



MER Network Pilot – linking the experimental design to theories, models and prior evidence

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Australia's National Science Agency



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Network themes

Post-fire recovery overarching questions:

- *How do Australian native ecosystems and biodiversity respond to mild and intense fire across space and time?*
- *Are they recovering towards pre-fire conditions or are new trajectories apparent?*
- *What are the predictors of recovery effectiveness and how do these inform future investments?*



Network themes

Post-fire weed management overarching questions:

- *How effective are NRM investments in weed management after fire for reducing target exotics and enhancing Australian native ecosystems and biodiversity?*
- *What are the predictors of effectiveness and how do these inform future investments?*

Design considerations

1. Experimental design within each site

2. Spread of sites across Australia



Design considerations

1. Experimental design within each site

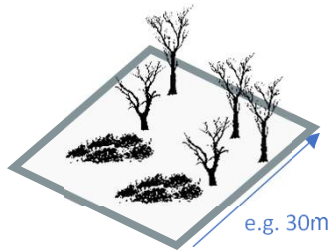
- Treatments (i.e. types of plots such as burnt or not)
- Replicates
- Layout
- (Measurements)



Design considerations: within sites

Treatments and replicates (tentative)

All sites will need:

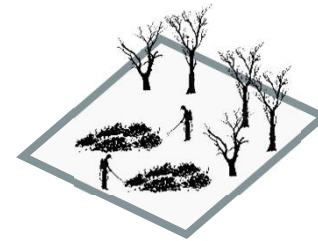


- **Burnt**
- **Untreated**
- x 4 replicates

Then choose *at least one* (preferably *both*) of the following plot options:



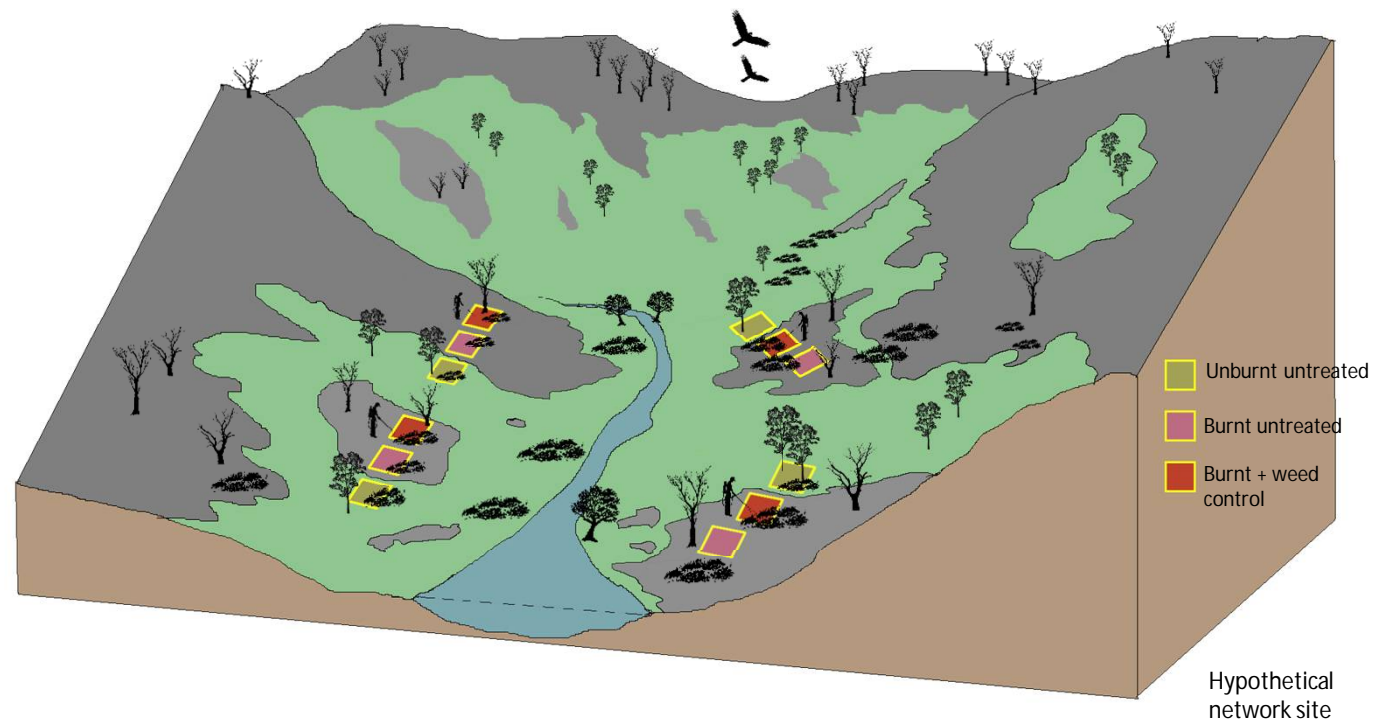
- **Unburnt** (matched to burnt)
- **Untreated**
- x 4 replicates



- **Burnt**
- **Treated for weeds**
- x 4 replicates

Design considerations: within sites

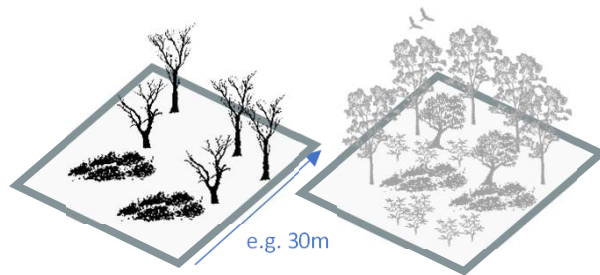
Example site-level configuration: "triplets"



Design considerations: within sites

Potential fourth treatment?

Should we add one of the following to the standard design?



- **Two fire intensities (high and low)**
- **Untreated**
- x 4 replicates



- **Unburnt** (matched to burnt)
- **Treated for weeds**
- x 4 replicates
- This would allow **2 x 2 factorial design**



- **Burnt**
- **Treated for weeds + replantings (or other management)**
- x 4 replicates

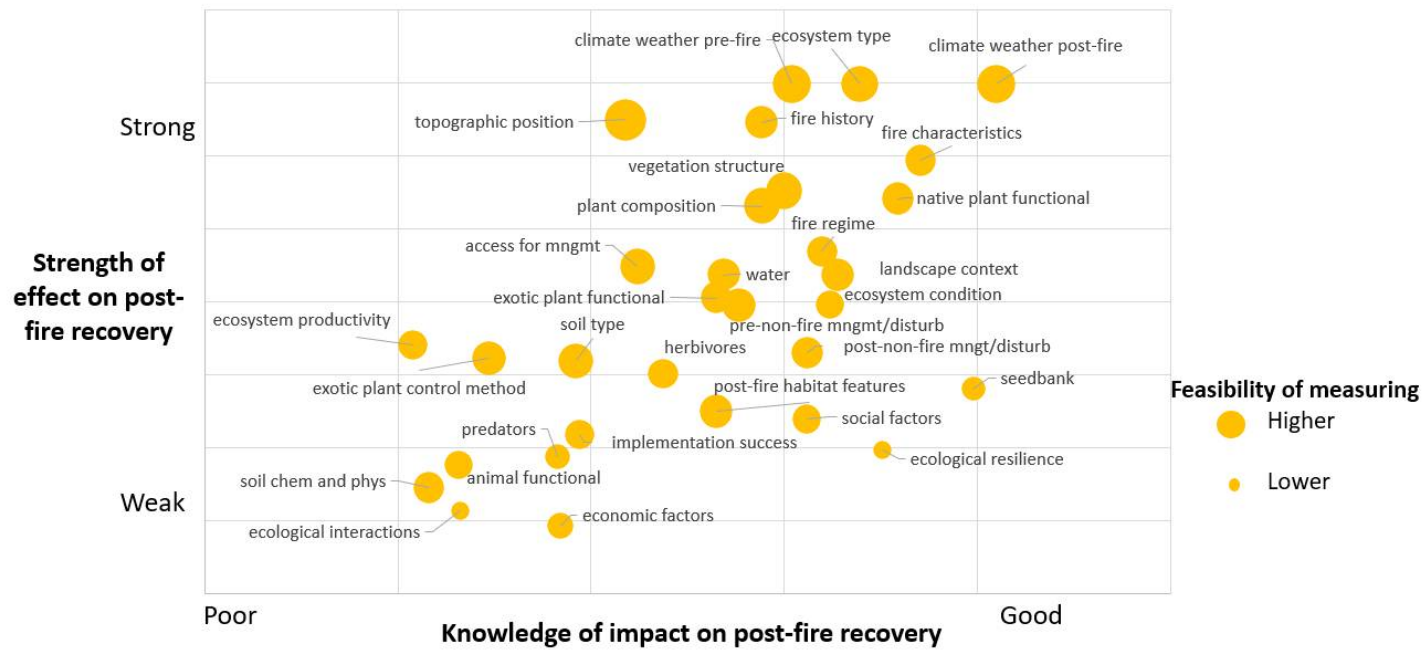
Design considerations

1. Experimental design within each site

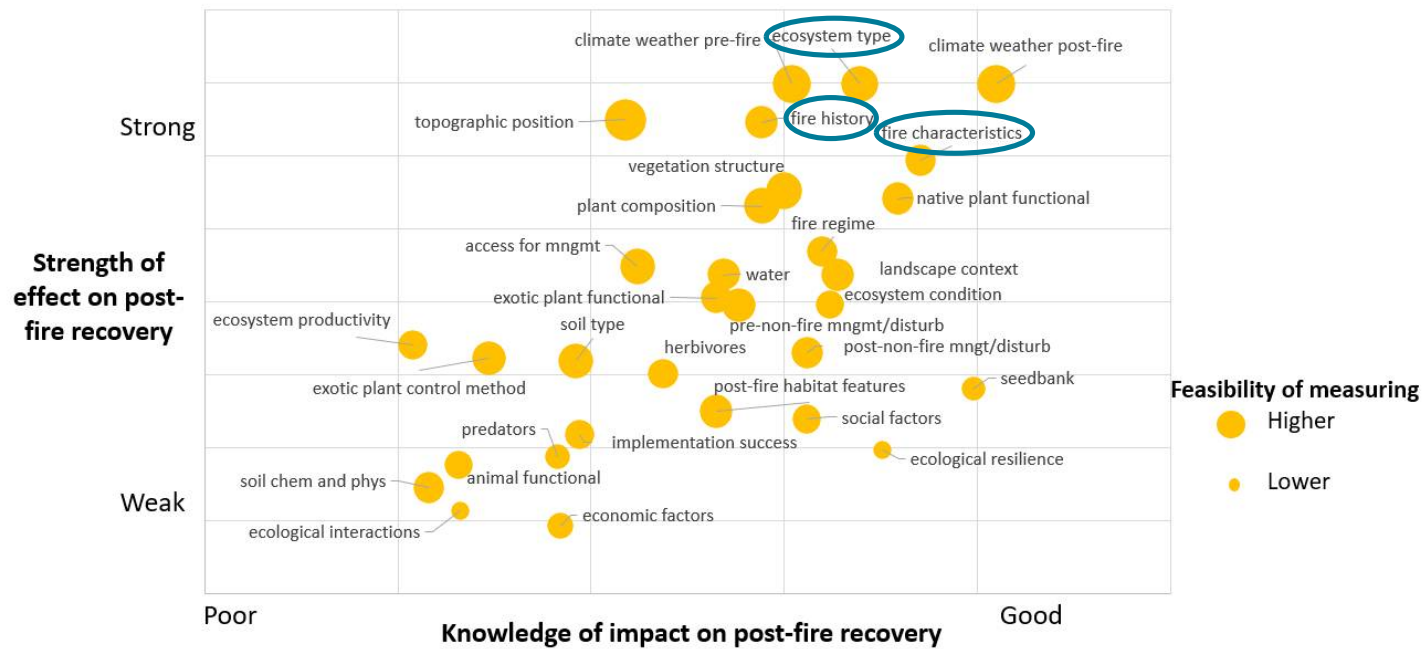
2. Spread of sites across Australia

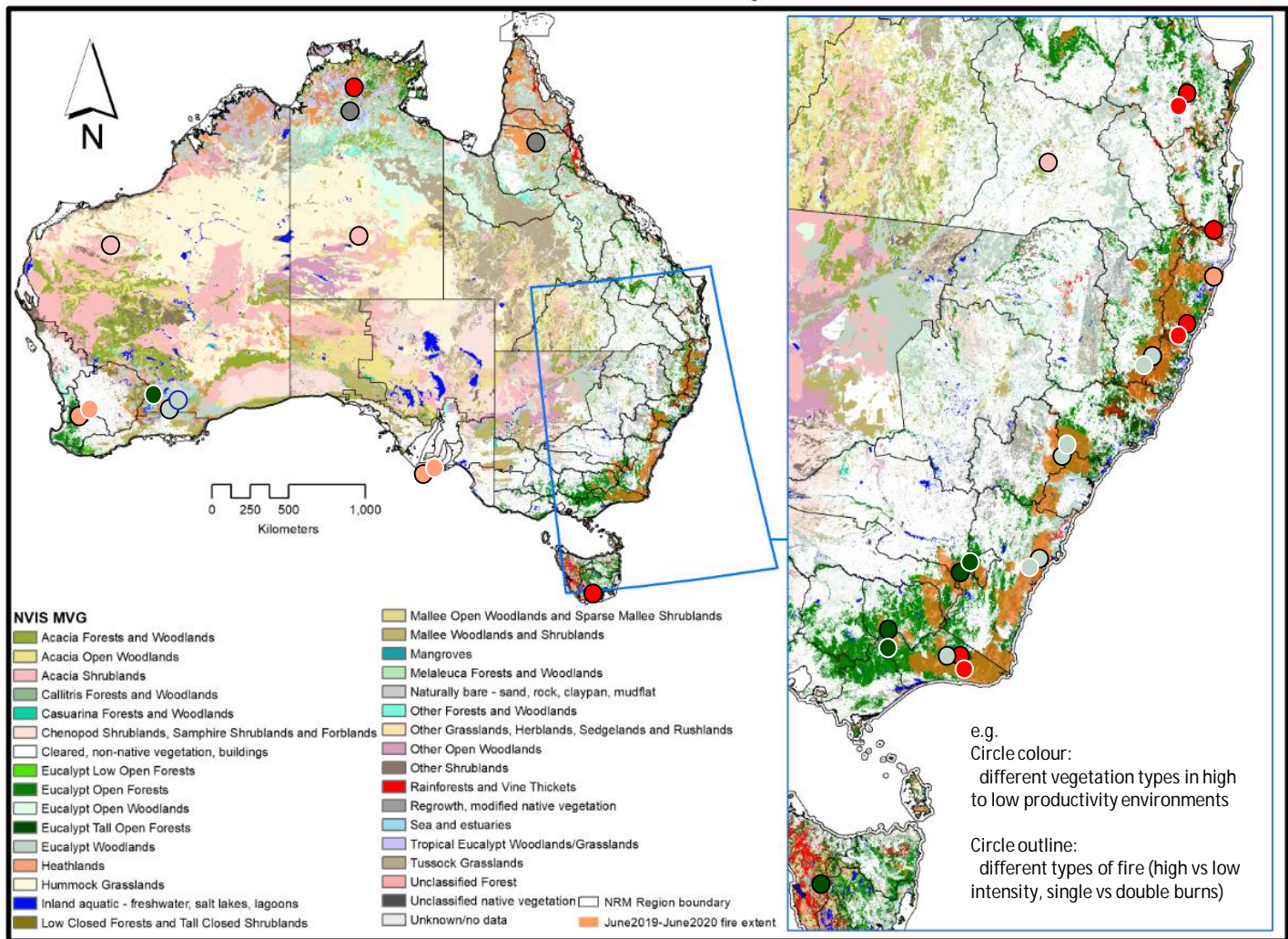


Importance and knowledge of site variables that drive effectiveness of post-fire recovery



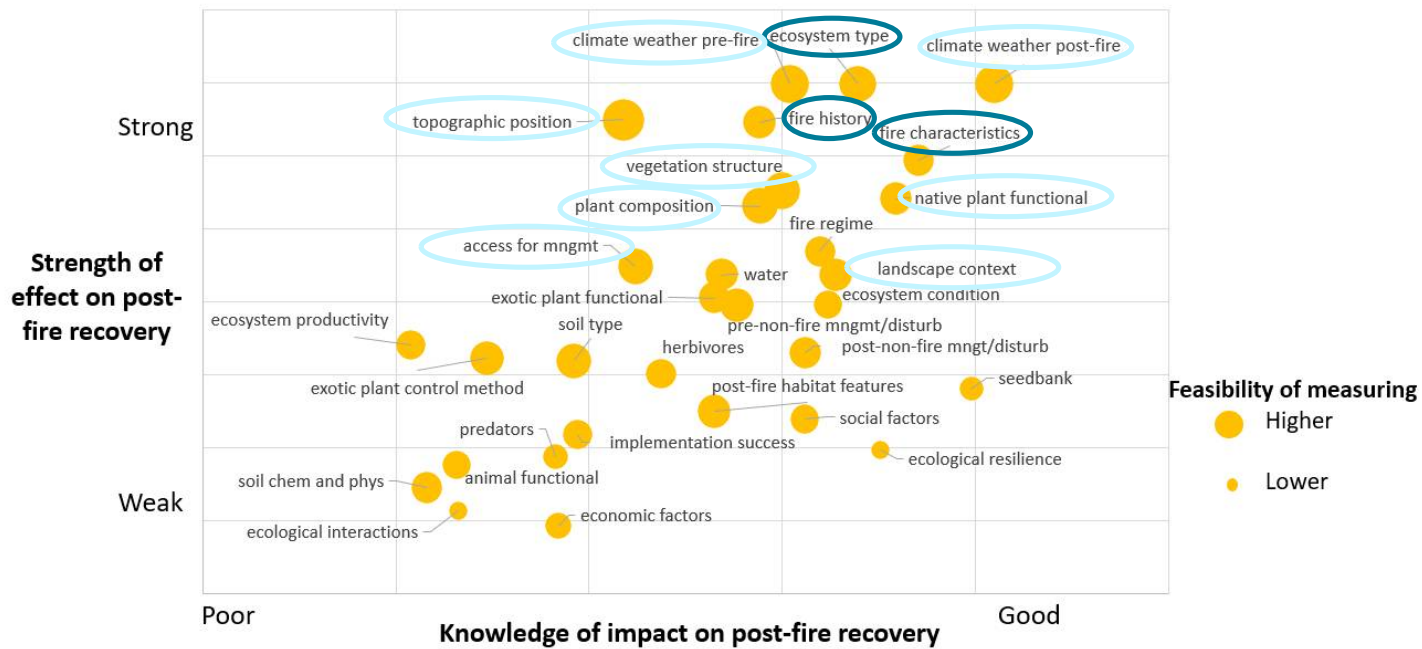
Importance and knowledge of site variables that drive effectiveness of post fire recovery



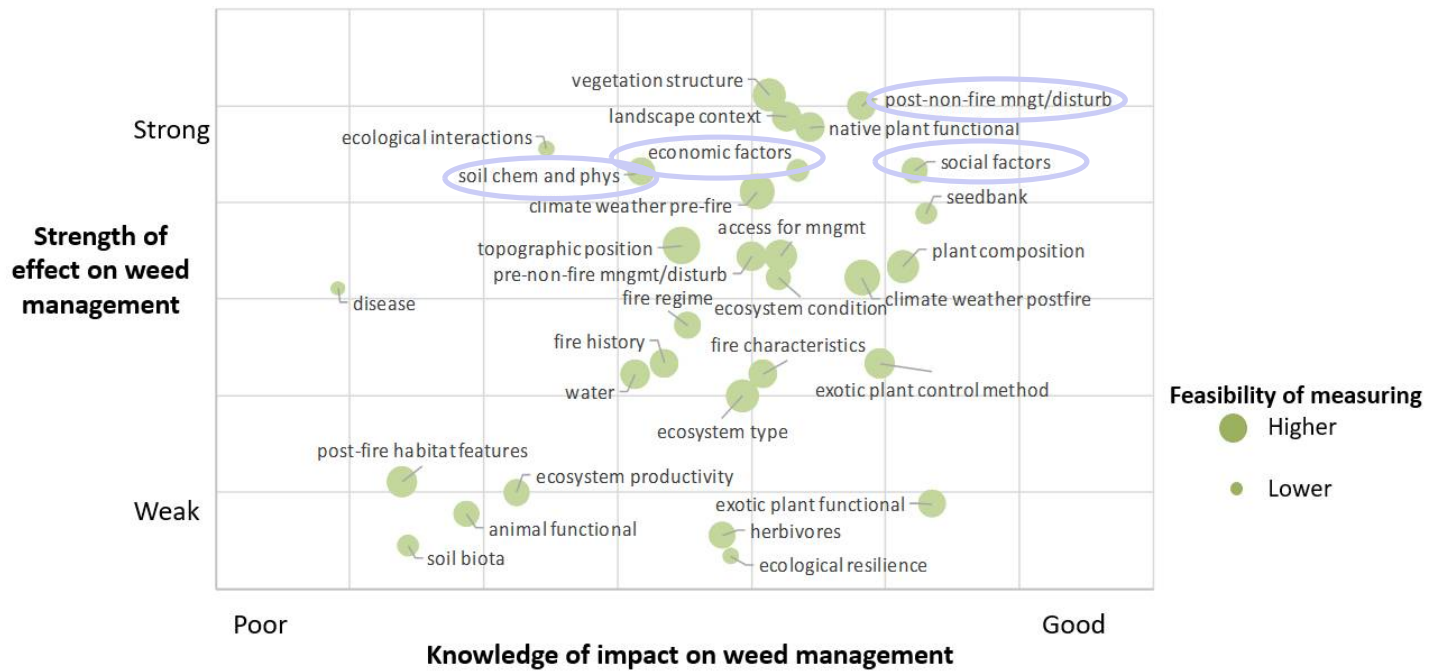


Hypothetical example

Importance and knowledge of site variables that drive effectiveness of post fire recovery



Importance and knowledge of site variables that drive effectiveness of weed management





Ways to be involved

Contribute to network design (workshops etc)

Establish a monitoring site and contribute data

Measure new things across established sites

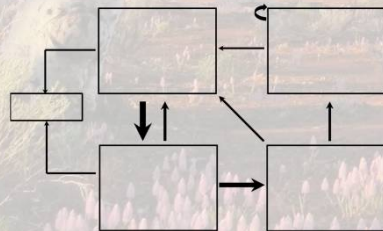
Come up with new questions to ask of the data

Analyse data

Write or contribute to publications

Linking to theory, models and evidence

- Helps to set hypotheses
- Contributes to ecological theory, that in turn can be used to improve management
- Facilitates exploration of data from a range of angles





Example: A continental-scale test of plant diversity-disturbance hypotheses

- Tests models of plant diversity response to disturbance (fire)
- Uses **burnt-unburnt pairs** across all sites
- Uses **plant species diversity data** (1-2 years post-fire)
- Contextual data on **fire intensity, ecosystem productivity**

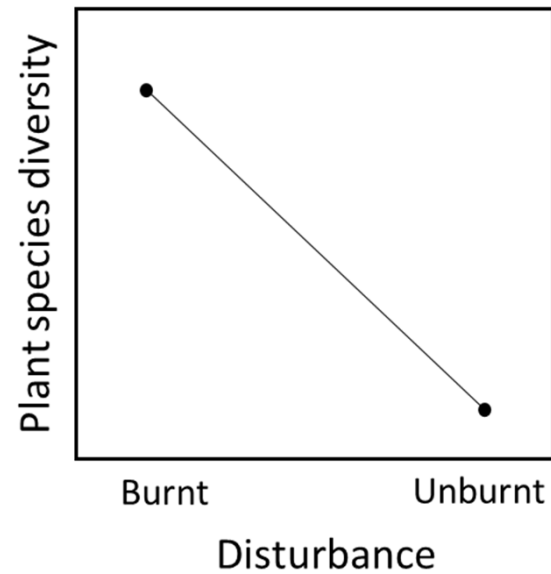


Example: A continental-scale test of plant diversity-disturbance hypotheses

1. Egler's (1954) Initial floristic composition model
2. Grime's (1973) Intermediate disturbance hypothesis
3. Huston's (1979) Dynamic equilibrium model
4. Miller et al. (2020) Disturbance response dependent on prior regime

Example:
A continental-scale test of plant diversity-disturbance hypotheses

(1) Egler's (1954) **Initial floristic composition model**

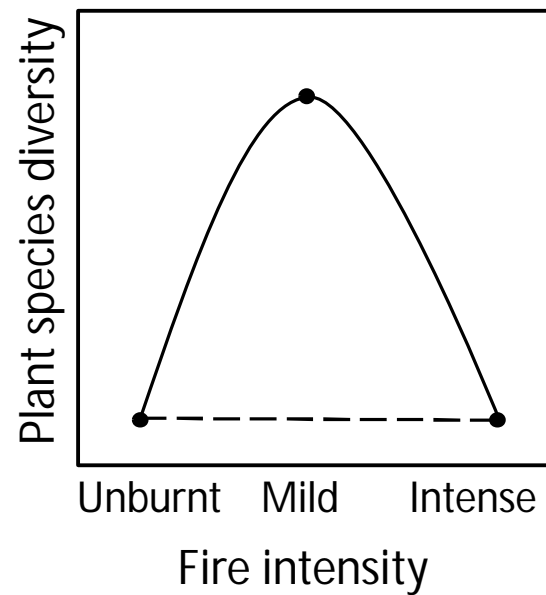


Egler, F.E. (1954) Vegetation science concepts. I. Initial floristic composition, a factor in old-field vegetation development. *Vegetatio*, 4, 412–418.



Example:
A continental-scale test of plant diversity-disturbance hypotheses

(2) Grime's (1973) **Intermediate disturbance hypothesis**



Grime JP (1973) Competitive exclusion in herbaceous vegetation. *Nature* 242:344–347.

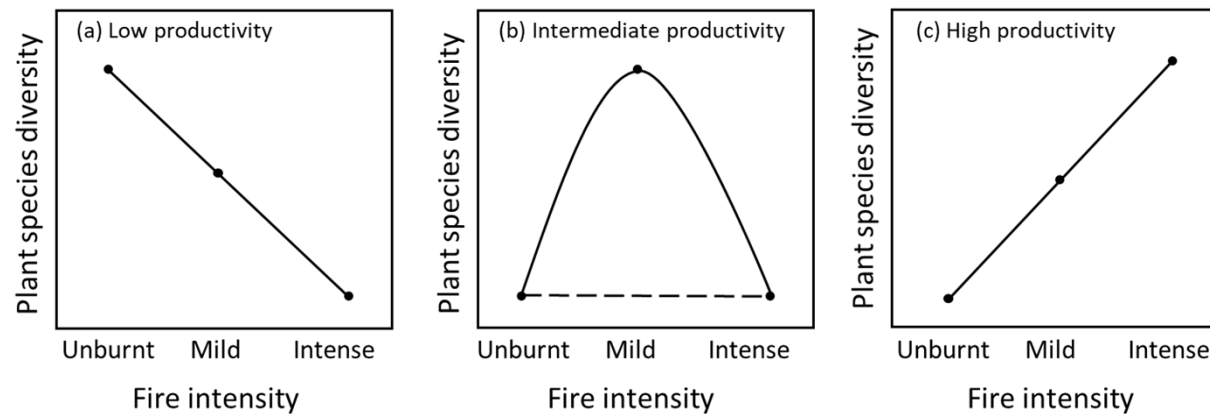
Connell JH (1978) Diversity in tropical rain forests and coral reefs. *Science*, 199:1302–1310.



Example:

A continental-scale test of plant diversity-disturbance hypotheses

(2) Huston's **dynamic equilibrium model**: diversity response to disturbance is dependent on ecosystem productivity



Modified from Figure 1, Huston (2004)

Huston MA (1979) A general hypothesis of species diversity. *American Naturalist* 113:81–101.

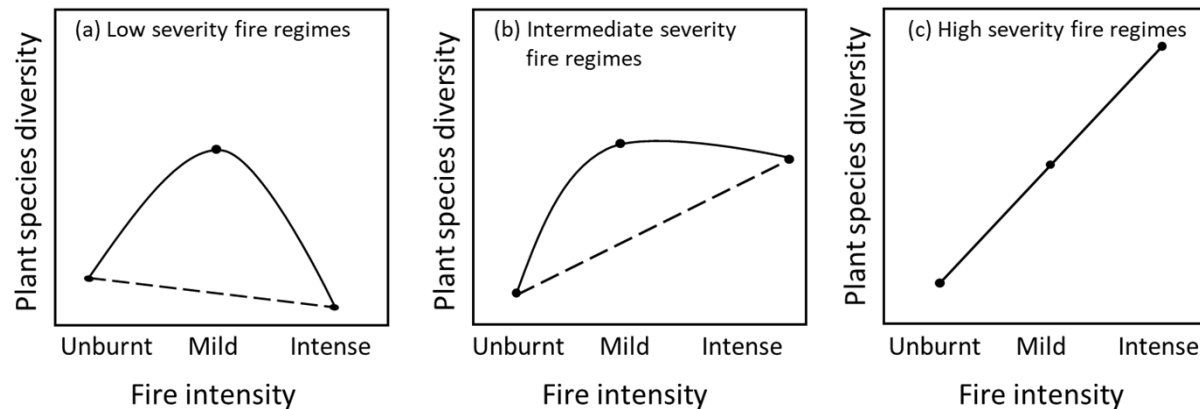
Huston MA (2004) Management strategies for plant invasions: manipulating productivity, disturbance, and competition. *Diversity and Distributions* 10:167-178



Example:

A continental-scale test of plant diversity-disturbance hypotheses

(4) Miller et al. (2020) ecosystem response to disturbance is dependent on **historical disturbance regime**



Miller JED, Safford HD (2020) Are plant community responses to wildfire contingent upon historical disturbance regimes? *Global Ecology and Biogeography* 29:1621-1633





Thank-you

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