# Ruby Paroissien

Ruby Paroissien

Impacts of changing fire season on *Doryanthes excelsa*

Impacts of increasing fire severity on threatened wet sclerophyll forest

Overview of the Australian Botanic Gardens Seedbank

# Acknowledgement of country

From across the lands of the Bedegal, Darug, Dharawal and Wandandian people

# Overview of me

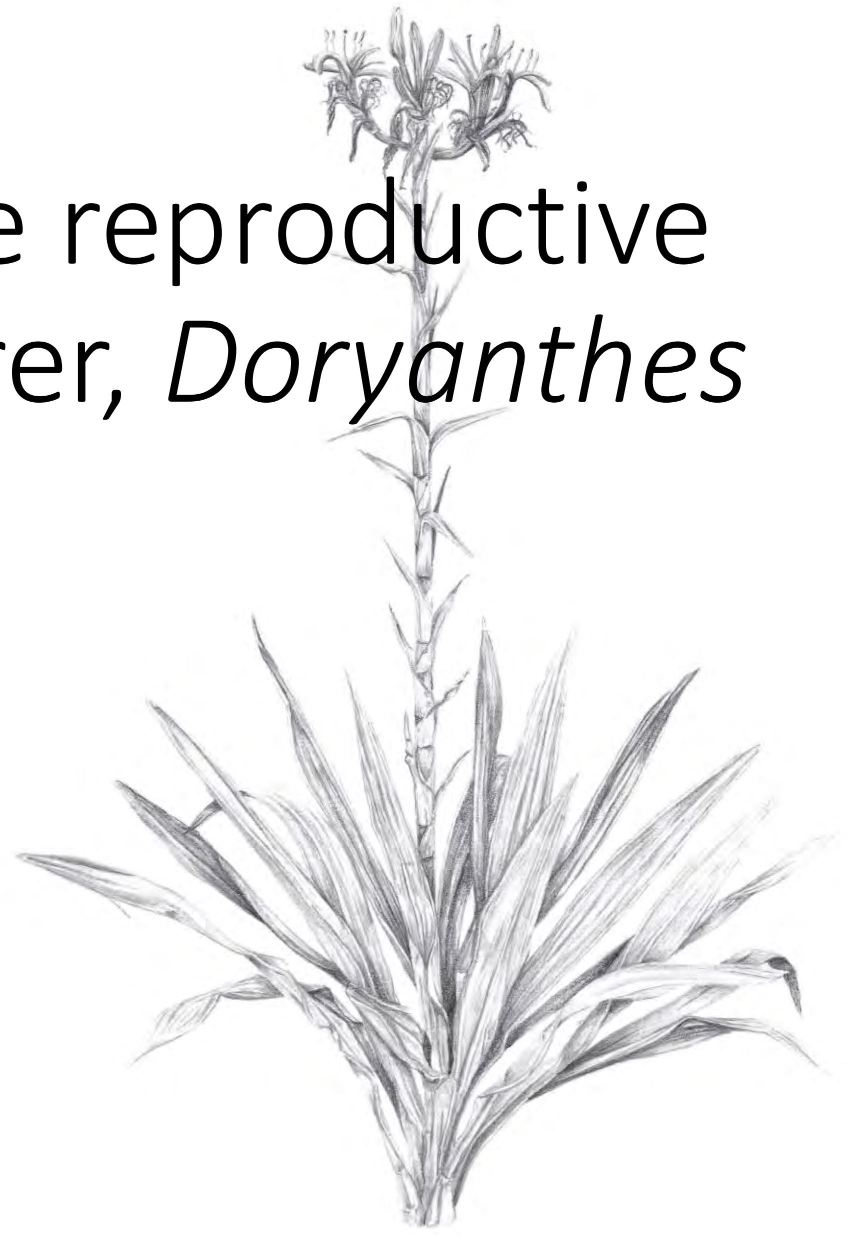
- Completed honours in 2020 looking at changing fire season and impacts on *Doryanthes excelsa*
  - Received the John Martyn Research Grant for The Conservation Of Bushland

- Completed a PhD 2022-2025 looking at impacts of changing fire on threatened wet sclerophyll forest

- Currently a Seedbank Curator at the Australian Botanic Gardens collecting and storing seeds for conservation outcomes

# Effects of fire season on the reproductive success of a post-fire flowerer, *Doryanthes excelsa*

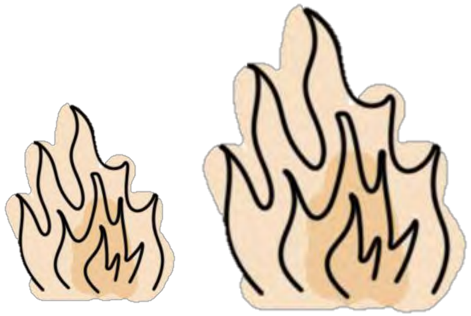
Ruby Paroissien
Mark Ooi



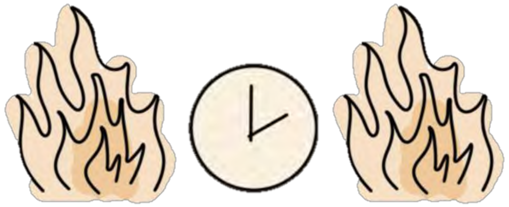
Gymea lily

# Fire regimes

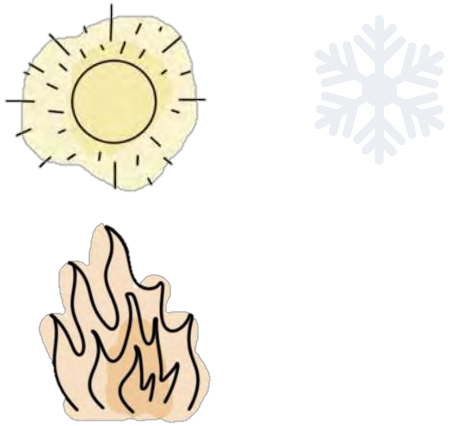
- Different vegetation types experience fire in a mostly consistent pattern
- This long-term pattern is called a fire regime and is characterised by:



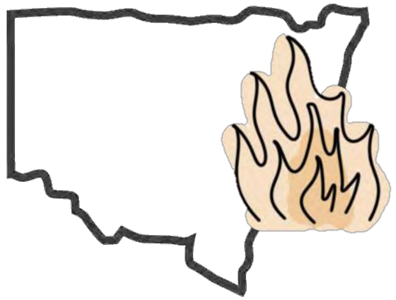
Fire severity



Fire frequency



Fire season



Fire extent

- Vegetation communities are adapted to particular fire regimes

# CHANGING FIRE REGIMES

- Grasslands: low severity, every 10 years
- Dry sclerophyll forest: High severity, every 30-50 years

- Plants are adapted to specific fire regimes
    - Resprouting – basal or epicormic buds e.g. Eucalypts
    - Post-fire seeding - Banksias

- Changes in fire regimes
    - Climate change
    - Management

- Impacts communities and individuals of plants

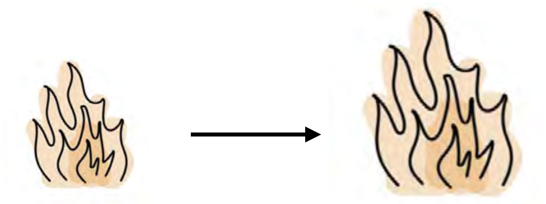
# 2019/2020 Australian megafires

- Increased warming and drying
- Between 8 and 30 megafires
- Greater extent
- Increased severity
- Burn areas below minimum fire frequency

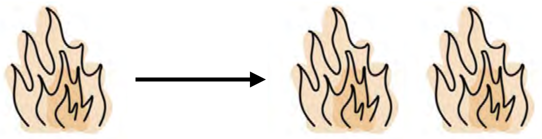
# How fire regimes change

- Available fuel, dryness of fuel, weather conditions, site moisture

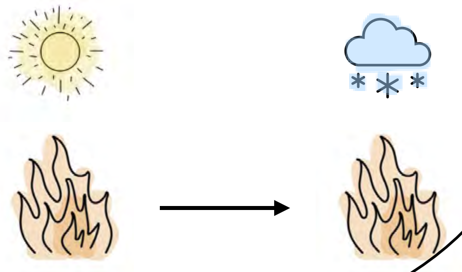
- Fire severity



- Fire frequency



- Fire season



- Extent

- Predictability

Less studied

# Fire season in Australia

- Historic fire season in Australia: summer (hotter and dryer)
- Prescribed burning: autumn or winter
- Climate change may cause fires in spring

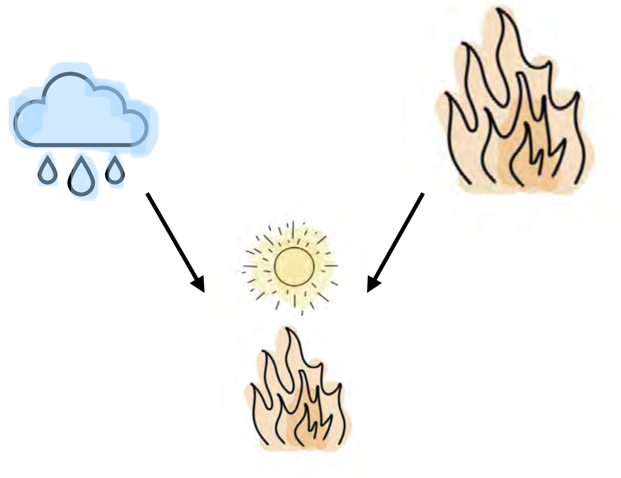
# Seasonal differences

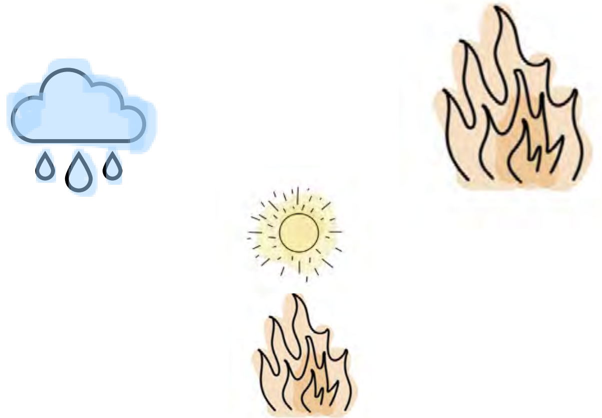
Seasonal rainfall

Aseasonal rainfall

- Mositure and severity cause of effects of fire season

- Moisture and severity independent of fire season





Phenology?

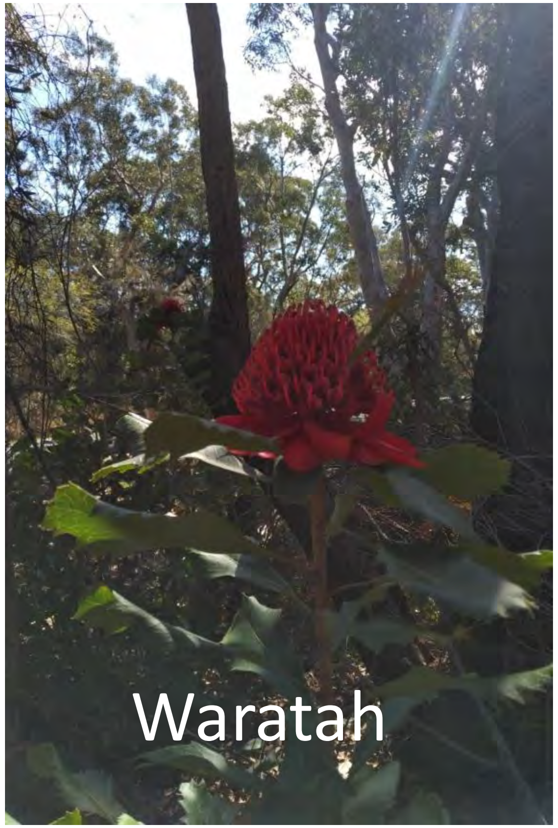
# Fire season on plants

Impacts on several life-history stages

- Reduction in flowering
- Changes to rates of germination
- Interrupt seasonal cycles (phenology) in flowering and nutrients
  - Poorly provisioned
  - Delaying flowering – Impact pollination and competition

# Post-fire flowerers

- Susceptible to changes in fire season
- Flowering stimulated by fire
- Mass flowering event
- Can lack seed dormancy
- Depend on post-fire conditions
- Some of Sydney's most prominent species






NSW

# *Doryanthes excelsa* - Gymea Lily!!

- Post fire flowerer
- Between Karuah and Mt Keira
- Resprouter
- Contractile roots
- Slow to flower (1.5 years)
- Slow to mature (7 to 10 years)
- Long lived species

# Aims

Changes in fire seasonality on the reproduction of the post fire flowerer, *Doryanthes excelsa*

- Reproductive effort
  - Number of flowering stems
  - Age of flowering stems
- Seed biology
  - Germination
  - Seed nutrient stores
- Preferred season

# Methods

- Field experiment - Royal and Heathcote National Parks
- 15 sites burnt 2015 -2018

  - Summer
  - Autumn
  - Spring

  - Wet
  - Dry

- Seed pods collected

  Laboratory experiments


# Fieldwork

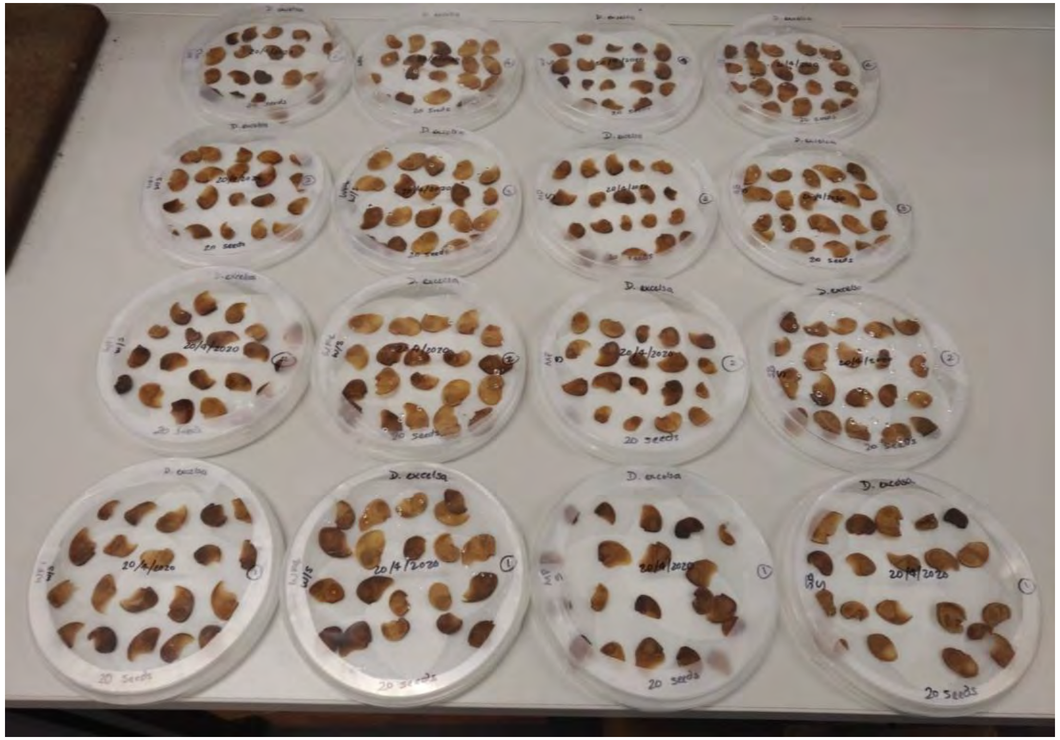
- 50 m transect
- Number of flowering stems
- Age of flowering stems (colour)
  Green – flowering late in current season
  Brown – flowering early in current season
  Grey – flowering in previous seasons (no fruit present)
- Number of seed pods

# Lab work

- Removed pods
- Ripe when brown, dry and splitting
- Only found enough pods to compare summer and spring fire seasons
- Germination at 25◦C day/15◦C night (March/April temps)
- Percentage and rates

Ballistically dispersed

Seeds with paper wing



# Seed testing

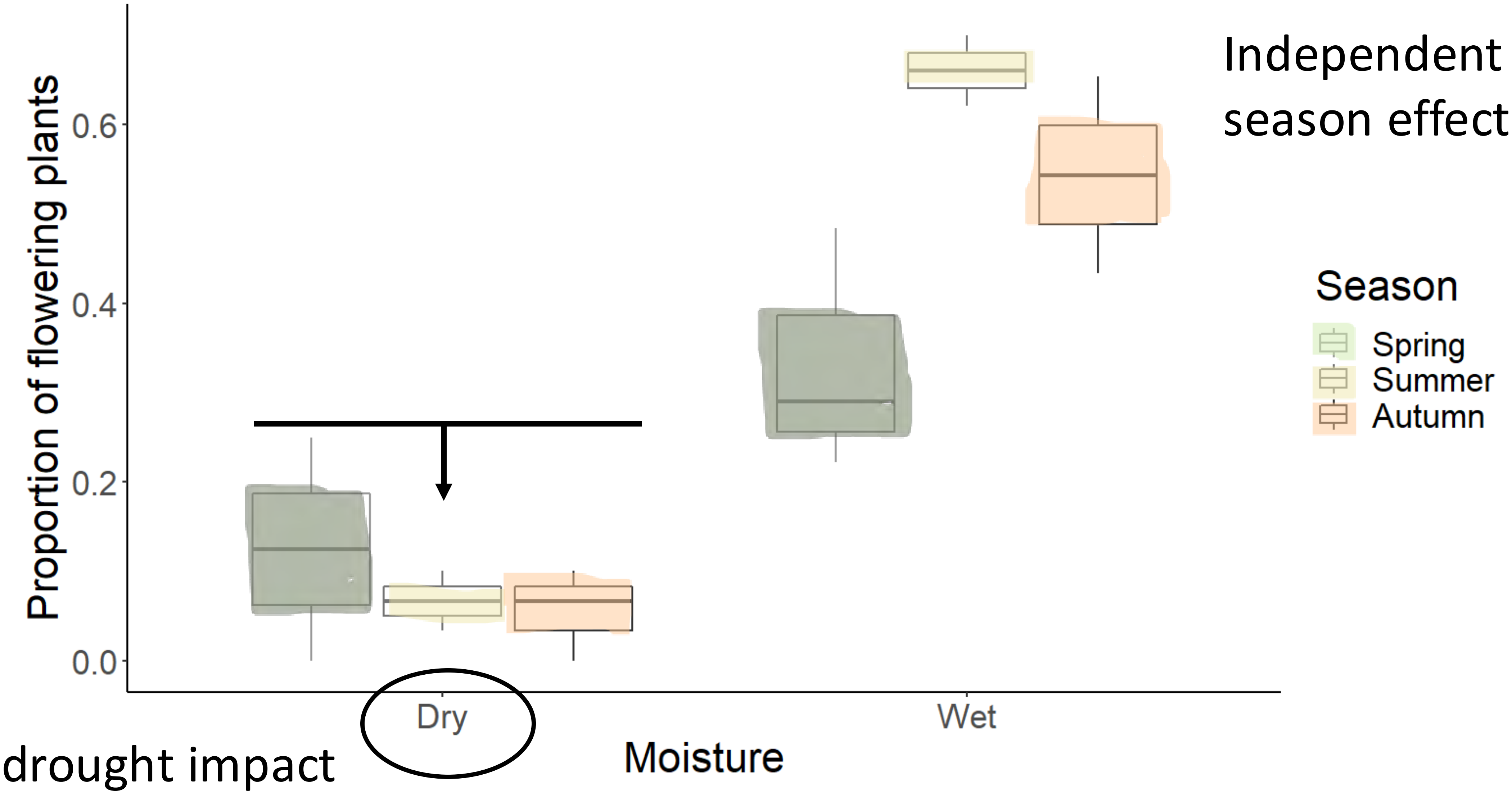
- External by other UNSW sectors
- Primary nutrients stored in seeds
  - Crude protein (from nitrogen – elemental analyser machine)
  - Total lipids (acid hydrolysis method)
  - Carbohydrates (sulfuric-acid-uv method)

# Results

- Greater proportion flowering when burnt
  - post fire flowerer

So does fire season impact the reproduction of *Doryanthes excelsa*?

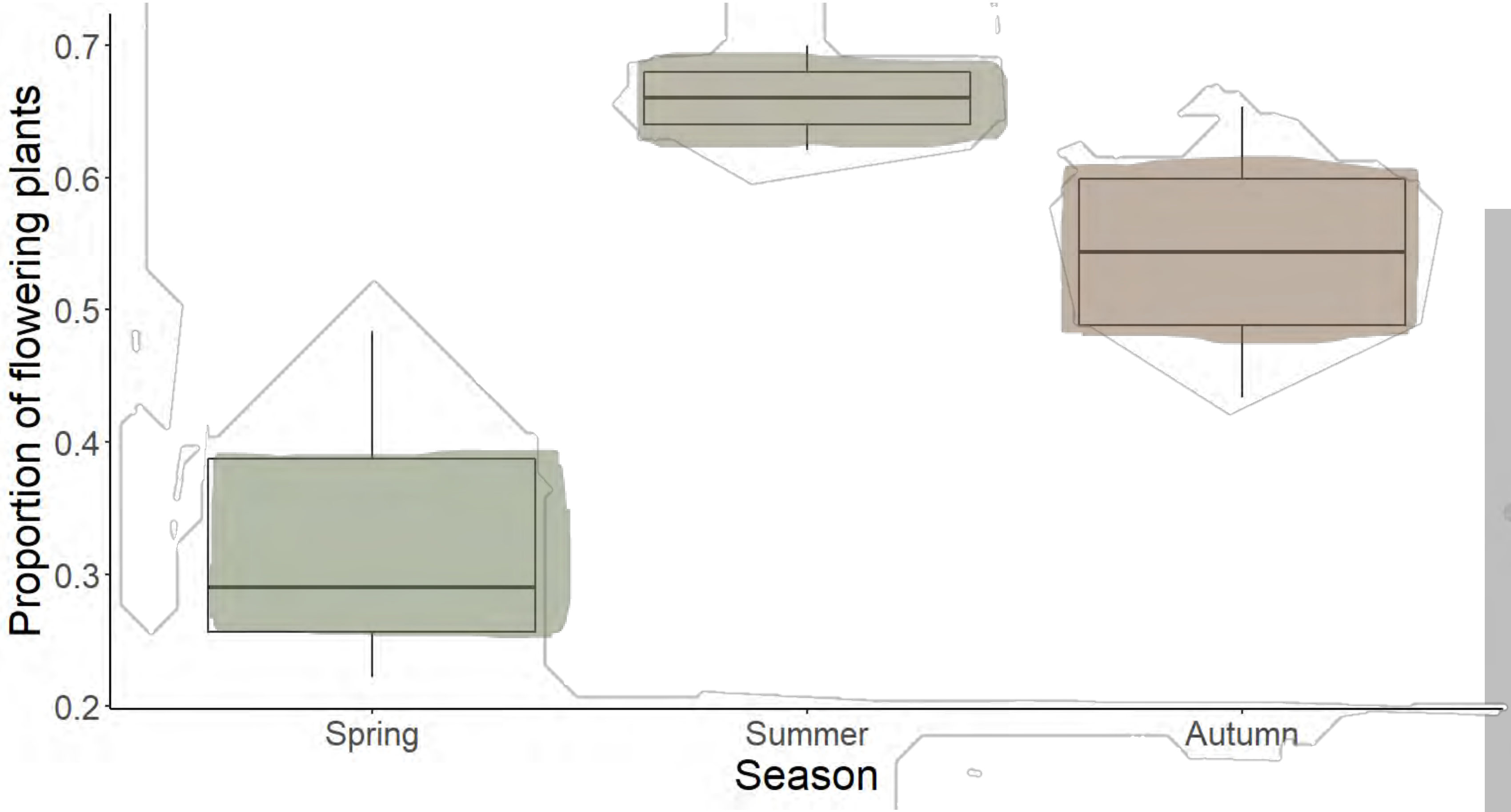
# Moisture and fire season independent?




Independent fire season effect

2019 drought impact

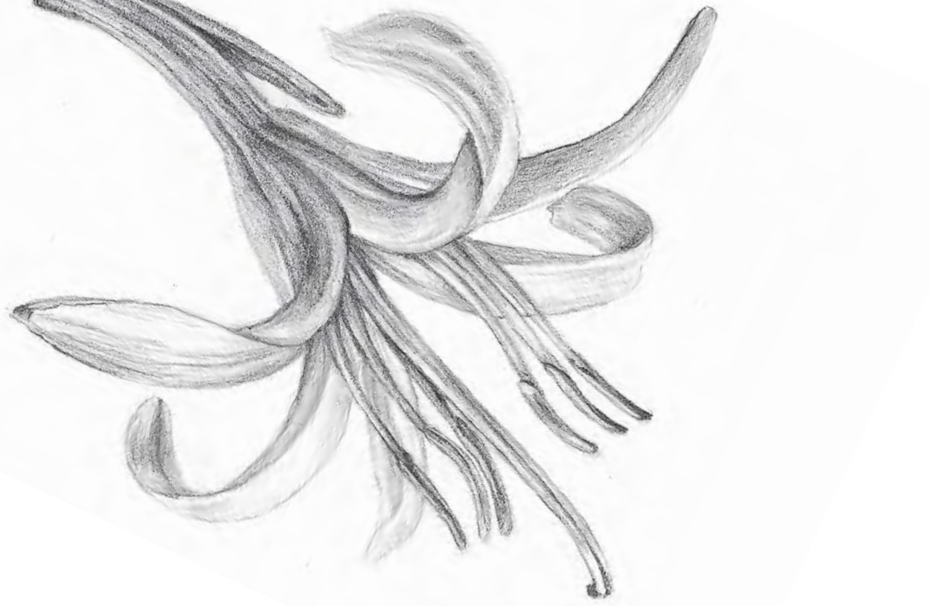
# Proportion flowering

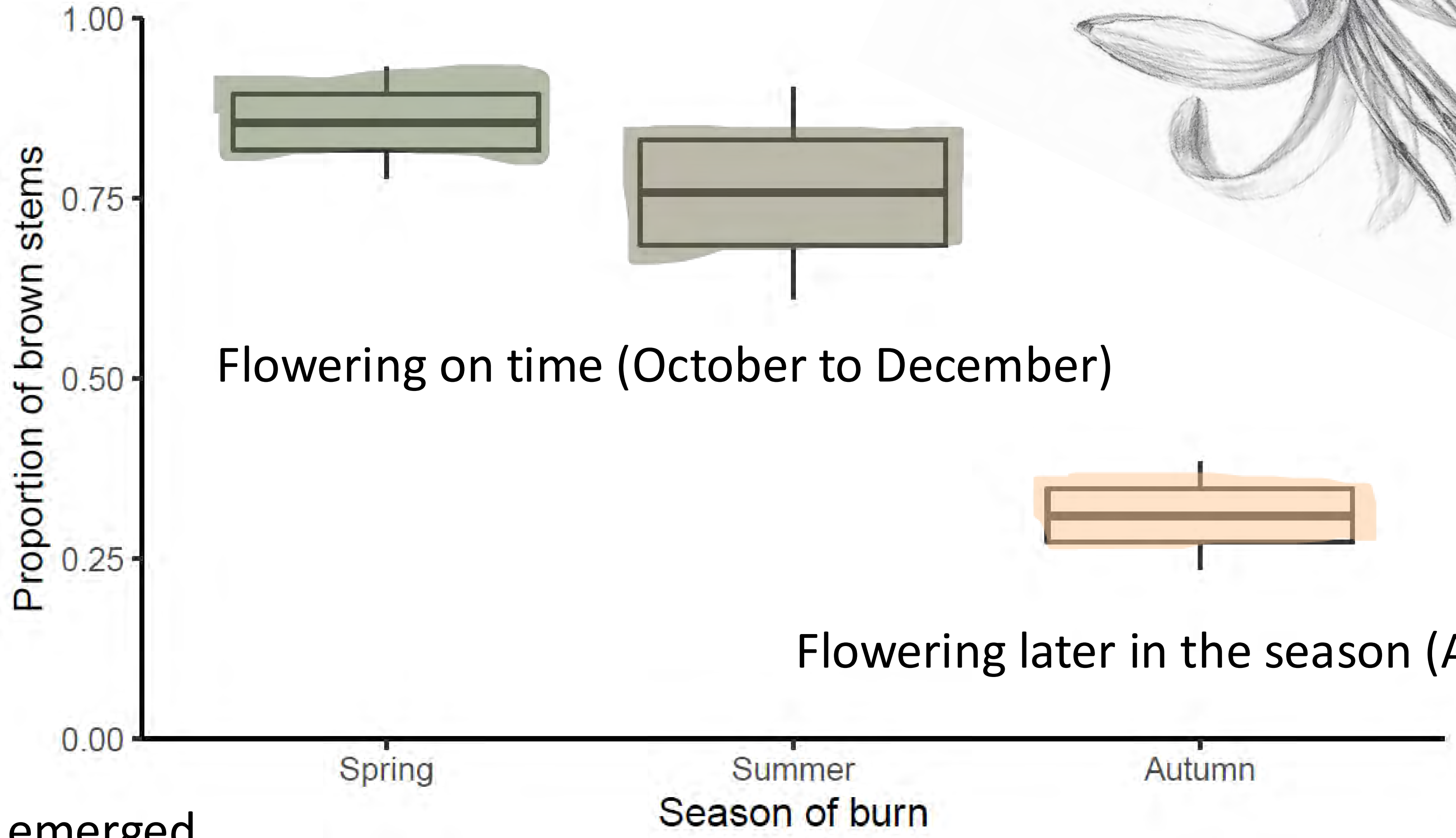



Impact with Phenology

Fire in spring is during peak flowering (deplete resources and reduce flowering)

# Delay in flowering






Flowering on time (October to December)

Flowering later in the season (April to June)

Stems that emerged during peak flowering

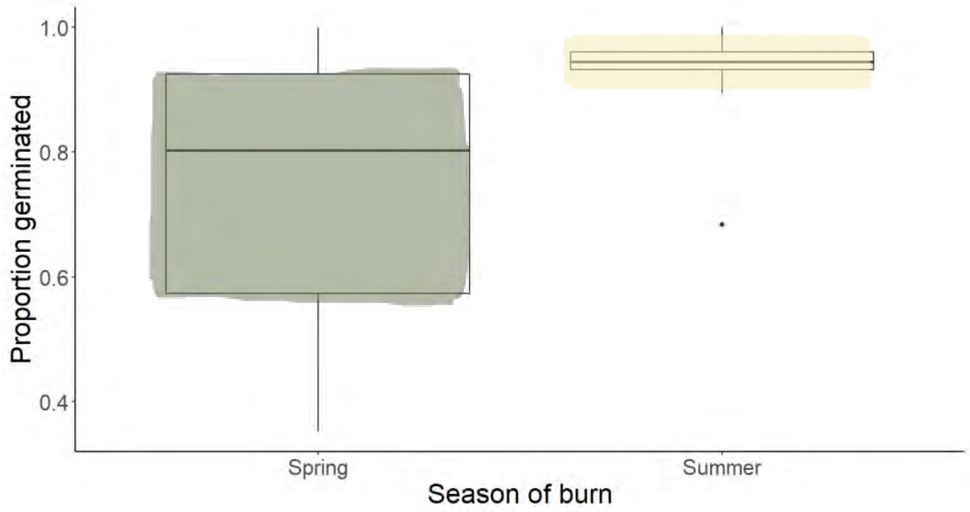
Impact synchronisation of flowering and seed output

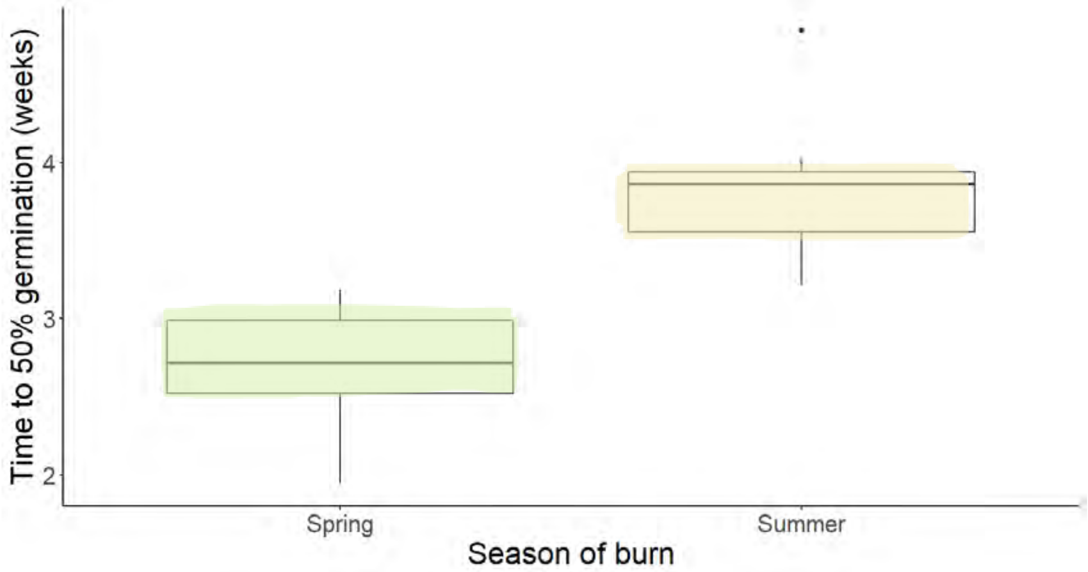
# Number of seed pods

Summer
more seed pods

Autumn
less seed pods

# Germination




| Spring | Summer |
|---|---|
| Lower germination | Higher germination |
| Faster germination | Slower germination |
| 2.7 weeks | 3.8 weeks |

# Seed nutrient stores

lipids store more energy for less weight

- No difference
  - Crude proteins
  - Carbohydrates
- **Significant difference**
  - Lipids


*Acacia* - 11%

# Fire severity and fire season independent?

- Impact of different fire severities

- Number of seed pods
- Germination
- Lipid levels

- No impact of different fire severities

- Percentage flowering
- Rate of germination

Should not be assumed effect of season of burn is due to a difference in severity

# Implication - phenology and nutrients

- During peak flowering
    - Reduced flowering

- Delayed flowering
    - Impact pollination and competition

- Fire early - Less time to accumulate soil nutrients

- Nutrients cycle seasonally in soil – less available

e.g. non-structural carbohydrate for resprouting peak in summer. Burning when levels are low:

- Reduced resprouting, flowering and pods
- Poor seed provisioning

# Summary

Preferred season of burn: summer

Autumn burn: delay flowering

Spring burn: reduce flowering and deplete seed lipids

For long lived species we may not see the full extent for some time

An important need to monitor changes

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Environmental and Experimental Botany

journal homepage: www.elsevier.com/locate/envexpbot

# Effects of fire season on the reproductive success of the post-fire flowerer *Doryanthes excelsa*

Ruby Paroissien [a,*], Mark K.J. Ooi [a,b]

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ARTICLE INFO

*Keywords:*
*Doryanthes excelsa*
Post-fire flowerer
Fire regime
Fire season
Reproduction
Seed ecology

ABSTRACT

Fire is an integral part of many ecosystems and recent record-breaking fires in natural systems around the world are indicative of changes occurring to the fire regime. Fire seasonality is one regime element that is shifting, and can impact the reproductive success of plant species, but rarely receives the spotlight when impacts of fire regimes are studied. We examined the effect of fire season on the reproductive effort and seed resourcing of the post-fire flowering *Doryanthes excelsa* from eastern Australia. We used field experiments at sites of different soil moisture levels (wet vs dry) burnt in different seasons (summer, autumn, spring) to measure the reproductive

Australian Research Council
Linkage Project Grant

NSW Office of Environment And Heritage
Saving Our Species Research Grant

John Martyn Research Grant
for the Conservation of Bushland

saving our species

Australian Government
Australian Research Council

STEP INC
Community-based Environment Protection since 1978

Statistical analysis support

STATS CENTRAL

Fire history records

NSW GOVERNMENT
Planning, Industry & Environment

Seed testing

Alia Rifai and Jayashree Arcot

UNSW SYDNEY
Engineering

Xrf Laboratory

UNSW THE UNIVERSITY OF NEW SOUTH WALES
Mark Wainwright Analytical Centre

UNSW THE UNIVERSITY OF NEW SOUTH WALES

Centre for Ecosystem Science

Ruby Paroissien
Mark Ooi

# Questions?

# Image credits

- Past burn images – Tom Le Breton
- Lambertia Formosa image - Justin Chan
- Xanthorea image - Bob Crombie (The Leader)
- Other images- Ruby Paroissien
- Drawings – Ruby Paroissien
- Icons - Powerpoint

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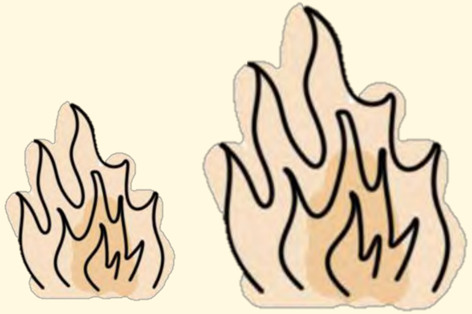
# Resilience and recovery of plant communities facing increasing fire severity

Ruby Paroissien
PhD presentation

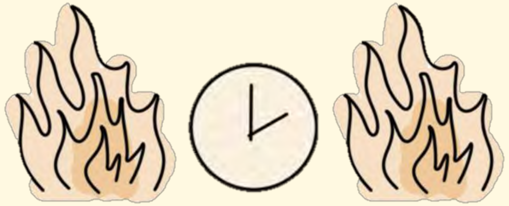
Supervisors: Mark Ooi, Ryan Tangney (DBCA), Cathy Offord (ABG)

# Fire regimes

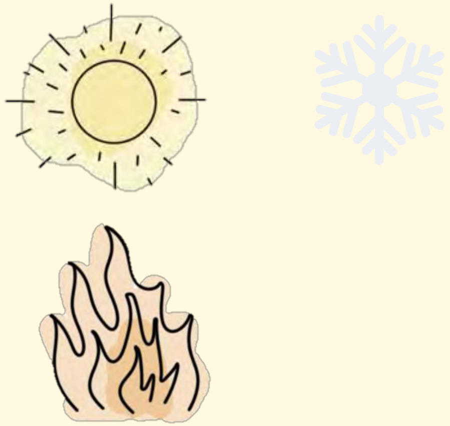
- Different vegetation types experience fire in a mostly consistent pattern
- This long-term pattern is called a fire regime and is characterised by:



Fire severity



Fire frequency



Fire season

Fire extent

- Vegetation communities are adapted to particular fire regimes

# Extremity of fires

- Fires regimes are altered by climate change

- 2019/2020 bushfires

- Bigger
- Hotter
- Longer period of time

Extreme severity burn

- Impact vegetation communities

# Wet sclerophyll forest

Ecotone between rainforest and dry sclerophyll forest

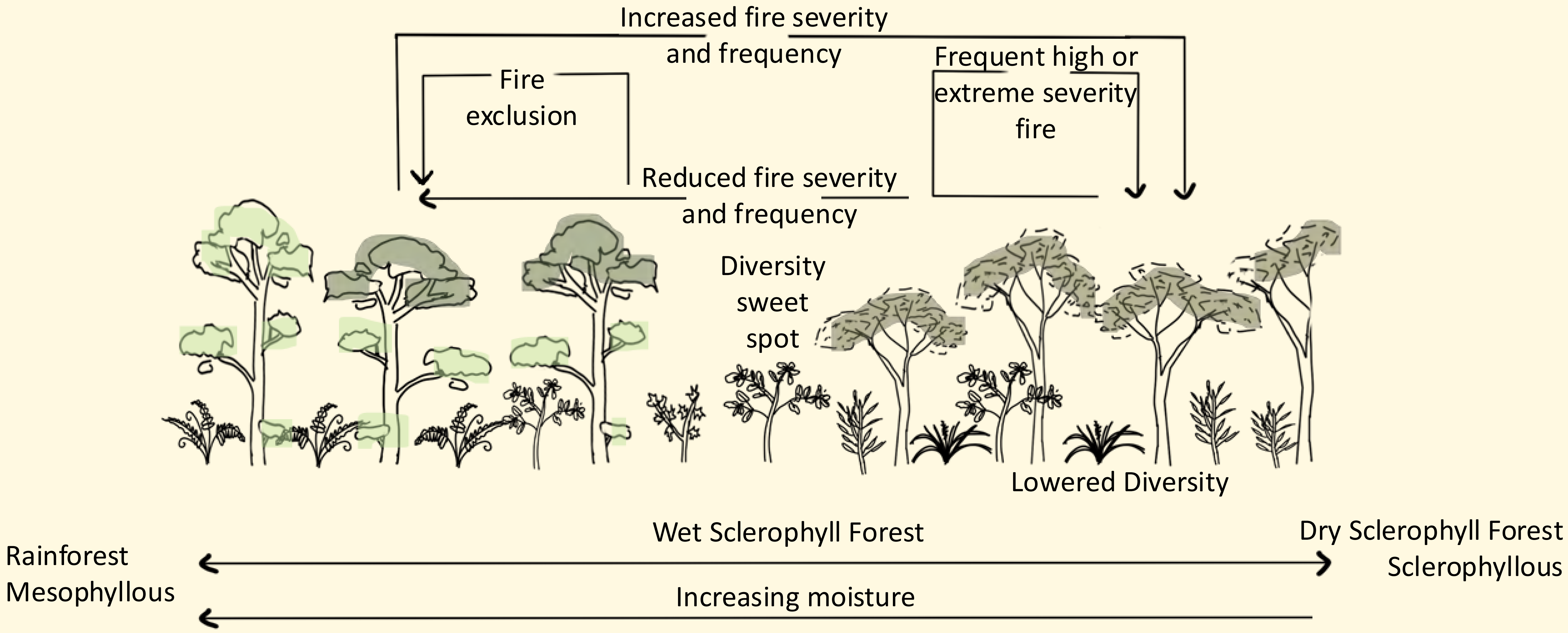
Two of three threatened WSF communities burnt during the 2019/2020 megafires

Unburnt

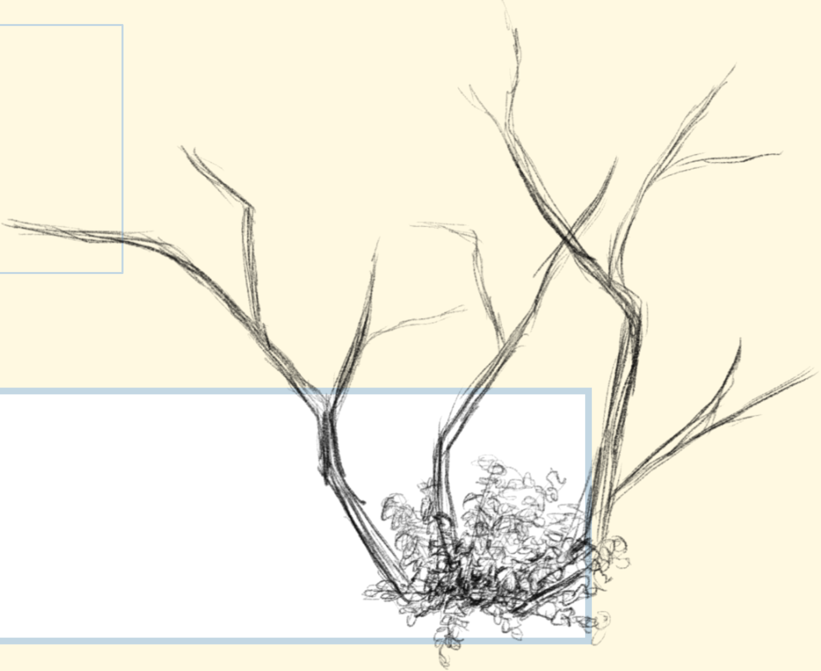
Moderate – High Severity

Extreme Severity

# Wet sclerophyll forest



# Pathways of recovery



PERSISTENCE

RECRUITMENT

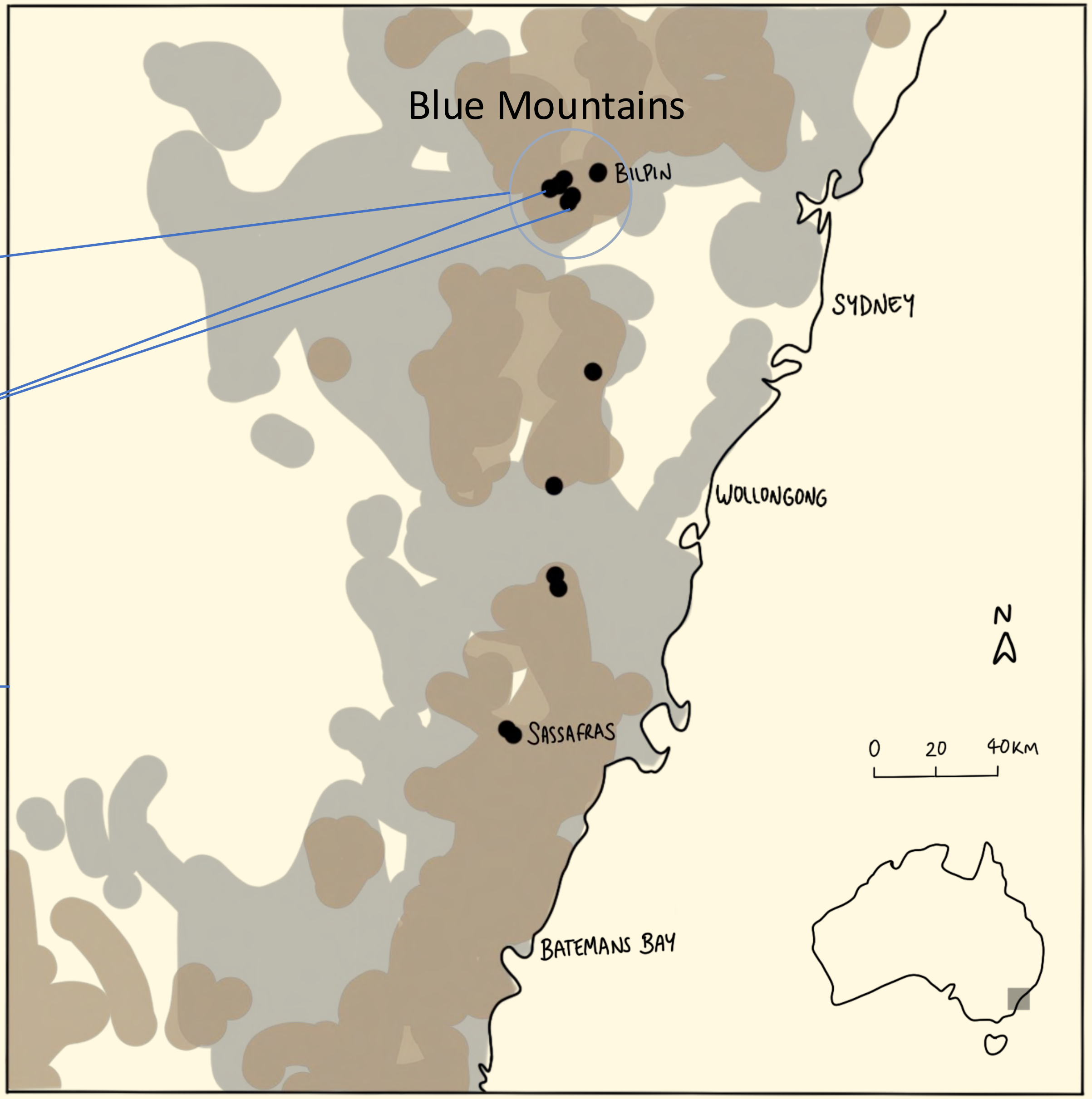
DISPERSAL

# Map of study locations

Recruitment - Soil seed bank

Dispersal - Seed rain

Functional group surveys




Wet sclerophyll forest

2019/20 Australian megafires

# Pathways of recovery

Functional group surveys

Plants surveyed 1 and 3 years post fire at differing fire severities

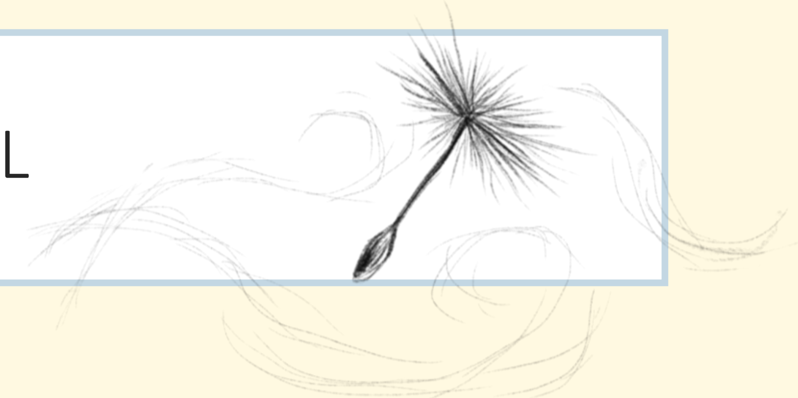
PERSISTENCE

Captured early

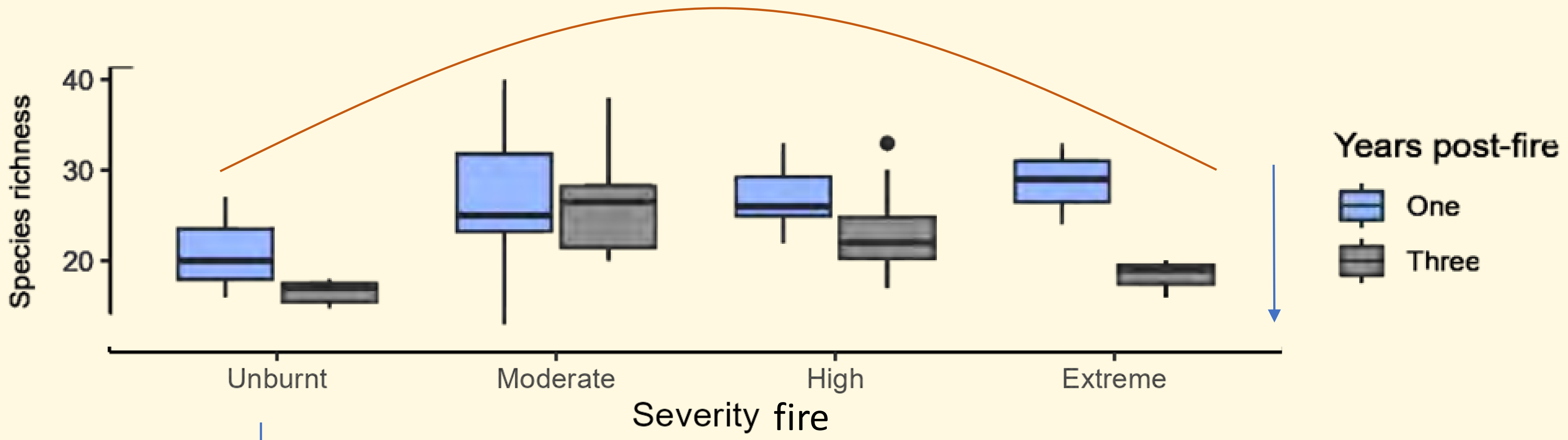
RECRUITMENT

Captured early

DISPERSAL



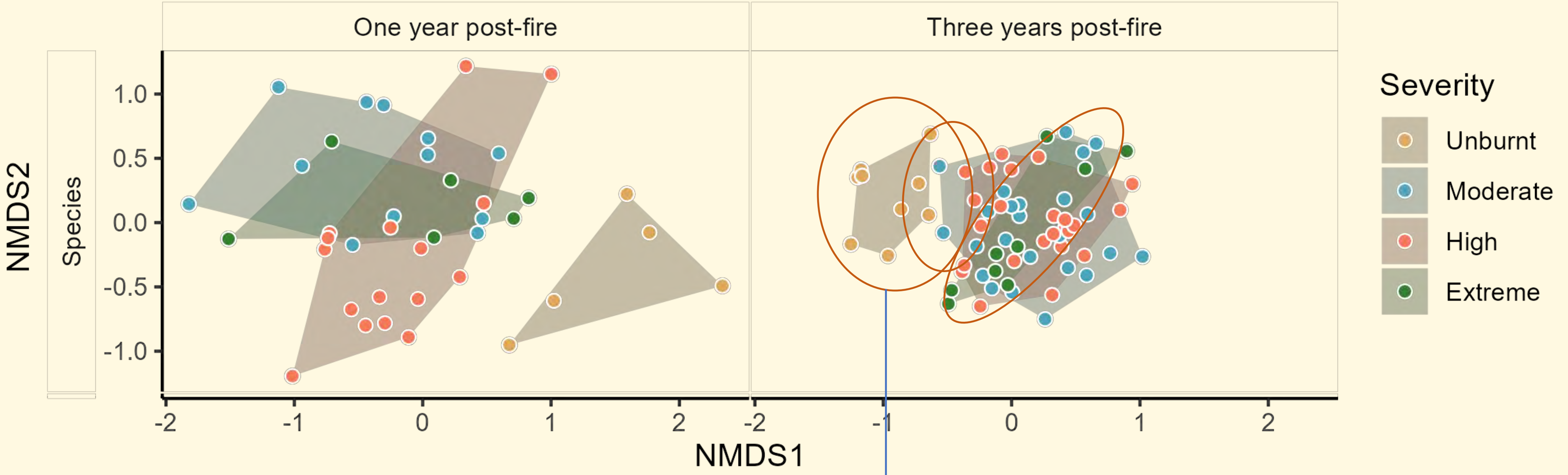
# Species richness aboveground



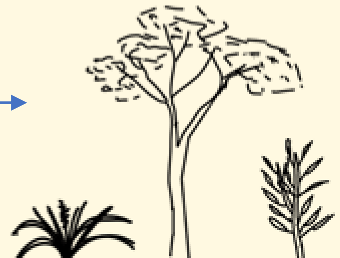

Common rainforest species

Both

# Shrub layer composition




Common rainforest species



Common dry sclerophyll species

Forest Ecology and Management 594 (2025) 122938

Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

# Shifts in functional group community diversity of threatened mesic forests with changing fire regimes

Ruby Paroissien [a,b,*], Ryan Tangney [a,c], Alexandria M. Thomsen [a], Catherine A. Offord [b,d], Mark K.J. Ooi [a]

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[b] Australian PlantBank, Botanic Gardens of Sydney, Mount Annan, NSW, Australia
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[d] Evolution and Ecology Research Centre, School of Biological, Earth and Environmental Sciences, UNSW, Sydney, New South Wales 2052, Australia

ARTICLE INFO

*Keywords:*
Fire regime
Fire severity
Wet sclerophyll forest
Threatened ecological community
Plant surveys

ABSTRACT

Changing fire regimes, including increased fire severity, may impact plant community recovery, altering structure and composition, potentially causing a state change. For threatened wet sclerophyll forests, mesic forests which contain both dry sclerophyll and rainforest elements, this could mean a shift to a more fire-prone species composition. We investigate how species and functional group diversity responses differ across a gradient of fire severity and how recovery changes with time since fire in a mesic forest community. We hypothesize that

# Pathways of recovery

Soil seed bank

PERSISTENCE

RECRUITMENT

Does the soil seed bank buffer losses at extreme fire severities?

DISPERSAL

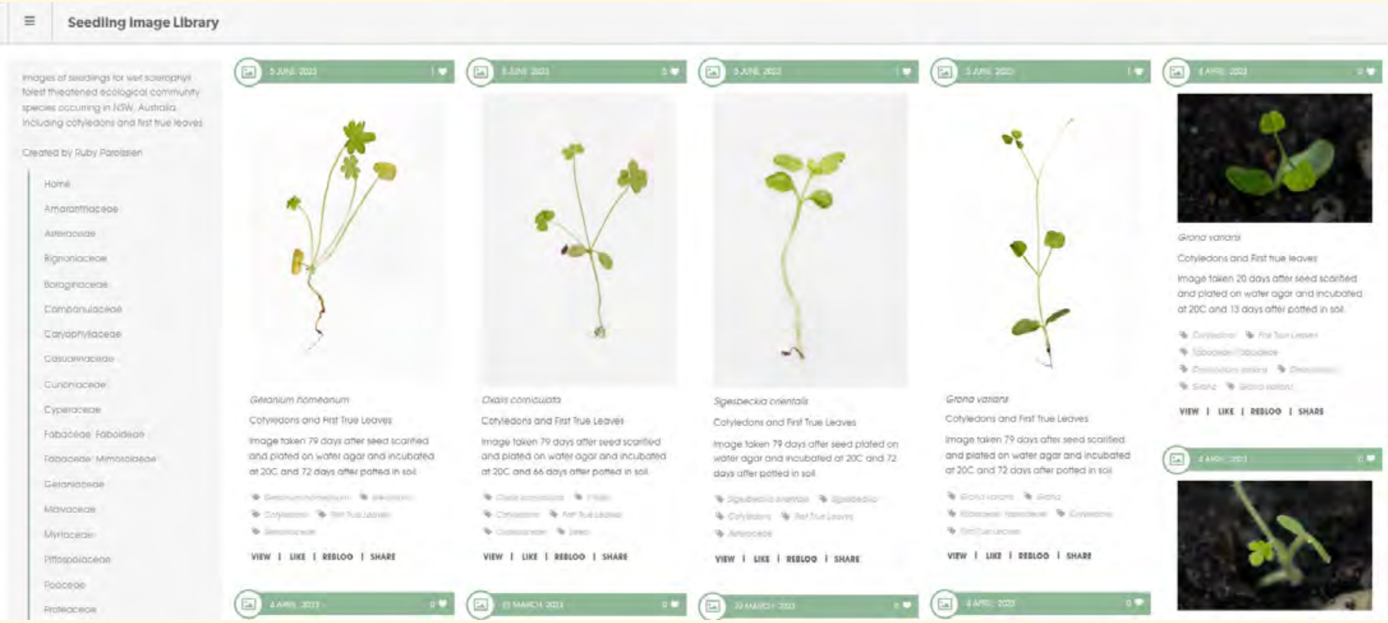
# Soil seed bank

- Recruit through a soil seed bank
- Dormancy broken in fire prone regions can occur by smoke and heat
- Extreme temperatures increase seed mortality
- Soil seed bank experiment post fire

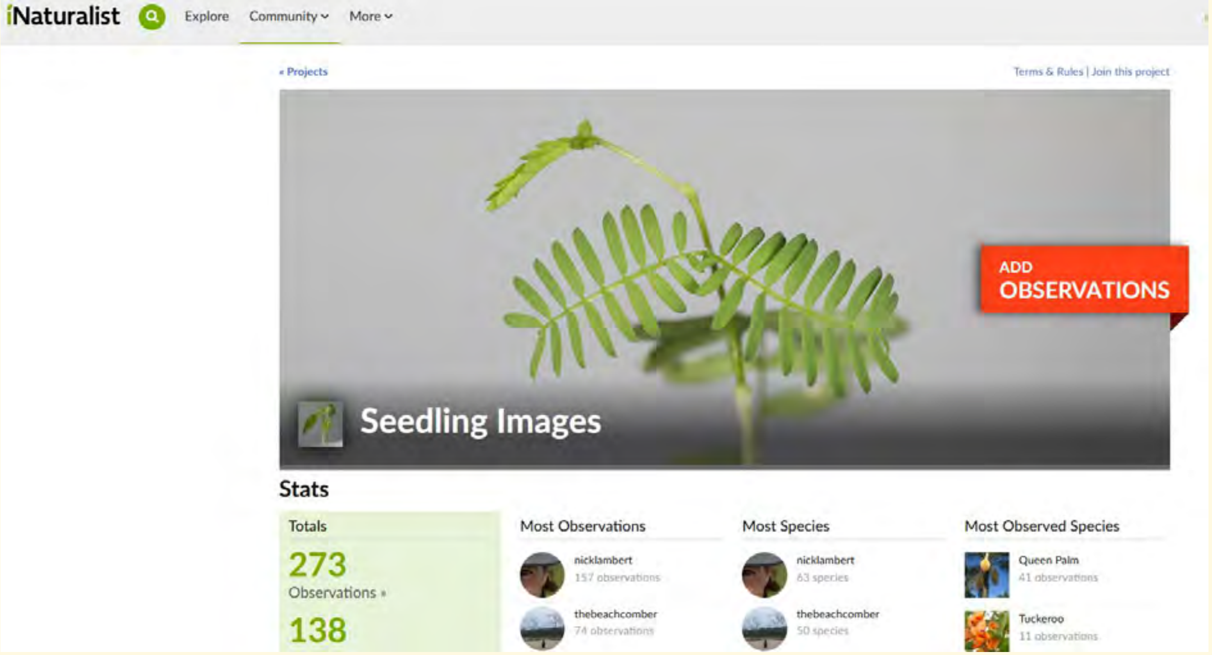
# Resources for seedling ID

Images of common WSF seedlings:

https://seedlingimage.tumblr.com/

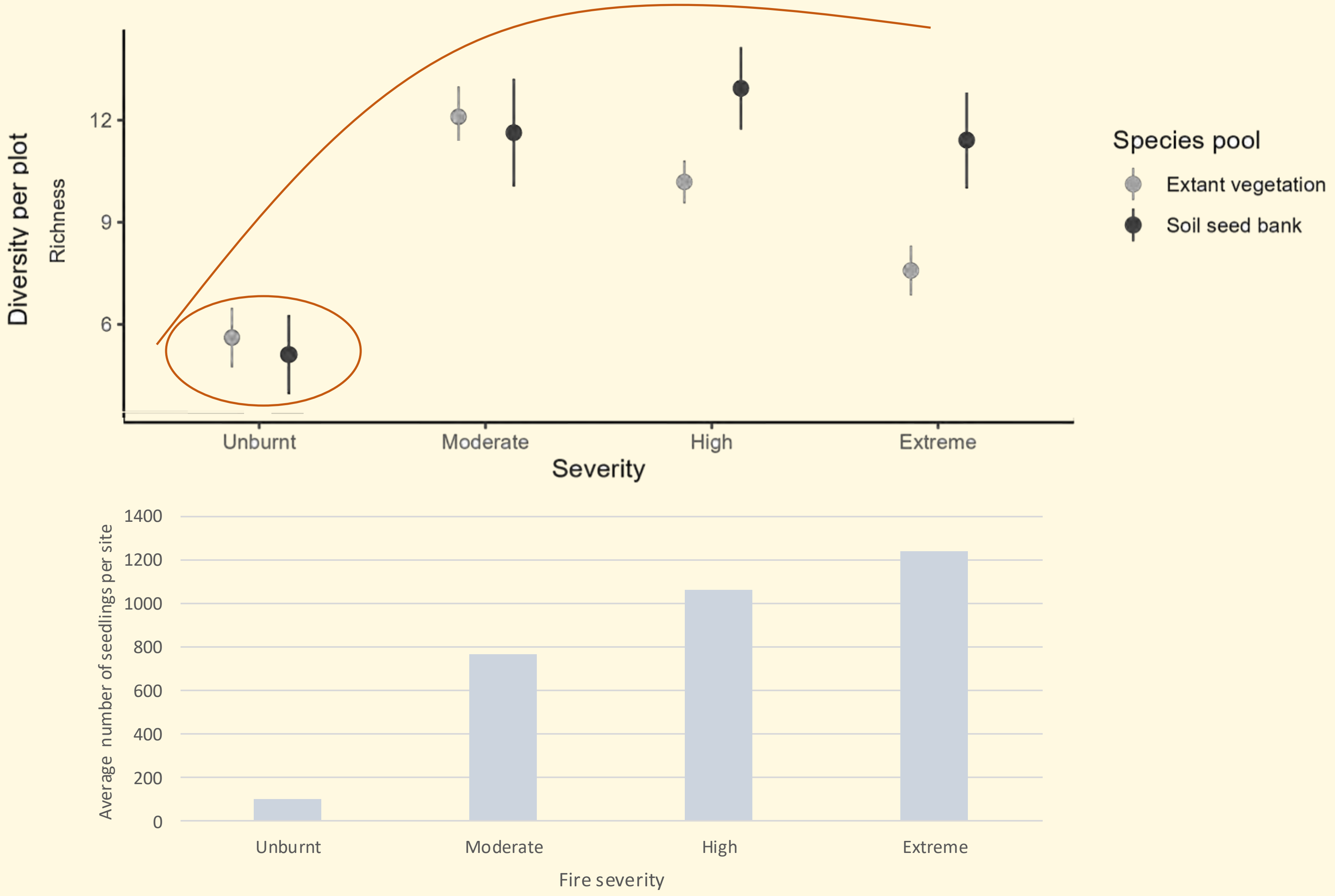



Inaturalist project: Seedling Images



# Richness in the soil seed bank

- Hump shape less present
- Soil seed bank buffers aboveground losses at extreme severity
- but not through rainforest species
- Soil seed bank when unburnt is significantly depleted



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DOI: 10.1111/1365-2435.70296

BRITISH ECOLOGICAL SOCIETY Functional Ecology

RESEARCH ARTICLE

# The post-fire recovery of soil seed banks along a fire severity gradient in an Australian threatened mesic forest

Ruby Paroissien[1,2] | Ryan Tangney[1,3] | Catherine A. Offord[1,2] | Mark Ooi[1]

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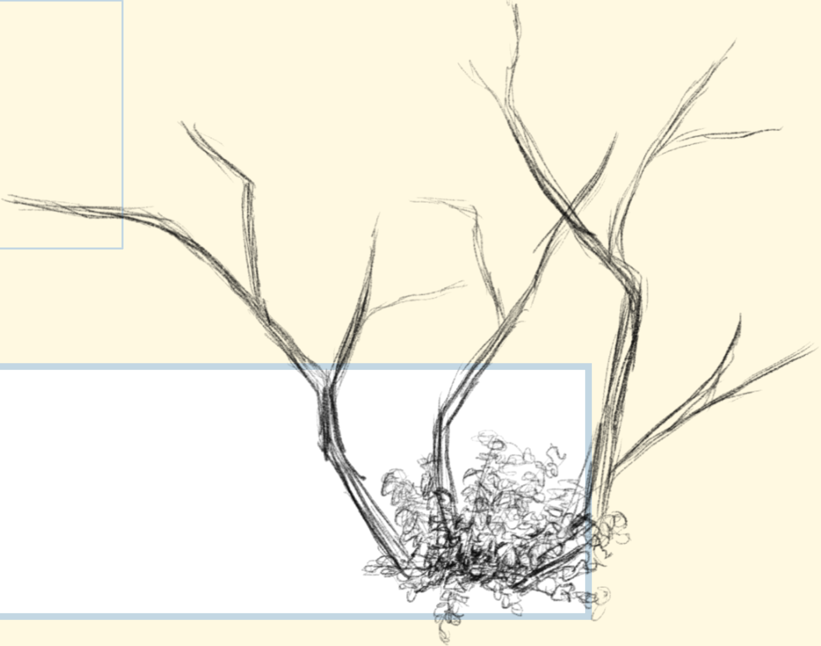
**Correspondence**
Ruby Paroissien

## Abstract

1. Climate change has increased the likelihood of extreme events, increas[illegible] number of days with dangerous fire weather conditions, resulting in fires with increased severity, frequency and extent. This can greatly impact vegetation communities by reducing diversity and slowing recovery.
2. The role of in situ soil seed banks in mediating impacts of shifting fire regimes is often unclear and may vary between different vegetation types. In particular, the impact of high fire severity, an increasingly common fire regime shift, may increase the likelihood of temperatures lethal to seeds in the soil, while higher fire frequencies may reduce diversity via increased immaturity risk. Here we aim

# Pathways of recovery

Seed rain



PERSISTENCE

RECRUITMENT

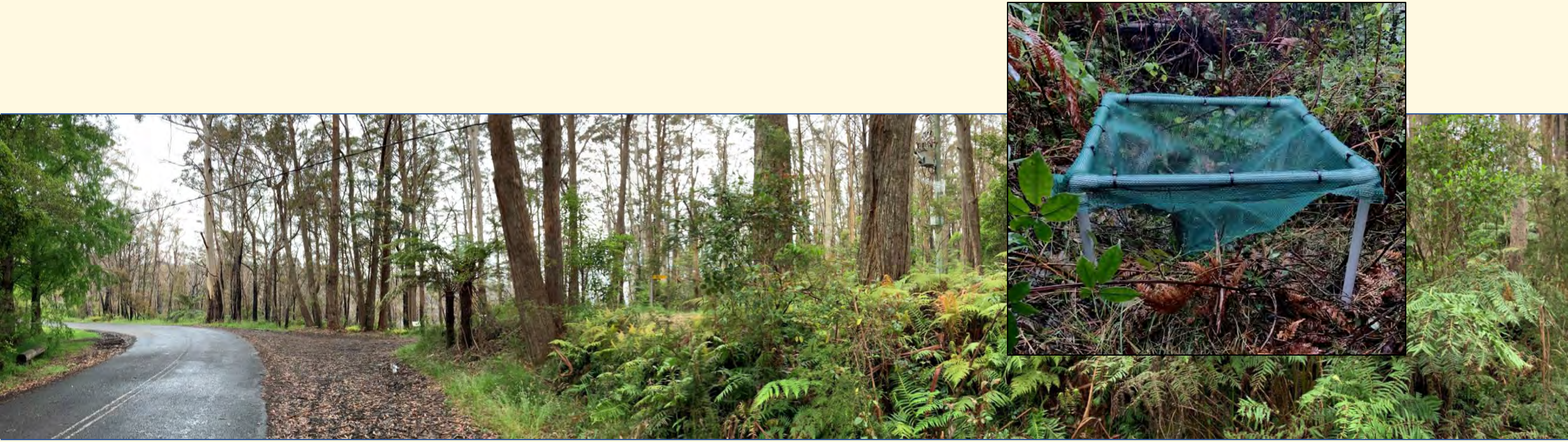
DISPERSAL

Does dispersal from unburnt sites contribute to diversity following extreme severity fire?

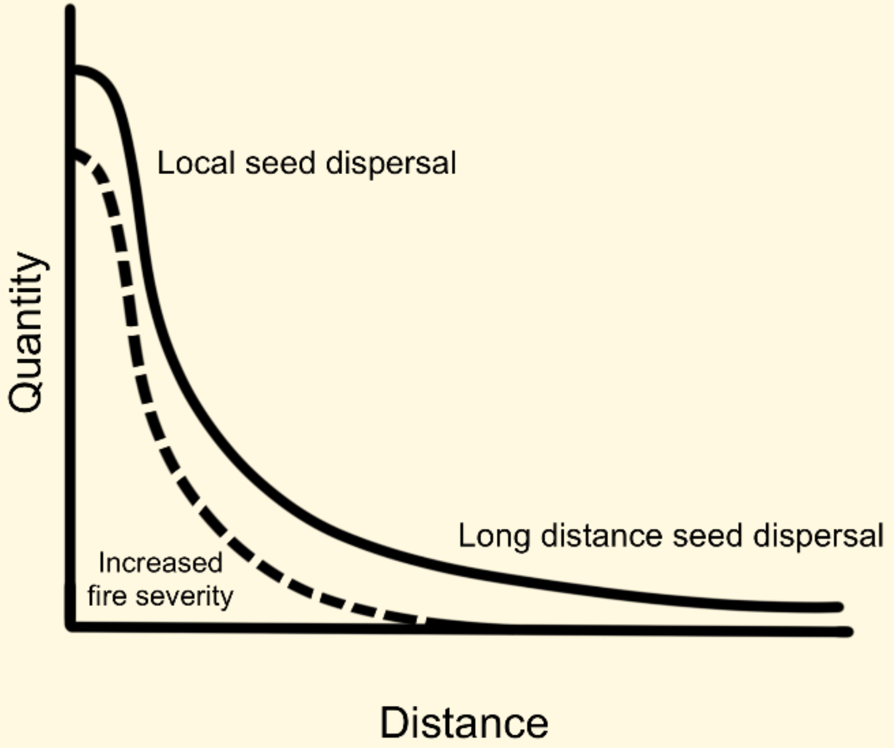
# Seed rain

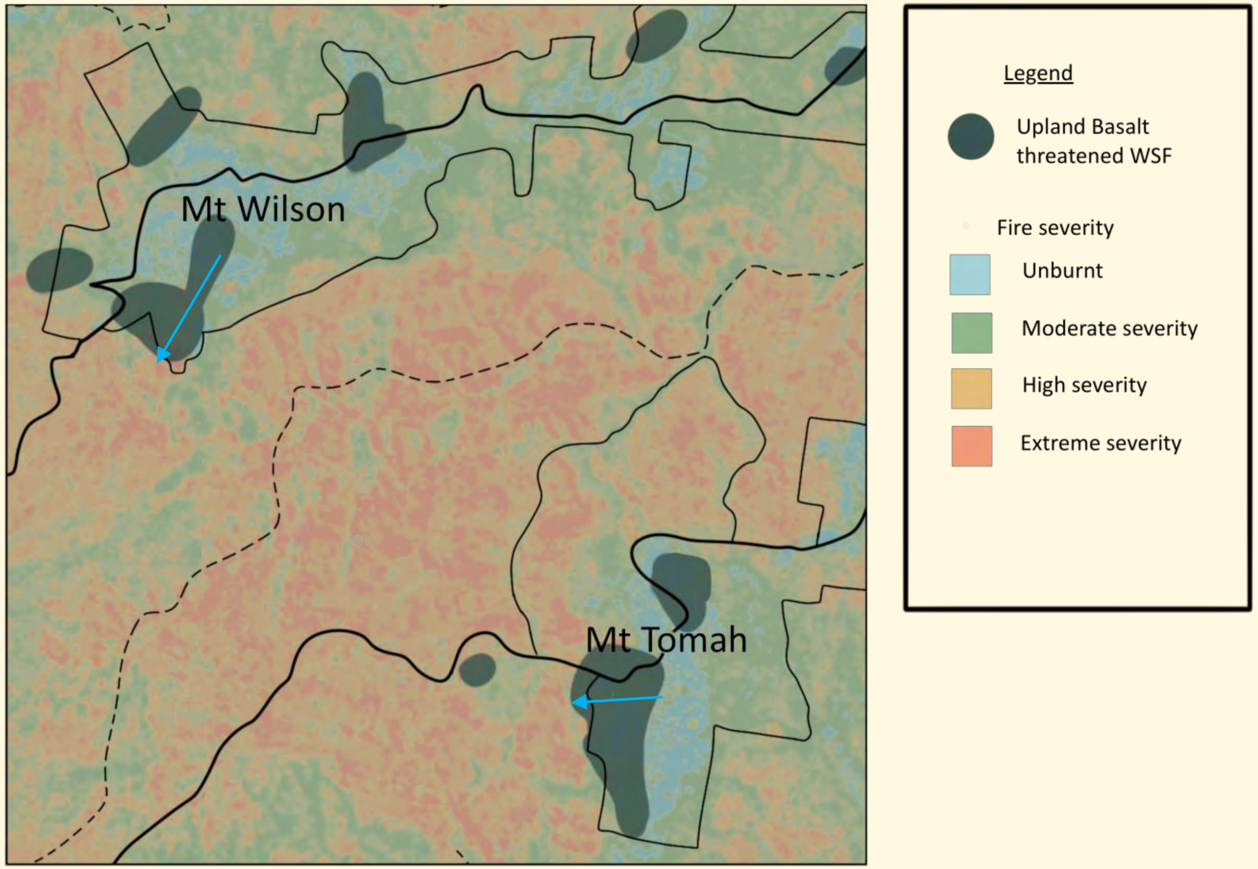
Species removed from burnt areas (rainforest species) may be able to disperse back in

Seed traps to capture dispersal from fire edge



# Extreme severity and extent could impact recovery via dispersal

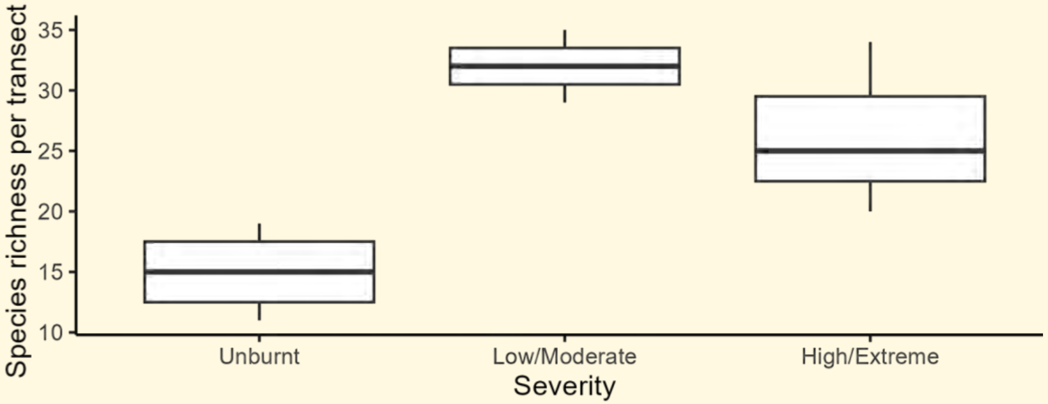


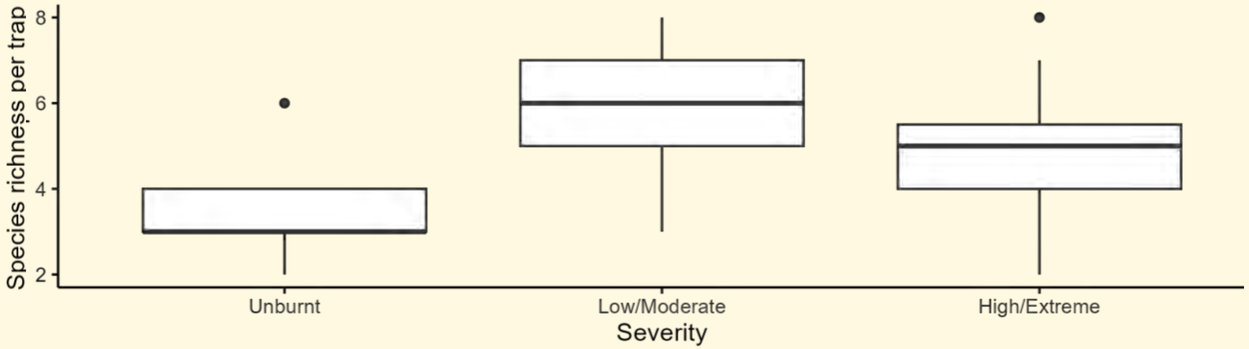
# Species richness

No rainforest species in seed rain

- Not fire cued dispersal
- Waiting for environment triggered recruitment events




Plant surveys at trap locations




Seed traps

60% similarity in species between surveys and seeds

Local dispersal - Maximum ‘minimum distance recorded’ was 20m

COLLECTION | RESEARCH ARTICLE
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# The effectiveness of seed rain in recolonising an ecotonal mesic forest following extreme-severity fire

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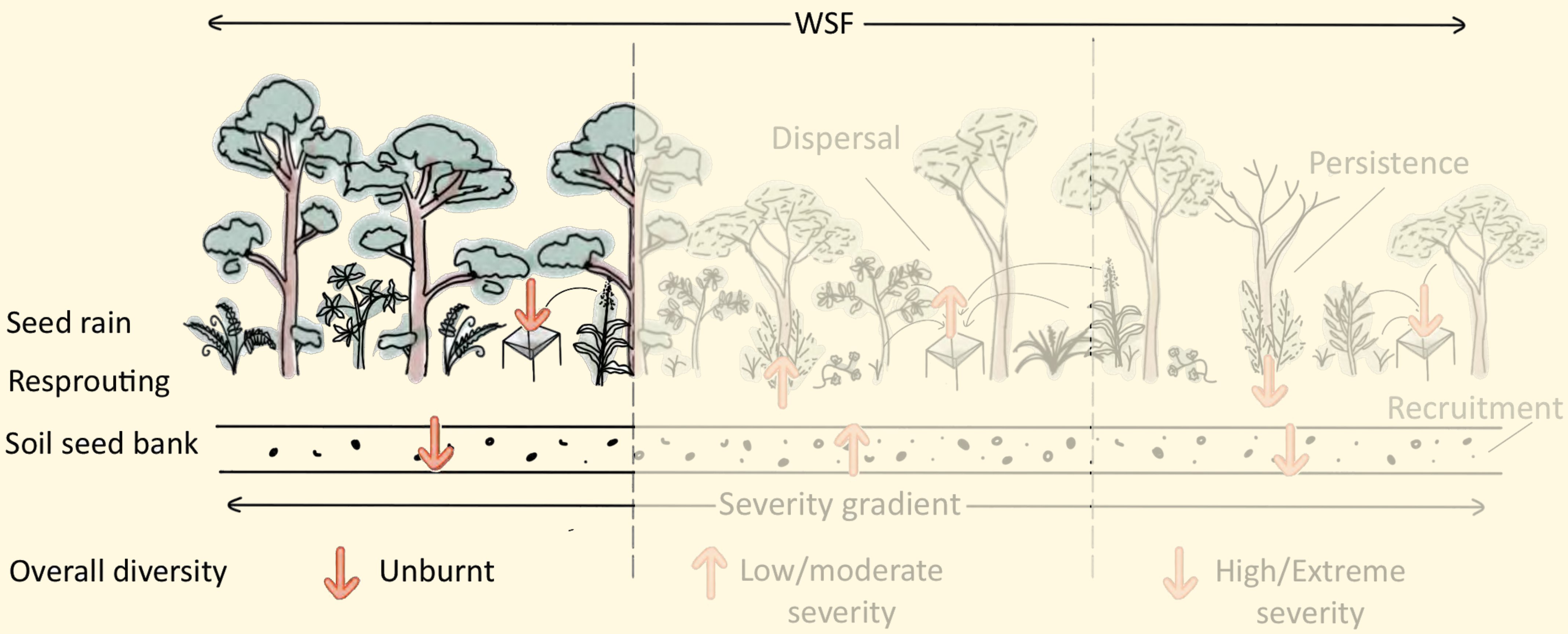
## ABSTRACT

**Context.** As fire severity and extent increase, recovery of fire-sensitive species in plant may rely increasingly on seed rain and dispersal from adjacent unburnt areas. The role in driving recovery trajectories is surprisingly understudied. How traits drive contextualise compositional differences and indicate recovery trajectories. **Aim** investigated seed rain in recently burned mesic forest, and the role of traits in dri recovery across a gradient of fire severities. **Methods.** We placed seed traps at two locations in the Blue Mountains, located in south-eastern Australia. All seeds that fell into seed traps were collected and identified each month for a year, 3 years following fire of differing severities. We then compared species diversity of seed collections with extant vegetation and measured the minimum dispersal distance each species was likely to have travelled. Variable selection was used to identify which traits affected dispersal distances. **Key results.** Rainforest species were generally lacking from recently burned sites in both extant vegetation and the seed rain. Composition of the seed rain indicated that dispersal occurred primarily from local sources, with minimum distance travelled largely determined by life form, dispersal type and dispersal height. Differences in species

# Overall trends



# What to do?
# Low diversity but unique diversity

- Long unburnt areas
  - Have low diversity
  - lack a soil seed bank
  - Don’t have regular predictable dispersal
  - Have diversity unrepresented in recently burnt especially sites burnt at extreme fire severity

- Promoting fire exclusion could maintain unique diversity
- Encourage the slow recolonisation of burnt areas

# Volunteers

Sarah

Patrick

Mikayala

Hiti

Bella

Not pictured:
Orlando
Michi
Ian

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ECOLOGICAL SOCIETY OF AUSTRALIA

UNSW
THE UNIVERSITY OF NEW SOUTH WALES

Centre for Ecosystem Science

BOTANIC GARDENS OF SYDNEY

# QUESTIONS?