Previous chapters have dealt with the nature and impact of fire regimes and how different regimes can be used to manage landscapes. This chapter deals with the 'nuts and bolts' of how to light and manage fires, and with the laws that affect fire management in north Australia.

Burning operations can be either strategic—as part of a management plan to deal with future fire threats ('prescribed burns') or tactical—suppression activities carried out in response to an immediate fire threat.

**What is prescribed burning?**

Prescribed burning is the deliberate ignition of vegetation and the subsequent control of the limits of the spread of the fire to achieve a desired management objective.

Prescribed fires can be applied in response to wildfire hazards, increases in native trees and shrubs, accumulation of rank ungrazed pasture or exotic weed invasions. Each management objective requires the implementation of an appropriate fire regime. This means manipulating the intensity (timing, season, fuel load and curing), extent and frequency of fires over time. On pastoral land, special grazing management may need to be considered.

**What is fire suppression?**

The risk of uncontrolled wildfires can be reduced using early fire to reduce the hazard and by establishing a network of firebreaks ready for any outbreak. However, when fast-moving uncontrolled wildfires do occur, the key for efficient control is rapid response. Most fire control or suppression operations involve indirect methods, fighting the fires by back-burning from firebreaks in the path of the wildfires. Graders and other earth-moving equipment are used extensively to establish these forward control lines. They should be in place in advance.
Managing fire behaviour

Fuel load, cover, moisture and weather conditions such as wind, temperature and humidity have the most influence on fire intensity. These factors have to be considered in the design and implementation of prescribed fires. Low-intensity fires (1000–2000 kW/m) are sufficient for removing rank grass and reducing wildfire hazards. High-intensity fires (>2000 kW/m) are required for reducing tree and shrubs.

What fuel load and cover is needed?
Fire intensity increases with higher fuel loads and cover (Figure 6.1). Dry fuel loads between 1500–2000 kg/ha (dry matter) and fuel cover of at least 40–50% are needed to support a continuous, moderate-intensity fire. Higher-intensity fires to control trees and shrubs need fuel loads of more than 3500 kg/ha and cover levels of more than 60%.

Fires will spread even if fuel loads are low as long as fuel cover is continuous. If grassy fuel becomes more discontinuous, particularly from grazing, the rate of fire spread will decrease and fires will become patchier.

What influences fire behaviour?
Fuel loads and accumulation rates vary between pasture communities. Average seasonal conditions produce sufficient growth for fire to occur every 1–3 years in tropical woodlands and 2–5 years in semi-arid woodlands.

Accumulation of high, continuous fuel loads after above-average rainfall seasons allows prescribed burning with higher fire intensities or increases wildfire risk. Fuel is rarely available during drought years, particularly in heavily stocked grazing lands.

Increasing grazing pressure reduces fuel load, fuel continuity and fire intensity. Flame heights are lower in grazed pastures, reducing the impact of fire on the tree and shrub canopy. Dry fuel loads may rarely exceed 2000 kg/ha in savanna types with low and variable rainfall or when stocking rates are higher (Figure 6.2). In some cases, spelling for a growing season may be needed to accumulate sufficient fuel.
Is weather and the timing of burning important?

Wind speed, air temperatures, humidity levels, fuel curing and grazing significantly affect fire behaviour, particularly fire intensity.

Temperature and humidity
Air temperature and relative humidity values change greatly throughout the year (Figure 6.3). Lower-intensity fires generally occur when air temperatures are below 25°C and relative humidity is higher than 50%. Burning when air temperatures are above 30°C and relative humidity is lower than 30% will increase fire intensity.

Relative humidity remains low between July and October and increases rapidly from November onwards with the onset of the wet season; however, there is considerable variation between locations in northern Australia. This humidity reduces the potential of high-intensity fires for woody vegetation management. Although late dry season fires tend to be more intense than those in the early dry season, there is significant variation in ‘fire weather’ between years.

Wind speed and direction
Constant wind speeds of at least 10 km/h are best for continuous, moderate- to high-intensity fires and burning should not be carried out when wind speeds are greater than 20 km/h. Between September and October, prevailing south-easterly winds change to northerly winds that are often gusty and frequently change direction, making it difficult to predict fire behaviour.

Fuel curing or drying
The degree to which fuel is cured during the early dry season will vary considerably between pasture types. Due to their rapid maturity and curing, pastures dominated by annual and biennial grasses can generally support effective fires earlier in the dry season than perennial grass pastures.

Grazing effects
If grassy fuel remains relatively undisturbed by grazing, fire intensity will generally be greatest with late dry season burns. For annual pastures that cure early or are preferentially grazed early in the year, burning earlier in the dry season ensures more effective fires.
How does weather and fire behaviour change during the day and night?

Changes in temperature, humidity, wind and fuel moisture through the day and night (diurnal changes) greatly affect fire behaviour. Fires generally increase in intensity as the day progresses when temperatures increase and humidity drops. With the onset of dusk, temperatures drop, humidity increases and winds generally subside. This often causes fires to die down and possibly to go out, particularly during the late wet and early dry season when fuels have higher moisture content and heavy dew may form.

How should you manage grazing after burning?

In grazing lands, prolonged or heavy grazing soon after burning can damage palatable perennial grasses. Resting pastures from grazing after burning for a short period (weeks to months) or for longer (years) will allow grasses to drop seed and recover. However, it is often not practical to move stock in extensive lands. Rotational burning will shift grazing pressure throughout the paddock each year and minimise the risk of overgrazing previously burnt patches.

What are the risks to pastures from burning?

Besides the threat of a fire getting out of control, burning removes standing pasture that can be used for grazing. The risk of running short of pasture is reduced by burning late in the dry season or immediately after the first significant rains, and by checking that the area and frequency of burning match the average seasonal conditions, pasture type and grazing pressure. In regions where rainfall varies greatly between years, seasonal forecasting based on the Southern Oscillation Index may indicate the chance of a poor wet season and the need to preserve feed supplies.

Fire Bans

Fire authorities declare Fire Bans in various ways across northern Australia. A Fire Ban means that no fires are to be lit in the open during the period of the declaration and in the area specified. The use of cooking fires is exempted under some legislation and other restrictions may prohibit the use of certain equipment or machinery. You should be familiar with the relevant state or territory legislation in regard to these restrictions.

Authorities may call a Fire Ban when weather conditions reach a point where the Grassland Fire Danger Rating is ‘extreme’. The ban may be extended or cancelled as conditions develop.

Authorities may also declare a Fire Ban when they have a number of incidents in progress and resources are committed to the extent that they could not respond to further fires.

Permits to Burn

Each of the north Australian states has a ‘Permit to Burn’ system designed to coordinate and advise on the use of fires. Permits allow authorities to control the number and size of fires lit at any one time. They also advise local landholders and officials that the fires are authorised. There are established networks of local issuing officers who decide if conditions are suitable and identify controls and resources needed to manage the fire within specified boundaries.

Some agencies have cut-off periods for the availability of permits. Others allow the use of fires by permit throughout the year, but with increasingly tighter controls as the season dries out. In the broader pastoral areas, agencies may allow the unrestricted use of fires during the wet season and early dry season but require landholders to obtain a permit during a declared Fire Danger Period.

Contact your local fire authority and ensure that you are familiar with the local state or territory requirements.
Applying fire

The effective use of fire in landscape management is determined by the ability to cheaply, safely and easily ignite and control prescribed and suppression burns. The choice of ignition and containment options is critical in extensive areas as they affect fire behaviour, the impact on plants and animals and the ultimate success of fire as a management tool.

Prescribed and suppression burns can be undertaken from the ground or the air and can be applied with a number of ignition methods. Some of these are outlined below.

**Ground operations**

Prescribed and suppression burning operations on the ground can depend on many variables—the type of fuel, the stage of curing, topography, weather conditions and the type of burn desired.

The normal controlled burn is started in a downwind corner when burning in a paddock or block. This fire is then allowed to burn back into the wind before the upwind face is ignited. Wet season burns may be started at any point and allowed to spread naturally as the fire is self-extinguishing from moist fuel and ground.

**Drip torches**

The most widely used igniter is the ‘fire bug’ or ‘drip torch’ using kerosene. A mixture of one-third petrol, two-thirds diesel is often used but can explode. **Kerosene only is recommended.** The fuel dribbles over the dry grass and is ignited by the burning wick.

Home-made techniques include lighting the end of a piece of polythene pipe or an old tyre and dragging it along through the grass behind a vehicle. Lighting a fire this way can be dangerous if the vehicle becomes held up or breaks down.

‘Wind/waterproof’ matches—with an extended head which burns for long enough to be thrown into grass—are useful for point ignitions.

**Capsule launchers**

Capsule launchers can propel an incendiary up to 100 m from a vehicle into adjacent bush and have been used to widen firebreaks. Vehicle-mounted versions use compressed air for propulsion.

A cheap and effective launcher consists of a 1 m length of 40 mm PVC tube capped at one end. A primed capsule dropped into the tube and flung out by hand will travel a surprising distance.
Flying in firebreaks at Carlton Hill Station, north-east Kimberley

To control wildfires on Carlton Hill Station just north of Kununurra, manager Geoff Warriner organises the Bush Fire Service (WA) plane to burn firebreaks in and around the property each year; he backs this up with a pattern of extra breaks put in from the ground.

**Overall fire management plan**
The key is aerial burning a firebreak around the perimeter of the property, with two other breaks burnt from north–south at intervals to divide up the property, and one from east–west across the middle. This creates six major blocks. Later in the season, additional breaks are burnt from roads and tracks to complement the aerial burning.

**How do we put in the firebreaks?**
Each year, we make arrangements with the Bush Fire Service for aerial incendiary burning of the boundary and internal firebreaks, and get our ‘Permit to Burn’ from the local shire.

We start burning as soon as the country will carry a fire, normally around Easter (March–April) and we stop in June.

The plane drops incendiaries to produce breaks which burn 100–1000 m wide before the fires self-extinguish (depending on fuel load and the amount of moisture remaining in the soil and pastures). The pilot is instructed to avoid the path flown for the previous year’s breaks and any areas burnt during the previous season, either by planned or unplanned fires.

After the aircraft work is complete, we burn additional breaks from roads and tracks all over Carlton Hill until June when it normally becomes too dangerous to continue to light up. As with the aerial burning, wherever possible these breaks are put on country that was not burnt during the previous year, and the pattern is designed to achieve maximum effect in the prevention of wildfire.

**What does this cost?**
The main cost of burning in this way is the hire of the Bush Fire Service aircraft—currently $500 an hour. It normally takes three hours flying time to burn the breaks around and across Carlton Hill. The incendiary pellets are included in this figure, and there is also no charge for ferrying the aircraft and materials to the property.

The additional costs for ground-based burning are mainly for labour.

*by Andrea Johnson*
**Flamethrowers**

The flamethrower is usually a specially designed device mounted on a trailer or vehicle. A 12 V fuel pump pushes out a diesel-petrol mix from a 120 L fuel tank. Fire extinguishers and an emergency shut-off are provided for safety but the flamethrower should be operated only by trained personnel.

The flamethrower can be used to create hot fires for woody weed control or pasture development. It can also be used in wildfire control for lighting up over large distances in a short time as it can be operated at speeds up to 60 km/h.

**Aerial operations**

Aerial burning can be used to reduce fuel loads, create barriers to late-season wildfires and to ensure diversity of habitat. They are usually undertaken by bushfire agencies—on behalf of the landholder.

Aerial burning can be carried out in conjunction with ground operations to increase the efficiency of rotational burning programs on pasture country, particularly in extensive pastoral lands. The time spent implementing and monitoring prescribed fires until reasonable ‘burn out’ is achieved using only ground ignition methods in large areas can be significant. Aerial burning in a grid pattern following a perimeter ignition from the ground would significantly decrease the time for ‘burn out’, reducing the time spent at the fire.

**Dropping incendiaries from aircraft**

Incendiary devices can be dropped from aircraft to start a prescribed fire. A capsule or ball containing potassium permanganate is injected with a quantity of ethylene glycol and immediately ejected from the aircraft. Combustion occurs within 30–40 seconds allowing the capsule to reach the ground before ignition.

The incendiary devices and equipment have to be approved by the Civil Aviation Safety Authority (CASA). Fixed-wing aircraft are used in the more extensive pastoral and conservation areas, being cheaper and faster, but helicopters allow greater precision and control on more subdivided land.

**Helitorch**

The use of Helitorch, a form of aerial ignition that delivers a continuous line of ignited gel, is effective for creating burnt firebreaks very early in the dry season and for controlling woody weeds such as *Mimosa pigra* on Top End flood plains. Its use is restricted as it is expensive and needs at least three trained staff to operate.

**Aerial controlled burning operations**

Aerial controlled burning operations have been used in the north since the early 1980s. They are generally limited to the tropical tall-grass areas although sometimes used to reduce fuel loads after a series of good seasons in the drier inland areas.

The bushfire agency works with the landholders toward the end of the wet season, agreeing on the location of drop lines and helping to develop a plan. Officers develop their regional and strategic plans in conjunction with adjoining regions. Each participating landholder must sign a contract and an indemnity that they are responsible for the control of the subsequent fire.

Aerial burning is normally undertaken from April through to June to produce ‘burnt firebreaks’. These fires break up the landscape in recognised fire risk areas or reduce fuels over large areas of unused or unproductive country. The burns are usually timed to coincide with the initial curing of the grass at the beginning of the dry season, using green and wet areas to stop the fires. At this time, nights are becoming cool and there is still dew to extinguish fires.

Recently, aerial burning has been undertaken in the early wet season to encourage greater fire regime and habitat diversity on parks, reserves and defence lands.
**Headfires or backfires?**

Many fires used in prescribed burning are lit as headfires. Headfires are lit upwind and burn with the wind direction. They are generally more intense and project heat energy upwards and, compared to backfires, impose greater damage to tree and shrub canopies. They also have higher rates of spread making burning in low and disturbed fuel loads more effective, while reducing the potential for damage to the pasture understorey.

Backfires are lit downwind and generally burn slowly into the wind. Backfires are used for lighting protective back-burns to save pasture on the downwind side from burning. They are especially important for controlling the progress of wildfires and ensuring safe containment of prescribed burns.

**Point, line or perimeter ignition**

Fire can be applied to an area in a number of ways (Figure 6.4). The choice of point, line or perimeter ignitions is important in terms of fire behaviour and vegetation response but the choice will be determined by the overall objective of the burn.

Point ignitions are lit from one or several points and allowed to spread out. They are generally less intense, patchy fires, often leaving islands of unburnt and partially burnt fuel.

Point ignitions are often recommended for conservation areas as fires spread out in all directions from a point allowing the fire to develop a range of intensities as it spreads. If fuel loads are discontinuous or areas for burning are very large, multiple point ignitions can be set in a grid pattern, either from the ground or air.

Line ignitions are applied with a continuous line of fire along one or several fire fronts. Line ignitions on several sides of a burn area become a perimeter burn. These fires are of higher intensity with higher rates of spread making them effective for tree and shrub management. Although they are relatively predictable and easy to manage, perimeter fires are less patchy and leave few refuges for wildlife and domestic animals to escape or resettle.

A fire regime where fire intensities are uniformly too high may cause undesirable effects on habitat, plant and animal diversity.

**Firebreaks**

The use of firebreaks, whether constructed or natural, enables fire managers to contain and control prescribed fires within an intended area. Several options exist for firebreak preparation, each with advantages and disadvantages.

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**Figure 6.4 Ignition methods**

A variety of methods can be used to ignite and control fires during prescribed burning. Reproduced by permission of CSIRO
In practice, the main objective of firebreaks in extensive lands is not so much to stop the progress of oncoming fires, but to provide a line clear of flammable material from which to conduct protective back-burning or initiate management headfires.

**Tactical or strategic firebreaks?**
Tactical firebreaks are put in to control an existing fire. Strategic breaks are part of a total land management plan. Strategic firebreaks should take into account topography, soil type and erosion—existing boundary fence lines do not always do this.

**Natural firebreaks**
Natural firebreaks include streams, rivers and other wet areas where a fire will not burn and areas carrying little fuel such as rocky outcrops or recently burnt areas. Patch or mosaic burning strategies can use natural firebreaks such as creeks and ridges or previously burnt areas to control fire spread.

The effective control of fires relying on natural firebreaks can be improved by the careful timing of burning in relation to season, fuel curing state, time of day and prevailing atmospheric conditions. For example, fires lit during the late wet season (March–April) or late afternoon may extinguish at night due to falling temperatures and formation of dew.

**Mechanical firebreaks**
Mechanical firebreaks can be created using a grader, disc harrows, slashing, rolling or flattening. In heavy grass, the trash has to be removed to ensure that the protective line is not breached. Increasing fuel loads, fire intensity, presence of trees within 20 m of firebreaks, and decreasing firebreak width will increase the chance of firebreak breach by oncoming fires. The width of an effective firebreak will depend on these factors and could be as much as four or five grader blades wide in higher rainfall regions of the NT.

Ideally firebreaks follow the ridges to minimise soil erosion. When constructing firebreaks, the opportunity for run-off to channel should be minimised by spreading out the windrows and putting in diversion banks every 150 m across any firebreak running up and down any 1° slope.

**Chemical firebreaks**
Chemical firebreaks can be constructed along fence lines or around the perimeter of areas designated for burning. Herbicides, such as glyphosate, applied to growing pasture during the wet season create a dead, cured strip that can be burnt, leaving a clear break surrounded by a green, unsprayed area. Using herbicide can be a cheaper option than using machinery.

Benefits of using chemical firebreaks include:
- can go where grader or dozer disturbance would be detrimental
- wider firebreaks (up to 19 m swath width at a single pass) depending on equipment
- less soil disturbance
- generally cheaper
- can spray during the wet season and then burn off before adjacent areas are cured
- can manipulate fuel curing where other methods are impractical

Herbicide should be applied towards the end of pasture growth between late February and early March. This ensures that treated, grassy fuel is killed and ‘dried off’ while surrounding grass is still green and safe burning conditions exist. The burning of firebreaks is best done during late March or early April and in the late afternoon when weather conditions promote a ‘hot’ clean burn.

There are many types of sprayers. One of the most useful types is the boomless jet with high-pressure pump. This can be supplied by backpack tank or tank mounted on a trailer and towed by a quadbike.
Fire management on Opium Creek, NT

Jeff Little manages Opium Creek Station some 180 km east of Darwin. The 200 sq. km property borders the Mary River system and the proposed Mary River National Park. Eucalypt woodland covers 60% of the station; the rest of the property is on the flood plain. As uncontrolled fire can have a devastating effect on the fragile, native flood plain pastures, fire management aims to reduce the threat of wildfires. Fire provides a cost-effective means of land management and weed control.

Fire management and the community
Fire management at Opium Creek is a major part of station management but also involves the community. As reducing the risk of wildfire is a community responsibility, Jeff is in the Point Stuart Volunteer Bushfire Brigade.

The results?
Jeff sees many benefits from his fire management strategy. They include:
- fewer wildfires
- protecting the fragile, native grass species on the flood plain
- less soil erosion on the chemically treated firebreaks
- better overall pasture management and property management
- reduced costs of replacing fences
- lower labour costs in fire management

The overall fire management plan
The key is the combined use of chemical application and fire to create firebreaks in strategic areas—these include fence lines on the dry scrub country and buffer strips bordering the flood plain between the high and low country. Three rocky ironstone outcrops on the property can create a real threat from wildfires due to lightning strike so they are control-burnt with buffer strips.

Practical methods on the property
Spraying buffer strips and fence lines
Herbicide is applied towards the end of the wet season while the vegetation is still lush and green. A single pass 10 m wide to either side of the fence is sprayed using a high-pressure boomless nozzle; this is mounted on a specially designed trailer/spray unit and pulled along at 12 km/h behind a quadbike.

Spraying the herbicide at the recommended rate speeds up the curing of the vegetation but leaves the root system of the grass and other species intact, thus lessening the risk of soil erosion.

Lighting the firebreaks
The sprayed grass is burnt when it has cured. The breaks are lit from the station quadbikes—with the local Point Stuart Volunteer Bushfire Brigade in attendance to help with fire control operations. The grass and other vegetation grows back after about 6–8 weeks, providing ground cover to avoid erosion but not enough growth to be a fire hazard.

by Jeff Little

How to burn a paddock
1 Light simultaneously two backfires, burning against the wind, proceeding from the starting point to corners A and B of the paddock.
2 Allow these backfires to burn until an adequate firebreak has been established.
3 Light a headfire, burning with the wind, proceeding from points A and B to point C simultaneously and as swiftly as possible.
Prescribed burning on pastoral land

Rotational burning within paddocks is an effective way to use fire on pastoral land, particularly where there are multiple objectives for using fire. It involves establishing strategic firebreaks within paddocks, dividing them into sections that can be burnt in sequence over a number of years. The proportion, season, frequency of burning will depend on the specific objectives (Table 6.1).

Rotational burning provides a number of significant benefits to pastoral production. Regular fire will help maintain tree–shrub structure and density. Wildfire hazard is also reduced as fuel loads are reduced and fragmented, impeding the spread of uncontrolled fire through the landscape. Removal of old, ungrazed pasture provides fresh nutritious regrowth to cattle and may even-out grazing across the landscape. This will also reduce the disturbance of fuel loads in sections designated for burning during the next season. The invasion of exotic weeds is reduced because all areas of a paddock are burnt over a number of years which allows invading weed seedlings to be more easily spotted and removed.

Where to burn?

Burning should be initially directed to areas that are consistently ignored by cattle, where wildfire hazards exist, or where native or exotic woody weed problems are emerging. Burning should be avoided in pasture communities that are heavily grazed by cattle or that are in poor condition.

When to burn?

This depends on your objectives. Some general guidelines are outlined in the table below. Burning during the late dry season will promote high-intensity fires that will have maximum effect on removing woody plants. Early dry season fires will be less intense and more easily controlled and can be used to maintain the vegetation structure while allowing for fuel reduction. A combination of early and late dry season burning in paddocks during the one year can be utilised to serve several management objectives.

How much and how often to burn?

It is important to burn at least 15–20% of total paddock areas. If burnt areas are too small, cattle grazing pressure will be concentrated, potentially causing long-term damage to pastures due to over-grazing. Moderate stocking rates will allow controlled burning of a proportion of most paddocks in most years without affecting the supply of standing feed to cattle. A diagram showing rotational burning and other paddock burning strategies is shown on page 72.

A general guide to the size and frequency of paddock fires for different rainfall zones is shown in Table 6.2. In wetter northern areas (>800 mm) where burning frequencies would be between 3–5 years, paddocks could be divided into thirds or quarters and a section burnt each year. In semi-arid areas (400–800 mm) where desired fire frequency is lower, paddocks could be divided into quarters or fifths and 20–25% of paddocks burnt either each year or following above-average years.

Table 6.1 Recommended burning conditions for prescribed burning on pastoral lands

<table>
<thead>
<tr>
<th>Management objective</th>
<th>Fire intensity</th>
<th>Fuel load (kg DM/ha)</th>
<th>Season of burn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintaining woody vegetation structure</td>
<td>Moderate–High</td>
<td>2000–3000</td>
<td>April–October</td>
</tr>
<tr>
<td>Change woody vegetation structure, control exotic weeds</td>
<td>High–Very High</td>
<td>2500–4500</td>
<td>August–October</td>
</tr>
<tr>
<td>Hazard reduction—reducing risk of wildfire</td>
<td>Low–Moderate</td>
<td>&gt;1500–2000</td>
<td>April–June</td>
</tr>
<tr>
<td>Hazard reduction and provide early, dry green pick for grazing *</td>
<td>Low–Moderate</td>
<td>&gt;1500</td>
<td>March–April</td>
</tr>
<tr>
<td>Remove old, rank pasture, modify grazing distribution</td>
<td>Low–Moderate</td>
<td>&gt;1500</td>
<td>November–December</td>
</tr>
</tbody>
</table>

* Burning during the late wet season to extend the period of green pick into the early dry is generally not recommended except in lightly stocked, extensive paddocks in high-rainfall areas.
Is planning necessary for prescribed fires?
Prescribed fires should be carried out when fuel and weather conditions are appropriate for each management objective rather than planning for a specific date. Prescribed fires often need to be lit at short notice so you need to be well prepared. Prior knowledge of correct fuel and weather conditions, and readiness for igniting and containing the fires is critical. It is important to have existing plans detailing what areas need to be burnt, what type of burn is required, what fuel and weather conditions are needed, and to have an ignition plan and firebreaks in place.

<table>
<thead>
<tr>
<th>Rainfall zone</th>
<th>Fire frequency (interval between fires)</th>
<th>Proportion of paddock burnt each year</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-rainfall areas &gt;700 mm</td>
<td>2–5 years</td>
<td>25–50%</td>
</tr>
<tr>
<td>Medium-rainfall areas 400–700 mm</td>
<td>4–7 years</td>
<td>20–30%</td>
</tr>
<tr>
<td>Low-rainfall areas &lt;400 mm</td>
<td>6–15 years</td>
<td>15–25%</td>
</tr>
</tbody>
</table>

Figure 6.5 Fire management calendar

The seasons and months in which to burn for specific objectives and how this timing coincides with changes in temperature, humidity, rainfall, pasture bulk and fuel moisture.
‘Going burning’ check list

Use this check list when preparing for a controlled, hazard reduction burn for grassland management.

1 Permit. Get a permit if necessary and abide by the instructions or advice.

2 Neighbours. Check with your neighbours. Do you know them or are they absentee? What is the minimum notice you need to give?

3 Values. What values on neighbouring land need to be protected?

4 Purpose. Why do you want to burn—fuel hazard reduction, development, shrub control?

5 Maps. Prepare and provide suitable maps for all sector bosses. Check that they are current and have a scale and legend.

6 Fuel type. What is the predominant vegetation—grass, scrub, trees? How is it likely to react?

7 Topography. How will topography affect the fire’s rate of spread and access?

8 Area. What area is to be burned? How long will it take?

9 Weather. What is the general and local forecast—wind speed and direction, temperature and humidity? How well cured is the grassland?

10 Firebreaks. Know their width, position and direction, and mark them on the map. Are they accessible and cleared to bare earth? Where are the fall-back areas, are they natural clearings or man-made breaks?

11 Water points. Where are the refilling points, are they overhead, stand-pipe, dam or creek?

12 Manpower. How many workers are needed to manage the fire and for mopping up? Is there any backup or stand-by? How well trained are they? Will they be safe?

13 Safety. Demand everyone wears safety apparel at all times. Are first-aid kits are on hand and complete? Is there a trained first aider?

14 Victuals. Where is the drinking water and other sustenance?

15 Equipment. What equipment is required? Is it readily available in safe working order? Do workers know how to use it correctly?

16 Communications. Demand correct radio procedure and protocol. What are the capabilities of the radio equipment? State reporting requirements. Keep everyone informed.

17 Lighting pattern. Where do we start burning? Who will light up and when? Watch the security of downwind edges.

18 Mop up and patrol. Are additional manpower and resources required? Will the burn be completed and declared ‘blackout’ before the next day? Who is responsible to declare the burnt area ‘safe’?

19 Wash up. Debrief personnel. Identify any problems that arose and correct them for the future. Publicly praise all for a good effort; privately upbraid those found wanting!
Suppressing fires

When suppressing fire in difficult terrain or in lightly stocked paddocks, back-burning will often be initiated from the nearest natural firebreak or existing cleared lines forward of the fire front, such as fence lines, roads and strategic firebreaks. As cleared breaks are established ahead of the fire front and flanks, back-burns are put in place around the graded perimeter effectively encircling the fire, removing the fuel from its path and stopping its progress. Although larger areas may be burnt out, this is often the most efficient and safest means of controlling large, established landscape fires.

Tactical firebreaks combined with back-burning may have to be rapidly installed in cases where existing firebreaks are far from the fire front, when the fire is still relatively small and controllable or where the value of unburnt land and pasture is high, and where firebreaks can be easily constructed. These firebreaks are thoroughly but rapidly constructed either ahead of the fire front or along both flanks of the heading fire, limiting its extent and rate of spread, reaching the fire front to finally extinguish its progress. This is called a parallel attack.

Be prepared

A rapid response to a wildfire requires having the appropriate equipment, ensuring that it is well serviced, functioning, ready for use and strategically located, and having personnel familiar with its use. Pastoral properties usually adapt station utilities with slip-on fire units or use water trailers whereas brigade vehicles are usually purpose-built 4WD vehicles or GFUs (grassfire fighting unit) carrying about 500 L of water. For larger fires, tanker trucks are used primarily as ‘motherships’ to fill smaller units.
Strategic fire management on Mataranka Station, NT

Over the past three years, Gary Riggs (manager), Kevin Wallace and Geoff Baker have developed a strategic fire management program on Mataranka Station about 90 km south of Katherine. The property is typical of the Mataranka and Sturt Plateau region with eucalypt woodland on red soils, but with a mixture of white sandy and gravelly soils.

Preventing wildfires
Firebreaks along the eastern boundary with its 56 km of frontage along the Stuart Highway consist of two breaks (each two blades wide) separated by 100 m. The middle section is burnt early in the dry season. About five weeks each year are spent on grading firebreaks, tracks and fence lines with another two weeks on the external firebreaks.

We burn a strip 200 m wide along the roadside during the mid to late wet season when the fire is self-extinguished by late afternoon humidity or storms. This is very effective and easy to implement and maintain as cattle grazing keeps the fuel load to a minimum throughout the year.

Other boundaries are sprayed with glyphosate early in the growing season (December) to drastically reduce the fuel load growth over the wet season. Spraying proves to be just as effective as grading, costs less and creates minimal soil disturbance. Glyphosate does not kill all plants, some of the vines keep growing.

Rotational burning
We first started rotational burning within paddocks in 1996 to reduce annual Sorghum and the density of young tree saplings as well as to reduce fire risk. Stock graze the freshly burnt areas making mustering much easier, while allowing the perennial grasses in the unburnt areas to build up root reserves and seed stores.

We burn one half of every paddock each year in the early wet season—after 100-150 mm of rain has fallen. This rain encourages the Sorghum to germinate so that it can be substantially knocked down while the fire is still hot enough to control the woody plants.

Fires are burnt fairly early in the day (usually 9–10 a.m.) to avoid storms in the afternoon and thus ensure a complete burn. We back-burn off tracks and fence lines using a quadbike with drip torch, then light up the whole perimeter section by section to avoid fire escaping into another paddock.

Costs of fire control
The costs of maintaining firebreaks on the station include wet season spraying, dry season grading and dry season roadside burning. These total $13,924 for the entire year—about $56 per km. Much of this cost is in grading major roads and fence lines which would be carried with or without a fire management strategy. The total cost for control burning is $2047 per year.

It is difficult to calculate the economical costs and potential losses due to uncontrolled wildfires. The relocation or agistment and supplementary feeding of cattle as a result of pasture loss is very expensive, while the loss of feed burnt could decrease productivity due to poor animal condition and lower calving rates. The benefits of fire control and rotational burning far outweigh the costs.

by Gary Riggs and Andrea Johnson

Gary Riggs, manager of Mataranka Station

Fire is used to control acacias on disturbed areas.
If I see a bushfire?
When people first see bushfires in northern Australia it can come as something of a shock—fires and smoke are frequent, fire trucks are rare and the country is often burnt and black. But fires are a natural part of the savanna landscape in northern Australia. Travellers still raise many questions. What do I do if a fire comes close? Should I report fires to the authorities? What can I do to help?

Landholders are responsible for fire management on their land, but many properties do not have the resources to conduct hazard reduction burns nor to control wildfires. They have to rely on their neighbours or the immediate community for assistance.

State and territory bushfire agencies provide varying levels of assistance to landholders for hazard reduction, coordination of fire management and firefighting when required.

Am I at risk from bushfires?
In most cases, no—the fires you see will not harm you if you know what to do and your property is well prepared. These fires are much less intense than the bushfires of southern Australia because they simply do not have the fuel to burn.

This is because much of the fuel (grass and tree litter) either decomposes or gets burnt each year. The amount of grass and litter in the north never rises above the equivalent of a few years’ growth, in contrast to southern forests where litter can accumulate over decades.

The intensity of bushfires also depends on the time of year. There are few fires in the wet season with its heavy rains. Fires become common in the early dry season (May to July) but cooler conditions and other factors limit their intensity.

Outbreaks can be more dangerous, however, in the late dry season (August to November), when the grass and tree litter is drier, it is hotter and fires can be fanned by strong winds. These fires can be a threat if adequate precautions are not taken.

What if I encounter a bushfire while driving?
If the fire is just burning the undergrowth with little smoke you should not be in any danger. In these northern regions, even higher-intensity fires rarely put out enough heat to make roadways impassable.

If there is a lot of smoke...
- Turn on car headlights
- Slow down and be aware that there could be people, vehicles, large trucks and livestock on the road.
- Follow directions of police and firefighters if present.
- If you cannot see clearly, pull over to the side of the road, stop your vehicle, keep the headlights on and wait until the smoke clears.

Should bushfires be reported?
Fires in the early dry season generally do not need to be reported.

Many of these fires are lit to manage the land. To prevent destructive wildfires the grass and litter load is reduced before the hotter time of the year by lighting low-intensity fires in the early dry season in key areas.

Later, hotter bushfires, seen from August to November, can be more harmful to property and the environment and have greater potential to harm people. These fires should be reported to the appropriate authority (see Table 6.3).
Volunteers

In all rural districts, successful fire management would be impossible without the contribution of volunteer firefighters. These men and women donate countless hours to the cause of fire management in their communities, not only fighting wildfires but, more importantly in tropical savannas, helping landholders implement hazard reduction programs which reduce the severity and impact of late dry season fires.

The safety of life and property and, in many cases, the health of local environments in rural areas relies to a large extent on the hard work of these volunteers.

In the tropical savannas, the role of volunteers in fire management is similar in Western Australia, Queensland and the Northern Territory although there are differences in the government support systems, funding processes and coordination. For example, in the Northern Territory volunteer bushfire brigades are independent incorporated bodies, but they receive operational funding support and are provided with firefighting units and tankers from the Bushfires Council through government grants. In contrast, Western Australian bushfire brigades are supported by a combination of state and local government resources.

Volunteer bushfire brigades often provide a focal point for social events within the community, and help to engender a sense of community spirit in rural areas. In the Northern Territory, brigades compete in and help organise an annual field day competition which brings teams from across the Territory together for an intense day of competition and socialising.

Brigades also often provide their services to help support other community groups and organisations, and form a valuable group of equipped and experienced personnel during times of civil emergency such as cyclones and floods.

A role for everyone

The primary function of volunteer bushfire brigades is to prevent and fight wildfires. There is always a demand for more volunteers who are willing and able to undertake tasks such as fuel hazard reduction, attending bushfires and operating firefighting equipment.
However, like any operational organisation, there are many tasks other than front-line fire management that are critical to the effective functioning of the brigade. These include equipment maintenance and repairs, fund-raising, organising promotional and social events, seeking sponsorship and support from local businesses and administration.

Volunteer bushfire brigades also rely on the active involvement and cooperation of landholders to undertake fire prevention works on their properties, to be prepared for wildfires and to coordinate these activities with their neighbours. A well-managed property with maintained firebreaks and reduced fuel zones around infrastructure greatly assists brigades when there is a wildfire to be fought and contained.

**What training is available?**

Volunteer firefighters are offered training appropriate to the tasks that they will be expected to undertake as members of a volunteer bushfire brigade. The skills and knowledge gained during training include fire behaviour, personal safety, fire suppression, how to operate tools and equipment, an understanding of the relevant laws and other issues useful to their activities. Advanced training is available to those who take on more senior and responsible positions within the brigade.

The training of firefighters has taken on national importance with the development of the Australian Fire Competencies. Training is now competency based; the curriculum and qualifications are nationally accredited and they can be articulated between the states and territories.

This training is promoted not only to the volunteer brigades and other land managers but also to rural people as a whole. Bushfire knowledge and skills is considered a life skill as important as first-aid training or learning to swim. Many volunteer bushfire brigades now require all their members to have this minimal qualification before they can go on the fire ground.

**How do I join a volunteer brigade?**

Contact your local bushfire management agency (Table 6.3) which will put you in contact with your local volunteer brigade.
Legislation

Legislation concerning fires in the landscape in northern Australia is administered by a number of different agencies. The main legislation regarding rural fire management is administered and enforced by relevant bushfire agencies in each jurisdiction. These are the Queensland Rural Fire Service, Bushfires Council of the NT, and the WA Fire and Emergency Services Authority respectively.

There is also legislation relating to state and territory land management agencies such as parks and wildlife agencies which controls the use of fire on their areas of management. Urban fire authorities also have responsibility for bushfire management around urban areas and have legal requirements for the use and control of bushfires; these can impose additional requirements on the landholder.

It is therefore important that you know within which jurisdiction your land falls, and be aware of the specific legislative requirements.

Relevance of fire legislation

In each of these states and the Territory, the general theme of fire management is that ‘fire is the landholder’s responsibility’. All agencies across northern Australia focus primarily on fire prevention measures as opposed to fire response and suppression.

Legislation has been drafted on this basis to enable landholders to use fire to manage their land responsibly. In each case, legislation puts in place a number of controls and restrictions to ensure that fire management is undertaken in a coordinated and sensible way, and to minimise the risk of fires escaping and causing damage to life and property.

These include the requirement to get permits to burn at various places and times, conditions and restrictions placed on the users in undertaking burning, and the requirement to advise neighbours and authorities where and when burning is being undertaken. Authorities may also impose fire bans during times of extreme weather conditions in order to prevent fires getting out of hand or to control the use of fire when resources are committed elsewhere.

Legislation also allows the agencies to enforce and undertake both fuel hazard reduction and to enforce establishment and maintenance of firebreaks. Some agencies also have provision for recovering costs associated with fire control operations.

The use of intense fires for woody plant control is becoming recognised as an essential land management tool. Agencies have various means to allow these fires to proceed during periods of high fire danger late in the dry season; however, there is still an onus on landholders to undertake early preparatory work in establishing firebreaks and ensuring that these fires remain under control.

Urban-rural interface

 Agencies managing fires on the urban interfaces around the various communities and town centres in northern Australia usually impose tight restrictions on the use of fire for land management purposes. This is because there is usually a high risk of damage to property and assets in these areas and there is a far greater input required to coordinate smaller landholdings.

Volunteer bushfire brigades are established by all three north Australian agencies. However, each is established and administered differently and has different levels of local and state government involvement. Most volunteer brigades are formed in the more populous rural interface areas, though brigades also exist in the broader pastoral areas. Volunteer bushfire brigades are an invaluable community resource which allow agencies to better coordinate fire prevention and control programs using local skills and knowledge. Landholders can combine their resources and help each other to undertake their fire management programs.

Your local fire legislation and authority

Each state and territory is listed in this document (see Table 6.3). If you are unaware, or need further information about fire management, you can contact the relevant agency which will give details on local contacts for permits, fire management advice and contact details for volunteer brigades in your area.

Each state and territory has differing mechanisms to implement fire restriction or prohibition times and areas and you must be aware of these regulatory controls before lighting any fire.

Unplanned fires occur regularly and it is in your best interest to know whom to contact quickly in the event of a bushfire affecting your property.
Table 6.3  Information on state and territory fire agencies and legislation

<table>
<thead>
<tr>
<th>Principal State/Territory Authority</th>
<th>Bushfires Council of the Northern Territory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managing Agency</td>
<td>Bushfires Council of the NT</td>
</tr>
<tr>
<td>Legislative Basis</td>
<td>NT Bushfires Act</td>
</tr>
<tr>
<td>Principal North Australian Office</td>
<td>1718 Albatross St Winnellie NT Ph (08) 8922 0844</td>
</tr>
<tr>
<td>Principal Officer</td>
<td>Chief Fire Control Officer</td>
</tr>
<tr>
<td>Regional Agency Officers</td>
<td>Regional Fire Control Officers</td>
</tr>
<tr>
<td>Voluntary Regional Authorities</td>
<td>Fire Wardens</td>
</tr>
<tr>
<td>Over-riding principle of all agencies</td>
<td>Fire suppression is the responsibility of landowner or occupier in each</td>
</tr>
<tr>
<td>Permits to burn</td>
<td>Required in a fire protection zone and during a fire danger period in a declared fire danger zone</td>
</tr>
<tr>
<td>Conditions of permit</td>
<td>Vary significantly between the states and territories and certain local</td>
</tr>
<tr>
<td>Fires for which permits are not required</td>
<td>Cooking or camp fires, disposal of animal carcass</td>
</tr>
<tr>
<td>Note: Strict and various conditions for lighting these fires exist</td>
<td></td>
</tr>
<tr>
<td>Permits issued by</td>
<td>Fire Control Officer or Fire Wardens</td>
</tr>
<tr>
<td>Volunteer brigades established, equipped and maintained by</td>
<td>Bushfires Council of the NT</td>
</tr>
<tr>
<td>Assistance provided to landholders</td>
<td>Equipment subsidy, aerial burning, fire prevention and control, training, communications</td>
</tr>
<tr>
<td>Regulations on the use of certain machinery and equipment</td>
<td>Controls on the use of oxywelding and cutting equipment, and requirements for spark arrestors and fire-extinguishers on machinery in the open</td>
</tr>
<tr>
<td>Fire restrictions and prohibition</td>
<td>Fire ban may be declared during very high or extreme fire weather conditions for specified area and time</td>
</tr>
</tbody>
</table>

Further reading


<table>
<thead>
<tr>
<th>Fire and Emergency Services Authority of Western Australia</th>
<th>Queensland Fire and Rescue Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bush Fire Service of WA</td>
<td>Qld Rural Fire Service</td>
</tr>
<tr>
<td>Bush Fires Act WA, FESA Act</td>
<td>Qld Fire and Rescue Authority Act</td>
</tr>
<tr>
<td>Unit 4, 16 Headland Pl Karratha WA Ph (08) 9143 1227</td>
<td>31 Grove St Cairns Qld Ph (07) 4039 8240</td>
</tr>
<tr>
<td>Executive Director Fire Services</td>
<td>Rural Fire Service Commissioner</td>
</tr>
<tr>
<td>District and Operations Managers</td>
<td>District and Regional Inspectors</td>
</tr>
<tr>
<td>Local Government, Bushfire Control Officers</td>
<td>Chief Fire Warden, Fire Wardens</td>
</tr>
</tbody>
</table>

Permits required during restricted burning times declared by shire and town councils

Permit or notification to burn required for all fires lit in the open

Cooking or camp fires, disposal of animal carcass, garden refuse, sawmill residue or use of incinerator

Enclosed cooking fires, disposal of animal carcass, disposal of sawmill residue involving material less than 2 m in height and diameter. Special exemptions for sugar cane Industry

Bushfire Control Officers

District Inspectors or Fire Warden

Local Governments

Qld Rural Fire Service

Equipment subsidy, aerial burning, fire prevention and control, training, communications

Equipment subsidy, aerial burning, fire prevention and control, training, communications

Controls on the use of oxywelding and cutting equipment, and requirements for spark arrestors and fire-extinguishers on machinery in the open

Controls on the use of oxywelding and cutting equipment, and requirements for spark arrestors and fire-extinguishers on machinery in the open

Prohibited burning times declared for specific zones and periods each year. May include vehicle and harvesting restrictions

Local fire ban imposed on entire or part local government area for a specified period

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