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FIRE SYMPOSIUM

AN INVITATION

RAVENSTHORPE TOWN HALL
Friday 22nd February

Admission - $10 donation
Door prize & raffle

Sponsored by:

- Friends of the Fitzgerald River National Park
- Shire of Ravensthorpe
- Tectonic Resources NL
- Lotteries Commission
- Land for Wildlife
- Department of Conservation & Land Management
- Skywest Airlines
- Fire & Emergency Services Authority
- Botanic Gardens & Parks Authority

For catering purposes, please RSVP to the Shire of Ravensthorpe phone 9838 1001; fax 9838 1282 by 20th February

AGENDA

8.30 am Registration

8.50 am Welcome

SESSION 1: EFFECT OF FIRE ON PLANTS, ANIMALS AND THE LANDSCAPE

9.00 am Dr Stephen Hopper *Fire and landscapes through time in the south-west*

9.45 am Angas Hopkins *How can we manage fire in this landscape to achieve desirable ecological and social outcomes?*

10.20 am Morning Tea

10.50 am Dr Mike Bamford *Fire and fauna in south-west ecosystems*

11.25 am Dr Colin Yates *The relationship between fire and rarity of plants and animals*

12.00 pm Lunch – Sponsored by Tectonic Resources NL

SESSION 2: FIRE MANAGEMENT, PLANNING AND IMPLEMENTATION

1.00 pm Dr Lachie McCaw *'Dead Man Zone' video; and Post-fire response of mallee-heaths in the Stirling Range*

1.40 pm Penny Hussey *Fire management in small bush remnants*

2.15 pm John Winton *Planning for community fire protection*

2.45 pm Greg Broomhall *Implementation of the Fire Management Plan in the Fitzgerald River National Park*

3.15 pm Afternoon tea

SESSION 3: OPEN FORUM

3.45 pm All speakers *Questions from audience to speakers on fire research, management, planning and implementation*

5.15 pm Presentation of Volunteer Awards

SOCIAL

5.30 pm Free Barbeque – with Bar available — Sponsored by Shire of Ravensthorpe (proceeds to Bush Fires Volunteers)

FIRE SYMPOSIUM

AN INVITATION

GAIRDNER HALL
Monday 25th February

Admission - $10 donation
Door prize & raffle

Sponsored by:

- Friends of the Fitzgerald River National Park
- Lotteries Commission
- Land for Wildlife
- Department of Conservation & Land Management
- Skywest Airlines
- BankWest
- Great Southern Plantations
- Fire & Emergency Services Authority
- Botanic Gardens & Parks Authority

For catering purposes, please RSVP to the Shire of Jerramungup phone 9835 1022; fax 9835 1161 by 21st February

AGENDA

8.30 am Registration

8.50am Welcome

Session 1: Effect of Fire on Plants, Animals and the Landscape

9.00 am Dr Stephen Hopper *Fire and landscapes through time in the south-west*

9.45 am Dr Cleve Hassell *The use of charcoal in sediments to indicate fire history*

10.20 am Morning Tea

10.50 am Dr Mike Bamford *Fire and fauna in south-west ecosystems*

Session 2: Fire Management, Planning and Implementation

11.25 am Penny Hussey *Fire management in small bush remnants*

12.00 pm Lunch

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1.40 pm Jeffry Ellett *Community fire management in the Cheyne Bay coastal reserve*

2.15 pm John Winton *Planning for community fire protection*

2.45 pm Greg Broomhall *Implementation of the Fire Management Plan in the Fitzgerald River National Park*

3.15 pm Afternoon tea

Session 3: Open Forum

3.45 pm All speakers *Questions from audience to speakers on fire research, management, planning and implementation*

ALL WELCOME

For further information, please contact
Gillian Craig 9838 1071 or Sylvia Leighton 9842 4522

Welcome to the Fire symposia

Good morning and welcome to our guest speakers and to all of you who have come to listen to them. I know that this is a busy time of year for most farmers, with the late harvest and many people shearing and crutching. So we are particularly pleased that you have taken some time to come and listen to the top people in the State speak about their research results and knowledge of fire and its impact on our environment. Many of you have travelled many miles to be with us today, so we are grateful for your presence.

This is the first of two symposia being held in the Fitzgerald Biosphere, the other being held at Gairdner on Monday. The idea for these symposia came about 2 years ago at a Friends of the Fitzgerald River National Park AGM, where we were discussing topics for workshops. There was a call for more information on Fire, because then, as now, there were discussions going on in the community about how often bush should be burnt, with suggestions ranging from every 3 years to 30 years or more.

Everyone has their own ideas on fire and how it should be managed. By the end of today, I anticipate that the discussions will be more informed and there will be greater understanding between those who suggest that burning should occur less often, and those who have a requirement to protect the community and property. This symposium is timely, as the Fitzgerald River National Park's Fire Management Plan needs to be reviewed, so hopefully there will be some discussion in the Open Forum later today about how to best achieve fire management that satisfies both social and environmental needs.

I was uncertain whether this function should be called a 'seminar' or a 'symposium'. Looking up the Oxford dictionary, I found that 'seminar' is *'meeting of a group of persons engaged in special study or research…'*, while a 'symposium' is *'**1.** an after-dinner drinking party with music, dancers or conversation, **2.** philosophical or other friendly discussion with a set of contributions on one subject from various authors'.* Consequently, the word symposium sounded much more apt, we'll start with the contributions on the one subject 'fire' and finish off the day with the 'drinking party and conversation'.

Special thanks are due to our sponsors:

- **Land for Wildlife**, with Sylvia Leighton providing considerable support in organising the day and supported Penny Hussey's attendance, plus some funds;
- **Shire of Ravensthorpe** for financial assistance and with special assistance by Nathan Cain for organising the evening's BBQ at Ravensthorpe;
- **Tectonic Resources NL** (better known in the area as RAV8) have provided our lunch (at Ravensthorpe);
- **Lotteries Commission** are providing a contribution for each 'community' person attending, so please make sure you sign the register;
- **Skywest Airlines** donated an airfare;
- **Shire of Jerramungup**;
- **Bankwest (Jerramungup)**;
- **Great Southern Plantation**
- **Department of Conservation & Land Management** supported the attendance of Greg Broomhall, Angas Hopkins, Lachie McCaw and Colin Yates, and provided some funds;
- **Fire & Emergency Services Authority** for supporting John Winton's attendance and some funds;
- **Botanic Gardens & Parks Authority** for supporting Dr Stephen Hopper's attendance.

Equipment has been provided by:

- **South Coast Regional Information Centre**
- **Jerramungup Resources Centre**
- **Department of Agriculture**
- **Department of Conservation and Land Management**

Also, thanks are due to:

- members of the **Friends of the Fitzgerald River National Park** who are the major organisors of today;
- **Bush Fire Volunteers**, in particular Rod Daw, who suggested speakers for today and is organising the BBQ tonight (at Ravensthorpe); and the
- **Ravensthorpe Hospital Auxillary** for catering for morning and afternoon teas and lunch at Ravensthorpe, and
- **Gairdner P&C** for catering at Gairdner.

So, please open your ears and listen to what our knowledgeable speakers have to say. We have a slight change to the program as Dr Lachie McCaw is unable to attend the Ravensthorpe symposia, although the video on the *'Dead Man Zone'* will still be shown. In his place, Jeffry Ellett has kindly agreed to come and speak on '*Community fire management in the Cheyne Bay coastal reserve'.* There will be a short question time following each speaker's presentation, and again there'll be an opportunity in the Open Forum session following afternoon tea to have your say on 'fire' and to ask any speaker further questions. We have Alan Carter, a very capable facilitator taking control of the Open Forum, to make sure everyone has the opportunity to be heard.

Thank you again for coming, and I trust that you will enjoy the day and learn much about the environment in which we live and the influence that fire has on it.

Gillian Craig
President
Friends of the Fitzgerald River National Park
22 February 2002

An evolutionary and historical perspective on south-west Australian landscapes, biodiversity and fire

Stephen D. Hopper
Botanic Gardens and Parks Authority, Kings Park and Botanic Garden, West Perth, W. A. 6005 email: steveh@kpbg.gov.au

The distinguishing historical hallmark of south-west Australia's globally significant, highly endemic biota has been its evolutionary response to 250 million years of uninterrupted terrestrial life on predominantly old, flat, weathered, nutrient-deficient landscapes. The fossil record and contemporary molecular phylogenetics show that both fire-adapted and fire-evading plants have pedigrees ranging from remarkably old to relatively recent. The hypothesis that fire has played a major role in plant speciation remains speculative. Because the south-west has such unusual landscapes and unique biodiversity, there is an accentuated need for the development of locally appropriate approaches to nature conservation and fire management. Three hypotheses stand out from this evolutionary and historical analysis – (i) major soil disturbance through glaciation last occurred in the south-west 250 million years ago – much of the present biota consequently has not evolved with nor adapted to rapid topsoil removal, so we need to be very cautious with the use of bulldozers in fire operations, and protect topsoil wherever possible; (ii) unprecedented turnover of plant species over short distances across south-western landscapes has existed throughout the Cainozoic, with fire-adapted and fire-evading flowering plants intermixed in complex mosaics from the mid-late Cretaceous – we should expect different responses and biodiversity outcomes over short distances from the same fire regime; (iii) present landscapes and biodiversity have been so altered by European landuse, dieback disease and weed invasion in many districts of the south-west that new approaches to fire management are needed – the Aboriginal way of local people managing fire as a special privilege at district level has much to commend it. Some other hypotheses are also explored briefly.

Use of fire can continue to improve if we retain a focus on persistent long-term learning, applying adaptive management that is purposeful, information-rich and information-sensitive, inclusive and flexible. Examples of adaptive management improving biodiversity conservation in the south-west include the protection from prescribed burns of young karri regrowth and of fire refuges such as granite outcrops in southern forests, the abandonment of prescribed burns in favour of other control strategies in urban reserves infested by veld grass, and the move from bulldozing firebreaks to slashing or chaining buffer strips in southern mallee-heaths.

An evolutionary and historical perspective on south-west Australian landscapes, biodiversity and fire

Stephen D. Hopper
Botanic Gardens and Parks Authority, Kings Park and Botanic Garden, West Perth, W. A. 6005
email: steveh@kpbg.gov.au

AIM:
This paper explores whether evolutionary and historical studies provide insights that help us better understand fire and its contemporary use in managing south-west Australian ecosystems.

OVERVIEW:
- **Landscape history, fossil record & past climates**
- **Plant molecular phylogenetics and fire adaptations**
- **Historical fire ecology – Aboriginal to contemporary**
- **A way forward – local fire use & adaptive management**

INTRODUCTION

- **One of Earth's 25 global biodiversity hotspots – 8000+ plant species, 75% endemic, more than 300 threatened.**

- **Seasonally dry, mediterranean climate with fire-prone, variably complex vegetation on flat landscapes:**

Robert Brown on Frenchman's Peak
13 January 1802

"We counted the smokes of 9 fires in different parts of the country w^ch as far as the eye could reach was dead level with here and there an isolated round hill of very moderate elevation. No wood could be perceivd, even the brush seemd short. Very little water. None seen except for very small lagoons, one each side of the mountain."

- **Challenge is to protect life and property from fire and conserve biodiversity – complex issues in space and time, high degree of uncertainty.**

- **Historical analysis and evolutionary science may be useful learning tools.**

LANDSCAPE HISTORY, FOSSIL RECORD & PAST CLIMATES

- **A flat, vegetated, occasionally burnt land since the Permian glaciation 250 Mya**

- **Unprecedented turnover of plants across the landscape throughout the Cainozoic from 66 Mya**

- **Essentially modern vegetation and fire regimes since the mid-Tertiary ca. 30 Mya**

- **Inland and upper west coast became modern first – more pervasive fire adaptations likely?**

- **South coastal and inland water-gaining sites refugial for fire-evading biota**

- **Pliocene rainforest elements disappeared 2-3 Mya, well before Aboriginal burning**

PLANT MOLECULAR PHYLOGENETICS AND FIRE ADAPTATIONS

- **Fire-adapted plants have old Cretaceous/Cainozoic pedigrees based on DNA sequence analysis**

Fire ephemerals
Gyrostemonaceae
***Anigozanthos* (Haemodoraceae)**

Post-fire flowering
Xanthorrhoeaceae, Dasypogonaceae
Orchids

Smoke-induced germination
Deep & diverse phylogenetic spread
Complexity – *Conostylis*, *Anigozanthos*

- **Sprouter/seeder strategies – multiple origins, not solely fire adaptations**

- **Adaptation to fire not universal and is complex – we have much to learn**

HISTORICAL FIRE ECOLOGY – ABORIGINAL TO CONTEMPORARY

- **Aboriginal use of fire was widespread, complex in space and time, but insufficiently documented**

- **Present landscapes and biodiversity so altered that new approaches to fire management are needed:**

  e.g. in Kings Park, frequent recurrent burns prior to World War II led to massive replacement of native plant understorey by South African veld grass *Ehrharta calycina* and a range of bulbous weeds such as *Gladiolus caryophyllaceous* and *Freesia* hybrids. In this environment, recurrent fire compared with other management approaches leads to native biodiversity loss and has no significant impact on the frequency of large wildfires.

- **Biological change occurs without human intervention – Chiddarcooping granite outcrop fire study**

Historical ecology shows that change, complexity & uncertainty are normal

CONCLUSION – A WAY FORWARD

- **The Aboriginal way of local people managing fire as a special privilege at district level has much to commend it:**

  If biodiversity conservation is a management aim, we should be cautious in applying the same fire regime over large areas, and tailor use of fire to local circumstances where there is high turnover of plant species across the landscape, especially in the wheatbelt.

- **We are still settlers in a globally unique environment – sustainable landscape management, including the use of fire, has yet to be achieved.**

- **We need to be focussed on persistent long-term learning and adaptation through time, applying adaptive management that is purposeful, information-rich and information-sensitive, inclusive and flexible**.

Fire Symposium, Ravensthorpe Friday 22 February 2002

How can we manage fire in this landscape to achieve desirable ecological and social outcomes?

Angas Hopkins
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WA Wildlife Research Centre
PO Box 51
Wanneroo WA 6946   (08) 9405 5135
angash@calm.wa.gov.au

DEPARTMENT OF
Conservation
AND LAND MANAGEMENT
Conserving the nature of WA

Outline of Presentation

- Fire management is an important issue in this region
- Some fire effects:
  - effects on vegetation structure (habitat)
  - effects on floristic composition of native vegetation
  - aspects of plant biology
- A simple fire effects model for planning
- Fire fuel accumulation rates
- Considerations for planning fire management

Good fire management is important

- The South West Region experiences a fire bioclimate - long, hot dry summers
- The native vegetation is highly flammable
- Wildfires do occur, and may need to be managed, or managed for
- Fire has been a factor in the evolutionary history of the biota; therefore fire may need to be introduced into managed landscapes to maintain natural, ecological processes
- Misapplication of fire regimes may lead to serious ecological damage

- Discussions will focus on fire regimes:

  fire frequency (time between fires)

  fire intensity

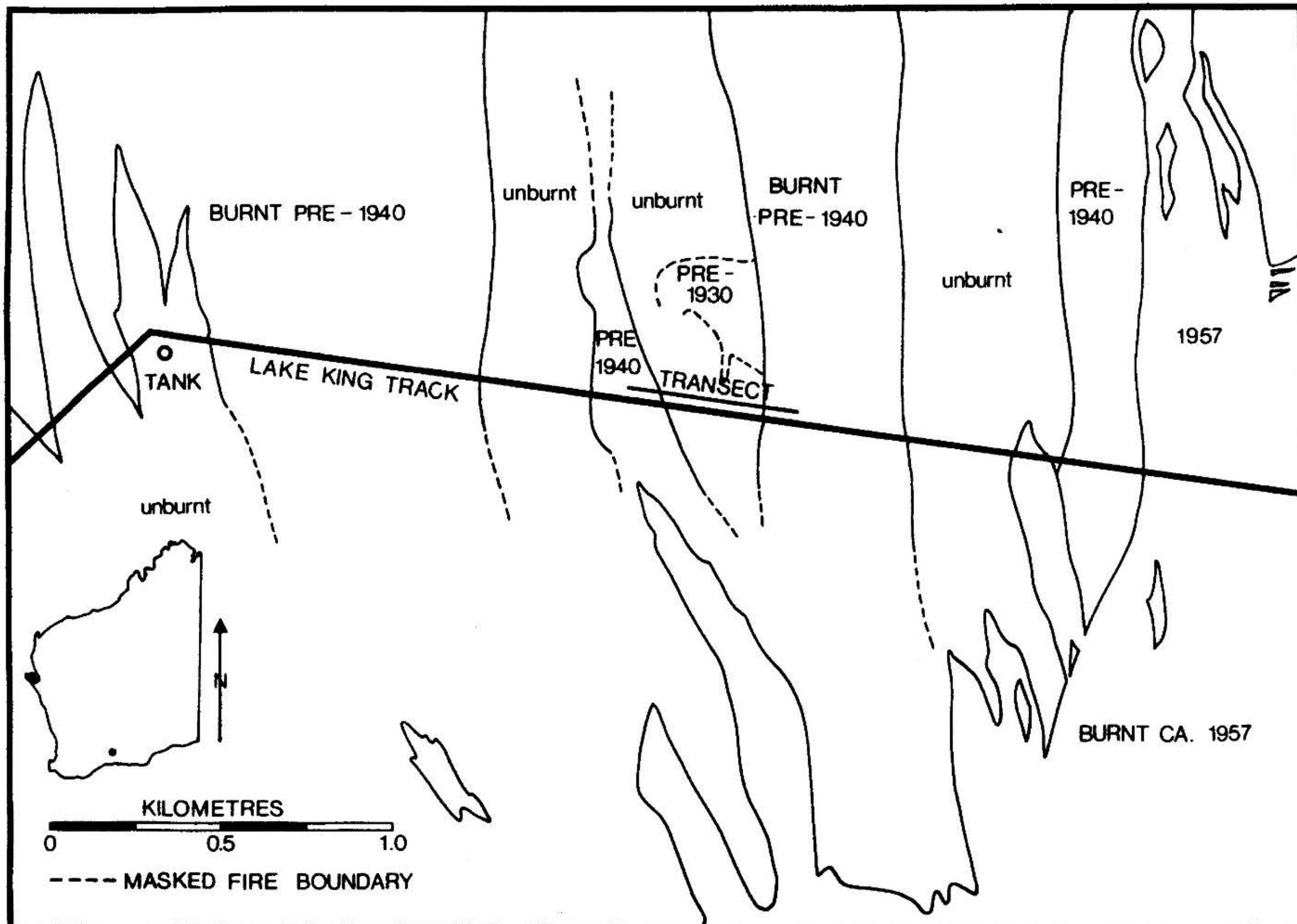
  season of each fire

  spatial factors eg area covered, shape of the burnt area, patchiness

Effects of fire on vegetation structure

In a published study east of Lake King (Hopkins and Robinson 1981):

- **a single fire in about 1938 burnt through a eucalypt woodland (*Eucalyptus cylindriflora*, *E diptera*, *E eremophila* up to 7 m tall)**
- **40 years later the regenerating vegetation was heath with emergent mallees ie the eucalypts were many stemmed shrubs to 3 m in height ie compared with the original trees**
- **the shrubs were also altered in form**
- **there was no noticeable impact on floristic composition**
- **the mallee heath is a more flammable vegetation type than the woodland**
- **a further fire within about 20-30 years would reinforce the mallee heath structure**
- **vegetation structure is an important fauna habitat issue**


BURNT PRE - 1940
unburnt
unburnt
BURNT
PRE - 1940
PRE -
1940
PRE -
1930
unburnt
1957
PRE
1940
TANK
LAKE KING TRACK
TRANSECT
unburnt
N
BURNT CA. 1957
KILOMETRES
0
0.5
1.0
MASKED FIRE BOUNDARY

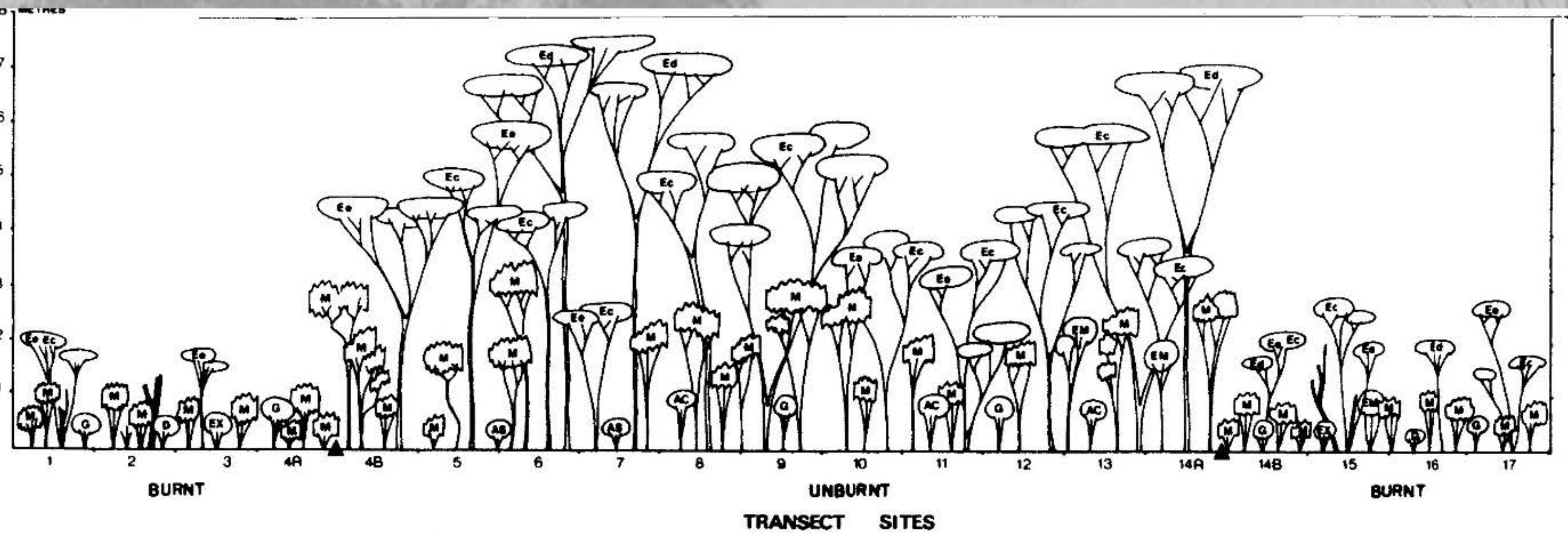


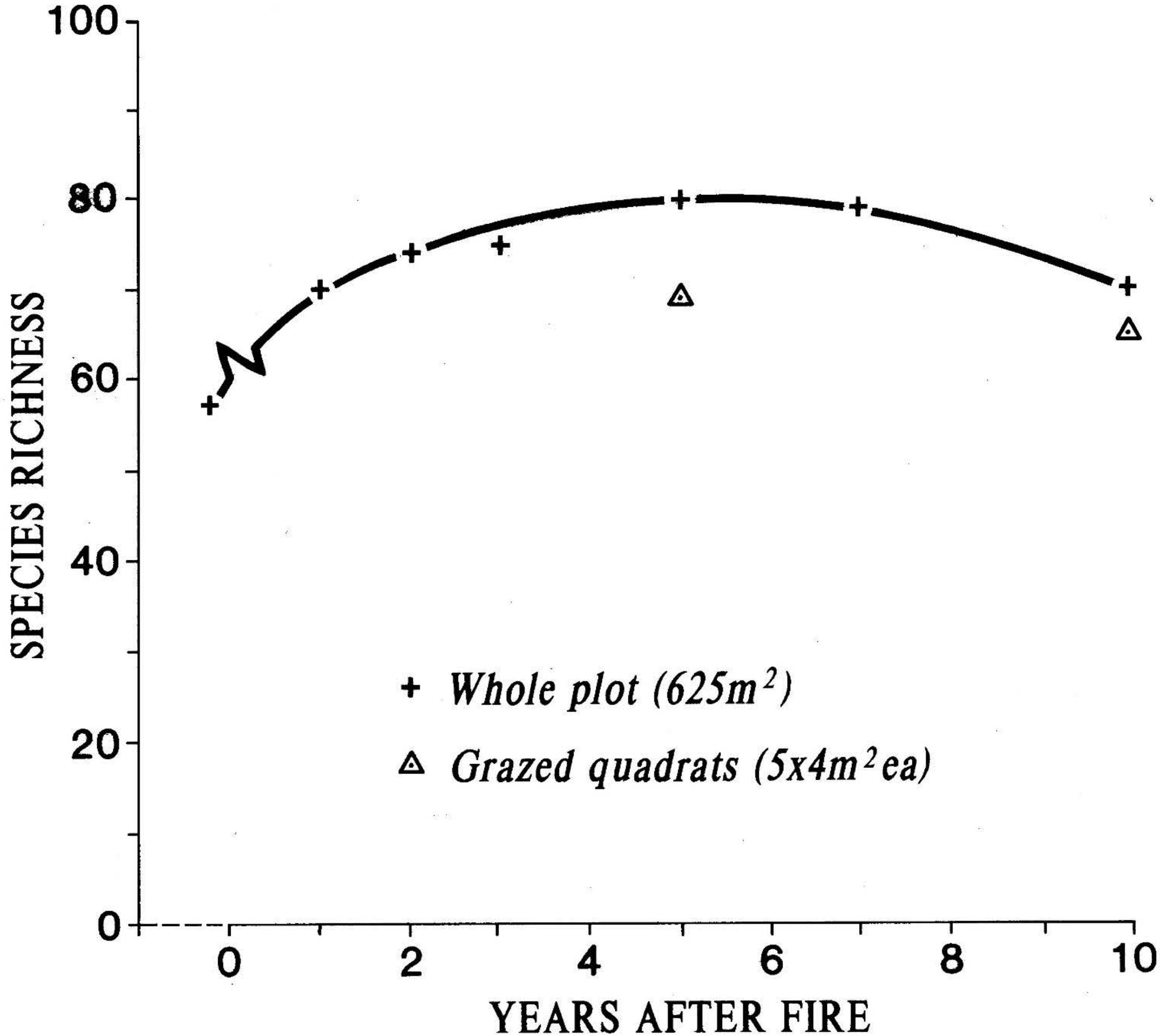
FIG. 3. Profile diagram of the vegetation along the study transect. AC = *Acacia mackeyana*, AS = *Astartea ambigua*. Ec = *Eucalyptus cylindiflora*, Ed = *E. diptera*. Ee = *E. eremophila*, EM = *Eremophila pachyphylla*, EX = *Exocarpus aphyllus*, D = *Daviesia acanthoclona*, G = *Grevillea pinaster*, M = *Melaleuca* spp.

East of Lake King

East of Lake King

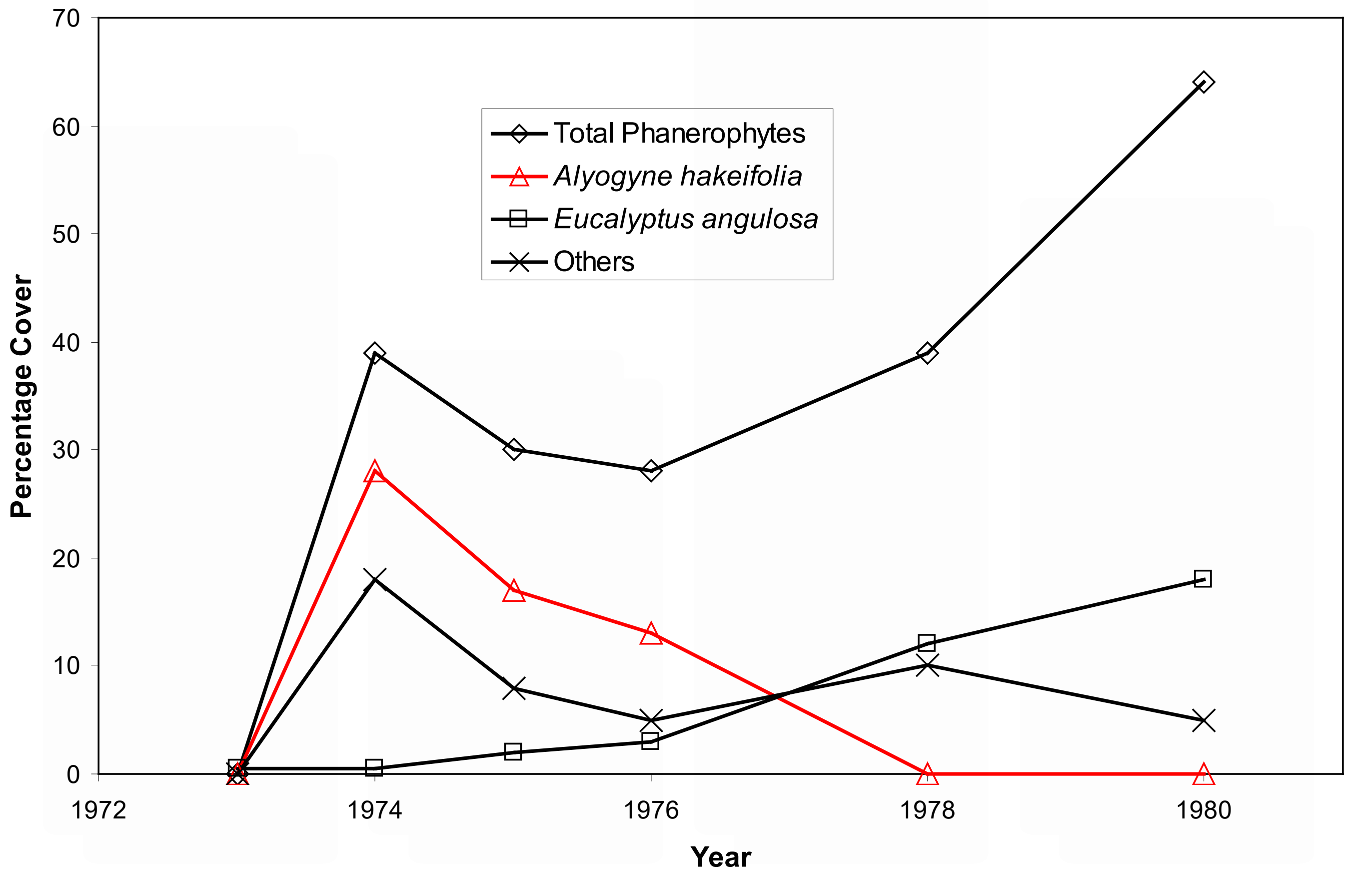
Effects of fire on floristic composition of native vegetation

- Life history characteristics of plant species are important in defining responses to a particular fire event, and to a fire regime
  - Degree of impact from fire of specified intensity ie fire sensitvity.
  - Sprouting vs regenerating from seed
  - Time to reproductive maturity
  - Location of the seed bank (and longevity of the stored seed).
- The presence of species that resprout gives the impression that there is a quick recovery of vegetation after fire – this can be quite deceptive
- There is often little change in species composition after a single fire; annuals and short-lived perennials may appear for a few years, and then disappear (into the seed bank)
- Species that are killed by fire, do not resprout, and store their seed store in woody or papery fruit on the plant are most at risk from inappropriate burning ie fire-sensitive, obligate seed regenerators with above-ground seed storage (bradysporous)



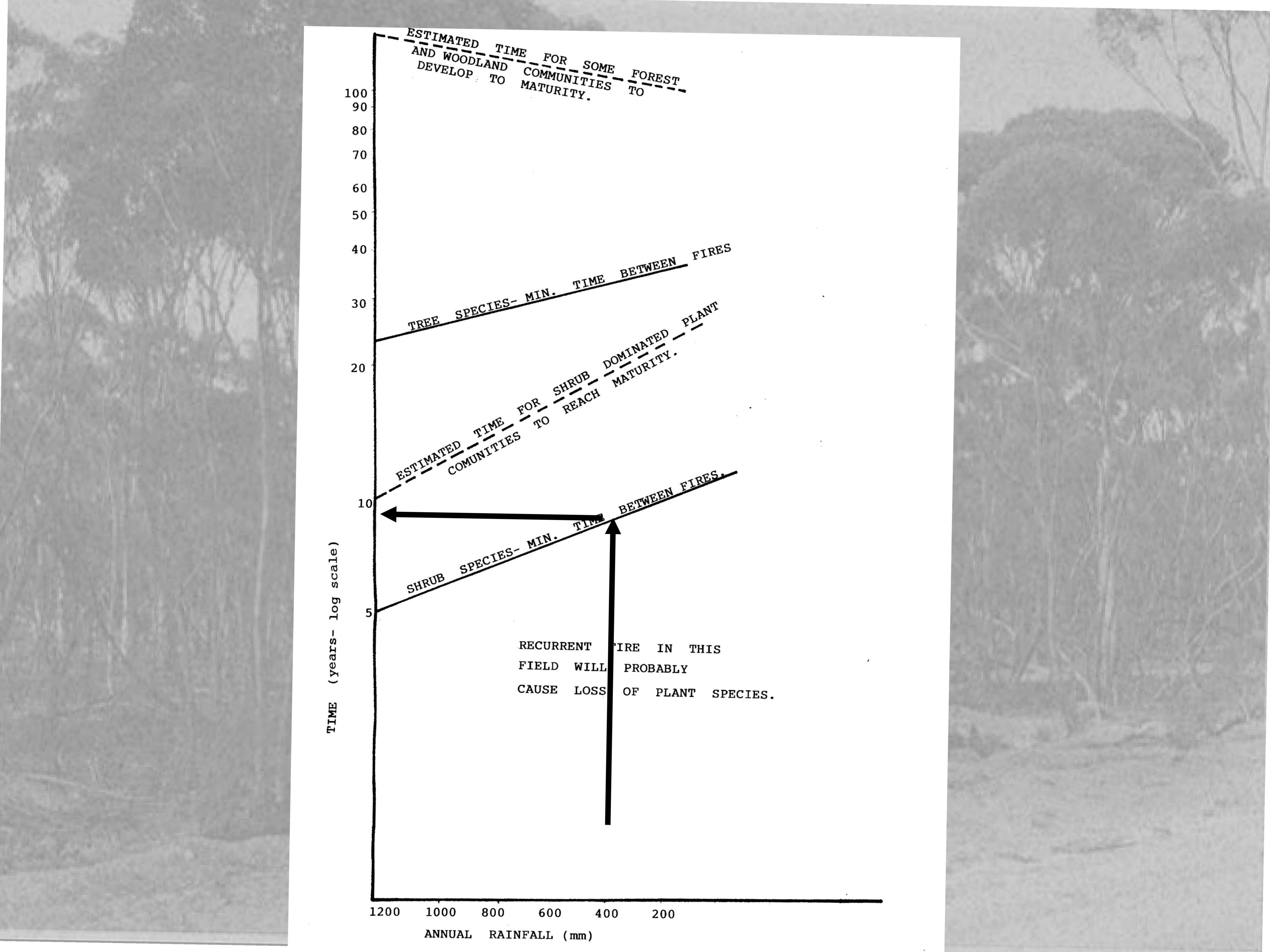
100
80
60
40
20
0
SPECIES RICHNESS
0
2
4
6
8
10
YEARS AFTER FIRE
+ Whole plot (625m2)
Δ Grazed quadrats (5x4m2 ea)

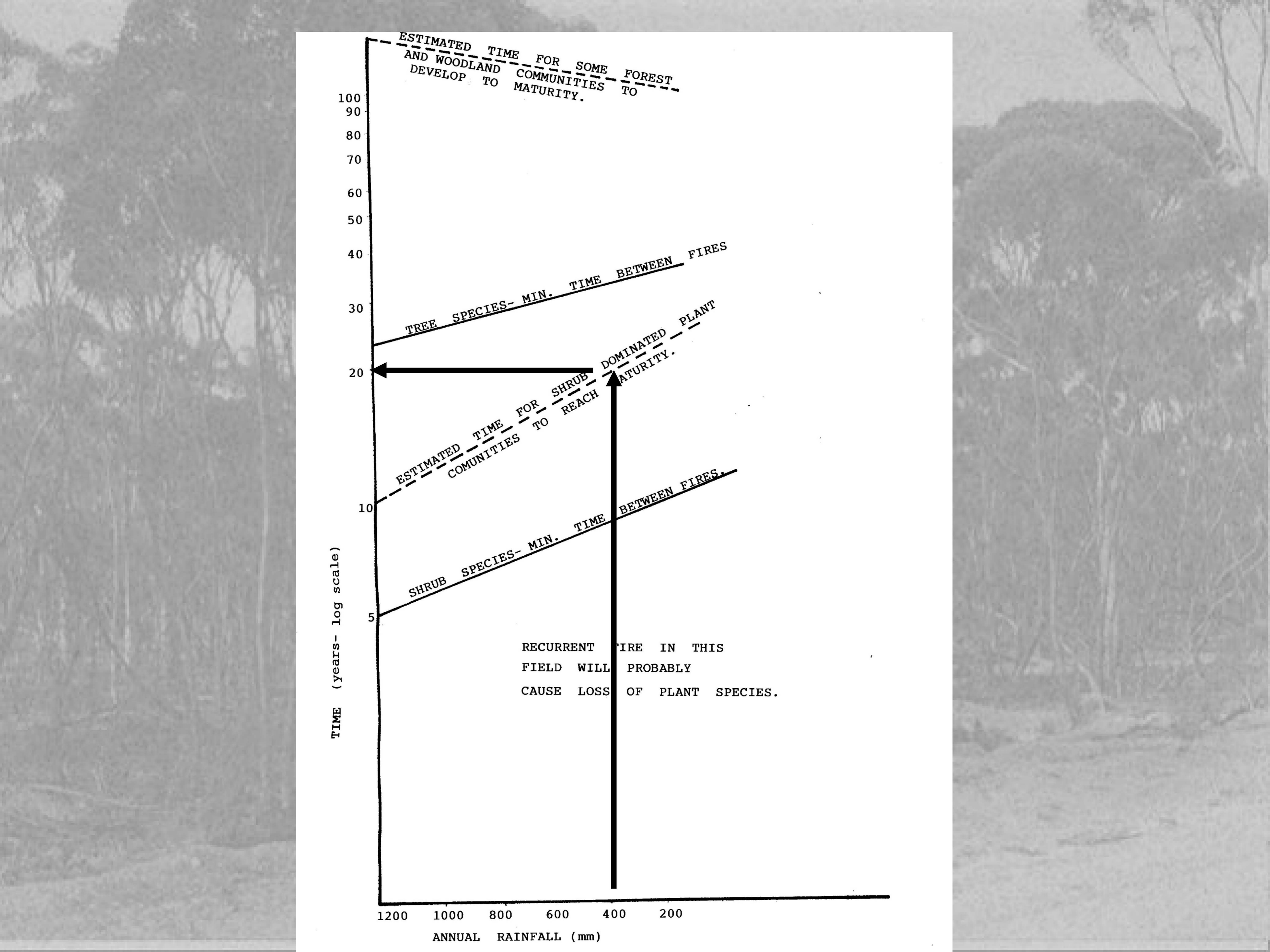
Middle Island: Regeneration after fire, H Plots



Category particularly vulnerable to inappropriate fire regimes
Indicator Species

- All plants killed by fire ie mature and immature
- Regenerate only from seed
- Seed storage on-plant
- Require time after fire to regenerate and to accumulate a sufficient seed bank
- As a guide, require 2.5 or 3 X Primary Juvenile Period ie time to reproductive maturity


ESTIMATED TIME FOR SOME FOREST AND WOODLAND COMMUNITIES TO DEVELOP TO MATURITY.
TREE SPECIES- MIN. TIME BETWEEN FIRES
ESTIMATED TIME FOR SHRUB DOMINATED PLANT COMUNITIES TO REACH MATURITY.
SHRUB SPECIES- MIN. TIME BETWEEN FIRES.
RECURRENT FIRE IN THIS FIELD WILL PROBABLY CAUSE LOSS OF PLANT SPECIES.
TIME (years- log scale)
100
90
80
70
60
50
40
30
20
10
5
1200
1000
800
600
400
200
ANNUAL RAINFALL (mm)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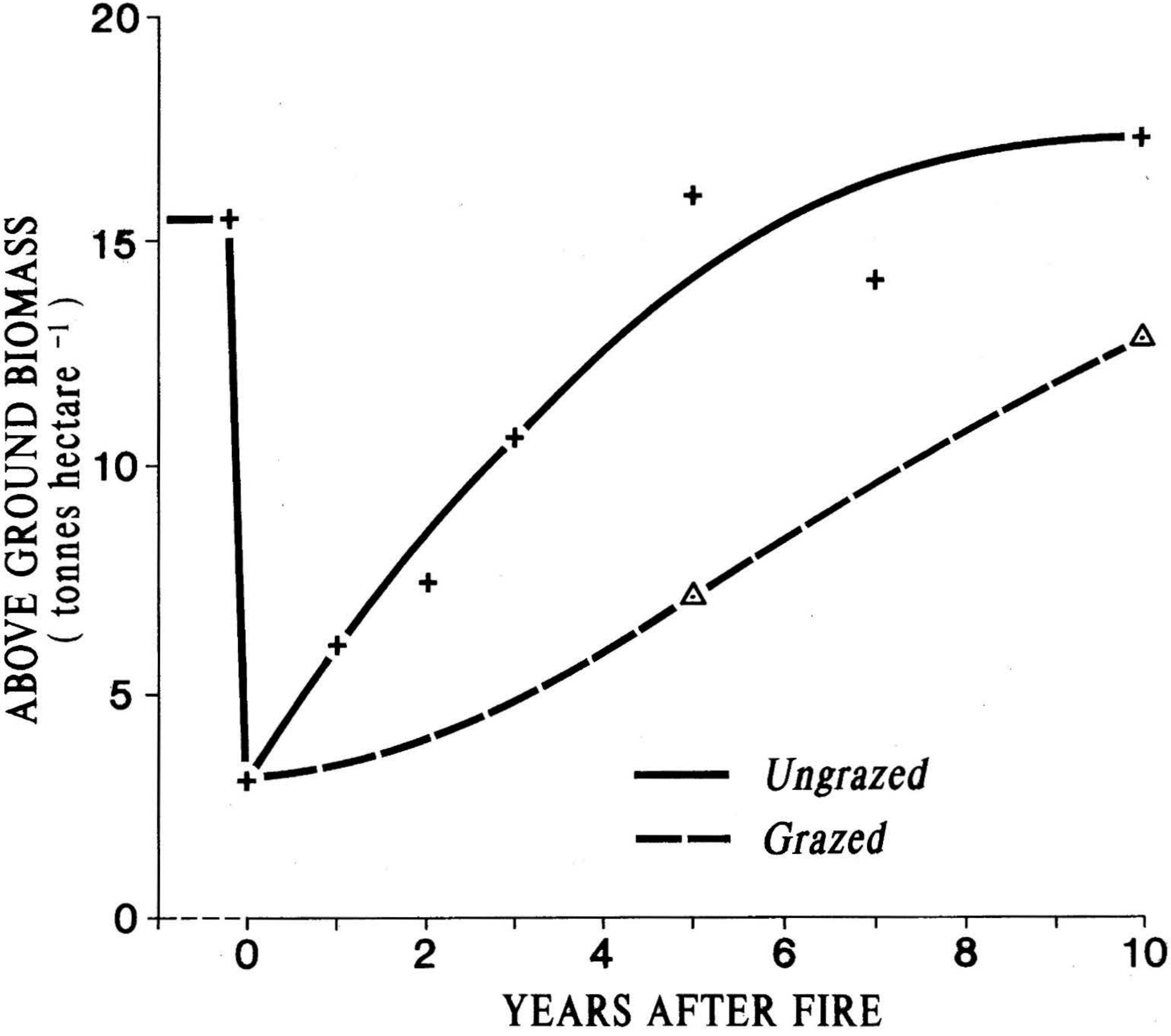
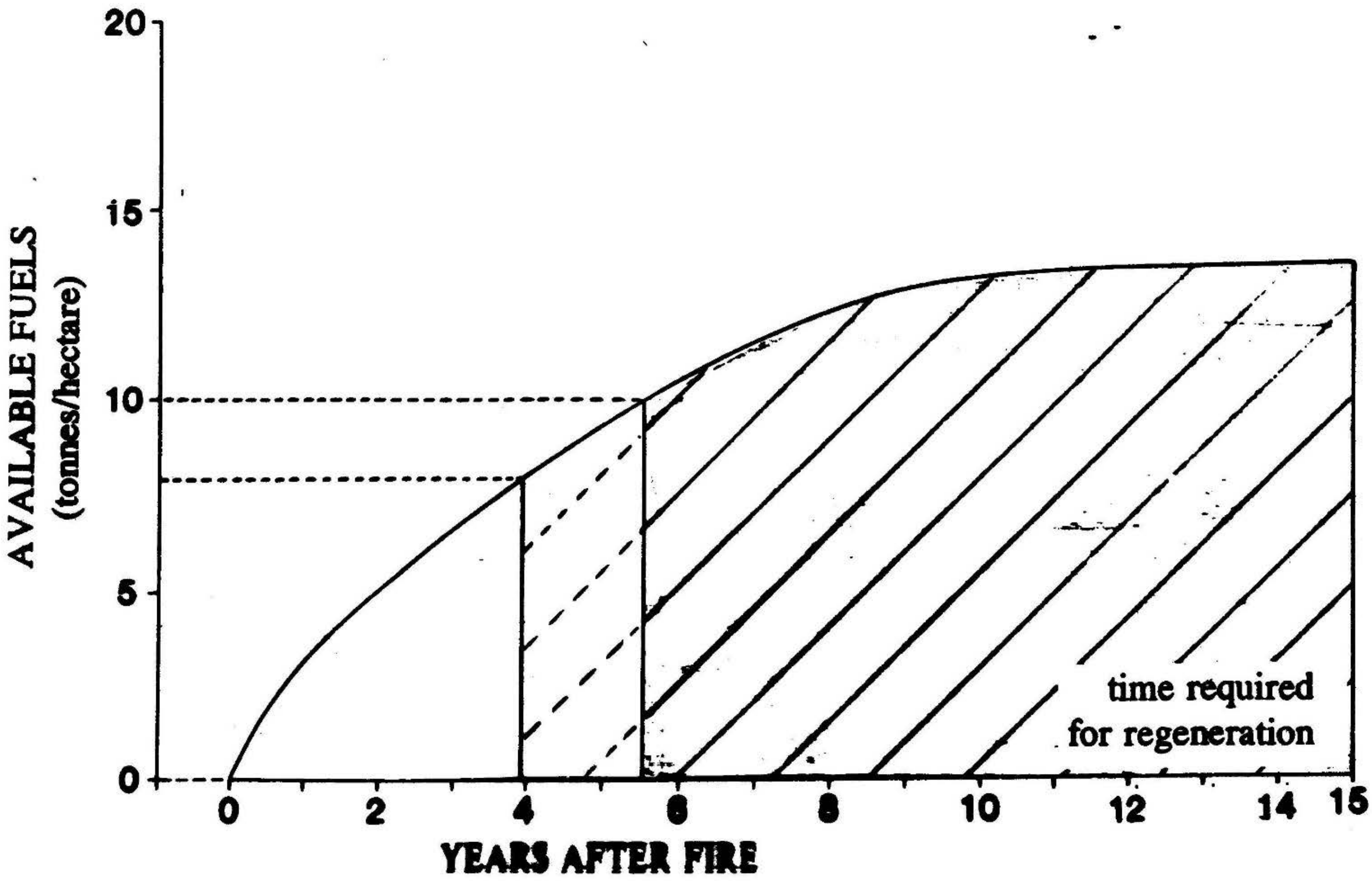
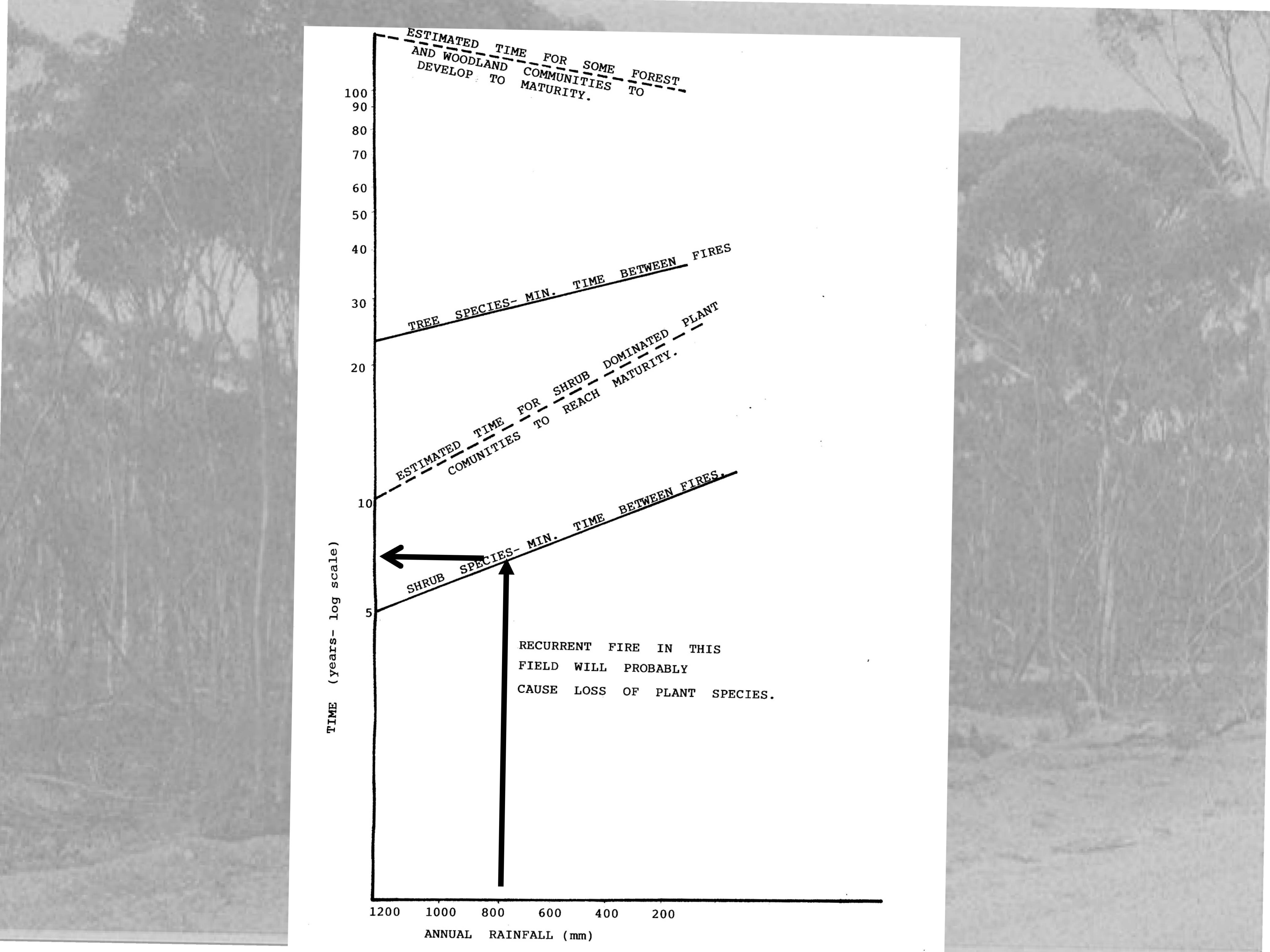
TIME (years- log scale)
100
90
80
70
60
50
40
30
20
10
5
1200
1000
800
600
400
200
ANNUAL RAINFALL (mm)



ABOVE GROUND BIOMASS
(tonnes hectare $^{-1}$)
20
15
10
5
0
0
2
4
6
8
10
YEARS AFTER FIRE
Ungrazed
Grazed



AVAILABLE FUELS
(tonnes/hectare)
20
15
10
5
0
0
2
4
6
8
10
12
14
15
YEARS AFTER FIRE
time required
for regeneration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ESTIMATED TIME FOR SHRUB DOMINATED PLANT COMUNITIES TO REACH MATURITY.
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RECURRENT FIRE IN THIS FIELD WILL PROBABLY CAUSE LOSS OF PLANT SPECIES.
TIME (years- log scale)
100
90
80
70
60
50
40
30
20
10
5
1200
1000
800
600
400
200
ANNUAL RAINFALL (mm)

Summary of Biological Evidence

There is likely to be a difference in fire regime requirements between fire management objectives

•to maintain biodiversity values

•to maintain manageable fire fuel loads

In other words, these two management objectives may conflict.

1. Define aims/ objectives for area
2. Identify sources, risks
3. Collate fire history data in conjunction with climatic data
4. Examine ways to manage sources/ risks without impact on biota
5. Survey area for vegetation, fuels, natural low-fuel areas, important biota requiring special attention
6. Redefine objectives if necessary
7. Assess management capability for both planned and unplanned fire
8. Examine simple methods for isolating sources from risk areas (strategic)
9. Plan other essential fire control measures
10. Plan ecological burning requirements
11. Undertake modeling where possible
12. Plan and implement monitoring programmes
13. Reassess plan regularly

Overall Management Objectives	Fire Management Objectives	Fire Management Strategies
1. Conserve the indigenous biota	* Protection to ensure that whole area is not burnt by a single fire * Fire exclusion from selected areas	Mosaic burning Construction of strategic fuel reduced zones Fire suppression
	* Maintenance of process	Ecological burning
2. Protection of neighbouring property	* Fire protection * Fire suppression	Construction of firebreaks Fuel reduction burning Fire fighting

	Fire Management Objectives	
	Protection	Maintenance of Process
Type of Prescribed Burn:	Fuel Reduction Burn	Ecological Burn
Regime characteristics:		
frequency	regular & frequent	irregular, infrequent (pseudo-random)
intensity	cool	hot
season	spring	late summer-autumn
spatial factors	patchy, often of limited areal extent	more uniform, often extensive

A systematic procedure in planning for fire management on nature conservation lands in Western Australia.

1. Define aims/ objectives for area
2. Identify sources, risks
3. Collate fire history data in conjunction with climatic data
4. Examine ways to manage sources/ risks without impact on biota
5. Survey area for vegetation, fuels, natural low-fuel areas, important biota requiring special attention
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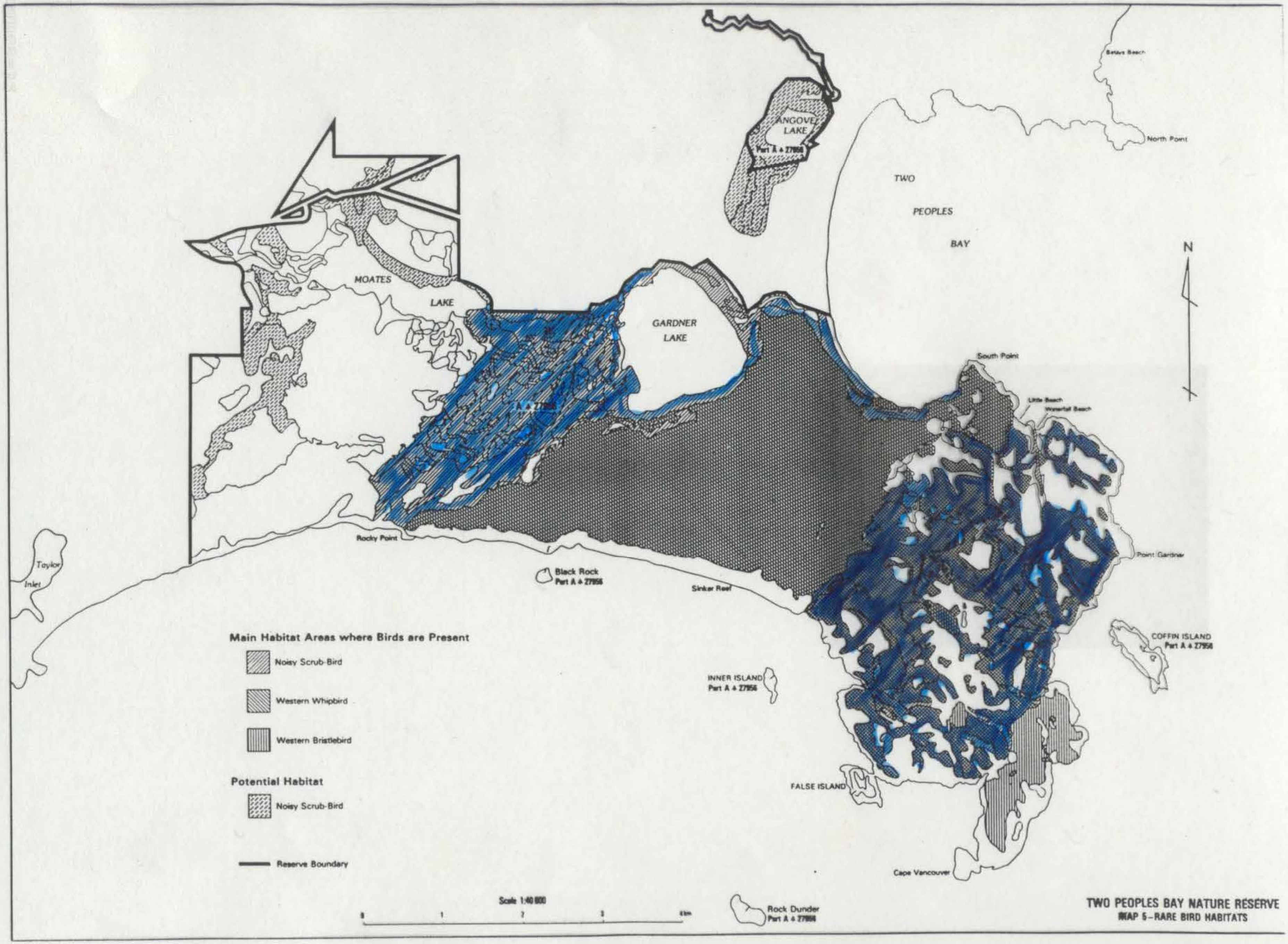
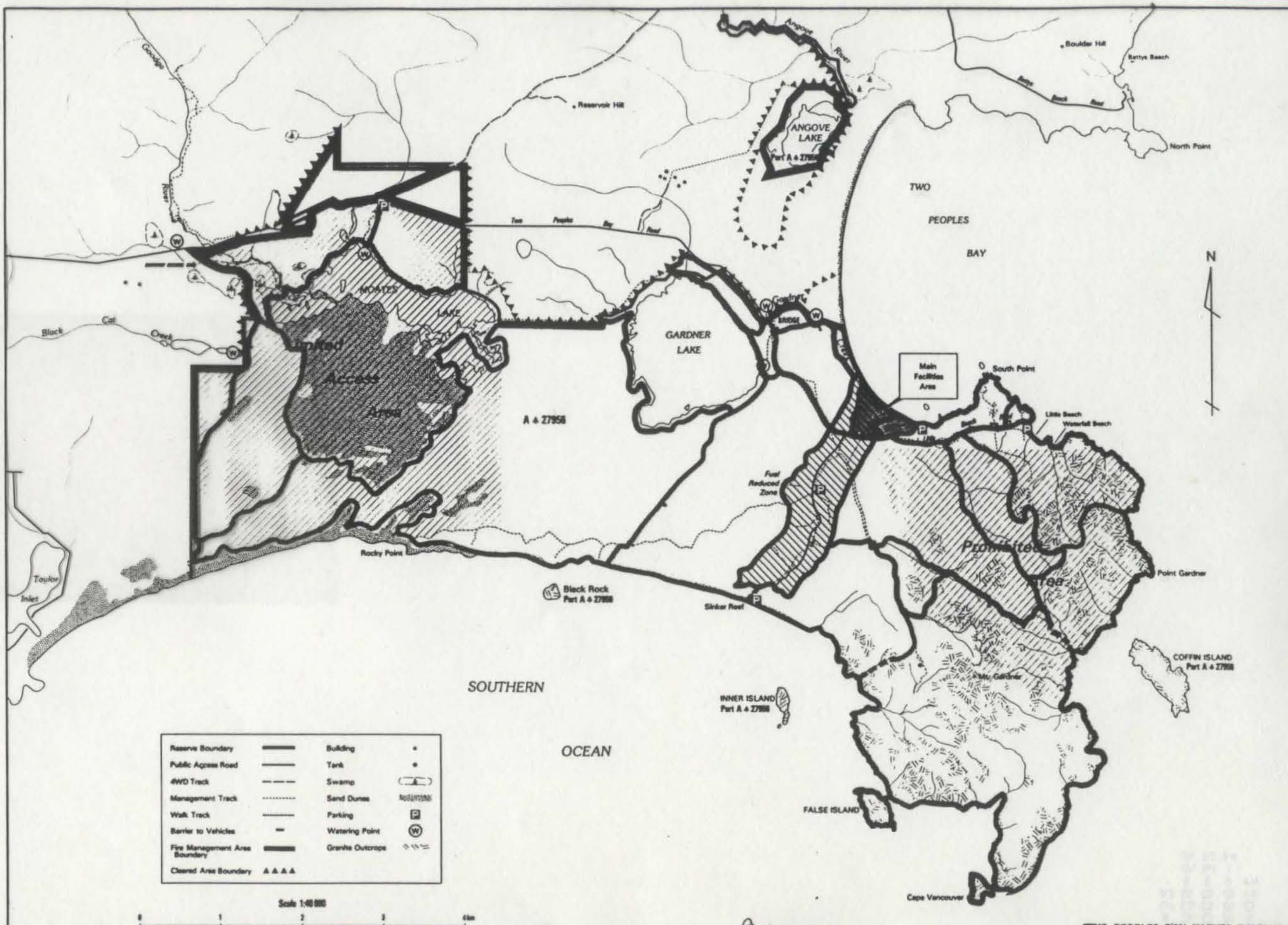


TWO PEOPLES BAY NATURE RESERVE
MAP 5—RARE BIRD HABITATS



TWO PEOPLES BAY NATURE RESERVE
MAP 8—PROPOSED ACCESS AND FIRE MANAGEMENT

FIRE AND FAUNA IN SOUTH-WEST ECOSYSTEMS

M.J. Bamford, 21/02/'02

Introduction

Whenever a fire is reported by the media, it is described as destroying the bush. While this may appear to be the case, the same report may feature animals that have survived the fire. Based on work on plants, fire could be described as a force for rejuvenation rather than destruction. But what of the animals? Impacts of fire upon fauna can be complex, but classes of effects can be recognised. Understanding these classes helps in understanding fire in conservation.

Immediate Impacts

Immediate impacts of fire are not as great as often assumed.

Many native animals have adaptive behavioural responses to increase their chance of surviving fire. e.g. Grey Kangaroos have been seen to hop through a fire to the safety of burnt ground, small birds will fly over the flames, Woylies with radio-collars fitted have been re-located alive after fire, marked Honey Possums have been recaptured after fire. Spiny-tailed Geckoes are arboreal but drop from bushes and shelter in scorpion burrows. Other reptiles will shelter in loose sand even if they would not normally burrow. Many of the examples of survival through fire do not rely on unburnt refugia.

Overall, survival through fire is great for frogs and reptiles that can burrow, and even for birds and mammals. Massive mortality events have been recorded as a result of intense fires, but it can't be assumed that such events are unnatural.

There are also some positive immediate impacts, such as birds of prey attracted to a fire.

Short-term Impacts

The survivors of a fire are faced with a totally altered landscape. Mortality due to increased predation and/or lack of food. Also get emigration, particularly of mammals and birds, with survival of emigrants dependent upon refugia. Not all species decline. For example, frogs and reptiles can survive periods of low food availability by virtue of their physiology, whereas birds and mammal cannot.

Extent of impact related to intensity of fire, presence of unburnt refugia and the structural changes wrought by fire. For example, where most vegetation is consumed by fire and all cover is therefore lost, impact on fauna will be greater than where trees and branches remain, and there may be leaf-fall following fire to create leaf-litter.

Not all short-term impacts are declines. Some species immigrate. Kangaroos and wallabies for grazing, Quendas and Woylies for fungi. “Open country” birds may colonise a burnt area. Enhanced survival of immature lizards (reduced predation?) Enhanced water levels in wetlands due to reduced evapotranspiration favour frogs.

Medium-Term Impacts

Species that flourish immediately after a fire decline in abundance within a few years.

There is a peak in abundance in some species 3-5 years after fire, these often being species that were uncommon before the fire. May be associated with particular stage of vegetation regeneration such that the vegetation provides structural and food requirements for a species for a while, but then population declines as vegetation matures and senesces. Such species therefore appear to need fire.

Some species recover in abundance in the medium-term and then achieve levels that change little with increasing time after fire. May have no need of fire.

Long-term Impacts

There are declines in abundance of some medium-term species, but increases in abundance of other species. These often critical for conservation (e.g. Noisy-Scrub-bird, Ground Parrot, Dibbler, Western Bristlebird). Some of these species take decades to return after fire and maintain high levels of abundance in very long-unburnt sites, suggesting they have no need of fire. Their response may be relictual. In some cases, however, the apparent dependency of a species upon long-unburnt vegetation may be an artefact of the fire regime. For example, a species that may thrive in a mosaic of long-unburnt and more recently-burnt vegetation may disappear if all the vegetation is burnt at once, surviving only in the total exclusion of fire.

Regime Impacts

Most studies look at single fires, but the fauna is determined by the fire history of a site. In a site that is frequently burnt, the only species present may be tolerant of fire and therefore studying such a site will reveal that fire has little impact on the species present. The assemblage of species can be altered by manipulating the fire regime: Frequency, season and spatial distribution.

Conservation Implications

To use fire in conservation management, we need to be able to understand enough of fire impacts to be able to predict what will happen. So what important features of fire effects on fauna do we understand?

- There is high survival through fire of many species, but can get massive mortality;
- There is mortality/emigration after fire in many cases, especially birds and mammals;
- There are some positive responses to fire (grazing species, availability of fungi fruiting bodies);
- For species that must recolonise after fire, the level of impact is influenced by the extent and patchiness of fire (the availability of refugia) and the degree of structural change to the vegetation caused by fire;
- There are short, mid and long-term responses to fire;
- These responses can often be linked to life history parameters, with the result that species are abundant at a time after fire when the vegetation has regenerated to a stage that meets their habitat requirements;
- The impact of fire can interact with other factors, such as the presence of introduced predators.

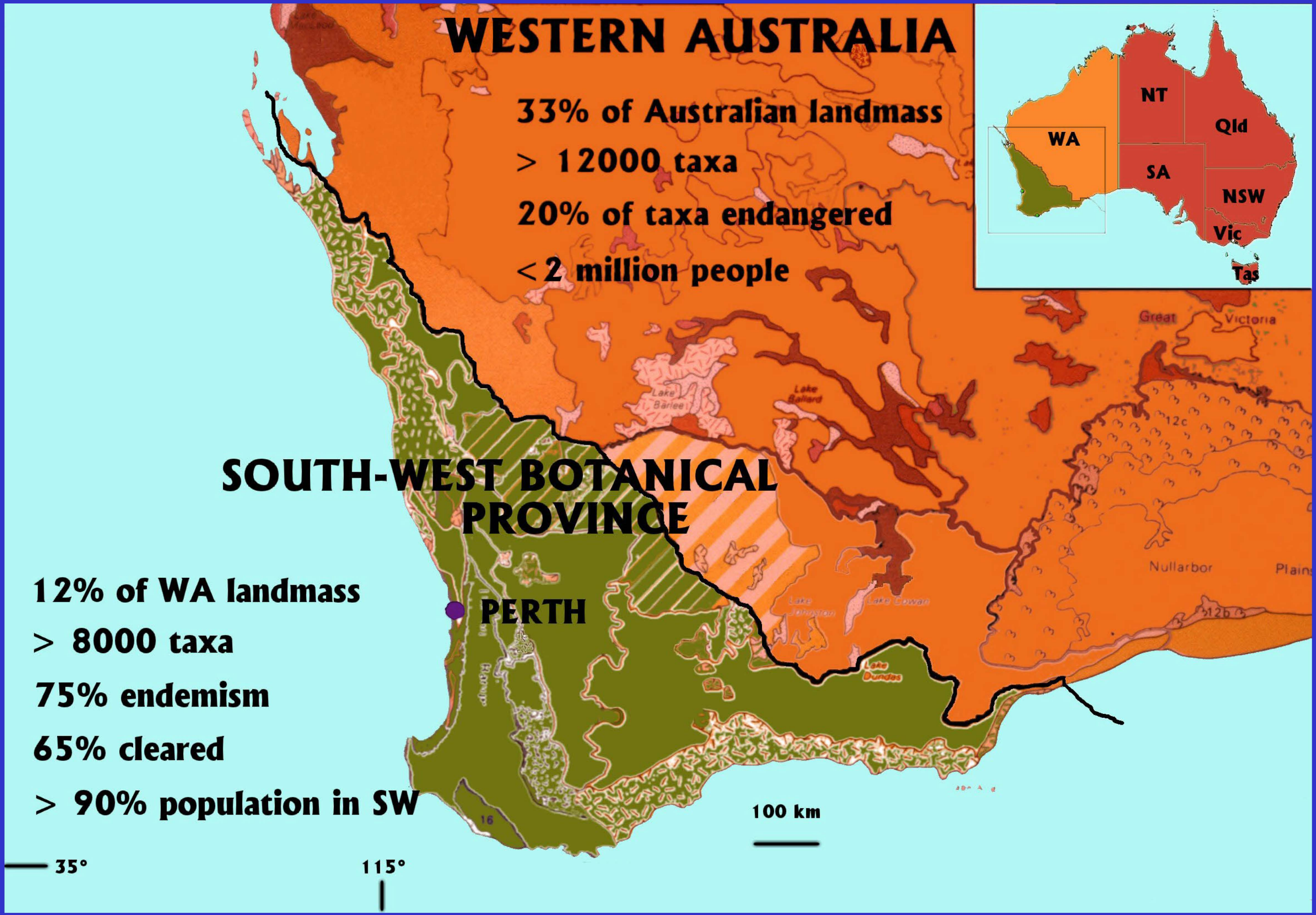
Fire and its relationship with rarity in south-west Western Australia

Dr. Colin Yates
Science Division
Department of Conservation and Land Management

Outline of talk

- Aim: to explore relationship between fire and rarity in south-west Western Australia
  - Background on patterns of biological diversity in south-west Western Australia
  - Define rarity and fire regime
  - Discuss theory related to fire, rarity and extinction
  - Provide an overview of empirical studies and present examples that have examined interaction of fire with rare plants and animals

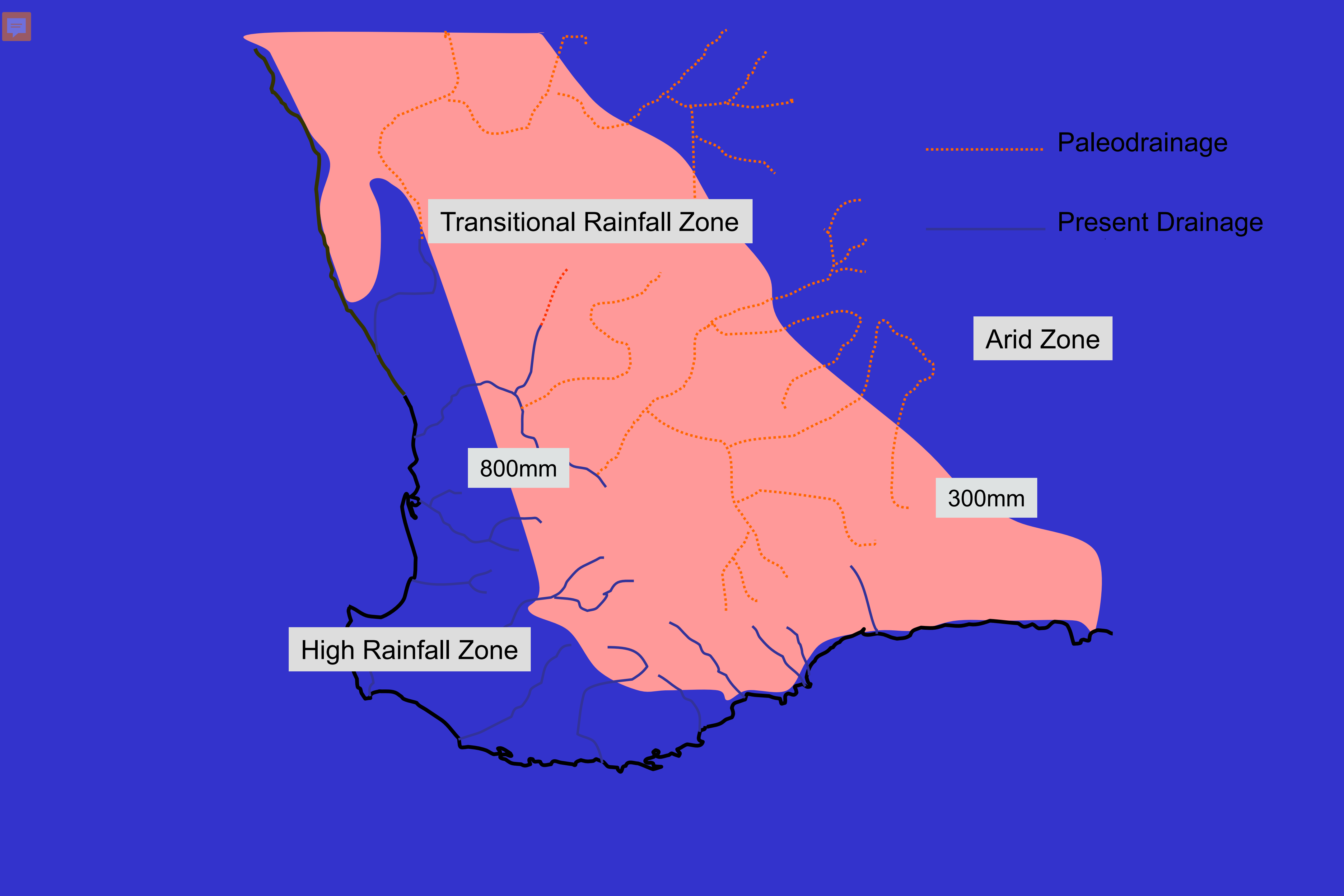
Global biodiversity hotspot



Patterns of plant diversity in South-west Australia

- Relict (Gondwanan) and more recently evolved species
- Considerable radiation within genera of woody perennials
- High local scale (α diversity), high species turnover along habitat or environmental gradients (β diversity) and high species turnover among equivalent habitats across geographical gradients (γ diversity)
- Large number of species have geographically restricted ranges
- Many species have naturally fragmented disjunct distributions, with little gene flow between populations

(Hopper 1979; Hopkins & Griffin 1984; Hopper et al. 1996; Coates 2000)



Paleodrainage
Present Drainage
Transitional Rainfall Zone
Arid Zone
800mm
300mm
High Rainfall Zone






History of fire in south-west Australia

- Earliest record of recurrent fire of uncertain frequency and intensity is in the late Pliocene 2.62 mya (*Dodson & Ramrath 2001*)
- Generally increasing aridity punctuated by warmer/wetter and cooler/drier periods in the Pleistocene, fire started by natural ignition sources is likely to have continued to be a major environmental feature until arrival of humans in the landscape
- Many parts of south-west Australia likely to have experienced repeated burning by Aborigines for the estimated 50 ka that these people have occupied the region

Fire and rarity

- Combination in the south-west of a large number of rare species especially plants and a Mediterranean climate with fire prone vegetation presents a significant opportunity to explore the relationship between fire and rarity

Biological rarity

- Rarity is an intuitive, relative, scale dependent concept
- In biology generally relates to the geographic range, habitat specificity and abundance of a taxon
- Over 2000 plant taxa are currently considered rare or poorly known with 357 listed as threatened under IUCN guidelines
- Recent floristic surveys revealed that greater than 25% and in some cases close to 50% of quadrat based flora records are of taxa recorded only in a single quadrat (*Wardell Johnson & Williams 1994; Gibson et al. 2000*)
- Rarity in south-west Australia's diverse flora is common and has been observed at all scales

Many causes of rarity

- Geologic and evolutionary history
- Myriad of ecological interactions (e.g. edaphic factors, predation, competition, pollination, fire?)
- Reproductive biology
- Genetics
- Population dynamics and influence of environmental and demographic stochasticity
- Human activities - habitat conversion, land management, harvesting

Fire regime

- Sequences of fires are characterized in terms of frequency, intensity, season and scale (*Gill 1975*)

- Fire regimes vary across south-west Western Australia depending on natural and human ignition sources, fuel characteristics and climate

Fire and distribution and abundance of plants and animals

- Knowledge of impact of fire on plants and animals has been derived largely by studying the responses of the biota to single fires

- However all species have evolutionary histories and their distribution and abundance while profoundly affected by single fire events, is more likely to have been shaped by the fire regime (sequences of fires)

- Resilience of plants and animals to a particular fire regime affects their distribution and abundance in the landscape and they are likely to have maintained some dynamic which in part reflects fire history

Fire life histories - plants - survival

Two basic fire life histories

- Non-sprouters - killed by fire, rely on seedling recruitment from seeds stored on plant or in soil to persist in the vegetation

- Sprouters - above ground biomass killed by fire but plant persists *in situ* by sprouting from fire protected dormant buds that are below ground or beneath bark

Fire life-histories - plants cont'd

- Fire may influence different phases of the plant life-cycle
  - stimulate flowering
  - stimulate seed germination through heat or smoke
  - facilitate seedling establishment
  - some species only occur in the vegetation in the first years following a fire (fire ephemerals)
- Morphological, phenological and functional characteristics interpreted as adaptations to fire but may have evolved in response to other factors?

Fire life histories - animals

- In case of animals general categories of fire response are more difficult to define

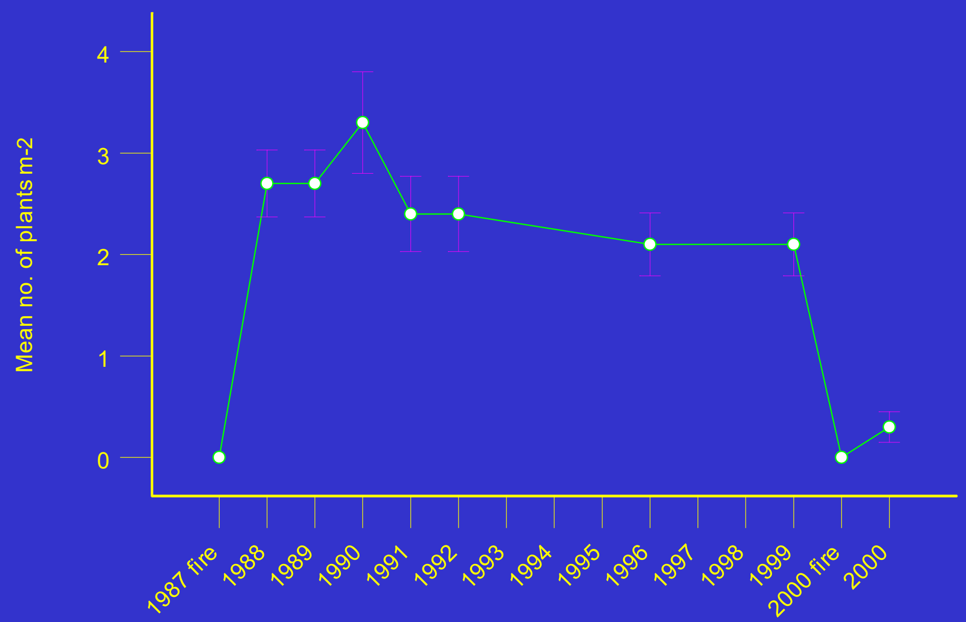
- In small ground dwelling vertebrates (< 5kg), broad categories of fire response based on requirements for shelter and to a lesser extent food and/or foraging patterns have been observed for mammals but no consistent patterns have been observed in reptiles or amphibians (*Friend 1993*)

Fire and extinction - plants

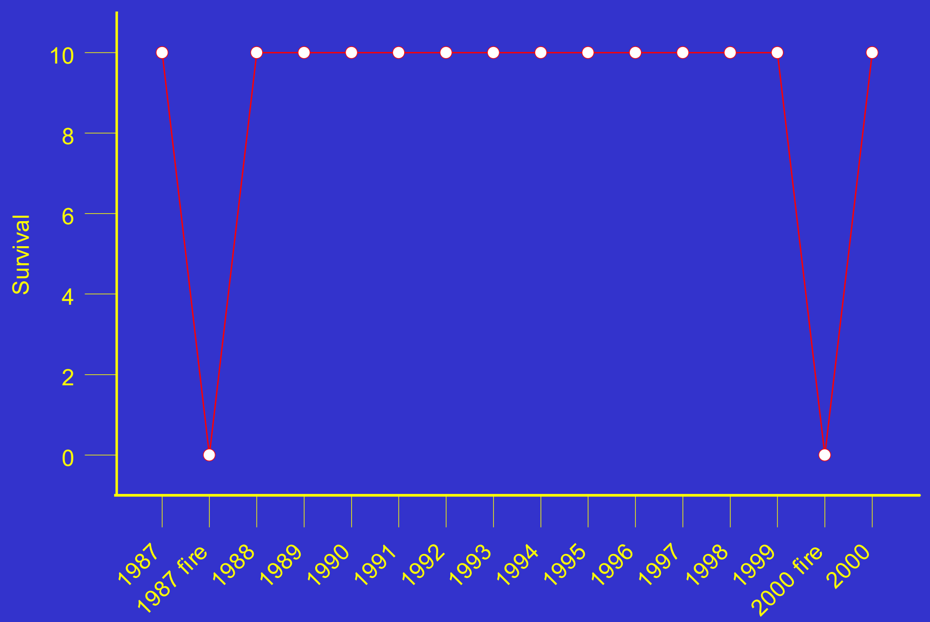
- Population viability models demonstrate that extinction probabilities in non-sprouting shrubs increase as fire frequency increases but are also affected by post-fire rainfall (*Burgman & Lamont 1992*)
- Spatially explicit models demonstrate that extinction probabilities in non-sprouting perennial shrubs *increase* with fire frequency and scale (*Bradstock et al. 1998*)
- *Non sprouters more susceptible to fire related extinction than sprouters*
- Recent empirical studies in fire prone heath and woodlands on Sydney sand-stones confirm this. More frequent fires were associated with declines in non-sprouting shrubs with canopy stored seed bank and non-leguminous species with a soil seed bank (*Cary & Morrison 1995; Morrison et al. 1995*)

Impact of two fires on granite endemics

Non-sprouter - *Hakea petiolaris*

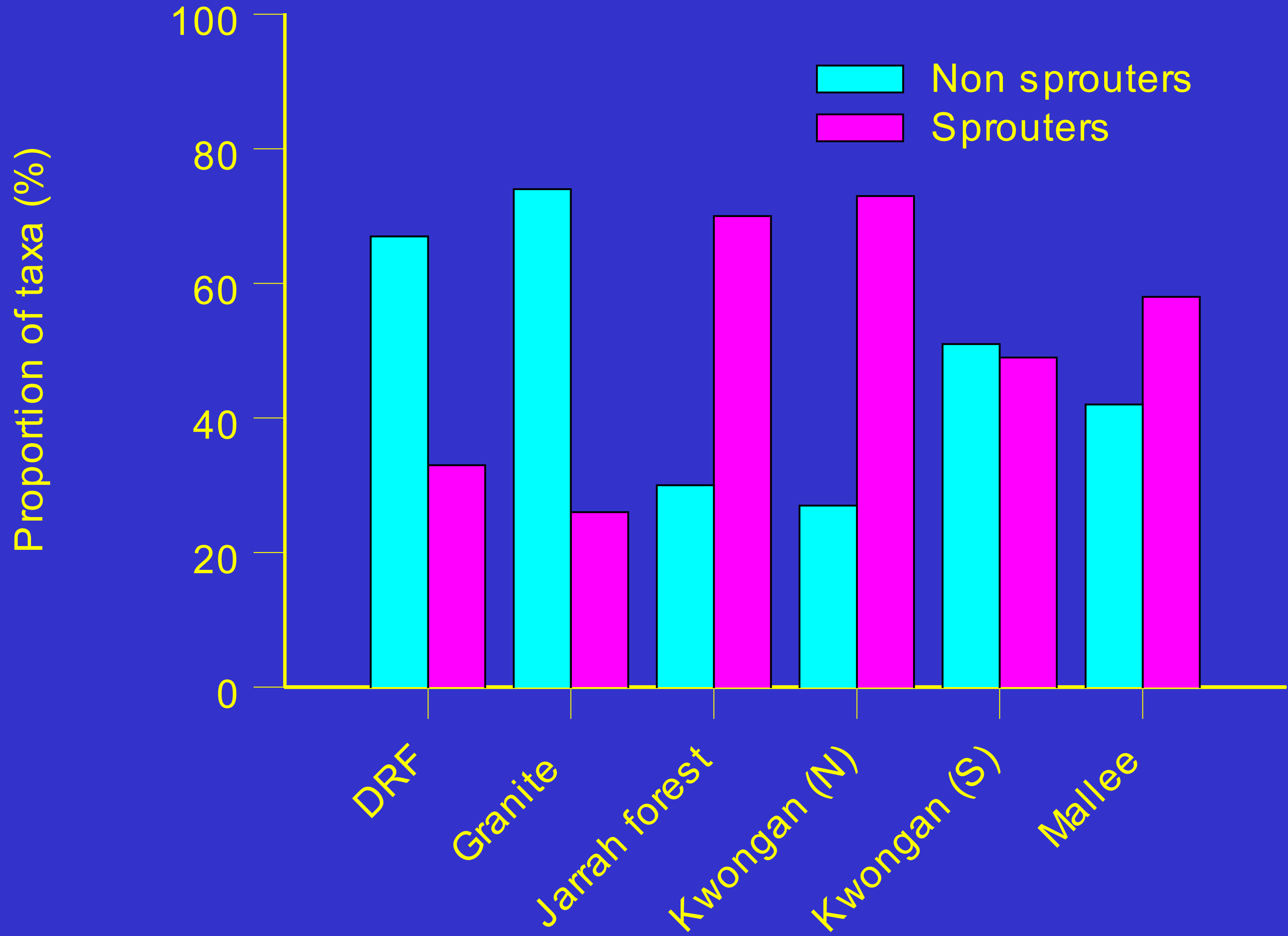


Sprouter - *Eucalyptus caesia*



(*Yates et al. 2002*)

Comparative fire response in rare (threatened) flora and major vegetation associations



Relationship between fire and extinction

- Fire driven mechanisms of plant population decline and extinction
  - death of standing plants and seeds (*fire intensity*)
  - failure of seed release and or germination (*fire intensity, post fire rainfall*)
  - interruption of maturation or developmental growth (*fire interval/frequency*)
  - failure of seed production (*fire interval/freqency, environmental variability*)

- Fire regimes associated with multiple mechanisms of plant population decline and extinction include *both* high frequency and low frequency fires (*Keith 1996*)

Shorter fire intervals (high frequency) and extinction

- Local extinction will occur if the fire interval is shorter than the time taken for plants to reach reproductive maturity (primary juvenile period)

Longer fire intervals (low frequency) and extinction

- Alternatively, if the fire interval is greater than plant longevity individuals may senesce and die before there is an opportunity for regeneration
- In non-sprouters that store their seed in the canopy, the seed bank does not persist for long following death of the parent and local extinction could result if there is complete senescence of the stand
- In non-sprouters that store their seed in the soil adults may die and apparent local extinction occur but the species can persist albeit as seeds in the soil for as long as this reserve remains viable

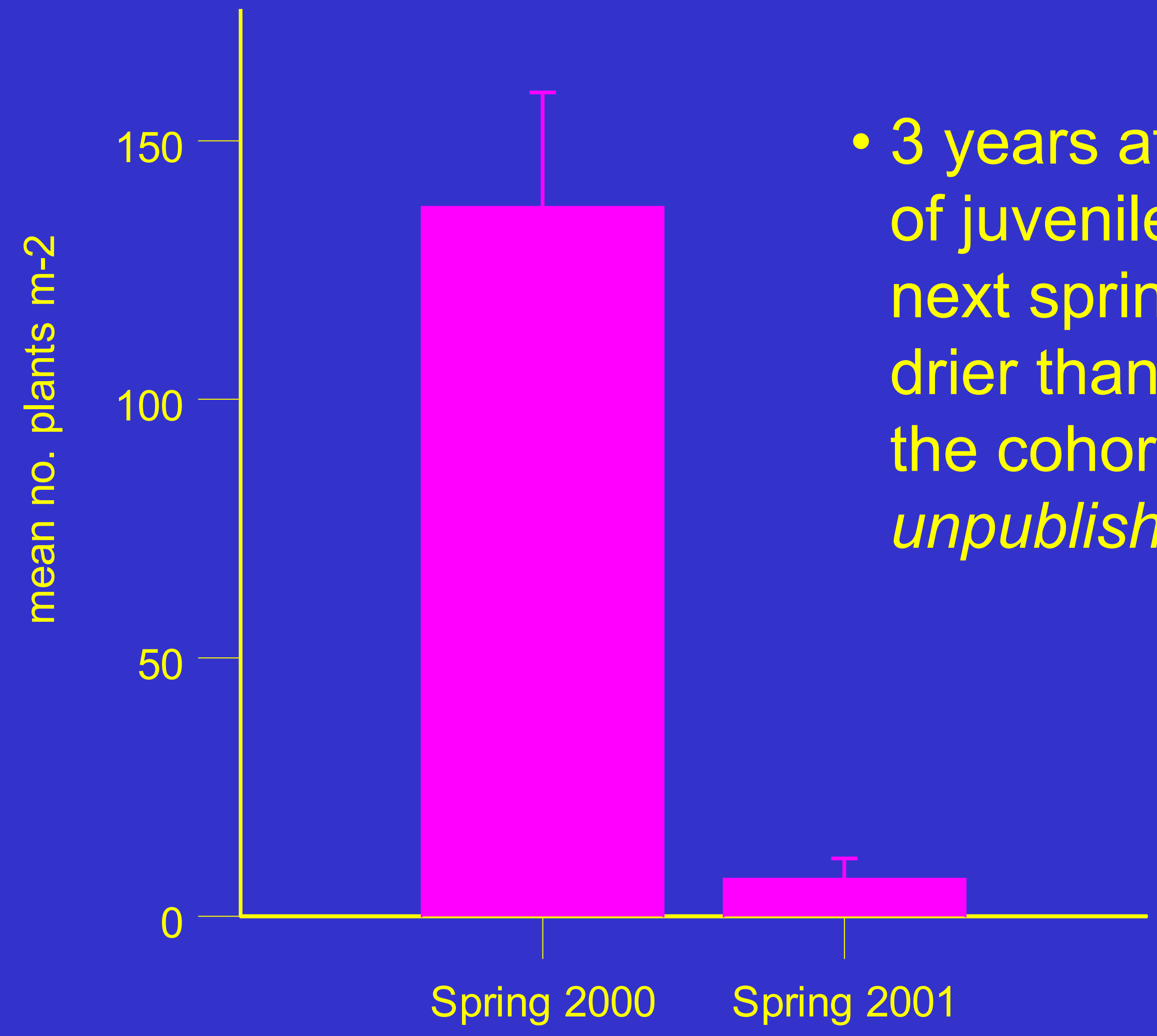
Banksia cuneata

- Non-sprouting shrub - killed by fire
- Canopy stored seed reserve
- Seedling recruitment restricted to first winter following fire

- Frequency of prescribed fires at intervals of 7 years results in reduced population size and 84% extinction risk because plants less than 12 years old carry relatively few seeds
- Frequency of prescribed fires at 15 - 25 year intervals results in increases in population size. However there was still a 50% risk of extinction because seedlings that establish after fire are highly susceptible to drought
- Long fire intervals lead to smallest risk of extinction because seedlings exposed to fewer droughts, but also leads to substantial population decline because plants do not live longer than 45 years (*Burgman & Lamont 1992*)

Post fire rainfall and extinction

e.g. Verticordia fimbrilepis ssp. fimbrilepis



- 3 years after a fire large number of juveniles were recorded but the next spring following considerably drier than average winter most of the cohort had died (*Yates & Ladd unpublished data*)

Increases in abundance of threatened plant taxa following fire which have long lived soil seed banks

- Upsurge in survey effort for threatened plant taxa in the south-west
- Numerous examples have been documented where fires have resulted in range extensions, increases in the number of populations or increases in local abundance of rare or presumed extinct plant taxa

Sowerbaea multicaulis

Photo Luke Sweedman

Status before fire
- presumed extinct

Status after fire
- range extension
- millions of plants

Calamphoreus inflatus

Photo Andrew Brown

Status before fire

- 2 populations, 250 plants

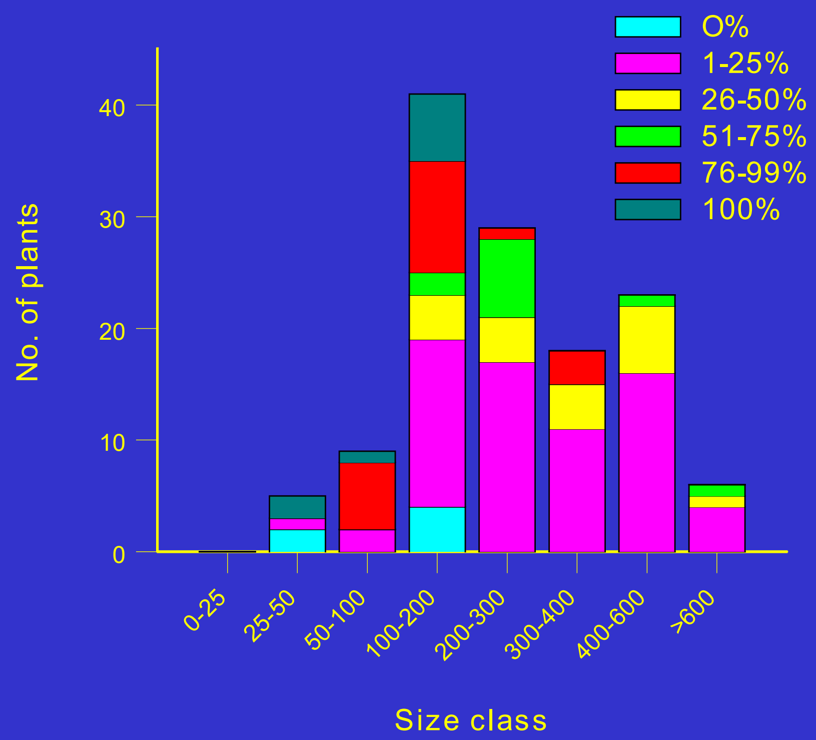
Status after fire

- 5 new populations, > 120 000 plants

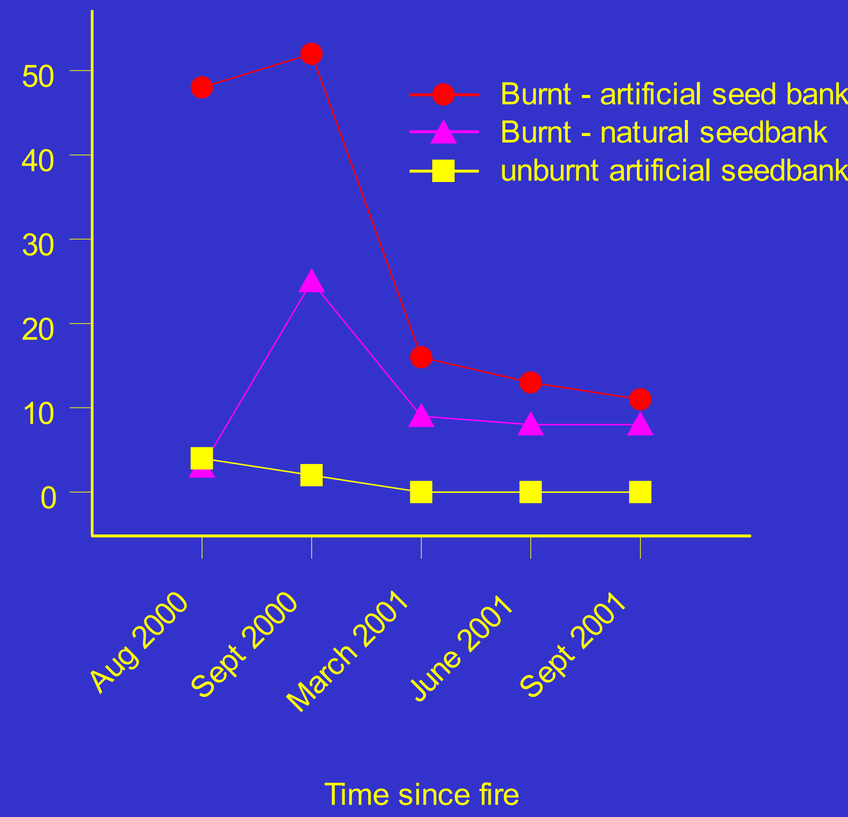
These examples indicate that adult rarity may be temporal and abundance related to time since fire for some rare taxa. In these taxa long - lived seed banks persist in the soil

Acacia cochlocarpa ssp. cochlocarpa

Population structure & health



Experimental fire



(*Yates and Broadhurst 2002*)

Fire and extinction - animals

- Animals also affected by fire frequency and scale
- K-selected species, characterized by low reproductive rates, long-lived individuals and small populations may be especially vulnerable
- If scale of each fire is large and homogeneity of the burnt area is excessive, less mobile animal species may be unable to recover their distribution and abundance if the source of colonists is too distant
- Animal species lacking fire secure shelter (eg burrows, underground interstices between soil particles) or the ability to avoid fire in time (aestivation) are most likely to be rare under a regime that burns large parts of the landscape simultaneously

Noisy scrub bird *Atrichornis clamosus*

Photo Babs and Bert Wells

- Limited flight
- Low breeding success
- Clutch of only one egg
- Breeds in relatively long unburnt dense vegetation
- In wetter gullies 4-6 years
- In drier gullies 4-10 years

(*Smith 1985 a,b,c*)

Dispersal to regenerating habitats and ability to re-establish a population and then increase in abundance before the next fire is likely to be slow and species only survives where fire has been excluded for long periods

Biogeography of rare species sensitive to fire

- In fire prone landscapes, the most fire sensitive organisms are likely to have retreated to areas where fire frequency is lower in the landscape and/or where refuges such as topographic features provide protection

- This is well illustrated in south-eastern Australia where fire sensitive rainforest species occur in wetter topographically protected gullies adjacent to fire prone eucalypt forest

Podocarpus drouynianus

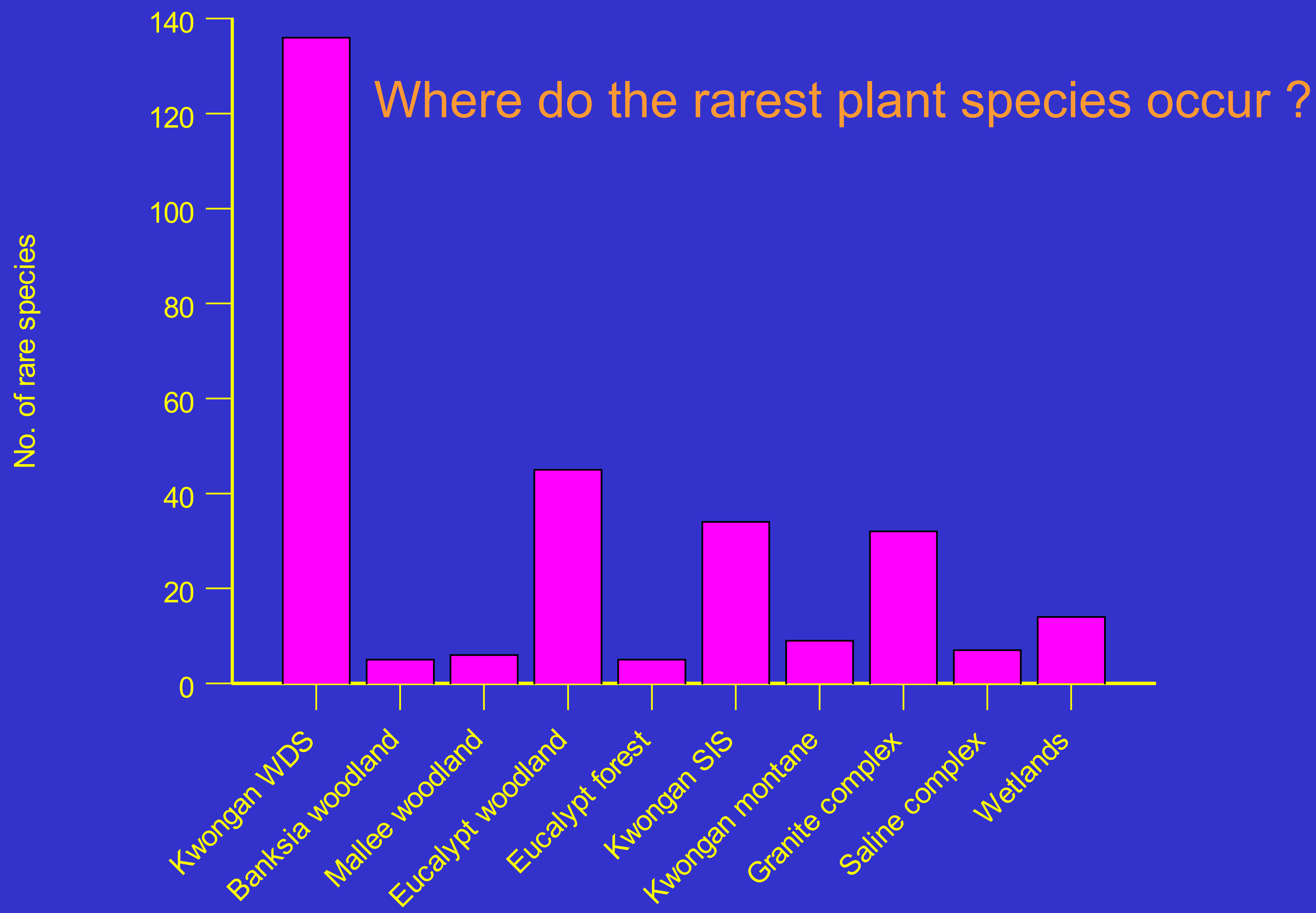
Photos Phil Ladd

Cainozoic fossil record (SW Aust) shows a decline of fire sensitive rainforest to almost complete extirpation and replacement by sclerophyll vegetation associated with the drying of the continent

A few of the most resilient sprouting species have persisted

Fire refugia in south-west Australia?

- The aridity, Mediterranean climate, flat landscape and long history of fire in south-west have provided few refuges for fire sensitive Gondwanan taxa to persist
- Nevertheless some areas have been indentified as fire refugia for fire sensitive narrowly endemic relictual and/or rare taxa
- These are the Tingle mosaic, granite rocks, Stirling Ranges, offshore islands and wetlands (*Hopper et al. 1996*)


Where do the rarest plant species occur ?
No. of rare species
0
20
40
60
80
100
120
140
Kwongan WDS
Banksia woodland
Mallee woodland
Eucalypt woodland
Eucalypt forest
Kwongan SIS
Kwongan montane
Granite complex
Saline complex
Wetlands

Two key questions arise from biogeographic analysis of rarity

- What role has fire played in plant rarity in Kwongan?
- Is there a correlation between rare species with fire-sensitive life histories and habitats identified as refuges such as tingle forests and granite outcrops

How has fire contributed to rarity in kwongan?

- Causes of extraordinary species richness and endemism?
- Role of fire in maintaining species richness, local rarity and as a process driving speciation have received increasing attention
- Variable fire regimes and environmental stochasticity allow less competitive relatively rarer species to co-exist with competitively superior species (*Cowling et al. 1996*)
- Niche partitioning (*Hopkins & Griffin 1984*)
- Accumulation of regional species richness through phylogenetic processes (*James 1981*)
- Combination of ecological and phylogenetic processes (*Hopper 1979; Hopper et al. 1996*)

Fire frequency in Kwongan ?

- Studies of *Banksia* life histories have inferred long term fire frequencies of 10-16 years (*Cowling et al. 1990; Witkowski et al. 1991; Enright et al. 1996; 1998*)
- More recently analysis of charcoal deposits in Holocene sediments in Fitzgerald River National Park have estimated average intervals of 30-60 years (Hassell 2000)
- There are anomalous rare kwongan species whose life histories are not consistent with a habitat more frequently burnt

Banksia tricuspis

- Locally abundant but geographically restricted occurring on lateritic uplands and breakaways over a 13 km range in the Lesueur National park
- Sprouts following fire but seedlings have a very long primary juvenile period compared to other kwongan banksias and also take longer to develop fire resistance (20 years) than might be expected in a fire prone environment (*Lamont & van Leeuwen 1988*)

Western whipbird (*Psophodes nigrogularis*)

In Fitzgerald River National Park no birds were recorded in sites burnt more recently than 17 years previously (*Chapman and Newbey 1995*)

Life history attributes of rare species in fire refuges

- Consider life-history attributes of rare, locally rare or narrowly endemic species where they have been studied in areas that have been identified as fire refuges such as the tingle forest and granite rocks

- Are taxa in these areas more fire sensitive than in surrounding landscape?

Tingle mosaic

- Rainfall highest, climate least seasonal and fire season shortest within south-coastal uplands (3700 km^2)
- Importance of this area for persistence of narrowly endemic high rainfall, relictual flora and fauna many with Gondwanan affinities (*Main & Main 1991; Wardell-Johnson & Williams 1996*)
- Relictual plant taxa - *Eucalyptus brevistylis, E. jacksonii, E. guilfoylei*
- Relictual animal taxa- spiders *Moggridgea tingle*

Tingle forest and fire

- Hypothesised that geographically restricted tingle forest are successor of Tertiary *Northofagus* rainforest and are unlikely to be able to cope with fire as well as other eucalypt forest types that occur in the region (Main 1987)

- Idea tested by comparing the responses of the three locally endemic relict eucalypts with regionally distributed more recently evolved congeners (*Wardell-Johnson 2000*)

Are locally endemic taxa more vulnerable to fire than regionally distributed congeners?

- The 3 tingle species sprouted following fire and were therefore not fire sensitive
- Two tingle species had life history traits that might preclude them from environments with a fire regime of more frequent fires where regionally distributed eucalypts are more common
- *E. brevistylis* - lower levels of post-fire seedling regeneration
- *E. jacksonii* - higher rates of hollow butting

Moggridgea tingle - Gondwanan relict

- One of the most striking fire sensitive animal species is the trapdoor spider *Moggridgea tingle*, which makes short cocoon-like tubes closed by a circular door, placed on the moss on the bark of tingle trees or on the ground. These nests are destroyed by fire

Granite Rocks

Numerous granite outcrops throughout relatively flat SW Aust landscape. Vary in spatial extent from < 1 ha to c. 2000 ha
Many rare plants confined to granite outcrops

- Provide natural fire breaks, records of patches which have not been burnt for 80-100 years
- May provide refugial opportunities for fire sensitive organisms in fire prone landscapes?

Granite rocks - fire refuge for the Noisy scrub-bird

- The most famous example of granite outcrops providing refuge for a fire sensitive species comes from the Mt Gardner headland east of Albany where *Eucalyptus* and *Agonis* low forest with a dense understorey adjacent to granite provided a last refuge
- Fire intervals < 10 years near extinction; intervals 30-50 years necessary for persistence
- Historical air photography showed extensive bare granite ridges provided a natural network of firebreaks allowing some areas to remain unburnt for long periods
- Fire exclusion has led to a spectacular recovery of the species

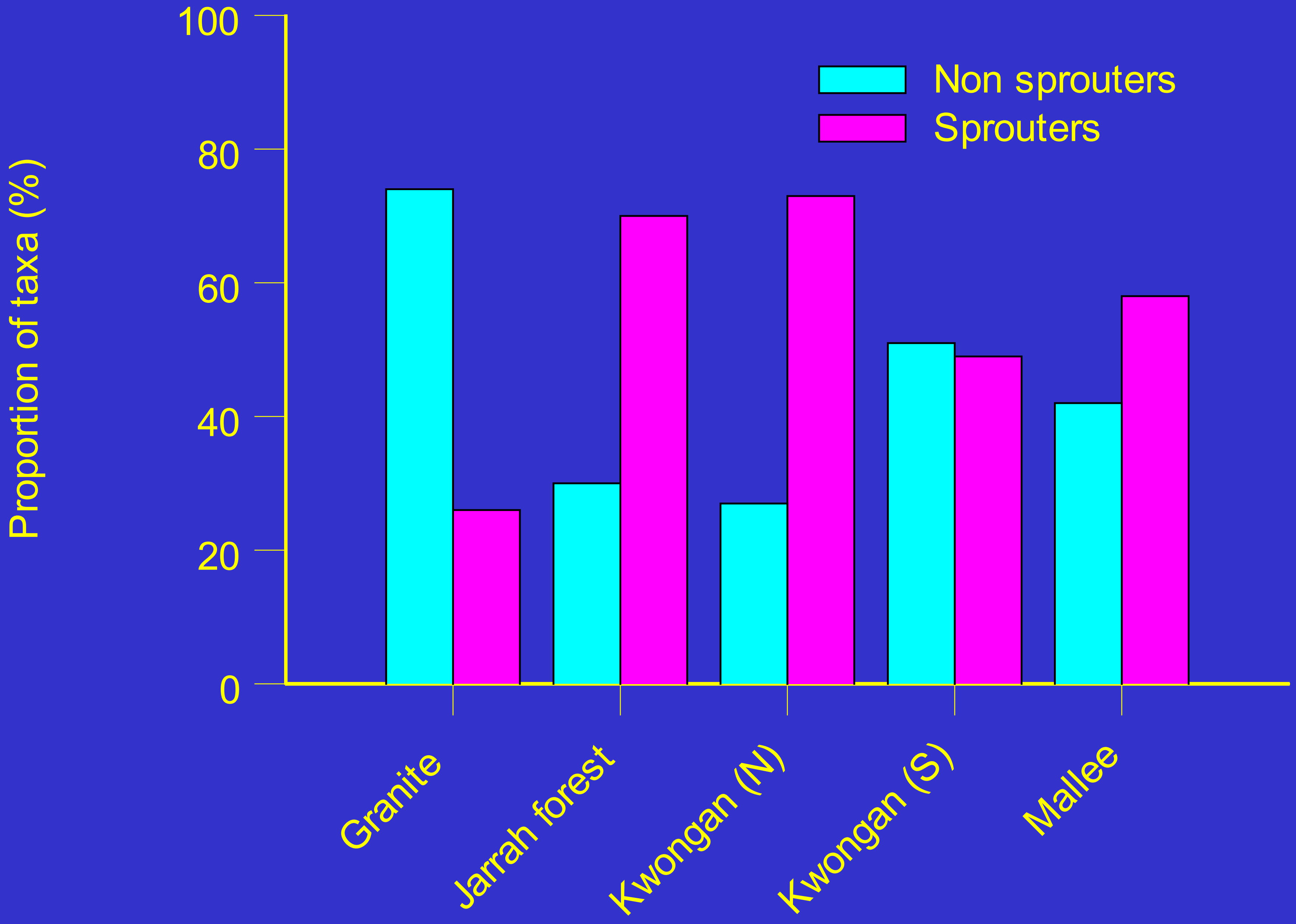
Granite outcrop - refuges for fire sensitive plants?

- Research in north-eastern NSW has found a higher proportion of non-sprouters (50 %) on granite outcrops than in surrounding forest (12%) *(Hunter 1999)*
- Hypothesized that the proportion of non-sprouter/sprouters in plant communities reflects the historical fire frequency
- High proportions of non-sprouters in vegetation are thought to reflect low fire frequencies

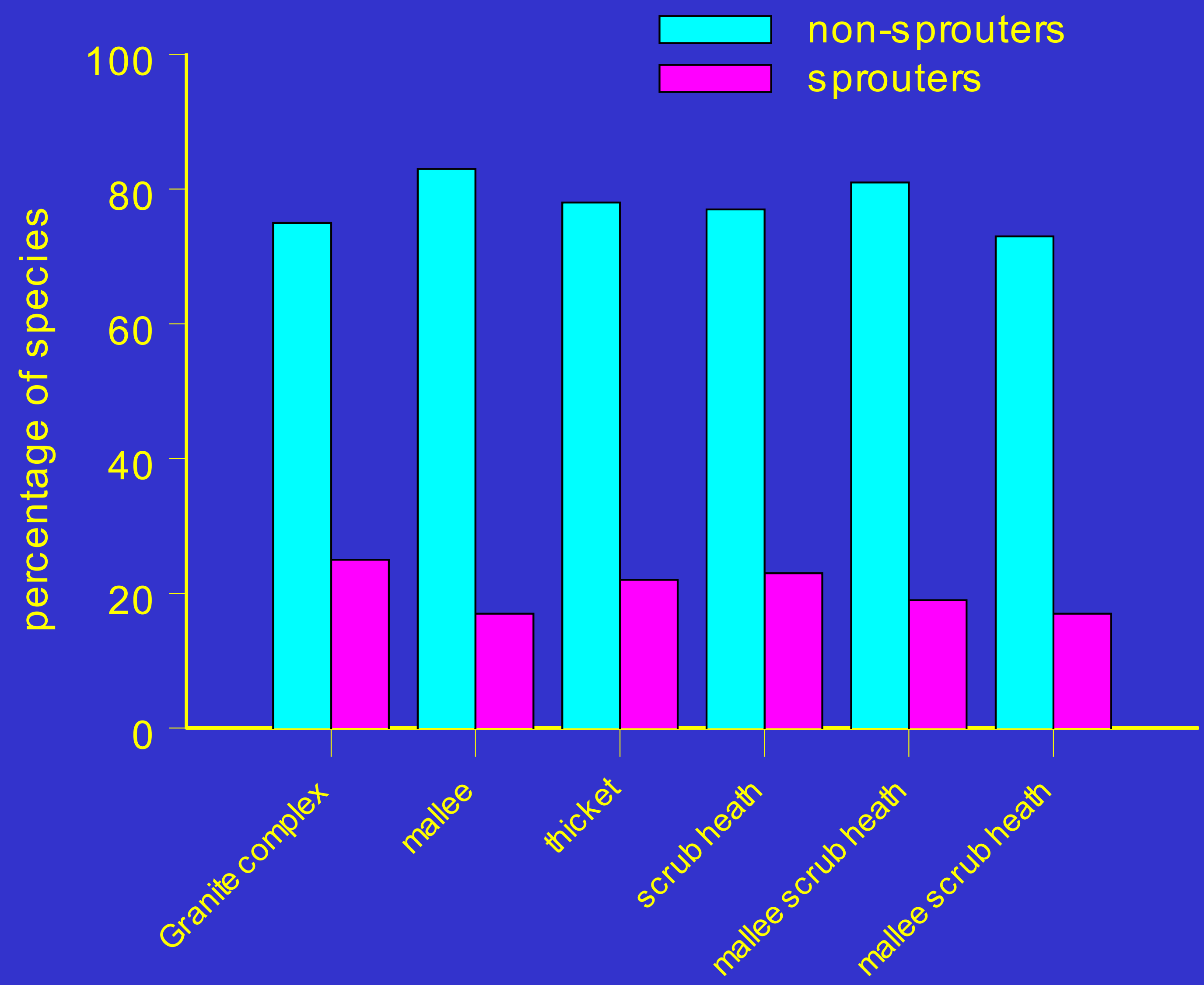
Granite outcrops refuges for fire sensitive plants SW Australia ? Chiddarcooping

- 74% of 148 recorded species were non-sprouters
- Recorded functional and phenological responses similar to that reported in fire-prone communities
  - Fire ephemerals (*Gyrostemon subnudus, Alyogyne hakeifolia, Codonocarpus cotinifolius*) were recorded in abundance in first few years following fires
  - Stimulated flowering in *Xanthorrhoea nana* and the rare locally endemic orchid *Cyanicula ashbyae*

(Yates et al. 2002)


Proportion of taxa (%)
100
80
60
40
20
0
Non sprouters
Sprouters
Granite
Jarrah forest
Kwongan (N)
Kwongan (S)
Mallee

Granite complex versus surrounding communities



Conclusions

- The greater proportion of rare (threatened) plants are non-sprouters and therefore their abundances are particularly susceptible to fire regimes
- Fire has been a recurring disturbance in south-west for a long time. The relatively flat subdued landscape has provided little topographic protection for fire sensitive communities
- Circumstantial evidence that some areas may burn less frequently than surrounding habitats and these may act as refuges for fire sensitive taxa or communities, but still much to be learnt

- The evidence that fire sensitivity is a major determinant of rarity is compelling for the Noisy scrub-bird and largely correlational for some other vertebrates and plants
- The greatest number of rare plant species occur in Kwongan where fire is a recurring but relatively infrequent disturbance. Fire may play a role in the maintenance of this diversity and rarity but there are alternative explanations for this biogeographic pattern

Fire behaviour and post-fire response of mallee-heath shrublands

Stirling Range National Park

Study aims

- - to investigate factors that control spread and intensity of bushfires in mallee-heath shrublands,
- - to develop a practical guide for predicting fire behaviour,
- - to investigate post-fire response of a mallee-heath plant community and identify plant species that are useful indicators of the effects of fire regimes.

Location and site details

- Two Mile Lake near the south-east corner of the Stirling Range NP,
- Annual average rainfall 450 mm,
- *Eucalyptus tetragona* mallee-heath association,
- Last burnt 20 years ago in 1969,

Vegetation Characteristics

- Layer of shrubs or mallees - 3-5m tall, <30% cover
- Intermediate stratum of shrub to 2m tall including *Banksia, Hakea, Xanthorrhea*
- Stratum of low shrubs up to 1m tall: *Banksia, Dryandra, Petrophile, Hakea, Epacrids*
- Wide range of species composition depending on soil type & rainfall.
- Fuel loads at maturity typically 10-15 t/ha.

Mallee-heath at Stirling Range National Park unburnt for 20 years

Experimental fires

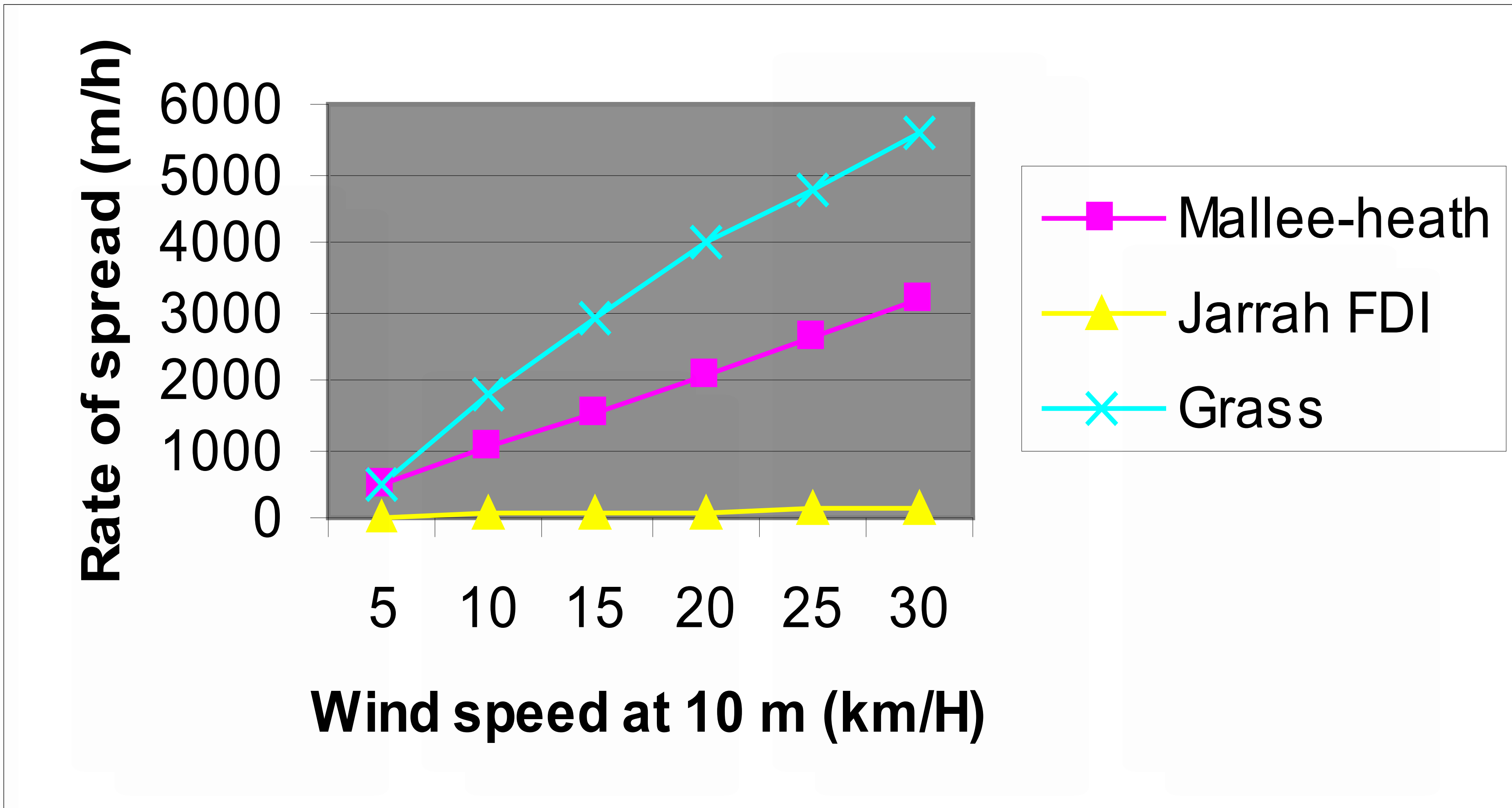
- 18 experimental fires conducted between October 1989 and May 1992,
- Fire size = 4 ha
- Fires ignited as a 200 m long line on upwind side of plot with a flamethrower,
- Fires lit in spring, summer and autumn,
- Two fires under Very High fire danger (Grassland fire danger 32-34)

Stirling Range - experimental fire G 19/02/1991
rate of spread 2400 m/h   fireline intensity 14 000 kW/m

Go - No Go Fire Spread

- Sudden and violent changes in fire behaviour are linked to small changes in:
  - wind speed and direction,
  - fuel moisture content
  - fuel structure.
- Established fires burning under summer conditions can exhibit severe behaviour, with rapid rates of spread and long flames.

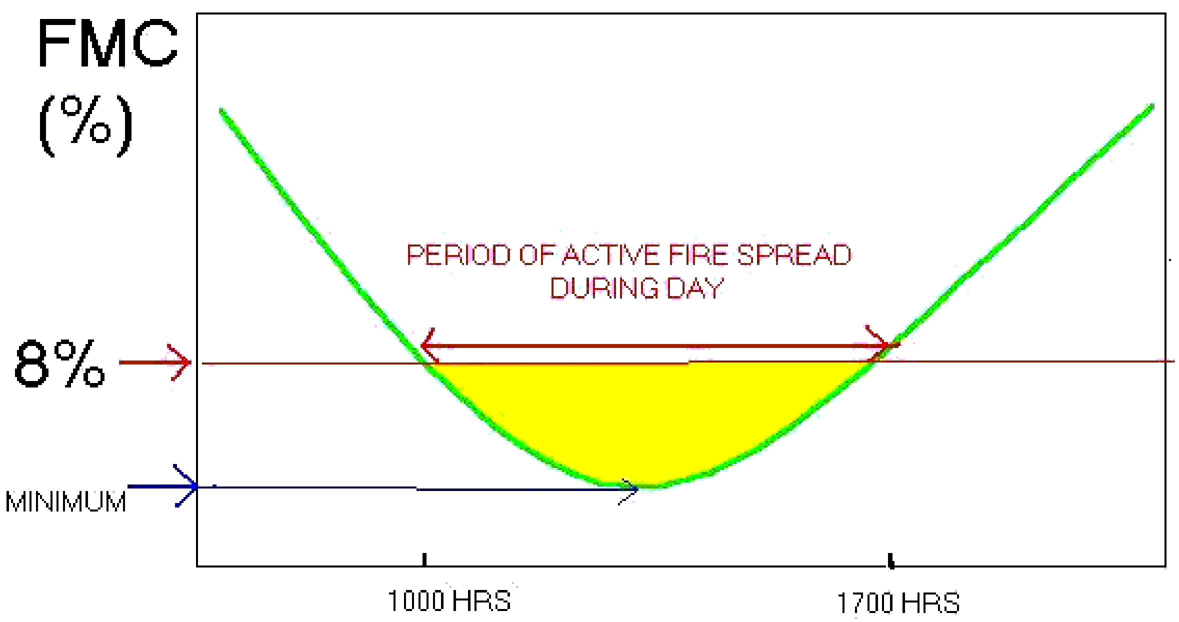
Predicted rates of spread for mallee-heath, cured grassland and standard Jarrah forest fuel, with a fuel moisture content of 7%



Factors Controlling Go - No Go Spread

- Litter moisture content controls whether fires will sustain and spread, or go out
- Wind speed has the dominant effect on rate of spread, if litter is dry (<8%)
- Need to be able to predict moisture content of shallow litter in order to predict when fires will spread or go out

TYPICAL PATTERN OF FINE FUEL MOISTURE CONTENT IN MALLEE-HEATH DURING A SUMMER DAY



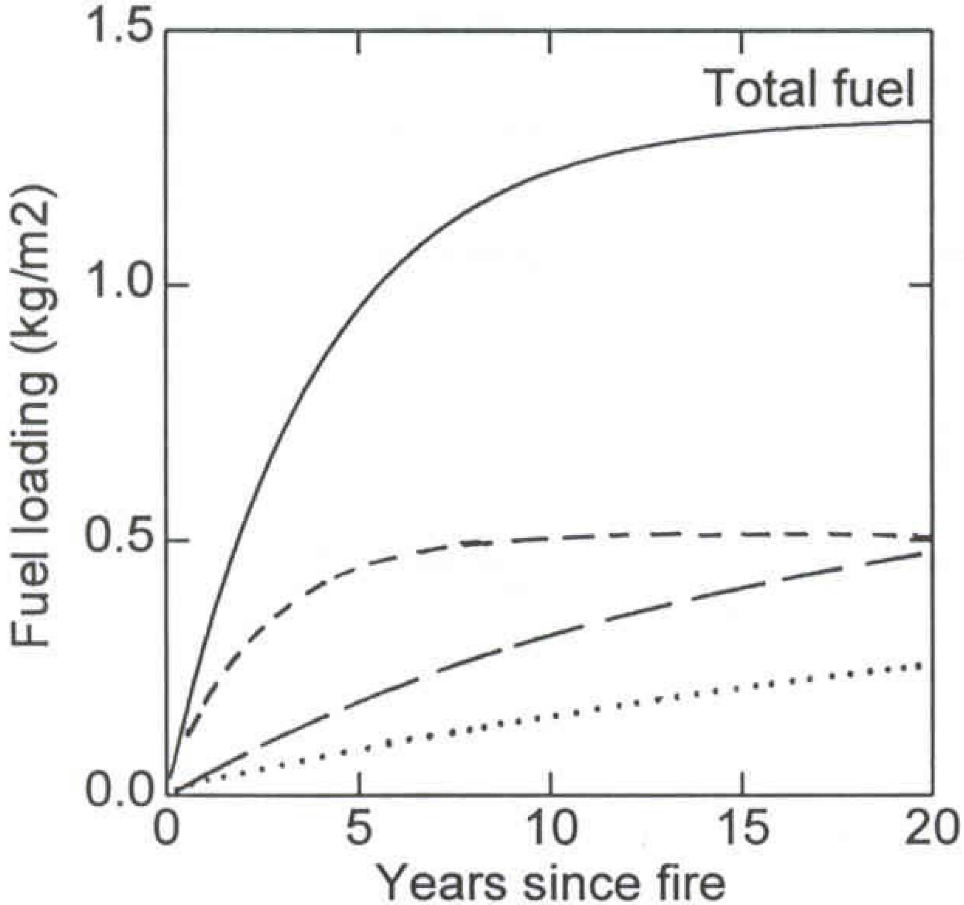
Mallee-heath fire behaviour guide

- **Select weather pattern**
  -(A) high pressure in the Bight
  winds East going South-east
  - (B) trough movement
  winds North to North-west, then West

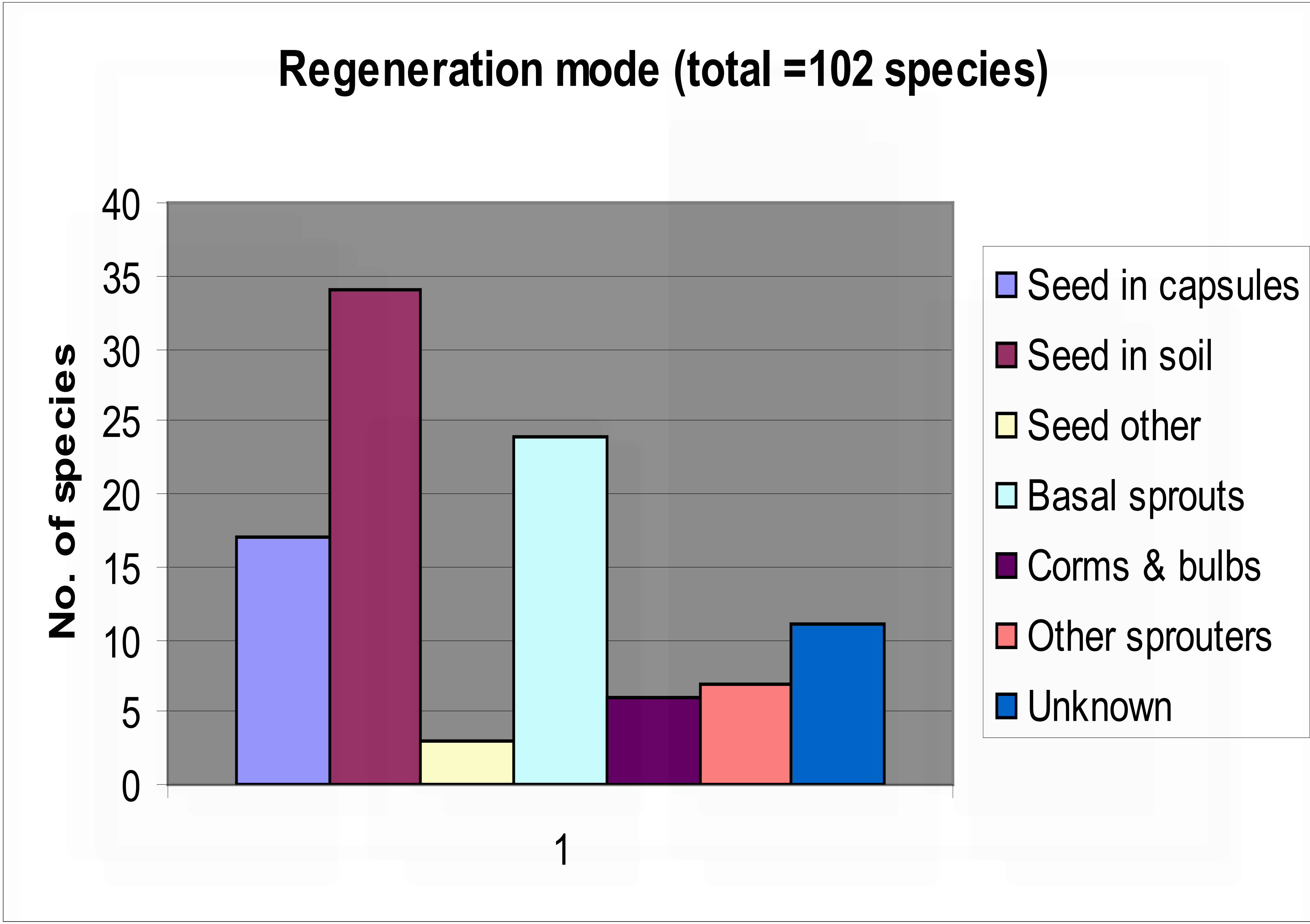
- **Based on forecast maximum temperature for the day, the tables predict:**
  - period of day during which fires are likely to spread actively
  - hourly moisture content of litter
  - forward rate of spread, as a function of ***litter moisture content*** and ***wind speed***
  - flame length, and fire intensity (in kW/m)

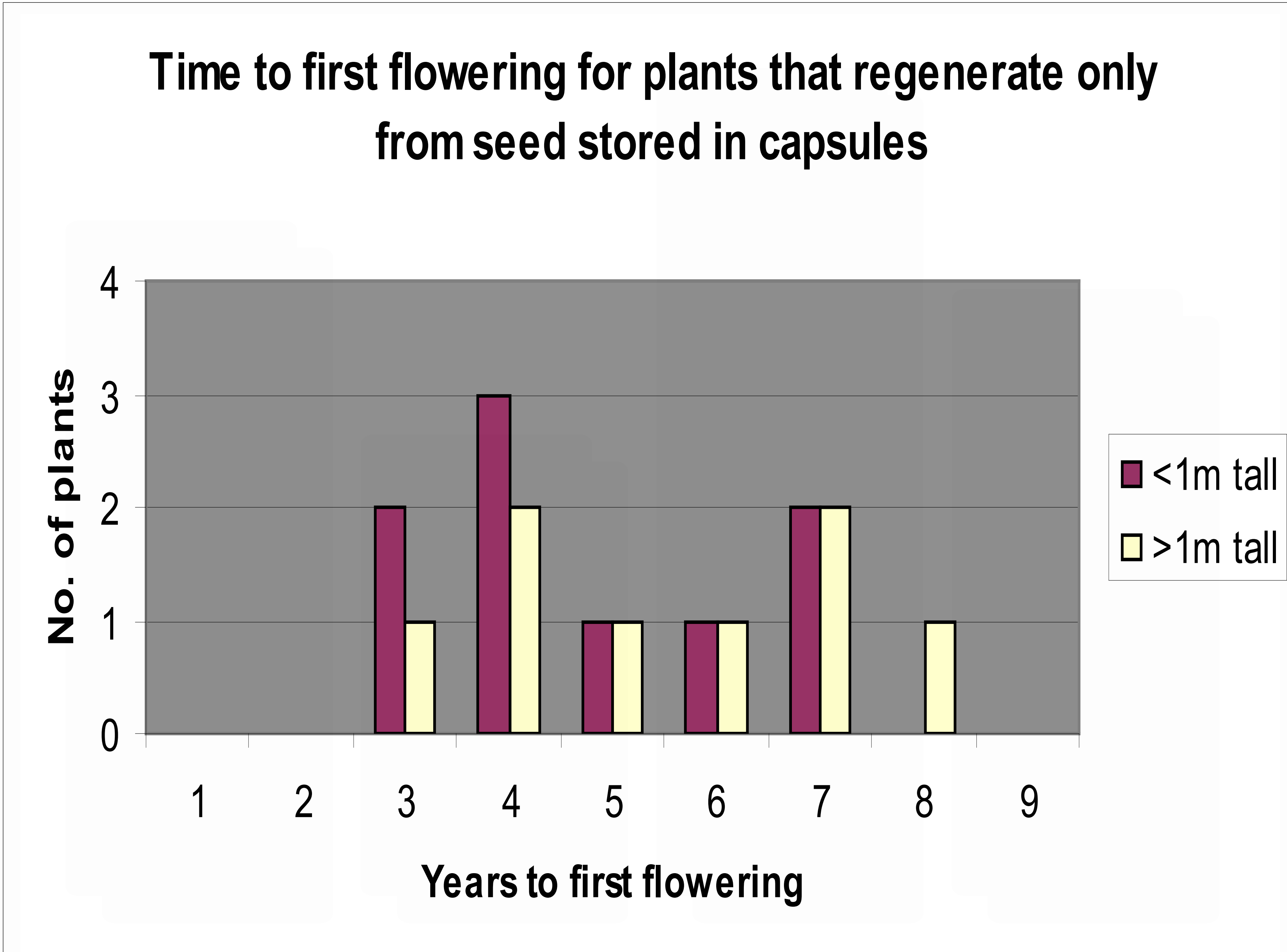
Responses to fire

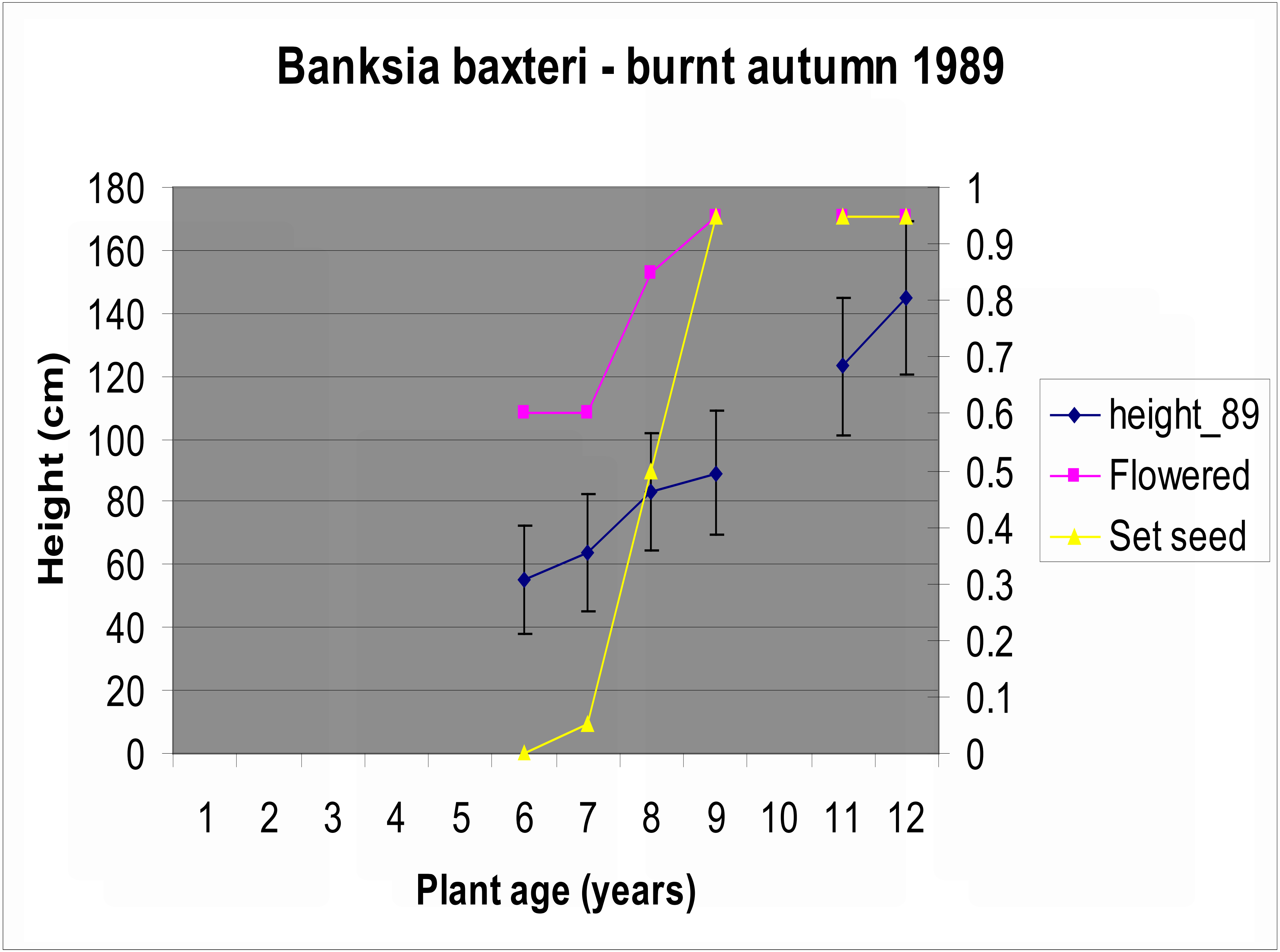
- Fuel accumulation rates,
- Plant attributes
  - re-sprouting
  - regeneration from seed
- Indicator plant species for fire regimes
- Plants that avoid fire



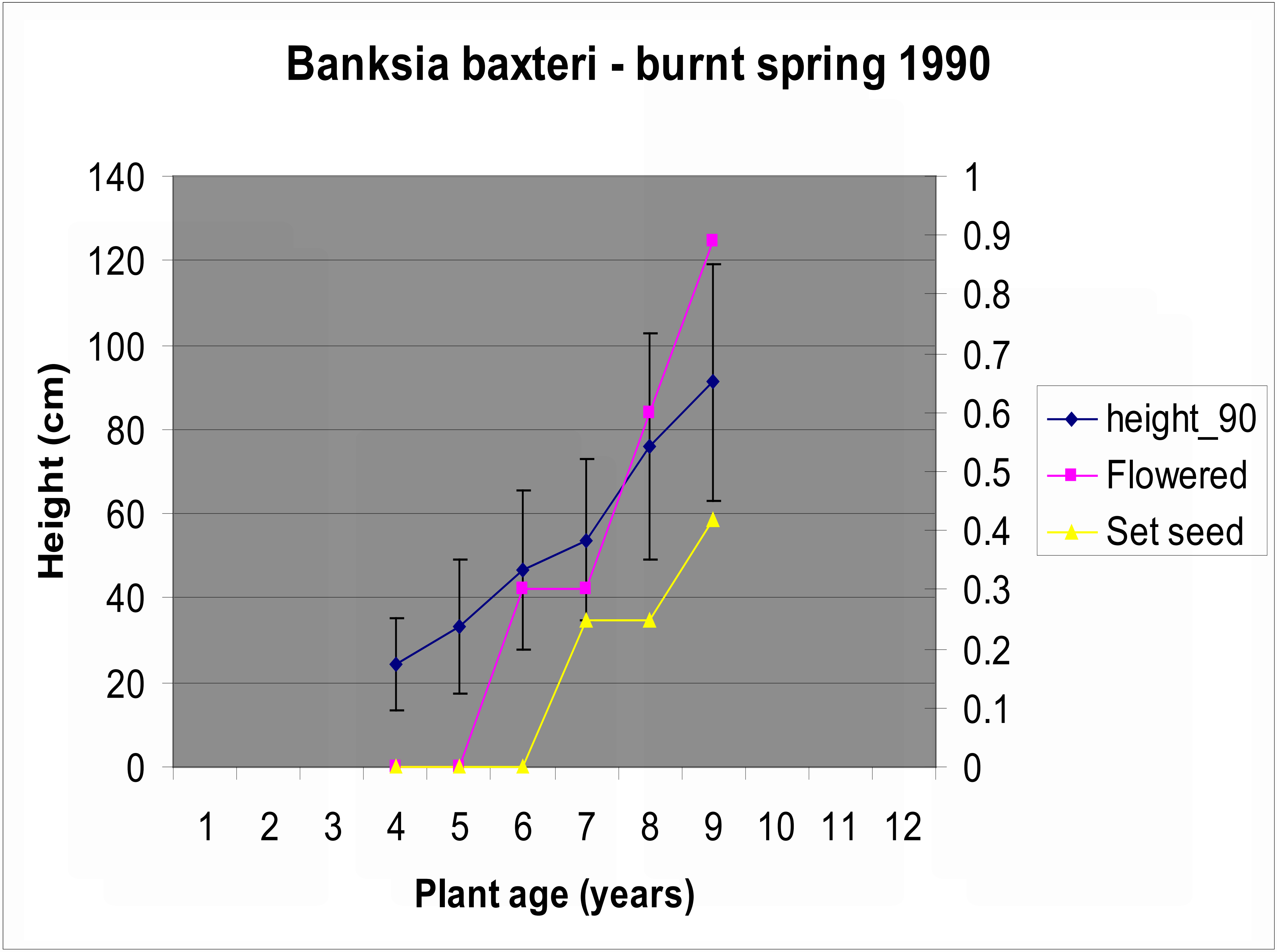
Fuel accumulation in mallee-heath up to 20 years post fire for litter (— —), dead <6 mm (· · · ·), live < 6 mm (- - -) and total fuel loading.


Regeneration mode (total =102 species)
No. of species
40
35
30
25
20
15
10
5
0
1
Seed in capsules
Seed in soil
Seed other
Basal sprouts
Corms & bulbs
Other sprouters
Unknown

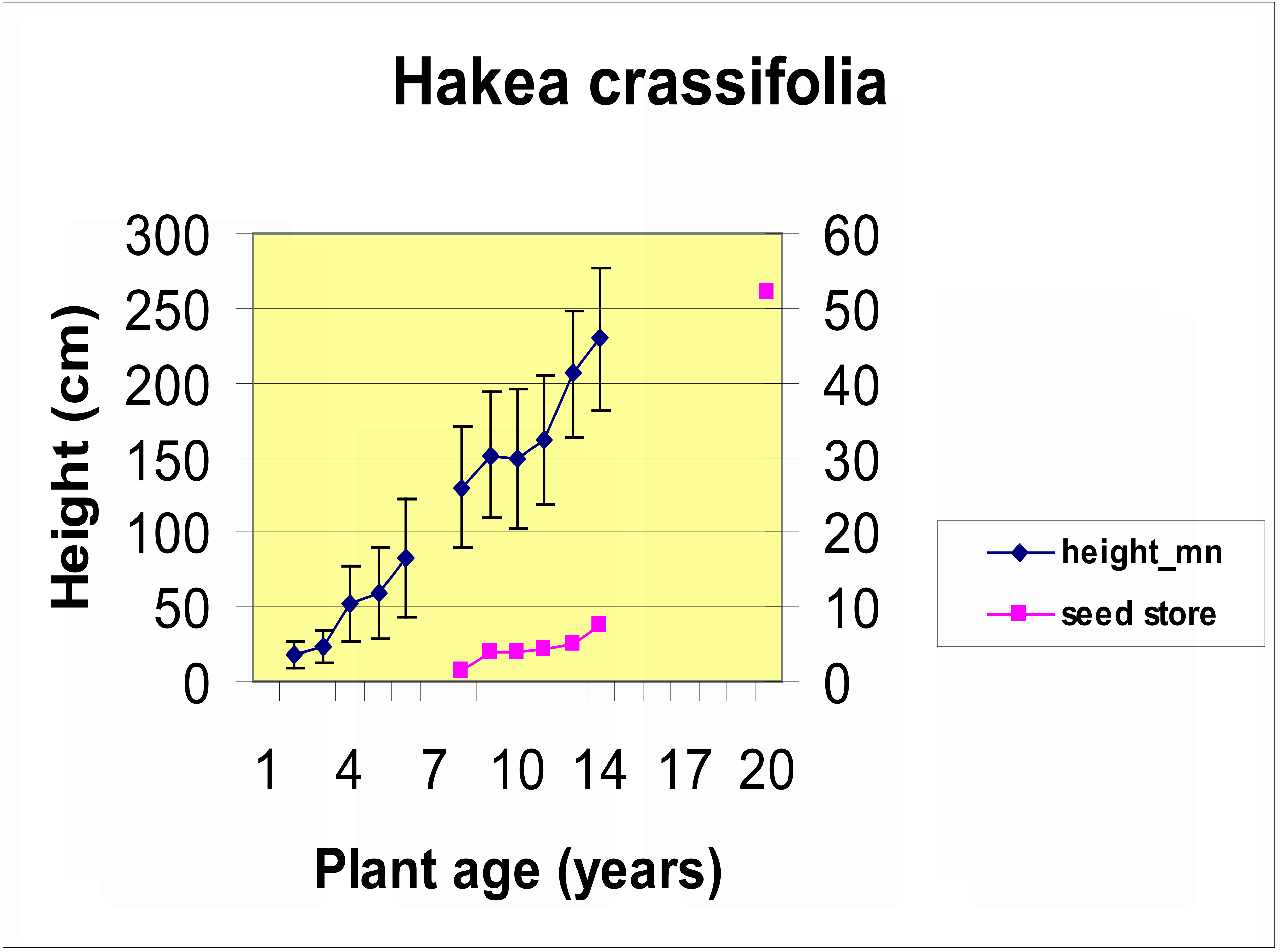

Time to first flowering for plants that regenerate only from seed stored in capsules
No. of plants
4
3
2
1
0
1
2
3
4
5
6
7
8
9
Years to first flowering
<1m tall
>1m tall



Banksia baxteri - burnt autumn 1989
Height (cm)
180
160
140
120
100
80
60
40
20
0
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1 2 3 4 5 6 7 8 9 10 11 12
Plant age (years)
height_89
Flowered
Set seed



Banksia baxteri - burnt spring 1990
Height (cm)
140
120
100
80
60
40
20
0
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1 2 3 4 5 6 7 8 9 10 11 12
Plant age (years)
height_90
Flowered
Set seed


Hakea crassifolia
Height (cm)
300
250
200
150
100
50
0
60
50
40
30
20
10
0
1
4
7
10
14
17
20
Plant age (years)
height_mn
seed store

Plants that avoid fire

- Some parts of the landscape experience fires less often than others
- Provide refuges for plant species that are slow to mature or intolerant of fire
- Reasons:
  - moisture differential
  - low fuel levels eg. rock outcrops, dunes
- Example: *Callitris*

Fire Management Issues

- Large reserves with limited access, & often difficult terrain
- Lightning ignition common (October-February)
- Major fire runs can burn out large areas in a day (100,000 ha)
- Dramatic effects on landscape and biota
- Vegetation may re-burn 5 to 8 years after fire, but before seed stores have been replenished (examples: Cape Arid 1993, Fitzgerald River 1997/98, Stirling Ranges 2000)

Strategies for managing fire

- Avoid perpetuating large tracts of even-aged vegetation,
- Aim to create and maintain patchiness within burns;
  - at landscape scale,
  - at localised scale,
- Identify fire refuges in landscape, and monitor condition of indicator plants and animals

The End

Fire in Small Remnants

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Introduction

Western Australia has flammable vegetation, dry summers and sources of ignition, so it is hardly surprising that fire is an important component of ecosystems. Over millions of years, native plants and animals have evolved various strategies that have enabled them to cope and persist in this fire-prone environment.

When humans discovered Australia, they already knew how to make fire, thus in some areas of the continent the nature of the fires and the frequency with which they occurred probably changed. After European settlement, the fire regime altered again.

In this paper, I am not going to discuss the effects of fire in detail, other speakers will be doing that (or, see "Managing Your Bushland"). Rather, I am going to discuss the problems presented by trying to manage fire in remnants of native vegetation, whilst at the same time trying to conserve that bushland and all its native flora and fauna. Where those remnants are small - say from 2.5 to 50 ha - and especially if they are isolated from other areas of native vegetation, they present very considerable difficulties for fire management.

Now, in this millennium, why might you consider deliberately burning your bushland?

Unplanned fire may occur at any time (though you can take steps to try and prevent it).

Planned fire may be prescribed for one of three reasons:
- to remove a perceived fire hazard
- to promote regeneration (or 'ecological renewal')
- to bare the ground prior to direct seeding.

It is assumed in this paper that the deliberate use of fire in your remnant is being considered for regeneration.

If planning to use fire in bushland, remember the following:

The effect of an individual fire varies, depending on -

- frequency between burns
- time of year
- type of fuel available
- intensity
- patchiness
- climatic events (eg rain, strong winds) before or after the fire.

In the same piece of bushland, different types of fires can result in the regeneration of different plants.

effect of fire on native plant communities

- severely damages - may kill - aerial parts
- causes stress - regrowth may be more prone to attack by predators and disease
- may release canopy-stored seed
- may stimulate subsequent flowering
- may induce germination in the soil-stored seed bank
- may stimulate growth from lignotuber (mallee root)
- removes herbivores (eg sap-sucking insects)
- removes parasites (eg mistletoe or dodder)
- provides optimum conditions for pollination of wind-pollinated understorey perennials (eg sedges)

and

- releases mineral nutrients to fuel a flush of new growth

effect of fire on native fauna

- some animals may be killed by the fire
- animals which survive may die of starvation or predation soon afterwards
- if the animals' food is increased by the fire, then so will that animal increase in numbers
- recolonisation can occur if immigration is possible from other bush areas
- if animals are killed, and they cannot recolonise, they will go locally extinct

Ref: "Managing Your Bushland" 1993. Hussey & Wallace. CALM. - Chap 9: "Fire"

Ref: "Fire Management Planning for Urban Bushland: a Guide for Landowners, Fire Officers and Bushland 'Friends' Groups". 2000. Davies. FESA.

Fire-induced regeneration

Nothing lives for ever. All living things must reproduce a new generation. In vegetation communities we call this ‘regeneration’. It is complicated in bushland by the fact that different organisms, both plants and animals, have different life spans.

Widespread tree/vegetation decline is evident in many small remnants. This could be caused by a single factor, eg rising water table, but also could have multiple causes, all reinforcing each other. Multiple factors are probably causing the decline of most trees including Yates, Wandoo, Marri, Jarrah and Tuart. In fact, all cases of vegetation decline probably have multiple causes, even if one main one is the most obvious trigger.

Without regenerative processes, gradual decline of mature plants will eliminate them from an area, leaving no replacement seedlings. Inland woodlands are particularly at risk as they often have multiple stressing factors. In addition, the understorey follows a cyclical pattern of growth / decline / renewal, often on a shorter timescale than the tree species (see an example of detail in “How to Manage your Wandoo Woodlands”). Work done in almost all SW Australian vegetation communities show that a ‘disturbance factor’ induces regeneration. One such could be fire.

Fire in kwongan and mallee shows a similar cyclic pattern, except that the surviving bits of plants tend to be underground (the mallee roots). On these extremely infertile and difficult soils, the most important role of fire may be in recycling nutrients. Without rapid decomposition by fungi or termites, or extensive leaf herbivory where the fauna recycle nutrients in their wastes, the nutrients remain held in living and dead plant material, so there is little left in the soil to fuel new growth.

Many remnants and farm bush blocks have remained unburnt for a very long time - perhaps since the original land clearing. This lack of fire may be contributing to their decline in diversity and health.

Ref: “How to Manage Your Wandoo Woodlands” 1999. Hussey *LFW* - CALM

Why does the deliberate use of fire present a greater problem in small blocks than in large ones?

Small bush remnants are very often isolated and subject to far more disturbing factors than they would have suffered prior to European settlement, putting the natural communities under great stress. They are thus less resilient and degradation to a simpler community often occurs very quickly.

Generally, the greater the 'edge-to-area ratio', the more effect the stress factors will have and the more quickly the bush is likely to degrade. Linear strips such as roadsides are the classic example. Nevertheless, healthy, undisturbed bushland is extremely resilient, resisting degradation and remaining in an excellent state. Disturbance is a key factor in opening up the bush to change, and fire is a major disturbance.

Factors which cause stress in small bush remnants:

- increased physical exposure caused by isolation (eg drying, windthrow)
- often less than 'ideal' shapes (eg mostly edge)
- increased competition caused by introduced plants and animals
- changes in community structure caused by loss of native flora/fauna and/or gain of introduced replacements
  (eg what changes have occurred in wheatbelt woodlands as the small mammal fauna changed from boodies, dalgytes and broad-faced potoroos to rabbits?
  eg wind-pollinated veld grass replaces fauna pollinated shrubs and ground layer - loss of resources for those fauna; eg honeyeaters or native bees)
- new diseases introduced (eg *Phytophthora* root-rot, chytrid disease of frogs)
- pollution from insecticides, herbicides, general air pollution
- changes in soil structure (eg trampling by hoofed mammals), nutrient balance (eg stock camp) and pH (eg superphosphate drift)
- soil erosion (removes soil seed bank and mycorrhizal partners)
- soil and paddock debris deposition (buries surface including rootstocks under non-wetting layer, decreasing water penetration into the root zone - prevents heat/chemicals leached from combustion products from reaching seeds and so stimulating germination)
- changes in hydrology, including salinity and waterlogging
- loss of essential links in the ecosystem (eg pollinators or mycorrhizal partners)
- change in fire regime
- lack of regenerative processes to create different age cohorts in the plant population
- ETC!

All these factors affect large areas of bushland also, but the size may buffer the effect. **This means, that if we wish to use fire for any reason at all, but especially for nature conservation, we need to be aware that the bush community's response to that fire may be very different to the response which would have occurred prior to land clearing.**

Small size as a problem in fire management

- one fire may destroy the whole block - leading to immediate severe fauna decline, either during the fire or due to starvation or predators soon afterwards
- lack of connectivity to other areas OR connectivity also destroyed - means fauna will find it difficult or impossible to escape the fire or to recolonise the regenerating bushland
- difficult to create a mosaic of vegetation of different ages since fire - which is essential to maximise resources for fauna
- small size fires do not create the same conditions as large scale fires - so may not stimulate the desired regeneration
- small burnt patches subject to high grazing pressure from herbivores (eg kangaroos or rabbits) so palatable regeneration is removed at the seedling stage - note: weed grasses spurned by native herbivores
- easy for weed invasion to occur at edges and quickly cover whole patch
- may not be large enough to support a native small/medium mammal population, and therefore will have a quicker fuel buildup than if the quendas, for example, were present

Small size as a benefit in fire management

- easier to protect a small, isolated remnant, and so permit long periods without fire, if that is what is desired
- easier to undertake labour-intensive management options, eg weed removal
- easier to direct seed in 'missing' species after a fire
- cost of undertaking necessary works is fairly low

Specific problems/issues to be considered in small blocks

Weeds

- many introduced plants - especially crop weeds - enjoy disturbance. (Preparation for cropping is one of the most extreme form of land disturbance.) These introduced plants displace native disturbance opportunists eg everlasting daisies and annual grasses. Perennial/woody weeds displace other species.
- This leads to change in community structure - different plants - diff resources for fauna - different responses to fire etc

Many weeds change the flammability, readiness to burn, ease of fire spread, frequency at which it will burn, temperature at ground level and other fire characteristics. Bunch grasses which evolved in southern Africa under a regime of annual burning (eg African Love Grass, Tambookie, Veld Grass), cause a massive change in the fire response when they come to dominate the ground layer of Western Australian communities. Veld Grass in Banksia woodland is a good example of this bad problem. Thus fire should not be used to 'control' these grasses, it merely encourages them, and discourages native species. Always remove the weeds <u>before</u> you try using fire to regenerate a weed-infested community.

Land for Wildlife recommends the removal of weed grasses *as a fire control measure* as well as for conservation reasons.

You can use the period immediately after a fire, (whether the fire was planned or unplanned) to undertake control of some difficult perennial weeds such as bridal creeper. It will respond to the fire with rapid growth from the tubers, often before native plants have started to resprout or seeds to germinate. Thus it can be hit immediately with a knock-down herbicide, without danger of damaging desirable native plant regeneration. In addition, because the fire opens up an area, it is easier to reach dense infestations, and to locate all sites for control work.

Grazing

Aboriginal people used to burn bushland to <u>attract</u> grazing animals. Heavy grazing pressure can undo all the good the regeneration burn has done! Needs fencing - plus culling in some instances.

Peoples' mental attitudes to fire

Our terminology is revealing. Fire is a 'disaster'. Is it - always? Or are we merely harking back to some European/Asian racial memory? Because fire was not used as a land management tool in Europe, were the early settlers here <u>unable</u> to recognise anything but its destructive elements? And does that attitude still prevail?

If you intend to use fire on your own block, or in a community-managed reserve, you may first need to explore and discuss with the people who will be affected by the fire, some common areas of concern, for example:

- the aesthetic appearance of the vegetation becomes important - ie there is often pressure to 'tidy up' standing dead material (this is extremely detrimental to regenerating bushland - can you think of at least 5 reasons why?)
- people see the 'wildflower display' (often wattles) two-seven years after the fire, and want to perpetuate that phase of the cycle (without understanding that an elixir for perpetual youthfulness has not yet been invented)
- in some vegetation communities (ie the Darling Scarp and in mallee) the fire response may include a swathe of native annual grasses. The community may perceive them as weeds and press for their removal
- there may be community resistance to the use of chemicals for weed control before or after the fire
- stock will cause immense, irretrievable damage if allowed access to the burnt area in the first years after the fire
- burnt vegetation is open and more easily invaded by recreating humans - new tracks are created, loose rocks removed, rubbish dumped, plants dug up, roos hunted etc at this time.
- fire control officers often fell large - especially hollow - trees to reduce a potential hazard from the 'roman candle' effect. Another fire - another tree. This causes a major loss of habitat, not only hollows but roosting sites etc. In addition the shade effect of the larger trees may have had a significant impact in moderating the climatic conditions in the lower stories - this is especially true of frost (and also the drying effect of strong winds). Without the large trees, these effects become more severe. (For a clear demonstration of this effect, look at power line corridors through otherwise intact vegetation blocks.)

- loss of seedlings to frost after a fire - especially on granite, may also occur.

In situations around townsites:
- there may be a sizeable workforce available (family or 'Friends' groups) to do intensive management, including pruning or individual plant removal designed to moderate fire characteristics in planned or unplanned fires.
- conflict of interest between close neighbours and local regulations is more likely to occur, and to raise problems. If not carefully discussed and understood, individualistic behaviour, whether pro-fire or anti-fire, can spark nasty community discontent.

When <u>never</u> to use fire for regeneration

- if soil is buried by wind-deposited material. The soil surface inc rootstocks is covered by a non-wetting layer of soil (usually sand), straw, weed seeds and sheep droppings. This prevents heat cracking buried seeds and the chemicals leached from combustion products from reaching seeds and so stimulating germination. In addition, buried rootstocks often don't respond by growth - lack of which stimulus?
Such a site - very common along sandplain roadsides - is basically stuffed - for ever.

- during or immediately after a severe drought. The plants are already under extreme stress, and being forced to regenerate could totally exhaust the resprouters' resources, and so lead to death. Give the bush a couple of years of average conditions in which to recover.

Management

The correct use of fire can stimulate regeneration and regrowth in bushland, thus creating habitats for fauna. As discussed elsewhere during this Workshop, this is part of the cycle of ecological renewal which has been happening in WA for millions of years. However, with the immense changes that have occurred in remnants since the advent of European settlers, the cycle has been changed and the effects of fire on a small block of remnant bushland may be very different from that which would once have occurred.

LFW currently advises landholders around the Perth metropolitan area that if 50%+ of the understorey shrubs are dying or dead, the area is ready for a regeneration fire. But note, if all the shrubs are gone (eg after a long period of grazing <u>or</u> a long period without fire) it may not carry a fire of sufficient intensity to promote regeneration in the soil stored seed bank. This latter point is even more important in farm bushland subject to generations of set stocking where soil erosion might have removed some seed.

If a mosaic is not possible, for any reason, a combination of 'heaps' and direct seeding is recommended, on-going in different locations every year. Smoked water can be tried, but it is expensive. Suppression of seedlings by extant mature trees can still occur. This may not be a problem in the long run, especially if there is a chance of an unplanned fire at some time in the future.

Essentially, to keep your bushland healthy, planned fire is a management tool you may need to consider. Before you get out the matches, though, work through the attached checklist and set up a small trial area first.

Land for Wildlife Officers, or other good field ecologists, can help with site-specific advice. But remember, though we may plan as well as we can, the result of fire in your small remnant is in the lap of the gods.

Small block fire management checklist

1 *What do you hope to achieve by burning this bushland?*
- protection of human property from wildfire?
- promote regeneration of the vegetation community?
- or both?

The answer will dictate what type of fire you use.

2 *Does the whole remnant need to be burnt, or will a smaller burn satisfy the objective?*
A smaller burn minimises the possibility of irreversible ecological failures (eg should a severe drought occur in the seasons following the fire)

3 *Can small areas be burnt over several years to create a mosaic of vegetation of differing ages since fire?*
This is the ideal situation for maintenance of resources for fauna.

4 *Is the remnant connected to other remnants by a suitable bush corridor?*
This will influence how fauna can get away from the fire, or return to regenerating areas.

5 *If it is not connected, can a bush corridor be planted prior to any burn being undertaken?*
Consider the needs of say, small birds, and design the corridor to facilitate their movement.

6 *Are the major plant species setting seed?*
If not, regeneration will be impeded - allow twice the length of time to first seeding of the dominant plants for an appropriate interval between fires

7 *Are there weeds in the bush?*
Control prior to the burn

8 *Is there a nearby source of weed seed?*
Leave a buffer between the source of the seed and the area to be burnt.

8 *Is spread of <u>Phytophthora</u> or other plant diseases possible?*
Take appropriate precautions.

9 *Is Declared Rare Flora, Threatened Fauna or a Threatened Community present?*
Obtain Ministerial permission to ‘take’, contact CALM.

10 *Are there special flora/fauna habitat features present, eg a wetland?*
They may need to be specially protected.

To set up a trial of regeneration using fire in a previously-grazed woodland or shrubland

- fence to exclude subsequent grazing (consider stock, rabbits and kangaroos)
- select a portion to be burnt
- if grass weeds present (eg Wild Oats, Love Grass, Veld Grass) control in the year preceding the planned burn
- if weeds can blow in from surrounding paddock, leave an unburnt buffer to trap weed seeds
- control (eliminate?) rabbits
- check the availability of native plant seed on site
- collect extra seed, especially of plants missing from the understorey, from similar vegetation types
- consider the possibility of water erosion from burnt site - design to minimise
- consider creating heaps to produce ashbeds
- if a locust plague is predicted for that year - do not burn
- set up photo-monitoring points
- conduct the burn
- direct seed into burnt area
- do follow-up weed control (and rabbits if not eliminated)
- monitor and record results
- tell others what worked - and what didn't …… and WHY

The use of charcoal in sediments to indicate fire history in Fitzgerald River National Park

Structure of seminar

- How past fire intervals were investigated
- Charcoal in sediments
- Charcoal production
- Sediment coring and sampling
- Catchment fire interval
- Location of core
- Processing and determination of RCA
- Resolution levels
- Results /Interpretation
- Comparison with other results
- Newness of methods

Lines of investigation

1. Historical information from early navigators and explorers.
2. Faunal habitat requirements of fire-age of vegetation.
3. Vegetation recovery after fire in marked plots.
4. Variation in charcoal content of an estuarine sediment core.

Historical Information

Vancouver 1791

D'Etrecasteaux 1792-3

Flinders 1801-2

King 1818

D'Urville 1826

Lockyer 1826-7

Nind 1826-9

Collie 1831-2

Dale 1832

Stokes 1840

Eyre 1841

Roe 1848-9

Gregorys, Helpman 1849

Faunal Requirements -Years after fire

Birds	Minimum	Optimal
Bristle-bird	10-16	14-50
Whip-bird	?15	30-50
Ground parrot	7-16	16-40+
Malleefowl	15-30	50-100
Mammals		
Tammar	?10-20	30-50+
Woylie	?10-20	20-50
Dibbler	?	?25-60
Wambenger	?	?25-60
Heath rat	?	?25-60
Western mouse	?	?24-60
Honey possum	10	(?15)20-50

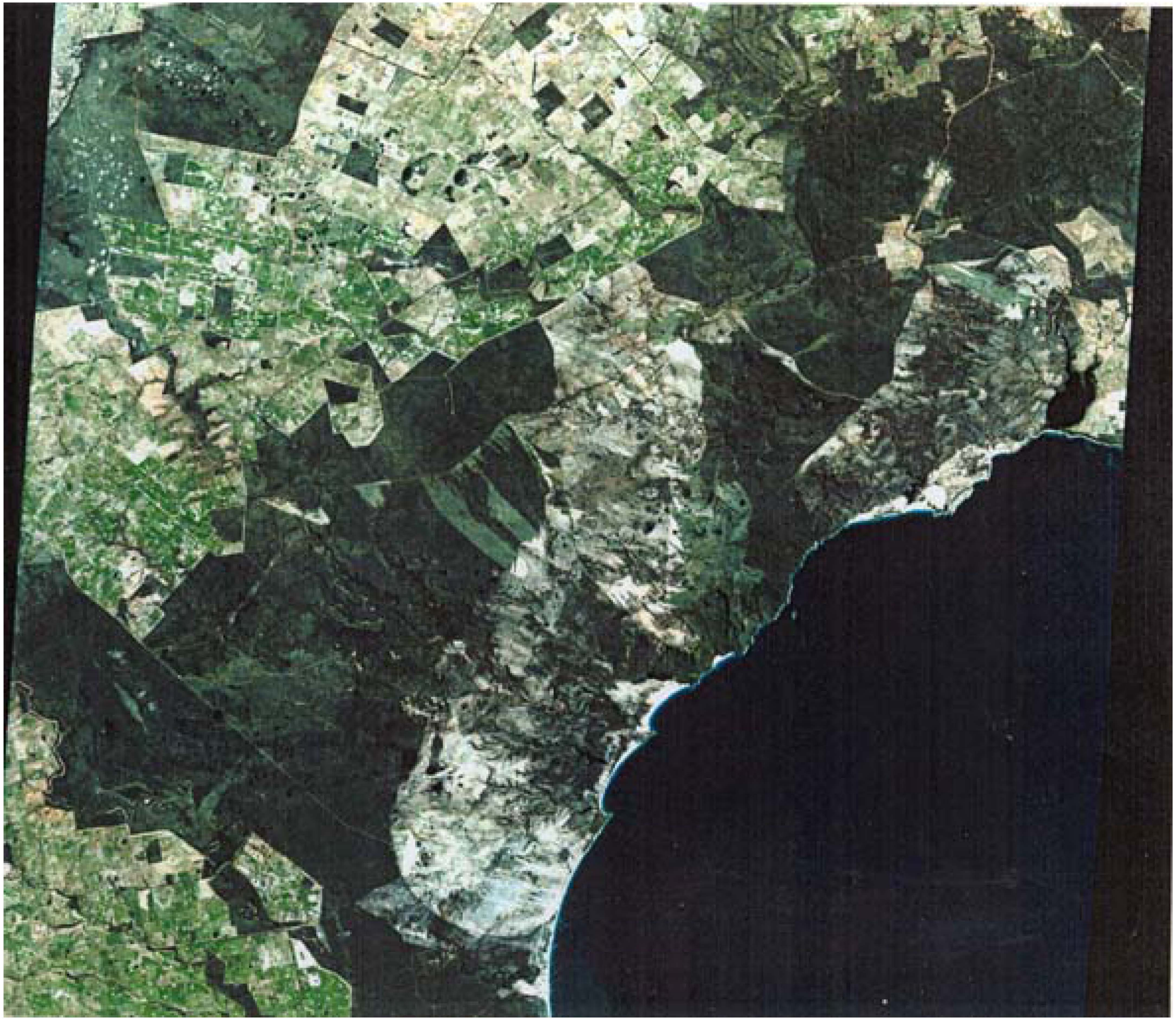
Vegetation recovery after fire

Biological survey 1985-87 -permanent plots 10x1m
Chapman and Newbey

15 plots burnt 1989, 5 in 1994

Initial rescoring at 1 year by CALM (mostly Yates, assisted in several by Hopper, Coates and Brown.

About 9% of species in plots require 10 years or more to commence flowering, equates to 150-170 species in whole Park.



Charcoal variation in estuarine core

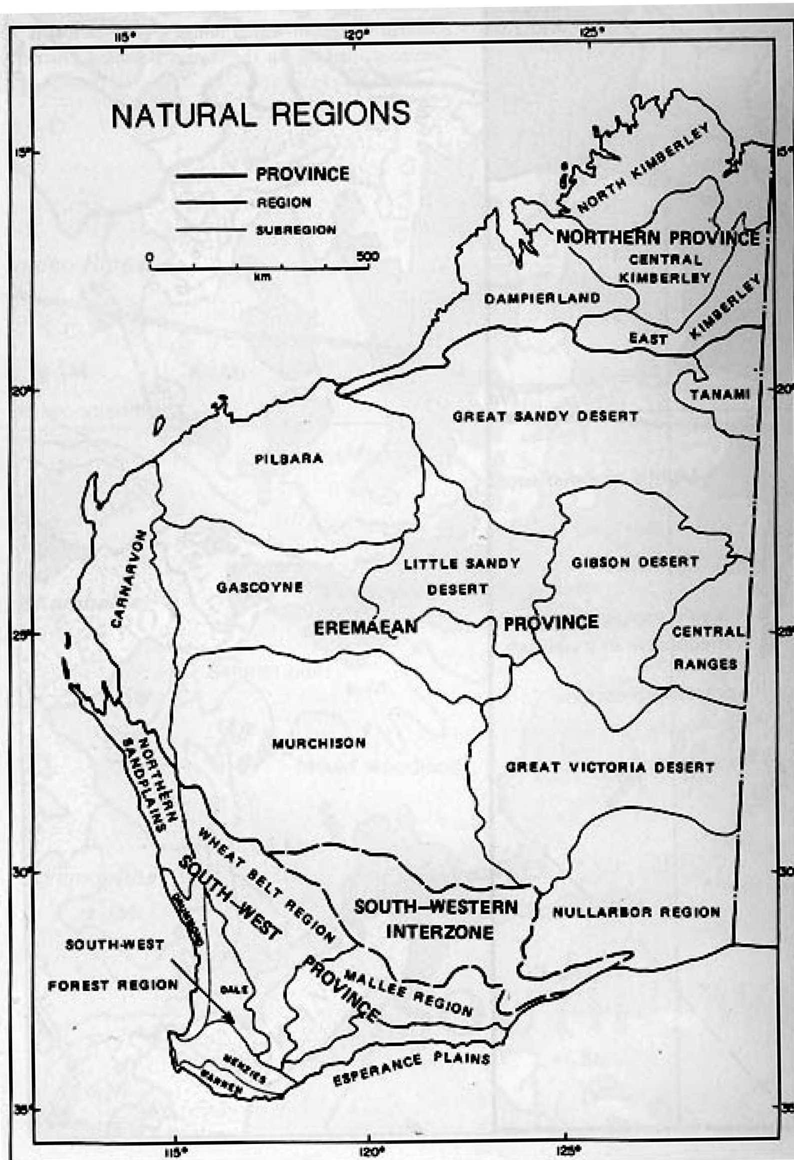
Highly organic river channel mud deposit

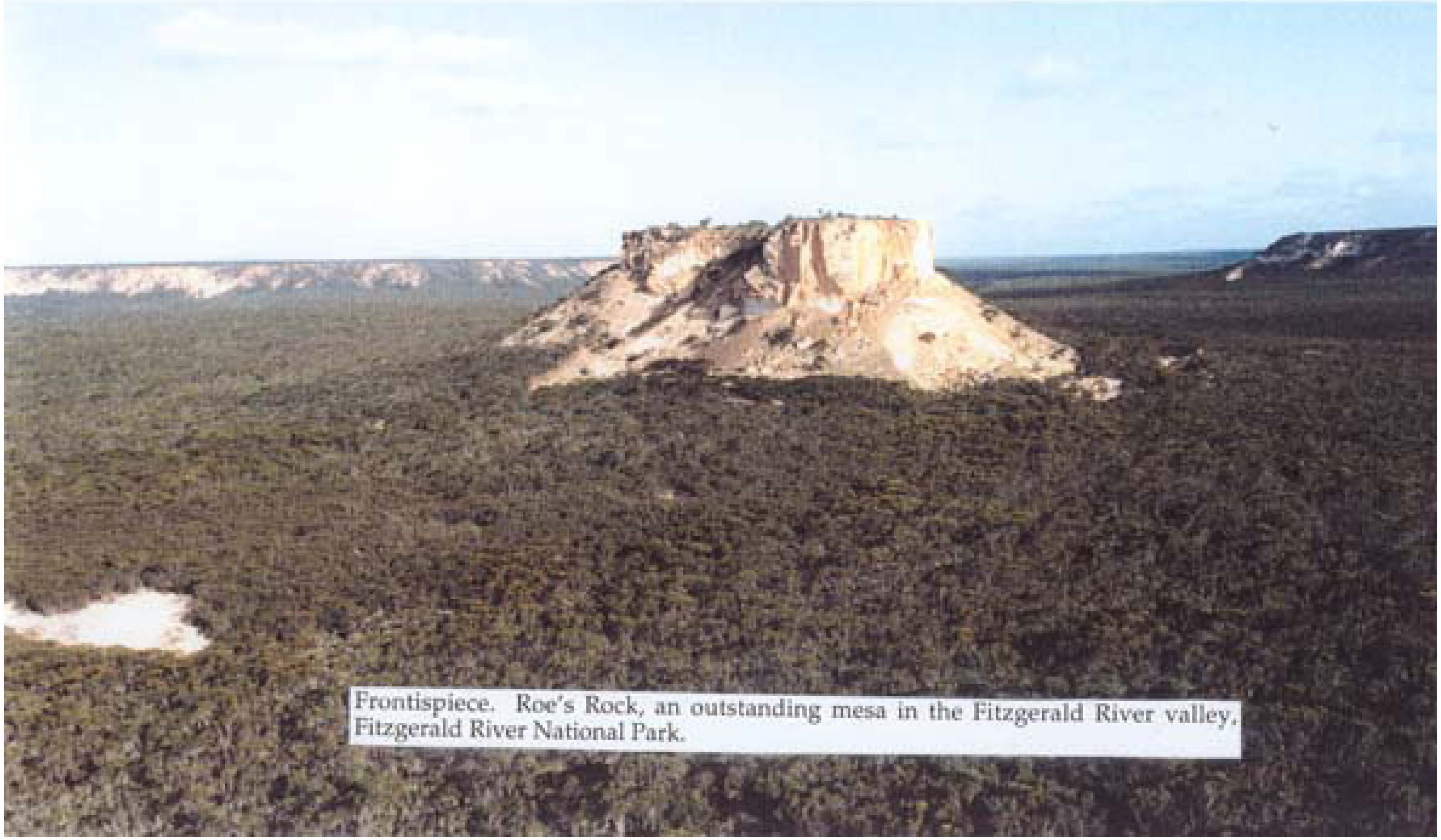
Reducing conditions preserve organic matter and charcoal

No signs of bioturbation, undisturbed bedding
Sedimentation appeared continuous

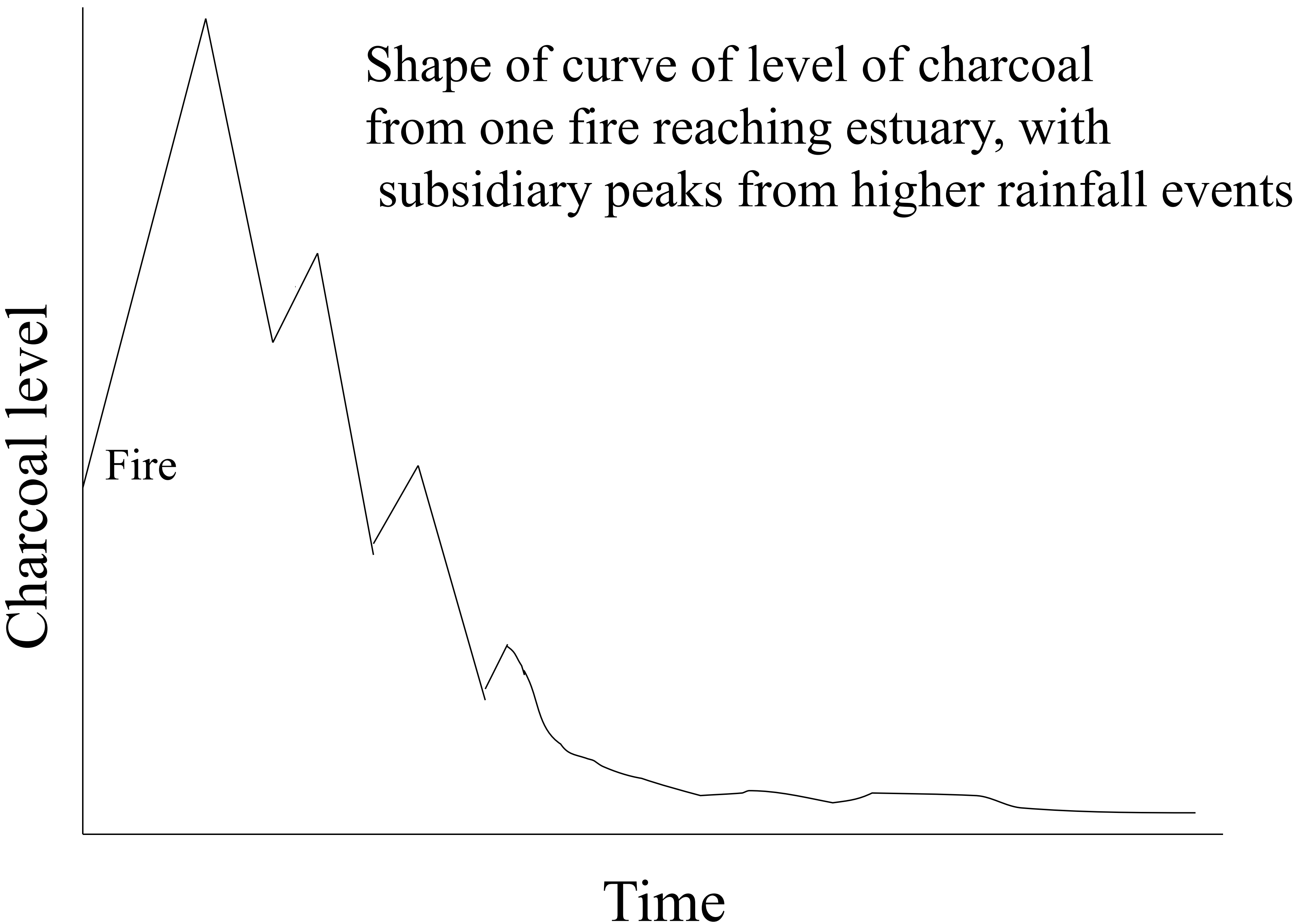
Rapid filling of channel to 2750BP

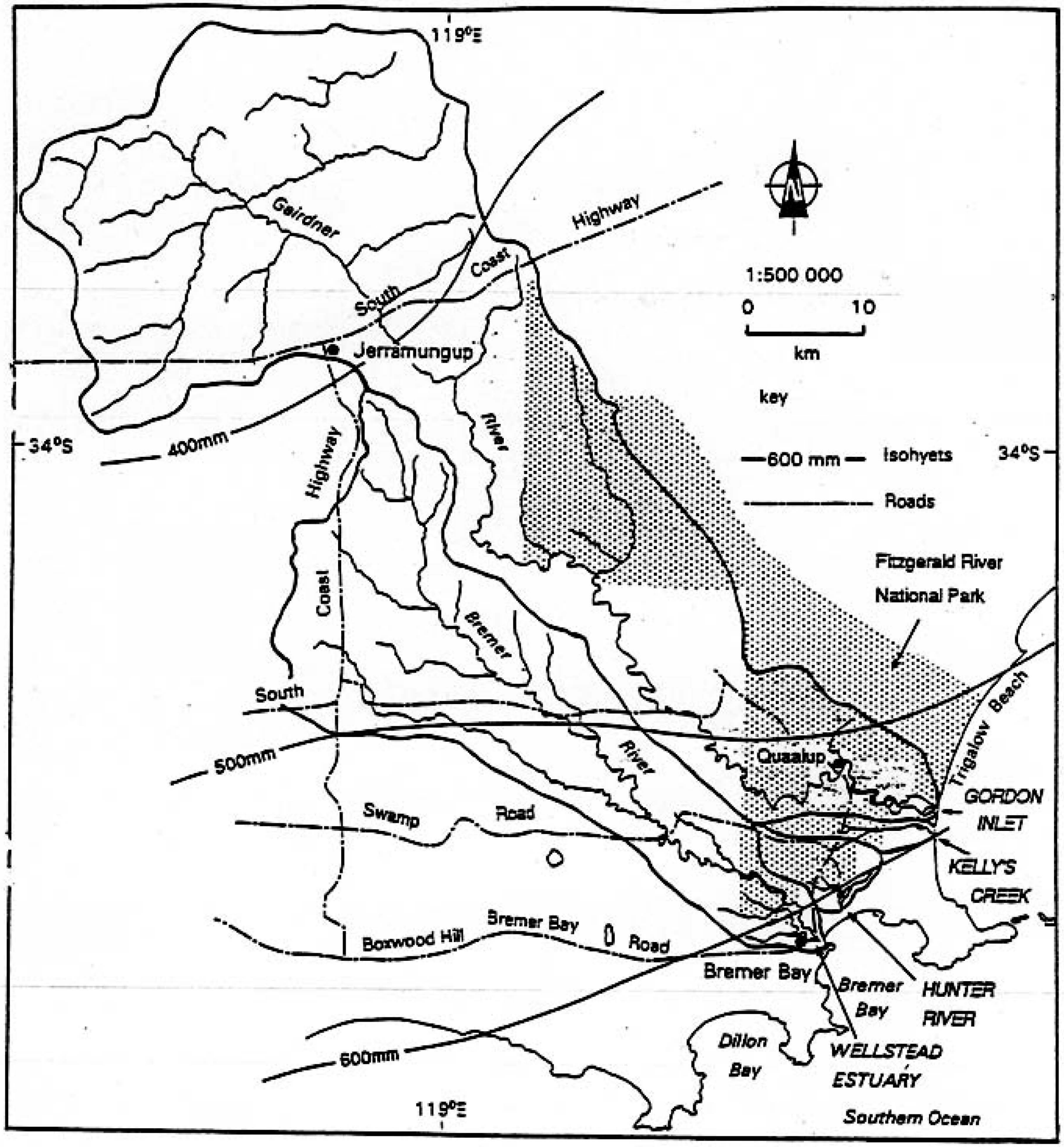
Coring by hand methods - difficult conditions
Core in two sections.


NATURAL REGIONS
PROVINCE
REGION
SUBREGION
0
500
km
115°
120°
125°
15°
20°
25°
30°
35°
NORTH KIMBERLEY
NORTHERN PROVINCE
CENTRAL KIMBERLEY
DAMPIERLAND
EAST KIMBERLEY
TANAMI
GREAT SANDY DESERT
PILBARA
CARNARVON
GASCOYNE
LITTLE SANDY DESERT
GIBSON DESERT
EREMAEAN PROVINCE
CENTRAL RANGES
MURCHISON
GREAT VICTORIA DESERT
NORTHERN SANDPLAINS
WHEAT BELT REGION
SOUTH-WEST PROVINCE
SOUTH-WESTERN INTERZONE
NULLARBOR REGION
SOUTH-WEST FOREST REGION
MALLEE REGION
ESPERANCE PLAINS



Frontispiece. Roe's Rock, an outstanding mesa in the Fitzgerald River valley, Fitzgerald River National Park.


Shape of curve of level of charcoal
from one fire reaching estuary, with
subsidiary peaks from higher rainfall events
Charcoal level
Fire
Time



119°E
Gairdner
Highway
Coast
South
Jerramungup
400mm
34°S
Highway
River
1:500 000
0
10
km
key
600 mm
Isohyets
Roads
34°S
Fitzgerald River
National Park
Coast
Bremer
South
River
500mm
Quaalup
Trigalow Beach
GORDON INLET
Swamp
Road
KELLY'S CREEK
Bremer Bay
Boxwood Hill
Road
Bremer Bay
Bremer Bay
HUNTER RIVER
Dillon Bay
600mm
WELLSTEAD ESTUARY
119°E
Southern Ocean

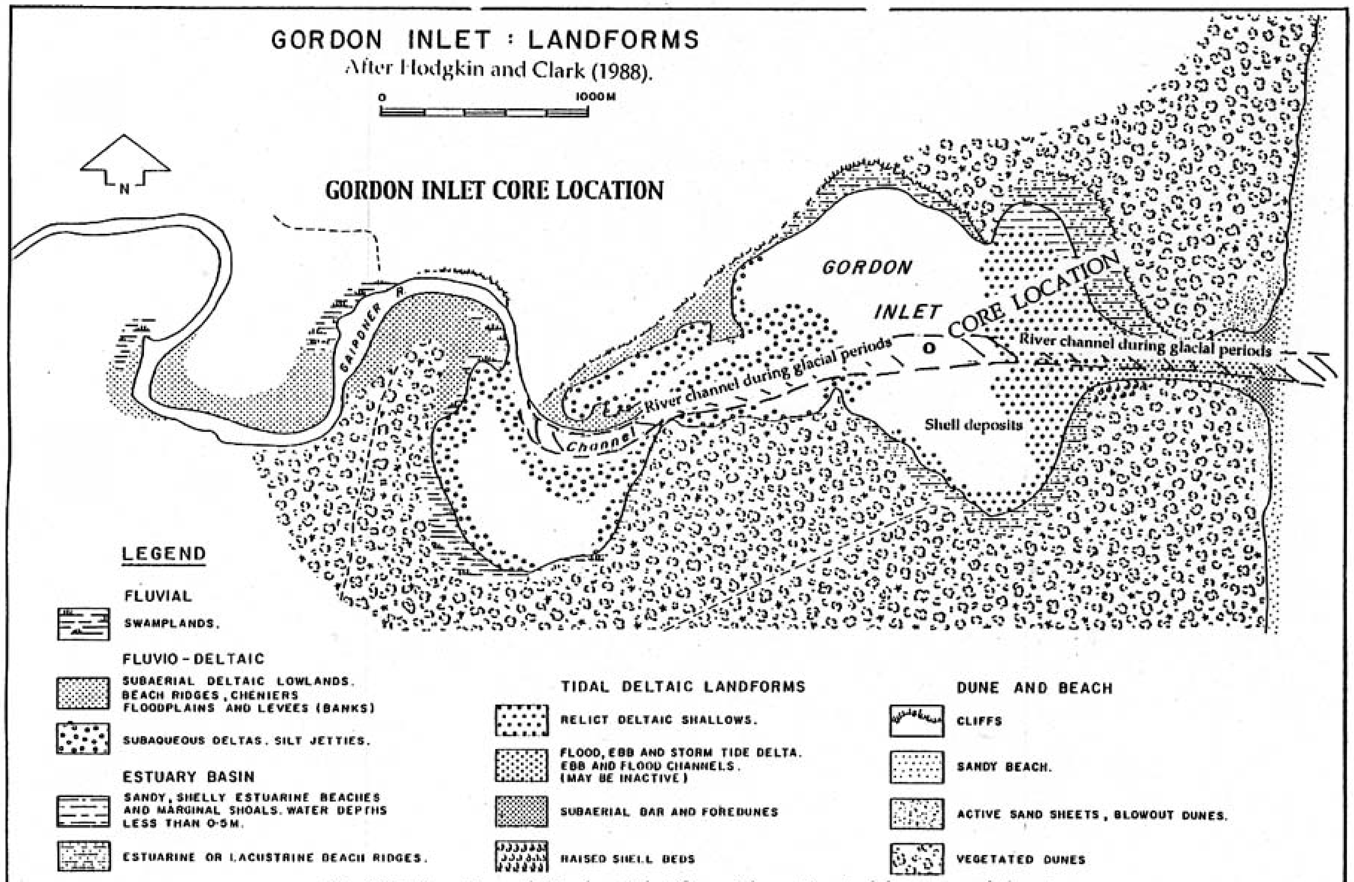


Fig 10.1. Location of Gordon Inlet Core. The estimated location of the river channel during glacial periods, when sea level dropped, is shown.

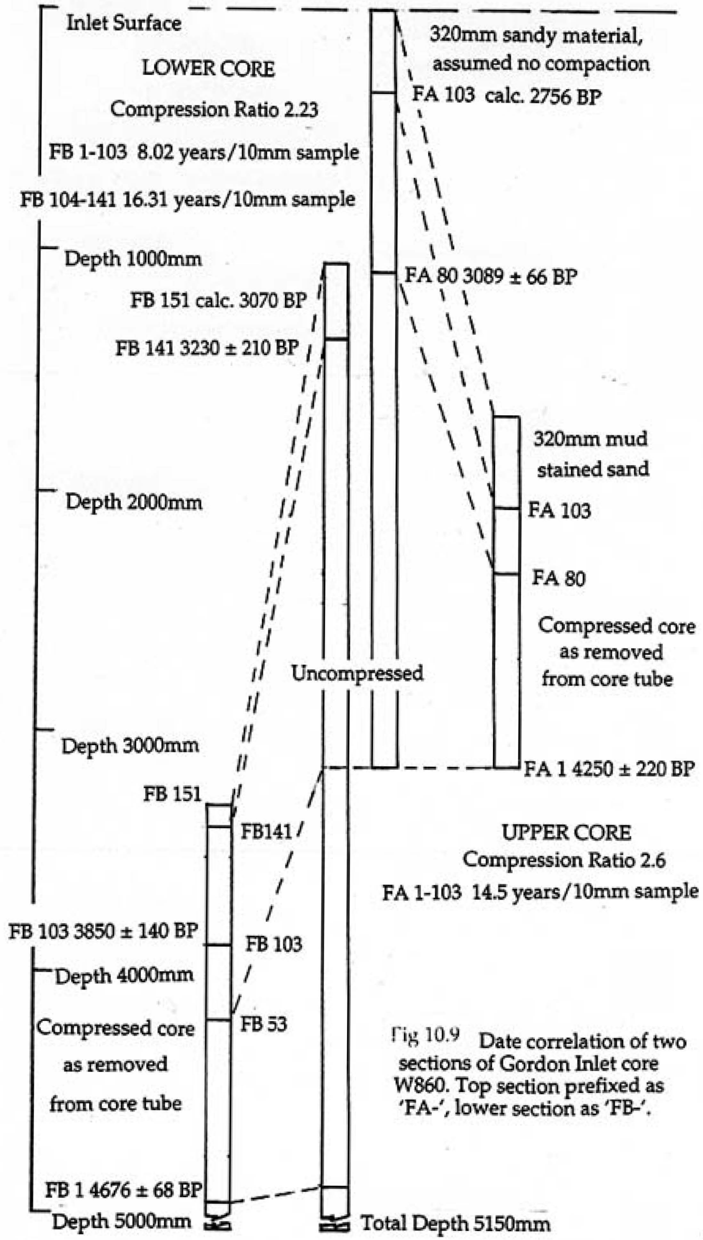


Fig 10.9 Date correlation of two sections of Gordon Inlet core W860. Top section prefixed as 'FA-', lower section as 'FB-'.

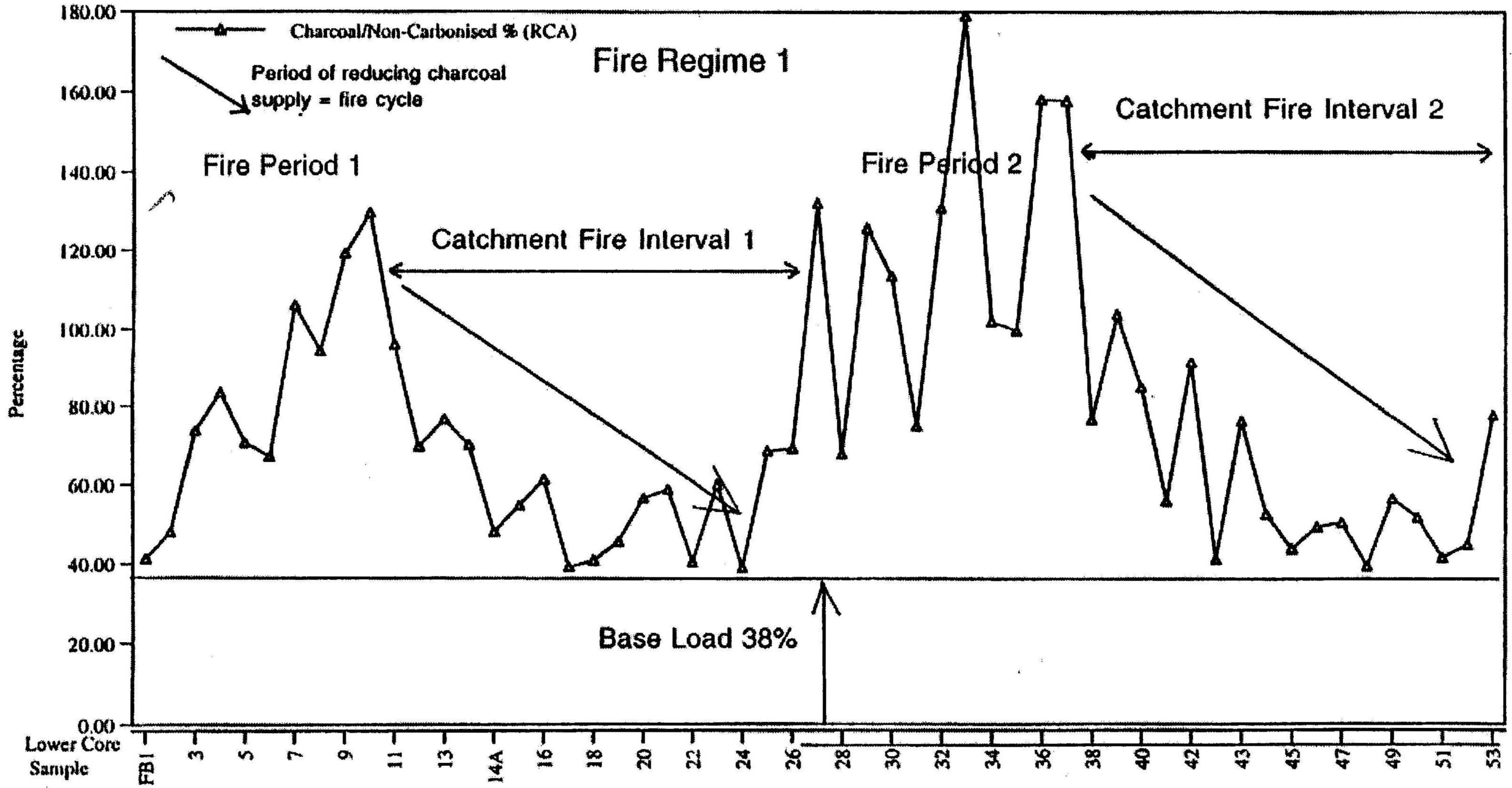
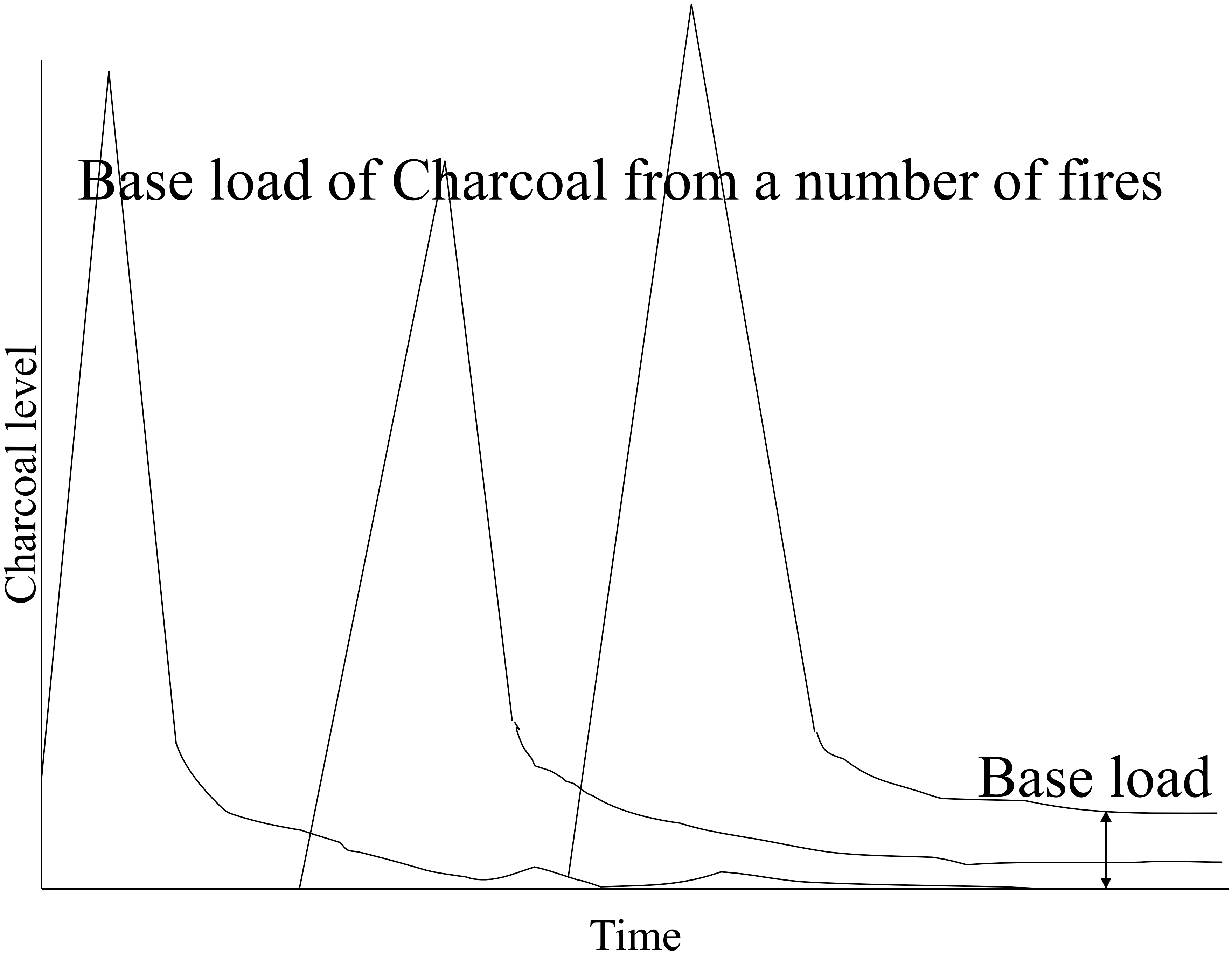


Fig 1 Lower section of Gordon Inlet core, plot of Relative Charcoal Abundance. Fire Regime 1 representing period 4676 (FB1) to 4250 (FB53) BP. Major catchment fire periods of about 50-80 years, major catchment fire intervals of about 140 years (each sample represents 8 years).


Base load of Charcoal from a number of fires
Charcoal level
Base load
Time

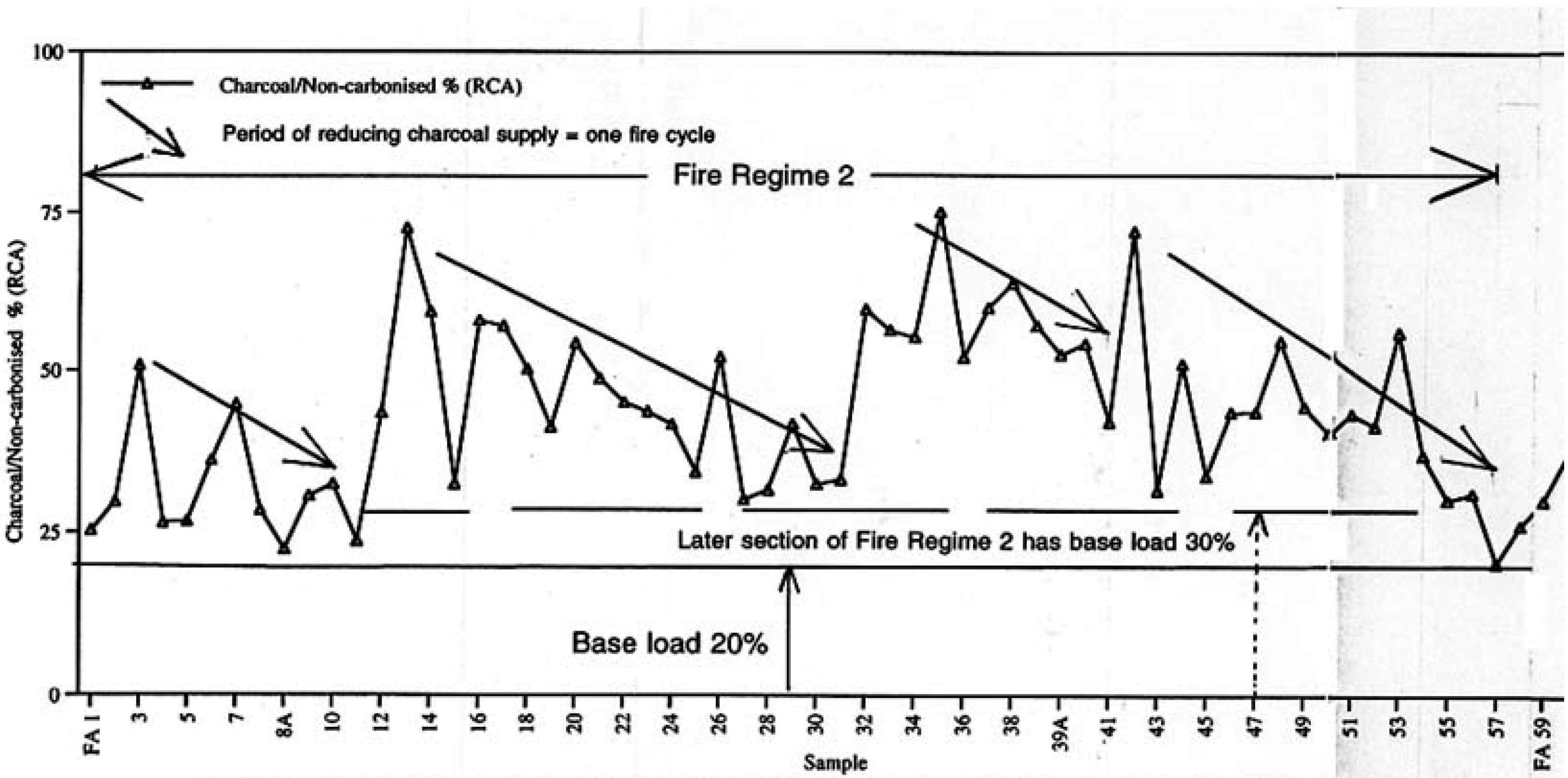


Fig 10.11a. Relative Charcoal Abundance (RCA) in Fire Regime 2, Upper Core samples FA1-57. Fou(fire cycles.

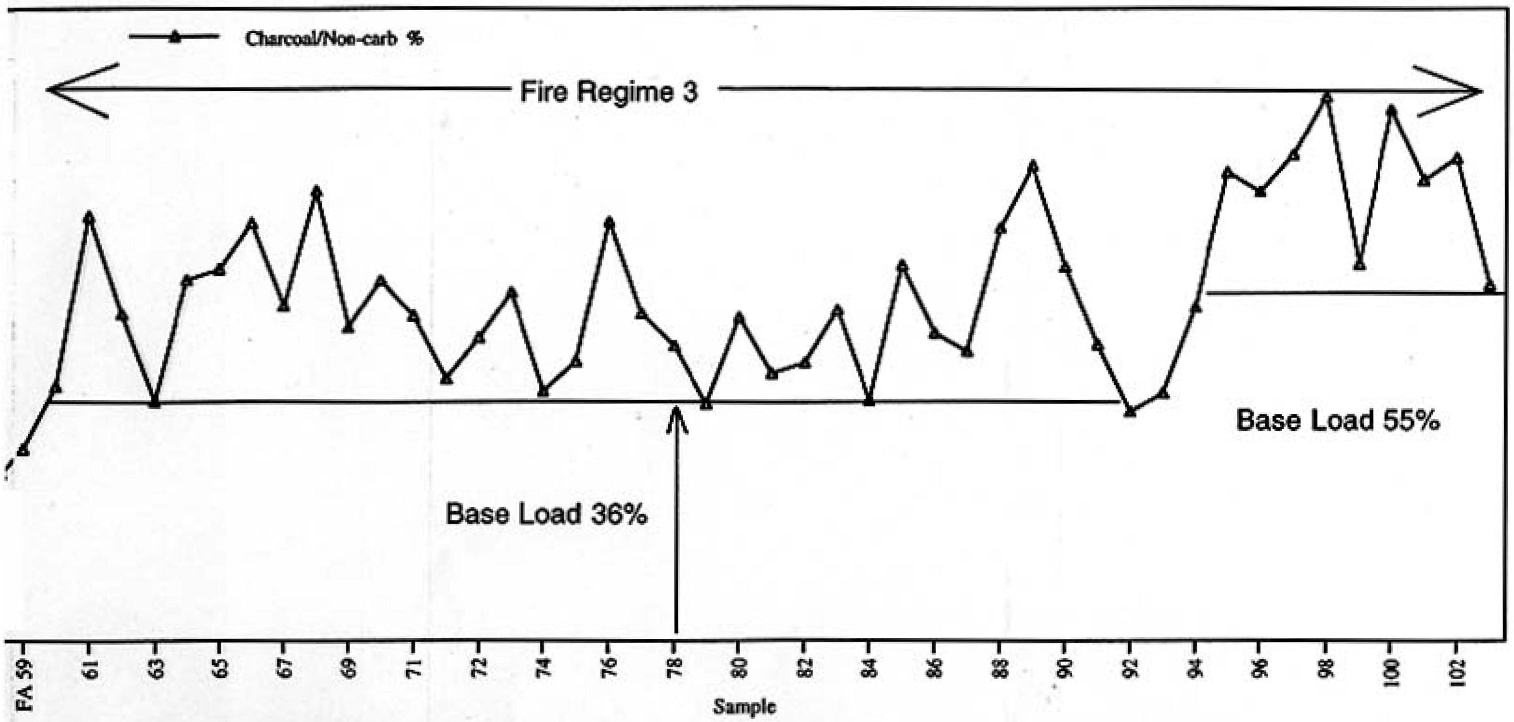


Fig 10.11b. Relative Charcoal Abundance (RCA) in Fire Regime 3, Upper Core samplesFA 58-103. No obvious fire cycles.

Conclusions

1. From historical data - fires at long intervals, shrublands dense and mature, little aboriginal use.

2. From faunal requirements - inferred fire intervals of 20-50+ years.

3. Plot recovery - part of flora requires 10-20 years to commence flowering.

4. Sediment charcoal variations suggest minimum fire intervals of 30-60 years.

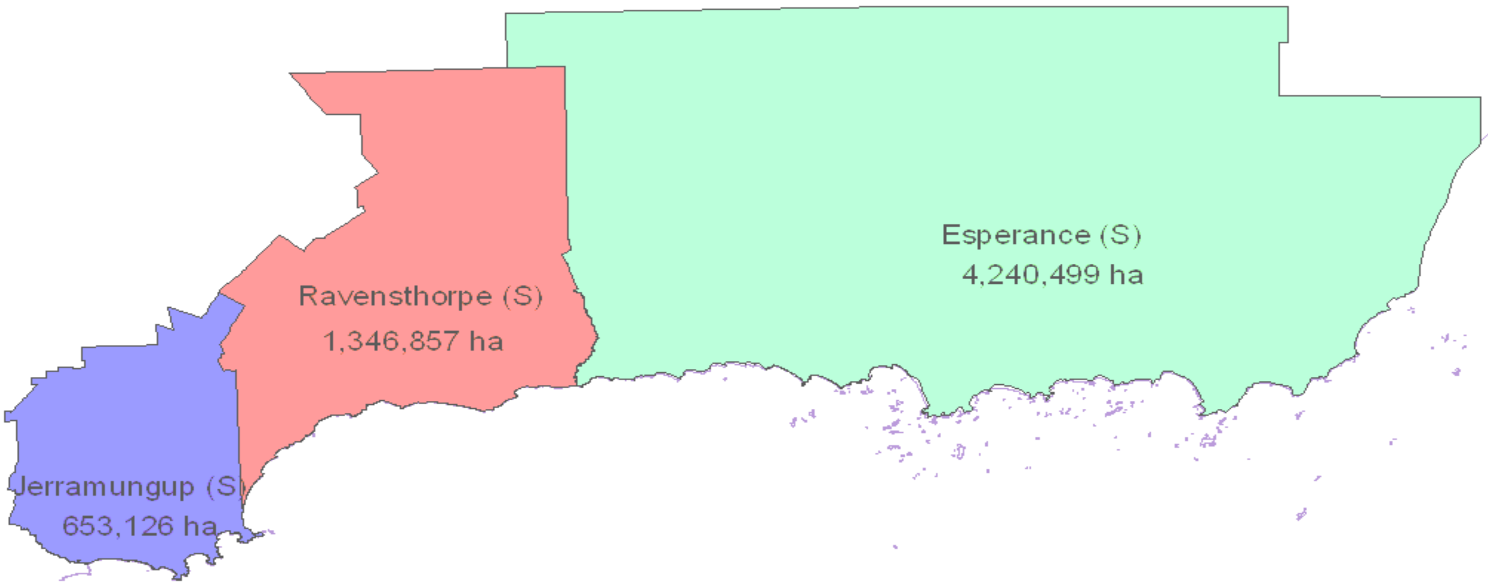
FESA

Fire & Emergency Services
Authority of Western Australia

Planning for Community Fire Protection

Presented by John Winton, FESA District Manager for Fire Services.

The Esperance District includes the Shires of Esperance, Ravensthorpe and Jerramungup.



FESA
Fire & Emergency Services
Authority of Western Australia

Responsibilities

- Fire and Rescue Services
- Bush Fire Service
- Relationship with Local Government

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Fire & Emergency Services
Authority of Western Australia

BUSH FIRE CONTROL OFFICERS

DUTIES

PREVENTING THE OUTBREAK OF BUSH FIRES

PROTECTING LIFE AND PROPERTY DURING A BUSHFIRE

CONTROLLING AND EXTINGUISHING A BUSH FIRE

FIRE MANAGEMENT

Prevention
Preparedness
Response
Recovery

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Prevention

Promotion of the education and delivery of prevention and risk management programs. These include initiatives such as:

- Media Campaigns
- Smoke Alarms
- School Education
- Risk Management Programs
- Local Authority Strategic Fire Planning
- Strategic acquisition and replacement of fire equipment
- Rural subdivisions
- Encouragement of compliance with the fire related sections of the Building Codes of Australia
- **The management of Crown Lands for fire prevention**

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Preparedness

- Training
- Exercising
- Mobilisation Planning
- Risk Identification
- Communications
- Bushfire Management
- Response Planning

Fire & Emergency Services Authority of Western Australia

Response

The major considerations in response to bushfire emergencies are:

- Life
- Property
- Environment

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Recovery

In the area of bush fire management, FESA's major role is in support of Local Authorities to undertake the P.P.R.R. roles.

FESA assists communities, employees and volunteers affected by bushfire to recover from the event effectively and efficiently.

- Prevention
- Preparedness
- Response
- Recovery

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Crown Land Fire Prevention Management

Under a MOU with Department of Land Administration, FESA Fire Services manages Crown land for fire prevention and response purposes.

Funds are made available for fire prevention on unallocated crown lands.

Fire Prevention is necessary to reduce the impact of bushfires on the communities in which they occur.

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Unallocated Crown Land Adjacent to Private Property

Fire behaviour and intensity is governed by three major factors:

- Fuel
- Weather
- Topography

Of these three factors, the one we have the greatest effect over is the fuel or vegetation component.

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Methods for fuel reduction:

- Fire Breaks
- Low fuel area at least 20 metres wide and installed by slashing or burning
- Natural Features
- Strategic low fuel areas at least 40 metres wide and installed by chaining with fire breaks on either side and the inside area burnt.

Prescribed burning is used as a management tool to reduce the impact of fires on private property.

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RISK MINIMISATION

GRADUATED FUEL REDUCTION

- **INTENSE AGAINST VALUES**
  - **BUFFERS, LOW FUEL AREAS, BLOCKS, CELLS**
- **BROADER PROTECTION AWAY FROM VALUES**
  - **CELLS BLOCKS**
  - **WIND DRIVEN FIRES**
- **AREA INVOLVED DICTATES APPROACH**

PRESCRIBED BURNING

- MUST BE PLANNED
- ENVIRONMENTAL CHECK
- OBJECTIVES
- COSTED
- TIMING
- WEATHER CONDITIONS
- EDGE PREPARATION
- DISEASE MANAGEMENT
- WATER POINTS
- ASSETS
- NOTIFICATION
- PUBLIC WARNINGS
- RESOURCES

BURN PRESCRIPTIONS CAN BE WRITTEN FOR:-

BLOCK OR CELLS
Limitations of Block Burning:

- Costs incurred in delineating the blocks.
- Requirement to install tracks into the landscape with the increased risk of spreading plant diseases.
- Lack of resources to implement the burning program.
- Failure to meet the objective of the burns.
- Requirement to re-burn at inappropriate intervals.
- Creation of large areas of one fuel age.

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Advantages of Wind Driven Fires:

- Large areas of unburnt vegetation are naturally created.
- Limit the spread of naturally occurring fires.
- Create a mosaic of vegetation ages
- Can be introduced continually into the environment
- Only small areas are required to obtain the effect required
- They can be installed under prescription
- They are cost effective
- Obviate the necessity for tracks.

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Elements to be Considered When Prescribing Wind Driven Fires

- Objective of the burn
- Wind direction
- Time of the year
- Period to rain
- Time of the day

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Implementation of the Fire Management Plan in the Fitzgerald River National Park.

Presentation at Ravensthorpe and Gairdner Fire Symposium by Greg Broomhall, Regional Operations Manager, Department of Conservation and Land Management (CALM), South Coast Region.

Preface:

A draft management plan for Fitzgerald River National Park was prepared by CALM and issued by the former National Parks and Nature Conservation Authority (NPNCA), for public comment. After considering public comment, the NPNCA submitted the revised plan to the Minister for the Environment for approval. The Minister approved the document as the management plan for Fitzgerald River National Park on 6th June 1991.

Previously on the 7th May 1991, the former Bush Fires Board endorsed the plan under Section 34(1) of the Bush Fires Act (1954), as the basis for the preparation of an annual works program by the fire advisory group (refer to Prescription 8, Section 9.2).

Overview:

The Fitzgerald River National Park (330,000ha), lies on the central south coast of Western Australia, 420km south east of Perth, between Bremer Bay and Hopetoun in the Shires of Jerramungup and Ravensthorpe. It is one of the largest and most biologically significant National Parks in Australia and provides an opportunity to maintain substantial parts of a south coast National Park in an undisturbed state.

Major values and attractions include the highly diverse flora (almost 20% of the State's described species), numerous rare species of flora, extensive natural landscapes with rugged coastal rangers, sea cliffs, gorges, inlets and opportunities for nature study, bush walking, camping, fishing and swimming. The Park also has richer fauna than any other conservation area in the south west of Western Australia. It contains several threatened fauna species and offers one of the best long-term survival prospects in Western Australia for the Ground Parrot and Dibbler. Many of these values are recognised nationally and internationally.

The Management Plan/Principles of Management:

The management plan is based on a number of "principles of management". The guiding principle is that the parks ecosystem is composed of numerous interrelated parts. Damage or change to any part may ultimately affect the whole ecosystem. These key "principles", then focus on dieback disease, fire, wilderness and recreational access. The focus of my presentation will be on fire and its management in the park.

Fire management in Fitzgerald River National Park must strive to meet the needs of both nature conservation and protection of visitors and the local community. The major wildfires which occurred in December 1989 and later in January 1997 were, initially at least, natural phenomena. However, they were and are unacceptable from a nature conservation viewpoint given that Fitzgerald River National Park is an area of remnant vegetation.

It is surrounded to the west and north, and partially to the east, by cleared farmland. Consequently, if the entire Park or very large proportions are burnt at one-time, re-colonisation by native fauna, particularly those restricted in numbers or by habitat would be compromised. Furthermore, burnt areas are difficult to interpret for dieback occurrence for several years, some areas up to 5 to 7 years and thus may compromise operational works or result in the risk of disease spread. The local community was and is also concerned about the magnitude of such fires and the damage, time and costs incurred on neighbouring farms and volunteer firefighters. Therefore, we can say that it is not acceptable, from either local community or nature conservation perspectives, to have large wildfires in the Fitzgerald River National Park.

The three "principles", to stem from this and indicated in the plan go on to say;

- Excessively large wildfires which threaten environmental and human life values are not acceptable.

- The unburnt north-west sector of the Park now has an even greater need for protection from large uncontrolled wildfires.

- It appears clear that a more pro-active approach to fuel reduction and vegetation/habitat management is required to minimise the risk of wildfires reaching large proportions.

Fire Management Objectives:

The plan lists a number of key objectives in terms of fire management for the park, these are:

1. Protect the lives of visitors, neighbours, staff and firefighters;
2. Protect community values in or near the Park, including settlements, private property, recreation facilities and public utilities.
3. Provide for the survival of populations of rare or restricted flora and fauna species by the maintenance of required habitat.
4. Where possible, restrict fires to a single cell.
5. Maintain an effective system of firebreaks and buffers, while minimising the construction of new firebreaks and the introduction and spread of disease and weeds by fire management operations.
6. Protect landscape values from damage and vulnerable soils from the risk of erosion as a result of wildfires, inappropriate fire regimes, firebreak locations or machinery activity.
7. Reduce the incidence of unplanned fires.

Strategy:

The basic strategy proposed for the park was to and currently still is, to provide a network of fuel reduced areas so as to reduce the likelihood of remaining tracts of mature vegetation being burnt at the one time. Some areas will not be prescribed burnt in the long term and be retained as reference areas (Appendix 1 – Master Plan).

The plan also indicated that the existing network of roads, tracks, buffers and recently burnt areas will be used to provide cell boundaries in the Park. This was also to include where appropriate, any firelines constructed during the 1989 wildfire event.

The strategy goes on to make several other statements:
- It will be at least 5 years before fire hazards develop in areas burnt by the December 1989 wildfires.
- A major review will be conducted in 1995.
- The management intent in the longer term is to conduct fuel reduction burning by aerial ignition.
- Four broad prescriptions for fire management will be used.

    - Buffers,
    - Prescribed fire within Management Cells.
    - No planned burn.

- Vegetation/Habitat Management.

(See the attached appendix 2 for detail of the above prescriptions).

Implementing the Fire Management Plan:

The management plan goes on to list 24 individual prescriptions or tasks required to ensure the broad objectives and strategies of the plan have or are being met. These range through;

- Prescribed Burning,
- Wildfire Suppression,
- Liaison,
- Research and Monitoring.

To assist CALM in implementing the planned strategy outlined in the fire section (9.2) and to work through the prescriptions listed, a Fire Working Group was formed. This approach is included as prescription 8 which states:

"Establish a fire advisory group with representatives from the two local bush fire organisations, Shires, Bush Fires Board (now Service) and CALM, to meet at least annually and review implementation of the fire plan and priorities. This group has the responsibility to set programmes for the year. CALM undertakes to implement each annual program set out. The group will consider the introduction of new technical knowledge and its application to the fire management of the park. The group shall report to the Shires, NPNCA (now Conservation Commission), Bush Fire Board (now Service) and CALM in a format to be determined".

The group held its first meeting on the 21st October 1991, at the Ravensthorpe Council Chambers. Since that time we have gone on to conduct twice yearly meetings; generally February and late August with the aim of revising the past 6 months operations and adjusting and setting the coming 6 to 12 monthly works program.

The group contains 7 key members, currently these are.

Greg Broomhall;	CALM (Chairman)
Peter Wilkins;	Ranger In Charge (FRNP), (Secretary)
John Winton;	Bush Fires Service
Rod Daw;	Chief Bushfire Control Officer – Ravensthorpe
Jim Lee;	Chief Bushfire Control Officer – Jerramungup
Graeme Lee;	Councillor – Ravensthorpe
John Mudie;	Councillor – Jerramungup

Other CALM staff who provide input as required are, Mal Grant, Environmental Officer CALM Ravensthorpe and the two assistant park rangers, Lanney Bleakley and Steve Mills.

One of the important aspects of the way the group operates is through the two Bush Fire Officers and councillors in being a conduit for community input in an ongoing manner to the fire management process. Their key role is to bring to the group community issues and comment and then to provide back both via individual feedback and to their respective committees progress and information on implementation of the plan.

The first task identified by the group at their initial meeting, was to analyse and prioritise the Master Burn Plan itself. This was done by breaking the plan into three broad time frames by year during its lifespan, then identifying individual jobs and assigning them an identification number; eg FR8, FR22. Copies of these maps were then provided to both Shires, the 2 CBFCO's and the Albany CALM office.

The group also took on the issue of assessing fire management requirements of several areas of adjoining Unallocated Crown Lands, in particular on the eastern end of the park. Areas of UCL in the western end of the park had already been included. This was considered important to ensure a uniform approach in adjoining areas and also to assist the local CBFCO in managing fire in their areas of responsibility.

From this base, the group has gone onto discuss and program a wide range of actions covering aspects of prescribed burning, wildfire control, firebreak construction and maintenance, water point improvements, training, communications and liaison.

In addition a mid term review of the fire plan was commenced in late 1995, in particular looking at fire management requirements in the wilderness sector of the park effected by the 1989 wildfires. This was done to determine if some form of fire protection works was required. Unfortunately just at the end of this process, another large wildfire burnt through previously unburnt areas which had "escaped", the 1989 fire, this required a further review and public consultation process. Subsequent works in these areas has therefore, been concentrated on track maintenance for management and firefighter access, areas of erosion control and water facility development.

Once programmes have been discussed and set by the group, CALM is then charged with the responsibility of implementing the required works and providing the necessary funding and resources. Local brigade groups have provided support in achieving many of the fuel reduction and habitat management burns conducted so far.

The use of fire as a management tool is both a complicated and difficult task. A detailed Burn Prescription (CALM 873), is required to be prepared and approved along with an Environmental Checklist (CALM 32), before any burn can be undertaken. (See Appendix 3 & 4 for examples of these forms).

The prescription process is required to take account of conservation and environmental values and in particular, the impact on flora and fauna habitats, dieback control, landscape planning and visual assessment procedures.

In addition any track or firebreak maintenance required must undergo a Hygiene Evaluation process prior to commencing to ensure that dieback disease spread is not occurring (Appendix 5).

As can be seen from the plan (Appendix 1), many of the burn cells are quite large (up to 4,000ha) and therefore can become quite complex in both their ignition and control requirements in addition to not impacting on conservation or park users identified in the prescription planning process. A combination of both ground/hand lighting and aerial ignition can and has been used.

The future challenge for the group, with the plan reaching or having reached the end of its "life", is to ensure that sound fire management practices are continued during the forthcoming plan review period and to possibly produce draft options for inclusion. These need to be based on both past good practice and future fire management requirements, within particular, strong consideration of both conservation and community values.

Therefore, in summary, the situation is;

- A Management Plan for the park was produced,
- It contained a Fire Management Section (9.2),
- This listed a number of objectives and strategies,
- These are to be achieved by working through a number of prescriptions,
- One of these indicated the need to form a Fire Working Group (prescription 8),

- The group sets work programmes and prioritises for CALM,
- With assistance in some areas from the community CALM is responsible for implementing these.
- CALM must report back on achievements.
- Fire Working Group to look at future direction and options for fire management.

Greg Broomhall
Operations Manager
South Coast Region

19 February, 2002

APPENDIX 2.

FIRE MANAGEMENT PRESCRIPTIONS
FITZGERALD RIVER NATIONAL PARK

1. *Buffers*
   Separation of cells by narrow, low-fuel buffers (up to 400m wide), provides protection for individual cells and a basis for more extensive use of prescribed fire within cells. Scrub rolling supported by prescribed burning will be used to establish buffers. These buffers by themselves are not capable of stopping large wildfires burning under severe conditions; however, they do provide positions from which to conduct suppression operations. Such buffers will help reduce the probability of large fires burning across the Park. This technique helped to control wildfires in the Park, under extreme conditions, in December 1989. Consideration will be given to widening some of the buffers within the life of the plan.

2. *Prescribed Fire Within Management Cells*
   In areas designated, prescribed burning on a cell basis will be undertaken as indicated in Map 9. Approximately 30-70% fuel reduction will be sought using aerial ignition to develop a mosaic of vegetation ages within cells. Prescribed burning operations will most likely be carried out in late spring and autumn.

3. *No Planned Burn*
   These areas will not be prescribe burnt for the duration of this plan. The intent is to retain these areas for reference in the long term. If a wildfire occurs in a 'no planned burn' area, consideration will be given to designating an alternative 'no planned burn' area. This should be part of the annual review by the fire advisory group (Prescription 8).

4. *Vegetation/Habitat Management*
   To protect the high conservation value of the northern cells, some prescribed burning may be necessary. This will ensure this area is not completely burnt in a single wildfire. In addition, research may indicate the need for prescribed burning to maintain rare fauna habitat.

   Cell boundaries will be protected by wide, open-edged buffers. Prescribed burning within cells will only occur after careful assessment to ensure rare fauna are not at risk. Consideration will be given to the use of aerially ignited mosaic burns.

THE DEVELOPMENT OF A MOSAIC FIRE REGIME USING 'WIND BURNS' FOR THE CHEYNE BAY COASTAL RESERVE.

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INTRODUCTION

Cheyne Bay coastal reserve (R31240, R14986, R14987) is located on the south coast between Cape Riche and the Beaufort Inlet some 100 kms to the east of Albany and 15 kms south of the township of Wellstead (Map 1). It is the largest area of bushland in the Wellstead district totalling over 10 500 hectares. In 1994 a severe summer wildfire caused massive destruction in the eastern end of the reserve causing safety concerns for the community when the fire escaped into nearby farmland.

The Wellstead community has always had an interest in learning about the biodiversity of the district. Over a decade ago the community was involved in various field surveys from which they later published; *Birds of the Wellstead District* 1991, *Eucalypts of the Wellstead District* 1992, *Banksias of the Wellstead District* 1994, *Mammals of the Wellstead District* 1987 and soon to be published *Acacia's of the Wellstead District.*

The Wellstead community has also had a strong interest to undertake and initiate better management of the large, mainly unvested coastal reserve. In 1997 they began work on *The Cheyne Bay Coastal Survey – Cape Riche to Pallinup River*. Consultants were employed to examine physical and biological features of the reserve including surveys of the indigenous flora and fauna. Information on the Aboriginal and European history of the area was also collated. Weed and Dieback (*Phytophthora cinnammomi*) outbreaks were mapped and the impacts of recreational activities and fire were also examined. In 1999 the *Cheyne Bay Management Plan* was produced in consultation with the Wellstead Land Conservation District Committee (LCDC) the City of Albany and the Department of Conservation and Land Management (CALM).

Significant biological records for the reserve include; three Declared Rare Flora (DRF) species, two presumed extinct flora and thirteen plant species listed on the *Priority Floral Species List* (CALM). Two bird species and one reptile species have also been recorded within the reserve and are listed on the *Threatened and Priority Fauna Lists* (CALM).

The *Cheyne Bay Management Plan* recommended that a fire regime needed to be devised that not only considered the safety of life and property but would also ensure protection of flora and fauna, including rare or endemically restricted species. The Fire Emergency Service Authority (FESA) consequently recommended that a fire management plan be prepared which addressed fire prevention, mitigation and suppression within the coastal reserve area and surrounding land.

COMMUNITY DECIDES ON A SUITABLE FIRE REGIME.

Due to the 'unvested' status of most of the reserve no local government agency was willing to be actively responsible for ensuring the fire management of the reserve. Members of the Wellstead community therefore began to devise a plan to develop a fire regime for the Cheyne Bay reserve which took into account both property protection and biodiversity protection. The Wellstead community recorded the fire history of the reserve for the past 35 years (refer to Table 1.)

Table 1: **A summary of the approximate dates and apparent causes of fire events in the Cheyne Bay coastal reserves within the last 35 years. It should be noted that there is no official record of a fire being caused in the reserve by lightning strike. Most causes have been related to human activities.**

Date	Description of Event
1960	Two fires escaped from Location 6230, 'Blackboy Hill', and passed through Location 6854, 'Jindalee', burning through the study area on to the Pallinup River. Another fire escaped from the same Location 6230 and burnt through Reserve 31240 and down to the coast at Cape Riche.
March 1981	Fire started at Boat Harbour campsite and burnt through Reserve 31240 to Location 7019
March 1983	Fire started at a fisherman's camp at Swan Gully and burnt through Reserve 31240 to the boundary of Location 6853.
April 1984	Fire started near Pallinup River and burnt into Location 6962 and 6228.
April 1984	Fire started near Pallinup River and burnt into Location 6962 and 6228. Fire started on at Swan Gully and burnt through the coastal reserve and Sandalwood Road to Location 7018.
1986	Location 6230 and burnt through Reserve 31240 to the coast.
1989	The Bush Fires Board burnt strips of bush from the Pallinup Estuary track through the study area to the ocean.
1994	Fire started at a campsite in the Paperbark Reserve on the north east side of the Pallinup River and burnt through the study area to the Boat Harbour Road.

The leader of the team was Jeff Ellett who had farmed in the Wellstead area since 1962. In the early 1970's Jeff became the Fire Control Officer for the Kojaneerup Brigade. In 1982 he became the Deputy Chief Fire Control Officer representing the north eastern section of the Albany Shire and he continued in this position until 1995.

Jeff began to investigate any information he could find on fire regimes suited to the coastal mallee heath. A mosaic burning pattern seemed to be the best way of breaking up the vegetation ages and fuel load through the reserve along with providing habitat and food for the wildfire that resided in the reserve. Jeff consulted with many local Noongar people in the region seeking information on how they managed the environment using burning practices and how to start off a mosaic burning program (details are presented in Table 2.) Through this information he learnt about the process of winter burns using northerly winds at a time of the year when cool temperatures and high moisture levels extinguish fires naturally in the evening. This kind of fire is sometimes referred to as 'wind burning' (pers. comm. John Winton, 2002).

Jeff also recognised that weather data for the area between Mt. Barker, Albany, north to the Stirling Ranges and east to Gairdner River is very poor. No data available portrays the change in temperature gradient which can occur from the coast through to the Stirling Ranges in the summer and autumn seasons. There is also very little data recording the dramatic wind changes which can occur during the different seasons in the south coast region. A high proportion of prescribed burns in the region escape the prescribed area due to unpredicted wind changes.

Table 2: **Information on the use of fire management provided by Noongar people to Jeff Ellett.**

Aboriginal people did most of their burning over the summer / autumn period, always very late in the day because burning at this time allows the bush to regenerate more quickly They never did any burning from early August through to the end of December (depending on the season) because all the wildlife were breeding and rearing young. They would know when the breeding season started when reptiles became active after hibernation. Due to the changed fire management of the bushland since Europeans arrived, many large blocks of bush have uniform age. To begin a mosaic pattern of burning in a large area of bush the first burn should occur in the middle of winter. Any section of the bush that will actually ignite should be burnt. In the following years other sections of the bush that will ignite with slightly less moisture in the fuel load should be burnt. Each year the bush is ignited slightly earlier in the winter moving toward late autumn conditions. By the third spring after a burn there is enough food and shelter for the wildlife to reinhabit the site.

BEGINNING A MOSAIC BURN REGIME FOR CHEYNE BAY COASTAL RESERVE.

After gaining permission and support from FESA in Albany the Wellstead community decided to try and start the mosaic burn pattern for the reserve. Large maps of the Cheyne Bay Reserve were created so that any burns could be placed on record. Decisions were made on desirable wind directions and wind speeds to carry out the first of the mosaic winter burns in the reserve. Inspections were carried out in the reserve examining accessibility to vegetation communities which were believed to be inflamable in the cool, moist conditions of winter. It was recognised that the most flamable species in the coastal heath vegetation of the reserve is the Dryandra (the common name being the kerosene or petrol bush.) The vegetation survey of Cheyne Bay reserve revealed that there are nine species of Dryandra in the reserve.

After carefully examining weather maps and listening to morning forecasts a day in July 2000 appeared to be suitable. The wind was north – north easterly at a speed of about 15 – 20 km. per hour. This kind of wind would take a fire started along the northern fire break boundary down toward the ocean. The intention was to light up strips of about 300 metres in length and leave the same length unburnt inbetween.

With only two persons required, strips along the northern firebreak of the reserve adjacent to Cape Riche were lit using liquid fuel to ignite the bush. Sites which contained Dryandras tended to ignite well. Other sites where Dryandra were sparse and thin on the ground did not tend to ignite. The strips were lit at about 11am and the fires extinguished naturally at about 2.30pm. The second day the wind was more northerly and the wind speed was a bit stronger so attempts were made to light up more areas. The fire's were started mid morning and stopped naturally at 3.30pm. By nightfall there was no fire remaining burning.

A few weeks later a local pilot was able to fly over the site and take aerial photographs showing the path of the strip burns. None of the fires had burnt as far as the coast and each one had retained a fairly narrow width and traversed over a range of elevations and vegetation communities (refer to images 1, 2, 3, 4.)

The following year more strips were burnt in the middle of the reserve and over near the eastern edge over three separate days in July 2001. Detailed records were made of wind direction, strength and the time of lighting. One of these burns did reach the coastline (refer to table 3 and images 4, 5, 6.)

Table 3: Mosaic burns done by Wellstead Community

Date	Description of Event
July 2000	Burning of sections of Reserve adjacent to Cape Riche. Weather conditions were north – north easterly wind at a speed of about 15 – 20 km. per hour. Fire started on first day at about 11am and stopped at 2.30pm. The second day the wind was more northerly and the wind speed was a bit stronger. The fire was started mid morning and stopped at 3.30pm. All fires died in the night.
14th July 2001	Corner of 'Nangunia' No. 3 two piece
15th July 2001	Corner of 'Barooga' No. 2 one piece
21st July 2001	Burnt to the coast, NNW winds

MONITORING OF EFFECTIVENESS OF MOSAIC FIRE REGIME.

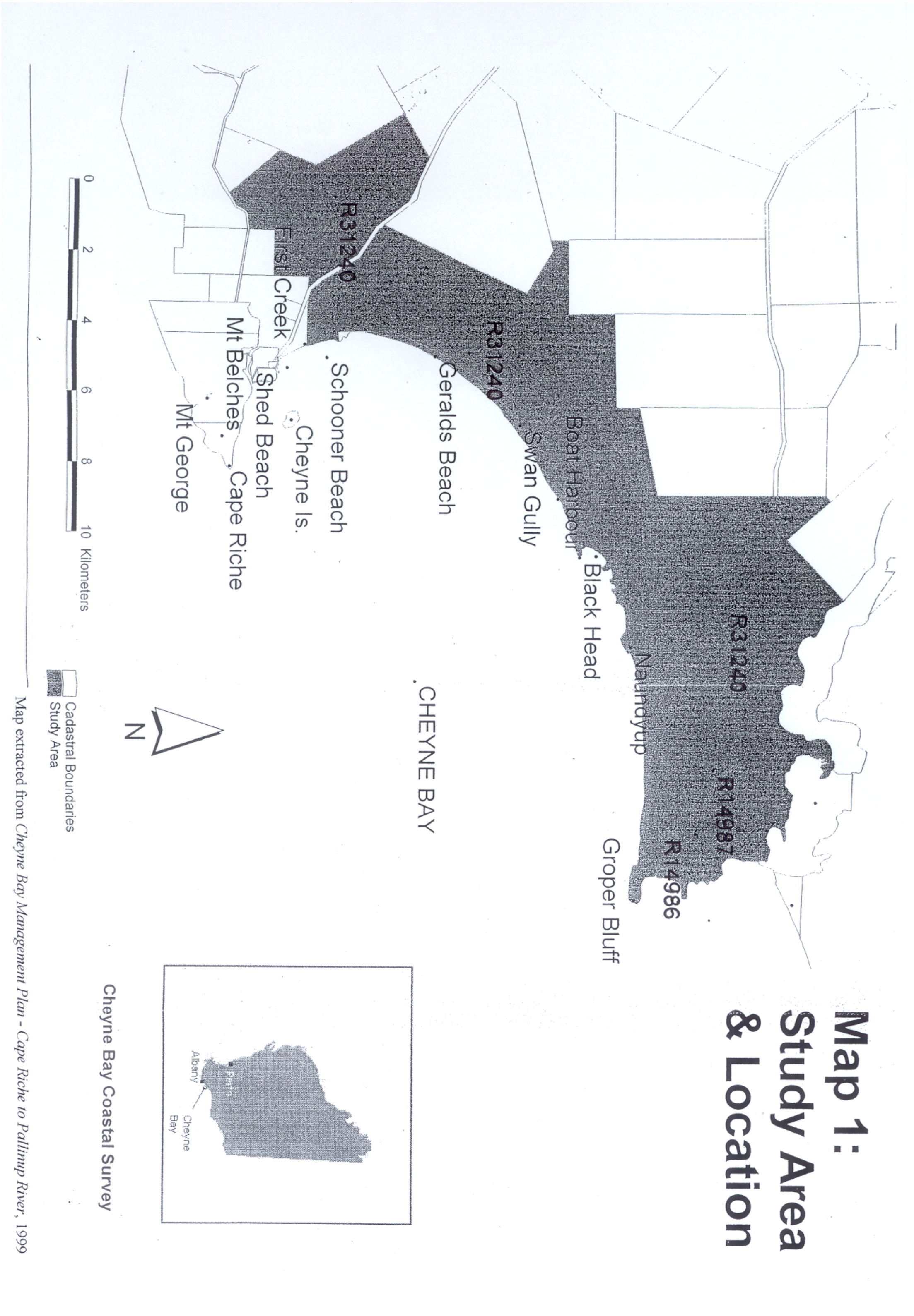
Monitoring stations measuring floral regeneration and faunal reestablishment have been set up in one of the sites burnt in July 2001. Assistance has been provided by staff from *Land For Wildlife*. The monitoring has been kept to simple techniques so that the Wellstead community can carry out much of the data collection. It is intended that the long term results will be collated and will increase understanding on the effect of winter burns on biodiversity.

The records of future wildfires in the reserve will also reveal whether mosaic burns reduce the number of uncontrollable fires which burn out large areas of the reserve and their impact on the safety of neighbouring farms and the biodiversity of the reserve.

SUMMARY

The Wellstead community believes that this technique of creating a mosaic using wind driven fires will provide a method of reducing the wildfire hazard to life and property posed by unburnt coastal heath, whilst at the same time ensuring the maintenance of local flora and fauna.

Map 1: Map showing Cheyne Bay Coastal Reserve. ***(map extracted from the Cheyne Bay Management Plan)***



ACKNOWLEDGEMENTS

Thanks go to Graeme Barr (FCO Wellstead Brigade) for the suggestion of a mosaic burning program. Thanks also to Bill Hassell . Thanks to the descendants of the original Aboriginal families of the area including Aidan Eades and Harley Coyne. Thanks also to Nick Gorman for doing the fire lighting.Thankyou to John Tonkin from FESA for his support and encouragement.

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Winter Burning In Fitzgerald River National Park

Preface:

The following information has been written as result of experience I gained with regard to winter burning in the heath and mallee country of the Fitzgerald River National Park. Much of what I record is drawn from observation without scientific recordings or back-up. However, a keen sense of weather conditions, together with having attended advanced weather courses provided by the (then) Bushfires Board of Western Australia and the Bureau of Meteorology allowed me to make informed decisions as to what would, or wouldn't, work in burning during the winter months. The processes I established in Fitzgerald River National Park may well be applicable in other areas of similar country along the south coast of Western Australia and even along sections of the west coast. Nevertheless, what I am writing about is concerned directly and solely with Fitzgerald River.

Much of what I learnt was through trial and error. If by providing this record I can enable other park managers to obtain similar results without having to go through the trials and tribulations I went through, then I have achieved much, not only for them, but also for the future of the park itself.

Background:

I arrived in Jerramungup mid October 1979 to take over as Ranger-in-Charge of the Fitzgerald River National Park.

I found the local community generally positive toward the park, but with strong concerns regarding the fire risk it presented. Much of the concern was as the result of nothing having been done toward alleviating the risk, apart from a double fireline having been installed down the western side of the park. A single fire access line lay across the northern boundary of the park.

Within a month of arriving at "the Fitzgerald" a member of the Bushfires Board took me to a Bushfire Brigade meeting at Gairdner. The Gairdner people were concerned that nothing had been done with the park regarding fuel reduction. I was able to gain a lot of insight as to what was required from that meeting, but had little idea about how to ameliorate their concerns without creating a disaster.

Shortly afterwards I was given an invitation which, wasn't to be denied, to a Jerramungup Fire Brigade meeting. The meeting was very well attended and the members expressed their concerns in no uncertain terms to me. The Jerramungup meeting was a little more positive, however, as the Captain and one of his lieutenants offered to accompany me through the park and discuss their concerns 'on the ground'. As a result of this we decided to try control burning the more dangerous sections down the west side of the park, with particular emphasis on the areas adjacent to the farmland. Being too near harvest time we set the burn for autumn.

We did get to carry out two days of burning. From this I was able to get an appreciation of what was required to carry out such reduction burns. In the two days with twelve light units, forty men, two heavy units plus two tankers we only managed to burn the buffer strip between the two firelines (with some jumpovers) for a total of around 15 to 16 kilometres.

Some days later, in conjunction with the Gairdner Fire Brigade we were able to burn another 4 kilometres. Unfortunately this control burn escaped and most of the day was spent in monitoring the subsequent wildfire. Luckily this was halted by running into the burn previously carried out by the Jerramungup Brigade.

As a result of all this work for comparatively small return together with very high risk, it was obvious that it wasn't going to be practical to burn a buffer zone around the entire two hundred odd kilometres of the park boundary. The sheer number of men and amount of equipment was too big to contemplate.

Shortly after these events we installed a second fireline parallel to the one on the northern boundary. Even though, by this time, it was becoming obvious that the buffer between would not be able to be burnt on any sort of regular basis. You can only press the goodwill of the locals so far as well as the use of their machines and equipment.

Having experienced all of the above, I now started to look at what other means we had to establish areas of low fuel which would be both strategic and provide refuge areas for the park's bird and animal life. It is from this perspective that the winter burning program was devised.

I never tried winter burning the first full winter we were there. The year was a draught year and as a consequence much of the mallee and its associated scrub shed a lot of its leaves. While that didn't make a lot difference to the build up on the ground, due to wind driving the litter into irregular heaps. It did make a lot of difference to the amount of standing fuel available. Toward the end of the following summer we blade-ploughed and root-raked the firelines across the northern boundary of the park to remove regrowth as well as reducing the rootstock to lessen the incidence of future regrowth.

Trials And Tribulations:

By the second winter that I was in charge of the park, I was getting frustrated at our inability to get any areas burnt in safety with only a small number of personnel.

I watched the weather pattern each night on the television with great interest. It occurred to me that in the build-up to rain, particularly from the northwest quarter, there was almost invariably one day, at least, of warm prefrontal winds in the Fitzgerald area. The more northerly the winds, the warmer they were.

In the middle of July I called up one of my other ranger's and got him to join me in doing some burning along the northern boundary. I worked out that the wind should carry the fire through the buffer zone between the two breaks. A distance of about 200 metres. The wind that particular day was almost due north. As the breaks lay east-west and the southern break was the newest I didn't believe we would have any trouble containing the fire to within the breaks. It was wintertime after all.

We went ahead and lit two kilometres of edge along the northern side of the buffer. I wasn't greatly concerned if I was wrong, as I didn't believe the fire would run very far if it did perchance jump the break. I was wrong on both counts. By the time we drove back after lighting the two kilometres we found that the fire had jumped the break for about 80% of the distance. From that we had three tongues of fire racing south into the park. All we were able to do was watch in frustration for most of the afternoon as the three fires made their way south. The western most tongue ran up to the edge of Quiss Road. It arrived at the road about 3-30 p.m. and we spent an hour fighting hard to stop it jumping that road and travelling further south. The other two tongues seemed to have run into low fuel and petered out. We had just got to the point where we were capitulating as the fire was across Quiss Road. It was starting to race away in quite heavy fuel at 4-30, when it suddenly went out as if someone had snuffed a candle. It was all over in minutes. Neither my partner nor myself noticed any special change in the weather. We looked across the park and there was little to acknowledge there had been fires burning throughout the afternoon. It provided much food for thought.

I went back to the scene next day and looked closely at what had happened. Everything I saw encouraged me to try again. I also saw that it didn't need to be from firebreaks or buffer zones. With commonsense and close observation of the weather we could get quite a bit of strip burning done during the winter. The other vital point was; the most dangerous winds during the summer were from the northeast. This meant that everything we burnt during winter provided a path directly across the most likely summer fires.

A week, or so, later I was returning from East Mt Barren via Hamersley Drive about three o'clock in the afternoon. I saw what I took to be a rain shower coming across the park from the west. The wind was holding steady in the west and quite warm. I took it as a good opportunity to light up a front approximately three hundred metres wide across the wind. The thinking being that it would travel only a short way before being doused by the rain. Again I scared myself. The so-called rain shower turned out to be a dust storm from neighbouring farmland. There was no rain at all. There was nothing I, nor anyone could do about the fire by then either. It was burning well. I drove on home to Jerramungup. At 5 p.m. my ranger from East Mt Barren rang to say he was being deluged with phone calls from the Hopetoun area about the huge bushfire. I assured him that it would be okay, as the fire would go out shortly, speaking from my experience of only a week before. At six o'clock he called again in concern. The fire was still raging in country, which hadn't been burnt for many years. My confidence was still intact, although by eight o'clock with the ranger giving quarter hour reports from the slope of East Mt Barren, I must admit I was getting worried. Just after eight o'clock while talking via radio the ranger reported that the fire suddenly went out. He stayed on watch for some time, but nothing came up so he went home. Early next morning he went out and reported that the fire was entirely out and it was drizzling light rain. I was able to fly over that burn a short time later. It had achieved something we could never have done with a machine. There was a straight burn, which maintained its width to within a few metres of the original fire I lit, for over six kilometres through rugged foothills and gullies at the southern end of Eyre Range.

I did no more burning in the park that winter. I did, however, spend quite some time with the Bushfires Board in the Ravensthorpe Ranges as we lit quite a lot of road edge with a flamethrower. Because we lit on many consecutive days, much of what we did was wasted as only the scrub directly lit burnt. The exercise was useful though as it gave me comparisons of weather conditions I could draw from. As well as knowledge of what fire would and could do in that country under winter conditions. I had much to think about over the summer as it was obvious that winter burning could be accomplished by one, or two persons and with reasonable planning it would provide much of the protection the Fitzgerald River National Park required.

Planning & Progress:

The next two winters I watched the weather pattern very closely. These winters were wetter by far than the first two I had experienced at Fitzgerald River. It was noticeable that the mallee thickened its foliage while the other shrubs mainly showed the benefit of the extra rain by displaying more flowers for a longer period.

In spite of being wet winters I was able to achieve a lot of strip burning. The weather pattern was always the same and the time to burn was on the day leading up to rain with the strong and warm north westerly.

Only once during all of the burning I did in Fitzgerald River National park did a fire reignite the following day. I burnt a block, not just a strip, to the north of Bremer Bay on the northeast side of the Bremer River. The fire burnt into the heavy timber country bordering the river and burnt up the next day. The residents of Bremer Bay were ecstatic as they saw that area as a huge threat to the town and told me it hadn't been burnt for as long as anybody could remember. Even though the fire continued through the second day it was extinguished that night as quite heavy rain fell. The whole job was carried out by two men.

By watching the forecast I could often warn one or the other of my men that we could be burning the next day. However, it was hard to tell ahead of time as often we would get out next morning and the weather would be totally unsuitable. It was most often the case of when the day was right, drop everything you had already planned, get out there and light up. When we did light up I was always cautious enough not to light more than three, or four, strips in any one day.

During the winter of 1984, my last at Fitzgerald, I got very little burning done. It was in the time leading up to the formation of C.A.L.M. Word had got around that I was having some success with the winter burning so I received a visit from the late Jock Smart who was head of the Forest Department's Fire Section then. We flew all over the park so that Jock could have a look at the effects of my burning programme. I am pleased to say he was impressed. He felt it was time we got the programme onto a more scientific footing, as he believed it could be carried out by aerial ignition and therefore get larger areas burnt each time. I expressed doubts unless they were able to maintain an aircraft on the ground for the winter, ready for the specific day when burning could be carried out. Nevertheless, Jock asked me to go over to Manjimup and learn how to measure standing fuel using a calibrated rod. He also gave me a supply of incendiaries to see how they went for use in ignition.

I spent many days out in the various parts of the park measuring fuel quantities and trying the incendiaries. I also measured fuel moisture, ambient temperature and wind speed. I drew up what I saw as an appropriate burn prescription, yet for all of that I could never get the burning results I had previously obtained. The incendiaries were quite hopeless as they would land in between shrubs and fizzle out on the bare sand in between. The occasional one, which landed in a shrub, would almost invariably flare up too quick for the shrub to set alight. Through it all the wind was the key and the only way to light a fire was with a hand torch using liquid fuel onto standing vegetation. I reported all my findings back to Jock and expressed my doubts as to whether they would have success at all using an aircraft. Subsequent trials have proven me to be right in my assessment.

Summary:

- A general prescription should be written for all winter burning so that time and resources are not wasted on each burning day, as each day, which is suitable, is precious.

- Study the weather pattern on television each night. It is the best guide. Be prepared when you see a front bearing down on the area from the northwest quarter. The preferable frontal direction is from nor nor west.

- At best you will only get between ten and twenty days in any winter when you can burn. Then you have to be sure you can get onto the ground where you wish to burn as it can get very boggy.

- The greatest advantage about this method is the lack of machinery use, therefore lessening the chance of spreading dieback. Providing, of course, that the aforementioned boggy conditions are avoided. This is where aircraft burning would be important, if perfected.

- Two people with a liquid fuel flamethrower mounted on a vehicle can light all that is required on any day. While I was there we used only hand torches.

- Much of what I did was similar to what the original inhabitants would have done. It was interesting to see the kangaroos move into the patches we'd burnt the year before. They provided a source of fresh green regrowth without scorching the ground.

- Incendiaries do not work in vegetation such as in the Fitzgerald River National Park. Possibly areas could be enlarged by using helicopter lighting methods using the gel-like fuel such as is now used in some of the forest areas. The gel fuel will stick to the standing vegetation and give it time to ignite.

- Whatever is done the wind is the most important factor of all. A warm day with a gentle breeze will not get the fire to run. The breeze needs to be in the vicinity of thirty five kilometres an hour to drive the fire through from shrub to shrub

- It can be quite daunting to light a fire that ultimately we have no control over except our own estimation of the weather. With firm decision making and a preparedness to try I was able to prove the system worked.

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FIRE SYMPOSIUM - SPEAKERS TAKE HOME MESSAGES AND SUMMARY OF DISCUSSION

Stephen Hopper	- south-west Australia is internationally recognised as one of the 25 'hotspots' in the world for biodiversity - local knowledge needs to be applied to local circumstances - we are still learning; sustainable landscape management has yet to be achieved - need to develop adaptive management practices and long term learning
Angas Hopkins	- there is a conflict between fire management for biodiversity and fire management for reducing or managing fuel loads and therefore we need to be clear about what we are trying to achieve - recommended an ecological burn approach which involves irregular/infrequent, hot, late summer/autumn, more uniform burns
Mike Bamford	- impact of fire on fauna varies substantially - we need to understand the impacts of different fire regimes on fauna - precautionary principle should <u>not</u> imply that no fire regime should be put in place - fire regimes will need to be determined by those fauna which require a larger interval between fires
Colin Yates	- our knowledge of the impact of fires is largely based on studies of single fire events but we need to acknowledge that there is also an evolutionary impact. - non-sprouting (seeding) plants are more susceptible to extinction than sprouters - there is risk to biodiversity associated with all fire regimes - external factors such as post-fire rainfall are also important in determining ecological impacts - refuges such as granite outcrops and wetlands are important for protecting some species
Rod Daw	- need to use local experience in developing fire management strategies (eg Eastern States experience is not always relevant)
Jeffry Ellett	- need to acknowledge Noongar experience and knowledge - coastal heathlands often only require smoke to promote regrowth - developing a mosaic burn process in his region with late autumn burns using wind to drive strips through the coastal heathland - need to map the burns that have taken place and record data on impacts etc.
Penny Hussey	- the introduction of weeds has changed the outcomes of using an Aboriginal approach to burning - controlling grass with fire is a real problem because it produces more weeds - never use fire for regeneration if the original soil is buried by wind-deposited material from surrounding paddocks - never use fire for regeneration during or immediately after a severe drought or if a locust plague is predicted - ploughing for fire breaks allows for weed invasion
John Winton	- FESA is required to ensure protection of life, property and the environment in that order - FESA has a memorandum with DOLA to manage fire prevention on unallocated crown land - chaining and, if possible, burning of bushland along the edges of private property is crucial - supports wind driven fire regime such as that described by Jeffry Ellett - we need to do something to prevent massive fires

Greg Broomhall	- FRNP Management Plan sets the ground rules for most activities and was endorsed by FESA's predecessor when it was released in 1991 - fire management in FRNP based on the development of buffers, prescribed burning within fire suppression cells, no burning areas and vegetation management.
Cleve Hassell	- catchment fire records are possible with research in inlets such as the Gordon to determine pulses in charcoal deposits brought down from the catchment by rain - has concluded from his research that 30-60 year interval is required between burns to maintain the biodiversity of the FRNP
Lachie McCaw	- mallee heath fires can change violently with small changes in wind direction and speed, moisture content of the vegetation and the structure of the heath - we need to be able to predict how fuel moisture content varies during the day so that this can be used in fire management - need to avoid large tracts of even-aged vegetation and instead create patchiness in the landscape
General discussion	- need for scientific research on the impact of different fire regimes - need to simplify fire management plans - need to consider giving property and the environment equal weight when determining fire management strategies with decisions based on local circumstance - need better communication between scientists, fire managers and the community - need more research on wind-driven mosaic burning strategy such as that at Cheynes Bay reserve - all fire management agencies should adopt an environmental assessment checklist similar to that used by CALM before any prescribed burning - need to train fire volunteers about the environmental impacts of fires - more research needed on problem associated with weed invasion in firebreaks - need scientific and community representation on Fire Management Advisory Committee for FRNP