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# Spinifex rangeland pastures and fire in Western Australia

Fire is integral to many ecosystems in the Western Australian rangelands. Rangeland fires affect more than just pastoralists and the businesses they run: these fires affect community safety and health, regional economies, societal and cultural values of landscape, biodiversity and tourism.

The Department of Primary Industries and Regional Development provides this information to support pastoral managers making decisions about sustainable resource use.



**Image 1: Fire risk management can help prevent or limit the extent of damaging wildfires.**

## The complex effects of fire

Fire, grazing and weather interact in complex ways to affect land condition and animal production for any given type of country.

Recently burned vegetation has relatively high productivity, diversity and palatability that is important for many native flora and fauna species. Long-unburnt areas are important for providing

breeding and shelter requirements of native fauna and for species with long life cycles, such as mature tree parasites, saprophytes and fungi.

We recommend monitoring rangeland condition, including response to fire, and adapting fire management to the needs of the pasture type, enterprise, lease, manager and season. Fire affects land systems and pasture types in different ways and has cumulative effects over time.

These guidelines for spinifex country are based on experience and research findings, providing a starting point for fire management at the property scale. Spinifex pastures are found in most rangeland regions (Figure 1).



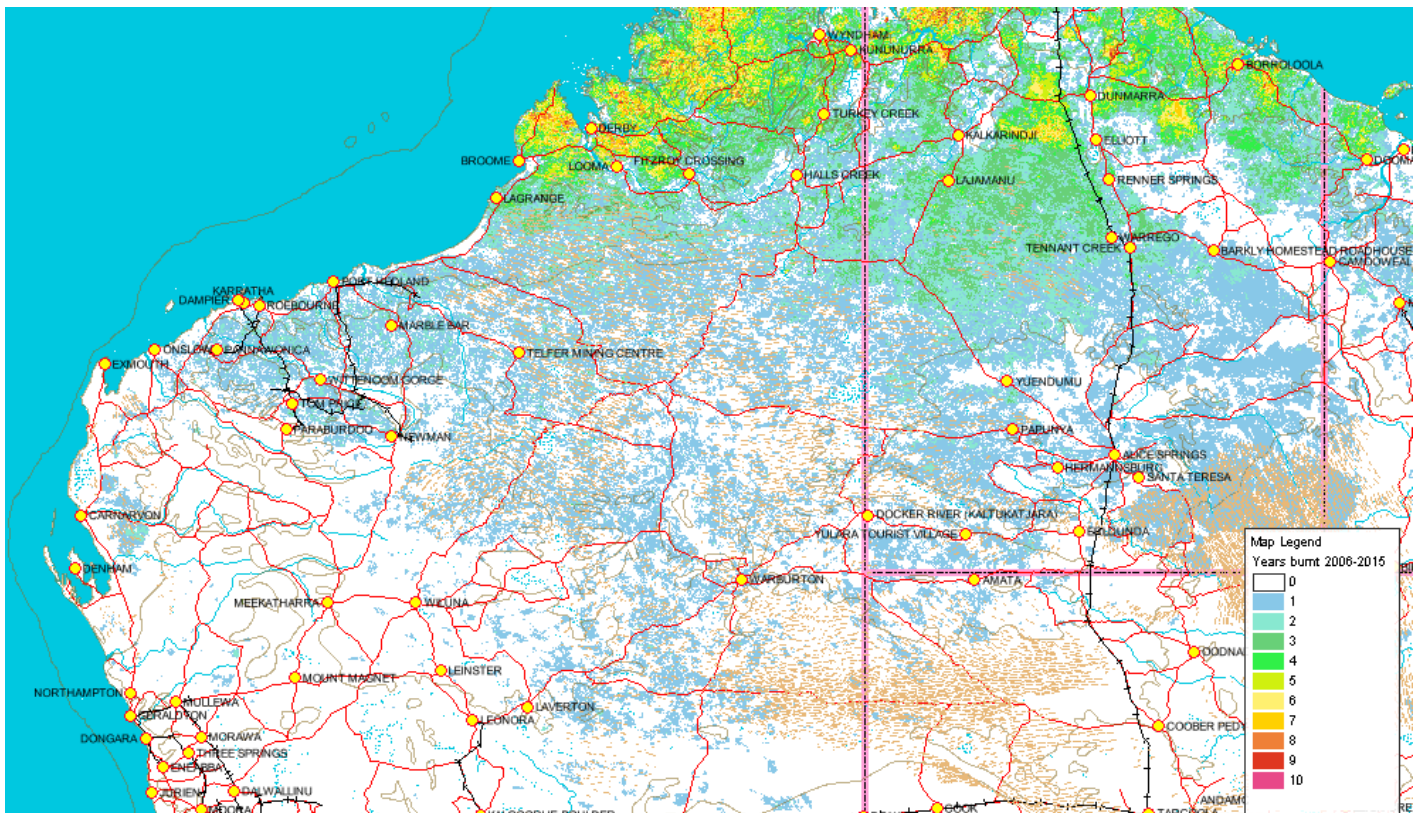
**Figure 1: Rangeland regions of Western Australia.**

## **Fire is an important tool for managing spinifex pasture**

Spinifex pastures in the rangelands provide enough fuel to carry fires on a regular basis (Figure 2). The frequency of fire increases from south to north and is correlated with rainfall. Return times to fire for spinifex range from 2 to 3 years in the high rainfall areas, up to about 15 years in the low rainfall areas.



Spinifex is found in most of the rangelands, and fire management for specific spinifex pasture is described in 'the different types of country' below.



**Figure 2: Fire frequency in country with spinifex vegetation increases from south to north in Western Australia and is correlated with rainfall (source: [www.firenorth.org.au/nafi3/](http://www.firenorth.org.au/nafi3/)). (©2017 NAFI)**

Controlled burning of spinifex pastures provides the most benefit to areas with an average annual rainfall of at least 200 millimetres (mm).

Uncontrolled fires pose significant economic, safety, and environmental risks to pastoral enterprises.

We recommend that stations develop a fire management plan for:

- prescribed burning and wildfire control
- spinifex hummock grass pastures
- areas with an average annual rainfall of at least 200mm
- grazing management.

Most research and information about spinifex burning for pastoral purposes in Western Australia comes from the Pilbara, Ashburton and northern Gascoyne. However, the general principles below – for managing spinifex pastures – will be similar for other areas.

## Reduce the risk of damage from fire

You can reduce the risk of damage from fire by:

- applying these general principles
- using visual fuel load guides available from the Department of Fire and Emergency Services (DFES) (<https://www.dfes.wa.gov.au/>)
- using the guidelines for managing pastures with fire in different types of country.

Spinifex pasture recovery after fire is strongly correlated with favourable seasonal conditions and good total grazing pressure control.

## General principles for managing fire in spinifex pastures in the Pilbara/Ashburton/Gascoyne

Managers with hummock spinifex pastures in the Pilbara, Ashburton and northern Gascoyne (Figure 1) use large-scale rotational burning to encourage fresh growth: livestock find fresh growth of spinifex is more palatable and digestible than mature spinifex. Long-term burning plans are required to maintain productivity.

The northern part of this area is characterised by a cool, dry season (winter) and a warmer, wetter summer season. Most grasses are mature and dry in the cool season. Winter rainfall is important for shrub and tree growth.

The southern part of this area has a fairly even rainfall distribution through the year, with a cooler winter.

Climatic conditions in this area are highly variable, and we recommend you use climate and weather forecasting systems and contact local advisers. See our website for more general climate information, as well as information for fire management in rangelands.

### Timing of burning

Early summer burning – when there is a high fuel load of dry material – is recommended to obtain a hot burn and kill mature spinifex. Rainfall later in summer can be expected to germinate spinifex and other useful plant species. Experienced managers in the Pilbara/Ashburton/Gascoyne use early summer burns.

Different regions and areas have specific burning recommendations. Be sure to check the guidelines for different types of country.

### Guidelines for burning

We do not recommend cool season (winter) burning: any cool season rainfall will favour undesirable shrubs and unpalatable herbs.

These conditions are preferred:

- weather conditions with adequate groundcover that allow fires to travel
- a high likelihood of summer germinating rains in the next month or so
- wind speeds of up to 20 kilometres per hour to carry fire in spinifex pastures
- where fuel loads are heavy, light winds, to reduce the risk of wildfires
- where fuel loads are light (plant cover 25–30%), heavy woody weed infestations are present or where pasture growth is very patchy, hot weather will give better conditions for burning.

Control of woody weeds, such as the poverty wattles *Acacia stellaticeps* and *Acacia bivenosa*, is only effective if the fine-fuel load is sufficient to support a relatively hot fire.

Low wind speeds are no guarantee that spinifex burns can be contained: willy-willys (dust devils) are frequently generated where cover is patchy, and the weather is unstable. Willy-willys can pick up burning material and carry it over long distances into unburnt areas. Have fire control options on-hand.

Spinifex burnt within the previous 3–4 years will usually be an effective firebreak. If wind grass (*Aristida contorta*), buffel grass (*Cenchrus ciliaris*) or wanderrie grass are in the pasture, they can

grow enough fuel load in a single good season to carry a fire. Regrowth of spinifex along wash lines may also be rapid: fuel loads sufficient to carry a fire can develop in 2 years in such places.

## A note on late summer and cool season burns for the Pilbara/Ashburton/Gascoyne

Avoid late summer burns: they predispose these pastures to weedy species germinating with cool season rains. Late summer burning is likely to expose soil surfaces and increase the risk of erosion for at least 9 months in more northerly parts of the Pilbara, where the incidence of winter rainfall is relatively low.

Burning in the cool season may be suitable for:

- large areas of rank spinifex without natural or existing internal barriers
- managers with limited spinifex burning experience
- managers burning in unfamiliar country.

The main costs of cool season burning are:

- a reduced level of control of woody species
- higher labour requirement: repeated efforts may be needed to achieve an effective burn during cool weather.

## Grazing management

### Stocking rate

Suggested annualised stocking rates range from 4 to 12 hectares per dry sheep equivalent (ha/DSE) or about 30–85 hectares per cattle unit (ha/CU) in the first few years after a fire and will need to decrease over time as *Triodia* returns to dominance. The Wiluna–Meekatharra survey (Mabbutt et al. 1963) suggested a stocking rate of 20ha/DSE (about 140ha/CU) for spinifex pastures 10 years after a fire.

- Defer grazing for at least 8 weeks after germinating rains, to allow the build-up of root reserves and seed-set of desirable plant species. Spelling after a fire may have to be longer if late summer rains are received.
- Spinifex grazing value is highest 1–3 years after fire, and gradually decreases over the following 4–10 years, depending on seasonal conditions and rainfall.

### Avoid overgrazing

Grazing pressure should be reduced before there are obvious signs of overgrazing. Livestock should be removed, water points turned off, and native and feral grazers should be controlled.

Signs of continued overgrazing on spinifex pastures include:

- long-term deterioration in pasture species composition
- accelerated rates of soil erosion
- patchy recovery of plant cover.

The first effective rains after burning have an important influence on species composition and suitable grazing pressure on the spinifex component of these pastures. Where opening rains occur in winter, species other than spinifex are favoured, particularly those in the Malvaceae family. Many post-fire plant species are potentially toxic to livestock.

Some inland pastures remain attractive to livestock for as long as 5 years after burning, and newly burnt areas may be only moderately preferred. In other areas, all grazing will be concentrated on the most recent burns and overgrazing is a high risk.

## Return time to fire and how much to burn

In the Pilbara and Gascoyne area, spinifex is commonly burnt every 5 to 10 years. Burning more frequently could harm species diversity, and may reduce potential livestock carrying capacity from the cumulative effects of fires. Appropriately timed fires can be used to remove stands of relatively unpalatable shrub species – like poverty bush (*Acacia stellaticeps*) – and promote regenerated spinifex pasture that has improved stock feed value.

Burn areas large enough for good grazing distribution throughout the pasture every 5 to 10 years. Use an appropriate pattern of planned burns to influence livestock distribution on leases with spinifex pastures: livestock will move to areas of new growth and the grazing value of spinifex is highest in the 1–3 years after burning.

Allow spinifex communities to set seed before burning again: these pastures will be more productive in the long term than pastures burnt more frequently. Seedset of soft spinifex is critical to maintain the spinifex community.

Do not burn all of the spinifex country on a lease in one go: develop an appropriate mosaic, patch-burning cycle for the conditions, and maintain most of the country in a productive subclimax condition.

A burning cycle of 7 years or more is likely to provide an adequate drop of soft spinifex seed. Flower production alone is a poor indicator of seedsetting – in some seasons, plants may flower but fail to set viable seed.

Trees and shrubs in these pastures need more than 2 years between burns to persist.

The best time for effective burns is generally early summer because this:

- optimises germination of palatable species after summer rain
- reduces germination and recruitment of less palatable, undesirable pasture species (for example, cockroach bush) promoted by cool season winter rains.

If the risk of wildfire is high, burn a little earlier in the year in cooler, less windy conditions to reduce the risk. This may give less control of woody weed species and may need more labour to keep fires burning.

Defer grazing of soft spinifex after a fire until the plants are well established – usually 1 wet season or when plants have a diameter of more than 12 centimetres.

## Risks from burning spinifex pastures

There are several risks:

- The preferred rotational burning interval is determined by the pasture's capacity to develop a fuel load sufficient to carry fire on a continuous front, and produce a hot enough fire to control woody shrub growth.
- Burning to improve grazing value may be ineffective where spinifex cover is less than 30%, particularly in stony country and on degraded alluvial soils.
- Desirable bluebush and saltbush shrubs will be killed by fire, and most of these species will not re-establish. This is particularly important for coastal areas, where these species are more common.
- Large-scale burns limit the length of margins with mature unburnt stands, which provide animal shelter. Fine-scale mosaic burning maximises the length of margins with unburnt country.



- The loss of traditional Aboriginal fire patterning (fine-scale mosaic burning) has been linked to the decline in small native mammal species in these rangelands.
- Fine-scale mosaic burning requires more labour and costs than more broad-scale burning.

Fine-scale mosaic burning is especially suited to areas with high conservation value and highly erodible alluvial soils.

We do not recommend regular burning of hard spinifex pastures in the central Gascoyne or to the south and east of the Gascoyne.

## Erosion risk and management

Bare soil surfaces exposed by burning will be susceptible to wind erosion, particularly if they are disturbed by livestock trampling when dry and before regrowth has started. Some level of soil erosion will inevitably occur where spinifex pastures are burnt, even if efforts are made to limit grazing pressure. The localised movement of sand in spinifex country can be viewed as a relatively natural process.

Finer-textured soils are more erosion prone, so mosaic-pattern burning is recommended in these areas, rather than large-scale burns. Moderate wind erosion in the form of wind piling and hummocking is common on burnt areas which have not yet stabilised with seasonal growth. Such areas may appear badly degraded until they are recolonised and stabilised by spinifex and other species after good rain.

You can limit sand build-up along tracks, fence lines and around water points with suitable fence placement and design, strategic management of fire, and grading.

## Post-fire management of spinifex pastures

Significant regrowth after burning will only occur after effective rains.

### Defer grazing until germination and re-establishment

After burning and the first germinating rains, livestock should be kept off burnt areas to permit pasture germination and re-establishment. Spinifex seedlings less than 6–8cm in diameter are most susceptible to overgrazing. Plants usually achieve this size about 3 months after germinating rains, if soil moisture levels are sufficient to sustain continuing growth.

Stocking rates should be set on the assumption that grazing will be concentrated on those areas that have been most recently burnt.

Once soft spinifex is re-established, grazing should start as soon as possible. If it does not, or if grazing pressure is too light, many resprouting undesirable perennials may have time to mature. Plants such as northern wanderrie grass (*Eriachne obtusa*), pebble bush (*Stylobasium spathulatum*), *Mirbelia spinosa* and *Grevillea* species have little grazing value once mature, although the fresh regrowth from their roots after burning can provide a valuable feed component.

### Spelling during the growing season

We recommend growing-season spelling (no grazing) for periods in the first year after a fire when a paddock is re-stocked. After 2–3 years of growth with good rains, pasture can sustain continuous grazing for up to a year. Further spelling during the growing season will increase the likelihood of seedset of other desirable species. Managers need to match the spell to the growing season to maintain and improve rangeland condition.

In the Pilbara and northern Gascoyne spinifex pastures after a fire, we recommend an initial spell of at least 6–8 weeks after effective rainfall. Spelling for 4–5 months in the first growing season



after a fire is recommended in these areas to allow time for the young plants to develop good root systems and give the best possible chance of desirable species setting seed. There is evidence that grazing established pastures late in the northern dry season will have a limited effect on perennial plant reserves.

Some inland pastures remain attractive to livestock for as long as 5 years after burning, and newly burnt areas may be only moderately preferred. In other areas, all grazing will be concentrated on the most recent burns and overgrazing is a high risk.

## **Buffel grass and spinifex pastures – a special case**

Buffel grass is widely distributed through the Pilbara. It has a relatively high soil phosphorous requirement that limits its potential to spread or dominate on many soil types. Buffel grass can potentially displace native plant species, including spinifex, on alluvial soils of relatively recent origin. Buffel grass invasion of spinifex pastures increases the fuel load and associated fire risk.

Buffel grass can spread at the expense of soft spinifex species in some conditions:

- Lighting small-scale 'muster fires' can attract heavy grazing pressure and re-establishment of spinifex is often delayed by overgrazing.
- Burning at too frequent an interval will prevent spinifex seedset and favour other plants invading, including buffel grass. Creeklines and other areas favourable for rapid regrowth of flammable biomass are at most risk of supporting too-frequent burning.

## **Guidelines for managing spinifex pastures with fire in different types of country**

### **The different types of country**

- Soft spinifex pastures in the northern Gascoyne, Ashburton and Pilbara
- Hard spinifex in the Pilbara
- Spinifex in the Kimberley
- Hard spinifex in the Carnarvon Basin
- Sandplain spinifex hummock grasslands in the North-eastern Goldfields
- Spinifex pastures in the Wiluna–Meekatharra area
- Sandplain mallee–acacia–spinifex in the Murchison River Catchment
- Sandplain spinifex hummock grasslands in the Sandstone–Yalgoo – Paynes Find area

### **Soft spinifex pastures in the northern Gascoyne, Ashburton and Pilbara**

Fire occurs naturally in spinifex pastures of the northern Gascoyne, Ashburton and Pilbara rangelands. Planned burning return times range from 2–3 years up to about 15 years. Burning at appropriate intervals makes young and relatively palatable plant material available for livestock. Palatable plant biomass is greatest during the first 3 years after a fire. A structured burning program can maximise pasture values by manipulating plant age, vigour and species composition.

The proportion of soft spinifex within spinifex pastures has a major bearing on the potential profitability of pastoral use. Soft spinifex palatability varies in response to soil conditions, climatic factors and genetic ecotype.

*Triodia pungens* (soft or gummy spinifex) is widely distributed on free-draining calcareous and alluvial soils and on fine-textured alluvial soils with a sandy surface overlay. *T. pungens* is found on some stony plains but rarely achieves a high plant density in these areas.

*T. pungens* varies greatly in form and palatability to livestock. Some forms bear relatively soft, resin-free leaf material. Others have rigid, flat, heavily resinous, dark-green leaf material. This latter type may be strongly stoloniferous, and after burning on some coastal soil types, these pastures recover primarily through vegetative means rather than from seed. Regrowth on old plants of coastal *T. pungens* is generally softer and more attractive to livestock than regrowth on older inland plants.

*Triodia schinzii* (oat-eared or soft spinifex) is restricted to sand dunes and areas of deep sand. Oat-eared spinifex is most readily identified by its open, feather-like seed head. *T. pungens* is referred to as gummy spinifex because of its resinous nature, but exuded resin is an unreliable characteristic for differentiating species because it may also be present to varying degrees in oat-eared spinifex.

During early re-establishment of spinifex pastures, livestock preference for annual grasses – for example, wind grass (*Aristida contorta*), palatable herbs and perennial ribbon grass (*Chrysopogon fallax*) – is substantially higher than for soft spinifex. The indicator species hop-a-long grass (*Paraneurachne muelleri*) has forage values similar to young soft spinifex and woollybutt grass and it is preferred by stock.

The long-term productive potential of particular spinifex pastures depends on the survival of the minor, more-palatable plant species. To retain these species, monitor and manage grazing pressure to prevent overgrazing.

## Hard spinifex pastures in the Pilbara

Useful feed rarely persists in these pastures for longer than 2 years after burning. Potential livestock carrying capacities are usually substantially below those of pastures with a good mix of soft spinifex. For hard spinifex pastures where soft spinifex is absent, the fire-responsive annuals and short-lived perennials may be the only plants with feed potential.

Where adequate stock watering facilities are present, planned burning and trial stocking at low rates may be worthwhile to increase or maintain plants with feed potential.

## Spinifex pastures in the Kimberley

These pastures are of most value for grazing when in the early stages of regeneration, 1–2 years after fire. Spinifex communities that are allowed to mature and set seed before burning again will be more productive in the long term than pastures burnt frequently.

The time to maturity of spinifex varies according to topography and the rainfall received over the seasons since the last fire. Managers can adjust burning to take account of this variation. As a guide, burn a proportion of the country each year, at intervals of 4–6 years. The burning plan needs to be flexible, taking into account any unplanned fires.

## Cool or hot fires?

Spinifex response to fire depends on the species and conditions at the time of burning.

For example, soft spinifex (*Triodia pungens*) burnt under cool conditions has been observed to resprout from rootstocks, while a hot fire kills most adult plants and regeneration will depend on seed stored in the soil.

Cool fires may promote the germination of acacias in the pasture, which is undesirable.

## Avoid early grazing

Young spinifex seedlings are vulnerable to being pulled out by grazers: wherever possible, grazing should be deferred until the seedlings are well established. In practice, this may mean a wet-season spell after burning.

## When to burn

Spinifex communities on rugged hilly country appear to regenerate from rootstocks and recover earlier than spinifex pastures relying on new germinations, even after fires occurring late in the dry season.

Best practice management encompasses burning early in the dry season and late in the year under suitable conditions. The main purpose of early burning is to provide firebreaks. These are required for wildfire control and to allow burns or wildfire mitigation to be safely conducted towards the end of the year.

## Hard spinifex pastures in the Carnarvon Basin

On recently burnt country, spinifex seedlings establish readily after 1 reasonable growing season, but cover remains low for 1–2 seasons.

In some situations (particularly on the Cardabia and Learmonth land systems) perennial shrubs emerge as pioneers together with spinifex and, compared with the climax stand, a much larger suite of species can be present. As such a stand matures, it is often classified as a shrubland, and projected foliar cover of the shrub component may reach 25%. Fire-responsive shrubs include umbrella wattle (*Acacia ligulata*), *A. spathulifolia*, poverty wattle (*A. translucens*), *Bonamia rosea*, star flower (*Calytrix* spp.), cockroach bush (*Cassia notabilis*), *Corchorus walcottii*, *Hannafordia quadrivalvis*, *Phyllanthus* spp., *Scaevola canescens*, pebble bush (*Stylobasium spathulatum*) and *Thryptomene baeckeacea*.

As the stand approaches its climax state (commonly 5 years after fire) it will normally resume the form of a hummock grassland as the shrub component diminishes through senescence or through competition and crowding by spinifex (Suijdendorp 1967). The shrub cover usually falls to below 15%.

Recently burnt spinifex stands support more useful forage than long-unburnt stands. Small shrubs, spinifex seedlings and annual forbs and grasses (in season) are prominent after fire and are more attractive to livestock than the large, spiny, hard spinifex hummocks present in mature stands. Pastoral value in these areas is moderate.

The presence or absence of desirable or undesirable species may be more closely linked to particular fire events and post-fire stages than to grazing pressure because of the relatively frequent occurrence of fire and low grazing value of these pastures.

Shrub invasion can be a problem in the northern areas on the Giralia and Uaroo land systems and is best regarded as a decline to fair or poor pasture condition. After a winter fire, conditions seem to favour the establishment of shrubs. Thick stands of unpalatable species, such as poverty wattle and cockroach bush, often develop at the expense of spinifex, and a stable but less productive shrubby association develops.

Burnt areas of the Cardabia land system in the north-west of the Carnarvon Basin are often dominated by low paperbark and other heath-forming species more typical of the South-West Botanical Province (Beard 1976). The significance of these species is poorly understood but it is possible that they represent a fire-induced transition (seral community) stage rather than a shrub invasion. There is research to clarify the response of hard spinifex and soft spinifex pastures to various burning regimes.

## Sandplain spinifex hummock grassland pastures in the North-eastern Goldfields

Fire has a significant influence in the vegetation of the sandplains. Spinifex hummocks are highly flammable and are particularly prone to fire, as is the foliage of myrtaceous plants found in the heath and mallee strata. Burning hummock grasslands rejuvenates spinifex and suppresses plants that are less fire-adapted. Those species competing with spinifex in early post-fire stages are generally outcompeted later by maturing spinifex stands.

Following fire (and subsequent rain) there is usually an initial response by diverse short-lived grasses and woody herb species. This initial response is usually followed by a gradual decline in diversity as spinifex returns. Occasionally, dense heath, proteaceous shrubs or acacias emerge instead of spinifex.

Accelerated soil erosion due to prescribed burning is uncommon and minor in the North-eastern Goldfields. Ground stability is rapidly restored by emerging post-fire regrowth.

## Spinifex pastures in the Wiluna–Meekatharra area

Generally, these pastures are used only after burning, when the volunteer growth of palatable species of *Kennedia*, *Danthonia* and *Sida* can outstrip *Triodia* in production. Under these conditions, stocking rates as high as 1DSE/4ha are feasible. This high productive capacity is transitory because *Triodia* is able to exclude the palatable species within 5 years.

A return to sufficient density of *Triodia* to carry a fire takes a further 10 years, during which time the carrying capacity of this pasture is less than 1DSE/20ha. Protecting the volunteer species from grazing in the early stages of growth does not appear to confer any extension in the useful life of this pasture.

Burning does not appear to deteriorate these pastures, or limit the return of *Triodia* dominance. There is likely to be a loss of the more palatable and desirable perennials with repeated burns and uncontrolled grazing.

If rains do not follow within a year of burning, burnt areas may suffer from wind erosion. Wind erosion may cause sand-piling around spinifex rings. Uncontrolled stocking may deplete the store of desirable shrubs and grasses in areas of run-on.

## Sandplain mallee–acacia–spinifex pastures in the Murchison River Catchment

The value of sandplain mallee–acacia–spinifex areas is generally limited to seasonal opportunities after good rains promote annual plants, particularly following prescribed burning.

In some severely overgrazed areas (for example, holding paddocks) the inedible hard spinifex has tended to increase where shrubs have been depleted. Where fire has been suppressed and grazing is lighter, shrubs tend to increase at the expense of hard spinifex. Most of these vegetation communities within the Murchison River Catchment survey area have little grazing.

## Sandplain spinifex hummock grasslands in the Sandstone–Yalgoo–Paynes Find area

Pastoralists in the Sandstone Land Conservation District and surrounds burn spinifex to promote a few years of improved production from annuals and facultative biennials. They prefer patch-burning to prevent losing the use of paddocks after a big fire until it is ready to carry fire again.



Shrub cover in these grasslands varies from less than 5% to over 25% projected foliar cover. Higher shrub cover is associated with past fire successions where acacias, particularly *Acacia coolgardiensis*, or heath species, such as *Baeckea cryptandroides*, are present.

Spinifex cover increases with time after fire, reaches maturity and then may decline as hummocks senesce. Mature spinifex populations can achieve a groundcover of up to 40%.

Successions after fire often involve many species and characteristically vary considerably from place to place as a result of:

- time and rainfall since the burn
- intensity of the burn
- seasonal conditions at the time of the burn.

Prominent after-fire grasses are *Aristida contorta*, *Monachather paradoxus* and *Amphipogon* spp.

Deferring grazing for a season after fire may increase the quality, quantity and duration of feed available.

Soil erosion is not usually a prolonged problem because plant cover re-emerges soon after rains following a fire.

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