Sheet-NRM-South.pdf