Guide to monitoring habitat structure

Version 1 (November 2012)

Fire and adaptive management

report no. 85

Department of Sustainability and Environment

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Contents

Foreword

The Victorian landscape has been subjected to many natural disturbances from drought, to fire to flood resulting in resilient floral and faunal communities that show remarkable recovery in the face of seemingly extreme disturbance. Understanding the relationship between the appropriate disturbance and positive outcomes in an environment prone to unpredictable disturbance is a major challenge for scientists and land managers.

Natural resource management is complex with land managers often required to make decisions and implement strategies with incomplete knowledge. Filling critical knowledge gaps will come from new science, and from monitoring and analysing the impact of management actions on the natural environment and adapting these actions to assist ecological improvements.

DSE has made a concerted effort to improve its understanding of the impact of management actions on biodiversity through the development of monitoring tools. The '*Guide to Monitoring Habitat Structure*' is an important new addition to the monitoring toolkit and represents a critical step towards incorporating habitat and fauna information into land management planning and action.

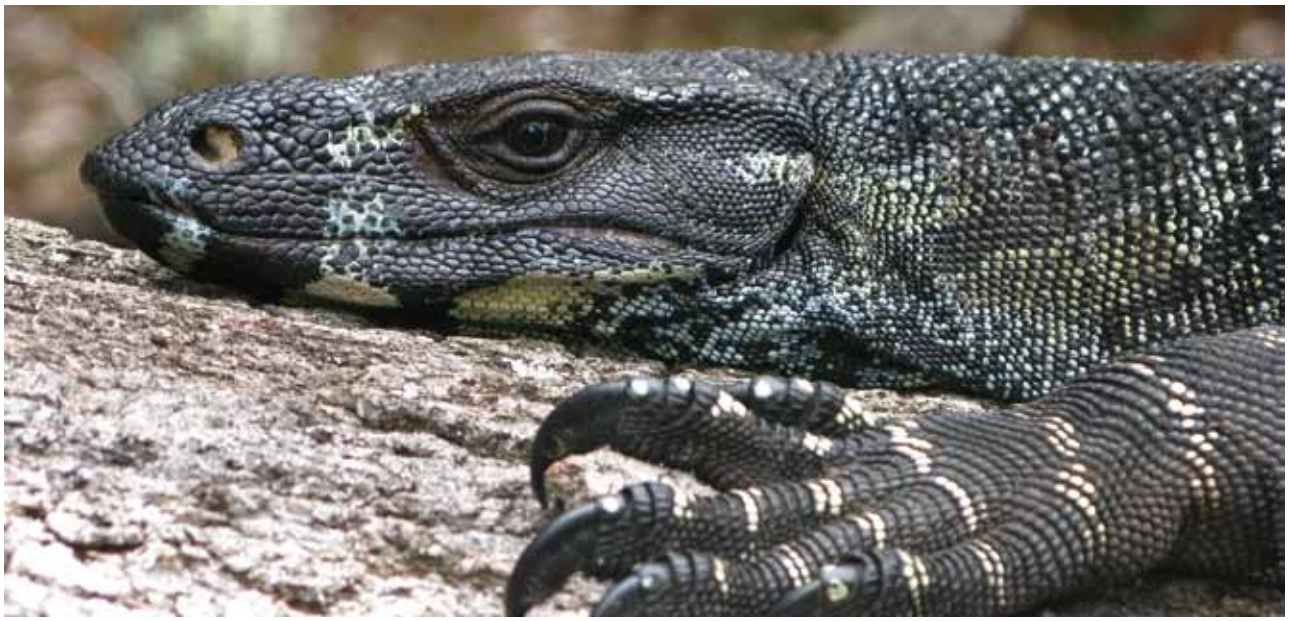
Habitat structure provides critical feeding, breeding and shelter sites for fauna. It provides the physical arrangement of the different growth stages and vegetation types in Victoria. Systematic monitoring of habitat structure across space and time will help managers better understand the effect that different management actions have on habitat structure and growth stage.

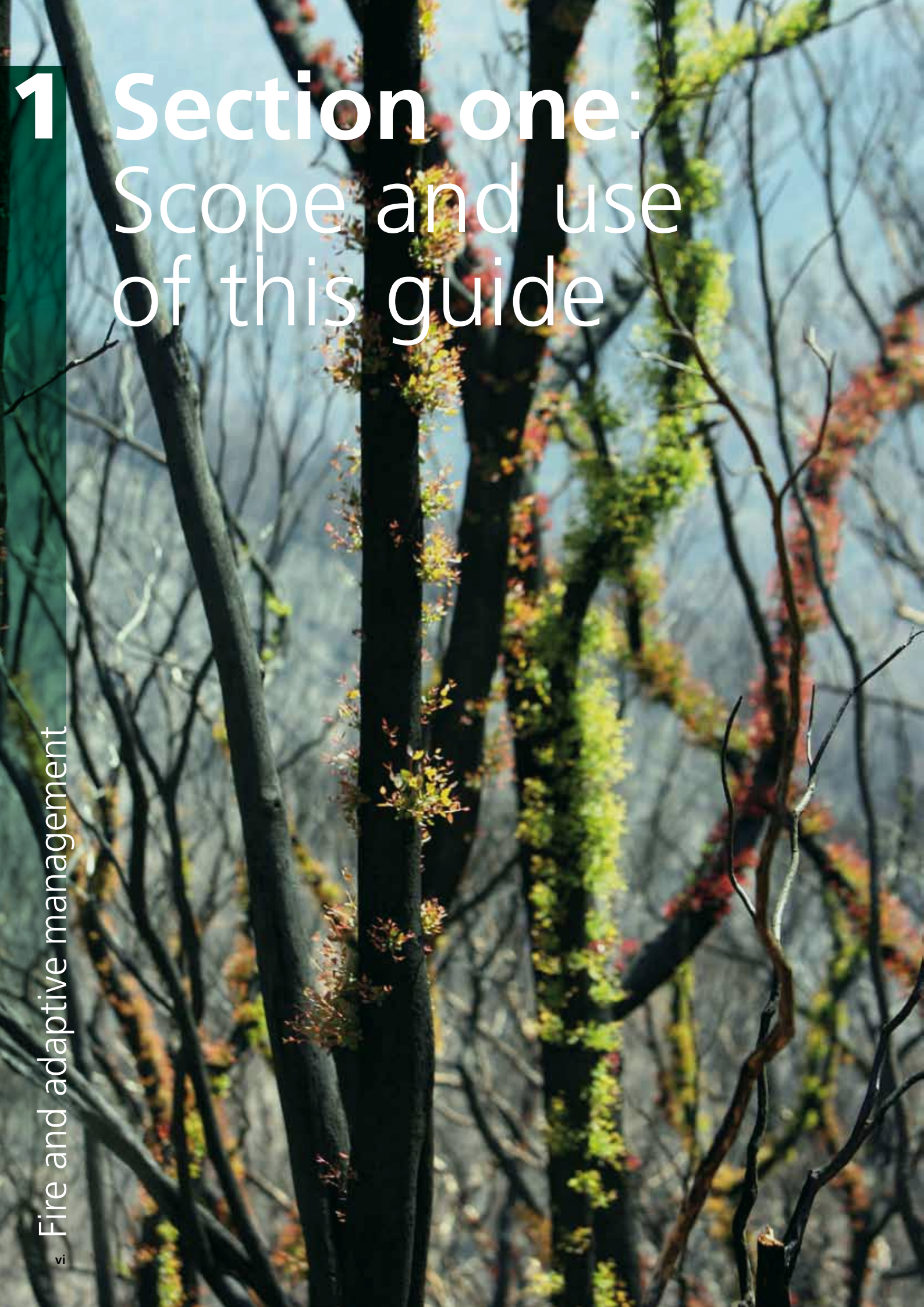
This knowledge is important to assess the performance of our current management, and to better predict the outcomes of future actions on the health and resilience of the natural ecosystems. DSE and Parks Victoria staff and interested members of the community will use '*the guide*' to collect information that will help refine and improve our management of fire.

The methods were developed through extensive engagement with the scientific community and field practitioners. They were designed so anyone interested in natural resource management can use them, including community and school groups. They have been successfully used by DSE and Parks Victoria since their roll out as a pilot program in 2009.

The '*Guide to Monitoring Habitat Structure*' is particularly relevant given the recommendations of the Victorian Bushfire Royal Commission and the need to increase our monitoring of the expanded planned burning program to understand its impact on biodiversity. It is now more crucial than ever to effectively evaluate the planned burning program. Understanding growth stage development through quantifying habitat structure is a major step towards improving our understanding.

Lee Miezis
Fire Division, DSE





1 Section one: Scope and use of this guide

Section one: Scope and use of this guide

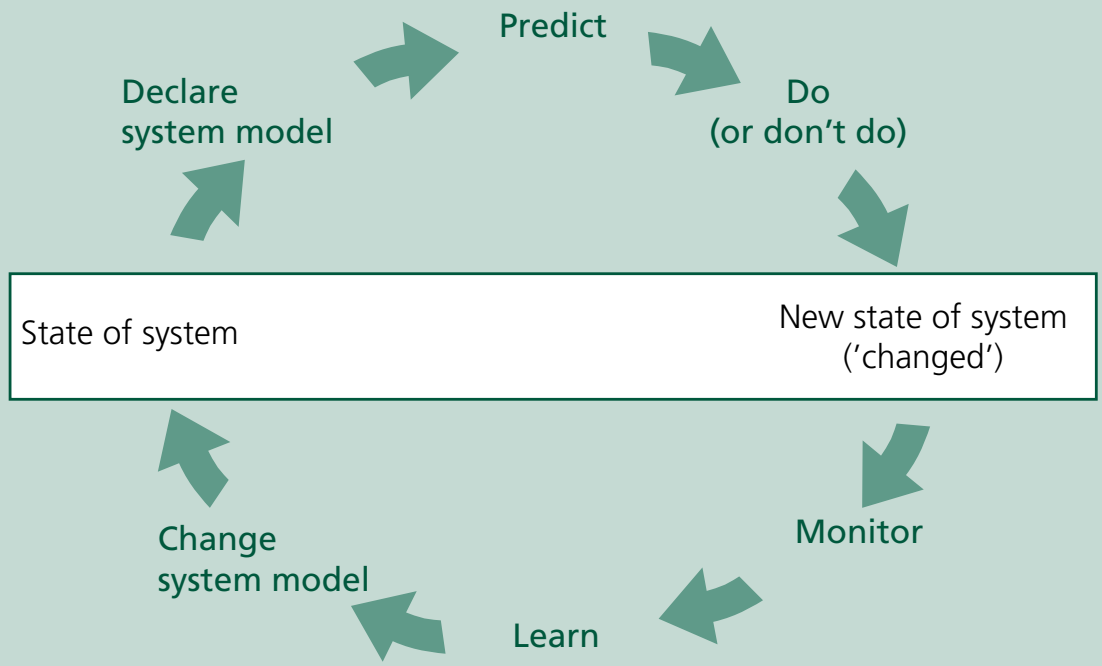
1. Introduction

This guide describes methods for assessing the structure of habitat as used by the Department of Sustainability and Environment (DSE). These methods apply to forest and mallee ecosystems, but are flexible and can be adapted to other ecosystems, such as grasslands. These methods are a currently used in DSE's Landscape Fire and Environmental Monitoring Program, but can also be used in isolation or to support other monitoring programs.

The methods were developed with assistance from scientists and practitioners from DSE's Fire Division and Arthur Rylah Institute for Environmental Research (ARIER), the Department of Forest and Ecosystem Science at Melbourne University, the Department of Zoology at La Trobe University and the School of Life and Environmental Sciences at Deakin University. The methods were tested in the field through a state-wide pilot program involving staff from both DSE and Parks Victoria (PV).

This guide complements the *Flora monitoring protocols for planned burning: a users' guide* (2008), which describes methods for assessing changes in flora and associating those changes with the incidence and severity of fire. This guide for monitoring habitat structure represents a critical step towards improving understanding about the relationship between fire and fauna.

This guide has been developed under the framework of adaptive management, or 'learning by doing'. The cycle, as shown in Box 1, involves land managers and others continually recognising gaps in knowledge, taking action, observing, learning and then applying the new knowledge through future actions.



Box 1: Cycle of learning by doing

First we must declare our **system model**, which is our current understanding of how the system works. We **predict** the likely outcomes of applying or not applying different management outcomes. We choose either to implement (**do**) or not to implement (**don't do**) a management action that may change the state of the system. We then **monitor** the state of the system and **learn** through interpreting the monitoring data and gaining knowledge from this interpretation. We then use these learnings to **change the system model**, based on our new understanding of the system.

The main focus of this guide is the 'monitor' phase of the cycle, which involves observing the state of habitat repeatedly, over time and across the landscape. Monitoring habitat allows changes to habitat to be identified and evaluated over time. The influence of actions or events can also be evaluated. Such evaluations, when combined with existing knowledge of relationships between habitat and the habitat preference of fauna, help managers in predicting habitat change and choosing management actions that better suit fauna.

This document is presented in two parts. The first part (Section 1 and 2) describes the overall monitoring process, from inception to the interpretation of meaning. The second part (Sections 3–7) describes the process of collecting habitat data in the field and includes a set of datasheets and instructions.

2. Context

Natural resource management is full of complexity and uncertainty, yet land managers and policy makers are still required to make decisions and implement strategies in an attempt to manage natural systems. Monitoring the outcomes and the effectiveness of the decisions will contribute to a more informed understanding of the system and help managers make better decisions based on science.

Understanding the relationship between management actions or disturbance events and fauna and habitat is a significant challenge for land mangers. While the life history characteristics of flora were described and modelled as an initial way of integrating biodiversity information into land management planning a large assumption of this process was that management suitable for flora would also cater for fauna. This was a cause of major concern in both government and the community as there was little or no scientific evidence to support this assumption.

To address this concern a conceptual model was developed in 2009 that links the needs of terrestrial vertebrate fauna to vegetation growth stages, via changes in habitat parameters (MacHunter et al. 2009). This '*Guide to monitoring habitat structure*' tests the underlying assumptions of that model described by ARIER (MacHunter et al. 2009). The main concepts underlying this model and their use for developing methods for monitoring habitat are described in detail in '*Guide to monitoring habitat structure: a rationale report*' (Treloar, 2012) however a brief summary of these concepts is also provided below.

Fauna are reliant on elements of the habitat (habitat parameters) to provide critical feeding, breeding and shelter sites. Most habitat parameters are structural features of the vegetation and will therefore change over time as the vegetation moves through defined growth stages from renewal to senescence. The duration of each growth stage will vary depending on the Ecological Vegetation Division (EVD). EVDs are groups of plant communities that occupy similar ecological niches and share similar responses to environmental variables, such as fire, floods, soil characteristics or topography. Different faunal species have different habitat requirements. As the habitat parameters change over time, through a range of growth stages, the fauna assemblages utilising the habitat will also change in response.

There is no 'optimal' stage of habitat, only stages that are 'suitable'. One particular growth stage of habitat will be unsuitable for all species of fauna, and fauna may require multiple growth stages of habitat to satisfy their requirements. Providing a diversity of habitat growth stages across the landscape and through time will allow fauna to move within and between the different stages. As the habitat develops over time, species may become locally extinct as they move away to more suitable areas, but they will still remain within the landscape and, providing there is sufficient landscape connectivity, can repopulate areas as they become 'suitable' over time.

Applying disturbances, such as fire, across the landscape has the potential to change the growth stage of the habitat. The extent to which the habitat is changed will depend on the severity, frequency and extent of the disturbance. Not all disturbances will completely reset the habitat to the first growth stage, and patchy disturbances may only change the growth stage of parts of the habitat. Monitoring the disturbance, as well as its impact on the habitat, will help improve understanding of the relationship between disturbance and habitat change.

It is important to distinguish that fauna are not responding to time but to the growth stage of the habitat parameters. The rate of growth will depend on factors such as rainfall, light and nutrient availability. Therefore, after a given period of time, say five years, habitats of the same type may show markedly different growth stages and may have different assemblages of fauna utilising them.

Monitoring habitat across time and space will support better understanding of the habitat growth stages and assist land managers to be more predictive about habitat development.

3. Limitations and applicability

The methods in this guide were developed from a pilot program held across Victoria. DSE and PV staff tested the methods for their suitability for collecting data about a range of habitat parameters, EVDs and EVD growth stages. Consistency between assessors and ease of use for people with different levels of skills was also considered.

The methods are designed to test and improve the assumptions of a particular model (refer to '*Guide to monitoring habitat structure: a rationale report*' (Treloar, 2013)). That model was developed for terrestrial vertebrate fauna. As such, the methods focus on habitat parameters important to mammals, birds and reptiles; however, some or all of these parameters will also be important to other faunal groups.

The protocols focus on monitoring habitat on public land and, in particular, habitats in forest and mallee ecosystems. The methods may be applied in other ecosystems, such as grasslands or linear habitats, but the sampling design or intensity may first need to be adjusted. While some flexibility has been built into the sampling design to allow the methods to be used in other systems, it is still important to keep the data collection as consistent as possible across the landscape. This is so data can be compared across space and time. Therefore, any changes made to the plot set-up or sampling intensity should not be undertaken lightly and, if you do choose to vary these things, keep in mind it may reduce the comparability of the data. If you do choose to make changes they should be recorded in the space provided on the datasheet (See Box 5 for more information).

It is recommended that the **standard** versions of the method should always be used; however, time availability and skill level of the assessors will influence method choice. When skills or time are limiting factors, the basic method should be used. It is also possible to use a combination of methods from the standard and basic methods, especially if you are working in a system where particular habitat parameters (e.g. coarse woody debris or tree hollows) are of great interest. In such cases, assessors may choose to use the standard version of the method for those habitat parameters and the basic method for the other habitat parameters.

Lastly, the methods were chosen for their objectiveness and to, where possible, reduce bias between observers. This monitoring program is designed to be long term and state-wide, with the involvement of many assessors. As such, some common but subjective assessment techniques were passed over in favour of more objective assessment techniques.

For a more detailed explanation of how the methods were developed and for a full list of reference material used in the development, please refer to *'Guide to monitoring habitat structure: a rationale report'* (Treloar, 2013).

1

Fire and adaptive management

2 Section two: Monitoring steps

Section two: Monitoring steps

Planning is a key element for a monitoring program to be successful. The figure below outlines the key steps used to plan and implement a monitoring program and how these steps fit within the **monitor**, **learn** and **review** steps of the adaptive management cycle.

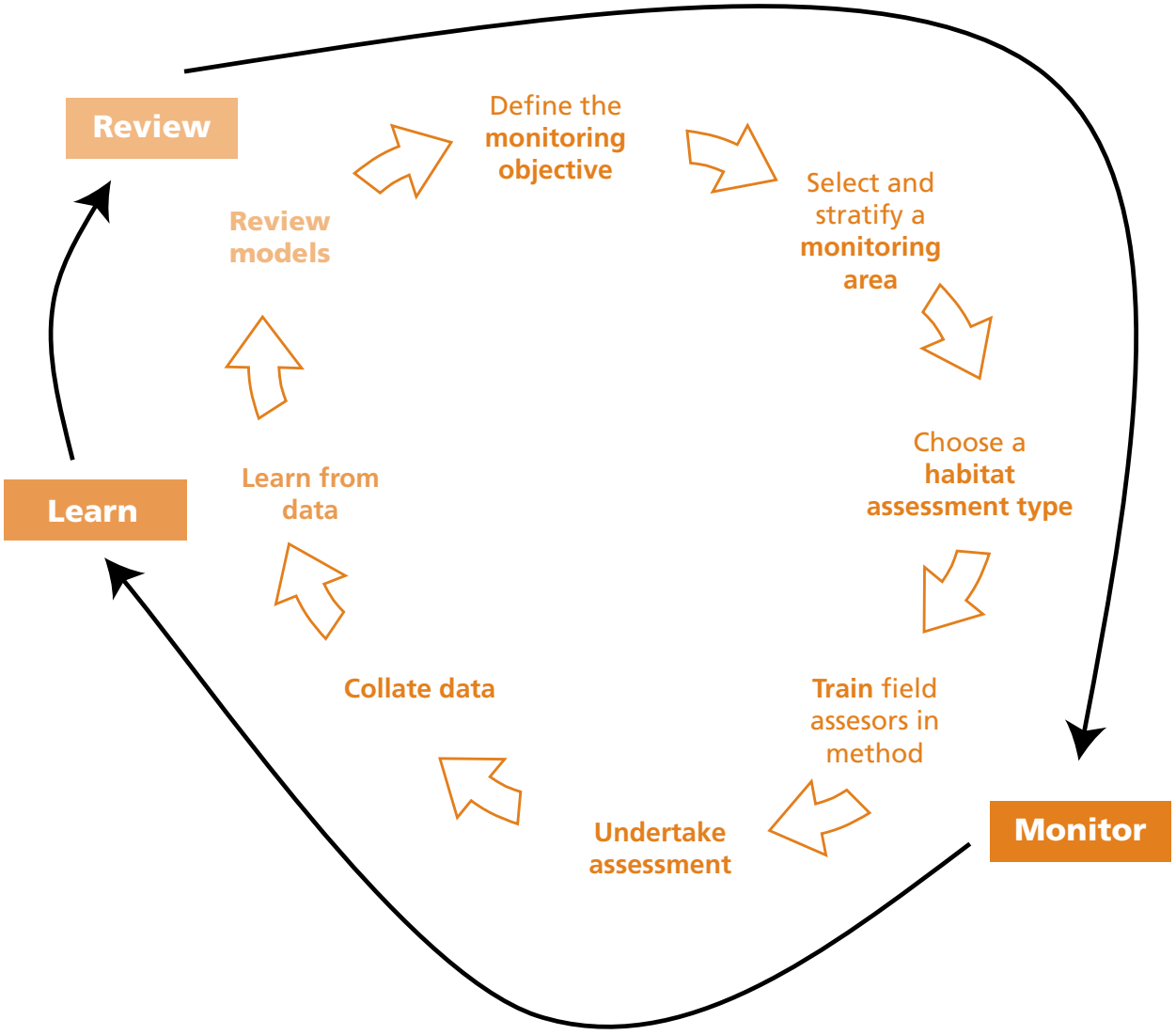


Figure 1. Effective monitoring involves eight steps, as shown in this flowchart.
The different colours identify how each step fits within the monitor, learn and review elements of the adaptive management cycle.

2

Fire and adaptive management

1 Define monitoring objective

Define monitoring objective	Select monitoring area	Choose assessment type	Train field assessors	Undertake assessment	Collate data	Learn from the data	Review the model

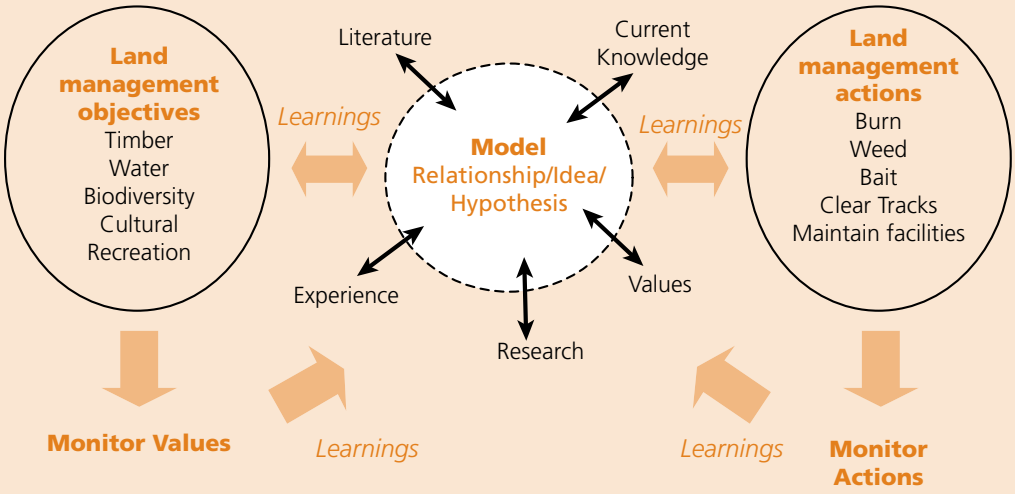
Monitoring needs to have a purpose, or objective, to be meaningful. Defining the monitoring objective will also inform where and when the monitoring should take place. While this guide identifies specific monitoring objectives outlined in Table 1, the next section is designed to assist land managers and other groups to develop their own objectives, if the objectives suggested in this guide do not meet their needs.

Linking objectives with actions – developing a model

For any given landscape there is a range of objectives that land managers need to achieve to effectively manage that landscape. These land management objectives will be based on what is considered valuable in the landscape, e.g. timber, water or biodiversity.

To achieve these land management objectives, land managers will apply a range of land management actions to the landscape, e.g. planned burning, weeding, predator control. Before applying a management action, the land manager needs to define the objective or purpose of the action so they can determine if they have achieved their desired outcome. Defining the framework or model that the objective sits within is an important first step.

In our world, relationships exist between things. Our understanding of these relationships is referred to as a model. A model may not be a comprehensive representation of the actual relationship, but rather our best guess of what that relationship is, based on current knowledge, values, experience, etc. By applying a management action to create a change in one thing, we can observe or monitor changes in the things it has relationships with, and therefore increase our understanding of those original relationships. This allows us to refine our model from the learnings that we've made. This is the core of adaptive management and is further demonstrated in Box 2.

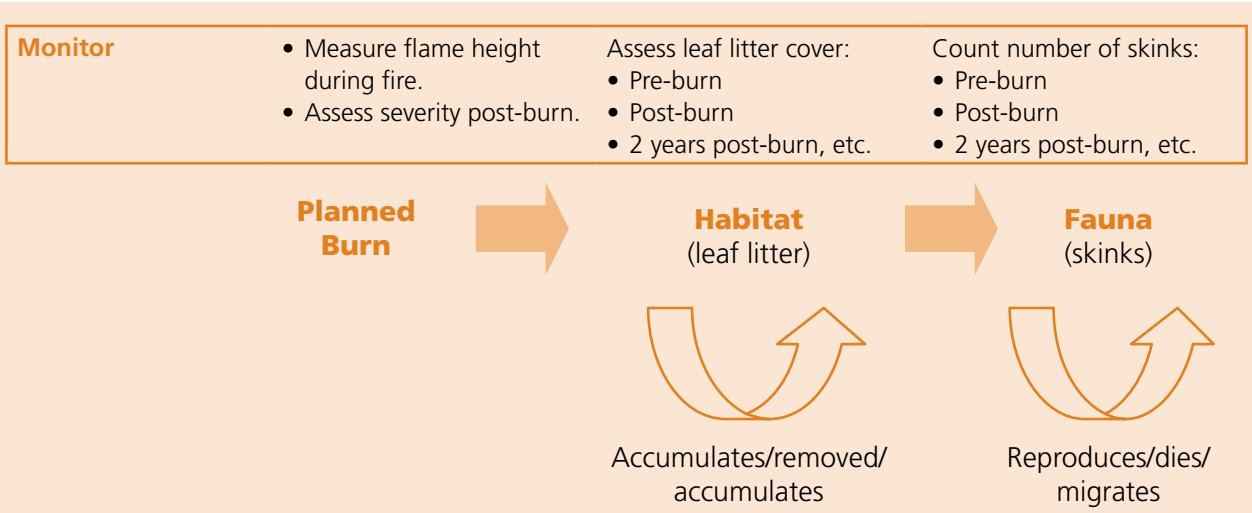


Box 2: Developing objectives for monitoring.

Land managers manage a range of values in the landscape, e.g. biodiversity, timber, cultural. Each value has an objective associated with it, which defines the desired outcome for that value – a **land management objective**. To achieve these desired outcomes, land managers will apply **land management actions** – e.g. burn, weed, bait – each of which will also have a desired outcome. The application of these actions will be based on a **model** of how that system works and of what is required to achieve the desired management outcome. **Monitoring** the outcome of the land management action will allow the manager to determine if their objective has been achieved. Monitoring the values from which the land management objectives have been developed will also determine if the applied action is achieving the desired land management objective. The learnings from monitoring both the outcome of the land management action and the changes to the item of value will help refine the model. The refined model will then inturn help improve development of land management objectives and the implementation of land management actions in the future.

Land managers can use their knowledge of existing relationships (models) to define their objectives for monitoring (what they want to learn) to improve their understanding of the relationship in the future (learnings). For example, we know that there is a relationship between fauna and habitat, between fire and habitat, and between fire and fauna (our model). To understand this relationship better, we can choose to apply a management action, such as a planned burn, with the objective of eliciting a change. We can then monitor the outcomes of the management action to gain a better understanding of the relationships (refine our model).

We will use a simple example involving skinks, litter and fire to demonstrate this further. Based on current knowledge, we know that there is a relationship between skinks and litter accumulation (Taylor & Fox 2001). We also know that there is a relationship between fire and litter removal. Our assumed understanding of these relationships forms the basis for our model and provides a framework under which we can test our assumptions. From our model we can develop an objective that may be to maintain skink presence across the landscape. Our model tells us that skink presence should be maintained if litter is maintained. It also tells us that fire will remove litter, where it is applied. Therefore, to achieve the objective of maintaining skink presence, the land manager may choose to apply a low-intensity, patchy fire regime to ensure that some litter is maintained, and thus skink presence is also maintained. To determine if the outcome has been achieved, and to learn about the effect of the management action, we need to monitor not only each item of interest but also the management action itself. This will tell us about the change to each item and how that relates to the management action. This example is illustrated in Box 3.



Box 3: Simple model for developing monitoring objectives.

For example, planned burns, litter and skinks have relationships (represented by arrows). The planned burn (management action) causes a change to leaf litter (habitat – item 1), which changes skink abundance (fauna – item 2). Monitoring the management action and each of the items will improve knowledge about the relationship between the items and the management actions. The learnings from the monitoring can be used to improve the knowledge about the relationship between fire, litter and skinks and refine the original model from which the objectives were developed.

Using a model to define the objective provides a framework within which land managers can learn from the actions they apply to the landscape, and understand why certain management actions have certain outcomes. Monitoring the outcomes of management actions in a formal way allows these learnings to be documented.

While it is important to recognise that land managers operate at broader scales than individual species and events, the simple example above serves as a guide to help direct the development of broader land management models that define how the landscape should react under particular management regimes.

This section has provided a simple example of how to define an objective. The next section looks at the objectives that have been identified as most relevant to this guide.

2

Monitoring objectives relevant to this guide

The model being tested by this guide is called the faunal vital attributes model and described in detail in MacHunter *et al*. (2009). This model describes the relationship between habitat parameters and growth stage development, and between fire severity and habitat parameter change. The model assumes that habitat follows a defined course of development through growth stages, and that fire of differing severities can return the habitat to earlier growth stages. From this model we have developed a list of potential objectives for monitoring, which are listed in Table 1.

Some of the objectives identified in the table require monitoring factors outside the scope of this guide, such as fauna and fire severity. Monitoring protocols for some of the associated factors can be found in the *Fire research report series*.

The objectives for this guide are focused on monitoring the features of vegetation that form important structural habitat. By monitoring habitat we can validate our understanding of habitat growth over time and the influence that disturbance has on that growth. Improving understanding about these relationships will allow the distribution of the habitat growth stages across the landscape to be mapped and increase the ability of land managers to predict how management actions will change the distribution of the habitat growth stages over time.

Evaluating this information together with data on the presence of fauna will allow the distribution of different fauna groups to also be mapped based on their relationship with the habitat growth stages. This analysis is beyond the scope of this guide but it is important to highlight the important part that monitoring habitat plays in managing fauna across the landscape.

The objectives in Table 1 provide guidance about why to implement habitat monitoring and will help inform where and when habitat monitoring should be implemented. Other factors that influence habitat development, such as trampling, grazing, disease, drought and rainfall, have not been considered in the model as yet. While the monitoring does not explicitly deal with these factors, this information can still be collected as it may lead to a better understanding of how some of these other factors influence changes to habitat.

Once you have identified which objective or objectives are applicable to you, continue onto the next section to start planning your monitoring. If the objectives in the table do not meet your needs, use the section above to assist you with developing your own objectives.

Box 4. Monitoring as part of the Landscape Fire and Environmental Monitoring Program

The standard versions of the habitat method are currently implemented as a part of the Landscape Fire and Environmental Monitoring Program. This program brings together several assessment types (flora, fauna, habitat, fuel and fire severity) to investigate the application of burning to achieve biodiversity and risk outcomes. The data will also help test the underlying models of each method including the faunal vital attributes model. The multiple objectives of the program influences how the monitoring areas and site locations are chosen. While the setup for this program is covered a separate document (*Protocol for establishing a landscape fire and environmental monitoring program*, *2012*), where the habitat method setup does differ for the Landscape program it will be outlined throughout this guide.

Table 1. Monitoring objectives relevant to this guide.

Monitoring objective	Purpose of monitoring	What to monitor	Where to monitor	When to monitor	Role in helping management activities
To determine the current growth stage of the habitat.	Verify that the observed growth stage of habitat is the same as the expected growth stage of habitat.	Habitat parameters.	Target areas of interest with a known disturbance history, e.g. choose one EVD and monitor an area/ areas that have a known disturbance history	Any time of year.	Provides land manager with accurate information about current stage of habitat development – useful for planning.
To determine habitat change over time.	Observe the natural growth of habitat and how that relates to the expected growth rate.	Habitat parameters.	Target areas of interest or priority, e.g. choose one EVD and monitor an area/areas that represent a range of disturbance histories	Any time of year and repeat at the same location at defined intervals.	Improves knowledge about how habitat parameters develop and how this is tied to growth stage development.
To determine event or action-driven habitat change, e.g. a planned burn.	Observe the change that events or actions cause to habitat.	Habitat parameters and event/ management action.	Target areas where an event or action is being implemented or has occurred, e.g. a planned burn.	• Prior to an action or event occurring (may not be possible if event is unplanned, e.g. wildfire). • Monitor the event or action (outside the scope of this report). • Undertake immediate post-event/action habitat monitoring. • Monitor habitat post-event at defined intervals, e.g. 2 yrs, 5 yrs, 10 yrs, 20 yrs.	Improves knowledge about the relationship between habitat and events or management actions that can alter the growth stage of the habitat parameters. Examples of events include fire and flood. Examples of actions include planned burns, logging and weeding.
To determine the association between habitat and fauna.	Explore the correlation between fauna presence and habitat type/ growth stage.	Habitat parameters and fauna.	Target sites that have or will have faunal surveys conducted.	At the same time or immediately before or after the fauna survey is conducted.	Improves knowledge about the habitat requirements of fauna. This knowledge is critical for land managers when planning management actions.
To determine the influence of fire severity on habitat change.	Explore the change that fires of different severities cause to habitat growth stage.	Habitat parameters and fire severity.	Target sites that are to be burnt – choose sites that will be burnt at different severities to gauge the range of effects that fire has on the habitat parameters.	• Pre-burn habitat assessment. • Immediate post-burn habitat assessment and a Fire Severity assessment • Post-burn habitat assessment at defined intervals, e.g. 2 yrs, 5 yrs, 10 yrs, 20 yrs.	• Improves knowledge about how fire severity influences the growth stage of habitat parameters. • Contributes to a better understanding about how the historical fire regime influences habitat parameter growth stage.

2. Select monitoring area

Once a monitoring objective has been identified, the area in which to conduct the monitoring must be selected. A monitoring area is a geographical area in which an assessor conducts an assessment (collects data). The area is typically small (e.g. the area of a planned burn), but may be as large as a region or the whole of Victoria.

One process for selecting a monitoring area, or monitoring areas, is:

1. Generate a list of all potential monitoring areas, based on the criteria outlined in Table 1.
2. Identify monitoring areas within the list that meet some or all of the following criteria:
   - New or different management practices
   - Contain EVDs that are a priority for monitoring (see Table 2)
   - Known histories of disturbance
   - Flora or fauna monitoring already being conducted
   - Satisfy local priorities
   - Accessible enough to justify the travel time.
3. Identify the EVDs within the monitoring area. If a monitoring area contains several EVDs, at least three plots should be established per EVD of interest. Dividing the monitoring area into sub-areas based on a particular variable of interest is called stratification (see Fig. 2). Stratify the monitoring area into EVD sub-areas and then decide which sub-areas are of most interest for assessment. This stratification is necessary as the development of the habitat parameters varies between EVD, so it is important to know which EVD the assessment is being conducted in.
4. Identify the number of years since the area was last disturbed. Stratify each EVD into sub-areas and then decide which of these sub-areas to assess. This is important as the habitat parameters will be at different stages of development in the different sub-areas.
5. If you want the monitoring to consider other factors (e.g. grazing or predator control), also stratify the monitoring area in relation to those factors, so that each assessment occurs in an area that is as uniform as possible.
6. Tally up the number of assessments required in the monitoring area, based on the number of stratification units identified (EVD, last year disturbed). At least two plots should be assessed in each stratification unit.
7. Determine the available resources to assist with monitoring. This will help determine the number of monitoring sites and stratification units that can be monitored. If there are not enough resources to monitor all stratification units, then select a sub-set of the most important units to sample.

If implementing monitoring as part of the Landscape Fire and Environmental Monitoring Program the area does not need to be stratified and instead plots are arranged on a systematic grid. More information about this is provided in Section 3 (6).

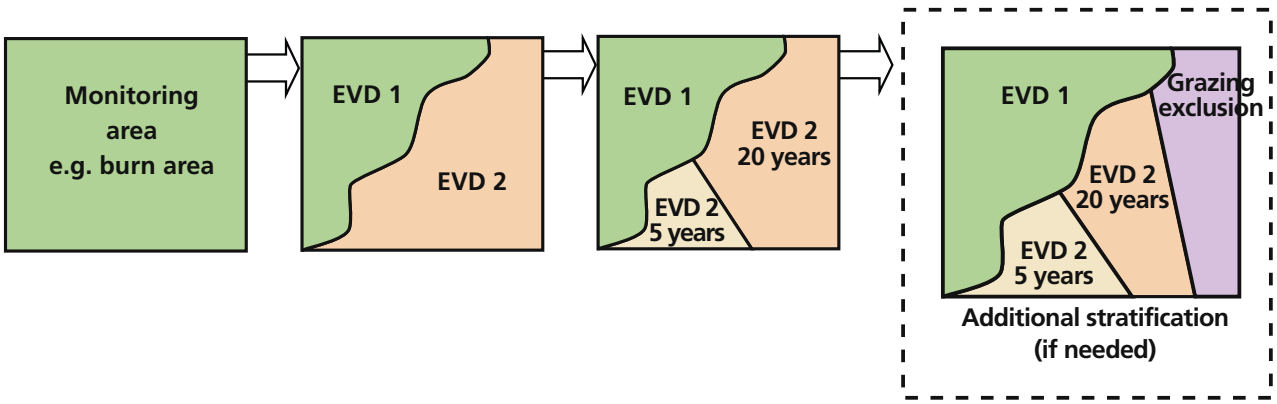
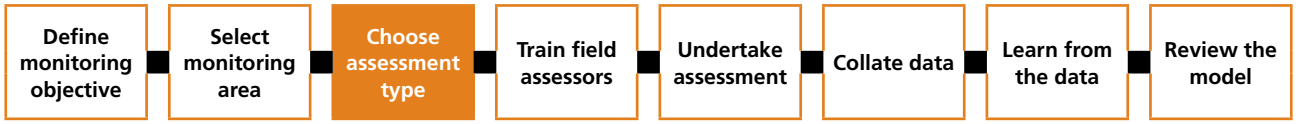


Figure 2. Stratification of a monitoring area by EVD, last-disturbed year and grazing.

3. Choose assessment type



Once the monitoring area and available resources have been determined, the type of habitat assessment to conduct can be chosen. This section introduces the assessment types and the skill and time requirements for each. Ensure that you can meet the requirements before starting an assessment.

Habitat assessment types

There are four habitat assessment types in this guide:

- Standard Forest Habitat Assessment
- Standard Mallee Habitat Assessment
- Basic Forest Habitat Assessment
- Basic Mallee Habitat Assessment.

Checking assessment type requirements

The EVD in which you conduct the assessment will determine whether to conduct the forest or mallee habitat assessment type.

As a rule DSE and PV staff conducting monitoring as part of the fire monitoring program should implement the **Standard** Forest or Mallee Habitat Assessment.

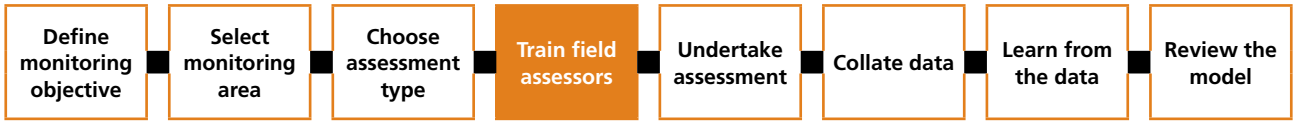
School and community groups that may not have the skills or resources to undertake the standard version of the method can instead use the Basic Forest or Mallee Habitat Assessment.

Table 2 describes the requirements for each habitat assessment type, including the EVD it should be conducted in.

Table 2. Requirements for each of the habitat assessments. The EVDs in bold are those considered in the model developed by ARIER and are a priority for monitoring.

Assessment type	EVD	Skill required	Time commitment
Standard Forest Habitat Assessment	**3 – Grassy heathy dry forest** 4 – Damp scrub 5 – Freshwater wetland (permanent) 6 – Treed swampy wetland **7 – Tall mixed forest** **8 – Foothills forest** **9 – Forby forest** **10 – Moist forest** 11 – Riparian (higher rainfall) **12 – Tall mist forest** 13 – Closed-forest 14 – High altitude shrubland/ woodland 15 – High altitude wetland 17 – Granitic hillslopes **22 – Dry woodland (non-eucalypt)** **23 – Inland plains woodland** **24 – Box ironbark** **25 – Riverine woodland/ forest** 26 – Freshwater wetland (ephemeral)	At least one assessor should have skills in tree species identification, or local knowledge of the tree species occurring in the monitoring area.	Requires about 1.5 days per EVD within the monitoring area (assumes 3 plots are assessed). Monitoring areas must be reassessed several times over a 50-year period, e.g. 2, 5, 10, 20, 30, 40 and 50 years.
Standard Mallee Habitat Assessment	1 – Coastal **2 – Heathland (sands)** 16 – Alpine treeless 18 – Rocky knoll 19 – Western plains woodland 27 – Saline wetland 28 – Chenopod shrubland **29 – Saltbush mallee** **30 – Hummock-grass mallee** **31 – Lowan mallee** **32 – Broombush whipstick** **20 – Basalt grassland** 21 – Alluvial plains grassland	At least one assessor should have skills in tree species identification, or local knowledge of the tree species occurring in the monitoring area.	Requires about 1.5 days per EVD within the monitoring area (assumes 3 plots are assessed). Monitoring areas must be reassessed several times over a 50-year period, e.g. 2, 5, 10, 20, 30, 40 and 50 years.
Basic Forest Habitat Assessment	Same EVDs as the Standard Forest Habitat Assessment.	Assessors of all skill levels can undertake assessment.	Requires about 1 day per EVD within the monitoring area (assumes 3 plots are assessed). Monitoring areas must be reassessed several times over a 50-year period, e.g. 2, 5, 10, 20, 30, 40 and 50 years.
Basic Mallee Habitat Assessment	Same EVDs as the Standard Mallee Habitat Assessment, except for EVD 20 and 21 which should only be assessed using the standard method.	Assessors of all skill levels can undertake assessment.	Requires about 1 day per EVD within the monitoring area (assumes 3 plots are assessed). Monitoring areas must be reassessed several times over a 50-year period, e.g. 2, 5, 10, 20, 30, 40 and 50 years.

4. Train field assessors



After the monitoring project has been planned, the field assessors will need to be trained to undertake the assessment. Training should only be conducted by someone who has been trained in how to deliver the habitat monitoring training. For training requests please contact your local DSE fire ecology staff or send an email to the fire monitoring inbox – firemonitoring@dse.vic.gov.au.

Topics that should be covered in the training are:

- Context – where does habitat monitoring sit in the fire monitoring program
- Assessment method and completing the datasheet
- Proper use of field equipment
- Using a Global Positioning System (GPS) to navigate to waypoints and record them
- Using the Argus database for storing the monitoring data
- Using safe and healthy work practices.

The data from individual assessors can be compared to make sure that the data they collect are consistent with the data from other assessors. To do this, ask each person to assess the same plots during the training.

Record the assessors' names on the top of the datasheet and enter this into Argus. Retaining this information is important as it helps keep the assessors responsible for their data, helps future users of the data to track and filter the origins and credibility of data, and enables assessors to establish credibility for themselves as data collectors.

5. Undertake assessment

Undertaking an assessment

Before starting an assessment, ensure that you have the appropriate equipment and have complied with the relevant health and safety procedures. Section 3 (2) provides a list of equipment required to undertake each assessment.

Follow the directions in Section 4 to undertake an assessment.

If possible, record how long it takes to measure a plot or a series of plots. These times can assist with future resource planning.

Suggested timeline for monitoring

The habitat assessment can be conducted at any time of year, as the structural features of the habitat that are being assessed are not strongly influenced by season. Instead, the objective of the monitoring should influence when the monitoring is conducted.

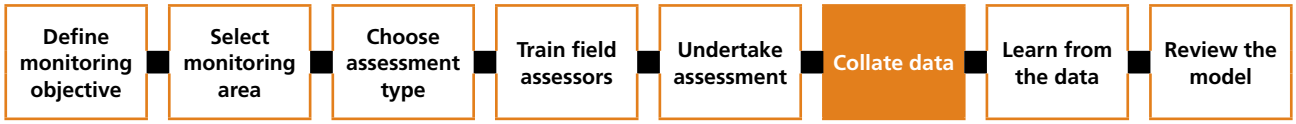
After an assessment has been conducted, monitoring needs to be repeated at the same location at specified time intervals. Below is a suggested timeline for monitoring. Shorter time intervals may be required if the monitoring area undergoes a significant change (e.g. due to an event or management action occurring), or longer time intervals may be needed if the monitoring area has not experienced any change (although no change is still important to record).

Table 3. Suggested timeline for monitoring habitat.

Stage	Timing	Action
Stage 1	Pre-action or event	Implement monitoring
Stage 2	Immediately post-action or event or Begin monitoring at 'Year 0'	Monitor 'changed state' or Implement monitoring
Stage 3	Year 2 (optional if monitoring is not implemented following a major change to habitat, e.g. after fire)	Repeat monitoring
Stage 4	Year 5	Repeat monitoring
Stage 5	Year 10	Repeat monitoring
Stage 6	Continuing every 10 years	Repeat monitoring

Return to Stage 2 following any event- or action-driven change, and begin working through the stages again.

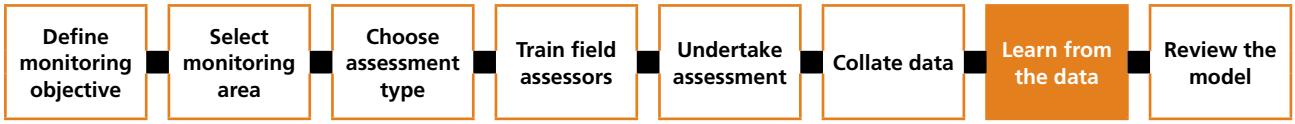
6. Collate data



Collating data

All of the monitoring data collected is to be stored in secure monitoring evaluation and reporting database curated by DSE. This database is currently being developed to align with changes to DSE's monitoring, evaluation and reporting requirements.

7. Learn from the data



Monitoring is more than just collecting data. It is also about making sense of what is observed in relation to the context it is observed in. Making sense of the data creates new knowledge, which in turn can lead to new or improved ways of doing things.

While statistical analysis of the data is required to ascertain the significance of the monitoring data, such analysis is beyond the scope of this guide. Instead this section will address each of the monitoring objectives and explore how the data can be used in the future to inform management decisions.

For monitoring to be meaningful, it needs to link back to the original question or purpose to address whether the objective was achieved or not. While most of the questions in this guide have a long-term focus, there will still be shorter-term indicators that point to whether the objectives are being met. As displayed in Box 2, the learnings will occur at different levels and needs to be fed back into each level of the cycle in order to improve future practices. If the objectives are not being met, it may point towards a new or different management action being required. Below example monitoring objectives, and how the data collected can inform management decisions in the future, is discussed.

Monitoring objective:

- **To determine the current growth stage of the habitat**
- **To determine how the growth stages of habitat change over time**

The data collected will provide the land manager with an accurate record of the current growth stage of habitat. The data collected will improve understanding about how the habitat parameters develop over time individually and collectively. Monitoring habitat change over time allows the change to be recorded in a consistent way so that the change can be modelled. Understanding how habitat changes and whether this change is linked to the growth stage of the vegetation is crucial to being able to predict growth stages in the future. Using space for time substitutions will allow the habitat development across the full range of growth stages to be modelled for each parameter individually and for each EVD as a whole. The monitoring will also validate whether EVDs are an appropriate vegetation classification system for assessing habitat. Land managers can use these models to predict and map how the habitat will look in the future. Continued monitoring over time will strengthen the assumptions of the model, giving more confidence to the predictions. .

Monitoring objective:

- **To determine event- or action-driven habitat change, e.g. fire**

Monitoring events or actions in relation to habitat change is critical to understanding the influence that events have on re-setting the growth stage of the habitat parameters. The type, extent, scale and intensity of the event/action will influence the growth stage of the habitat parameters differently. Some parameters may be greatly affected after the slightest disturbance, while others will require disturbances of greater magnitude to be affected. The data collected from the monitoring will increase land managers' understanding of how habitat is influenced by events or action, and allow them to then predict how future events or actions will influence the habitat. Monitoring the outcomes of their actions to see if they matched their predictions will allow the land manger to test the strength of their predictions and, over time, improve their predictive power through continued application and monitoring of actions and events.

Monitoring objective:

- **To determine the association between habitat and fauna**

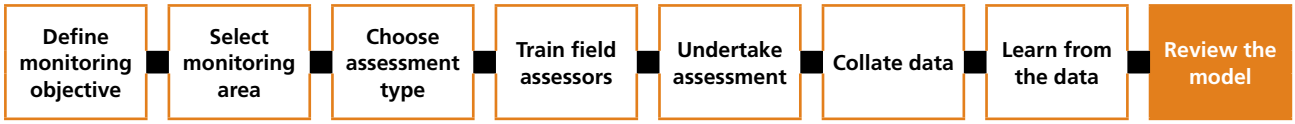
Ultimately, the reason for monitoring habitat is to understand how it influences fauna. Understanding what drives and promotes the presence and abundance of fauna is crucial. Most of the actions undertaken by land managers influence the land and thus the habitat. Knowing how these actions change the habitat and ultimately the fauna will allow land managers to make more informed management decisions based on science. Understanding the dynamic between habitat and fauna will allow land managers to use habitat as a surrogate for faunal occurrence and be predictive about how their management actions will influence species. Collecting data about the habitat and relating it to faunal information will allow any patterns or relationships to emerge. As these relationships begin to emerge, they will guide where to conduct future monitoring so that the strength of the relationships can be tested. Pairing the habitat data with the faunal data will also highlight knowledge gaps and areas that need to have greater focus. This knowledge will help land mangers to be more strategic about their placement of monitoring sites in the future.

Monitoring objective:

- **To determine the influence of fire severity on habitat change**

Fire is a common but necessary disturbance to the environment of Victoria and Australia. However, the severity of the fire will influence the extent of the disturbance with not all fires completely resetting every habitat parameter back to its original growth stage. Monitoring the fire severity and the resulting change to each habitat parameter, and to the habitat as a whole, will help land mangers better understand how fire will affect the growth stage of the habitat. This understanding will allow them to make better-informed decisions about when, where and how to apply fire in the landscape and to be more confident about achieving their desired outcomes.

8. Review the model



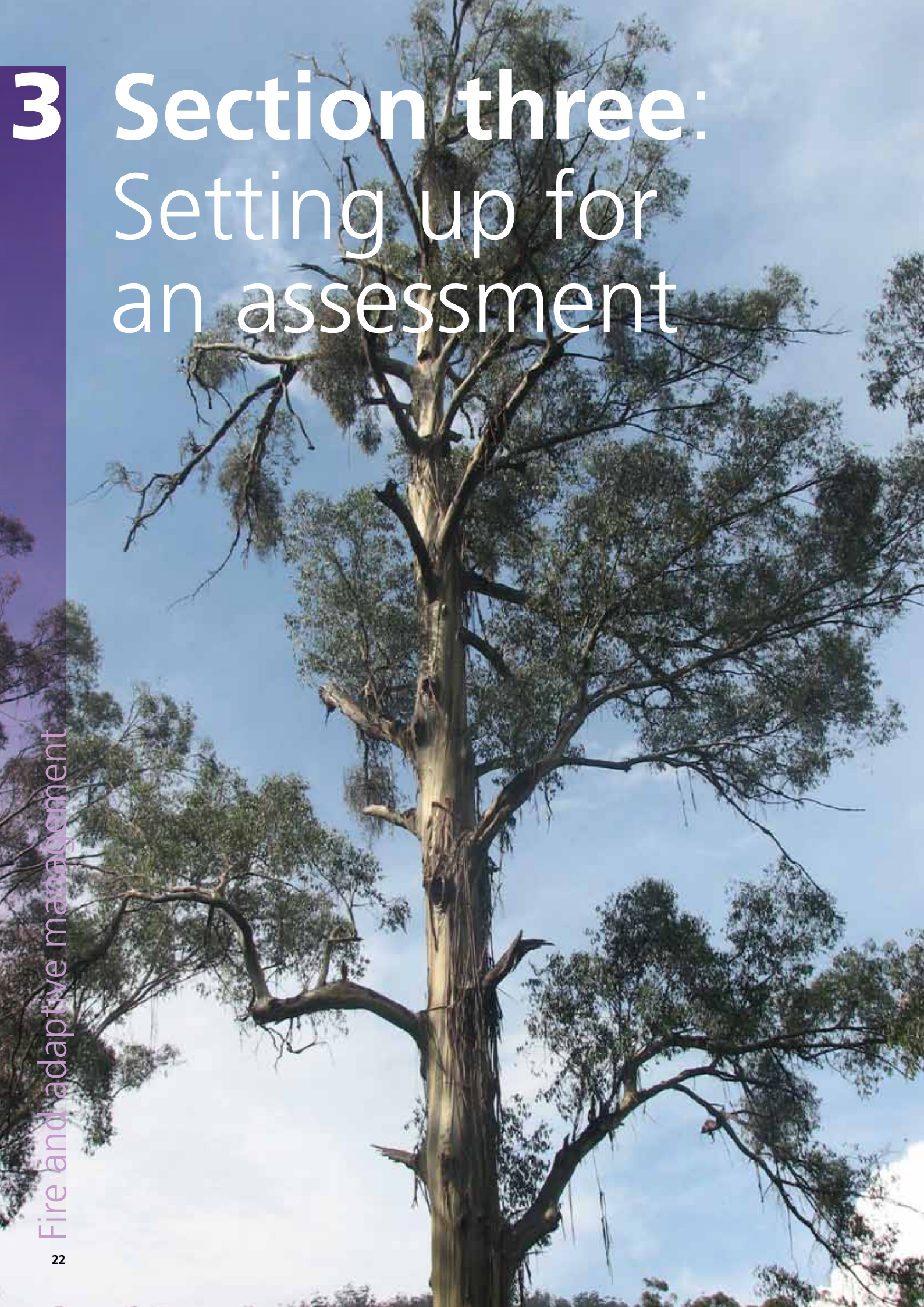
The final stage in the adaptive management cycle is to review the model, based on the learnings from the monitoring. In this case, we are testing the assumptions of the fauna vital attributes model.

If monitoring validates the assumptions of the model, this suggests the model is accurately reflecting the real-world situation; therefore, the model does not need changing. To increase your confidence about the accuracy of the model, continue to implement monitoring. If the results from the monitoring continue to support the model, then perhaps target your monitoring to a new scenario where you may learn something new.

If the monitoring observations do not support the assumptions of the model, then look for reasons as to why this may be the case. Unexpected outcomes may be the result of factors not considered in the model (e.g. grazing or drought), rather than because the model is incorrect. Look for associations between possible causes and the monitoring outcomes, though it can be difficult to attribute a change to a cause, especially if the amount of data is small. Unexpected outcomes may also be a result of measurement error or observer bias.

To determine the validity of these unexpected outcomes, more monitoring should be implemented to strengthen the confidence of what has been learnt. If the unexpected outcome continues to occur, then the model may need revising. An unexpected outcome may also signal the need to change or refine a management action to achieve a more desired outcome. In this case, other factors, such as the objective of the action, may need to be considered.

3 Section three: Setting up for an assessment



Section three: Setting up for an assessment

Setting up for an assessment is the same for both standard and basic assessments, and is covered at the start of this section.

1. Time and resource requirements

The standard habitat assessment takes approximately 3.5 hours to complete – 1 hour per transect plus plot set-up time. The basic habitat assessment takes approximately 2.5 hours to complete – 40 minutes per transect plus plot set-up time. These times are based on two people working together, but will vary depending on the density of trees and logs and the experience of the assessors.

2. Equipment required

Table 4. List of equipment required to undertake a habitat assessment.

Equipment	Paperwork	Stationery
• Star picket – 4 per plot • GPS – at least 1 per group • Compass – at least 1 per group • Ruler – 1 per pair • 50- or 100-metre measuring tape – at least 1 per pair • Diameter tape (5 metres or 10 metres) – 1 per pair • Structure pole divided into categories of 0–0.2 metres 0.2–0.5 metres, 0.5–1 metre and 1–2 metres for the standard habitat assessment; and 0–0.5 metres, 0.5–1 metre and 1–2 metres for the basic habitat assessment – 1 per pair (see Box 5 for how to make a structure pole) • Binoculars (for hollow spotting) • Digital camera • Flagging tape	Datasheets required per plot Standard field datasheets: • 1 copy of the site information datasheet per plot • 3 copies of the point datasheet (the mallee point datasheet is 3 pages long – 3 copies of each page are required) • 6 copies of the CWD datasheet • 6 copies of the first tree characteristics datasheet (more may be required if there are many trees along the transect) • 3 copies of the second tree characteristics datasheet (has space for tree species totals) • 3 copies of the tree stump datasheet • 3 copies of the comments datasheet per plot • Mallee version only – 3 copies of the triodia datasheet Basic field datasheets: • 1 copy of the site information datasheet • 3 copies of the point datasheet (the mallee point datasheet is 3 pages long – 3 copies of each page are required) • 6 copies of the first CWD and tree characteristics datasheet (more may be required if there are many trees or logs along the transect) • 3 copies of the second CWD and tree characteristics datasheet • 3 copies of the comments datasheet • Mallee version only – 3 copies of the triodia datasheet	• clipboard – 1 per pair • Pencils • Eraser

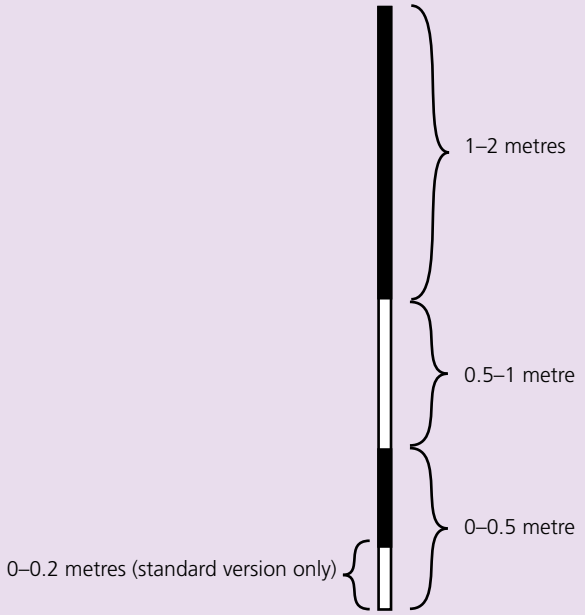
Box 5: Making a structure pole.

A structure pole can be made out of any material, e.g. wood, metal or plastic. However, for this assessment, a 2-metre structure pole is required, which can be difficult to transport to the field. To overcome this, we suggest making a structure pole using two pieces of electrical conduit and a joiner. This allows the structure pole to be taken apart for easy transport. It will take about 20 minutes to make.

Instructions:

1. From your local hardware store, purchase a piece of electrical conduit exactly 15 millimetres in diameter and at least 2 metres in length, and a joiner.
2. Using a saw, cut the electrical conduit in half to create two 1-metre poles.

3. Glue the male part of the joiner on to one pole and the female part of the joiner to the other pole (see picture on left).
4. Screw the two poles together.
5. Measure the length of the pole when joined together.
6. Saw off any excess electrical conduit to make the total length exactly 2 metres.
7. Use a permanent marker or coloured tape to mark out height sections along the pole – 0.5 metres and 1 metre for the basic habitat assessment; 0.2 metres, 0.5 metres and 1 metre for the standard habitat assessment (see diagram below).



3. Assessor requirements

The standard habitat assessment is designed for people with some skill and experience in ecological sampling of terrestrial environments, thus it is expected that, as a rule, staff should undertake the standard assessment. The basic habitat assessment is designed for people with no specialised knowledge or skill in environmental sampling, such as school groups or community groups that want to participate in monitoring but may not have the skills or time to undertake the standard assessment.

Participation in a training session is necessary before undertaking either a standard or basic assessment, to ensure all assessors interpret the instructions in the same way.

4. Timing

A habitat assessment can be conducted at any time of year, as the structural features of the habitat being assessed are not influenced by season. Instead, the objective of the monitoring should influence when the assessment is conducted. For further information on monitoring objectives refer to Section 2 (1).

The *guide to monitoring habitat structure* focuses on observing change to habitat parameters at a landscape scale; therefore, monitoring does not need to be tied to a particular burn event. This is because fauna have the ability to move around the landscape and changes to habitat at a particular location may not influence the presence of fauna within the landscape, but rather influence their location in the landscape.

If the objective of the monitoring is to observe the relationship between the habitat parameters and growth stage, the monitoring can be conducted at any time of year. It should be repeated as the vegetation progresses into different growth stages.

If the objective of monitoring is to observe the relationship between fire severity and change to habitat, monitoring should be conducted during the six months prior to a burn being implemented. Post-burn habitat monitoring should be conducted a few weeks after the burn, in conjunction with the fire severity assessment. It is important to record fire severity, as it may be variable throughout the monitoring area, with some parts of the habitat showing marked change and other parts showing little or no change.

5. Select monitoring area

The monitoring objective will dictate the choice of monitoring area for each assessment. For example, if the objective is to monitor habitat change as a result of a planned burn, then monitoring will be targeted at an area that is to be burnt. If, however, the objective is to monitor natural habitat change over time to help refine the relationships defined by the model, then monitoring can be targeted at any area with a known EVD and growth stage. These are just some of the objectives of monitoring habitat. For further guidance on developing a monitoring objective and choosing a corresponding monitoring area refer to Section 2 (1) and (2).

6. Choose plot location

A habitat assessment can be conducted in the EVDs listed in Table 2.

If your habitat monitoring is being conducted as part of the Landscape Fire and Environmental Monitoring Program you do not need to stratify the monitoring area as the plot locations will be chosen by a systematic grid setup. For further guidance follow the instructions in the "*Procedure for establishing a landscape fire and environmental monitoring program*".

For habitat monitoring conducted in all other areas please follow the instructions below:

a. Obtain a map of the monitoring area that shows contours, watercourses, roads, EVDs and a coordinate grid. Stratify your monitoring area by EVD and last-burnt information (see Figure 2).

b. Determine the number of plots you will need to assess in the area (see 7, below), which will be determined by:
   - Number of EVDs in the monitoring area
   - Number of growth stages within each EVD
   - Size of the monitoring area
   - Resources and time available for monitoring.

c. Using your map of the area, identify potential locations for the plots in each stratification unit. If practicable, first drive around the perimeter of the monitoring area to get an idea of the site characteristics and best potential locations for plots. Ideally, plots should be located where:
   - Access is reasonably easy
   - Roads and tracks are at least 50 metres away from the end point of each transect, to avoid edge effects
   - Vegetation is representative of the EVD in the area
   - There is at least 500 metres between the centre-point of neighbouring plots
   - The area meets the objective of the monitoring.

d. Randomly select your plot locations for each stratification unit, e.g. number each potential plot and then draw numbers out of a hat to select the required number of plots.

   N.B. If the monitoring objective is related to a burn event, consult with the Fire Management Officer or Burn Officer in Charge to find out how they expect to conduct the burn. This will provide further guidance on placing plots in locations that are more likely to represent the variation across the burn.

e. Navigate to the first plot, take a GPS reading and record the coordinates of the data-point in the field datasheet. Also, mark them as a way-point within the GPS. On the datasheet record the:
   - Full easting and northing coordinates using the Geocentric Data of Australia (GDA 94). Both coordinates have seven digits, but the datasheet already shows the first digit of the easting, which in Victoria is always zero.
   - Zone, i.e. Zone 54 or 55
   - GPS accuracy in metres (should be better than 10 metres). You may need to wait a little longer until the GPS acquires signals from more satellites.

7. Number of plots and spacing

The size and variation within the monitoring area will influence the total number of windmill-shaped plots required. It is recommended that monitoring should be conducted at a minimum of three plots for both the standard and basic habitat assessment. This should be used as a guide only, as ultimately the monitoring objectives, size of the monitoring area and stratification units within the monitoring area will determine the monitoring effort required.

There should be a minimum of 500 metres between the centre-points of neighbouring plots to ensure independence between neighbouring plots. This may need to be reduced or increased, depending on the size of the monitoring area.

8. Set up plot

Below are the instructions for setting up a habitat plot. It is important during the initial plot setup to take the time to ensure the transects are laid out as straight and as tight as possible. This will help ensure that assessors returning to the site to conduct repeat assessments are sampling along the same lines as when the plot was first set up.

a. After navigating to the chosen centre-point of the plot, use the compass to face north.

b. Use a star picket to mark the centre-point of the plot.

c. Anchor the 100-metre measuring tape to the star picket at the centre-point of the plot.

d. Using the compass as a guide, hold the measuring tape in your right hand and run the tape out to 50 metres, staying on a bearing of north and keeping the measuring tape as tight as possible. This may be difficult if trees and shrubs get in the way, but do your best to stay as close to the compass bearing as possible and not let the tape measure droop between plants.

e. On steep slopes where walking along the left side of the measuring tape may affect the right side (e.g. if the left side is the up slope) you may switch to walking along the right side (the down slope) and undertake measurements on the left side. Record this change on the front page of the datasheet under variations to the method.

f. Once at the 50 metre mark, gently tug on the tape measure to make the transect as straight and as tight as possible. Mark the end of each 50-metre transect with a star picket.

g. Mark the trees at the midpoint of the transect with fluorescent paint. This will increase the likelihood that transects laid out for repeat assessments will be laid along the same line as before.

h. Walk back to the centre of the plot along the same side of the measuring tape as you walked out on. This is to avoid trampling the vegetation (keep the measuring tape on your left side when walking back to the centre, unless you are on a slope that prevents this).

i. If the transect is curving straighten it as much as possible.

j. Repeat this process for the angles of 120° and 240°, so that three 50-metre transects are laid out (shown in black in Figures 3 and 4).

The sampling design for the Standard and Basic Forest Habitat Assessment is slightly different than the one used for the Standard and Basic Mallee Habitat Assessment. The figures below show the different sampling set-up.

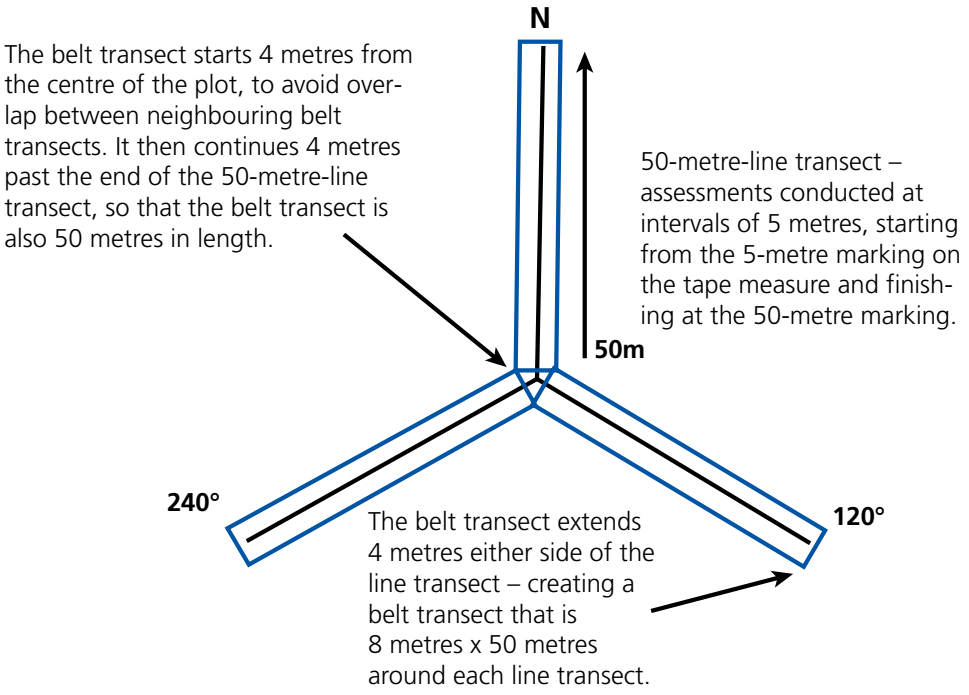


Figure 3. Set-up of the plot for the Standard and Basic Forest Habitat Assessment.

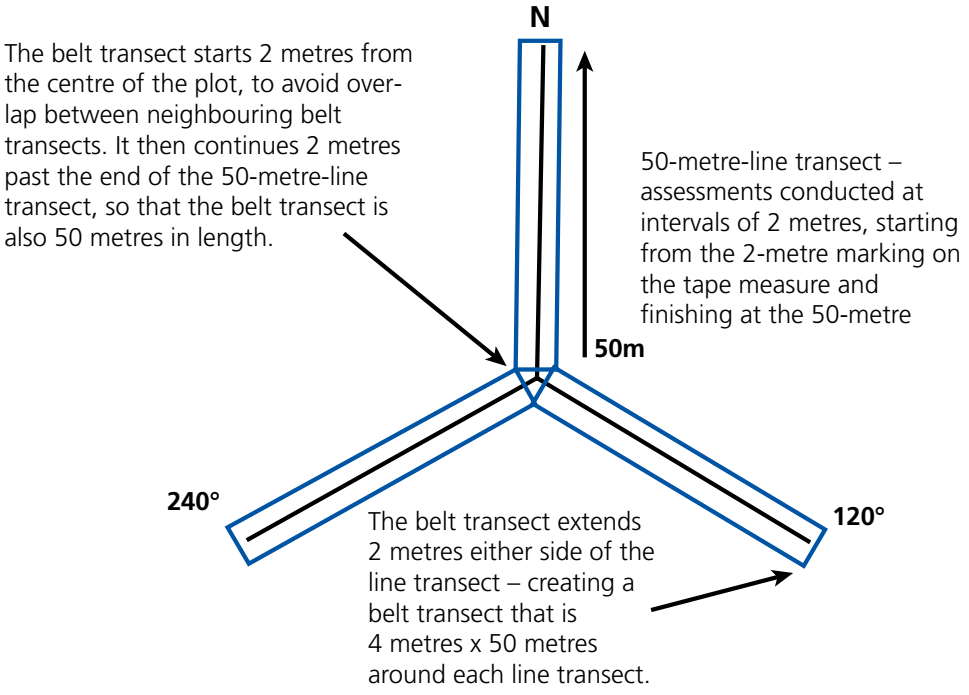


Figure 4. Set-up of the plot for the Standard and Basic Mallee Habitat Assessment.

Box 6: Alternative plot setup

Number of transects

There may be cases where the windmill shaped plot will be inappropriate or unnecessary for sampling a particular habitat type e.g. in linear riparian strips or strips of vegetation along a roadside. In these examples the windmill shaped plot will be too large to fit and instead one long transect can be used. By joining the three 50 metre transects together to create one long 150 metre transect, the same number of points and same area will be sampled. While the one long transect will not reduce the bias for slope if the linear strips are largely flat this will not be an issue. If there is an effect of slope, then multiple transects will need to be sampled to effectively assess the variation of slope.

Transect length

While 50 metre transects are the standard method setup if the assessment is being conducted in an area with very thick and continuous vegetation it may be more efficient to reduce the length of the transect to a minimum of 20 metres and implement more plots to pick up the variation. The continuity and consistency of the vegetation should be used to determine how long the transect needs to be but keep in mind that reducing the length of the transect will also potentially reduce the number of logs and trees that will be assessed so consider their spacing before choosing to reduce the transect length.

In fragmented areas where monitoring areas will be small it is unlikely that plots with 50 metre transects will fit inside the monitoring area without interfering with each other. To ensure independence between the plots and so that more than one plot can be sampled reduce the length of the transects so as to fit in more plots and still have independence between each plot.

Belt transect width

If the trees are widely spaced the specified belt transect area may not be large enough to sample an adequate number of trees. If this is the case the belt transect will need to be widened. Remember however that to ensure the belt transects do not overlap near the centre point of the plot they will need to start further away from the end of the line transect and finish further away from the centre point to ensure this doesn't happen. For every metre that is added to the belt transect width an extra half a metre will need to be added to the start point of the belt transect eg if the belt transect is 10 metres wide it will need to start 5 metres past the end of the line transect (at the 55 metre mark) and finish at the 5 metre mark of the line transect.

Recording changes on the datasheet

If any changes are made to the standard plot setup they must be recorded on the first page of the datasheet in the space provided.

9. Sampling design

Starting at the first interval (5 metres for forest; 2 metres for mallee) assess the following parameters at each interval (every 5 metres for forest; every 2 metres for mallee) along each line transect:

- Organic litter
- Ground cover
- Vegetation structure.

Assess the following parameters when they intersect with the line transect:

- Coarse woody debris
- Hollows in logs.

Around each line transect, create an imaginary belt transect (shown in blue in Figures 3 and 4) by walking along the line transect and using the structure pole or a small measuring tape to determine the outer edge of the belt transect. For the Standard and Basic Forest Habitat Assessments, the width of the belt transect is 8 metres, i.e. the belt transect extends 4 metres either side of the line transect (see Figure 3). For the Standard and Basic Mallee Habitat Assessments, the belt transect is 4 metres wide, extending 2 metres either side of the line transect (see Figure 4).

For the forest habitat assessments, the belt transect needs to start 4 metres past the end of the line transect and finish 4 metres from the centre of the plot. This is so the belt transects do not overlap each other in the middle of the plot but are still 50 metres in length.

For this same reason, when undertaking the mallee habitat assessments, the belt transect needs to start 2 metres past the end of the line transect and finish 2 metres from the centre of the plot.

The final shape of the plot will resemble a windmill.

Assess the following parameters within the area contained by the belt transect:

- Trees
- Tree stumps.

Mallee method only:

Assess the following parameters at the 25 and 50 metre mark of each line transect:

- Triodia

Suggestion: To improve sampling efficiency, assessors can work in pairs – one as scribe and the other undertaking the assessment. If there are multiple pairs, each pair should work on a separate transect of the windmill. Working from the centre-point of the plot, each pair should measure organic litter depth, ground cover and vegetation structure on their way down the line transect. In the mallee Triodia should also be measured on the way down the transect. On their way back up the line transect, towards the centre-point of the plot, the pair should assess coarse woody debris, trees and tree stumps.

10. Complete datasheet

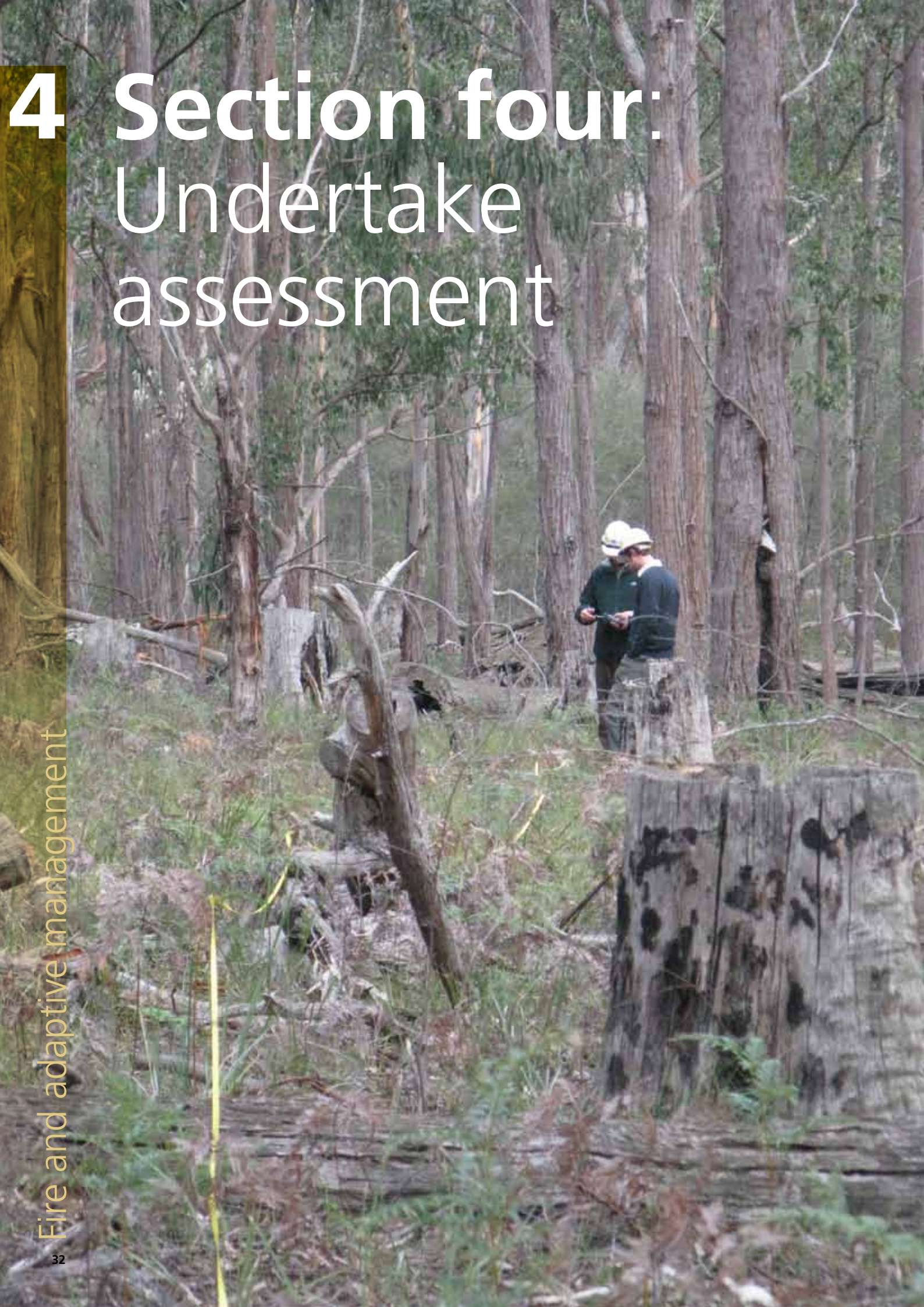
Fill in the first page of the datasheet before beginning data collection. This datasheet records important information about the plot, which is required so it can be revisited in the future. Most of this information can be filled in at the office prior to going out in the field. It is important to record a value in every box on the datasheet. For values that are absent, record an A or draw a line through the box. Do not leave any blank space. A blank space means the parameter has not been assessed; it does not mean 'absent'.

The table below outlines the general information to be recorded on the first page of the datasheet:

Table 5. Example of the type of information to be recorded on the first page of the datasheet.

Field	Details
Monitoring area name	For example, Silvan Reservoir.
Data-point grouping name	Unique name identifying the assessment type and group of plots being used, e.g. SFHA Grey Gum Track for the Standard Forest Habitat Assessment conducted on Grey Gum Track.
Assessor's name and organisation	Record the names and organisations of the people responsible for collecting the data and indicate any person(s) responsible for any species identification.
Assessment date	Date that the assessment took place in the field.
Ecological Vegetation Division (EVD) and Ecological Vegetation Class (EVC)	Use a map to identify the EVD and EVC and then verify this in the field. You can find EVC maps on FireWeb or on the DSE external website. Search for 'interactive maps' and then open 'biodiversity interactive map'.
Number of years since the area was last burnt	Use a map to identify the year that the area was last burnt and then verify this in the field. You can find fire history maps on FireWeb or on the DSE external website. Search for 'interactive maps' and then open the 'fire plan map'.
Further comments about fire regime	Record anything that doesn't seem to fit with the known fire history, e.g. evidence of fire in long-unburnt sites.
Further comments about other variables	Record information about the area, particularly in relation to drought, grazing or other factors that may be influencing the site.
Plot name	Unique code for each windmill-shaped plot, e.g. GGT01 for Plot 1 of the Grey Gum Track data-point grouping. Choose codes that are easy to enter into the GPS and least likely to become confused with plot names from other assessments over the years.
Plot location description	Brief description of how to find the plot and any significant landmarks that will make it easier to find.
Coordinates and GPS accuracy	Full easting and northing coordinates of the: • Centre-point of the plot • End-point of each line transect. Record the accuracy of each coordinate as displayed on the GPS.
Length of line transect	Will only be different to that specified in the plot set-up if monitoring is being conducted in a system other than forest or mallee, e.g. grassland, linear strips.
Diameter of structure pole	Should be the same as that specified in the equipment list.
Distance between each interval along transect	Will only be different to that specified in the plot-set up if monitoring is being conducted in a system other than forest or mallee, e.g. grassland, linear strips.
Total width of belt transect	Will only be different to that specified in the plot set-up if monitoring is being conducted in a system other than forest or mallee, e.g. grassland, linear strips.
Variations made to standard method	Only applies if the methods specified do not suit the system being monitored, i.e. if these methods are being applied in systems other than forest and mallee.

4 Section four: Undertake assessment



Section four: Undertake Assessment

This section outlines how to undertake either a standard or basic habitat assessment, in both forest and mallee habitats.

Important information

The method:

- Is the same for both forest and mallee habitats, unless specified. In this case, separate instructions are provided.
- Is almost identical for the standard and basic assessment. If there is no indication of method version, follow the outlined method when completing both the standard and the basic versions of the assessment. Where the method differs, there will be specific steps outlined for each version of the assessment. Complete only those steps outlined for the assessment type you are conducting.
- Must be repeated for each line transect of the plot – N, 120° and 240°.

The assessment method is divided into four parts:

i. **Monitoring at points along the line transect**
ii. **Monitoring at a subset of points along the line transect**
iii. **Monitoring at intersections with the line transect**
iv. **Monitoring inside the belt transect.**

The field datasheets, reflect the method provided for each habitat parameter and provide a space for each observation to be recorded. There are separate datasheets for each level of assessment (standard and basic) and each habitat type (forest and mallee).

Note: A shortened version of each method is provided in Section 6, to be used when in the field. These methods, although comprehensive, do not contain the complete method description for each habitat parameter. They should only be referred to after the complete method contained in this manual has been read and fully understood. It is recommended that the pages containing the tables of categories should be printed out and laminated for use in the field.

After setting up for the assessment, record the following information about the transect as a whole:

- Plot name – the name of the plot that the transect belongs to.
- Transect angle – the angle at which the transect has been laid out.
- Position on slope and aspect of transect – whether the transect is located on a ridge, gully, slope or flat, and the aspect the transect is facing if on a slope (N, S, E or W).

Box 7: Photographing the plot.

It may be useful to photograph the plot to create a visual reference. First, prepare a label for your photo, displaying the name of the monitoring area, the name of the plot and the date. Try and take the photo when there are few shadows, e.g. in the middle of the day when the sun is directly overhead or when the sun is behind a cloud.

Stand in the centre of the plot facing toward the first line transect. Have someone hold the photo label in the corner of the photo so that it is close enough to read but does not obstruct the photo too much. Take the photo and record the photo number on the first page of the datasheet. Repeat this process for the other transects. If the vegetation is particularly dense, it is also recommended to take a photo at the end of each transect, looking back toward the centre of the plot.

1. Monitoring at points along the line transect

a. Where to conduct the assessment

Forest: 5-metre intervals along the line transect.
Mallee: 2-metre intervals along the line transect.

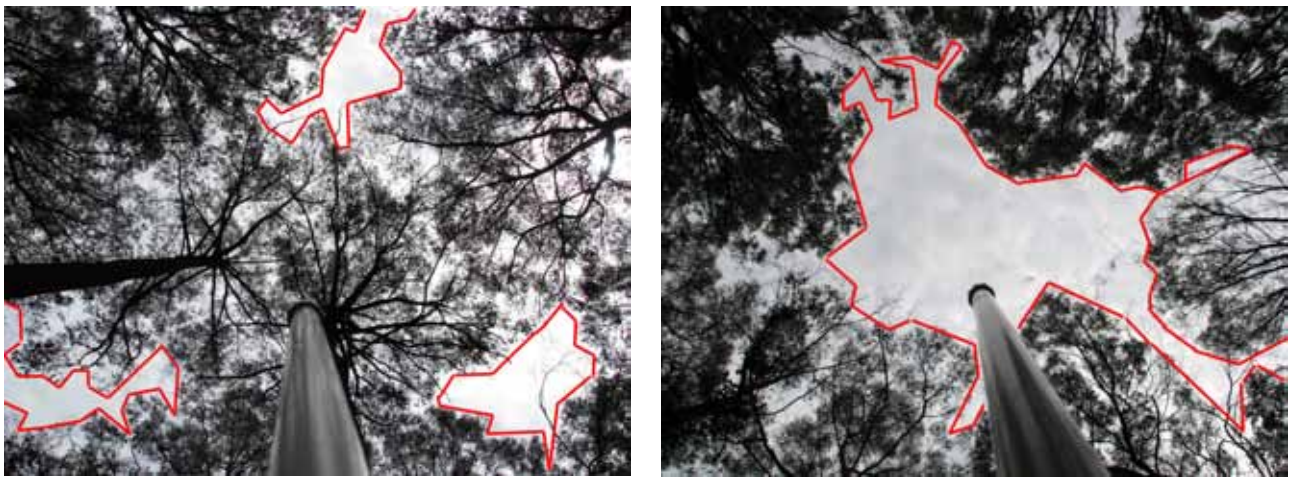
Assessments should be conducted directly beside each mark along the measuring tape used to lay out the line transect (referred to as the assessment point throughout the method). The assessments should be made on the opposite side of the measuring tape to that which was walked along when setting up the line transect.

b. Crown cover

Equipment: Structure pole

Crown cover is assessed as presence or absence of the upper-most layer of canopy (most commonly eucalypts) above each assessment point along the line transect.

- Place the structure pole vertical to the ground at each assessment point along the line transect (Forest: every 5 metres, Mallee: every 2 metres). Make sure the structure pole is placed directly beside each mark along the measuring tape, on the opposite side of the measuring tape to that which was trampled during plot set-up.
- Look up along the line of the structure pole towards the canopy.
- If the structure pole continued all the way up to the eucalypt canopy and would pass within the bounds of any tree crown, record this as present (P). Within the bounds means that if a polygon was traced around the tree crown, the structure pole would sit inside the area contained by the polygon. If crowns are overlapping, the polygon should be traced around the entire area covered by the overlapping crowns.
  - If the structure pole would sit outside the area contained by the polygon, i.e. in between tree crowns, record this as absent (A). Use Figure 5 as a guide.



A. **B.**

Figure 5. Images showing canopy with polygons traced around the bounds of the tree crowns.
In example A, the structure pole is sitting within the bounds of the crown so crown cover would be recorded as 'P', but in example B the structure pole is sitting outside the crown so would be recorded as 'A'.

c. Sub-canopy **(Standard forest habitat assessment only)**

Equipment: Structure pole

Only recorded in EVDs with a clearly present sub-canopy layer.

In some vegetation types, a distinct sub-canopy layer will be present. This will usually occur in tall forest where eucalypts form the upper-most canopy and species such as acacias and wattles will create a lower canopy layer. It may also occur where there are young or regenerating eucalypts that have yet to reach the canopy. If the vegetation does have a sub-canopy layer, complete the following assessment.

- In the same way as crown cover was recorded, record the presence of the sub-crown layer above each assessment point.

d. Vegetation structure

Equipment: Structure pole

Vegetation is assessed by its vertical structure. The structural form categories were devised based on the structural features of the vegetation, rather than on taxonomic groupings. While the names of some of the structural form categories represent taxonomic groups, for the purpose of this assessment vegetation is allocated to a structural form category based purely on their structural characteristics. For example, *Phragmites australis* is taxonomically a grass, but structurally is similar to a sedge, so is allocated to the structural form category of Sedge/Rush.

The structural form categories are discrete categories, except for dead matter, i.e. plants can only be assigned to one structural form category unless that plant contains both live and dead material. In this case, any live material making contact with the structure pole is assigned to one of the live structural form categories and any dead material is assigned to dead matter.

Examples:

- A tree fern taller than 3 metres should only be recorded in the 'Fern – tree' structural form category, and not the structural form category of 'tree' as well.
- A regenerating eucalypt with both live and dead branches making contact with the structure pole is recorded in the 'Regeneration – eucalypt' structural form category for each height section the live material is in contact with, and in the 'Dead matter' structural form category for each height interval the dead material makes contact with.

Table 6. Structural form categories.

Category	Description
Grass – spreading 	Grasses that create new plants by running roots, e.g. wire grass, couch.
Grass – tussock 	Grasses where most of the leaves originate close to the centre of the plant forming a tussock. The leaves are soft to touch without hard edges, e.g. wallaby grass and common tussock grass.

Category	Description
Grass – hummock 	A grass of semi-arid and arid environments that consists of raised interwoven balls of prickly foliage (particular to Triodia species in Victoria).
Sedge/Rush 	Non-woody plants with sharp edges or wiry, long, linear leaves, often tussocky. Includes sedges, rushes, some grasses, e.g. Phragmites australis, many perennial lilies, Lomandra and Xanthorrhoea species that do not have a trunk.
Herb 	Non-woody flowering plants, not covered by the above categories, some herbs may be up to 1.5 metres tall or taller, e.g. Great Mullein and Showy Cassinia.

Category	Description
Chenopod/Zygophyllum (Mallee version only) 	Small shrubs or herbs well adapted to saline or arid conditions, e.g. saltbush Atriplex and Maireana sp. and rounded many-stemmed dwarf shrubs of Zygophyllum sp., characterised by flowers with four or five white or yellow petals, e.g. coast twin leaf and shrubby twin leaf.
Creeper/Rambler 	Any plant that grows on other plants or the ground and is incapable of self-support, e.g. small leaf clematis, blackberry, smilax.
Fern – stalked 	Ground ferns that have the majority of their biomass at the top of a stem, with little connection to the ground underneath, e.g. bracken.

Category	Description
Fern – clumped 	Ground ferns that form clumps with the majority of their biomass arising from the ground, e.g. mother shield-fern, fishbone water-fern.
Fern – tree 	Ferns with a fibrous trunk and a (usually) single crown of fronds.
Xanthorrhoea 	Grass trees with a trunk.
Regeneration – eucalypt 	Woody plants, self-supporting, either young or suppressed eucalypts, i.e. not yet reaching the canopy or the typical mature height of the species at the site.

Category	Description
Shrub/regeneration – non-eucalypt 	Woody plants, either young or suppressed trees or shrubs of species that form the canopy at this site, i.e. not yet reaching the canopy or typical mature height for the species at this site.
Tree 	All woody species >3 metres in height (Forest) or > 2 metres in height (Mallee).
Dead matter 	Any vegetation that is dead, even if it is attached to a live plant, e.g. a dead branch attached to a live tree. N.B. Bark is not considered dead matter if attached to a live stem.

Note: Woody does not mean tough. A woody plant lays down lignin in its stem tissue (i.e. its stems consist of wood, at least towards the base of the stems). Bamboos, banana palms and thistles are not woody (they lack lignified stems). Cranberry heath (although only 3 cm tall) is woody.

Vegetation structure is measured in layers using a 2-metre structure pole (see Figure 6 and Box 8). The structure pole is divided into the following height sections:

- **Standard assessment:** vegetation structure is measured in the height sections of 0–0.2 metres, 0.2-0.5 metres, 0.5–1 metre and 1–2 metres.
- **Basic assessment**: vegetation structure is measured in the height sections of 0–0.5 metres, 0.5–1 metre and 1–2 metres.

To measure vegetation structure:

- Place the pole vertically at each assessment point along the measuring tape (**Forest**: 5 metres, 10 metres, 15 metres, etc.; **Mallee**: 2 metres, 4 metres, 6 metres, etc.).
- Starting from the top of the structure pole, record for the height section of 1–2metres, an 'X' beside each structural form category that makes contact with the pole.
- Each plant can only be assigned to one structural form category, unless it has both live and dead material touching the pole (see previous instructions).
- If the same plant is making contact with the pole in multiple height sections it should be recorded for each height section it makes contact with.
- If there are no touches for a particular structural form category, record the value as absent 'A'. If there are many null values in a row, a line can be drawn down through the boxes to indicate no data was present for that category rather than writing 'A' in each box.
- Record dead matter as a separate structural form category to living material, even if the dead material is attached to a living plant.
- Repeat this process for the remaining height sections.

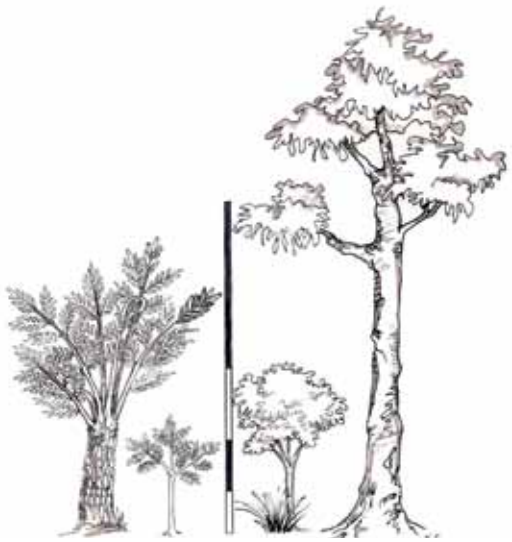


Figure 6. Structure pole showing different structural forms making contact at different height intervals.
This structure pole has 'Grass – tussock' making contact with the pole in the 0–0.2 m height section, 'Fern – stalked' and 'Shrub/regeneration non-eucalypt' both making contact in the 0.2–0.5 m height section, 'Shrub/regeneration non-eucalypt' making contact in the 0.5–1 m height section and 'Fern – tree' and 'Tree' making contact in the 1–2 m height section.

Box 8: Using the structure pole.

Assessments made with the structure pole must always be done with the bottom of the pole in contact with the ground at the assessment point. If this is not possible, due to the presence of coarse woody debris or large rocks covering the assessment point, then place the pole either beside or above the obstruction and make the assessments assuming the pole is making contact with the ground at the correct point. For example, if a 1.2-metre diameter log is obstructing the correct position of the pole, record 'Coarse woody debris' on the datasheet (ignoring the structural form categories) for the first 1.2 metres, and then perform a normal structure measurement for the remaining 0.8 metres above the log. This also should be applied if a tree sits at the assessment point – record 'Tree' for each height interval the tree covers. Structural assessments should not occur above 2 metres from the ground.

e. Ground cover

Equipment: Structure pole

Ground cover is assessed in categories (see Table 7). These categories are discrete, i.e. if a substrate is attributed to one category it cannot be attributed to another category. In some cases it may be appropriate to record multiple ground-surface categories, e.g. if the structure pole is touching a rock (R) with cryptogamic crust (C) on the surface, both R and C will be recorded.

- Place the structure pole vertical to the ground at each assessment point along the line transect (**Forest**: every 5 metres, **Mallee**: every 2 metres). Make sure the structure pole is placed directly beside each mark along the measuring tape, on the opposite side of the measuring tape to that which was trampled during plot set-up.
- Using the categories listed below, record the substrate the structure pole is sitting on at each assessment point.
- If a standing tree is obscuring the point, record ground cover as absent (A).

Table 7. Categories of ground cover.

Category	Description
B 	Bare ground/soil – exposed mineral earth.
C 	Cryptogamic crust – crust-like layer formed on the surface of solid structures such as the soil surface, rocks and logs. Includes algae, fungi, lichens, mosses and liverworts.
R 	Rocks – a mass of hard consolidated matter.
L 	Litter – any dead organic material sitting above the soil layer <6 mm in diameter. Includes leaves, twigs and the duff layer.

Category	Description
FWD 	Fine woody debris **Forest** – dead organic material >6 mm but finer than 10 cm. **Mallee** – dead organic material >6 mm but finer than 5 cm.
CWD 	Coarse woody debris **Forest** – logs >10 cm in diameter. **Mallee** – logs >5 cm in diameter.
V 	Vegetation – any plant material live or dead that is not already part of the litter or fine woody debris.
W 	Water.

f. Litter bed depth

Equipment: Ruler

The litter bed depth is measured from the soil surface (point where mineral soil is exposed) to the top of the litter bed (the top of the leaves, twigs and bark, including duff lying on the soil surface).

- At each assessment point along the line transect (Forest: 5 metres, 10 metres, 15 metres, etc.; Mallee: 2 metres, 4 metres, 6 metres, etc.) place a ruler vertically down into the litter so that the end of the ruler is sitting level with the soil surface.
- Record the highest point the horizontal litter layer reaches on the ruler to the nearest 5 millimetres, i.e. ignore any leaves or twigs that are sitting up vertically above the consistent horizontal layer.
- If the ruler makes contact with any litter, this should be recorded as at least 5 millimetres.
- Remember to account for the extra tip on the ruler by adding this amount to the total litter depth.
- If no litter is touched, record this as zero e.g. if there is bare ground, or rocks at the assessment point.
- See Figure 7 for guidance.

Figure 7. How to measure litter bed depth using a ruler.

2. Monitoring as a subset of points along the transect (Mallee version only)

a. Triodia

Equipment: Measuring tape

Triodia is an important habitat parameter in Mallee habitat and is to be assessed at the 25 metre mark and the 50 metre mark of each transect.

- Assess the two triodia clumps/rings nearest to the 25 metre mark of the transect.
- Only assess rings that have >50% continuous live or dead plant matter.
- Rings that are dead and no longer standing should not be assessed.
- For each triodia record its growth form as being a clump (C) or Ring (R).
- Measure the height in centimetres of the triodia, excluding any flowering stems.
- Measure the diameter in centimetres of the vegetative part of the plant at its widest point
- Measure the diameter in centimetres of the internal donut if present – the hole in the middle of the Triodia.
- Repeat at the 50 metre mark of each transect

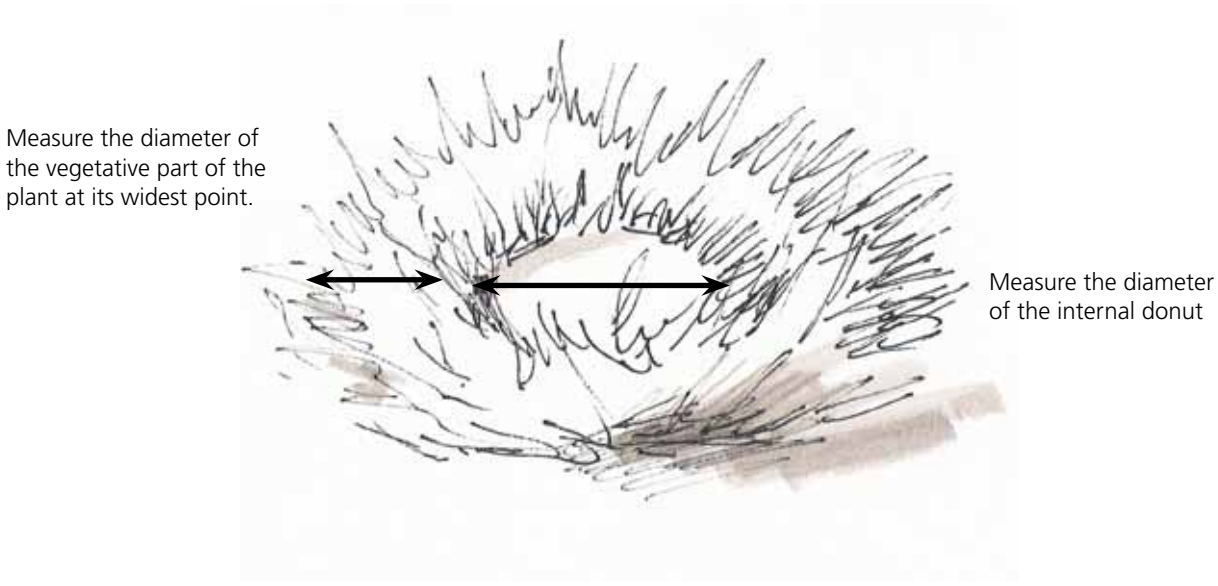


Figure 8. Measuring a triodia ring.
Both the diameter of the vegetative part of the plant and the internal donut (if present) are to be measured.

3. Monitoring at intersections with the line transect

a. Coarse woody debris

Equipment: Diameter measuring tape

- **Forest habitats**: Coarse woody debris is defined as any log not attached to a tree that is >10 centimetres in diameter and >1 metre in length. Only assess logs that meet these requirements.
- **Mallee habitats**: Coarse woody debris is defined as any log not attached to a tree that is >5 centimetres in diameter and >1 metre in length. Only assess logs that meet these requirements.

Coarse woody debris is to be assessed when the central axis of a log **intersects with the line transect** (see Figure 9). If the central axis of the log does not cross the line transect, do not include it. The line transects are deliberately laid out at three different angles to ensure the sampling of coarse woody debris is not biased by variables such as ground slope. Only logs that form an angle <45° to the ground should be assessed as a log. If the log is >45° to the ground, it should be recorded as a dead tree.

- Assess all logs that have their central axis intersecting with the line transect. Exclude logs that are still attached to a live tree.
- Assign each new log a number, starting from 1 and working up.
- If the log has multiple stems that intersect the transect, assign each stem a letter to reflect the stems are attached to the same base. For example, if log number 1 has two stems that intersect with the line transect, record the log number as being 1A for the first stem and 1B for the second stem. If a stem does not intersect with the line transect, do not record it.
- Record the features of each stem on a separate line on the datasheet.
- Record the distance from the starting point of the line transect to the log, i.e. the centre-point of the plot (read this number from the measuring tape used to lay out the line transect).
- Measure the diameter, in centimetres, of the log at the point it intersects with the line transect.

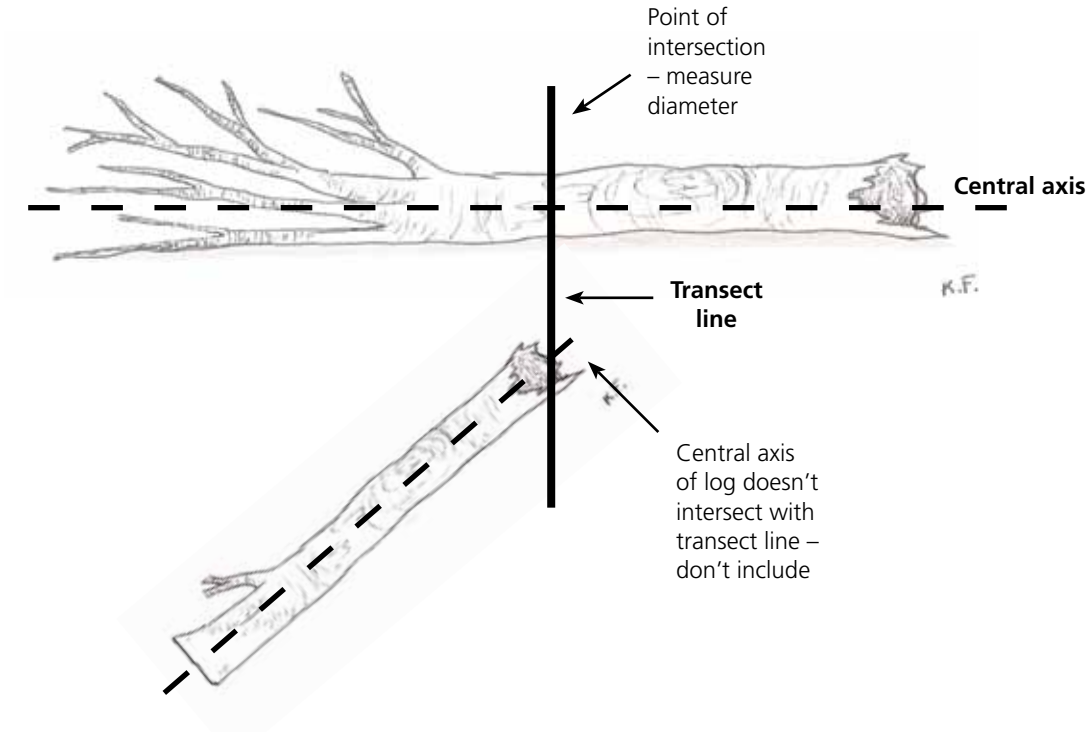


Figure 9. Diagram showing the transect line crossing a piece of coarse woody debris.
The diameter of the log is measured at the point where the log intersects with the measuring tape. If the central axis of the log does not cross the line transect, it is not included in the sample.

Standard assessment:

- Record the decay stage of the log using the classes in Table 8.

Basic assessment:

- Continue on to part b.

Table 8. Decay classes for assessing logs.

Use the descriptions and photos as a guide when assigning logs to a decay class.

Decay class	Description
1 	Log is solid and cylindrical in shape, and may or may not have bark. Few imperfections such as splits, holes and no fungal fruiting bodies present. Little or no indication of burn damage.
2 	Log retains much of original shape but has presence of some or all of fungal fruiting bodies, splits, crack or decayed ends showing signs of rot or burn damage to <10% of total surface area.
3 	Beginning to lose 'tree-like' appearance with log containing splits and crack, exposing rot or burn damage to 11–20% of overall surface area. Exterior of log may be moderately soft with no bark retained.
4 	Losing 'log-like' appearance with large sections of exterior wood missing. Exposed rot or burn damage to 21–50% of log surface area. May be moderately soft.
5 	Rotting or burnt wood roughly in the shape of a log, often only solid wood present along sides of log and may be embedded partly in soil or ash. >50% of surface area is rotting or showing burn damage. May be quite soft and wet.

b. Hollows in logs

Equipment: Diameter measuring tape

Standard assessment:

- Check each piece of coarse woody debris for presence of hollows that occur within the part of the log contained within the belt transect area (see Figure 10).
- For each log with a round hollow with a minimum entrance width >20 millimetres (approximately a 20¢ coin) and an apparent cavity, measure the size (in centimetres) of the entrance across the maximum entrance width. For logs with narrow cracks, the width (not length) must exceed 20 millimetres to be recorded as a hollow. Record this value on the datasheet.
- If a log contains more than one hollow, record the maximum entrance width (in centimetres) of each hollow entrance on a separate line on the datasheet.
- If the log contains no hollows, or only has hollows with a minimum entrance width <20 millimetres, then record as absent (A).

Basic assessment:

- Check each piece of coarse woody debris for presence of hollows that occur within the part of the log contained within the belt transect area (see Figure 10).
- Record any log that contains hollows that have a minimum entrance width >20 millimetres (approximately a 20¢ coin) and an apparent cavity as present (P). If the log contains no hollows, record as absent (A).

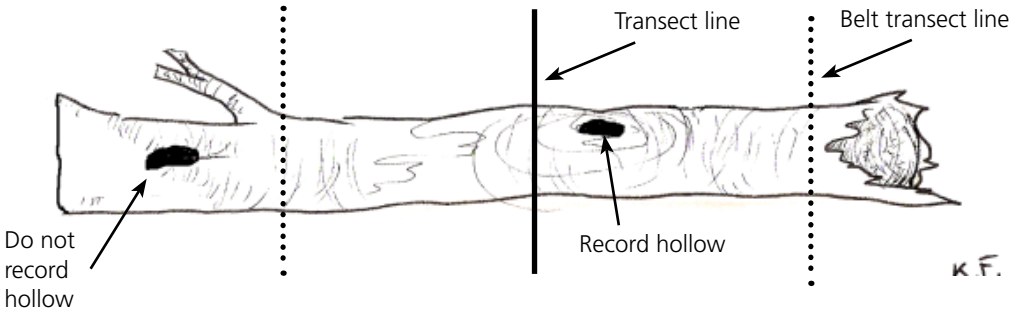


Figure 10. Diagram showing how to record hollows in logs.
Only include hollows that occur within the part of the log that is contained inside the belt transect area.

4. Monitoring inside the belt transect

All parameters for this section must be measured within the area contained by the belt transect. Record the width of the belt transect in the space provided on the datasheet. The belt transect area is:

- **Forest**: 50 metres x 8 metres (see Figure 3)
- **Mallee**: 50 metres x 4 metres (see Figure 4).

a. Trees

Forest habitat: Both live and dead trees are to be assessed. Only record trees that have the centre-point of their trunk at insertion point in the ground, inside the area of the belt transect (see Figure 11).

Live trees include trees that may have been recently burnt and have not yet re-sprouted. For eucalyptus species (*Eucalyptus*, *Angophora* or *Corymbia*) live trees are assessed if they are >3 metres in height or length of living stem, and >20 centimetres in diameter at breast height (1.3 metres) or at 1.3 metres from their insertion point. All other species are assessed when they are > 3 metres in height and >10 centimetres in diameter.

Dead trees may be under 3 metres if they have a broken-off top but must be >1.3 metres in height, otherwise they are assessed as a tree stump. Use the diameters specified above for dead trees as well.

Live and dead eucalypts between 10 and 20 centimetres in diameter are to be counted rather than assessed.

Mallee habitat: Both live and dead trees are to be assessed. Live trees are defined as being >2 metres in height or length of living stem and >5 centimetres in diameter at the widest point above any obvious lignotuber on the stem. Dead trees may be under 2 metres in length of stem if they have a broken-off top but must be >1.3 metres in height or length of stem, or they are assessed as tree stumps. Only record trees that have the centre-point of at least one stem inside the area of the belt transect (see Figure 11) and only record those stems that arise from within the belt transect area (have their lignotubers inside the belt transect area).

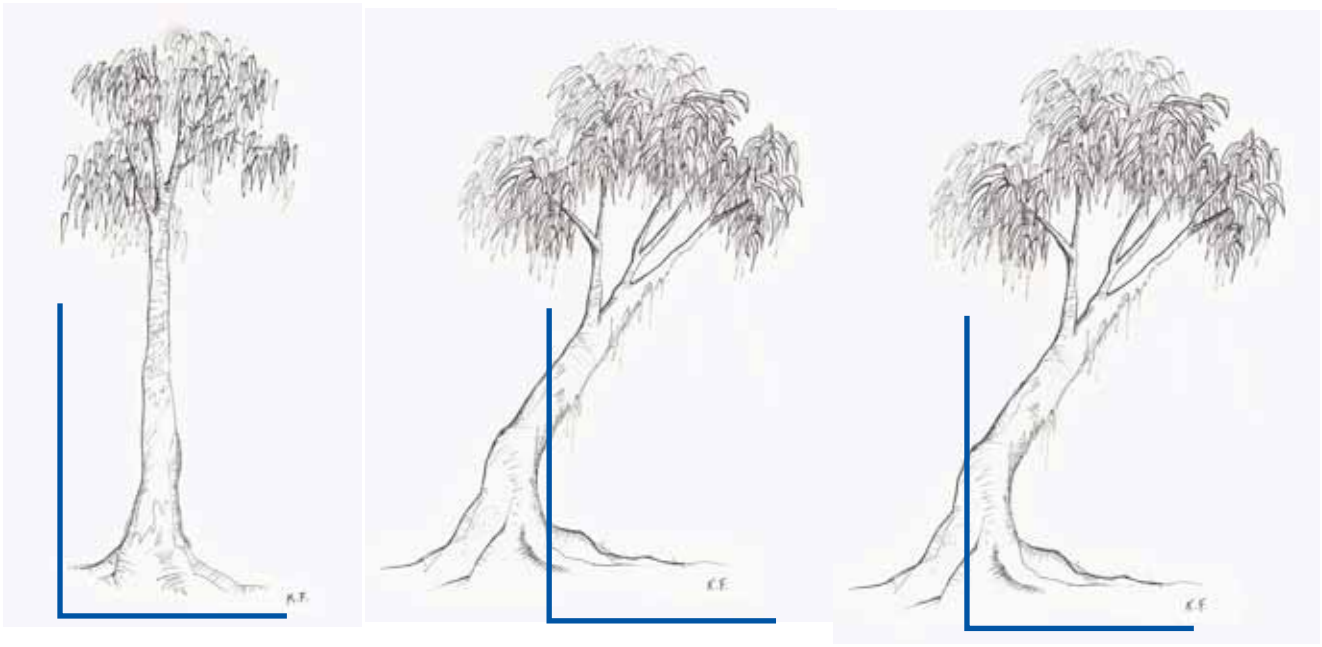


Figure 11. Inclusion of trees in the belt transect.
The centre of the trunk base must fall within the area of the belt transect for the tree to be included in the assessment.

- Walk through the belt transect and record the relevant features for the first 10 trees of each tree species occurring inside the belt transect area. In **forest**, eucalypts must be >20 centimetres in diameter to be assessed and other tree species must be >10 centimetres to be assessed. In **mallee**, trees must be >5 centimetres in diameter to be assessed.
- **Forest method only**: Count the number of live eucalypts and the number of dead eucalypt trees that are between 10 and 20 centimetres in diameter. Record these figures in the spaces provided.
- Record the features of the first 10 trees of each species occurring in the belt transect.
- Assign each different tree species a number (species number), and each individual tree a number (tree number) so that it is easier to keep track of how many trees have been assessed for each species. For example, tree 1.1 will be the first tree assessed for the first species encountered, tree 1.2 will be the second tree assessed for the first species and tree 2.1 will be the first tree assessed for the second species encountered.
- If there are less than 10 trees of a particular species, only record the features of the trees occurring in the belt transect.
- If there are more than 10 trees of a particular species within the belt transect area, count the number of remaining trees for that species and record this number in the space provided on the datasheet .
- If 10 trees for a particular species have already been assessed and there is an obvious habitat tree (large, old, lots of hollows and hollow-bearing characteristics), record the features of this tree as well and any other trees that are similar.
- Repeat this process for any species that has more than 10 trees in the belt transect area.

For each tree assessed, record the following:

(i) Diameter

Equipment: Diameter measuring tape

Forest habitat: Tree diameter is measured at breast height (1.3 metres) or at 1.3 metres from the tree's insertion point. Only record the diameter for eucalypt species that are >20 cm in diameter and the diameter of all other tree species that are >10 cm in diameter.

Mallee habitat: Tree diameter is measured at the widest part of the individual stem above any obvious lignotuber (bulge in the stem). In the case of multi-stemmed trees, assess diameter above where the stems branch out. Trees must be >5 cm in diameter to be assessed.

- For each tree assessed, assign it a number to reflect the tree species and tree number being assessed (see above for guidance).
- Record the distance (in metres) of each tree from the starting-point of the line transect, i.e. the centre-point of the plot. Use the measuring tape laid out for the line transect to determine this distance.
- In the same box as the distance record an 'L' or an 'R' to indicate if the tree sits to the Left or the Right of the measuring tape. Make sure that the side recorded refers to the side of the tape when working back towards the centre of the plot. This will help when conducting post burn assessments to ensure the tape measure is in the correct place.
- Use a diameter tape to record the diameter of each tree to the nearest centimetre.
- For trees with multiple stems, record the diameter of each stem. If a base has more than three stems, measure the largest stem, the smallest stem and one stem of average size. Record each diameter on a separate line on the datasheet. In the row below, record the total number of stems with the letter S beside, e.g. 5S for a tree with 5 stems in total. If the tree has three or less stems, the total number of stems does not need to be recorded as this can be determined from the number of diameter measurements.

Record the following features about the tree as a whole (i.e. record a feature as present if it occurs on any of the trees stems):

(ii) Species

Standard assessment:

- Record the scientific name of each tree species assessed.
- If the scientific name is unknown, record the common name and then look up the scientific name upon returning to the office (e.g. use a reference guide, such as Costermans 2000, to assist with identification; collecting leaves and fruits will also assist with identification).
- For eucalypts, if the species is unknown then record the grouping of eucalypts it belongs to, e.g. stringybark, box, ironbark, ash, peppermint.
- If the tree is a eucalypt, record if it has presence of epicormic growth (see Figure 12). Record this as an 'E' in the same column as species name, e.g.
  - *Eucalyptus regnans* (E) – tree with epicormic growth
  - *Eucalyptus regnans* – tree without epicormic growth.

Basic assessment:

- Record if each tree is a eucalypt – includes species of Eucalyptus, Angophora or Corymbia – Y or N.
- If the species is known, record this on the datasheet – the species details are recorded in the standard assessment.
- If the tree is a eucalypt, record if it has presence of epicormic growth (see Figure 12). Record this as an 'E' in the same column as species, e.g.
  - YE – eucalypt with epicormic growth
  - Y – eucalypt without epicormic growth
  - N – non-eucalypt.

Figure 12. Eucalypt tree showing presence of epicormic growth.

(iii) Visible hollows and hollow-bearing characteristics

Equipment: Binoculars

Standard assessment:

- Rapidly assess each tree for obvious hollows using binoculars. Only record hollows as present if they are >20 millimetres in diameter and appear to have a cavity.
- For each hollow observed, estimate the height in metres of each hollow entrance from the ground. Record the height of different hollows on separate lines of the datasheet.
- Record the aspect (N, NE, E, SE, S, SW, W, NW, Vertical) of each hollow observed.
- For each tree, record if it has the following hollow-bearing characteristics (record present – P – or absent – A – on the datasheet for each). See Figure 13 for examples of each:
- Dead spouts or large broken-off limbs – limbs with the ends broken off that leave an exposed opening.
- Fissures – any narrow crack in trunk >20 millimetres wide and >30 millimetres long.
  - Butt scar – deformities on the stem of a tree that meet the ground.

A. B. C.

Figure. 13. Examples of A. a dead spout, B. a fissure and C. a butt scar.

Basic assessment:

- Rapidly assess each tree for obvious hollows using binoculars. Only record hollows as present if they are >20 millimetres in diameter and appear to have a cavity.
- For each tree with an obvious hollow, record on the datasheet whether the hollow is located in the:
- Canopy (C) – trunk above 1.3 metres from the ground
- Basal area (B) – trunk below 1.3 metres from the ground
- Has hollows in both canopy and basal area (K).
- For each tree, record if it has the following hollow-bearing characteristics (record present – P – or absent – A – on the datasheet for each). See Figure 13 for examples of each:
  - Dead spouts or large broken-off limbs – limbs with the ends broken off that leave an exposed opening.
  - Fissures – any narrow crack in trunk >20 millimetres wide and >30 millimetres long.
  - Butt scar – deformities on the stem of a tree that meet the ground.

(iv) Bark type

Record the dominant bark type of each tree using the categories listed below. If a tree has two bark types present that are of equal dominance, record each bark type (see Figure 14).

Figure 14. An example of a tree with two different bark types.
This tree would be recorded as bark type 47 - 4 for the coarsely fibrous bark at the bottom of the trunk and 7 for the smooth bark at the top of the stem and in the branches.

Table 9. Photographs and descriptions of each bark type category.

Category	Bark type	Description
1	Stringybark 	Bark is made up of fine fibrous material less than 1 mm in thickness covering the whole trunk. The fibrous nature of the bark is obvious and extends up to 0.5 m or more, without breaks, along the trunk. Old bark is retained on the trunk of the tree forming a relatively spongy fibrous mass with deep vertical fissures. The outer bark may weather to a greyish colour. The bark forms long strands when peeled off. E.g. messmate – *E. obliqua*, brown stringybark – *E. baxteri*, red stringybark – *E. macrorhyncha*, desert stringybark – *E. arenacea*, blanket-leaf – *Bedfordia arborescens*, lower part of trunk for *E. delegatensis*, alpine ash.
2	Ironbarks 	Tree characterised by layers of old, coarse bark retained on the trunk and branches. Old bark is accumulated and held very tightly to the trunk. The bark becomes rough, compacted and furrowed with age. As the bark is not prone to burning, there may be little or no evidence of charring on the bark following fire. E.g. red ironbark – *E. tricarpa*, mugga – *E. sideroxylon*, buloke – *Allocasaurina luehmannii*.
3	Ribbon or candle bark 	Tree characterised by the annual shedding of old bark layers, exposing the smooth new bark underneath. Old bark is shed in the form of long strips or ribbons of bark, which often drape around the trunk, over branches and surrounding shrubs. As the bark dries, the sides of the bark pieces curl tightly inwards to form a candle-like shape. Old bark is shed at various times of the year so that the trunk may have a mottled appearance. E.g. candelbark – *E. rubida*, blue gum – *E. globulus*, manna gum – *E. viminalis*, grey mallee – *E. socialis*.
4	Coarsely fibrous barks 	Trees characterised by short-strand fibrous bark. The layers of old dead bark are retained on the trunk and branches and break away as 'chunks', not as long fibrous strands. E.g. yellow bloodwood – *Corymbia gummifera*, southern mahogany – *E. botryoides*, lightwood – *Acacia implexa*, narrow-leaved peppermint – *E. radiata*, black box – *E. largiflorens*, grey box – *E. microcarpa*, yellow box – *E. melliodora*, lower sections of trunk for mountain ash – *E. regnans*.

Category	Bark type	Description
5	Platy barks 	Trees characterised by layers of old, fine fibrous bark retained on the trunk and branches. Young bark is tightly held to the trunk. Old bark tends to flake or break off in small strands or pieces when rubbed or as a result of burning or weathering. Bark shed is not strongly seasonal. E.g. silvertop – *E. sieberi* , black sheoke, *Allocasuarina littoralis*, blackwood – *Acacia melanoxylon*, belah – *Casuarina cristata*.
6	Papery barks 	Shrubs and trees growing from 2–30 metres tall, often with flaky exfoliating bark. Old bark is retained on the trunk and branches and builds up into a thick spongy mass. Bark layers tend to split, allowing sheets of bark to become loose and eventually detach. E.g. swamp paperbark – *Melaleuca ericifolia*, salt paperbark – *Malaleuca halmaturorum*, coast tea tree – *Leptospermum laevigatum*.
7	Smooth or gum bark 	Trees characterised by the annual shedding of old bark layers, exposing the smooth living bark underneath. The bark is not shed in long strands (i.e. like candelbark), does not accumulate in long strands at the base of the trunk nor held up in the canopy. Includes species where the old bark tends to peel into large vertical slabs (<50 centimetres in length) or flake into small flakes when shed. Most of the bark falls off the tree within a short time of shedding. Some small amounts of bark may be retained on the stem or branches for a considerable time before falling. E.g. river red gum – *E. camaldulensis*, mountain gum – *E. dalympleana*, yellow gum – *E. leucoxylon*, bog gum – *E. kitsoniana*, snow gum – *E. pauciflora*.

(v) Shedding bark (standard assessment only)

Allocate each tree recorded as bark type 3 (ribbon or candle bark) to one of the following categories (see Figure 15 for examples):

0 – No bark shedding greater than 30 cm in length.
1 – Less than 50% of the trees stem surface area contains shedding bark.
2 – More than 50% of the trees stem surface area contains shedding bark.

0. **1.** **2.**

Figure 15. Examples of the three categories of shedding bark.

(vi) Burn damage

Record any visible burn damage on each tree using the following categories and the photos below as a guide:

0 – No indication of fire damage.
1 – Some charcoal on bark.
2 – Burnt bark and scarring.
3 – Severely burnt, forming a burnt-out arch or bridge in the trunk.

0. **1.** **2.** **3.**

Figure 16. Examples of each burn damage category.

(vii) Tree condition

Rate the condition of each tree using the scale below (also refer to Figure 17 for examples):

0 – Dead (it is important to record dead trees as well as live trees).
1 – Senescing, dying, dieback.
2 – Signs of stress, some dieback but mostly healthy.
3 – Tree apparently healthy.

0. **1.** **2.** **3.**

Figure 17. Examples of each tree condition category.

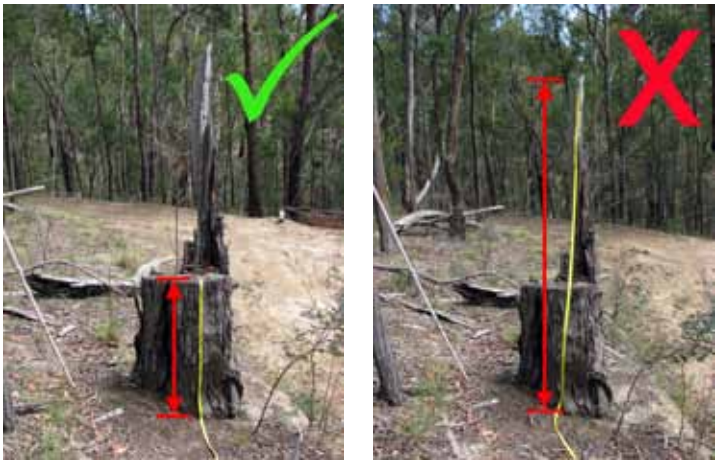
b. Tree stumps

Equipment: Diameter measuring tape

Tree stumps are defined as the lower end of a tree (<1.3 metres) that remains in the ground after most of the stem or trunk has been removed. Only include tree stumps that have the centre-point of their trunk inside the area of the belt transect (see Figure 11) and that are >10 centimetres in diameter. If a tree stump is >1.3 metres, it should be assessed as a dead tree.

Walk through the belt transect and record the following features for each tree stump inside the belt transect area:

- Assign each tree stump assessed a number, starting from 1.
- Record the distance (in metres) of each tree stump from the starting point of the plot, i.e. the centre-point of the plot. Use the measuring tape laid out for the line transect to determine this distance.
- Use a diameter tape to record the diameter, in centimetres, around the widest section of each tree stump – measure above where the roots begin to branch out. For stumps that are missing sides, measure around the existing piece of wood.
- Use the reverse side of the diameter tape to record, in centimetres, the height from the ground of each tree stump – record the consistent horizontal height of the stump, ignore any bark that may be sticking up from where the trunk has broken off if it is not consistent with the height of the rest of the stump (see Figure 18).



A. B.

Figure 18. Measuring stump height.
Measure the consistent horizontal height of the stump as shown in Figure 18A. Ignore any bark that may be sticking up from where the trunk has broken off if it is not consistent with the height of the rest of the stump as shown in Figure 18B.

Standard assessment:

- Record the width, in centimetres, of any hollow in the top of each tree stump.
- Record the depth, in centimetres, of the hollow cavity in the top of each tree stump.
- Record the decay stage of the tree stump using the classes in Table 10, below.

Basic assessment:

- Record the presence of any hollow in the stump, present or absent.
- Record the decay stage of the tree stump using the classes in Table 10, below.

Table 10. Decay classes fro tree stumps.

Decay class	Description
1 	Tree stump is solid and cylindrical in shape and may or may not have bark. Few imperfections, such as splits, holes and no fungal fruiting bodies present. Little or no indication of burn damage.
2 	Tree stump retains much of original shape but has presence of some or all of fungal fruiting bodies, splits, cracks and decayed end showing signs of rot or burn damage to <10% of total surface area.
3 	Beginning to lose stump-like appearance with tree stump containing splits and cracks, exposing rot or burn damage to 11–20% of overall surface area. Exterior of tree stump may be moderately soft with no bark retained.
4 	Losing stump-like appearance with large sections of exterior wood missing. Exposed rot or burn damage to 21–50% of stump surface area. May be moderately soft.
5 	Rotting or burnt wood roughly in the shape of a stump, often only solid wood present along sides of stump. >50% of surface area is rotting or showing burn damage. May be quite soft and wet.

4

Fire and adaptive management

5 Section five: Repeating the assessment in the future

Section five: Repeating the assessment in the future

As discussed in Section 2 (5) monitoring needs to be repeated at each site at specified time intervals. If there is no disturbance to a site a full habitat assessment should be repeated two years after the initial assessment was conducted. If there is a disturbance (e.g. a planned burn), then a habitat assessment should be conducted within a few weeks of the disturbance occurring. If the disturbance is patchy e.g. only affecting part of the habitat plot then the length of time between the initial habitat assessment and the disturbance event should be used to determine if the whole plot needs to be reassessed or just the section of the plot that has changed. If the disturbance is in relation to a burn event then a fire severity assessment will also need to be conducted along each transect to pick up the variation in fire severities throughout the habitat plot.

See below and Table 3 for further guidance about the timelines for repeating the habitat assessment:

No disturbance

If there has been no disturbance to the habitat the growth stage of the habitat should be used to determine how frequently repeat assessments need to be conducted. If the habitat is relatively young e.g. less than 10 years old, more frequent habitat assessment will need to be conducted as the habitat will change more rapidly during this period. If this is the case it is advised that a full habitat assessment should be conducted two years after the initial habitat assessment was conducted. Repeat assessments should be conducted at year five and year 10 and then every 10 years after that.

If the habitat is more than 10 years old a repeat assessment at two years may not be required if there has been little or no change to the habitat in that time. In this case rather than conducting a full habitat assessment just note that the plot was revisited and that there was no significant change to the habitat since the previous assessment. A complete habitat assessment should then be conducted within five years of the initial assessment and repeated five years after that at approximately 10 years post initial assessment. Repeat assessments should be conducted every 10 years after that.

If there is a disturbance to the plot at any time follow the instructions below.

Patchy disturbances

If there is only a short time interval between when the initial habitat assessment was conducted and the disturbance occurring e.g. less than six months then only the transects that have been affected by the disturbance should be reassessed. If a transect has remained unaffected by the disturbance then it does not need to be reassessed. Make sure to walk along apparently unaffected transects to ensure that there have been no changes since the initial habitat assessment was conducted. It may be useful to take a copy of the data from the initial assessment so you can verify if there has been a change or not.

If there is more than 12 months between when the initial assessment was conducted and when the disturbance occurs the whole habitat plot should be reassessed as the sections of the plot that were unaffected by the disturbance may still have changed due to natural growth. In the time between assessments the habitat may have moved from one growth stage to the next, so it is important to repeat the whole assessment rather than just on the sections that have been affected by disturbance. This will then give a representation of how both disturbed and undisturbed habitat changes.

Two years after the disturbance a repeat assessment should be conducted across the whole habitat plot and again at five years and 10 years post-disturbance. Repeat assessments should be conducted every 10 years after that unless there is another disturbance. If at any time during the timeline a disturbance occurs the timeline is reset to the beginning again.

Complete disturbance to the site

If the entire habitat plot has been affected by a disturbance then a full habitat assessment should be conducted within a few weeks of the disturbance occurring. Repeat assessments should then be conducted at two, five and ten years after the disturbance and again every 10 years after that. If there is a disturbance to the plot at any time the timeline is reset to the beginning and depending on the nature of the disturbance (patchy or complete) begin working through the appropriate timeline again.

Steps to undertake a repeat habitat assessment

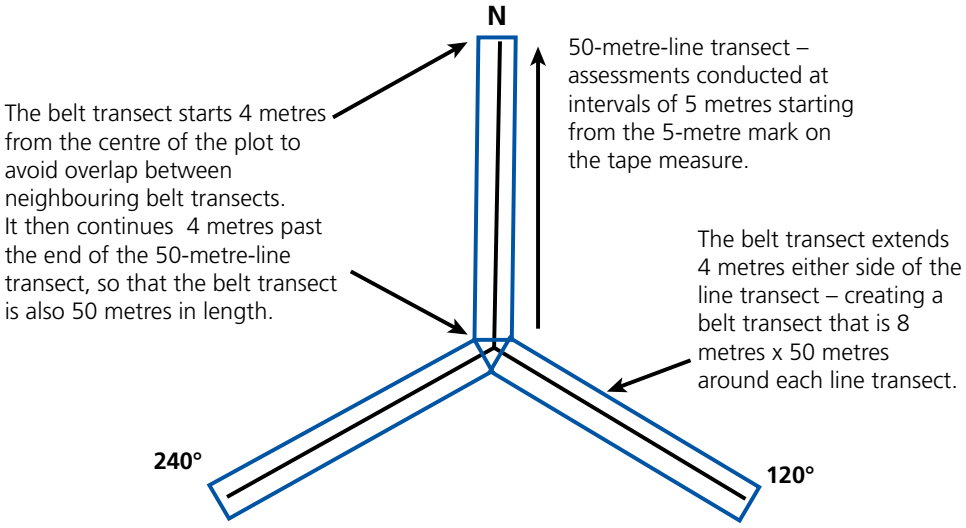
- Download the previous data set collected for each habitat plot so you can take it in to the field with you.
- Upload the plot coordinates into a GPS so that each plot can be located in the field. Use the plot location information recorded during the initial assessment to help guide you to the plot location.
- Navigate to each plot and fill in the first page of the datasheet – this information should be the same as the initial assessment except for the section relating to fire history and disturbance.
- Record for each transect if there has been a disturbance. A space is provided for this.
- Complete the habitat assessment at each plot location as required – see above.

6 Section six: Field methods and datasheets

Section six: Field Methods and Datasheets

1. Standard Forest Habitat Assessment: Method Version 1 Feb 2012

Plot set-up:



After setting up for the assessment, record the following information about the transect as a whole:

- Plot name – the name of the plot that the transect belongs to.
- Transect angle – the angle at which the transect has been laid out.
- Position on slope and aspect of transect – whether the transect is located on a ridge, gully, slope or flat, and the aspect the transect is facing if on a slope (N, S, E or W).

i. Monitoring at points along the line transect

Each parameter should be assessed at each assessment point (every 5 metres along the measuring tape). The assessments should be made on the opposite side of the measuring tape to that which was walked along when setting up the line transect.

Crown cover

Equipment: Structure pole

Crown cover is assessed as presence or absence of the upper-most layer of canopy above each assessment point along the line transect.

- If the structure pole continued all the way up to the canopy and would pass within the bounds of any tree crown, record this as present (P). Within the bounds means that if a polygon was traced around the tree crown, the structure pole would pass through the area contained by the polygon.
- If the structure pole has open sky directly above it, record this as absent (A).

Sub-canopy

Equipment: Structure pole

In vegetation types where there is a distinct sub-canopy layer i.e. formed by acacias and wattles or young or suppressed eucalypts, record its presence above each assessment point using the instructions for crown cover.

Vegetation structure

Equipment: Structure pole

Vegetation is assessed by its structure. The structural form categories are based on the structural features of the vegetation, rather than on taxonomic groupings (see table on page 68). Categories are discrete, except for dead matter, i.e. plants can only be assigned to one structural form category unless that plant contains both live and dead material. In this case, any live material making contact with the structure pole is assigned to one of the live structural form categories and any dead material is assigned to dead matter.

Vegetation structure is measured in layers using a 2-metre structure pole. To measure vegetation structure:

- Place the pole vertical to the ground at each assessment point along the measuring tape (5 metres, 10 metres, 15 metres etc.).
- Starting from the top of the structure pole, record for the height section of 1-2metres, an 'X' beside each structural form category that *makes contact* with the pole. If the same plant touches the pole in multiple height sections record it once for each section it touches.
- Each plant can only be assigned to one structural form category, unless it has both live and dead material touching the pole (see previous instructions).
- If there are no touches for a particular structural form category or height section, record the value as absent (A) or draw a line through the boxes if there are many null values in a row.
- Record dead matter as a separate structural form category to living material, even if the dead material is attached to a living plant.
- Repeat this process for the remaining height sections.

Ground cover

Equipment: Structure pole

Ground cover is assessed in discrete categories (refer to table on page 68), i.e. if a substrate is attributed to one category it cannot be attributed to another category. In some cases it may be appropriate to record multiple ground surface categories, e.g. if the structure pole is touching a rock (R) with cryptogamic crust (C) on the surface, both R and C will be recorded.

- Place the structure pole vertical to the ground at each assessment point along the line transect (every 5 metres). Make sure the structure pole is placed directly beside each mark along the measuring tape, on the opposite side of the measuring tape to that which was trampled during plot set-up.
- Using the categories on page 68, record the substrate the structure pole is sitting on at each assessment point.
- If a standing tree is obscuring the point, record ground cover as absent (A).

Litter bed depth

Equipment: Ruler

The litter bed depth is measured from the soil surface (point where mineral soil is exposed) to the top of the litter bed (the top of the leaves, twigs and bark, including duff lying on the soil surface).

- Use a ruler to measure the depth of the horizontal litter layer to the nearest 5 millimetres. Ignore any leaves or twigs that are inconsistent with the horizontal layer.
- Remember to account for the tip of the ruler if the measurements do not start from the ruler's edge.
- If no litter is present, record as zero '0' and move onto the ground cover assessment.

iii. Monitoring at intersections with the line transect

Coarse woody debris

Equipment: Diameter measuring tape

Log definition – any log not attached to a tree that is >10 centimetres in diameter and >1 metre in length.

- Assess all logs that have their central axis intersecting with the line transect. Exclude logs that are still attached to a tree.
- Assign each new log a number, starting from 1. If the log has multiple stems that intersect the transect, assign each stem a letter to reflect the stems are attached to the same base, e.g. 1A and 1B. If a stem does not intersect, do not record it. Record the features of each stem that intersects with the transect on a separate line on the datasheet.
- Record the distance of the log from the centre-point of the plot.
- Measure the diameter, in centimetres, of the log at the point it intersects with the line transect.
- Record the decay stage of the log using the classes on page 68.

Hollows in logs

Hollow definition – entrance width is >20 millimetres and has a cavity. Cracks must be wider, not longer, than 20mm to be included.

- Record widths of hollows only if they occur inside the belt transect area.
- Record different hollows on separate lines of the datasheet – record as 'A' if no hollows present inside the belt transect area.

v. Monitoring inside the belt transect

Trees

- Both live and dead trees that meet the minimum diameter requirements are to be assessed. Only record trees that have the centre-point of their trunk at insertion point in the ground, inside the area of the belt transect.
- *Live trees* – >3 metres in height and >20 cm in diameter for eucalypts and >10 cm in diameter for non-eucalypts. Measured at breast height (1.3 metres). Includes trees that may have been recently burnt and have not yet re-sprouted.
- *Dead trees* – may be under 3 metres but >1.3 metres in height, otherwise they are assessed as a tree stump. Use the same diameters as specified for live trees.
- *Live and dead eucalypts between 10 and 20cm diameter* – count total of each and record on data sheet.
- Only assess the features of the first 10 trees of each species that meet the minimum specified diameters.
- Assign each different tree species a number (species number), and each individual tree a number (tree number) so it is easier to keep track of how many trees have been assessed for each species. For example, tree 1.1 will be the first tree assessed for the first species encountered, tree 1.2 will be the second tree assessed for species one and tree 2.1 will be the first tree assessed for the second species encountered.
- If there are more than 10 trees of a species count the number of remaining of trees of that species in the belt transect. Repeat for any tree species with more than 10 individual trees.
- If more than 10 trees have been assessed and there is an obvious habitat tree, record the features of this tree as well.
- For each tree assessed, record the following information:
  - Distance of tree from centre of plot
  - Side of transect the tree occurs on – L or R when facing towards the centre of the plot.
  - Diameter in centimetres at breast height (1.3 metres above ground). If multi-stemmed, assess diameter of each stem separately. If there are more than three stems, measure the largest stem, the smallest stem and one stem of average size. Then record total number of stems beside.
  - Species – record the scientific name of each tree species assessed or record the common name until the scientific name can be confirmed. For eucalypts, if the species is unknown, then record the grouping of eucalypts it belongs to, e.g. stringybark, box, ironbark, ash, peppermint.
  - Epicormic growth – record an 'E' beside the eucalypt species name if epicormic growth is present.
  - Hollows – obvious presence (>20 millimetres with apparent cavity)
    - Height of entrance above ground (metres)
    - Aspect of hollow entrance (N, NE, E, SE, S, SW, W, NW, Vertical).
  - Presence of hollow-bearing characteristics (record present – P – or absent – A – for each):
    - Dead spouts or large broken-off limbs – limbs with the ends broken off that leave an exposed opening
    - Fissures – any narrow crack in trunk >20 millimetres wide and >30 millimetres long
    - Butt scar – deformities on the stem of a tree that meet the ground.
  - Bark type – record the dominant bark type of each tree using the categories listed on page 69 (if the tree has two dominant bark types, record both).
  - Shedding bark – amount if classified as bark type 3 using categories on page 69.
  - Burn damage – recorded as any visible burn damage on each tree using the categories on page 69.
  - Tree condition – rate the condition of each tree using the categories on page 69.

Tree stumps

Equipment: Diameter measuring tape

Definition – lower end of a tree (<1.3 metres) remaining in the ground after trunk has been removed. Only include stumps if centre-point is inside the area of the belt transect. If stump is taller than 1.3 metres, assess it as a dead tree.

- Assign each tree stump assessed a number, starting from 1.
- Record the distance (in metres) of each tree stump from the starting point of the plot.
- Record the diameter in centimetres, around the widest section of each tree stump – measure above where the roots begin to branch out.
- Record the consistent height of the tree stump, in centimetres – ignore bark that may be sticking up.
- Record the presence of any hollow in each stem, present or absent.
- Record the decay stage of the tree stump using the classes in table on page 69.

Categories for Standard Forest Habitat Assessment Version 1 Feb 2012

Structural form categories

Category	Description
Grass – spreading	Grasses that create new plants by running roots, e.g. wire grass, couch.
Grass – tussock	Grasses where most of the leaves originate close to the centre of the plant forming a tussock. The leaves are soft to touch, without hard edges, e.g. wallaby grass and common tussock grass.
Grass – hummock	A grass of semi-arid and arid environments that consists of raised interwoven balls of prickly foliage (particular to Triodia species in Victoria).
Sedge/Rush	Non-woody plants with sharp edges or wiry, long, linear leaves, often tussocky. Includes sedges, rushes, some grasses, e.g. *Phragmites australis*, many perennial lilies, *Lomandra* and *Xanthorrhoea* species that do not have a trunk.
Herb	Non-woody flowering plants, not covered by the above categories, some herbs may be up to 1.5 metres tall or taller, e.g. great mullein and showy cassinia.
Creeper/Rambler	Any plant that grows on other plants or the ground and is incapable of self-support, e.g. small leaf clematis, blackberry, smilax.
Fern – stalked	Ground ferns that have the majority of their biomass at the top of a stem, with little connection to the ground underneath, e.g. bracken.
Fern – clumped	Ground ferns that form clumps with the majority of their biomass arising from the ground, e.g. mother shield-fern, fishbone water-fern.
Fern – tree	Ferns with a fibrous trunk and a (usually) single crown of fronds.
Xanthorrhoea	Grass trees with a trunk.
Regeneration – eucalypt	Woody plants, self-supporting, either young or suppressed eucalypts, i.e. not yet reaching the canopy or the typical mature height of the species at the site.
Shrub/regeneration – non-eucalypt	Woody plants, either young or suppressed trees or shrubs of species that form the canopy at this site, i.e. not yet reaching the canopy or typical mature height for the species at this site.
Tree	All woody species >3 metres in height (Forest).
Dead matter	Any vegetation that is dead, even if it is attached to a live plant, e.g. a dead branch attached to a live tree. N.B. Bark is not considered dead matter if attached to a live stem.

Ground cover categories

B	Bare ground/soil – exposed mineral earth.
C	Cryptogamic crust – crust-like layer formed on the surface of solid structures such as the soil surface, rocks and logs. Includes algae, fungi, lichens, mosses and liverworts.
R	Rocks – a mass of hard consolidated matter.
L	Litter – any dead organic material sitting above the soil layer <6 mm in diameter. Includes leaves, twigs and the duff layer.
FWD	Fine woody debris – dead organic material >6 mm but finer than 10 cm in diameter.
CWD	Coarse woody debris – logs >10 cm in diameter.
V	Vegetation – any plant material live or dead that is not already part of the litter or fine woody debris.
W	Water.

Log decay class categories

1	Log is solid and cylindrical in shape, and may or may not have bark. Few imperfections such as splits, holes and no fungal fruiting bodies present. Little or no indication of burn damage.
2	Log retains much of original shape but has presence of some or all of fungal fruiting bodies, splits, crack and decayed ends showing signs of rot or burn damage to <10% of total surface area.
3	Beginning to lose 'tree-like' appearance, with log containing splits and crack, exposing rot or burn damage to 11–20% of overall surface area. Exterior of log may be moderately soft with no bark retained.
4	Losing 'log-like' appearance with large sections of exterior wood missing. Exposed rot or burn damage to 21–50% of log surface area. May be moderately soft.
5	Rotting wood roughly in the shape of a log, often only solid wood present along sides of log and may be embedded partly in soil. >50% of surface area is rotting or showing burn damage. May be quite soft and wet.

Bark type categories

Category	Bark type	Description
1	Stringybark	Fine fibrous material <1 mm thick covering the whole trunk. Fibrous nature of bark is obvious, extending up to 0.5 m or more, without breaks, along the trunk. Old bark is retained on the trunk forming a relatively spongy fibrous mass with deep vertical fissures. The bark forms long strands when peeled off. E.g. messmate – *E. obliqua*, brown stringybark – *E. baxteri,* red stringybark – *E. macrorhyncha,* blanket-leaf – *Bedfordia arborescens,* lower part of trunk for alpine ash – *E. delegatensis.*
2	Ironbarks	Layers of old, coarse bark that becomes rough, compacted and furrowed with age. Bark is not prone to burning and may show little or no evidence of charring following fire. E.g. red ironbark – *E. tricarpa*, mugga *E. sideroxylon*, buloke – *Allocasaurina luehmannii*.
3	Ribbon or candle bark	Annual shedding of old bark layers in long strips or ribbons of bark exposing new bark underneath. As the bark dries, the sides of the bark pieces curl tightly inwards to form a candle-like shape. E.g. candelbark – *E. rubida*, blue gum – *E. globulus*, manna gum – *E. viminalis.*
4	Coarsely fibrous barks	Short-strand fibrous bark. Old bark is retained on trunk and breaks away as 'chunks', not as long fibrous strands. E.g. red bloodwood – *Corymbia gummifera,* southern mahogany – *E. botryoides,* lightwood – *Acacia implexa,* narrow-leaved peppermint – *E. radiata,* black box – *E. largiflorens*, grey box – *E. microcarpa*, yellow box – *E. melliodora*, lower sections of trunk for mountain ash – *E. regnans.*
5	Platy barks	Layers of old, fine fibrous bark retained on the trunk and branches that tends to flake or break off in small strands or pieces when rubbed or as a result of burning or weathering. E.g. silvertop – *E. sieberi,* black sheoke, *Allocasuarina littoralis*, blackwood – *Acacia melanoxylon,* belah – *Casuarina cristata.*
6	Papery barks	Shrubs and trees with flaky exfoliating bark that tends to split, allowing sheets of bark to become loose and eventually detach. E.g. swamp paperbark – *Melaleuca ericifolia*, salt paperbark – *Malaleuca halmaturorum,* coast tea tree – *Leptospermum laevigatum*.
7	Smooth or gum bark	Annual shedding of old bark layers, exposing the smooth living bark underneath. Bark is not shed in long strands (i.e. like candelbark), but tends to peel into large vertical slabs (<50 centimetres in length) or flake into small flakes when shed. E.g. river red gum – *E. camaldulensis*, mountain gum – *E. dalympleana*, yellow gum – *E. leucoxylon*, bog gum – *E. kitsoniana*, snow gum – *E. pauciflora.*

Shedding bark categories

0	No bark shedding greater than 30 cm in length.
1	Less than 50% of the tree's stem surface area contains shedding bark.
2	>50% of tree's stem surface contains shedding bark.

Burn damage categories

0	No indication of fire damage.
1	Some charcoal on bark.
2	Burnt bark and scarring.
3	Severely burnt, forming a burnt-out arch or bridge in the trunk.

Tree condition categories

0	Dead (it is important to record dead trees as well as live trees).
1	Senescing, dying, dieback.
2	Signs of stress, some dieback but mostly healthy.
3	Tree apparently healthy.

Tree stump decay class categories

Class	Description
1	Solid, cylindrical in shape with or without bark. Few imperfections, such as splits, holes and no fungal fruiting bodies present. Little or no indication of burn damage.
2	Retains much of original shape but has presence of some or all of fungal fruiting bodies, splits, crack and decayed end showing signs of rot or burn damage to <10% of total surface area.
3	Losing stump-like appearance, containing splits and crack, exposing rot or burn damage to 11–20% of overall surface area. Exterior of stump may be moderately soft with no bark retained.
4	Losing stump-like appearance with large sections of exterior wood missing. Exposed rot or burn damage to 21–50% of stump surface area. May be moderately soft.
5	Rotting wood roughly in the shape of a stump, often only solid wood present along sides of stump. >50% of surface area is rotting or showing burn damage. May be quite soft and wet.

2. Standard Forest Habitat Assessment: Datasheet V1 Feb 2012

Monitoring area name													
Data-point grouping name (name identifying the group of points used in this assessment)													
Assessors and organisation													
Assessment date													
Ecological Vegetation Division (EVD) and Ecological Vegetation Class (EVC)													
Number of years since the area was last burnt (from fire plan map)									Burn number				
Verify last-burnt data (tick one box)													
									☐ Appears to be correct				
									☐ Appears to be more years since last burnt				
									☐ Appears to be less years since last burnt				
Further comments (about fire regime, e.g. fire season or fire severity)													
Further comments. Record details about other variables of interest (e.g. drought, grazing)													
Plot name											Zone		54 55 (circle one)
Plot location description													
GPS coordinates (GDA 94)		Start of transect										GPS accuracy (m)	
Easting		0											
Northing													
Transect angle		End of transect										GPS accuracy (m)	Photo number
North	Easting	0											
	Northing												
120°	Easting	0											
	Northing												
240°	Easting	0											
	Northing												

Method – the specified method is in bold. If changes to the specified method have been made, please record them below. (Note: changes should be made with caution as the data may not be comparable.)	
Length of line transect	**50 metres** /_____
Diameter of structure pole (millimetres)	5 mm / 8 mm / 10 mm / **15 mm** / 20 mm /_____
Distance between assessment points	1 metre / 2 metres / **5 metres** / _____
Total width of belt transect (metres)	2+2 = 4 m / 3+3 = 6 m / **4+4 = 8 m** / _____
Side of transect measurements were recorded	**Left** /Right
Variations to standard method	

Habitat parameters measured at points along the line transect						
Assessment point number		**1**	**2**	**3**	**4**	**5**
Crown cover – present or absent						
Sub-canopy – present or absent						
1–2 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Fern – stalked					
	Fern – clumped					
	Fern – tree					
	Xanthorrhoea					
	Regen – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
0.5–1 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Fern – stalked					
	Fern – clumping					
	Fern – tree					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					

SFHA – V1 Feb 2012					
Plot name		Transect angle	N	120°	240°
Position on slope and aspect of transect					

Assessment point number		**1**	**2**	**3**	**4**	**5**
0.2–0.5 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Fern – stalked					
	Fern – clumped					
	Fern – tree					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
0–0.2 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Fern – stalked					
	Fern – clumped					
	Fern – tree					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
Ground cover (B, C, R, L, V, FWD, CWD, W)						
Litter bed depth (to nearest 5 mm)						

Habitat parameters measured at points along the line transect						
Assessment point number		**6**	**7**	**8**	**9**	**10**
Crown cover – present or absent						
Sub-canopy – present or absent						
1–2 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Fern – stalked					
	Fern – clumped					
	Fern – tree					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
0.5–1 m	Grass – spreading					
	Grass – clumping/tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Fern – stalked					
	Fern – clumped					
	Fern – tree					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					

SFHA – V1 Feb 2012					
Plot name		Transect angle	N	120°	240°
Position on slope and aspect of transect					

Assessment point number		**6**	**7**	**8**	**9**	**10**
0.2–0.5 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Fern – stalked					
	Fern – clumped					
	Fern – tree					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
0–0.2 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Fern – stalked					
	Fern – clumped					
	Fern – tree					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
Ground cover (B, C, R, L, V, FWD, CWD, W)						
Litter bed depth (to nearest 5 mm)						

Standard Forest Habitat Assessment – V1 Feb 2012					
Plot name		Transect angle	N	120°	240°
Coarse woody debris (measured when intersecting with line transect)					
Log number (starting from 1)	**Distance from centre of plot**	**Diameter of log at point it intersects with transect (cm)**	**Decay state (1–5)**	**Hollow entrance width (cm), if present**	

SFHA – V1 Feb 2012: Habitat parameters measured inside belt transect area.												
Plot name			Transect angle			N		120°		240°		
Total width of belt transect (e.g. 4 m either side = 8 m total)												
Trees – measured throughout belt transect												
Tree number (starting from 1.1)	Distance from centre of plot and side of transect tree sits on (L or R)	Diameter at breast Height (1.3 m) measured in cm	Scientific name of tree species Presence of epicormic growth (E)	Height of hollow above ground (m)	Aspect of hollow (N, NE, E, SE, S, SW, W, NW,V)	Dead spout/broken-off limbs (P/A)	Fissures (P/A)	Butt scar (P/A)	Bark type (1–7)	Amount of shedding bark if bark type 3 (0–2)	Burn damage (0–3)	Tree condition (0–3)

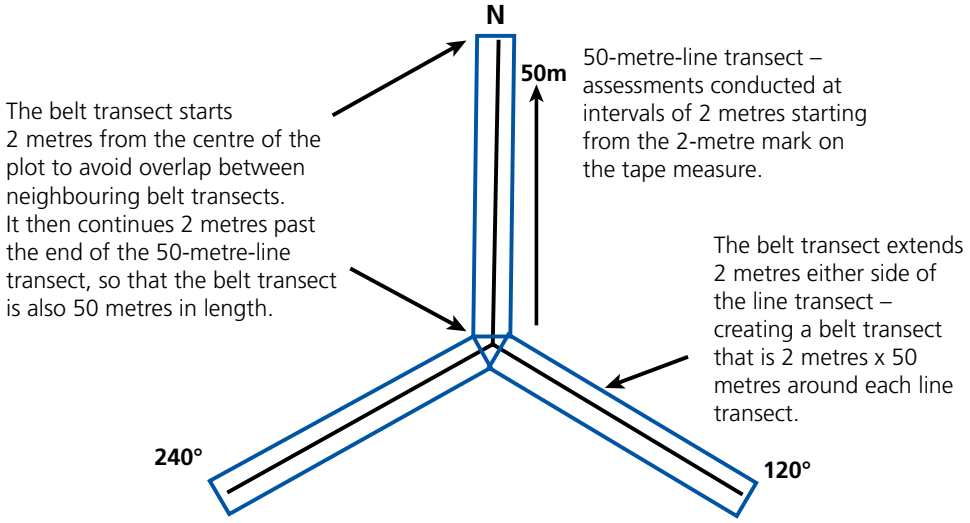
SFHA – V1 Feb 2012: Habitat parameters measured inside belt transect area.													
Plot name				Transect angle		N		120°		240°			
Total width of belt transect (e.g. 4 m either side = 8 m total)													
Trees – measured throughout belt transect													
Tree number (starting from 1.1)	Distance from centre of plot and side of transect tree sits on (L or R)	Diameter at breast Height (1.3 m) measured in cm	Scientific name of tree species Presence of epicormic growth (E)	Height of hollow above ground (m)	Aspect of hollow (N, NE, E, SE, S, SW, W, NW, V)	Dead spout/broken-off limbs (P/A)	Fissures (P/A)	Butt scar (P/A)	Bark type (1–7)	Amount of shedding bark if bark type 3 (0–2)	Burn damage (0–3)	Tree condition (0–3)	
# of trees per species in the rest of the belt transect (add as required).								# of Eucalypts 10-20cm					
Species 1		Species 2		Species 3		Species 4		Live					
								Dead					

SFHA V1 Feb 2012: Plot name			Transect angle	N	120°	240°
Tree stumps – measured throughout belt transect area						
Stump number	**Distance from centre of plot (m)**	**Diameter of stump at widest point (cm)**	**Height of stump (cm)**	**Width of hollow, if present (cm)**	**Depth of hollow, if present (cm)**	**Decay class (1–5)**

Monitoring at points along the line transect	
Assessment point number	**Comments**
Monitoring at intersections along the line transect	
CWD comments	
Monitoring inside the belt transect	
Tree comments	
Tree stump comments	

3. Standard Mallee Habitat Assessment: Method Version 1 Feb 2012

Plot set-up:



After setting up for the assessment, record the following information about the transect as a whole:

- Plot name – the name of the plot that the transect belongs to.
- Transect angle – the angle at which the transect has been laid out.
- Position on slope and aspect of transect – whether the transect is located on a ridge, gully, slope or flat, and the aspect the transect is facing if on a slope (N, S, E or W).

i. Monitoring at points along the line transect

Each parameter should be assessed at each assessment point (every 2 metres along the measuring tape). The assessments should be made on the opposite side of the measuring tape to that which was walked along when setting up the line transect.

Crown cover

Equipment: Structure pole

Crown cover is assessed as presence or absence of the upper-most layer of canopy above each assessment point along the line transect.

- If the structure pole continued all the way up to the canopy and would pass within the bounds of any tree crown, record this as present (P). Within the bounds means that if a polygon was traced around the tree crown, the structure pole would pass through the area contained by the polygon.
- If the structure pole has open sky directly above it, record this as absent (A).

Vegetation structure

Equipment: Structure pole

Vegetation is assessed by its structure. The structural form categories are based on the structural features of the vegetation, rather than on taxonomic groupings (see table on page 81). Categories are discrete, except for dead matter, i.e. plants can only be assigned to one structural form category unless that plant contains both live and dead material. In this case, any live material making contact with the structure pole is assigned to one of the live structural form categories and any dead material is assigned to dead matter.

Vegetation structure is measured in layers using a 2-metre structure pole. To measure vegetation structure:

- Place the pole vertical to the ground at each assessment point along the measuring tape (2 metres, 4 metres, 6 metres etc.).
- Starting from the top of the structure pole, record for the height section of 1–2metres, an 'X' beside each structural form category that *makes contact* with the pole. If the same plant touches the pole in multiple height sections record it once for each section it touches.
- Each plant can only be assigned to one structural form category, unless it has both live and dead material touching the pole (see previous instructions).
- If there are no touches for a particular structural form category or height section, record the value as absent (A) or draw a line through the boxes if there are many null values in a row.

- Record dead matter as a separate structural form category to living material, even if the dead material is attached to a living plant.
- Repeat this process for the remaining height sections.

Ground cover

Equipment: Structure pole

Ground cover is assessed in discrete categories (refer to table on page 81), i.e. if a substrate is attributed to one category it cannot be attributed to another category. In some cases it may be appropriate to record multiple ground surface categories, e.g. if the structure pole is touching a rock (R) with cryptogamic crust (C) on the surface, both R and C will be recorded.

- Place the structure pole vertical to the ground at each assessment point along the line transect (every 2 metres). Make sure the structure pole is placed directly beside each mark along the measuring tape, on the opposite side of the measuring tape to that which was trampled during plot set-up.
- Using the categories listed on page 81, record the substrate the structure pole is sitting on at each assessment point.
- If a standing tree is obscuring the point, record ground cover as absent (A).

Litter bed depth

Equipment: Ruler

The litter bed depth is measured from the soil surface (point where mineral soil is exposed) to the top of the litter bed (the top of the leaves, twigs and bark, including duff lying on the soil surface).

- Use a ruler to measure the depth of the horizontal litter layer to the nearest 5 millimetres. Ignore any leaves or twigs that are inconsistent with the horizontal layer.
- Remember to account for the tip of the ruler if the measurements do not start from the ruler's edge.
- If no litter is present, record as zero '0' and move onto the ground cover assessment

ii. Monitoring at a subset of points along the line transect

Triodia

Equipment: Measuring tape

Triodia is an important habitat parameter in Mallee habitat and is to be assessed at the 25 metre mark and the 50 metre mark of each transect.

- Assess the two triodia clumps/rings nearest to the 25 metre mark of the transect that have >50% continuous live or dead plant matter. Do not include rings that are dead and no longer standing.
- Record its growth form as being a clump (C) or Ring (R).
- Measure the height in centimetres of the triodia, excluding any flowering stems.
- Measure the diameter in centimetres of the vegetative part of the plant at its widest point
- Measure the diameter in centimetres of the internal hole if present.
- Repeat at the 50 metre mark of each transect

iii. Monitoring at intersections with the line transect

Coarse woody debris

Equipment: Diameter measuring tape

Log definition – any log not attached to a tree that is >5 centimetres in diameter and >1 metre in length.

- Assess all logs that have their central axis intersecting with the line transect. Exclude logs that are still attached to a tree.
- Assign each new log a number, starting from 1. If the log has multiple stems that intersect the transect, assign each stem a letter to reflect the stems are attached to the same base, e.g. 1A and 1B. If a stem does not intersect, do not record it. Record the features of each stem that intersects with the transect on a separate line on the datasheet.
- Record the distance of the log from the centre-point of the plot.
- Measure the diameter, in centimetres, of the log at the point it intersects with the line transect.
- Record the decay stage of the log using the classes in the table on page 81.

Hollows in logs

Hollow definition – entrance width is >20 millimetres and has a cavity. Cracks must be wider, not longer, than 20mm to be included.

- Record widths of hollows only if they occur inside the belt transect area.
- Record different hollows on separate lines of the datasheet – record as 'A' if no hollows present inside the belt transect area.

iv. Monitoring inside the belt transect

Trees

Definition – live and dead trees >2 metres in height and >5 centimetres in diameter at breast height (1.3 metres). 'Live trees' include trees that may have been recently burnt and have not yet re-sprouted. Dead trees may be under 2 metres but >1.3 metres in height, otherwise they are assessed as a tree stump. Only record trees that have the centre point of their trunk at its insertion point in the ground, inside the area of the belt transect.

- Only assess the features of the first 10 trees of each species type – count the number of remaining trees for each tree species type in the rest of the belt transect. Record the total number of trees for each species in the space provided.
- Assign each different tree species type a number (tree type), and each individual tree a number so that it is easier to keep track of how many trees have been assessed for each species type. For example, tree 1.1 will be the first tree assessed for the first species encountered, tree 1.2 will be the second tree assessed for the first species type and tree 2.1 will be the first tree assessed for the second species type encountered.
- For each tree assessed, record the following information about the tree as a whole:
  - Distance of tree from centre of plot.
  - Side of transect the tree occurs on – L or R when facing towards the centre of the plot.
  - Diameter in centimetres at the widest part of the individual stem above any obvious lignotuber (bulge in the stem). For multi-stemmed trees, assess diameter above where the stems branch out. If a base has more than three stems, measure the largest stem, the smallest stem and one stem of average size and then write beside how many stems there were in total.
  - Species – record the scientific name of each tree species assessed or record the common name until the scientific name can be confirmed. For eucalypts, if the species is unknown then record the grouping of eucalypts it belongs to, e.g. stringybark, box, ironbark, ash, peppermint.
  - Epicormic growth – record an 'E' beside the eucalypt species name if epicormic growth is present.
  - Hollows – obvious presence (>20 millimetres with apparent cavity)
    - Height of entrance above ground (metres)
    - Aspect of hollow entrance (N, NE, E, SE, S, SW, W, NW vertical).
- Presence of hollow-bearing characteristics (record present – P – or absent – A – for each):
  - Dead spouts or large broken-off limbs – limbs with the ends broken off that leave an exposed opening
  - Fissures – any narrow crack in trunk >20 millimetres wide and >30 millimetres long
  - Butt scar – deformities on the stem of a tree that meet the ground.
- Bark type – record the dominant bark type of each tree using the categories listed on page 82 (if the tree has two dominant bark types, record both).
- Shedding bark – amount if classified as bark type 3 using the categories on page 82.
- Burn damage – recorded as any visible burn damage on each tree using the categories on page 82.
- Tree condition – rate the condition of each tree using the categories on page 82.

Tree stumps

Equipment: Diameter measuring tape

Definition – lower end of a tree (<1.3 metres) remaining in the ground after trunk has been removed. Only include stumps if centre-point is inside the area of the belt transect. If stump is taller than 1.3 metres, assess it as a dead tree.

- Assign each tree stump assessed a number, starting from 1.
- Record the distance (in metres) of each tree stump from the starting point of the plot.
- Record the diameter in centimetres, around the widest section of each tree stump – measure above where the roots begin to branch out.
- Record the consistent height of the tree stump, in centimetres – ignore bark that may be sticking up.
- Record the presence of any hollow in each stem, present or absent.
- Record the decay stage of the tree stump using the classes on page 82.

Categories for Standard Mallee Habitat Assessment Version 1 Feb 2012

Structural form categories

Category	Description
Grass – spreading	Grasses that create new plants by running roots, e.g. wire grass, couch.
Grass – tussock	Grasses where most of the leaves originate close to the centre of the plant forming a tussock. The leaves are soft to touch without hard edges, e.g. wallaby grass and common tussock grass.
Grass – hummock	A grass of semi-arid and arid environments that consists of raised interwoven balls of prickly foliage (particular to Triodia species in Victoria).
Sedge/Rush	Non-woody plants with sharp edges or wiry, long, linear leaves, often tussocky. Includes sedges, rushes, some grasses, e.g. Phragmites australis, many perennial lilies, Lomandra and Xanthorrhoea species that do not have a trunk.
Herb	Non-woody flowering plants, not covered by the above categories, some herbs may be up to 1.5 metres tall or taller, e.g. great mullein and showy cassinia.
Chenopod/ Zygophyllum	Small shrubs or herbs well adapted to saline or arid conditions, e.g. saltbush Atriplex and Maireana sp. and rounded, many-stemmed dwarf shrubs of Zygophyllum sp., characterised by flowers with four or five white or yellow petals, e.g. coast twin leaf and shrubby twin leaf.
Creeper/Rambler	Any plant that grows on other plants or the ground and is incapable of self-support, e.g. small leaf clematis, blackberry, smilax.
Xanthorrhoea	Grass trees with a trunk.
Regeneration – eucalypt	Woody plants, self-supporting, either young or suppressed eucalypts, i.e. not yet reaching the canopy or the typical mature height of the species at the site.
Shrub/regeneration – non-eucalypt	Woody plants, either young or suppressed trees or shrubs of species that form the canopy at this site, i.e. not yet reaching the canopy or typical mature height for the species at this site.
Tree	All woody species >2 metres in height and >5 cm diameter.
Dead matter	Any vegetation that is dead, even if it is attached to a live plant, e.g. a dead branch attached to a live tree. N.B. Bark is not considered dead matter if attached to a live stem.

Ground cover categories

B	Bare ground/soil – exposed mineral earth.
C	Cryptogamic crust – crust-like layer formed on the surface of solid structures such as the soil surface, rocks and logs. Includes algae, fungi, lichens, mosses and liverworts.
R	Rocks – a mass of hard consolidated matter.
L	Litter – any dead organic material sitting above the soil layer < 6mm in diameter. Includes leaves, twigs and the duff layer.
FWD	Fine woody debris – dead organic material >6 mm but finer than 5 cm in diameter.
CWD	Coarse woody debris – logs >5 cm in diameter.
V	Vegetation – any plant material live or dead that is not already part of the litter or fine woody debris.
W	Water.

Log decay class categories

1	Log is solid and cylindrical in shape, and may or may not have bark. Few imperfections such as splits, holes and no fungal fruiting bodies present. Little or no indication of burn damage.
2	Log retains much of original shape but has presence of some or all of fungal fruiting bodies, splits, crack and decayed ends showing signs of rot or burn damage to <10% of total surface area.
3	Beginning to lose 'tree-like' appearance with log containing splits and crack, exposing rot or burn damage to 11–20% of overall surface area. Exterior of log may be moderately soft with no bark retained.
4	Losing 'log-like' appearance with large sections of exterior wood missing. Exposed rot or burn damage to 21–50% of log surface area. May be moderately soft.
5	Rotting wood roughly in the shape of a log, often only solid wood present along sides of log and may be embedded partly in soil. >50% of surface area is rotting or showing burn damage. May be quite soft and wet.

Bark type categories

Category	Bark type	Description
1	Stringybark	Fine fibrous material <1 mm thick covering the whole trunk. Fibrous nature of bark is obvious, extending up to 0.5 m or more, without breaks, along the trunk. Old bark is retained on the trunk forming a relatively spongy fibrous mass with deep vertical fissures. The bark forms long strands when peeled off. E.g. messmate – *E. obliqua*, brown stringybark – *E. baxteri*, desert stringybark – *E. arenacea*, blanket-leaf – *Bedfordia arborescens*.
2	Ironbarks	Layers of old, coarse bark that becomes rough, compacted and furrowed with age. Bark is not prone to burning and may show little or no evidence of charring following fire. E.g. red ironbark – *E. tricarpa*, mugga – *E. sideroxylon*, buloke – *Allocasaurina luehmannii.*
3	Ribbon or candle bark	Annual shedding of old bark layers in long strips or ribbons of bark exposing new bark underneath. As the bark dries, the sides of the bark pieces curl tightly inwards to form a candle-like shape. E.g. candelbark – *E. rubida*, blue gum – *E. globulus*, manna gum – *E. viminalis*, grey mallee – *E. socialis*.
4	Coarsely fibrous barks	Short-strand fibrous bark. Old bark is retained on trunk and breaks away as 'chunks', not as long fibrous strands. E.g. red bloodwood – Corymbia gummifera, southern mahogany – *E. botryoides*, lightwood – *Acacia implexa*, narrow-leaved peppermint – *E. radiata*, black box – *E. largiflorens*, grey box – *E. macrocarpa*.
5	Platy barks	Layers of old, fine fibrous bark retained on the trunk and branches that tends to flake or break off in small strands or pieces when rubbed or as a result of burning or weathering. E.g. silvertop – *E. sieberi*, black sheoke, *Allocasuarina littoralis*, blackwood – *Acacia melanoxylon*, belah – *Casuarina cristata*.
6	Papery barks	Shrubs and trees with flaky exfoliating bark tending to split, allowing sheets of bark to become loose and eventually detach. E.g. swamp paperbark – *Melaleuca ericifolia*, salt paperbark – *Malaleuca halmaturorum*, coast tea tree – *Leptospermum laevigatum*.
7	Smooth or gum bark	Annual shedding of old bark layers, exposing the smooth living bark underneath. Bark is not shed in long strands (i.e. like candelbark), but tends to peel into large vertical slabs (<50 centimetres in length) or flake into small flakes when shed. E.g. river red gum – *E. camaldulensis*, mountain gum – *E. dalympleana*, yellow gum – *E. leucoxylon*, bog gum – *E. kitsoniana*, snow gum – *E. pauciflora*.

Shedding bark categories

0	No bark shedding greater than 30cm in length.
1	Less than 50% of the trees stem surface area contains shedding bark.
2	>50% of trees stem surface contain shedding bark.

Burn damage categories

0	No indication of fire damage.
1	Some charcoal on bark.
2	Burnt bark and scarring.
3	Severely burnt, forming a burnt-out arch or bridge in the trunk.

Tree condition categories

0	Dead (it is important to record dead trees as well as live trees).
1	Senescing, dying, dieback.
2	Signs of stress, some dieback but mostly healthy.
3	Tree apparently healthy.

Tree stump decay class categories

Class	Description
1	Solid, cylindrical in shape with or without bark. Few imperfections, such as splits, holes and no fungal fruiting bodies present. Little or no indication of burn damage.
2	Retains much of original shape but has presence of some or all of fungal fruiting bodies, splits, crack and decayed end showing signs of rot or burn damage to <10% of total surface area.
3	Losing stump-like appearance, containing splits and crack, exposing rot or burn damage to 11–20% of overall surface area. Exterior of stump may be moderately soft with no bark retained.
4	Losing stump-like appearance with large sections of exterior wood missing. Exposed rot or burn damage to 21–50% of stump surface area. May be moderately soft.
5	Rotting wood roughly in the shape of a stump, often only solid wood present along sides of stump. >50% of surface area is rotting or showing burn damage. May be quite soft and wet.

4. Standard Mallee Habitat Assessment: Datasheet V1 Feb 2012

Monitoring area name													
Data-point grouping name (name identifying the group of points used in this assessment)													
Assessors and organisation													
Assessment date													
Ecological Vegetation Division (EVD) and Ecological Vegetation Class (EVC)													
Number of years since the area was last burnt (from fire plan map)									Burn number				
Verify last-burnt data (tick one box)													
Further comments (about fire regime, e.g. fire season or fire severity)													
Further comments. Record details about other variables of interest (e.g. drought, grazing)													
Plot name											Zone		54 55 (circle one)
Plot location description													
GPS coordinates (GDA 94)		Start of transect										GPS accuracy (m)	
Easting		0											
Northing													
Transect angle		End of transect										GPS accuracy (m)	Photo number
North	Easting	0											
	Northing												
120°	Easting	0											
	Northing												
240°	Easting	0											
	Northing												

Method – the specified method is in bold. If changes to the specified method have been made, please record them below. (Note: changes should be made with caution as the data may not be comparable.)	
Length of line transect	**50 metres** /_____
Diameter of structure pole (millimetres)	5 mm / 8 mm / 10 mm / **15 mm** / 20 mm /_____
Distance between assessment points	1 metre / **2 metres** / 5 metres / _____
Total width of belt transect (metres)	**2+2 = 4 m** / 3+3 = 6 m / 4+4 = 8 m / _____
Side of transect measurements were recorded	**Left** /Right
Variations to standard method	

Habitat parameters measured at points along the line transect						
Assessment point number		**1**	**2**	**3**	**4**	**5**
Crown cover – present or absent						
1–2 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Chenopod/Zygophyllum					
	Creeper/Rambler					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
0.5–1 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Chenopod/Zygophyllum					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					

SMHA – V1 Feb 2012					
Plot name		Transect angle	N	120°	240°
Position on slope and aspect of transect					

Assessment point number		**1**	**2**	**3**	**4**	**5**
0.2–0.5 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Chenopod/Zygophyllum					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
0–0.2 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Chenopod/Zygophyllum					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
Ground cover (B, C, R, L, V, FWD, CWD, W)						
Litter bed depth (to nearest 5 mm)						

Habitat parameters measured at points along the line transect						
Assessment point number		**6**	**7**	**8**	**9**	**10**
Crown cover – present or absent						
1–2 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Chenopod/Zygophyllum					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
0.5–1 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Chenopod/Zygopphyllum					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					

SMHA – V1 Feb 2012					
Plot name		Transect angle	N	120°	240°
Position on slope and aspect of transect					

Assessment point number		**6**	**7**	**8**	**9**	**10**
0.2–0.5 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Chenopod/Zygophyllum					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
0–0.2 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Chenopod/Zygophyllum					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
Ground cover (B, C, R, L, V, FWD, CWD, W)						
Litter bed depth (to nearest 5 mm)						

Habitat parameters measured at points along the line transect						
Assessment point number		**11**	**12**	**13**	**14**	**15**
Crown cover – present or absent						
1–2 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Chenopod/Zygophyllum					
	Creeper/Rambler					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
0.5–1 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Chenopod/Zygophyllum					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					

SMHA – V1 Feb 2012					
Plot name		Transect angle	N	120°	240°
Position on slope and aspect of transect					

Assessment point number		**11**	**12**	**13**	**14**	**15**
0.2–0.5 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Chenopod/Zygophyllum					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
0–0.2 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Chenopod/Zygophyllum					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
Ground cover (B, C, R, L, V, FWD, CWD, W)						
Litter bed depth (to nearest 5 mm)						

Habitat parameters measured at points along the line transect						
Assessment point number		**16**	**17**	**18**	**19**	**20**
Crown cover – present or absent						
1–2 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Chenopod/Zygophyllum					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
0.5–1 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Chenopod/Zygopphyllum					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					

SMHA – V1 Feb 2012					
Plot name		Transect angle	N	120°	240°
Position on slope and aspect of transect					

Assessment point number		**16**	**17**	**18**	**19**	**20**
0.2–0.5 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Chenopod/Zygophyllum					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
0–0.2 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Chenopod/Zygophyllum					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
Ground cover (B, C, R, L, V, FWD, CWD, W)						
Litter bed depth (to nearest 5 mm)						

Habitat parameters measured at points along the line transect						
Assessment point number		21	22	23	24	25
Crown cover – present or absent						
1–2 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Chenopod/Zygophyllum					
	Creeper/Rambler					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
0.5–1 m	Grass – spreading					
	Grass – clumping/tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Chenopod/Zygophyllum					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					

SMHA – V1 Feb 2012					
Plot name		Transect angle	N	120°	240°
Position on slope and aspect of transect					

Assessment point number		21	22	23	24	25
0.2–0.5 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Chenopod/Zygophyllum					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
0–0.2 m	Grass – spreading					
	Grass – tussock					
	Grass – hummock					
	Sedge/Rush					
	Herb					
	Creeper/Rambler					
	Chenopod/Zygophyllum					
	Xanthorrhoea					
	Regeneration – eucalypt					
	Shrub/regen – non-euc					
	Tree					
	Dead matter					
Ground cover (B, C, R, L, V, FWD, CWD, W)						
Litter bed depth (to nearest 5 mm)						

Standard Mallee Habitat Assessment – V1 Feb 2012						
Triodia						
Transect Angle	Assessment point	Triodia number	Growth Form (C or R)	Height of Triodia (cm)	Diameter of vegetation (cm)	Diameter of donut if present (cm)
N	25	1				
N	25	2				
N	50	1				
N	50	2				
120	25	1				
120	25	2				
120	50	1				
120	50	2				
240	25	1				
240	25	2				
240	50	1				
240	50	2				

Standard Mallee Habitat Assessment – V1 Feb 2012					
Plot name		Transect angle	N	120°	240°

Coarse woody debris (measured when intersecting with line transect)				
Log number (starting from 1)	**Distance from centre of plot**	**Diameter of log at point it intersects with transect (cm)**	**Decay state (1–5)**	**Hollow entrance width (cm), if present**

Tree stumps – measured throughout belt transect area						
Stump number	**Distance from centre of plot (m)**	**Diameter of stump at widest point (cm)**	**Height of stump (cm)**	**Width of hollow, if present (cm)**	**Depth of hollow, if present (cm)**	**Decay class 1–5**

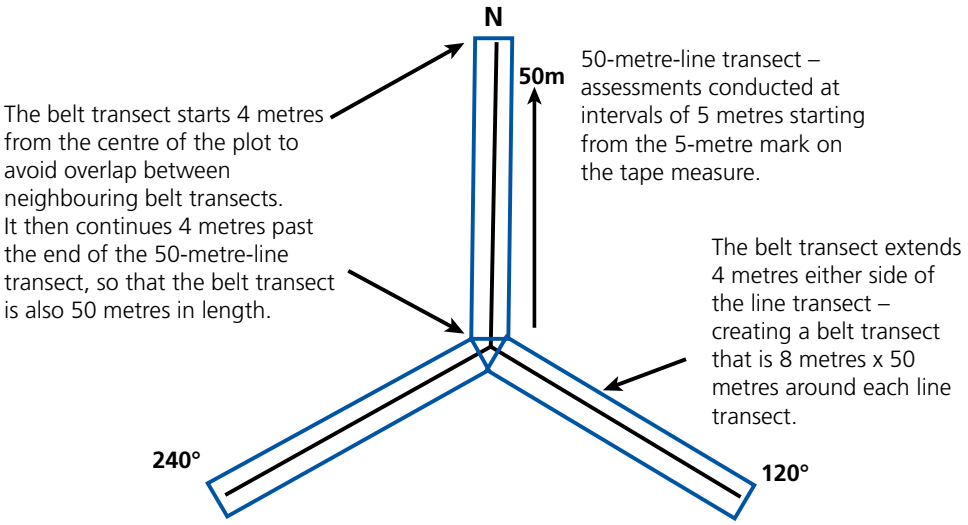
SMHA – V1 Feb 2012: Habitat parameters measured inside belt transect area												
Plot name			Transect angle		N		120°		240°			
Total width of belt transect (e.g. 2 m either side = 4 m total)												
Trees – measured throughout belt transect												
Tree number (starting from 1.1)	Distance from centre of plot and side of transect tree sits on (L or R)	Diameter at widest part of stem, measured in cm	Scientific name of tree species Presence of epicormic growth (E)	Height of hollow above ground (m)	Aspect of hollow (N, NE, E, SE, S, SW, W, NW, V)	Dead spout/broken-off limbs (P/A)	Fissures (P/A)	Butt scar (P/A)	Bark type if eucalypt (1–7)	Amount of shedding bark if bark type 3 (0–2)	Burn damage (0–3)	Tree condition (0–3)

SMHA – V1 Feb 2012: Habitat parameters measured inside belt transect area.													
Plot name				Transect angle		N		120°		240°			
Total width of belt transect (e.g. 2 m either side = 4 m total)													
Trees – measured throughout belt transect													
Tree number (starting from 1.1)	Distance from centre of plot and side of transect tree sits on (L or R)	Diameter at widest part of stem, measured in cm	Scientific name of tree species Presence of epicormic growth (E)	Height of hollow above ground (m)	Aspect of hollow (N, NE, E, SE, S, SW, W, NW, V)	Dead spout/broken-off limbs (P/A)	Fissures (P/A)	Butt scar (P/A)	Bark type if eucalypt (1–7)	Amount of shedding bark if bark type 3 (0–2)	Burn damage (0–3)	Tree condition (0–3)	
Number of trees in the rest of the belt transect area by tree species (add more if needed).				S1 =_____ S2 = _____ S3 = _____ S4 = _____									

Monitoring at points along the line transect	
Assessment point number	**Comments**
Monitoring at a subset of points along the line transect	
Triodia comments	
Monitoring at intersections along the line transect	
CWD comments	
Monitoring inside the belt transect	
Tree comments	
Tree stump comments	

5. Basic Forest Habitat Assessment: Method Version 1 Feb 2012

Plot set-up:



After setting up for the assessment, record the following information about the transect as a whole:

- Plot name – the name of the plot that the transect belongs to.
- Transect angle – the angle at which the transect has been laid out.
- Position on slope and aspect of transect – whether the transect is located on a ridge, gully, slope or flat, and the aspect the transect is facing if on a slope (N, S, E or W).

i. Monitoring at points along the line transect

Each parameter should be assessed at each assessment point (every 5 metres along the measuring tape). The assessments should be made on the opposite side of the measuring tape to that which was walked along when setting up the line transect.

Crown cover

Equipment: Structure pole

Crown cover is assessed as presence or absence of the upper-most layer of canopy above each assessment point along the line transect.

- If the structure pole continued all the way up to the canopy and would pass within the bounds of any tree crown, record this as present (P). Within the bounds means that if a polygon was traced around the tree crown, the structure pole would pass through the area contained by the polygon.
- If the structure pole sits outside the crown, record this as absent (A).

Vegetation structure

Equipment: Structure pole

Vegetation is assessed by its structure. The structural form categories are based on the structural features of the vegetation, rather than on taxonomic groupings (see table on page 98). Categories are discrete, except for dead matter, i.e. plants can only be assigned to one structural form category unless that plant contains both live and dead material. In this case, any live material making contact with the structure pole is assigned to one of the live structural form categories and any dead material is assigned to dead matter.

Vegetation structure is measured in layers using a 2-metre structure pole. To measure vegetation structure:

- Place the pole vertical to the ground at each assessment point along the measuring tape (5 metres, 10 metres, 15 metres etc.).
- Starting from the top of the structure pole, record for the height section of 1-2metres, an 'X' beside each structural form category that *makes contact* with the pole. If the same plant touches the pole in multiple height sections record it once for each section it touches.
- Each plant can only be assigned to one structural form category, unless it has both live and dead material touching the pole (see previous instructions).
- If there are no touches for a particular structural form category or height section, record the value as absent (A) or draw a line through the boxes if there are many null values in a row.
- Record dead matter as a separate structural form category to living material, even if the dead material is attached to a living plant.
- Repeat this process for the remaining height sections.

Ground cover

Equipment: Structure pole

Ground cover is assessed in discrete categories (refer to table on page 98), i.e. if a substrate is attributed to one category it cannot be attributed to another category. In some cases it may be appropriate to record multiple ground-surface categories, e.g. if the structure pole is touching a rock (R) with cryptogamic crust (C) on the surface, both R and C will be recorded.

- Place the structure pole vertical to the ground at each assessment point along the line transect (every 5 metres). Make sure the structure pole is placed directly beside each mark along the measuring tape, on the opposite side of the measuring tape to that which was trampled during plot set-up.
- Using the categories listed on page 98, record the substrate the structure pole is sitting on at each assessment point.
- If a standing tree is obscuring the point, record ground cover as absent (A).

Litter bed depth

Equipment: Ruler

The litter bed depth is measured from the soil surface (point where mineral soil is exposed) to the top of the litter bed (the top of the leaves, twigs and bark, including duff lying on the soil surface).

- Use a ruler to measure the depth of the horizontal litter layer to the nearest 5 millimetres. Ignore any leaves or twigs that are inconsistent with the horizontal layer.
- Remember to account for the tip of the ruler if the measurements do not start from the ruler's edge.
- If no litter is present, record as zero '0' and move onto the ground cover assessment.

iii. Monitoring at intersections with the line transect

Coarse woody debris

Equipment: Diameter measuring tape

Log definition – any log not attached to a tree that is >10 centimetres in diameter and >1 metre in length.

- Assess all logs that have their central axis intersecting with the line transect. Exclude logs that are still attached to a tree.
- Assign each new log a number, starting from 1. If the log has multiple stems that intersect the transect, assign each stem a letter to reflect the stems are attached to the same base, e.g. 1A and 1B. If a stem does not intersect, do not record it. Record the features of each stem that intersects with the transect on a separate line on the datasheet.
- Record the distance from the starting point of the line transect to the log, i.e. the centre-point of the plot (read this number from the measuring tape used to lay out the line transect).
- Measure the diameter, in centimetres, of the log at the point it intersects with the line transect.

Hollows in logs

Hollow definition – entrance width is >20 millimetres in diameter and has a cavity. Cracks must be wider, not longer, than 20 mm to be included.

- Record the presence (P) of any hollows that occur in the section of the log that is sitting inside the belt transect area. If the log contains no hollows or the hollows occur on the log outside the belt transect area, record as absent (A).

iv. Monitoring inside the belt transect

Trees

- Both live and dead trees that meet the minimum diameter requirements are to be assessed. Only record trees that have the centre-point of their trunk at insertion point in the ground, inside the area of the belt transect.
- *Live trees* – >3 metres in height and >20 cm in diameter for eucalypts and >10 cm in diameter for non-eucalypts. Measured at breast height (1.3 metres). Includes trees that may have been recently burnt and have not yet re-sprouted.
- *Dead trees* – may be under 3 metres but >1.3 metres in height, otherwise they are assessed as a tree stump. Use the same diameters as specified for live trees.
- *Live and dead eucalypts between 10 and 20cm diameter* – count total of each and record on data sheet.
- Only assess the features of the first 10 trees of each species that meet the minimum specified diameters.
- Assign each different tree species a number (species number), and each individual tree a number (tree number) so it is easier to keep track of how many trees have been assessed for each species. For example, tree 1.1 will be the first tree assessed for the first species encountered, tree 1.2 will be the second tree assessed for species one and tree 2.1 will be the first tree assessed for the second species encountered.
- If there are more than 10 trees of a species count the number of remaining of trees of that species in the belt transect. Repeat for any tree species with more than 10 individual trees.
- If more than 10 trees have been assessed and there is an obvious habitat tree, record the features of this tree as well.
- For each tree assessed, record the following information about the tree as a whole:
  - Distance of tree from centre of plot.
  - Side of transect the tree occurs on – L or R when facing towards the centre of the plot.
  - Diameter in centimetres at breast height (1.3 metres above ground). If multi-stemmed, assess diameter of each stem separately. If there are more than three stems, measure the largest stem, the smallest stem and one stem of average size. Then record total number of stems beside.
  - Species – record Y or N if the tree is a eucalypt (includes species of *Eucalyptus*, *Angophora* or *Corymbia*). If species name is known, record it on the datasheet.
  - Epicormic growth – if the tree is a eucalypt, record if it has presence of epicormic growth (record as an E beside the Y for eucalypt) .
  - Hollows – obvious presence (>20 millimetres with apparent cavity)
    - Canopy (C) – trunk above 1.3 metres from the ground
    - Basal area (B) – trunk below 1.3 metres from the ground
    - Has hollows in both canopy and basal area (K).
  - Presence of hollow-bearing characteristics (record present – P – or absent – A – for each):
    - Dead spouts or large broken-off limbs – limbs with the ends broken off that leave an exposed opening
    - Fissures – any narrow crack in trunk >20 millimetres wide and >30 millimetres long
    - Butt scar – deformities on the stem of a tree that meet the ground.
- Bark type – record the dominant bark type of each tree using the categories listed in the table on page 99 (if the tree has two dominant bark types, record both).
- Burn damage – recorded as any visible burn damage on each tree using the categories listed on page 99.
- Tree condition – rate the condition of each tree using the categories listed on page 99.

Tree stumps

Equipment: Diameter measuring tape

Definition – lower end of a tree (<1.3 metres) remaining in the ground after trunk has been removed. Only include stumps if centre-point is inside the area of the belt transect. If a tree stump is > 1.3 metres in height, assess it as a dead tree.

- Assign each tree stump assessed a number, starting from 1.
- Record the distance (in metres) of each tree stump from the starting point of the plot.
- Record the diameter in centimetres, around the widest section of each tree stump – measure above where the roots begin to branch out.
- Record the consistent height of the tree stump, in centimetres – ignore bark that may be sticking up.
- Record the presence of any hollow in each stem, present or absent.
- Record the decay stage of the tree stump using the classes in the table on page 99.

Categories for Basic Forest Habitat Assessment Version 1 Feb 2012

Vegetation structural form categories

Category	Description
Grass – spreading	Grasses that create new plants by running roots, e.g. wire grass, couch.
Grass – tussock	Grasses where most of the leaves originate close to the centre of the plant forming a tussock. The leaves are soft to touch without hard edges, e.g. wallaby grass and common tussock grass.
Grass – hummock	A grass of semi-arid and arid environments that consists of raised interwoven balls of prickly foliage (particular to *Triodia* species in Victoria).
Sedge/Rush	Non-woody plants with sharp edges or wiry, long, linear leaves, often tussocky. Includes sedges, rushes, some grasses, e.g. *Phragmites australis*, many perennial lilies, *Lomandra* and *Xanthorrhoea* species that do not have a trunk.
Herb	Non-woody flowering plants, not covered by the above categories, some herbs may be up to 1.5 metres tall or taller, e.g. great mullein and showy cassinia.
Creeper/Rambler	Any plant that grows on other plants or the ground and is incapable of self-support, e.g. small leaf clematis, blackberry, smilax.
Fern – stalked	Ground ferns that have the majority of their biomass at the top of a stem, with little connection to the ground underneath, e.g. bracken.
Fern – clumped	Ground ferns that form clumps with the majority of their biomass arising from the ground, e.g. mother shield-fern, fishbone Water-fern.
Fern – tree	Ferns with a fibrous trunk and a (usually) single crown of fronds.
Xanthorrhoea	Grass trees with a trunk.
Regeneration – eucalypt	Woody plants, self-supporting, either young or suppressed eucalypts, i.e. not yet reaching the canopy or the typical mature height of the species at the site.
Shrub/regeneration – non-eucalypt	Woody plants, either young or suppressed trees or shrubs of species that form the canopy at this site, i.e. not yet reaching the canopy or typical mature height for the species at this site.
Tree	All woody species >3 metres in height (Forest).
Dead matter	Any vegetation that is dead, even if it is attached to a live plant, e.g. a dead branch attached to a live tree. N.B. Bark is not considered dead matter if attached to a live stem.

Ground cover categories

B	Bare ground/soil – exposed mineral earth.
C	Cryptogamic crust – crust-like layer formed on the surface of solid structures such as the soil surface, rocks and logs. Includes algae, fungi, lichens, mosses and liverworts.
R	Rocks – a mass of hard consolidated matter.
L	Litter – any dead organic material sitting above the soil layer <6 mm in diameter. Includes leaves, twigs and the duff layer.
FWD	Fine woody debris – dead organic material >6 mm but finer than 10 cm in diameter.
CWD	Coarse woody debris – logs >10 cm in diameter.
V	Vegetation – any plant material live or dead that is not already part of the litter or fine woody debris.
W	Water.

Bark type categories

Category	Bark type	Description
1	Stringybark	Fine fibrous material < 1mm thick covering the whole trunk. Fibrous nature of bark is obvious, extending up to 0.5 m or more, without breaks, along the trunk. Old bark is retained on the trunk forming a relatively spongy fibrous mass with deep vertical fissures. The bark forms long strands when peeled off. E.g. messmate – *E. obliqua*, brown stringybark – *E. baxteri*, red stringybark – *E. macrorhyncha*, blanket-leaf – *Bedfordia arborescens,* lower part of trunk for alpine ash – *E. delegatensis.*
2	Ironbarks	Layers of old, coarse bark that becomes rough, compacted and furrowed with age. Bark is not prone to burning and may show little or no evidence of charring following fire. E.g. red ironbark – *E. tricarpa*, mugga *E. sideroxylon*, buloke – *Allocasaurina luehmannii*.
3	Ribbon or candle bark	Annual shedding of old bark layers in long strips or ribbons of bark exposing new bark underneath. As the bark dries, the sides of the bark pieces curl tightly inwards to form a candle-like shape. E.g. candelbark – *E. rubida*, blue gum – *E. globulus*, manna gum – *E. viminalis.*
4	Coarsely fibrous barks	Short-strand fibrous bark. Old bark is retained on trunk and breaks away as 'chunks', not as long fibrous strands. E.g. red bloodwood – *Corymbia gummifera*, southern mahogany – *E. botryoides,* lightwood – *Acacia implexa,* narrow-leaved peppermint – *E. radiata,* black box – *E. largiflorens*, grey box – *E. microcarpa*, yellow box – *E. melliodora*, lower sections of trunk for mountain ash – *E. regnans.*
5	Platy barks	Layers of old, fine fibrous bark retained on the trunk and branches that tends to flake or break off in small strands or pieces when rubbed or as a result of burning or weathering. E.g. silvertop – *E. sieberi,* black sheoke, *Allocasuarina littoralis*, blackwood – *Acacia melanoxylon,* belah – *Casuarina cristata.*
6	Papery barks	Shrubs and trees with flaky exfoliating bark that tends to split, allowing sheets of bark to become loose and eventually detach. E.g. swamp paperbark – *Melaleuca ericifolia*, salt paperbark – *Malaleuca halmaturorum,* coast tea tree – *Leptospermum laevigatum*.
7	Smooth or gum bark	Annual shedding of old bark layers, exposing the smooth living bark underneath. Bark is not shed in long strands (i.e. like candelbark), but tends to peel into large vertical slabs (<50 centimetres in length) or flake into small flakes when shed. E.g. river red gum – *E. camaldulensis*, mountain gum – *E. dalympleana*, yellow gum – *E. leucoxylon*, bog gum – *E. kitsoniana*, snow gum – *E. pauciflora.*

Burn damage categories

0	No indication of fire damage.
1	Some charcoal on bark.
2	Burnt bark and scarring.
3	Severely burnt, forming a burnt-out arch or bridge in the trunk.

Tree condition categories

0	Dead (it is important to record dead trees as well as live trees).
1	Senescing, dying, dieback.
2	Signs of stress, some dieback but mostly healthy.
3	Tree apparently healthy.

Tree stump decay classes

Class	Description
1	Tree stump is solid and cylindrical in shape and may or may not have bark. Few imperfections, such as splits, holes and no fungal fruiting bodies present. Little or no indication of burn damage.
2	Tree stump retains much of original shape but has presence of some or all of fungal fruiting bodies, splits, crack and decayed end showing signs of rot or burn damage to <10% of total surface area.
3	Beginning to lose stump-like appearance with tree stump containing splits and crack, exposing rot or burn damage to 11–20% of overall surface area. Exterior of tree stump may be moderately soft with no bark retained.
4	Losing stump-like appearance with large sections of exterior wood missing. Exposed rot or burn damage to 21–50% of stump surface area. May be moderately soft.
5	Rotting wood roughly in the shape of a stump, often only solid wood present along sides of stump. >50% of surface area is rotting or showing burn damage. May be quite soft and wet.

6. Basic Forest Habitat Assessment: Datasheet V1 Feb 2012

Monitoring area name													
Data-point grouping name (name identifying the group of points used in this assessment)													
Assessors and organisation													
Assessment date													
Ecological Vegetation Division (EVD) and Ecological Vegetation Class (EVC)													
Number of years since the area was last burnt (from fire plan map)								Burn number					
Verify last-burnt data (tick one box)													
Further comments (about fire regime, e.g. fire season or fire severity)													
Further comments. Record details about other variables of interest (e.g. drought, grazing)													

Plot name										Zone			54 55 (circle one)
Plot location description													
GPS coordinates (GDA 94)		Start of transect										GPS accuracy (m)	
Easting		0											
Northing													
Transect angle		End of transect										GPS accuracy (m)	Photo number
North	Easting	0											
	Northing												
120°	Easting	0											
	Northing												
240°	Easting	0											
	Northing												

Method – the specified method is in bold. If changes to the specified method have been made, please record them below. (Note: changes should be made with caution as the data may not be comparable.)	
Length of line transect	**50 metres** /_____
Diameter of structure pole (millimetres)	5 mm / 8 mm / 10 mm / **15 mm** / 20 mm /_____
Distance between assessment points	1 metre / 2 metres / **5 metres** / _____
Total width of belt transect (metres)	2+2 = 4 m / 3+3 = 6 m / **4+4 = 8 m** / _____
Side of transect measurements were recorded	**Left** /Right
Variations to standard method	

BFHA – V1 Feb 2012: Habitat parameters measured at points along the line transect.												
Plot name				Transect angle		N	120°	240°				
Position on slope and aspect of transect												
Assessment point number		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Crown cover – present or absent											
1–2 m	Grass – spreading										
	Grass – tussock										
	Grass – hummock										
	Sedge/Rush										
	Herb										
	Creeper/Rambler										
	Fern – stalked										
	Fern – clumped										
	Fern – tree										
	Xanthorrhoea										
	Regeneration – eucalypt										
	Shrub/regen – non-euc										
	Tree										
	Dead matter										
0.5–1 m	Grass – spreading										
	Grass – tussock										
	Grass – hummock										
	Sedge/Rush										
	Herb										
	Creeper/Rambler										
	Fern – stalked										
	Fern – clumped										
	Fern – tree										
	Xanthorrhoea										
	Regeneration – eucalypt										
	Shrub/regen – non-euc										
	Tree										
	Dead matter										
0–0.5 m	Grass – spreading										
	Grass – tussock										
	Grass – hummock										
	Sedge/Rush										
	Herb										
	Creeper/Rambler										
	Fern – stalked										
	Fern – clumped										
	Fern – tree										
	Xanthorrhoea										
	Regeneration – eucalypt										
	Shrub/regen – non-euc										
	Tree										
	Dead matter										
Ground cover (B, C, R, L, V, FWD, CWD, W)											
Litter bed depth (to nearest 5 mm)											

BFHA – V1 Feb 2012: Plot name		Transect angle	N	120°	240°

Coarse woody debris – measured when intercepting with line transect			
Log number (starting from 1)	Distance from centre of plot (m)	Diameter of log at point intersected by transect (cm)	Hollow(s) present (P/A)

Trees stumps – measured throughout belt transect area					
Total width of belt transect (e.g. 4 m either side = 8 m total)					
Stump Number	Distance from centre of plot (m)	Diameter of stump at widest point(cm)	Height of stump (cm)	Hollow(s) present (P/A)	Decay class 1–5

BFHA – V1 Feb 2012: Plot name		Transect angle	N	120°	240°

Trees – measured throughout belt transect area										
Total width of belt transect (e.g. 4 m either side = 8 m total)										
Tree number (starting from 1.1)	Distance from centre of plot and side of transect tree sits on (L or R)	Diameter at breast height (1.3 m), measured in cm	Eucalypt (Y/N) Epicormic growth (E)	Visible hollows (Absent, C, B or K)	Dead spout/Broken-off limbs (P or A)	Fissures (P or A)	Butt scar (P or A)	Bark type (1–7)	Burn damage (0–3)	Tree condition (0–3)

BFHA – V1 Feb 2012: Plot name		Transect angle	N	120°	240°

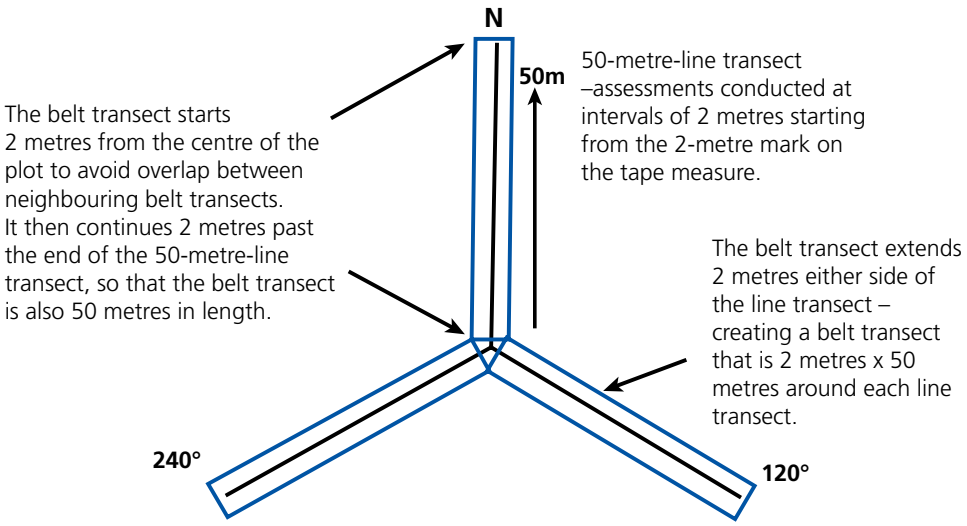
Trees – measured throughout belt transect area										
Total width of belt transect (e.g. 4 m either side = 8 m total)										
Tree number (starting from 1.1)	Distance from centre of plot and side of transect tree sits on (L or R)	Diameter at breast height (1.3 m), measured in cm	Eucalypt (Y/N) Epicormic growth (E)	Visible hollows (Absent, C, B or K)	Dead spout/Broken-off limbs (P or A)	Fissures (P or A)	Butt scar (P or A)	Bark type (1–7)	Burn damage (0–3)	Tree condition (0–3)

# of trees per species in the rest of the belt transect (add as required).	# of Eucalypts 10-20cm	
S1 = _____ S2 = _____ S3 =_____	Live	
	Dead	

Monitoring at points along the line transect	
Assessment point number	**Comments**
Monitoring at intersections along the line transect	
CWD comments	
Monitoring inside the belt transect	
Tree comments	
Tree stump comments	

7. Basic Mallee Habitat Assessment: Method Version 1 Feb 2012

Plot set-up:



After setting up for the assessment, record the following information about the transect as a whole:

- Plot name – the name of the plot that the transect belongs to.
- Transect angle – the angle at which the transect has been laid out.
- Position on slope and aspect of transect – whether the transect is located on a ridge, gully, slope or flat, and the aspect the transect is facing if on a slope (N, S, E or W).

i. Monitoring at points along the line transect

Each parameter should be assessed at each assessment point (every 2 metres along the measuring tape). The assessments should be made on the opposite side of the measuring tape to that which was walked along when setting up the line transect.

Crown cover

Equipment: Structure pole

Crown cover is assessed as presence or absence of the upper-most layer of canopy above each assessment point along the line transect.

- If the structure pole continued all the way up to the canopy and would pass within the bounds of any tree crown, record this as present (P). Within the bounds means that if a polygon was traced around the tree crown, the structure pole would pass through the area contained by the polygon.
- If the structure pole has open sky directly above it, record this as absent (A).

Vegetation structure

Equipment: Structure pole

Vegetation is assessed by its structure. The structural form categories are based on the structural features of the vegetation, rather than on taxonomic groupings (see table on page 108). Categories are discrete, except for dead matter, i.e. plants can only be assigned to one structural form category unless that plant contains both live and dead material. In this case, any live material making contact with the structure pole is assigned to one of the live structural form categories and any dead material is assigned to dead matter.

Vegetation structure is measured in layers using a 2-metre structure pole. To measure vegetation structure:

- Place the pole vertical to the ground at each assessment point along the measuring tape (2 metres, 4 metres, 6 metres etc.).
- Starting from the top of the structure pole, record for the height section of 1-2metres, an 'X' beside each structural form category that *makes contact* with the pole. If the same plant touches the pole in multiple height sections record it once for each section it touches.
- Each plant can only be assigned to one structural form category, unless it has both live and dead material touching the pole (see previous instructions).

- If there are no touches for a particular structural form category or height section, record the value as absent (A) or draw a line through the boxes if there are many null values in a row.
- Record dead matter as a separate structural form category to living material, even if the dead material is attached to a living plant.
- Repeat this process for the remaining height sections.

Ground cover

Equipment: Structure pole

Ground cover is assessed in discrete categories (refer to table on page 108), i.e. if a substrate is attributed to one category it cannot be attributed to another category. In some cases it may be appropriate to record multiple ground-surface categories, e.g. if the structure pole is touching a rock (R) with cryptogamic crust (C) on the surface, both R and C will be recorded.

- Place the structure pole vertical to the ground at each assessment point along the line transect (every 2 metres). Make sure the structure pole is placed directly beside each mark along the measuring tape, on the opposite side of the measuring tape to that which was trampled during plot set-up.
- Using the categories listed on page 108, record the substrate the structure pole is sitting on at each assessment point.
- If a standing tree is obscuring the point, record ground cover as absent (A).

Litter bed depth

Equipment: Ruler

The litter bed depth is measured from the soil surface (point where mineral soil is exposed) to the top of the litter bed (the top of the leaves, twigs and bark, including duff lying on the soil surface).

- Use a ruler to measure the depth of the horizontal litter layer to the nearest 5 millimetres. Ignore any leaves or twigs that are inconsistent with the horizontal layer.
- Remember to account for the tip of the ruler if the measurements do not start from the ruler's edge.
- If no litter is present record as zero '0' and move onto the ground cover assessment.

ii. Monitoring at a subset of points along the line transect

Triodia

Equipment: Measuring tape

Triodia is an important habitat parameter in Mallee habitat and is to be assessed at the 25 metre mark and the 50 metre mark of each transect.

- Assess the two triodia clumps/rings nearest to the 25 metre mark of the transect that have >50% continuous live or dead plant matter. Do not include rings that are dead and no longer standing.
- Record its growth form as being a clump (C) or Ring (R).
- Measure the height in centimetres of the triodia, excluding any flowering stems.
- Measure the diameter in centimetres of the vegetative part of the plant at its widest point
- Measure the diameter in centimetres of the internal hole if present.
- Repeat at the 50 metre mark of each transect

iii. Monitoring at intersections with the line transect

Coarse woody debris

Equipment: Diameter measuring tape

Log definition – any log not attached to a live tree that is >5 centimetres in diameter and >1 metre in length.

- Assess all logs that have their central axis intersecting with the line transect. Exclude logs that are still attached to a tree.
- Assign each new log a number, starting from 1. If the log has multiple stems that intersect the transect, assign each stem a letter to reflect the stems are attached to the same base, e.g. 1A and 1B. If a stem does not intersect, do not record it. Record the features of each stem that intersects with the transect on a separate line on the datasheet.
- Record the distance from the starting point of the line transect to the log, i.e. the centre-point of the plot (read this number from the measuring tape used to lay out the line transect).
- Measure the diameter, in centimetres, of the log at the point it intersects with the line transect.

Hollows in logs

Hollow definition – entrance width is >20 millimetres in diameter and has a cavity. Cracks must be wider, not longer, than 20mm to be included.

- Record the presence (P) of any hollows that occur in the section of the log that is sitting inside the belt transect area. If the log contains no hollows or the hollows occur on the log outside the belt transect area, record as absent (A).

iv. Monitoring inside the belt transect

Trees

Definition – live and dead trees >2 metres in height and >5 centimetres in diameter at breast height (1.3metres). 'Live trees' include trees that may have been recently burnt and have not yet re-sprouted. Dead trees may be under 2 metres but >1.3 metres in height, otherwise they are assessed as a tree stump. Only record trees that have the centre-point of their trunk at insertion point in the ground, inside the area of the belt transect.

- Only assess the features of the first 10 trees of each species type – count the number of remaining trees for each tree species type in the rest of the belt transect. Record the total number of trees for each species in the space provided.
- Assign each different tree species type a number (tree type), and each individual tree a number so that it is easier to keep track of how many trees have been assessed for each species type. For example, tree 1.1 will be the first tree assessed for the first species encountered, tree 1.2 will be the second tree assessed for the first species type and tree 2.1 will be the first tree assessed for the second species type encountered.
- For each tree assessed, record the following information about the tree as a whole:
  - Distance of tree from centre of plot.
  - Diameter in centimetres at the widest part of the individual stem above any obvious lignotuber (bulge in the stem). For multi-stemmed trees, assess diameter above where the stems branch out. If a base has more than three stems, measure the largest stem, the smallest stem and one stem of average size and then write beside how many stems there were in total.
  - Species – record Y or N if the tree is a eucalypt (includes species of Eucalyptus, Angophora or Corymbia). If species name is known, record it on the datasheet.
  - Epicormic growth – if the tree is a eucalypt, record if it has presence of epicormic growth (record as an 'E' beside the Y for eucalypt).
  - Hollows – obvious presence (>20 millimetres with apparent cavity)
    - Canopy (C) – trunk above 1.3 metres from the ground
    - Basal area (B) – trunk below 1.3 metres from the ground
    - Has hollows in both canopy and basal area (K).
  - Presence of hollow-bearing characteristics (record present – P –or absent – A – for each):
    - Dead spouts or large broken-off limbs – limbs with the ends broken off that leave an exposed opening
    - Fissures – any narrow crack in trunk >15 millimetres wide and >30 millimetres long
    - Butt scar – deformities on the stem of a tree that meet the ground.
- Bark type – record the dominant bark type of each tree using the categories listed on page 109 (if the tree has two dominant bark types, record both).
- Burn damage – recorded as any visible burn damage on each tree using the categories on page 109.
- Tree condition – rate the condition of each tree using the categories on page 109.

Tree stumps

Equipment: Diameter measuring tape

Definition – lower end of a tree (<1.3 metres) remaining in the ground after trunk has been removed. Only include stumps if centre-point is inside the area of the belt transect. If a tree stump is > 1.3 metres in height, assess it as a dead tree.

- Assign each tree stump assessed a number, starting from 1.
- Record the distance (in metres) of each tree stump from the starting point of the plot.
- Record the diameter in centimetres, around the widest section of each tree stump – measure above where the roots begin to branch out.
- Record the consistent height of the tree stump, in centimetres – ignore bark that may be sticking up.
- Record the presence of any hollow in each stem, present or absent.
- Record the decay stage of the tree stump using the classes in the table on page 109.

Categories for Basic Mallee Habitat Assessment Version 1 Feb 2012

Vegetation structural form categories

Category	Description
Grass – spreading	Grasses that create new plants by running roots, e.g. wire grass, couch.
Grass – tussock	Grasses where most of the leaves originate close to the centre of the plant forming a tussock. The leaves are soft to touch without hard edges, e.g. wallaby grass and common tussock grass.
Grass – hummock	A grass of semi-arid and arid environments that consists of raised interwoven balls of prickly foliage (particular to *Triodia* species in Victoria).
Sedge/Rush	Non-woody plants with sharp edges or wiry, long, linear leaves, often tussocky. Includes sedges, rushes, some grasses, e.g. *Phragmites australis*, many perennial lilies, *Lomandra* and *Xanthorrhoea* species that do not have a trunk.
Herb	Non-woody flowering plants, not covered by the above categories, some herbs may be up to 1.5 metres tall or taller, e.g. great mullein and showy cassinia.
Chenopod/Zygophyllum	Small shrubs or herbs well adapted to saline or arid conditions, e.g. saltbush *Atriplex* and *Maireana* sp. and rounded many-stemmed dwarf shrubs of *Zygophyllum* sp., characterised by flowers with four or five white or yellow petals, e.g. coast twin leaf and shrubby twin leaf.
Creeper/Rambler	Any plant that grows on other plants or the ground and is incapable of self-support, e.g. small leaf clematis, blackberry, smilax.
Xanthorrhoea	Grass trees with a trunk.
Regeneration – eucalypt	Woody plants, self-supporting, either young or suppressed eucalypts, i.e. not yet reaching the canopy or the typical mature height of the species at the site.
Shrub/regeneration – non-eucalypt	Woody plants, either young or suppressed trees or shrubs of species that form the canopy at this site, i.e. not yet reaching the canopy or typical mature height for the species at this site.
Tree	All woody species >2 metres in height >5 cm diameter.
Dead matter	Any vegetation that is dead, even if it is attached to a live plant, e.g. a dead branch attached to a live tree. N.B. Bark is not considered dead matter if attached to a live stem.

Ground cover categories

B	Bare ground/soil – exposed mineral earth.
C	Cryptogamic crust – crust-like layer formed on the surface of solid structures such as the soil surface, rocks and logs. Includes algae, fungi, lichens, mosses and liverworts.
R	Rocks – a mass of hard consolidated matter.
L	Litter – any dead organic material sitting above the soil layer < 6mm in diameter. Includes leaves, twigs and the duff layer.
FWD	Fine woody debris – dead organic material >6 mm but finer than 5 cm in diameter.
CWD	Coarse woody debris – logs >5 cm in diameter.
V	Vegetation – any plant material live or dead that is not already part of the litter or fine woody debris.
W	Water.

Bark type categories

Category	Bark type	Description
1	Stringybark	Fine fibrous material <1 mm thick covering the whole trunk. Fibrous nature of bark is obvious, extending up to 0.5 m or more, without breaks, along the trunk. Old bark is retained on the trunk forming a relatively spongy fibrous mass with deep vertical fissures. The bark forms long strands when peeled off. E.g. messmate – *E. obliqua*, brown stringybark – *E. baxteri*, desert stringybark – *E. arenacea*, blanket-leaf – *Bedfordia arborescens.*
2	Ironbarks	Layers of old, coarse bark that becomes rough, compacted and furrowed with age. Bark is not prone to burning and may show little or no evidence of charring following fire. E.g. red ironbark – *E. tricarpa*, mugga *E. sideroxylon*, buloke – *Allocasaurina luehmannii.*
3	Ribbon or candle bark	Annual shedding of old bark layers in long strips or ribbons of bark exposing new bark underneath. As the bark dries, the sides of the bark pieces curl tightly inwards to form a candle-like shape. E.g. candelbark – *E. rubida*, blue gum – *E. globulus,* manna gum – *E. viminalis*, grey mallee – *E. socialis.*
4	Coarsely fibrous barks	Short-strand fibrous bark. Old bark is retained on trunk and breaks away as 'chunks', not as long fibrous strands. E.g. red bloodwood – *Corymbia gummifera*, southern mahogany – *E. botryoides,* lightwood – *Acacia implexa,* narrow-leaved peppermint – *E. radiata,* black box – *E. largiflorens*, grey box – *E. macrocarpa*.
5	Platy barks	Layers of old, fine fibrous bark retained on the trunk and branches that tends to flake or break off in small strands or pieces when rubbed or as a result of burning or weathering. E.g. silvertop – *E. sieberi,* black sheoke, *Allocasuarina littoralis*, blackwood – *Acacia melanoxylon,* belah – *Casuarina cristata.*
6	Papery barks	Shrubs and trees with flaky exfoliating bark tending to split, allowing sheets of bark to become loose and eventually detach. E.g. swamp paperbark – *Melaleuca ericifolia*, salt paperbark – *Malaleuca halmaturorum,* coast tea tree – *Leptospermum laevigatum*.
7	Smooth or gum bark	Annual shedding of old bark layers, exposing the smooth living bark underneath. Bark is not shed in long strands (i.e. like candelbark), but tends to peel into large vertical slabs (<50 centimetres in length) or flake into small flakes when shed. E.g. river red Gum – *E. camaldulensis*, yellow gum – *E. leucoxylon*, bog gum – *E. kitsoniana.*

Burn damage categories

0	No indication of fire damage.
1	Some charcoal on bark.
2	Burnt bark and scarring.
3	Severely burnt, forming a burnt-out arch or bridge in the trunk.

Tree condition categories

0	Dead (it is important to record dead trees as well as live trees).
1	Senescing, dying, dieback.
2	Signs of stress, some dieback but mostly healthy.
3	Tree apparently healthy.

Tree stump decay class categories

Class	Description
1	Tree stump is solid and cylindrical in shape and may or may not have bark. Few imperfections, such as splits, holes and no fungal fruiting bodies present. Little or no indication of burn damage.
2	Tree stump retains much of original shape but has presence of some or all of fungal fruiting bodies, splits, crack and decayed end showing signs of rot or burn damage to <10% of total surface area.
3	Beginning to lose stump-like appearance with tree stump containing splits and crack, exposing rot or burn damage to 11–20% of overall surface area. Exterior of tree stump may be moderately soft with no bark retained.
4	Losing stump-like appearance with large sections of exterior wood missing. Exposed rot or burn damage to 21–50% of stump surface area. May be moderately soft.
5	Rotting wood roughly in the shape of a stump, often only solid wood present along sides of stump. >50% of surface area is rotting or showing burn damage. May be quite soft and wet.

8. Basic Mallee Habitat Assessment: Datasheet V1 Feb 2012

Monitoring area name													
Data-point grouping name (name identifying the group of points used in this assessment)													
Assessors and organisation													
Assessment date													
Ecological Vegetation Division (EVD) and Ecological Vegetation Class (EVC)													
Number of years since the area was last burnt (from fire plan map)									Burn number				
Verify last-burnt data (tick one box)													
Further comments (about fire regime, e.g. fire season or fire severity)													
Further comments. Record details about other variables of interest (e.g. drought, grazing)													

Plot name											Zone		54 55 (circle one)
Plot location description													
GPS coordinates (GDA 94)		Start of transect										GPS accuracy (m)	
Easting		0											
Northing													
Transect angle		End of transect										GPS accuracy (m)	Photo number
North	Easting	0											
	Northing												
120°	Easting	0											
	Northing												
240°	Easting	0											
	Northing												

Method – the specified method is in bold. If changes to the specified method have been made, please record them below. (Note: changes should be made with caution as the data may not be comparable.)	
Length of line transect	**50 metres** /_____
Diameter of structure pole (millimetres)	5 mm / 8 mm / 10 mm / **15 mm** / 20 mm /_____
Distance between assessment points	1 metre / **2 metres** / 5 metres / _____
Total width of belt transect (metres)	**2+2 = 4 m** / 3+3 = 6 m / 4+4 = 8 m / _____
Side of transect measurements were recorded	**Left** /Right
Variations to standard method	

BMHA – V1 Feb 2012: Habitat parameters measured at points along the line transect.											
Plot name				Transect angle				N	120°	240°	
Position on slope and aspect of transect											
Assessment point number		1	2	3	4	5	6	7	8	9	10
Crown Cover – present or absent											
1–2 m	Grass – spreading										
	Grass – tussock										
	Grass – hummock										
	Sedge/Rush										
	Herb										
	Chenopod/Zygophyllum										
	Creeper/Rambler										
	Xanthorrhoea										
	Regeneration – eucalypt										
	Shrub/regen – non-euc										
	Tree										
	Dead matter										
0.5–1 m	Grass – spreading										
	Grass – tussock										
	Grass – hummock										
	Sedge/Rush										
	Herb										
	Chenopod/Zygophyllum										
	Creeper/Rambler										
	Xanthorrhoea										
	Regeneration – eucalypt										
	Shrub/regen – non-euc										
	Tree										
	Dead matter										
0–0.5 m	Grass – spreading										
	Grass – tussock										
	Grass – hummock										
	Sedge/Rush										
	Herb										
	Chenopod/Zygophyllum										
	Creeper/Rambler										
	Xanthorrhoea										
	Regeneration – eucalypt										
	Shrub/regen – non-euc										
	Tree										
	Dead matter										
Ground cover (B, C, R, L, FWD, CWD, V, W)											
Litter bed depth (to nearest 5 mm)											

BMHA – V1 Feb 2012: Habitat parameters measured at points along the line transect.											
Plot name				Transect angle			N	120°	240°		
Position on slope and aspect of transect											
Assessment point number		11	12	13	14	15	16	17	18	19	20
Crown cover – present or absent											
1–2 m	Grass – spreading										
	Grass – tussock										
	Grass – hummock										
	Sedge/Rush										
	Herb										
	Chenopod/Zygophyllum										
	Creeper/Rambler										
	Xanthorrhoea										
	Regeneration – eucalypt										
	Shrub/regen – non-euc										
	Tree										
	Dead matter										
0.5–1 m	Grass – spreading										
	Grass – tussock										
	Grass – hummock										
	Sedge/Rush										
	Herb										
	Chenopod/Zygophyllum										
	Creeper/Rambler										
	Xanthorrhoea										
	Regeneration – eucalypt										
	Shrub/regen – non-euc										
	Tree										
	Dead matter										
0–0.5 m	Grass – spreading										
	Grass – tussock										
	Grass – hummock										
	Sedge/Rush										
	Herb										
	Chenopod/Zygophyllum										
	Creeper/Rambler										
	Xanthorrhoea										
	Regeneration – eucalypt										
	Shrub/regen – non-euc										
	Tree										
	Dead matter										
Ground cover (B, C, R, L, FWD, CWD, V, W)											
Litter bed depth (to nearest 5 mm)											

BMHA – V1 Feb 2012: Habitat parameters measured at points along the line transect.												
Plot name				Transect angle		N	120°	240°				
Position on slope and aspect of transect												
Assessment point number		**21**	**22**	**23**	**24**	**25**						
Crown cover – present or absent												
1–2 m	Grass – spreading											
	Grass – tussock											
	Grass – hummock											
	Sedge/Rush											
	Herb											
	Chenopod/Zygophyllum											
	Creeper/Rambler											
	Xanthorrhoea											
	Regeneration – eucalypt											
	Shrub/regen – non-euc											
	Tree											
	Dead matter											
0.5–1 m	Grass – spreading											
	Grass – tussock											
	Grass – hummock											
	Sedge/Rush											
	Herb											
	Chenopod/Zygophyllum											
	Creeper/Rambler											
	Xanthorrhoea											
	Regeneration – eucalypt											
	Shrub/regen – non-euc											
	Tree											
	Dead matter											
0–0.5 m	Grass – spreading											
	Grass – tussock											
	Grass – hummock											
	Sedge/Rush											
	Herb											
	Chenopod/Zygophyllum											
	Creeper/Rambler											
	Xanthorrhoea											
	Regeneration – eucalypt											
	Shrub/regen – non-euc											
	Tree											
	Dead matter											
Ground cover (B, C, R, L, FWD, CWD, V, W)												
Litter bed depth (to nearest 5 mm)												

BMHA – V1 Feb 2012: Plot name		Transect angle	N	120°	240°

Coarse woody debris – measured when intercepting with line transect				Trees stumps– measured throughout belt transect area					
				Total width of belt transect (e.g. 2 m either side = 4 m total)					
Log number (starting from 1)	Distance from centre of plot (m)	Diameter of log at point intersected by transect (cm)	Hollow(s) present (Y/N)	Stump number	Distance from centre of plot	Diameter of stump at widest point (cm)	Height of stump (cm)	Hollow(s) present (p/A)	Decay class 1-5

BMHA – V1 Feb 2012: Plot name		Transect angle	N	120°	240°

Trees – measured throughout belt transect area										
Total width of belt transect (e.g. 2 m either side = 4 m total)										
Tree number (starting from 1.1)	Distance from centre of plot and side of transect tree sits on (L or R)	Diameter at breast height (1.3 m), measured in cm	Eucalypt (Y/N) Epicormic growth (E)	Visible hollows (Absent, C, B or K)	Dead spout/Broken-off limbs (P or A)	Fissures (P or A)	Butt scar (P or A)	Bark type (1–7)	Burn damage (0–3)	Tree condition (0–3)

BMHA – V1 Feb 2012: Plot name		Transect angle	N	120°	240°

Tree number (starting from 1.1)	Distance from centre of plot and side of transect tree sits on (L or R)	Diameter at breast height (1.3 m), measured in cm	Eucalypt (Y/N) Epicormic growth (E)	Visible hollows (Absent, C, B or K)	Dead spout/Broken-off limbs (P or A)	Fissures (P or A)	Butt scar (P or A)	Bark type (1–7)	Burn damage (0–3)	Tree condition (0–3)

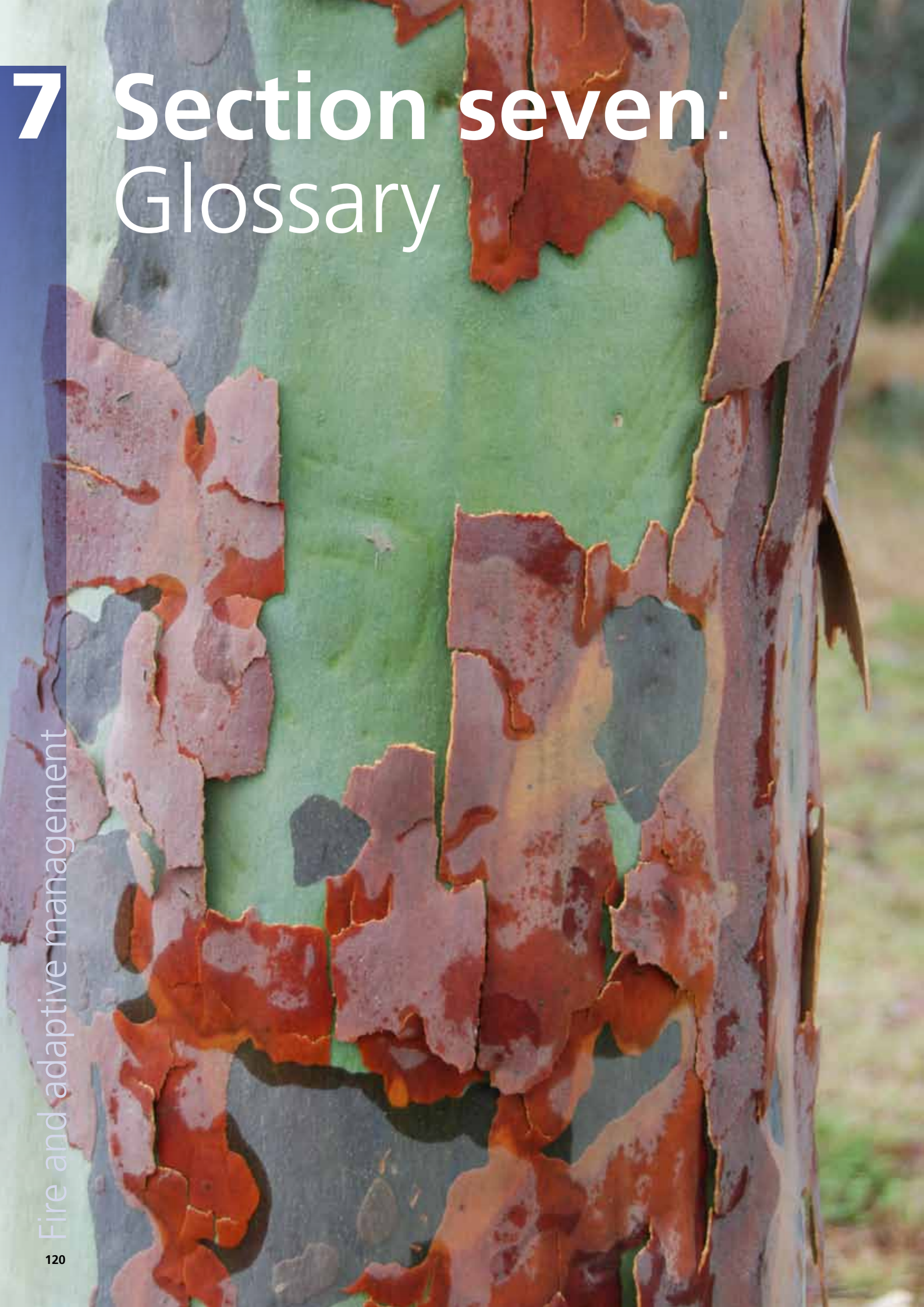
Number of trees in the rest of the belt transect area by tree species (add as required).	S1 = _____ S2 = _____ S3 =_____

Monitoring at points along the line transect	
Assessment point number	**Comments**
Monitoring at intersections along the line transect	
CWD comments	
Monitoring inside the belt transect	
Tree comments	
Tree stump comments	

6

Fire and adaptive management

7 Section seven: Glossary



Section seven: Glossary

Adaptive management: Also known as 'learning by doing'. A management cycle that involves land managers and others continually recognising gaps in knowledge, taking action, observing, learning and then applying the new knowledge through future actions.

Assessment: A data event that involves collecting a set of data. An assessment has a defined assessor, time, place, purpose and method; e.g. field sampling of a plot for indicator species pre- and post-fire.

Assessment point: Locality of collection of observation data. Assessment points can be a single point in the landscape, a quadrant, transect, etc.

Argus: An online database developed specifically for storing and accessing monitoring data about the effects of fire, http://fireweb.dse.vic.gov.au/argus.

Biodiversity: The variety of life forms (different plants, animals and micro-organisms), the genes they contain and the ecosystems they form (Fire Ecology Working Group, 2004).

Bushfire: An unplanned grass, scrub or forest fire (see 'wildfire' in Fire Ecology Working Group 2004).

Data-point grouping: A set of plots/assessment points in the landscape that are tied to a specific assessment at which an assessor collects data in a particular monitoring area.

DSE: Department of Sustainability and Environment. A Victorian Government Department responsible for balancing the development and protection of Victoria's natural and cultural resource base, including resource and industry development, land identification, and the protection, conservation and management of Victoria's natural and cultural environment.

Duff: A layer of litter in advanced state of decay; leaf and twig fragments are visible but tightly bounded by fungal mycelia; typically cool and moist.

Ecological burn: Treatment of vegetation in nominated areas by use of fire, primarily to achieve specified ecological objectives (Fire Ecology Working Group 2004).

Ecological Vegetation Class (EVC): The components of a vegetation classification system. They are groupings of vegetation communities based on floristic, structural and ecological features. An EVC may comprise one or a number of floristic communities that exist within a common set of ecological processes and habitat variables and may occur across a number of biogeographical zones.

Ecological Vegetation Division (EVD): Groups of plant communities (EVCs) that occupy similar ecological niches and share similar responses to environmental variables, such as fire, floods, soil characteristics or topography.

Fauna assemblage: Groups of fauna species that occupy the same ecological niche.

Fire ecology: The study of the interrelationships between fire and the biota (Fire Ecology Working Group 2004).

Fire history: The record of fire events, over time, at a particular site or over a particular area of vegetation type; best depicted in spatial form using maps or computer-based Geographic Information Systems (Fire Ecology Working Group 2004).

Fire interval: The time period between successive fires at a particular site or over a particular area or vegetation type (Fire Ecology Working Group 2004).

Fire Management Zone: An area of land upon which fire is managed for specific asset, fuel and ecological objectives. The Code of Practice for Fire Management on Public Land (Revision 1) (2006) identifies four Fire Management Zones:

(i) Asset Protection Zone
(ii) Strategic Wildfire Moderation Zone
(iii) Ecological Management Zone
(iv) Prescribed Burning Exclusion Zone.

Fire regime: The season, intensity, frequency and scale of fire in a given area over a period of time. Some definitions also include the type of fire (Fire Ecology Working Group 2004).

Fire season: The period/s of the year during which fires are likely to occur, spread and do sufficient damage to warrant organised fire control.

Fire severity: A measure of the vegetation that has been consumed by fire.

FireWeb: An internal DSE system that provides fire management information, including locations and status of fires/burns, burn plans, current and forecasted weather, a mapping tool and background information/ manuals.

Forest: An area, incorporating all living and non-living components, that is dominated by trees with an existing or potential stand height exceeding 5 metres, and with existing or potential projective foliage cover of over-storey strata of at least 30 percent. This definition includes Australia's diverse native forests and plantations, regardless of age. It is also sufficiently broad to encompass areas of trees that are sometimes described as woodlands.

Habitat: The area or environment where an organism or ecological community normally lives or occurs.

Habitat package: The collection of habitat parameters that together form a habitat; need to assess all elements of the habitat package to determine if some parameters are more important for fauna than others.

Habitat parameter: A component of habitat that can be measured, e.g. coarse woody debris, ground cover and canopy cover.

Habitat structure: The physical features of the vegetation that provides feeding, breeding and shelter sites for organisms.

Hollow: Visible cavity on the bole or branches of trees or stags.

Key fire response species: Those species whose life histories or vital attributes indicate that they are vulnerable to either a regime of frequent fires or to long periods of fire exclusion (Fire Ecology Working Group 2004).

Mallee: A small multi-stemmed eucalypt, or a formation composed of mallee eucalypts, or the geographical area with mallee formations.

Model: A representation of a system based on current knowledge that allows for investigation of the properties of the system and, in some cases, prediction of future outcomes.

Monitoring area: A geographical area in which an assessor conducts an assessment (collects data). The area is typically small (e.g. the area of a planned burn), but may be as large as a region or the whole of Victoria.

Monitoring objective: The reason or purpose for doing monitoring. The monitoring objective is derived from the question that needs answering and will help drive when and where the monitoring will be applied to best answer that question.

Planned burning: The controlled application of fire, under specified environmental conditions, to a predetermined area; and, at the time, intensity and rate of spread required to attain planned resource management objectives (DSE 2005).

Public land: All State forest, national park and protected public land as defined by Section 3 of the Forests Act 1958 (or its future equivalent).

PV: Parks Victoria. Under the Parks Victoria Act 1998, Parks Victoria's responsibilities are to provide services to the State and its agencies for the management of parks, reserves and other land under the control of the State. For the purpose of the Forests Act 1958, Parks Victoria is considered part of the DSE.

Rare or threatened species: When used in the context of species or communities of flora or fauna, refers to those indigenous species or communities that are listed under Schedule 2 of the Flora and Fauna Guarantee Act 1988, and/or other lists maintained by the DSE, including lists of vulnerable or endangered species (Fire Ecology Working Group 2004).

Senescing: A plant or tree that is dying.

Growth stage: The successional stages that vegetation progresses through, from renewal to senescence; each growth stage lasts for a defined length of time.

Species composition: The full range of species that occur in the area studied; in composition lists, the species are often ranked from most to least important on some stated parameter (e.g. number of individuals, biomass or cover), or categorised as being rare, occasional or common (Fire Ecology Working Group 2004).

Species diversity: The variety and abundance of different types of organisms; in relation to fauna, it is the variety and abundance of fauna species.

Stratification: Dividing a group or population into categories based on one or more chosen variables.

Structure pole: A pole of consistent height and diameter that is used for assessing the vertical structure of vegetation. The contacts that the vegetation makes with the pole at defined height intervals are recorded.

Tolerable fire intervals: The maximum and minimum fire intervals for fire disturbance across an area or vegetation type that are within the limits set by the constituent species' life histories; guide how frequent fire needs to be in the future to allow persistence of all species at the site (Fire Ecology Working Group 2004).

Vital attributes: The key life history features that determine how a species lives and reproduces; for fire, these attributes govern how a species responds to fire and/or persists within a particular fire regime (Fire Ecology Working Group 2004).

8 Section eight: List of Reports in this series

Section eight: List of Reports in this Series

1. 1977. A study of the distribution of aerially applied fire retardant in softwood plantations. R. Rawson.
2. 1978. Low-intensity prescribed burning in three *Pinus radiata* stand types. D.S. Thomson.
3. 1978. Fuel properties before and after thinning in young Radiata Pine plantations. D.F. Williams.
4. 1979. Using fire to reduce fuel accumulations after first thinning in Radiata Pine plantations. P.R. Billing.
5. 1979. Some of the effects of low-intensity burning on Radiata Pine. P.R. Billing.
6. 1980. A low-intensity prescribed burning operation in a thinned Radiata Pine plantation. P.R. Billing.
7. 1980. Some aspects of the behaviour of the Caroline Fire of February 1979. P.R. Billing.
8. 1981. Changes in understorey vegetation in Sherbrooke Forest following burning or slashing. R. Rawson and B. Rees.
9. 1981. Hazard-reduction burning in the Big Desert. P.R. Billing.
10. 1981. The effectiveness of fuel-reduction burning: five case histories. P. Billing.
11. 1982. A fire tornado in the Sunset Country January 1981. P. Billing and R. Rawson.
12. 1982. A summary of forest fire statistics, 1972-73 to 1980-81. R. Rawson and B. Rees.
13. 1982. Fuel moisture changes under Radiata Pine. M. Woodman.
14. 1982. Fuel-reduction burning in Radiata Pine plantations. M. Woodman and R. Rawson.
15. 1982. Project MAFFS/HERCULES: the Modular Airborne Fire Fighting System in Victoria. R. Rawson, B. Rees, E. Stuckey, D. Turner, C. Wood, and M. Woodman.
16. 1982. Using fire to reduce aerial fuels in first thinned Radiata Pine. P.R. Billing and J.V. Bywater.
17. 1982. Fuel properties before and after second thinning in Radiata Pine. M. Woodman.
18. 1983. Retardant distributions from six agricultural aircraft. B. Rees.
19. 1983. The Bright plantation fire: November 1982. N. Watson, G. Morgan and D. Rolland.
20. 1983. Otways Fire No. 22 – 1982/83: aspects of fire behaviour. P. Billing.
21. 1983. Otways Fire No. 22 – 1982/83: a case study of plantation protection. P. Billing.
22. 1984. Forest fire statistics, 1974-75 to 1983-84. B. Rees.
23. 1985 The Avoca Fire, 14 January 1985. P. Billing.
24. 1985. Fuel management in Radiata Pine following heavy first thinning. P. Norman.
25. 1985. Effectiveness of fuel-reduction burning: 10 case studies. R. Rawson, P. Billing and B. Rees.
26. 1986. Operational aspects of the Infra-Red Line Scanner. P. Billing.
27. 1987. Heathcote fire: Bendigo Fire No.38 – 1986/87. P. Billing.
28. 1987. Monitoring the ecological effects of fire. F. Hamilton (ed.)
29. 1990. Fire behaviour and fuel-reduction burning – Bemm River. A.J. Buckley.
30. 1991. Fire hazard and prescribed burning of thinning slash in eucalypt regrowth forest. A.J. Buckley and N. Corkish.
31. 1992. Assessing fire hazard on public land in Victoria: fire management needs and practical research objectives. A.A.G. Wilson.
32. 1992. Eucalypt bark hazard guide. A.A.G. Wilson.
33. 1992. Fuel reducing a stand of eucalypt regrowth in East Gippsland: a case study. A.J. Buckley.
34. 1992. Monitoring vegetation for fire effects. M.A. Wouters.
35. 1993. Elevated fuel guide. A.A.G. Wilson.
36. 1993. Wildfire behaviour in heath and other elevated fuels: a case study of the 1991 Heywood fire. M.A. Wouters.
37. 1993. The accumulation and structural development of the wiregrass (*Tetrarrhena juncea*) fuel type in East Gippsland. L.G. Fogarty.
38. 1993. A case study of wildfire management in the Byadlbo and Tingaringy Wilderness Areas. A.G. Bartlett.
39. 1993. Developing fire management planning in Victoria: a case study from the Grampians. M.A. Wouters.
40. 1993. Fuel reducing regrowth forests with a wiregrass fuel type: fire behaviour guide and prescriptions. A.J. Buckley.
41. 1993. The effect of fuel-reduction burning on the suppression of four wildfires in western Victoria. S.R. Grant and M.A. Wouters.
42. 1994. Fire behaviour and fire suppression in an elevated fuel type in East Gippsland: Patrol Track wildfire, February 1991. A.J. Buckley.
43. 1996. Fuel hazard levels in relation to site characteristics and fire history: Chiltern Regional Park case study. K. Chatto.

44. 1998. Effectiveness of fire-fighting first attack operations by the Department of Natural Resources and Environment from 1991/92-1994/95. G.J. McCarthy and K.G. Tolhurst.
45. 1997. The development and testing of the Wiltronics T-H Fine Fuel Moisture meter. K. Chatto and K. Tolhurst.
46. 1997. Analysis of fire causes on or threatening public land in Victoria 1976/77 – 1995/96. C. Davies.
47. 1998. Overall fuel hazard guide. G.J. McCarthy, K. Chatto and K. Tolhurst.
48. 1999. Development, behaviour, threat and meteorological aspects of a plume-driven bushfire in west-central Victoria: Berringa Fire February 25-26, 1995. K. Chatto, K. Tolhurst, A. Leggett and A. Treloar.
49. 2000. Assessment of the effectiveness and environmental risk of the use of retardants to assist in wildfire control in Victoria. CSIRO Forestry and Forest Products.
50. 2001. Effectiveness of broadscale fuel-reduction burning in assisting with wildfire control in parks and forests in Victoria. G.J. McCarthy and K. Tolhurst.
51. 2003. Effectiveness of aircraft operations by the Department of Natural Resources and Environment and Country Fire Authority 1997-98. G.J. McCarthy.
52. 2003. Modelling transport, dispersion and secondary pollutant formation of emissions from burning vegetation using air quality dispersion models. O.D. Valianatos, K. Tolhurst, S. Seims and N. Tapper.
53. 2003. Determination of sustainable fire regimes in the Victorian Alps using plant vital attributes. G.J. McCarthy, K. Tolhurst and K. Chatto.
54. 2003. Prediction of fire-fighting resources for suppression operations in Victoria's parks and forests. G.J. McCarthy, K. Tolhurst, M. Wouters.
55. 2003. Ecological effects of repeated low-intensity fire in a mixed eucalypt foothill forest in south-eastern Australia. Summary report (1994-99).
56. 2003. Effects of repeated low-intensity fire on the understorey of a mixed eucalypt foothill forest in south-eastern Australia. K. Tolhurst.
57. 2003. Effects of a repeated low-intensity fire on fuel dynamics in a mixed eucalypt foothill forest in south-eastern Australia. K. Tolhurst and N. Kelly.
58. 2003. Effects of repeated low-intensity fire on carbon, nitrogen and phosphorus in the soils of a mixed eucalypt foothill forest in south-eastern Australia. P. Hopmans.
59. 2003. Effects of repeated low-intensity fire on the invertebrates of a mixed eucalypt foothill forest in south-eastern Australia. N. Collett and F. Neumann.
60. 2003. Effects of repeated low-intensity fire on bird abundance in a mixed eucalypt foothill forest in south-eastern Australia. R.H. Loyn, R.B. Cunningham and C. Donnelly.
61. 2003. Effects of repeated low-intensity fire on terrestrial mammal populations of a mixed eucalypt foothill forest in south-eastern Australia. M. Irvin, M. Westbrooke and M. Gibson.
62. 2003. Effects of repeated low-intensity fire on insectivorous bat populations of a mixed eucalypt foothill forest in south-eastern Australia. M. Irvin, P. Prevett and M Gibson.
63. 2003. Effects of repeated low-intensity fire on reptile populations of a mixed eucalypt foothill forest in south-eastern Australia. M. Irvin, M. Westbrooke and M. Gibson.
64. 2003. Effects of repeated low-intensity fire on tree growth and bark in a mixed eucalypt foothill forest in south-eastern Australia. K. Chatto, T. Bell and J. Kellas.
65. 2003. A review of the relationship between fireline intensity and the ecological and economic effects of fire, and methods currently used to collect fire data. K. Chatto and K. Tolhurst.
66. 2003. Effects of fire retardant on vegetation in eastern Australian heathlands: a preliminary investigation. T. Bell.
67. 2003. Effects of fire retardant on heathland invertebrate communities in Victoria. N. Collett and C. Schoenborn.
68. 2003. Effects of fire retardant on soils of heathland in Victoria. P. Hopmans and R. Bickford.
69. 2004. Analysis of wildfire threat: issues and options. A.A.G. Wilson.
70. 2004. Surface fine-fuel hazard rating – forest fuels in East Gippsland. G. J. McCarthy.
71. 2004. An evaluation of the performance of the Simplex 304 helicopter belly-tank. H. Biggs.
72. 2004. Operational performance of the S-64F Aircrane Helitanker – 1997/98 fire season. H. Biggs.
73. 2008 Underpinnings of fire management for biodiversity conversation in reserves. M. Gill.
74. 2008. Flora monitoring protocols for planned burning: a user's guide. J. Cawson and A. Muir.
75. 2008. Flora monitoring protocols for planned burning: a rationale report. J. Cawson and A. Muir.
76. 2010. Adaptive management of fire: the role of a learning network. C. Campbell, S. Blair and A.A.G. Wilson.

77. 2010. Understanding, developing and sharing knowledge about fire in Victoria. S. Blair, C. Campbell, A.A.G. Wilson and M. Campbell.
78. 2010. Developing a fire learning network: a case study of the first year. C. Campbell, S. Blair and A.A.G. Wilson.
79. 2010. A case study of a strategic conversation about fire in Victoria, Australia. S. Blair, C. Campbell and M. Campbell.
80. 2012. Guiding principles: facilitating, learning, understanding and change through relationships. C. Campbell, M. Campbell and S. Blair.
81. 2010. Fire Boss amphibious single engine air tanker: final report, November 2008. H. Biggs.
82. 2010. Overall fuel hazard assessment guide. 4th Edition July 2010. F. Hines, K.G. Tolhurst, A.A.G. Wilson and G.J. McCarthy.
83. 2010. Growth stages and tolerable fire intervals for Victoria's native vegetation datasets. D.C. Cheal.
84. Forthcoming. Fuel hazard assessment guide: a rationale report. F. Hines and A.A.G. Wilson.
85. 2012. Guide to monitoring habitat structure. S.M. Treloar.
86. 2012. Guide to monitoring habitat structure: a rationale report. S.M. Treloar.
87. 2011. A literature review on the social, economic and environmental impacts of severe bushfires in south-eastern Australia. C. Stephenson.
88. 2011. The impacts, losses and benefits sustained from five severe bushfires in south-eastern Australia. C. Stephenson.
89. 2011. Establishing a link between the power of fire and community loss: the first step towards developing a bushfire severity scale. S. Harris, W. Anderson, M. Kilinc and L. Fogarty.
90. 2012. Review of resilience concepts and their measurement for fire management. M. McCarthy.
91. 2012. Relationships between disturbance regimes and biodiversity: background, issues and approaches for monitoring. J. Di Stefano and A. York.

Supplementary reports

1. 1992. Ecological effects of fuel reduction burning in a dry sclerophyll forest: a summary of principal research findings and their management implications. Department of Conservation and Environment, Victoria. K Tolhurst, D.W. Flinn, R.H. Lyon, A.A.G.Wilson and I.J. Foletta.
2. 1992. Ecological effects of fuel-reduction burning in a dry sclerophyll forest: first progress report. Department of Conservation and Environment, Victoria. K. Tolhurst and D. Flinn (eds.).

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