

Planned Burn Guidelines

Wet Tropics Bioregion of Queensland



Prepared by: Queensland Parks and Wildlife Service (QPWS) Enhanced Fire Management Team, Queensland Department of National Parks, Recreation, Sport and Racing (NPRSR).

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Disclaimer

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Front cover photograph: Bishop's Peak, Mark Parsons, QPWS (2010).

Bp2007

Foreword

With over 590 ecosystems, the Wet Tropics bioregion (refer to Figure 1) is complex and diverse for its relatively small size. Usually recognised for its world heritage rainforest values, the bioregion contains equally significant fire-tolerant and adapted species, communities and landscapes. While the science and practice of managing these ecosystems is complex and poses significant challenges for ecologists and practitioners an underlying concern is that the absence of fire from these systems causes a transition towards a closed forest of indeterminate value with extensive loss of biodiversity values.

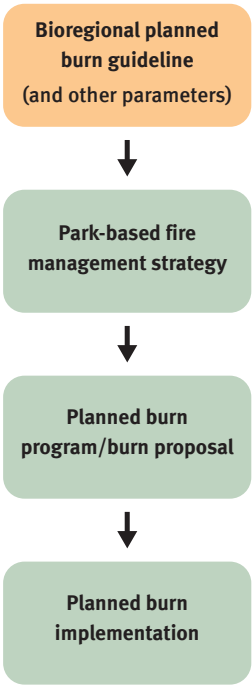
These planned burn guidelines aim to provide direction towards understanding the role, ecology and practice of Wet Tropics fire management. Irrespective of the need to balance complex issues, competing viewpoints and priorities, what I hope emerges is an understanding of the importance of fire management to maintain the resilience and complexity of the wet tropics—and to inspire you to use and view fire as a conservation tool to halt further loss or weakening of the integrity of our lowland, highland and wetland fire-adapted communities.

Mark Parsons
Conservation Officer
Northern Region
Queensland Parks and Wildlife Service.

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How the planned burn guideline fits into the QPWS Fire Management System.

Purpose of this guideline

This guideline was developed as part of the Department of National Parks, Recreation, Sport and Racing’s (NPRSR) Queensland Parks and Wildlife Service (QPWS) Fire Management System to support the formation of fire strategies, burn proposals and on-ground planned burn implementation (supported by the Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go). They assist rangers and other land managers to:

- protect life and property
- maintain healthy ecosystems
- promote awareness of fire management issues in the field
- identify clear fire management objectives to address those issues; and how to assess objectives to assist in adaptive management
- identify suitable fire behaviour, burn tactics and weather conditions to achieve objectives
- provide information and tools to assist in implementing planned burns.

Please note that this planned burn guideline uses ‘fire vegetation groups’ provided in ParkInfo that assist their integration into maps and fire strategies. A fire vegetation group is a group of related ecosystems that share common fire management requirements.

Scope

- This guideline applies to the Wet Tropics bioregion (refer to Figure 1) and covers the following fire vegetation groups: lowland open forests; open forests of the foothills and ranges; tall open forests; grasslands, sedgelands and fern-lands; montane communities; fire-sheltered shrublands; melaleuca communities; riparian/fringing/dune communities; rainforests; and mangroves and saltmarshes (refer to Appendix 1 for regional ecosystems contained in each fire vegetation group).
- It covers the most common fire management issues arising in the Wet Tropics. In some cases, there will be a need to include issues in fire strategies or burn proposals beyond the scope of this guideline (e.g. highly specific species management issues).
- This guideline recognises and respects Traditional Owner traditional ecological knowledge and the importance of collaborative fire management. Consultation and involvement should be sought from local Traditional Owners in the preparation and implementation of planned burns and specific guidelines incorporated into fire strategies where relevant.
- Development of the guideline has been by literature review and a knowledge-capturing exercise, using both scientific and practical sources. It will be reviewed as new information becomes available.



Sylvia Millington, QPWS, Mt Coom (2010).



Figure 1: Map of the Wet Tropics bioregion of Queensland.

Fire and climate in the Wet Tropics bioregion

Depending on local climatic conditions there can be up to four seasons in the Wet Tropics bioregion (this will vary from moister to drier climatic areas): The **early burn period** following seasonal heavy rain—fire self-extinguishes overnight and will not burn through areas that were burnt the year before. The **secondary burn season**—fires will burn through the night and will extinguish within areas that were burnt the year before. **Falling leaf season**— a blanket of leaves often crosses natural water features during the dry season and fires will generally not go out (fires in dry conditions will often favour woody species over grasses). **Storm burning**—from December through to January (where climatic conditions allow) is a useful way to achieve intense, wind-supported fire where rain can be reliably expected to follow providing good conditions for regeneration.

Fire risk is linked to the occurrence of fire weather days or sequences of days (FDR very high+ / FDI 25+). In the Wet Tropics bioregion these days have an average temperature above 30°C, low humidity (less than 50 per cent) and sustained winds of more than 35 km/hr (refer to Figure 2).

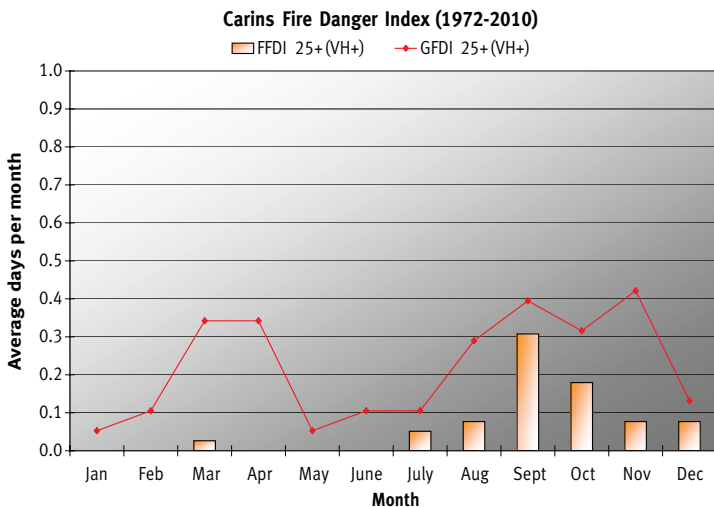


Figure 2: Fire weather risk in the Wet Tropics bioregion.

A fire weather day or sequence of days (FDI 25+) rarely occurs but is most likely at the end of the mid dry into the late dry season (approximately August to October). Data (Lucas 2010).

Further information can be found in the QPWS Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go and on the Bureau of Meteorology website at <www.bom.gov.au>.

How to use this guideline

Step 1: Know your local fire strategy. This planned burn guideline works with and supports your local fire strategy. While the guideline should address the majority of issues in your area, it is essential you also review your fire strategy before completing your planned burn proposal to ensure all ecological issues are considered (e.g. zoning plan, threatened species, fire histories, *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* and other legislative requirements).

Step 2: Observe the country. It is essential to regularly observe the country that you manage (and the surrounding landscape). Familiarise yourself with this guideline so it becomes part of your observation of the environment as you go about your work. To assist you in observing the environment, undertake this simple exercise:

1. If a **canopy** is present (e.g. for open forests and woodlands) observe the following:
 - a) Is tree branch foliage dying? Is there epicormic regrowth on branches? Are there any dead trees?
 - b) Are there habitat trees (e.g. trees with hollows)?
 - c) Are there rainforest, scrub or riparian ecosystems nearby?
2. For fire vegetation groups with a **mid-layer** (trees above the height of shrubs and grasses but not yet in the canopy) observe the following:
 - a) What are the mid-layer trees (young canopy trees, wattles, casuarinas or rainforest species)? How open or dense is the mid-layer?
 - b) Is there evidence of fire? What is the prevalence and height of blackened bark?
3. For fire vegetation groups with a **ground-layer** of grasses, sedges or shrubs, observe where relevant:
 - a) The presence of grasses and grass clumps. Do the grasses look healthy and vigorous? Are there well-formed grass clumps?
 - b) Is there a build-up of dead and decaying matter associated with grasses, shrubs, ferns or sedges?
 - c) Are shrubs looking healthy and vigorous? Are there dying crowns on the shrubs?
 - d) Does the ground-layer have a diversity of species or is it dominated by one or a few juvenile tree species? Are weeds dominating the understorey?

Step 3: Read the relevant chapters of this guideline and decide which issues apply to the area you are observing. It is common for burn proposals to address more than one issue—do not necessarily limit yourself to one issue per burn proposal.

Step 4: Consider your fire management priorities. Each chapter offers guidance for determining fire management priorities. The statements about priorities are based on a standard QPWS planned burn proposal prioritisation framework intended to guide both land managers and approval bodies.

Step 5: Choose measurable objectives. Each chapter of this guideline provides measurable objectives to include in your burn proposals (be guided also by the objectives in your fire strategy). Choose one or more objectives whilst observing the land. Do you need to adjust the objectives so they apply to your situation? Do you need to develop objectives not already included in these guidelines? If you find it difficult to identify your objectives, contact your natural resource management ranger or equivalent.

Step 6: Write a burn proposal. The **measurable objectives, fire behaviour, tactics** and **weather conditions** sections of each chapter can be copied directly into your burn proposals. Copy (ctrl+c) statements from a PDF version of this guideline and paste them (ctrl+v) into the burn proposal. Note that you may have to adjust the wording.

Step 7: Is your burn ready to go? Refer to the QPWS Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go. Becoming familiar with the tools in this guideline will enable you to predict fire behaviour and achieve your burn proposal objectives.

Step 8: Review the measurable objectives in your burn proposal. After a fire, undertake the post-fire assessment recommended by this guideline (as defined in your burn proposal). This will indicate if you have achieved your planned burn objectives. This guideline provides information on how to report the results in your fire report.

Step 9: Review your fire management issue (re-apply this guideline to the burn area starting from Step 1). Return to the burn area after one year and then a few years after the original burn—once again applying this guideline. Many issues (such as weed control) are not resolved with a single burn and it is important to keep observing the land. If the results of fire management are unexpected or difficult to understand please seek further advice. If this process identifies shortfalls in your fire strategy, consider reviewing it. Step 9 can be implemented as part of a structured photo-monitoring process at various locations within the estate. Instructions can be obtained from the QPWS Fire Management System.

Chapter 1: Lowland open forest

This fire vegetation group contains a range of open eucalypt forest and woodland communities (from 12–30 metres in height) in the lowlands of the wet tropics bioregion, up to 200 metres in altitude. Depending on the frequency and severity of fire, the understorey may contain grasses, shrubs and small trees and/or rainforest pioneers. Most of these ecosystems have a biodiversity status of **endangered** or **of concern** due to extensive clearing of lowland areas (Queensland Herbarium 2011a). Tall open coastal communities (< 120 metres altitude), typically with a canopy of swamp mahogany, poplar gum and blue gum, provide critical habitat for the **endangered** mahogany glider (QPWS 2001).

Fire management issues

Where fire is common, the understorey is usually dominated by tall grasses, herbaceous plants, lilies, sedges, pandanus and in some areas grasstrees and other shrubs. Absence of fire can lead to overabundant saplings that create shading impacts on understorey diversity and degrades habitat for fauna including the mahogany glider. Planning fires needs to take account of cane harvesting and smoke impacts on urban settlements.

Issues:

1. Maintain healthy lowland open forest.
2. Reduce overabundant saplings and seedlings.
3. Manage high biomass exotic grasses.
4. Reduce *Lantana camara*.

Extent within bioregion: 65 354 hectares (ha), 3 per cent; **Regional ecosystems:** Refer to Appendix 1 for list.

Examples of this FVG: Girringun National Park, 9 488 ha; Hinchinbrook Island National Park, 5 709 ha; Girramay National Park, 5 680 ha; Paluma Range National Park, 2 530 ha; Monkhouse Timber Reserve, 2 264 ha; Daintree National Park, 1 650 ha; Tully Gorge National Park, 1 496 ha; Clemant State Forest, 1 333 ha; Mowbray National Park, 1 042 ha; Kuranda National Park, 941 ha; Cardwell State Forest, 819 ha; Abergowrie State Forest, 480 ha; Hull River National Park, 449 ha; Mount Mackay National Park, 341 ha; Kuranda State Forest, 333 ha; Wooroonooran National Park, 312 ha; Maria Creek National Park, 282 ha; Ella Bay National Park, 244 ha; Malbon Thompson Forest Reserve, 240 ha; Grey Peaks National Park, 219 ha; Murray Upper State Forest, 195 ha; Goldsborough Valley USL Lands, 182 ha; Russell River National Park, 172 ha; Dinden National Park, 154 ha; Family Islands National Park, 147 ha; Basilisk Forest Reserve, 136 ha; Annan River (Yuku Baja-Muliku) National Park, 133 ha; Japoon National Park, 129 ha; Trinity Forest Reserve, 125 ha; Mount Lewis National Park, 124 ha; Annan River (Yuku Baja-Muliku) Resources Reserve, 119 ha; Macalister Range National Park, 115 ha; Djiru National Park, 108 ha; Goold Island National Park, 84 ha; Gadgarra Forest Reserve, 81 ha; Koombooloomba Forest Reserve, 65 ha; Cedar Bay National Park, 63 ha.



Lowland open forest is home to the mahogany glider *Petaurus gracilis*, which is one of Australia's arboreal mammals. Its ability to glide, den hollows and food sources are threatened by open forest transitioning to a closed structure in the absence of fire (QPWS 2007).

Appropriate fire management is critical to the survival of this species.

Mark Parsons, QPWS,
Jourama Falls (2001).

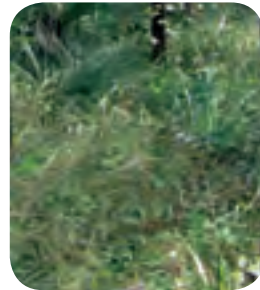
Issue 1: Maintain healthy lowland open forest

Maintain lowland forests and woodlands with mosaic burning.

Awareness of the environment

Indicators of healthy lowland open forests:

- Lowland open forests have a ground layer of tall grasses, legumes, lilies and sedges; with a few canopy species (enough to eventually replace the canopy), wattle, xanthorrhoea, pandanus, casuarinas or other small trees in the understorey; and a healthy canopy.
- Pockets of rainforest occur mainly along creeks and gullies, but thinning 25–40 metres away, where rainforest pioneers may be present but not in sufficient density to reduce the vigour and health of lower stratum grasses and shrubs or inhibit the movement of the mahogany glider.
- Presence of mature hollow-bearing live trees, typically poplar gum, swamp mahogany and bloodwood (essential for mahogany glider nesting) and an open structure in the mid stratum.
- Isolated or scattered distribution of cocky apple *Planchonia careya* and *Siris Albizia procera* (both mahogany glider food trees) and she-oaks or wattles (e.g. *Acacia crassicarpa* and *Acacia flavescens*).



Healthy lowland open forest. Note in the enlargement to the left, the diverse ground layer of grasses, sedges and legumes. *Dianella* spp. and *Lomandra* spp. are often present and blady grass is dominant near creeks.

Wayne Kington, QPWS, Yarrabah Girringun National Park (2010).



Healthy lowland open forest with *Xanthorrhoea* spp. and grasses present in understorey.
Mark Parsons, QPWS, Sunday Creek, Girringun National Park (2010).



Throughout lowland open forests, isolated pockets of rainforest are common along creek-lines and gullies but should thin out within 40 m of the creek or gully. Note the sharp boundary between the rainforest pocket and sclerophyll area.
Mark Parsons, QPWS, Little Stony Creek (2010).



Pandanus or cycads are often present as scattered plants or forming a grove in the mid stratum of healthy lowland open forests.

Mark Parsons, QPWS, Mullers Creek, Girringun National Park (2009).



The legume *Cajanus reticulatus* may be abundant in the ground layer after fire and thins in the third year. As it thins, it can be used to indicate when fire is becoming due.

Mark Parsons, QPWS, Lemon Tree Creek, Girringun National Park (2010).



In lowland open forests below 120 m in altitude, mahogany glider habitat emergent trees (live trees > 30 cm in diameter with hollows \geq 10 cm), are important indicators of forest health.

Mark Parsons, QPWS, Mullers Creek, Girringun National Park (2010).

Signs of where fire is required to maintain healthy lowland open forest:

- Grasses thinning, collapsing or appearing matted with a build-up of dead material.
- Although pockets of rainforest are desirable, there is an abundance of rainforest pioneers colonising beyond these pockets into the forest in general. Rainforest pioneers such as *Melastoma* spp., *Chionanthus ramiflora*, *Mallotus philippensis*, *Alyxia spicata*, *Glochidion* spp. beginning to emerge above ground layer plants. As this advances (refer to Issue 2), shading from rainforest pioneers begins to impact on the vigour and health of understorey plants.
- An overabundance of acacia, she-oak or eucalypt species has germinated after fire and are beginning to shade out understorey plants.
- *Xanthorrhoea* spp. where present, are beginning to form brown skirts.
- Bracken fern may become dominant.



Rainforest pioneers are starting to dominate the understorey and will eventually shade-out ground layer diversity if left unburnt.

Mark Parsons, QPWS, Conn Creek, Girringun National Park (2010).



Brown skirts on *Xanthorrhoea* spp. provide habitat for invertebrates and skinks. However, as the skirts build up they indicate the need for fire management to maintain a forest with an open structure. Microhabitat such as this will develop over time. Although fire initially reduces them, it also maintains the forest that allows them to exist. In the absence of fire, such open forest habitat features would eventually perish. With appropriate planned burn conditions, unburnt patches and habitat features remain, in contrast to wildfires which burn extensive areas.



Kangaroo grass is starting to matt, die off at the base and accumulate dead material. Dead and matting grasses are important habitat for invertebrates and skinks. However, they also indicate the forest requires fire to maintain grass health in general.



Low severity mosaic burns can help retain refuge areas as shown below; also, various fauna have strategies to survive fires.

All photos: Mark Parsons, QPWS, Mullers Creek, Girringun National Park (2010).



As rainforest pioneer shading advances, the ground layer begins to become sparse, grasses collapse, look less vigorous and build up dead material. However, shade tolerant sedges persist.

Mark Parsons, QPWS, Conn Creek, Girringun National Park (2010).



A high-severity fire in mahogany glider habitat caused a flush of wattles to germinate. These wattles will soon begin to shade-out the ground-layer and form a dense sub-canopy if a burn does not scorch them soon. Acacias are depicted, but equally, the overabundant seedlings could be she-oaks, eucalypts or rainforest pioneers.

Mark Parsons, QPWS, Mullers Creek, Girringun National Park (2010).

Discussion

- Most of the biodiversity in this fire vegetation group is within the ground layer. Regular fire plays an important role in maintaining the diversity of grasses, lilies, legumes, sedges and shrubs.
- Often, there are rainforests pioneers present in the ground layer. Fire keeps rainforest pioneers low in the profile. In the absence of fire, rainforests pioneers can grow into the mid stratum and begin to shade-out other ground layer species such as grasses, lilies, legumes, sedges and shrubs, impacting on diversity. Eventually it is difficult to reintroduce fire and the ecosystem is likely to transition to a closed forest. System change to closed forest is very rapid in this fire vegetation group (about 15 years).
- In the wet tropics, rainforests species tend to be able to quickly colonise in lowland open forests, irrespective of if they are near a rainforest margin.
- Where grazing occurs, it may be relevant to alleviate grazing pressure in the year prior to burning to allow accumulation of fuel.
- Transitioning/thickening threatens the habitat of the mahogany glider by reducing the efficiency of gliding, den hollows and food sources (QPWS 2001).

What is the priority for this issue?

Priority	Priority assessment
Very high	Planned burn required to maintain areas of special conservation significance .

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select at least two of the following as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
> 75 % of saplings < 2 metres are scorched to the tip.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity), estimate the percentage of overabundant saplings (above ground components) scorched.	<p>Achieved: > 75 %.</p> <p>Partially Achieved: 25–75 %.</p> <p>Not Achieved: < 25 %.</p>
> 90 % of the grass clumps remain as stubble.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity) and estimate grass stubble remaining after fire.	<p>Achieved: > 90 % bases remain.</p> <p>Partially Achieved: 75–90 % bases remain.</p> <p>Not Achieved: < 75 % bases remain.</p>
> 95 % of standing dead trees and standing live hollow-bearing trees (habitat trees) retained.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity) and estimate number of habitat trees. Determine the percentage retained after fire.	<p>Achieved: > 95 % retained.</p> <p>Partially Achieved: 90–95 % retained.</p> <p>Not Achieved: < 90 % retained.</p>

<p>25–60 % spatial mosaic of burnt patches.</p>	<p>Choose one of these options:</p> <ul style="list-style-type: none"> a) Visual estimation of percentage of vegetation burnt—from one or more vantage points, or from the air. b) Map the boundaries of burnt areas with GPS, plot on GIS and thereby determine the percentage of area burnt. c) In three locations (that take account of the variability of landform and ecosystems within burn area), walk 300 or more metres through planned burn area estimating percentage of ground burnt within visual field. 	<p>Achieved: 25–60 % burnt.</p> <p>Partially Achieved: between 15–25 % or 60–75 % burnt.</p> <p>Not Achieved: < 15 % or > 75 % burnt.</p>
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If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.

Fire parameters

What fire characteristics will help address this issue?

Fire severity

Low but vary with occasionally **moderate**-severity fire to ensure reduction of rainforest pioneers and to contribute to ground layer diversity, especially legumes. The occasional **high**-severity fire is required to stimulate the germination of mahogany glider food trees.

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm ⁻¹)	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Low (L)	< 150	< 0.5	< 2.5	Significant patchiness. Litter retained but charred. Humus layer retained. Nearly all habitat trees, fallen logs and grass stubble retained. Some scorching of elevated fuels. Little or no canopy scorch.
Moderate (M)	150–500	0.5–1.5	2.5–7.5	Moderate patchiness. Some scorched litter remains. About half the humus layer and grass stubble remain. Most habitat trees and fallen logs retained. Some scorch of elevated fuels. Little or no canopy scorch.
High (H)	500–1000	1.5–3.0	7.5–15.0	Some patchiness. Some humus remains. Some habitat trees and fallen logs affected. At least some canopy scorch in moderate < 20m height canopy, mid stratum burnt completely (or nearly so).

Note: This table assumes good soil moisture and optimal planned burn conditions.

Fire frequency / interval (refer to Appendix 2 for a discussion)

- Fire frequency should primarily be determined through **on-ground assessment of vegetation health, fuel accumulation and previous fire patchiness** and adjusted for wildfire risk and drought cycles.
- Apply mosaic-planned burns across the landscape at a range of frequencies to create varying stages of post-fire response (i.e. recently burnt through to the maximum period). Consider a broad fire interval range of between two to five years.

Mosaic (area burnt within an individual planned burn)

- A mosaic is achieved with generally 25–60 per cent burnt.

Other considerations

- Ensure successive fires are somewhat variable in intensity, season, frequency (do not burn to a prescription of every 'x' years) and spatially (each fire creating a different mosaic of burnt and unburnt areas).



Low-severity fires created through spot ignition are desirable, and help in creating a mosaic of burnt and unburnt areas, retaining leaf mulch and (blackened) leaf litter on the ground and micro refuges for fauna.

Mark Parsons, QPWS, Fishers Creek, Girringun National Park (2010).



An occasional moderate-severity fire will help control overabundant saplings.
Mark Parsons, QPWS, Mullers Creek, Girringun, National Park (2010).



The occasional high-severity fire stimulates the germination of mahogany glider food trees such as *Albizia procera* (depicted centre). Once germinated however, return to lower-severity fires to allow these small trees to establish.

Mark Parsons, QPWS, Mullers Creek, Girringun National Park (2010).



Generally, it is very desirable to create a mosaic of burnt and unburnt areas. Unburnt areas are important fauna refuges and create a wider diversity of habitat.

Mark Parsons, QPWS, Blady Grass Creek, Girringun National Park (2010).

What weather conditions should I consider?

It is important to be aware of conditions prior to and following burns so that undesirable conditions and weather changes can be avoided, or to help with burn planning.

Season: Commence burning soon after the wet season (generally **April–May**) when a fire is likely to carry into the night, but not overnight. Avoid burning later in the dry season (**September–October**) unless for a specific purpose (e.g. managing thickening)

FFDI: < 12 and occasional up to 20 for higher severity fire

DI (KBDI): 100–150

Wind speed: < 15 km/hr.

What burn tactics should I consider?

Tactics will be site specific and different burn tactics may need to be employed at the same site (e.g. due to topographical variation). Also, during the burn, tactics should be reviewed and adjusted as required to achieve burn objectives. What is offered below is not prescriptive; rather it is a toolkit of suggested tactics that may assist in this issue.

- **Afternoon or evening ignition** generally creates milder burn conditions, promoting a low to moderate severity fire. Often this tactic will assist in creating a mosaic of burnt and unburnt patches and conditions where fire may self-extinguish overnight. This is particularly important if burning later in the dry season, or when burning adjacent to non-target communities and property.
- **Use of natural barriers.** The lowlands of the wet tropics have numerous natural barriers such as rock outcrops, creeks and rainforest gullies. Fire tends not to spread out extensively (except in very dry conditions). Natural barriers are useful in creating containment areas and landscape mosaics.
- **Consider adjacent primary production activities.** Often this fire vegetation group neighbours agricultural land uses such as sugarcane production. Planned burns in adjoining areas should be undertaken when the prevailing weather conditions (in particular wind direction) will direct the resulting fire, smoke and any airborne embers away from the sugar cane crop or mulch (“trash blanket”) that follows harvesting. Line lighting the windward edge along the margin of the sugar cane is preferred when undertaking this type of burn so that a safe perimeter can be established. Establishing cooperative arrangements with cane farmers and rural fire brigades is essential in managing this issue.
- **Smoke issues.** Be aware of potential smoke impacts on urban settlements. Planned burns in adjoining areas should be undertaken when the prevailing weather conditions (in particular wind direction) will direct the resulting smoke away from settled areas.



Spot ignition in lowland open forest.

Justine Douglas,
QPWS, Cape Sandwich,
Hinchinbrook Island
National Park (2004).

- **Spot ignition** is often used in lowland open forest, to alter the desired intensity of a fire and create the desired mosaic of burnt and unburnt areas. Spots closer together will result in a line of a greater intensity (as spots merge and create hot junction zones) while increased spacing between spots or alternatively a single spot ignition will result in a lower intensity fire with a greater mosaic of unburnt and burnt patches. The spacing of the spots may vary throughout the burn due to changes in weather conditions, topography and fuel loads.
- **A low intensity backing fire.** A slow moving, low intensity backing fire will generally result in a more complete coverage of an area and a better consumption of fuel. This tactic creates high residence time useful to reduce overabundant saplings, while ensuring fire intensity and rate of spread are kept to a minimum. Burning downhill can also create a low-intensity backing fire.
- **Progressive burning.** A number of burns of varying size and severity are lit in an area throughout the year when conditions allow. This creates a rich mosaic of burnt and unburnt patches and can be used to establish a safe perimeter allowing further planned burns to take place within secured areas. Refer to the glossary for a fuller discussion.
- **Aerial ignition.** Where access is difficult and limited. Used in tandem with good soil moisture and other landscape features such as drainage lines, moist gullies and vegetation communities including rainforests, this technique is an efficient means to create a landscape mosaic.



Landscape features such as this creek line help to control the movement of fire and create a landscape mosaic of burnt and unburnt areas.

Tim Devlin, QPWS, The Saddle, Paluma Range National Park (2004).

Issue 2: Reduce overabundant saplings and seedlings

In lowland open forests, overabundance of rainforest pioneers, she-oaks and acacias may reduce the health and diversity of the ground layer through competition and shading. If left unmanaged, the forest can transition from an open to a closed structure, in which fire becomes difficult to reintroduce.

Awareness of the environment

Key indicators:

- Mid-stratum is generally dominated by young trees including rainforest pioneers, she-oaks or acacias. Common rainforest examples are hard milkwood *Alstonia muelleriana*, northern guioa *Guioa acutifolia*, red kamala *Mallotus philippensis*, macaranga *Macaranga involucreta* and *Macaranga tanarius*.
- Understorey or mid-stratum is difficult to see through or walk through.
- Ground layer plants declining in health, diversity and abundance due to shading.
- Grasses thinning and sometimes being replaced by creeping shade grass *Oplismenus* spp.
- Vines starting to smother cycad fronds.
- Bracken, where present, is mostly dead.
- Presence of *Alyxia* spp. vine climbing into mid-stratum.



These mid-stratum rainforest pioneers are becoming dense – however, sparse grasses persist in ground-layer. Fire is needed here to prevent the pioneers shading out the grasses completely.

Mark Parsons, QPWS, Conn Creek, Girringun National Park (2010).



Mid-stratum overabundance has produced a screen that is difficult to see through. Ground layer grasses are thinning but will still carry fire easily.

Mark Parsons, QPWS, Little Stony Creek, Girringun National Park (2010).



She-oak overabundance in the mid-stratum. Understorey is less diverse. Grasses are very sparse. Bracken fern is dominant with numerous dead fronds.

Mike Ahmet, QPWS, Dinden National Park (2008).



Notice the presence of *Alyxia* vine. Shading of ground has progressed. Grasses are sparse and shaded leaf litter is becoming prominent. Fire will only carry in dry conditions.

Mark Parsons, QPWS, Conn Creek, Girringun National Park (2010).



In some areas it may be too late to try and restore open forest communities. However, where it is determined a conservation priority, several fires may be required (starting with a high-severity fire) to reduce the overabundance of rainforest pioneer species. The right conditions will be difficult to achieve. Notice the absence of grasses under *Polyscias australiana* and acacias, which have grown beyond the mid-stratum.

Mark Parsons, QPWS, Conn Creek, Girringun National Park (2010).



A sequence illustrating cycad decline in the absence of fire, followed by an image of recovery from a recent fire. The second photo in the series could be used as an indicator of when fire is overdue, and the third photo when fire is well overdue.

First three photos: Jenise Blaik, QPWS, Many Peaks Range (2010).

Post fire photo: Mark Parsons, QPWS, Broadwater (2009).

Discussion

- The speed of woody thickening (due to tree overabundance) in wet tropics lowland open forests is rapid due to higher rainfall and warmer temperatures.
- Fire keeps rainforest pioneers low in the profile in the ground layer. In the absence of fire, rainforests pioneers can grow into the mid-stratum and begin to shade out other species in the ground layer such as grasses, sedges, shrubs, and ferns; impacting on diversity. Eventually it is difficult to introduce fire into an area and the system is likely to transition to a closed forest (Williams et al. 2012). In the wet tropics, rainforests species can quickly colonise vegetation groups that are not necessarily near an existing rainforest margin.
- The open forest and woodlands of the coastal lowlands are quite susceptible to acacia and she-oak thickening. Certain acacias and she-oaks can germinate en masse. In the absence of fire, seed stock can build-up, this is likely to lead to a mass germination event after wildfire (which tends to be of a higher severity). Where this has occurred, it is likely that more than one fire will be required to control overabundance. Post fire observations are essential to monitor the kill rate and germination of acacias and she-oaks in order to ascertain the need of subsequent fires.
- It is important to ensure the recruitment of open forest and woodland canopy species. Although **moderate** to **high**-severity fires may be necessary to control mid-stratum sapling overabundance, it may also have an impact on canopy species recruitment. Therefore once mid stratum overabundance is controlled, it is important to return to a **low** to **moderate**-severity fire regime (refer to Issue 1).

What is the priority for this issue?

Priority	Priority assessment
High	Planned burns to maintain ecosystems in areas where ecosystem health is good.
Medium	Planned burn in areas where ecosystem health is poor but recoverable.
Low	Planned burn in areas where ecosystem structure and function has been significantly disrupted .

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select at least two of the following as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
> 75 % of mid stratum saplings are scorched to the tip.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity), estimate the percentage of overabundant saplings (above ground components) scorched.	<p>Achieved: > 75 %.</p> <p>Partially Achieved: 25–75 %.</p> <p>Not Achieved: < 25 %.</p>
> 95 % of standing dead trees and standing live hollow-bearing trees (habitat trees) retained.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity) and estimate number of habitat trees. Determine the percentage retained after fire.	<p>Achieved: > 95 % retained.</p> <p>Partially Achieved: 90–95 % retained.</p> <p>Not Achieved: < 90 % retained.</p>
Restore cycad health (if cycads are present).	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity) and assess health of cycads.	<p>*Achieved: Cycads recovered.</p> <p>Not Achieved: Cycads did not recover.</p> <p>*cycads take several months to recover and may not have green material immediately after fire.</p>
<i>Alyxia</i> spp. vine reduced to ground layer.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity) and assess height of <i>Alyxia</i> spp. vine.	<p>Achieved: <i>Alyxia</i> spp. vine reduced to ground layer.</p> <p>Not Achieved: <i>Alyxia</i> spp. vine still present in mid-stratum.</p>

If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.

Fire parameters

What fire characteristics will help address this issue?

Fire severity:

- **Moderate** for most situations where young trees are less than eight metres tall. Where young trees are taller than eight metres, a **high**-severity fire might be necessary. Use high-severity fire with caution, as there will be an impact on habitat trees and fallen logs (refer to table below), and the fire will be much harder to contain.
- Avoid lower severity burns, as this will exhaust fuel and reduce opportunities for subsequent higher severity burns.

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm ⁻¹)	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Moderate (M)	150–500	0.5–1.5	2.5–7.5	Moderate patchiness. Some scorched litter remains. About half the humus layer and grass stubble remain. Most habitat trees and fallen logs retained. Some scorch of elevated fuels. Little or no canopy scorch.
High (H)	500–1000	1.5–3.0	7.5–15.0	Some patchiness. Some humus remains. Some habitat trees and fallen logs affected. At least some canopy scorch in moderate < 20 m height canopy, mid stratum burnt completely (or nearly so).

Note: This table assumes good soil moisture and optimal planned burn conditions.

Fire frequency / interval (refer to Appendix 2 for a discussion)

- More than one planned burn may be required to manage this issue. Monitor outcomes until overabundant saplings/seedlings are controlled.
- Once the area has recovered, the recommended regime for healthy lowland open forests and woodlands can be resumed (refer to Issue 1).

Mosaic (area burnt within an individual planned burn)

- As much of the area dominated by mid stratum saplings as possible burnt.

Other considerations

- Due to the landform of the coastal lowlands, there are greater opportunities to contain fire within natural barriers such as channels and waterways, and therefore a greater opportunity to carry out fires that address thickening issues. However, be aware of the presence of cane farms, settlements and roads.
- For acacia and she-oak thickening it is important to observe post fire germination and kill rates to ascertain the need for subsequent fires. If the initial fire triggers a flush of new acacia and she-oak seedlings, follow-up planned burn within two years with **moderate**-severity fire.
- It is likely that more than one planned burn will be required to manage this issue.
- If a fire has triggered a flush of eucalypt seedlings, do not burn for four to five years, the next burn should be of a **low**-severity to allow some of the seedlings to establish.



Depicting a desirable fire severity to control mid stratum overabundance.

Mark Parsons, QPWS,
Mullers Creek, Girringun
National Park (2010).

What weather conditions should I consider?

Season: Mid to late dry season as conditions allow. Progressive burning through the year in surrounding healthy areas, commencing soon after the wet season, will make it easier to manage late dry season burns

FFDI: 5–24

DI (KBDI): 120–180

Wind speed: < 23 km/hr

What burn tactics should I consider?

Tactics will be site specific and different burn tactics may need to be employed at the same site (e.g. due to topographical variation). Also, during the burn, tactics should be reviewed and adjusted as required to achieve burn objectives. What is offered below is not prescriptive; rather it is a toolkit of suggested tactics that may assist in this issue.

- While a moderate intensity fire is mostly recommended to address this issue this is largely dependant upon the height of the saplings. A **running fire** of a higher intensity may be required initially where there is a lack of surface and near-surface fuels due to shading-out or if the thicket is well developed. **Line or strip ignition** is used to create a fire of higher intensity or to help fire carry through moist or inconsistent fuels. This is also useful to reduce overabundant saplings/seedlings. In this instance a follow-up planned burn will be required in the two to three years post fire to kill surviving and new seedlings/saplings.
- **A backing fire with good residence time.** A slow moving backing fire (lit against the wind on the smoky edge or down-slope) will ensures the fire has a greater amount of residence time, while ensuring fire intensity and rate of spread are kept to a minimum. Greater residence time is useful in reducing overabundant seedlings/saplings.
- **Spot ignition.** Can be used effectively to alter the desired intensity of a fire particularly where there is an accumulation of volatile fuels. Spots closer together will result in a line of a greater intensity (as spots merge and create hot junction zones) while increased spacing between spots will result in a lower intensity fire.

Issue 3: Manage high biomass exotic grasses

Refer to Chapter 11 (Issue 3), regarding fire management guidelines.

It is important to be aware of the presence of high biomass grasses as they can dramatically increase fire severity and can be promoted by fire. Sometimes fire can be used to help in their control.



Basal reshooting of thatch grass. Fire is not effective in its control and too frequent fire promotes it.

Mark Parsons, QPWS, Princess Hill, Girringun National Park (2006).



As a taller grass, guinea grass can create dramatic flares of higher fire severity on the edge of a control line, increasing the risk of spot over and embers.

Mark Parsons, QPWS, Mullers Creek, Girringun National Park (2006).

Issue 4: Reduce *Lantana camara*

Refer to Chapter 11 (Issue 5), regarding fire management guidelines.

The presence of *Lantana camara* may require an altered approach to fire management or for well established infestations, integrated use of fire and herbicide.



The use of a broadleaf herbicide or splatter mix prior to planned burning can increase success rate of controlling thickets of lantana.

QPWS, Henrietta Creek, Girringun National Park



Dense infestations are often the source for lantana spread. Carried by small fruit eaters such as star finches, the seeds require gut passage to germinate. Using integrated control including fire helps discourage this seed spread.

Mark Parsons, QPWS, Black Bream Track, Girringun National Park (2008).

Chapter 2: Open forests of the foothills and ranges

This fire vegetation group contains open eucalypt forest and woodland communities with a grassy, shrubby and mixed grassy/shrubby understorey, found in the foothills and ranges of the Wet Tropics. Open forests of the foothills and ranges extend through much of the wet tropics, from moist to dry locations. It includes habitat for **endangered** flora and fauna.

Fire management issues

The main fire management issue is the maintenance of an open grassy, shrubby or mixed grassy/shrubby structure with regular mosaic burning, which will also help ensure habitat and food sources for the **endangered** northern bettong. An open structure can be threatened by overabundant saplings and weeds (usually caused by too infrequent burning or a too severe fire event). The presence of high-biomass grasses may unexpectedly increase severity of fires impacting on the health of ecosystems. Fire management in the coastal hill slopes requires special attention due to steep slopes and urban and rainforest interface issues.

Issues:

1. Maintain healthy open forests of the foothills and ranges.
2. Reduce overabundant saplings in the mid-stratum.
3. Fire management in the coastal hill slopes (including Cairns hill slopes).
4. Manage high biomass invasive grasses.
5. Reduce *Lantana camara*.

Extent within bioregion: 484 103 ha, 24 per cent; **Regional ecosystems:** Refer to Appendix 1 for complete list.

Examples of this FVG: Girringun National Park, 67 216 ha; Monkhouse Timber Reserve, 36 413 ha; Paluma Range National Park, 27 153 ha; Mount Windsor National Park, 15 988 ha; Daintree National Park, 15 517 ha; Dagmar Former State Forest, 9 379 ha; Mount Lewis National Park, 9 244 ha; Kuranda National Park, 8 868 ha; Hinchinbrook Island National Park, 7 192 ha; Kuranda State Forest, 4 650 ha; Dinden State Forest, 3 688 ha; Mount Fox State Forest, 3 544 ha; Wairuna Station (Proposed addition to Girringun National Park), 3 535 ha; Lannercost State Forest, 3 446 ha; Herberton Range State Forest, 3 428 ha; The Bluff State Forest, 3 149 ha; Abergowie State Forest, 3 149 ha; Girramay National Park, 3 051 ha; Kirrama National Park, 2 761 ha; Clemant State Forest, 2 702 ha; Dinden National Park, 2,693 ha; Koombuloomba South Forest Reserve, 2 652 ha; Wooroonooran National Park, 2 585 ha; Little Mulgrave Forest Reserve, 2 505 ha; Macalister Range National Park, 2 498 ha; Goldsborough Valley USL Lands, 2 410 ha; Tumoulin State Forest, 2 071 ha; Paluma State Forest, 2 053 ha; Danbulla State Forest 2, 1 922 ha; Cardwell State Forest, 1 881 ha; Ravenshoe State Forest 1, 1 499 ha; Mowbray National Park, 1 411 ha; Upper Granite Normanby (under negotiation with Aboriginal Land and NP), 1 374 ha; Ravenshoe State Forest 3, 1 367 ha; Formartine State Forest, 1 298 ha; Herberton Range National Park, 1 198 ha; Gadgarra Forest Reserve, 1 169 ha.

Issue 1: Maintain healthy open forests of the foothills and ranges

Maintain healthy open forest/woodland using mosaic burning.

Awareness of the environment

Indicators of healthy open forests of the foothills and ranges:

- Healthy open forest with a grassy, shrubby or mixed grassy/shrubby understorey with a few canopy species of variable sizes (to eventually replace the canopy) and a healthy canopy.
- Lower and mid stratum tree species are present, but **are not** having noticeable shading effects on ground layer plants.
- The forest is easy to walk through or see through.
- Rock outcrop and rock pavement areas that have grasses, leaf litter, and fire-sheltered refuges of sedges, ferns and fire-sensitive shrubs (see Chapter 6: Fire sheltered shrubland).



Woodland with a healthy grassy understorey.

Paul Williams, Vegetation Management Science Pty Ltd, Mt Bluff (2010).



Blue gum/iron bark open forest with a healthy grassy understorey. Because of the drier location, the grasses will naturally appear less green and vigorous. Note that tree recruitment is sparse, but sufficient to replace the canopy over time.

Paul Williams, Vegetation Management Science Pty Ltd (2010).



Open forest with a healthy grassy understorey. However, there is little tree recruitment. Consider introducing low-severity burns early in the dry season to encourage eucalypt regeneration.

Mark Parsons, QPWS, Rapid Creek, Girringun National Park (2005).



Note healthy understorey of cockatoo grass favoured by the northern bettong for food and shelter. Note casuarina showing signs of drought stress.

Ian Holloway, QPWS, Herberton Range.



Open forest with a healthy mixed grassy/shrubby understorey. Shrubby in this context refers to sclerophyllous (hard-leaved) shrubs such as the banksias depicted. There are also young trees present sufficient for canopy recruitment but not in such numbers that they would shade out the ground layer.

Paul Williams, Vegetation Management Science Pty Ltd, Mount Windsor (2006).



Pink bloodwood and turpentine open forest in a moist location with a mixed grassy/shrubby understorey.

Paul Williams, Vegetation Management Science Pty Ltd (2009).



Burning in shrubby dominated open forest. Due to soils, some areas are naturally dominated by sclerophyllous shrubs with very little grass present.

Paul Williams, Vegetation Management Science Pty Ltd (2009).



Some areas of this fire vegetation group have rocky terrain and sheltered areas (refer to Chapter 6, fire-sheltered shrubland).

Mark Parsons, QPWS, Paluma Range (2007).



Areas of bare rock also occur.

Mark Parsons, QPWS, Paluma Range (2007).

The following may indicate that fire is required to maintain open forest with a grassy, shrubby or mixed grassy/shrubby understorey:

- Grasses becoming sparser or grass clumps are poorly formed.
- There is an accumulation of dead material and collapsing grasses.
- Shrubs with lower leaves and some branches dying.
- Accumulation of leaf litter.
- In drier areas, young she-oaks or acacias starting to become abundant in the ground stratum.
- Xanthorrhoea where present, have brown skirts.
- Cycads where present, are in poor health with fronds drooping or browning in large numbers, or vines starting to smother.
- In moister areas of the coastal foothills, rainforest pioneers starting to become abundant and beginning to emerge above the ground stratum. Rainforest pioneers commonly include: *Polyscias* spp., *Melicope* spp. (such as *evodia*), *Alstonia* spp. and *Alphitonia* spp.
- Where they are known to occur, reduction in the abundance of shrub species such as *Banksia spinulosa*, *Prostanthera* spp., *Cajanus* spp., *Grevillea parallela* and *Callitris macleayana*.



Mahogany/ ironbark open woodland with a grassy understorey. Note drooping, dead skirts accumulation on grass trees. Grass clumps are becoming poorly formed, although due to the dry location this is a difficult indicator to assess.

Mike Ahmet, QPWS, Dinden National Park.



Note build-up of dead material beneath grasses.

Paul Williams, Vegetation Management Science Pty Ltd, Herberton (2010).



Note the build up of dead grass material, fallen leaf litter and dead branches on shrubs.

Paul Williams, Vegetation Management Science Pty Ltd, Herberton (2010).



Brown skirts on *Xanthorrhoea* spp. provide habitat for invertebrates and skinks. However, as the skirts build up they indicate the need for fire management to maintain a forest with an open structure. Microhabitat such as this will develop over time. Although fire initially reduces them, it also maintains the forest that allows them to exist. In the absence of fire, such open forest habitat features would eventually perish. With appropriate planned burn conditions, unburnt patches and habitat features remain, in contrast to wildfires which burn extensive areas.



Kangaroo grass is starting to matt, die off at the base and accumulate dead material. Dead and matting grasses are important habitat for invertebrates and skinks. However, they also indicate the forest requires fire to maintain grass health in general.



Low severity mosaic burns can help retain refuge areas as shown below; also, various fauna have strategies to survive fires.

All photos: Mark Parsons, QPWS, Mullers Creek, Girringun National Park (2010).



Where *Banksia spinulosa* is known to occur, as it begins to become less abundant, this is an indication that fire has been long absent.

Paul Williams, Vegetation Management Science Pty Ltd.



Where cycad fronds begin to brown-off in large numbers, this is an indication that fire has been long absent.

Paul Williams, Vegetation Management Science Pty Ltd, Crystal Cascade (2010).

Discussion

- It is important to distinguish ‘shrubs’ from juvenile trees or saplings. Shrubs remain small plants when mature and certain types of open forest are characterised by an abundance of shrubs in the lower stratum (e.g. *Banksia aquilonia*, *Dodonaea triquetra* and *Banksia spinulosa*). If an **abundance of juvenile trees or saplings** are present, without the intervention of fire, they will cause the system to transition to closed forest. Fire is required if the land manager intends to maintain an open forest with a grassy or shrubby understorey.
- The distribution of northern bettong appears to be limited by the availability of its main food source, truffles and other fire dependent species such as cockatoo grass, and lilies (Dennis 2001). Regular mosaic burning will promote growth of grasses and some species of truffle while maintaining the open forest structure which allows ease of movement for foraging. Kangaroo grass and xanthorrhoea also provide important refuges, as the bettongs build tunnel shaped ‘nests’ to shelter in.

- Be aware that signs of poor health can also be a result of drought. Implementing fire during drought conditions is not recommended as this could compound health problems. Also consider whether the area has naturally poor soil, and therefore grasses may always appear less vigorous.
- In moister areas, there may be rainforests species present in the ground layer. Fire keeps rainforest species low in the profile. In the absence of fire, rainforests species can grow into the mid stratum and begin to shade-out grasses and other species in the ground layer such as herbaceous plants, lilies and sedges, impacting on diversity (refer to Issue 2). Eventually it is difficult to introduce fire into an area and the system is likely to transition to a closed forest.

What is the priority for this issue?

Priority	Priority assessment
High	Planned burns to maintain ecosystems in areas where ecosystem health is good .

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select at least two of the following as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
> 75 % of saplings < 2 m are scorched to the tip.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity), estimate the percentage of overabundant saplings (above ground components) scorched.	<p>Achieved: > 75 %.</p> <p>Partially Achieved: 25–75 %.</p> <p>Not Achieved: < 25 %.</p>
< 25 % of young eucalypt trees > 5 m tall are scorched to tip.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity), estimate the number of scorched eucalypt trees > 5m tall.	<p>Achieved: < 25 %.</p> <p>Partially Achieved: 25–50 %.</p> <p>Not Achieved: > 50 %.</p>
> 90 % of the grass clumps remain as stubble.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity) and estimate grass stubble remaining after fire.	<p>Achieved: > 90 % bases remain.</p> <p>Partially Achieved: 75–90 % bases remain.</p> <p>Not Achieved: < 75 % bases remain.</p>
50–70 % spatial mosaic of burnt patches.	<p>Choose one of these options:</p> <ul style="list-style-type: none"> • Visual estimation of percentage of vegetation burnt—from one or more vantage points, or from the air. • Map the boundaries of burnt areas with GPS, plot on GIS and thereby determine the % of area burnt. • In three locations (that take account of the variability of landform and ecosystems within burn area), walk 300 or more metres through planned burn area estimating percentage of ground burnt within visual field. 	<p>Achieved: 50–80 % burnt.</p> <p>Partially Achieved: between 25–50 % or 70–80 % burnt.</p> <p>Not Achieved: < 25 % or > 80 % burnt.</p>

If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.



Patchiness can be visually assessed via a walk-through over a burnt site. Ensure to take in features such as ridgelines and gullies, which as indicated in this photo, will influence patchiness.

QPWS, Herberton Range (2009).



Consider monitoring the suitability of fire management for maintaining northern bettong habitat by using quadrats to assess recruitment of grasses, sedges, lilies and food resources such as cockatoo grass following fire.

Contact your local natural resource management staff for further information.

Andy Baker, QPWS, Davies Creek (2009).

Fire parameters

What fire characteristics will help address this issue?

Fire severity:

- **Low** to **moderate**.
- Repeated **low**-severity fires can contribute to an overabundance of saplings in the mid-stratum. An occasional moderate-severity fire may be needed to manage overabundant saplings.

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm ⁻¹)	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Low (L)	< 150	< 0.5	< 2.5	Significant patchiness. Litter retained but charred. Humus layer retained. Nearly all habitat trees, fallen logs and grass stubble retained. Some scorch of elevated fuels. Little or no canopy scorch.
Moderate (M)	150–500	0.5–1.5	2.5–7.5	Moderate patchiness. Some scorched litter remains. About half the humus layer and grass stubble remain. Most habitat trees and fallen logs retained. Some scorch of elevated fuels. Little or no canopy scorch.

Note: This table assumes good soil moisture and optimal planned burn conditions.

Fire frequency / interval (refer to Appendix 2 for a discussion)

- Fire frequency should primarily be determined through on-ground assessment of vegetation health, fuel accumulation and previous fire patchiness, adjusting for wildfire risk and drought.
- Apply mosaic planned burns across the landscape at a range of frequencies to create varying stages of post-fire response (i.e. recently burnt through to maximum time frame). Consider the following broad fire intervals:
- **Moist grassy open forest** (see GIS layer): two to five years.

- **Dry grassy open forest** (see GIS layer): two to five years.
- **Grassy to shrubby** (see GIS layer): six to ten years.

Mosaic (area burnt within an individual planned burn)

- A mosaic is achieved with generally 25–70 per cent burnt within the target communities.

Other considerations

- Across the landscape, burning some areas at shorter intervals and some at longer intervals will also add to diversity. Too frequent fire can eliminate shrubs, many of which require several years in order to mature and set seed prior to the next fire event.
- In grassy areas, at intervals greater than **three years**, mosaic burning becomes harder to achieve (as dry fuel becomes more continuous) and there is greater reliance on tactics, topography and choice of conditions to achieve a patchy burn.

What weather conditions should I consider?

It is important to be aware of conditions prior to and following burns so that undesirable conditions and weather changes can be avoided, or to help with burn planning.

Season: April-May to September

FFDI: < 12

DI (KBDI): 80–160

Wind speed: < 23 km/hr.



Chip lines can be useful to create temporary boundaries for mosaic burning. QPWS (2010).

What burn tactics should I consider?

Tactics will be site specific and different burn tactics may need to be employed at the same site (e.g. due to topographical variation). During the burn, regularly review and adjust tactics as required to achieve burn objectives. What is offered below is not prescriptive; rather it is a toolkit of suggested tactics that may assist in this issue.

- **A backing fire with good residence time.** A slow moving backing fire (lit against the wind on the smoky edge or lit from upslope) will generally result in a more complete coverage of an area and ensures fire has greater residence time, and minimises severity and rate of spread. Greater residence time reduces understorey density and results in greater consumption of fuel (which in some cases is desirable).
- **Using previously burnt grasses.** The first year after fire, regrowth grasses can be used as a fire line as they are green and will not carry fire **early in the year**. During the second year, there is a build up of dead grass material as the first year of grasses die-off. Fires will carry at this time, and especially during the third year when there is two years of dead grass build up.
- **Spot ignition.** Can be used to alter the desired intensity of a fire particularly where there is an accumulation of volatile fuels. Spots closer together will result in a line of a greater intensity (as spots merge and create hot junction zones) while increased spacing between spots will result in a lower-intensity fire. The spacing of the spots should regularly vary throughout the burn due to changes in weather conditions, topography and fuel loads.
- **Aerial ignition.** Where access is difficult, limited, or to cover extensive areas. Spot ignition and backing fires can be implemented with aerial ignition.
- **Progressive burning** is an approach to planned burning where ignition is carried out throughout much of the year as conditions allow. In the Wet Tropics, ignition can begin early in the year after heavy seasonal rain, with numerous small ignitions creating a fine-scale mosaic. These burnt areas can provide opportunistic barriers to fire for burning later in the year. They also provide fauna refuge areas. Progressive burning helps create a rich mosaic of intensities, burnt/unburnt areas, and seasonal variability. Be aware of how fire behaves differently in different seasons. Refer to the glossary for a fuller discussion.

Issue 2: Reduce overabundant saplings in the mid-stratum

Overabundance of rainforest pioneers, she-oaks, eucalypts and acacias may reduce the health of the ground layer through competition and shading.

Awareness of the environment

Key indicators:

- Mid-stratum is dominated by young eucalypts, rainforest pioneers, she-oaks or acacias.
- Understorey is difficult to see through or walk through.
- Grasses are scattered, poorly formed and collapsing. Other ground layer plants reduced in abundance and health.
- Cycads are in poor health or vines starting to smother cycad fronds.
- Accumulation of leaf litter, ribbons of bark suspended in shrubs and lower branches.
- Heavy fuels (> 6 mm) accumulate.
- Shrubs where present, are declining in diversity and abundance.



Where *Banksia spinulosa* is known to occur, as it begins to become less abundant, this is an indication that fire has been long absent.

Paul Williams, Vegetation Management Science Pty Ltd.



Where cycad fronds begin to brown-off in large numbers, this is an indication that fire has been long absent.

Paul Williams, Vegetation Management Science Pty Ltd, Crystal Cascade (2010).



A high-severity fire can cause a flush of *Acacia* spp. to germinate. If a second fire is not planned, these grow up to shade out ground layer diversity. *Acacia* spp. is used in the example; however the same is true for eucalypts and she-oaks.

Paul Williams, Vegetation Science Pty Ltd, Herberton (2010).



Overabundance of eucalypts in the understorey will eventually lead to too much shading.

Mike Ahmet, QPWS, Millstream National Park (2010).



Fire was used to scorch overabundant forest she-oaks. Forest she-oaks resprout from the base requiring follow up burns to avoid further overabundance.

Mark Parsons, QPWS, The Saddle, Paluma Range National Park (2011).



Scattered distribution or pockets of rainforest pioneers and taller she-oaks represent habitat diversity. However once these dominate it can be difficult to restore an open structure.

Mark Parsons, QPWS, Mt Zero, Taravale (2011).

Discussion

Why are saplings overabundant?

An overabundance of saplings in the understorey may be triggered in response to:

- a high severity fire event with no subsequent fire to thin the resulting flush of tree seedlings/saplings. If a fire triggers a flush of seedlings/saplings, it will be necessary to plan a subsequent burn
- repeated low severity, early season fires (not hot enough to scorch saplings)
- prolonged absence of fire
- certain acacias and she-oaks can germinate en masse. In the absence of fire, seed stock can build up, which is likely to lead to a mass germination event after wildfire (which tends to be a higher-severity fire). Where this has occurred, it is likely that more than one fire will be required to address the issue. Post fire observations are essential to monitor the kill rate and germination of acacias and she-oaks in order to ascertain the need of subsequent fires.

Potential impacts of overabundant saplings

- A thickening of trees may result in a lower diversity of plants within the understorey due to shading. This thickening threatens the health of the ecosystem leading to transition to a closed structure of indeterminate value, in which it is difficult to re-introduced planned fire.
- Too many saplings can change the structure from open to closed, and is one of the main threats to habitat for the endangered northern bettong found only in the wet tropics. Most importantly, it leads to a reduction of its main food sources and restricts movement for foraging.
- Canopy species in the understorey are necessary for ventual replacement of canopy; it is a question of how many and balancing this against shading of the understorey.

What is the priority for this issue?

Priority	Priority assessment
High	Planned burns to maintain ecosystems in areas where ecosystem health is good .
Medium	Planned burn in areas where ecosystem health is poor but recoverable.

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select at least two of the following as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
> 75 % of mid-stratum saplings are scorched to the tip.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity), estimate the percentage of overabundant saplings (above ground components) scorched.	Achieved: > 75 %. Partially Achieved: 25–75 %. Not Achieved: < 25 %.
> 95 % of standing dead trees and standing live hollow-bearing trees (habitat trees) retained.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity) and estimate number of habitat trees. Determine the percentage retained after fire.	Achieved: > 95 % retained. Partially Achieved: 90–95 % retained. Not Achieved: < 90 % retained.
Restore cycad health (if cycads are present).	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity) and assess health of cycads.	*Achieved: Cycad recovered. Not Achieved: Cycad did not recover. *cycads will take several months to recover and may not have green material immediately after fire.

If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Moderate to high.** Aim for scorch height sufficient to scorch to the tip of overabundant saplings (see table below). Although moderate to high-severity fire is recommended, low-severity fires on the advent of the wet season may produce scorch of pioneers in areas of good grass cover.

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm ⁻¹)	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Moderate (M)	150–500	0.5–1.5	2.5–7.5	Moderate patchiness. Some scorched litter remains. About half the humus layer and grass stubble remain. Most habitat trees and fallen logs retained. Some scorch of elevated fuels. Little or no canopy scorch.
High (H)	500–1000	1.5–3.0	7.5–15.0	Some patchiness. Some humus remains. Some habitat trees and fallen logs affected. At least some canopy scorch in moderate < 20 m height canopy, mid stratum burnt completely (or nearly so).

Note: This table assumes good soil moisture and optimal planned burn conditions.

Fire extent

- Greater than 80 per cent of area dominated by understorey trees burnt.

Fire frequency / interval (refer to Appendix 2 for a discussion)

- Avoid low-severity fires in moist open forest at intervals of greater than five years, as this tends to create rainforest transition issues.

Repeated fires

- It is likely that more than one planned burn will be required to manage this issue. If the initial fire triggers a flush of new seedlings, follow-up planned burn within two years with **moderate**-severity fire.
- It is important to ensure the recruitment of open forest and woodland canopy species. Although **moderate** to **high**-severity fires may be necessary to control mid stratum sapling overabundance, it may also have an impact on canopy species recruitment. Therefore once mid stratum overabundance is controlled, it is important to return to a **low** to **moderate**-severity fire regime (refer to Issue 1).



An example of successful fire management of overabundant saplings. They are consistently scorched to the tip and yet grass stubble and unburnt fuels remain to promote a quick recovery of grasses.

Mark Parsons, QPWS, Wallaman Falls, Girringun National Park (2011).

What weather conditions should I consider?

It is important to be aware of conditions prior to and following burns so that undesirable conditions and weather changes can be avoided, or to help with burn planning.

Season: July to November (drier conditions)

FFDI: 8–18

Wind speed: < 23 km/hr. Winds greater than 15 km/hr can help carry fire into thickening areas.

What burn tactics should I consider?

Tactics will be site specific and different burn tactics may need to be employed at the same site (e.g. due to topographical variation). During the burn, regularly review and adjust tactics as required to achieve burn objectives. What is offered below is not prescriptive; rather it is a toolkit of suggested tactics that may assist in this issue.

- **Commence lighting on the leeward (smoky) edge.** This can be a useful way to create a containment edge for a higher severity fire ignited inside the burn area.
- **Backing fire with good residence time.** A slow moving backing fire (lit against the wind on the smoky edge or lit from upslope) will generally result in a more complete coverage of an area and ensures the fire has a greater amount of residence time, while ensuring fire intensity and rate of spread are kept to a minimum. Greater residence time is useful in reducing understorey density.
- While a moderate severity fire is often sufficient to address this issue, it is dependant upon the height of the saplings. A **running fire** of a higher intensity may be required initially where there is a lack of surface and near surface fuels due to shading or if the thicket is well developed. In this instance a follow-up planned burn will be required in the two to three years post burn to kill surviving saplings and any new seedlings.
- **Line or strip ignition** is used to create a fire of higher intensity or to help fire carry through moist or inconsistent fuels. This is also useful to reduce overabundant trees (through scorching).
- **Aerial ignition.** Where access is difficult and limited, or to cover extensive areas.

Issue 3: Fire management in the coastal hill slopes (including Cairns hill slopes)

The complex fire management issues of the coastal hill slopes require particular management approaches. Open forests and woodlands of the coastal hill slopes interface with urban areas, forestry, sugar cane and other crops. The land is steep, and dissected by sheltered rainforest gullies usually on an eastern aspect. There are complex land-use patterns such as walking tracks and easements for communication and power and some utilities at the top of the slopes. Also, there are various land tenures, especially in the lower slopes, that complicate management of fire.

Awareness of the environment

Key indicators to be aware of include the presence of:

- nearby urban areas or settlements
- nearby farms, sugar cane and other crops
- forestry areas including timber plantations
- walking track and communication easements
- infrastructure, especially if it is upslope (e.g. for power or communications)
- rainforests, especially if it is upslope
- areas of high fuel load or high biomass grasses that may dramatically increase fire severity.



Residences nestled into the open forests of the foothills are a common feature of the Cairns hill slopes.

Jonathan Roth, QPWS, Cairns (2008).



Burning near residences.

Mark Parsons, QPWS (2010).

Discussion

- Backing fire ignited from higher slopes with aerial ignition is the usual approach to fire management on the coastal hill slopes, though not exclusively. The fire is allowed to back down and extinguish along constructed fire lines or natural features. If necessary, the urban interface zones can be burnt away from after a sufficient period of backing fire from higher slopes.
- If forest structure is beginning to change from open to closed due to overabundant tree species, it might be necessary to light a fire from down slope to ensure sufficient penetration through these areas (refer to Issue 2). However, ensure containment and safety issues are addressed first.
- Urban interface areas introduce a range of additional challenges to planned burning, especially with regard to access behind properties, timber fences and dumped green waste. Be aware of these issues when planning burns.
- Inter-agency cooperation is usually required due to tenure and interface issues. Participation or cooperation from main roads, emergency services, traffic control, local government and others may have to be organised, especially emergency services and Cairns regional council.
- Planned burning on the Cairns hill slopes usually comes under media scrutiny. Media and neighbours need to be kept informed (e.g. through media releases and letterbox drops).
- Where high biomass grasses are present, they can dramatically increase the severity of fire. Be aware of the presence of these grasses (refer to Chapter 11, for fire management guidelines).
- In sugar cane areas, fire management often follows harvest time. Cane at harvest time is highly flammable, and caution is required.
- As the urban interface increases and development moves upslope, fire becomes increasingly difficult to manage. Fire managers must become increasingly strategic in these areas.

What is the priority for this issue?

Priority	Priority assessment
Highest	Planned burn required to protect life and/or property , usually within protection zones .
Very high	Planned burn required to mitigate hazard or simplify vegetation structure , usually within wildfire mitigation zones .

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select at least two of the following as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
Fuel reduced to less than 5 tonnes per hectare (t/ha).	Immediately or very soon after fire: fuel load assessed at several locations (taking into account variability in landform) using Step 5 of the QPWS Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go.	<p>Achieved: Fuel load reduced to < 5 t/ha across the fire association.</p> <p>Partially Achieved: Fuel load reduced to < 5 t/ha across the fire association but duff/humus layer removed.</p> <p>Not Achieved: Fuel load not reduced to < 5 t/ha.</p>
Fuel reduced to overall low fuel hazard.	Immediately to very soon after fire: fuel load assessed at several locations (taking into account variability in landform) using the Overall Fuel Hazard Guide (Hines et al. 2010b).	<p>Achieved: Overall fuel hazard reduced to low.</p> <p>Partially Achieved: Overall fuel hazard reduced to low or moderate.</p> <p>Not Achieved: Overall fuel hazard not reduced to low or moderate.</p>

<p>Fire extent or patchiness of:</p> <ul style="list-style-type: none"> • 90–100 % burnt Protection Zones. • 60–80 % burnt Wildfire Mitigation zones. • 40–60 % burnt Conservation zones. 	<p>There are three options:</p> <ol style="list-style-type: none"> 1. From one or more vantage points, estimate aerial extent of ground burnt. 2. In three locations (that take account of the variability of landform within burn area), walk 300 m through planned burn area estimating percentage of ground burnt within visual field. 3. Walk into one or more gully heads, and down one or more ridges and estimate percentage of ground burnt within visual field. 	<p>Achieved:</p> <ul style="list-style-type: none"> • 90 % Protection zones. • 60–80 % Wildfire mitigation zones. <p>Partially Achieved:</p> <ul style="list-style-type: none"> • Mosaic or patchiness of 80–90 % for protection zones. • Mosaic or patchiness of 50 % to 80 % for wildfire mitigation zones. • The extent and rate of spread of any subsequent wildfire would still be limited. <p>Not Achieved:</p> <ul style="list-style-type: none"> • Mosaic or patchiness of < 80 % for protection zones. • Mosaic or patchiness of < 50 % for wildfire mitigation zones. • High proportion of patchiness, unburnt corridors extend across the area (the extent and rate of spread of any subsequent wildfire would not be limited).
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If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System. In urban interface areas, consider ongoing monitoring of fuel load.



Backing fire from upslope areas. In this area, fire is allowed to travel down slope towards constructed fire lines. If necessary, once the fire has backed down most of the hill slope, the area behind the settlement can be line ignited to create a buffer.

Jonathan Roth, QPWS, Edmonton Spur (2010).

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Low to moderate.**
- Repeated **low**-severity fires will contribute to an overabundance of saplings in the mid-stratum. Some moderate intensity fires should be planned where overabundant saplings are becoming a problem.

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm ⁻¹)	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Low (L)	< 150	< 0.5	< 2.5	Significant patchiness. Litter retained but charred. Humus layer retained. Nearly all habitat trees, fallen logs and grass stubble retained. Some scorching of elevated fuels. Little or no canopy scorch.
Moderate (M)	150–500	0.5–1.5	2.5–7.5	Moderate patchiness. Some scorched litter remains. About half the humus layer and grass stubble remain. Most habitat trees and fallen logs retained. Some scorch of elevated fuels. Little or no canopy scorch.

Note: This table assumes good soil moisture and optimal planned burn conditions.

Fire frequency / interval (refer to Appendix 2 for a discussion)

- Consider a broad fire interval range of between two to five years for dry grassy open forest. For areas influenced by arson or areas with a poor coverage of previous fire, increase the fire frequency to one to two years where possible.

Mosaic (area burnt within an individual planned burn)

- Create a mosaic as appropriate to mitigate wildfire movement during the dry season. Generally:
 - 90–100 per cent burnt for protection zones
 - 60–80 per cent burnt for wildfire mitigation zones
 - 40–60 per cent burnt for conservation zones.

What weather conditions should I consider?

It is important to be aware of conditions prior to and following burns so that undesirable conditions and weather changes can be avoided, or to help with burn planning.

Season: April/May to September

FFDI: < 12

DI (KBDI): 80–160

Wind speed: < 23 km/hr

What burn tactics should I consider?

Tactics will be site specific and different burn tactics may need to be employed at the same site (e.g. due to topographical variation). During the burn, regularly review and adjust tactics as required to achieve burn objectives. What is offered below is not prescriptive; rather it is a toolkit of suggested tactics that may assist in this issue.

- **Backing fire ignited from higher slopes with aerial ignition** will create a slow moving backing fire which will generally result in a more complete coverage of an area and help to minimise fire intensity and rate of spread. Greater residence time will increase consumption of fuel. In the right conditions, where natural barriers or constructed fire lines are present, a backing fire should self-extinguish.
- At the urban interface zone, if necessary, **burn away from interface areas** after a sufficient period of backing fire from higher slopes. The backing fire should have descended downwards extensively prior to burning away from lower slope interface areas. If lower slope interface areas are ignited too early, this will create a running fire upslope, which is usually undesirable unless specifically planned in order to control overabundant trees.

- **Consider adjacent primary production activities.** Often this fire vegetation group neighbours agricultural land uses such as sugar cane production. Planned burns in adjoining areas should be undertaken when the prevailing weather conditions (in particular wind direction) will direct the resulting fire, smoke and any airborne embers away from the sugar cane crop or mulch (“trash blanket”) that follows harvesting. Line lighting the windward edge along the margin of the sugar cane is preferred so that a safe perimeter can be established. Establishing cooperative arrangements with cane farmers and rural fire brigades is essential in managing this issue.
- Rainforest gullies or areas can be used to **break up fires**, and as boundaries to contain fires within small sections. At the same time, it is important to protect rainforest margins by using appropriately moist conditions of burning, or by backing fire downhill and/or away from rainforest margins (refer to Chapter 11 [Issue 7], for fire management guidelines).
- These areas are highly prone to arson, and **progressive burning** is an important strategy. Burns early in the year create areas of low fuel helping to limit the extent and severity of later wildfires. Refer to the glossary for a fuller discussion.
- When planning burns, be aware of the need to choose conditions (especially wind direction) that will **minimise smoke impacts** on settlements. Be aware that inversion layers (when temperatures increase with altitude) prevent dispersion of smoke and therefore should be avoided. Consult weather forecasts.



In the foothills around Cairns, fire management often occurs in close proximity to residential areas.

Mark Parsons, QPWS, Toomulla (2010).

Issue 4: Manage high biomass invasive grasses

Refer to Chapter 11 (Issue 3), regarding fire management guidelines.

It is important to be aware of the presence of high biomass grasses as they can dramatically increase fire severity and can be promoted by fire. Sometimes fire can be used to help in their control.



Shown as rusty red in the foreground, grader grass outbreaks are easily spread by disturbance such as slashing fire trails. Often, exclusion of fire is necessary.

Shane O'Connor, DERM, Princess Hill, Girringun National Park (2006).

Issue 5: Reduce *Lantana camara*

Refer to Chapter 11 (Issue 4), regarding fire management guidelines.

The presence of *Lantana camara* may require an altered approach to fire management or for well established infestations, integrated use of fire and herbicide.



Monitoring weather conditions is useful in choosing the best time to push fire into lantana thickets.

Mark Parsons, QPWS, Mt Fox, Girringun National Park (2008).

Chapter 3: Tall open forest

This fire vegetation group includes tall (> 30 m) open eucalypt forests and woodlands within the moist uplands and highlands of the wet tropics. They are typically dominated by one or a mix of canopy species including rose gum *Eucalyptus grandis*, *Eucalyptus resinifera*/*Corymbia intermedia* (intermingled), *Eucalyptus tereticornis* (in belts adjacent to rainforests), *Eucalyptus pellita* (large areas north of Mossman and near Cairns), cadaghi *Corymbia torelliana* and turpentine *Syncarpia glomulifera*. The understorey or ground layer may be dominated by:

- grasses
- sedges and leaf litter
- sclerophyllous (hard leaf) shrubs
- rainforest/vine forest
- various combinations of the above.

Fire management issues

Fire plays a central role in these forests with longer fire frequencies leading to a transition from an open to a closed structure (Ash 1988; Stanton 1989; Harrington and Sanderson 1994; Williams and Tran 2009; Williams et al. 2010). Planned burning helps to maintain representative examples of this fire vegetation group (Smith 1993; Harrington et al. 2000), and especially grassy dominated ground layers, which have a propensity to transition from open grassy eucalypt forest to closed forest (Wet Tropics Management Authority 2004; Williams and Tran 2009). Transitioning is often irreversible and has caused many of these ecosystems to have an **endangered** biodiversity status (Queensland Herbarium 2011a). Loss of open structure threatens suitable habitat for species such as the **endangered** northern bettong and vulnerable yellow-bellied glider (Wet Tropics Management Authority 2004; Williams et al. 2010).

In managing these forests, it is important to understand the mechanism of transitioning. Most rainforest pioneers resprout after fire, however unlike eucalypts they must resprout from ground level. Therefore fire keeps them trapped near the ground where they co-exist with grasses, shrubs, ferns and other species. Fire can promote a pulse of rainforest germinates, and in the absence of fire for several years, rainforest germinates and saplings shade out ground layer plants, inhibit fire and create conditions favouring further rainforest recruitment and closed forest transition (Williams et al. 2006, 2012).

Because these forests are very moist, there are limited windows of opportunity to conduct planned burns. A high level of importance should be placed on responding operationally to suitable weather conditions.

Fire management in tall open forest requires a carefully considered integrated approach. Beginning early in the year, surrounding fire-adapted communities should be burnt to create areas of low fuel that help contain higher-severity late-season fires. Late-season conditions are often required to allow tall open forests to dry sufficiently so that they can carry fire. The degree to which tall open forests can carry fire depends on understorey characteristics as influenced by the stage of transitioning to closed forest. The land manager should aim to keep representative examples of tall open forest as described below, where possible using fire to halt the transition to a denser state.

Issues:

1. Manage a grassy or shrubby tall open forest. These forests have an understorey that can carry fire much of the year after seasonal heavy rains.
2. Manage tall open forests where seedlings / saplings are abundant in the mid-stratum. Mid stratum tree overabundance has caused the ground layer to become sparser often characterised by sedges interspersed with leaf litter. Fire will carry in the right conditions, but using nearby grassy areas to help carry fire is useful.
3. Manage tall open forests at an advanced stage of transitioning. Trees have shaded-out the ground layer, which is now characterised by leaf litter and an absence of ground layer plants. It is probably necessary to use nearby grassy areas to carry fire into these areas. Windows of opportunity for fire are few.
4. Reduce *Lantana camara*.

Extent within bioregion: 93 352 ha, 5 per cent; **Regional ecosystems:** Refer to Appendix 1 for list.

Examples of this FVG: Giringun National Park, 11 219 ha; Paluma Range National Park, 7 352 ha; Daintree National Park, 5 310 ha; Monkhouse Timber Reserve, 5 149 ha; Koombooloomba Forest Reserve, 4 900 ha; Paluma State Forest, 3 823 ha; Mount Windsor National Park, 3 230 ha; Kirrama National Park, 3 103 ha; Herberton Range State Forest, 2 927 ha; Wooroonooran National Park, 2 848 ha; Mount Lewis National Park, 2 416 ha; Dinden National Park, 2 179 ha; Gadgarra Forest Reserve, 1 896 ha; Herberton Range National Park, 1 542 ha; Kuranda National Park, 1 193 ha; Tully Falls National Park, 1 131 ha; Goldsborough Valley USL Lands, 1 025 ha; Tumoulin State Forest 859 ha, Girramay National Park 857 ha, Danbulla National Park 849 ha, Abergowrie State Forest, 777 ha; Little Mulgrave Forest Reserve, 749 ha; Herberton Range Conservation Park, 574 ha; Ravenshoe State Forest 1, 560 ha; Macalister Range National Park, 466 ha.

Issue 1: Manage a grassy or shrubby tall open forest

Maintain tall open forests and woodlands that have a grassy or sclerophyllous (hard-leaved) shrubby dominated understorey.

Awareness of the environment

Key indicators of a tall open forest with a grassy understorey:

- Tall open forest ground layer is dominated by grasses (predominantly kangaroo grass and/or blady grass, and occasionally other native grass species) with occasional sedges; shrubs; bracken; legumes or any mix of these. Some young canopy species are present in the mid and lower stratum (enough to eventually replace the canopy).
- Lower and mid stratum tree species are present, but are not having noticeable shading effects on ground layer plants.
- The forest is easy to walk through or see through.



Tall open forest with a healthy grass layer. Mid stratum trees are in low numbers and do not impact on the ground layer.

Paul Williams, Vegetation Management Science Pty Ltd, Taravale, plot 6 (2005).



Tall open forest with a healthy grass layer. Although there are a number of rainforest and she-oak young trees, they are in insufficient numbers to impact on ground layer.

Mark Parsons, QPWS, Taravale, plot 6 (2006).



Northern bettong prefer habitat with grassy open ridges, shrubby influenced gullies and rock/ pavement outcrops. Notice rock outcrop.

Andy Baker, QPWS, Davies Creek (2010).

The following may indicate that fire is required to maintain the grassy structure:

- Rainforest, she-oak or acacia tree saplings or seedlings starting to become abundant and beginning to emerge above the ground stratum. Rainforest pioneers commonly include: *Polyscias* spp., *Melicope* spp. (such as evodia), *Alstonia* spp., and *Alphitonia* spp.
- Grasses becoming sparser or grass clumps poorly formed. An accumulation of dead material and collapsing grasses.
- Bracken fern, where present, is accumulating dead fronds.



Grass layer still healthy but an overabundance of rainforest pioneers are beginning to emerge above ground layer.

Mark Parsons, QPWS, Taravale, plot 10 (2004).



Although this area is due for fire, it is also important to allow recruitment of canopy species (e.g. rose gum). Manage the frequency and intensity of fire carefully to avoid scorching most of the recruiting rose gum.

Mark Parsons, QPWS, Mount Windsor (2010).



Left: Grass layer becoming sparse as a result of shading from rainforest and she-oak species.

Above: Enlarged detail of left photo highlighting collapsing grasses and an accumulation of dead grassy material.

Mark Parsons, QPWS, Taravale, plot 3 (2004).



Grass layer becoming sparser as a result of shading and competition from rainforest and she-oak species.

Mark Parsons, QPWS, Taravale, plot 4 (2006).



Near boulders or gullies, bracken fern shelters yellow-footed antechinus, rough scaled snakes and northern bettongs. With planned burn conditions, habitat features remain, in contrast to wildfires which burn extensive areas. However, as bracken fern declines in health, even these sheltered areas require fire. Fire should be patchy here.

Mark Parsons, QPWS, Deep Creek, Girramay National Park (2009).



A sequence illustrating clumping grass decline in the absence of fire. Sorghum is used as an example, but decline in *Themeda* spp. and other clumping species is similar. Dead and matting grasses (as illustrated in the bottom row) are important habitat for invertebrates and skinks. However, they also indicate the forest requires fire to maintain grass health in general. Lower severity fires and moist conditions help keep habitat refuges in place.



Wayne Kington, QPWS / David Kington, QPWS, Lamington National Park (2009).



Mark Parsons, QPWS, Mullers Creek (2010).

Key indicators for tall open forests with a shrubby understorey:

- Understorey is dominated by a diverse sclerophyllous (hard-leaved) shrub layer of continuous height. Scattered sedges, grasses and ferns may be present. Some young canopy species are present in the mid and lower strata (enough to eventually replace the canopy).
- Lower and mid stratum tree species **are not** having noticeable shading effects on shrub or ground layer.



Some tall open forests have a sclerophyllous shrubby understorey. These have longer fire frequencies than grassy communities.

Yellow-bellied gliders live in *Eucalyptus grandis* (rose gum) and feed on *Eucalyptus resinifera*. This habitat is threatened by transitioning.

Andy Baker, QPWS, Daintree National Park (2009).



A shrubby understorey and good recruitment of canopy trees of various ages. The recruiting canopy trees are numerous, but do not shade out the understorey as rainforest pioneers would.

Mark Parsons, QPWS Mt Windsor (2010).

The following may indicate that fire is required to maintain shrubby types:

- Shrubs looking unhealthy, for example beginning to lose lower level leaves, spindly branches are present or some crowns (ends of branches) are dying. There is an accumulation of brown leaves on shrubs.
- Abundant rainforest, she-oak or acacia tree species are emerging among the shrubs. Rainforest colonists may include: *Polyscias* spp., *Melicope* spp. (such as evodia), *Alstonia* spp., and *Alphitonia* spp.
- Vines are starting to grow over some of the shrubs.
- *Lantana camara* is beginning to establish as thickets.
- Suspended litter and bark is perched in shrubs (e.g. rose gum bark ribbons).



Sedge and rainforest trees starting to emerge in a shrubby tall open forest. Notice the suspended ribbon bark.

Mark Parsons, QPWS, Mt Windsor (2010).

What is the priority for this issue?

Priority	Priority assessment
Very high	Planned burn required to maintain areas of special conservation significance .

Discussion

- It is important to distinguish ‘shrubs’ from juvenile trees or saplings. Shrubs remain small plants when mature and certain types of tall open forest are characterised by an abundance of shrubs in the lower stratum (e.g. *Banksia aquilonia*, *Dodonaea triquetra* and *Banksia spinulosa*). However, if an abundance of juvenile trees or saplings are present, without the intervention of fire they will usually cause the system to transition to closed forest. Therefore fire is required if the land manager intends to maintain a tall open forest with a grassy or shrubby understorey.
- In the wet tropics, there is a group of rainforest pioneers that tend to always be present in the ground layer of this fire vegetation group and can quickly grow into the mid stratum in the absence of fire.



Rainforest tree species resprouting after fire.

Paul Williams,
Vegetation Science
Pty Ltd, Paluma Range
National Park (2004).



Where sufficient fuel accumulates, follow up burning can assist to suppress pioneer recruitment. Having conditions that enable a backing burn will promote a greater residence time, which may scorch the base of resprouting plants.

Mark Parsons, QPWS,
Taravale (2009).

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Measurable objectives	How to be assessed	How to be reported (in fire report)
> 75 % of saplings < 2 m are scorched to the tip.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire severity), estimate the percentage of overabundant saplings (above ground components) scorched.	Achieved: > 75 %. Partially Achieved: 25–75 %. Not Achieved: < 25 %.
< 25 % of young eucalypt trees > 5 m tall are scorched to the tip.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity), estimate the number of scorched eucalypt trees > 5 m tall.	Achieved: < 25 %. Partially Achieved: 40–50 %. Not Achieved: > 50 %.
> 75 % fallen logs (with a diameter ≥ 10 cm) retained.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity) and estimate number of fallen logs retained after fire.	Achieved: > 75 % retained. Partially Achieved: 50–75 % retained. Not Achieved: < 50 % retained.

If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.



Objectives achieved as seen one week after fire. 100 per cent reduction of saplings and seedlings, while at the same time retention of all habitat trees, fallen logs and recovery of grasses.

Paul Williams, Vegetation Science Pty Ltd, Taravale, plot 1 (2004).



A low-severity fire has resulted in a patchy mosaic burn. Most but not all saplings and seedlings have been reduced across a broad area. This burn is still considered a success.

Paul Williams, Vegetation Science Pty Ltd, Taravale, plot 6 (2004).

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Low.** With the occasional **moderate** severity fire (see table below, except that a good coverage of fire is desirable rather than a patchy fire). An occasional moderate-severity fire helps to ensure emerging overabundant trees are managed while low-severity fires help ensure enough canopy trees establish to replace the canopy. It is important to strike this balance between tree reduction and canopy tree recruitment.

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm ⁻¹)	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Low (L)	< 150	< 0.5	< 2.5	Significant patchiness. Litter retained but charred. Humus layer retained. Nearly all habitat trees, fallen logs and grass stubble retained. Some scorching of elevated fuels. Little or no canopy scorch.
Moderate (M)	150–500	0.5–1.5	2.5–7.5	Moderate patchiness. Some scorched litter remains. About half the humus layer and grass stubble remain. Most habitat trees and fallen logs retained. Some scorch of elevated fuels. Little or no canopy scorch.

Note: This table assumes good soil moisture and optimal planned burn conditions.

Fire frequency / interval (refer to Appendix 2 for a discussion)

- Fire frequency should primarily be determined through **on-ground assessment of vegetation health, fuel accumulation** and **previous fire patchiness** and adjusted for wildfire risk and drought cycles.

- Apply mosaic-planned burns across the landscape at a range of frequencies to create varying stages of post-fire response (i.e. recently burnt through to the maximum time frame). Consider a broad fire interval range of between three to five years for **grassy** understorey and six to ten years for **shrubby** understorey.

Mosaic (area burnt within an individual planned burn)

- Because of a propensity for these systems to transition, aim to achieve a good coverage of fire. Despite this, in moister areas such as near gullies, unburnt areas tend to remain. This will help retain features such as ground epiphytes and denser pockets.

Landscape mosaic

- It is recommended that at least 30 per cent of wet tropics tall open forests with grassy or shrubby understoreys be burnt each year (refer to supporting GIS layer).

Other considerations

- When planning suitable fire severity and fire frequencies, take into account wildfires. Occasional wildfires are not an ecological concern in tall open forest, but do not allow a wildfire driven regime to dominate.



A low severity fire in northern bettong habitat.

Mark Parsons, QPWS, Zero Creek, Mt Zero (2007).

What weather conditions should I consider?

It is important to be aware of conditions prior to and following burns so that undesirable conditions and weather changes can be avoided, or to help with burn planning.

Season:

- Any time of the year **after the wet season** when rain can be reliably expected or good **soil moisture exists**.
- Be aware of the need to keep grassy areas unburnt where and if they are required during late-season burns to ‘push’ fire into adjacent areas that are transitioning to closed forest (refer to Issue 2 and Issue 3).

FFDI: < 12

DI (KBDI): 100–160

Wind speed: < 15 km/hr

Soil moisture: Good moisture conditions to protect grass bases, hollow-bearing trees and fallen logs.

What burn tactics should I consider?

Tactics will be site specific and different burn tactics may need to be employed at the same site (e.g. due to topographical variation). Also, during the burn, tactics should be reviewed and adjusted as required to achieve burn objectives. What is offered below is not prescriptive; rather it is a toolkit of suggested tactics that may assist in this issue.

- **Progressive burning.** Fires (of varying extents, severity and at various times) are lit in surrounding fire-adapted communities from early in the year when conditions allow. This progressively creates areas of low fuel acting as a buffer to undertake burns in tall open forests later in the year (after these forests have dried out sufficiently). Refer to the glossary for a fuller discussion.
- **Using previously burnt grasses.** The first year after fire, regrowth grasses are green and will not carry a fire **early in the year** and can be used as a fire line. During the second year, there is a build up of dead grass material as the first year of grasses die-off. Fires will carry at this time, and especially during the third year when there is two years of dead grass build up.
- **Commence lighting on the leeward (smoky) edge.** This can be a useful way to create a containment edge for a higher severity fire ignited inside the burn area.

- **Backing fire with good residence time.** A slow moving backing fire (lit against the wind on the smoky edge or lit from upslope) will generally result in a more complete coverage of an area and ensures the fire has a greater amount of residence time, while ensuring fire intensity and rate of spread are kept to a minimum. Greater residence time is useful in reducing understorey density.
- **Spot ignition.** Can be used to alter the desired intensity of a fire particularly where there is an accumulation of volatile fuels. Spots closer together will result in a line of a greater intensity (as spots merge and create hot junction zones) while increased spacing between spots will result in a lower intensity fire. The spacing of the spots will regularly vary throughout the burn due to changes in weather conditions, topography and fuel loads.
- **Aerial ignition.** Where access is difficult or limited, or to cover extensive areas. Spot ignition and backing fires can be implemented with aerial ignition.



Spot igniting from a ridge spur allowing fire to back downhill into tall open forest.

Tim Devlin, QPWS, Mt Kinduro (2006).



Spot ignition, such as lighting around the back of this very tall tree, creates small fingers of fire that gradually draw into a forest. This can be very useful in steep terrain in order to reduce fire severity.

Tim Devlin, QPWS, Attie Creek (2009).

Issue 2: Manage tall open forests where seedlings / saplings are abundant in the mid-stratum

Tall open forests and woodlands in which pioneer rainforest, she-oak or acacia saplings or seedlings are abundant in the mid-stratum creates a sparser ground layer often characterised by sedges interspersed with leaf litter. Fire is required in order to prevent further thickening and the creation of a ground layer of shaded leaf litter in which fire becomes difficult to reintroduce.

Awareness of the environment

Key indicators of mid stratum overabundance:

- Mid-stratum has an abundance of seedlings/saplings including rainforest pioneers, she-oaks or acacias.
- In areas that were once grassy, the ground layer is becoming dominated by sedges interspersed with leaf litter. Other scattered leafy plants may be present.
- Grasses, sedges, dianellas, ferns and/or shrubs are declining in health and abundance due to shading. Grasses collapsing and appearing very sparse.
- Mid or lower-stratum is difficult to see through or walk through.
- Ground layer or shrubs are smothered by leaf litter in some areas.
- For shrubby tall open forests, mature shrubs have sparse crowns or are beginning to die with little or no new recruitment of shrubs in the ground layer.
- An accumulation of fuels with a diameter > 6 mm.
- Ribbon bark and fine branch material perched in shrub and sapling foliage.
- Bracken fern smothering native grasses, and dead material building up around bracken fern.



Shading from rainforest and she-oaks has created a ground layer characterised by sedges interspersed with leaf litter. Grasses and other ground layer plants are sparse.

Mark Parsons, QPWS, Taravale, plot 4 (2004).



Shading due to she-oaks. She-oak needles can smother native grasses. Barb wire grass and lomandra tend to persist under she-oaks but not in great numbers.

Mark Parsons, QPWS, Taravale, plot 5 (2004).



Mid-stratum has an abundance of young rainforest trees. Mid and lower-stratum is difficult to see through. Fallen material suspended in foliage.

Mark Parsons, QPWS, Taravale, plot 7 (2004).



Notice bracken fern smothering grasses, and presence of dead bracken fronds.

Justine Douglas, QPWS, Hinchinbrook Island (2008).

Discussion

- In the wet tropics, there is a group of rainforest pioneers that tend to always be present in the ground layer of this fire vegetation group and can grow into the mid-stratum quickly in the absence of fire.
- Certain she-oaks, acacias and hopbush *Dodonaea* spp. can germinate en masse. Where this has occurred, it is likely that follow up fires will be required. Post fire observations are essential to monitor the kill rate and germination of acacias in order to ascertain the need for subsequent fires.
- It is important to ensure the recruitment of tall open forest and woodland canopy species. Although **high**-severity fires may be necessary to control mid-stratum sapling overabundance, it may also have an impact on canopy species recruitment. Therefore once overabundant mid-stratum trees are controlled, return to a **low** to **moderate**-severity regime (refer to Issue 1).



Hopbush overabundance can quickly emerge after fire.
QPWS.

What is the priority for this issue?

Priority	Priority assessment
High	Planned burns to maintain ecosystems in areas where ecosystem health is good .
Medium	Planned burn in areas where ecosystem health is poor but recoverable.

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select at least two of the following as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
> 75 % of saplings < 2 m are scorched to the tip.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity), estimate the percentage of overabundant saplings scorched.	<p>Achieved: > 75 %.</p> <p>Partially Achieved: 25–75 %.</p> <p>Not Achieved: < 25 %.</p>
< 25 % of young eucalypt plants > 5 m tall are scorched to the tip.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity), estimate the number of scorched saplings >5m tall.	<p>Achieved: < 25 %.</p> <p>Partially Achieved: 40–50 %.</p> <p>Not Achieved: > 50 %.</p>
> 75 % fallen logs (with a diameter ≥ 10 cm) retained.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity) and estimate number of fallen logs retained after fire.	<p>Achieved: > 75 % retained.</p> <p>Partially Achieved: 50–75 % retained.</p> <p>Not Achieved: < 50 % retained.</p>

If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.



In moist conditions, a moderate intensity fire should still allow retention of habitat trees and fallen logs, and promote grass recruitment.

Enlargement highlights grass recruitment.

Paul Williams, Vegetation Management Science Pty Ltd, Taravale, plot 5 (2004).

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Moderate to high.** Aim to scorch to the top of mid-stratum saplings so that all the leaves of undesired saplings are brown after fire. The target scorch height should be as high as the tip of the mid-stratum trees that you wish to control. If using high-severity fire, be aware of the potential for impacts on mature trees and fallen logs, and that the fire will be harder to contain (see tactics section and address containment issues prior to burning). Once mid-stratum overabundance is controlled, return to a low to moderate-severity regime (refer to Issue 1).
- It is possible that **low to moderate**-severity backing fire, with a high residence time around the base of overabundant saplings would be sufficient to brown off the leaves and kill the above ground component of the plant. But more testing should be undertaken to confirm this.

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm ⁻¹)	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Moderate (M)	150–500	0.5–1.5	2.5–7.5	Moderate patchiness. Some scorched litter remains. About half the humus layer and grass stubble remain. Most habitat trees and fallen logs retained. Some scorch of elevated fuels. Little or no canopy scorch.
High (H)	500–1000	1.5–3.0	7.5–15.0	Some patchiness. Some humus remains. Some habitat trees and fallen logs affected. At least some canopy scorch in moderate. < 20 m height canopy, mid stratum burnt completely (or nearly so).

Note: This table assumes good soil moisture and optimal planned burn conditions.

Fire frequency / interval (refer to Appendix 2 for a discussion)

- Increase frequency of fire until overabundance is controlled.

Mosaic (area burnt within an individual planned burn)

- As much of the area dominated by mid stratum trees as possible.

Other considerations

- If the initial fire triggers a flush of new she-oak, hopbush or acacia seedlings, plan a follow-up burn within three years. A backing fire will help reduce seedlings.



A moderate-severity backing fire. Scorching to the tip of the sapling helps to ensure the above ground component is reduced.

Mark Parsons, QPWS, Girringun National Park (2010).

What weather conditions should I consider?

It is important to be aware of conditions prior to and following burns so that undesirable conditions and weather changes can be avoided, or to help with burn planning.

Season: Dry season (October, November, December or sometimes-early January)

FFDI: < 18

DI (KBDI): 140–190

Wind speed: < 23 km/hr. A good wind speed 15–23 km/hr can help achieve the desired severity. Be aware of containment issues.

Other considerations: A key factor for this issue is being available to implement burns as the window of opportunity (suitable weather) arises.

What burn tactics should I consider?

Tactics will be site specific and different burn tactics may need to be employed at the same site (e.g. due to topographical variation). Also, during the burn, tactics should be reviewed and adjusted as required to achieve burn objectives. What is offered below is not prescriptive; rather it is a toolkit of suggested tactics that may assist in this issue.

- **Progressive burning.** Fires (of varying extents, severity and at various times) are lit in surrounding fire-adapted communities from early in the year when conditions allow. This progressively creates areas of low fuel acting as a buffer to undertake burns in tall open forests later in the year (after these forests have dried out sufficiently). Refer to glossary for a fuller discussion.
- **Commence lighting on the leeward (smoky) edge.** This can be a useful way to create a containment edge for a higher severity fire ignited inside the burn area.
- Using **grassy areas to push fire** into areas with less available fuel is a common method to help fire carry into areas of tall open forest that are transitioning and therefore have an understorey less likely to carry fire.
- **A backing fire with good residence time.** A slow moving backing fire (lit against the wind on the smoky edge or lit from upslope) will generally result in a more complete coverage of an area and ensures the fire has a greater amount of residence time, while ensuring fire intensity and rate of spread are kept to a minimum. Greater residence time is useful in reducing understorey density.
- Creating a **running** fire (through closely spaces spot ignition or line ignition with the wind or slope) may help fire carry into areas transitioning to closed forest. Be aware of the risk of undesirable impacts such as loss of habitat trees and fallen logs and the need to return to a lower-severity regime once issue is controlled.
- **Line or strip ignition** is used to create a fire of higher intensity or to help fire carry through moist or inconsistent fuels. This is also useful to reduce overabundant trees (through scorching).
- **Aerial ignition.** Where access is difficult and limited, or to cover extensive areas.

Issue 3: Manage tall open forests at an advanced stage of transitioning

Abundant rainforest, acacia, or she-oak trees have shaded out the ground layer, which is characterised by leaf litter and an absence of ground layer plants. The tall open forest is close to transitioning to a closed forest where planned burns can no longer be reliably introduced. It is often necessary to use nearby grassy areas to carry fire into these areas. Windows of opportunity for fire management are few. These tall open forests can occur as pockets inside rainforest areas.

Awareness of the environment

Key indicators of where fire management is required

- Abundant rainforest pioneers, she-oaks or acacias are reaching beyond the mid-stratum and forming an almost closed structure.
- Ground layer plants are almost absent, and the ground layer is dominated by leaf litter.
- Vines scramble onto mid-stratum saplings and lower-canopy branches.
- Presence of ferns on rocks and epiphytes in the lower or mid-stratum.
- Dead, dying, or rank sword sedge *Gahnia* spp.
- An accumulation of fuels with a diameter > 6 mm on the ground and suspended in foliage.
- Heavy build up of bark around bases of trees.



A mature stage of transitioning in a shrubby tall open forest. Notice the abundance of rainforest pioneers and a build up of heavy fuels on the ground and suspended in shrubs. It is still possible to introduce fire.

Mark Parsons, QPWS,
Mount Windsor (2010).



A mature stage of transitioning. In the right conditions, it is still possible to introduce fire.
Mark Parsons, QPWS, Girringun National Park (2008).



An advanced stage of transitioning. It would be very difficult to introduced planned fire.
Paul Williams, Vegetation Management Science Pty Ltd, Mt Fox (2005).



Other indicators of long unburnt areas include the presence of ferns on rocks, epiphytes in the mid or lower-stratum and dead or dying Gahnia. These are also important features that add habitat diversity and refuge, so their loss in any one single fire event is not desirable.

Mark Parsons, QPWS, Mount Windsor (2010).



Discussion

- Certain she-oaks, acacias and hopbush *Dodonaea* spp., can germinate en masse. Where this has occurred, it is likely that follow up fires will be required. Post fire observations are essential to monitor the kill rate and germination of acacias in order to ascertain the need for subsequent fires.
- It is important to ensure the recruitment of tall open forest and woodland canopy species. Although **high**-severity fires may be necessary to control mid-stratum sapling overabundance, it may also have an impact on canopy species recruitment and therefore should be interspersed by **low**-severity fires.

What is the priority for this issue?

Priority	Priority assessment
Medium	Planned burn in areas where ecosystem health is poor but recoverable.
Low	Planned burn in areas where ecosystem structure and function has been significantly disrupted .

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Measurable objectives	How to be assessed	How to be reported (in fire report)
> 50 % of saplings scorched to the tip.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity); estimate the percentage of overabundant saplings scorched by fire.	<p>Achieved: > 50 %.</p> <p>Partially Achieved: 25–50 %.</p> <p>Not Achieved: < 25 %.</p>
Regeneration of eucalypt species.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity), estimate the number of live eucalypt saplings > 5 m tall.	<p>Achieved: Abundant eucalypt regeneration observed.</p> <p>Partially Achieved: Some eucalypt regeneration observed.</p> <p>Not Achieved: Little or no eucalypt regeneration observed.</p>

If the above objectives are not suitable, refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.



An advanced stage of transitioning. Site not burnt for at least 15 years.
Mark Parsons, QPWS, Taravale, plot 7 (2009).



The same site eight months later. Post fire, the reduction of saplings to ground level is clearly visible.
Mark Parsons, QPWS, Taravale, plot 7 (2010).

Fire parameters

What fire characteristics will help address this issue?

Fire severity

High. And sometimes up to **very high** for highly-advanced transitioning, however it is not recommended to exceed an average **flame height of five metres**. Aim to scorch to the tip of overabundant trees so that all the leaves of undesired trees are browned after fire. Be aware that these higher-severity fires are recommended only to address this specific issue and need to be implemented with due caution and consideration of containment issues.

It is possible that **moderate**-severity backing fire, with a high residence time around the base of overabundant saplings would be sufficient to brown off the leaves and kill the above ground component of the plant. But more testing should be undertaken to confirm this.

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm ⁻¹)	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
High (H)	500–1000	1.5–3.0	7.5–15.0	Some patchiness. Some humus remains. Some habitat trees and fallen logs affected. At least some canopy scorch in moderate < 20 m height canopy, mid stratum burnt completely (or nearly so).
Very high (VH)	1000–3000	3.0–10.0	Extensive scorching	All understorey burnt to ash (or nearly so). Most habitat trees and fallen logs affected. Extensive crown scorch.

Note: This table assumes good soil moisture and optimal planned burn conditions.

Fire frequency / interval (refer to Appendix 2 for a discussion)

- This issue will not be resolved with one fire. Follow up burns are essential. Monitor fuel build-up and plant response and plan subsequent fires in the following years accordingly.

Mosaic (area burnt within an individual planned burn)

- Good burn coverage is required in areas dominated by overabundant seedlings or saplings.

Other considerations

- If the initial fire triggers a flush of new she-oak, hopbush or acacia seedlings, plan a follow-up burn within three years.

What weather conditions should I consider?

It is important to be aware of weather predictions prior to and following burns so that undesirable conditions and weather changes can be avoided.

Season: Dry season (October, November and December)

FFDI: 18–24

DI (KBDI): 150–200

Wind speed: 15–23 km/hr. Use wind to help carry fire into transitioning areas. Be aware of containment issues.

Other considerations: Be available to implement burns as a priority as windows of opportunity arise. Some cases of transitioning can only be addressed under rare weather conditions.

What burn tactics should I consider?

Tactics will be site specific and different burn tactics may need to be employed at the same site (e.g. due to topographical variation). Also, during the burn, tactics should be reviewed and adjusted as required to achieve burn objectives. What is offered below is not prescriptive; rather it is a toolkit of suggested tactics that may assist in this issue.

- **Progressive burning.** Fires (of varying extents, severity and at various times) are lit in surrounding fire-adapted communities from early in the year when conditions allow. This progressively creates areas of low fuel acting as a buffer to undertake burns in tall open forests later in the year (after these forests have dried out sufficiently). Refer to glossary for a fuller discussion.
- **Commence lighting on the leeward (smoky) edge.** This can be a useful way to create a containment edge for a higher severity fire ignited inside the burn area.
- Using **grassy areas to push fire** into areas with less available fuel is a common method to help fire carry into areas of tall open forest that are transitioning and therefore have an understorey less likely to carry fire.
- Creating a **running** fire (through closely spaces spot ignition or line ignition with the wind) may help fire carry into areas transitioning to closed forest. Be aware of the risk of undesirable impacts such as loss of habitat trees and fallen logs.
- **Line or strip ignition** is used to create a fire of higher intensity or to help fire carry through moist or inconsistent fuels. This is also useful to reduce overabundant trees (through scorching).
- **Aerial ignition.** Where access is difficult or limited.

Issue 4: Reduce *Lantana camara*

Refer to Chapter 11 (Issue 5), regarding fire management guidelines.



Lantana infestations in tall open forests can dominate the ground and mid-strata layers.

Mark Parsons, QPWS, Girringun National Park (2008).



The same site three months later following the integrated use of fire and herbicide (splatter mix), to remove *lantana* biomass from this endangered ecosystem. Grasses have begun to establish.

Mark Parsons, QPWS, Girringun National Park (2008).

Chapter 4: Grasslands, sedgelands and fernlands

This fire vegetation group is treeless and shrubless, dominated by one or two species of grass, sedge or fern, with other ground layer plants scattered. This group occurs in coastal, lowland and highland areas; in relatively small extents. It includes a range of ecosystems that are quite different in terms of their fire management needs as described below.

Coastal wetland grasslands, sedgelands and fernlands

In the wet tropics, grasslands, sedgelands and fernlands often occur within coastal wetland systems (such as Eubenangee Swamp) and are typically permanently or seasonally inundated.

Highland grasslands, sedgelands and fernlands

These communities are very restricted in distribution. Sedgelands and fernlands occur in moist highland on shallow soils usually on slopes with perpetual water available from clouds or seepage. Upland grasslands tend to occur in drier highland areas in the west of the wet tropics.

Grasslands of the coastal slopes

Grasslands dominated by kangaroo grass *Themeda triandra* and *Themeda triandra* with blady grass *Imperata cylindrica* occur on steep coastal hill-slopes of coastal headlands and nearby islands, particularly Orpheus Island and the Palm Island group. These occur on shallow soils and readily dry-out under the influence of coastal breezes.