Climate Ready Revegetation in Yass Region

A project assisting the adaptation of plants to climate change

Yass Area Network of Landcare Groups

Core team in YAN- Sonya Duus, Elizabeth Goodfellow, Gill Hall*, Kath McGuirk, Sue McIntyre

With assistance from Macquarie Uni - Dr Nola Hancock

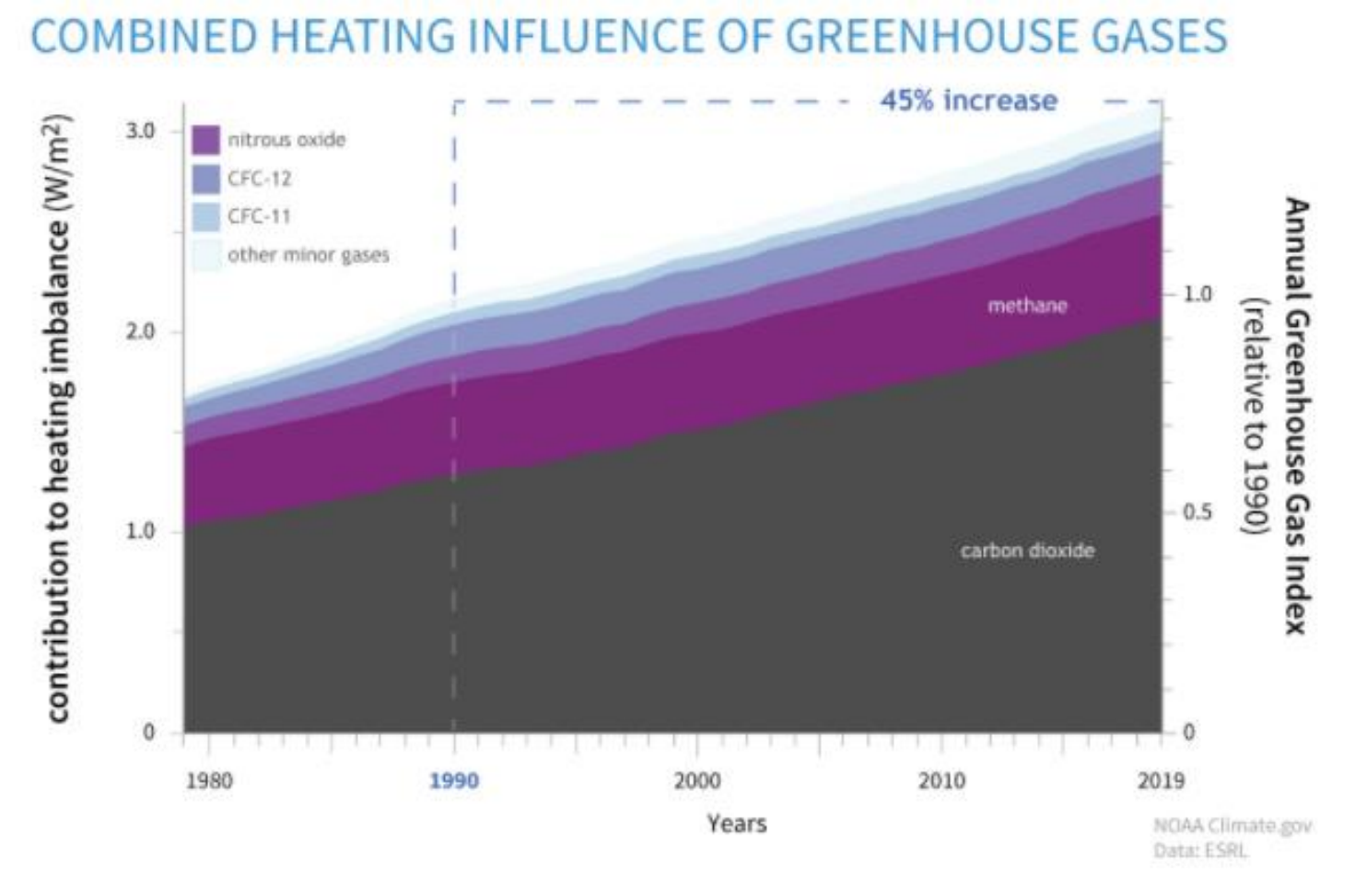
Team at DPIE -Polly Mitchell, Isobel Cummings and Joanne Wilson

Greening Australia -Stephen Bruce

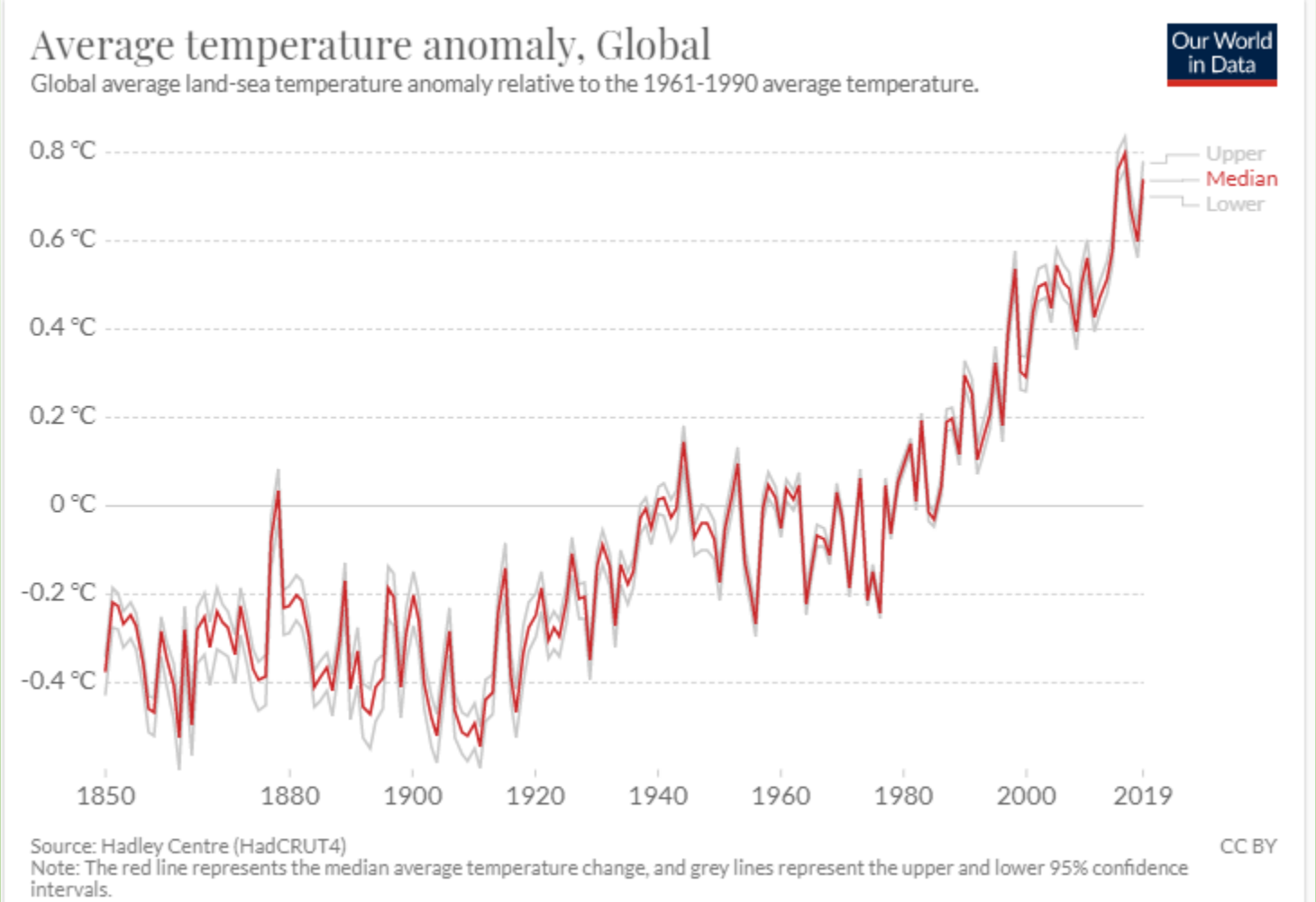
*presenter

Why do this project?

Reason for project



https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide



https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions

Greening Australia

Great Southern Landscapes

The exact cause of the Monaro dieback is still a mystery, but scientists fear that climate change may be to blame. The prolonged periods of drought and increasing temperatures the Monaro is experiencing are thought to be the potential cause for the outbreak of Eucalyptus Weevil – a tiny beetle which invades stressed gums in vast numbers and feasts on the leaves.

https://www.greeningaustralia.org.au/projects/monaro-comeback/

Greening Australia

Great Southern Landscapes

https://www.greeningaustralia.org.au/projects/monaro-comeback/

Climate change is here

It is affecting our landscape and lives

DESPAIR!!!!!

Or…

What can we do?

Let’s do something!

Greening Australia

Great Southern Landscapes

Monaro Comeback

https://www.greeningaustralia.org.au/projects/monaro-comeback/

Climate Ready Revegetation in Yass Region

Project aim

To assist the survival of native plant species during climate change in the YAN Landcare Region through judicious selection of seed provenance to enhance genetic diversity

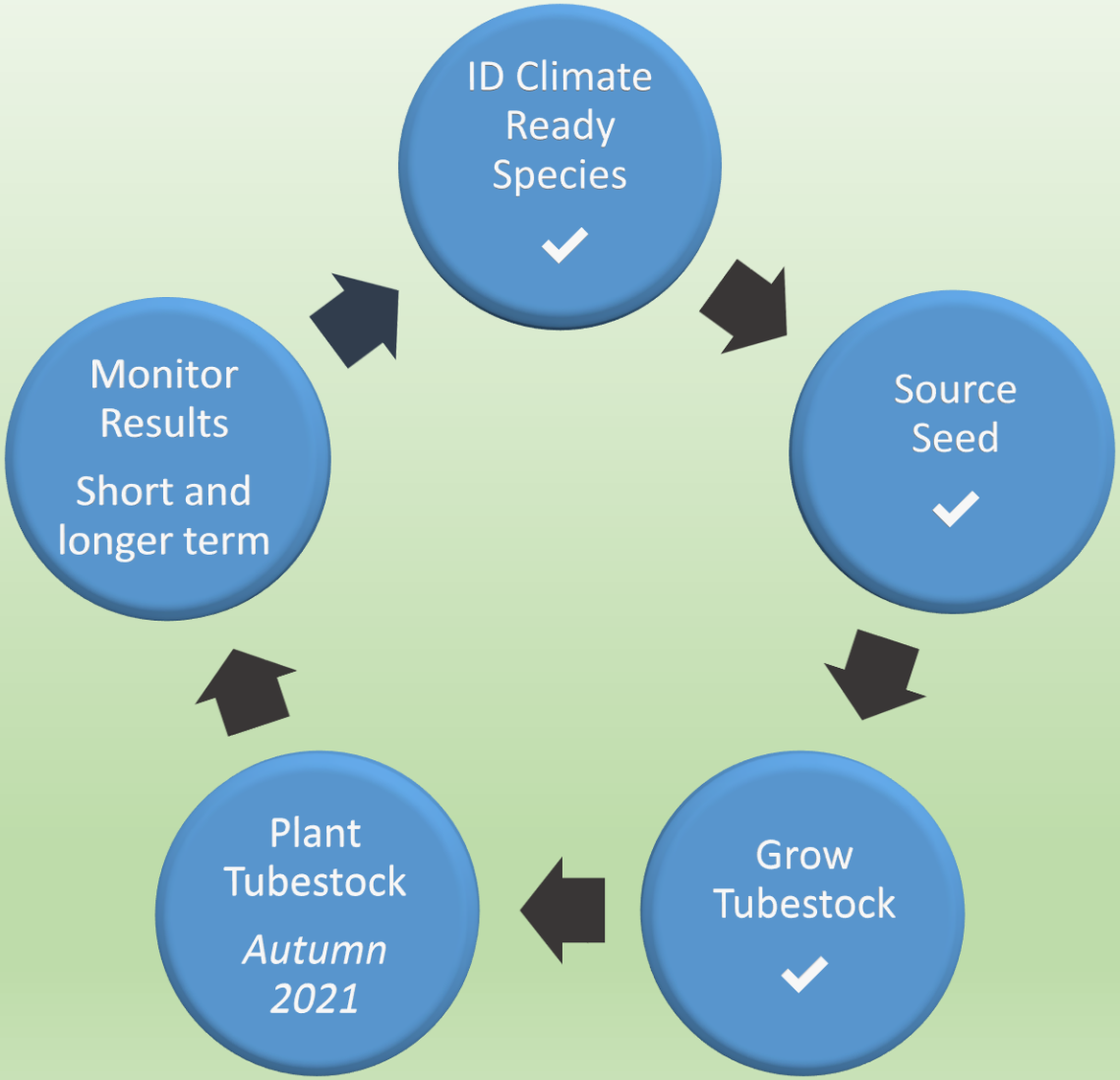
Plant survival in climate change

- Those plant populations with greater genetic diversity are more likely to survive changed conditions due to a greater ability to adapt

- Populations of plants with a current wide distribution, including into hotter areas, may be more likely to be able to survive changed conditions

- Regeneration of plant populations is key to the concept of more likely survival of a species through genetic diversity

Climate Ready Revegetation is an ongoing practice



Need interested landholders with sites suitable for viable revegetation and ongoing plant regeneration

Project outline - 3 streams

1. ***Identifying species & sourcing seed***

Identify suitable *climate ready* species likely to tolerate climate change and obtain genetically diverse admixture seed for these species

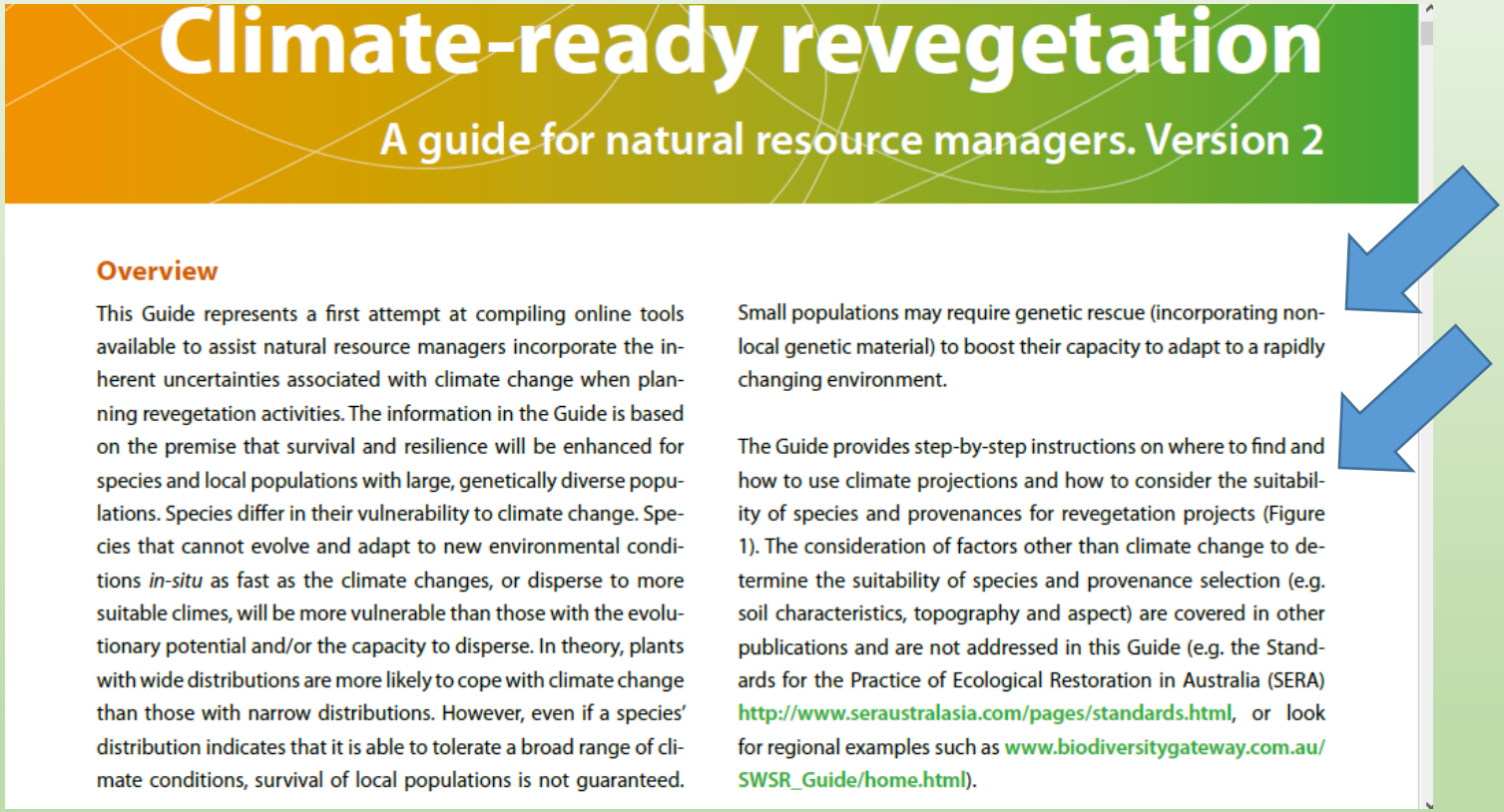
2. ***Nursery practices***

Incorporate *climate ready* strategies into standard nursery and revegetation practices

3. ***Experimental trial***

Run a small 5yr trial to assess whether there is any difference in survival of plants from local versus admixture provenances

1. *Identifying species & sourcing seed*



Climate-ready revegetation

A guide for natural resource managers. Version 2

Overview

This Guide represents a first attempt at compiling online tools available to assist natural resource managers incorporate the inherent uncertainties associated with climate change when planning revegetation activities. The information in the Guide is based on the premise that survival and resilience will be enhanced for species and local populations with large, genetically diverse populations. Species differ in their vulnerability to climate change. Species that cannot evolve and adapt to new environmental conditions *in-situ* as fast as the climate changes, or disperse to more suitable climes, will be more vulnerable than those with the evolutionary potential and/or the capacity to disperse. In theory, plants with wide distributions are more likely to cope with climate change than those with narrow distributions. However, even if a species' distribution indicates that it is able to tolerate a broad range of climate conditions, survival of local populations is not guaranteed. Small populations may require genetic rescue (incorporating non-local genetic material) to boost their capacity to adapt to a rapidly changing environment.

The Guide provides step-by-step instructions on where to find and how to use climate projections and how to consider the suitability of species and provenances for revegetation projects (Figure 1). The consideration of factors other than climate change to determine the suitability of species and provenance selection (e.g. soil characteristics, topography and aspect) are covered in other publications and are not addressed in this Guide (e.g. the Standards for the Practice of Ecological Restoration in Australia (SERA) http://www.seraustralasia.com/pages/standards.html, or look for regional examples such as www.biodiversitygateway.com.au/SWSR_Guide/home.html).

Please cite as: Hancock, N., Harris, R., Broadhurst, L. and Hughes, L. 2018. *Climate-ready revegetation. A guide for natural resource managers.* Version 2. Macquarie University, Sydney. Accessible from: **http://anpc.asn.au/resources/climate_ready_revegetation**

http://anpc.asn

Presented at YAN workshop late 2018

1. Identifying species & sourcing seed

Methods adapted from 'Climate–Ready Revegetation' desktop guide

1. Determine the projected climate for Yass region

2. For each local species in the YAN landcare nurseries, study the current distribution and '*current climate envelope*' (temperature and rainfall)

4. Overlay the species' current climate envelope with the projected climate for Yass and assess whether the species is likely to survive in the projected climate (YES, MARGINAL or NO)

5. Using an 'admixture' provenance strategy determine where to request seed from. Once obtained, assess the adequacy of admixture provenances

IN FUTURE: If a species seems less likely to survive, consider another species with a similar ecological role (could be from outside our locality)

‘Flavour’ of process…

or go and get a cup or tea or glass of wine while we talk data and graphs…..

Data sources

- Data on CURRENT climate for YASS (Worldclim from ALA)
- Data for FUTURE projections for Yass+40km (modified NARCLiM Climate Projections 2070)
- Species occurrence data (to be done for 70 species on YAN nursery lists using Nichefinder)

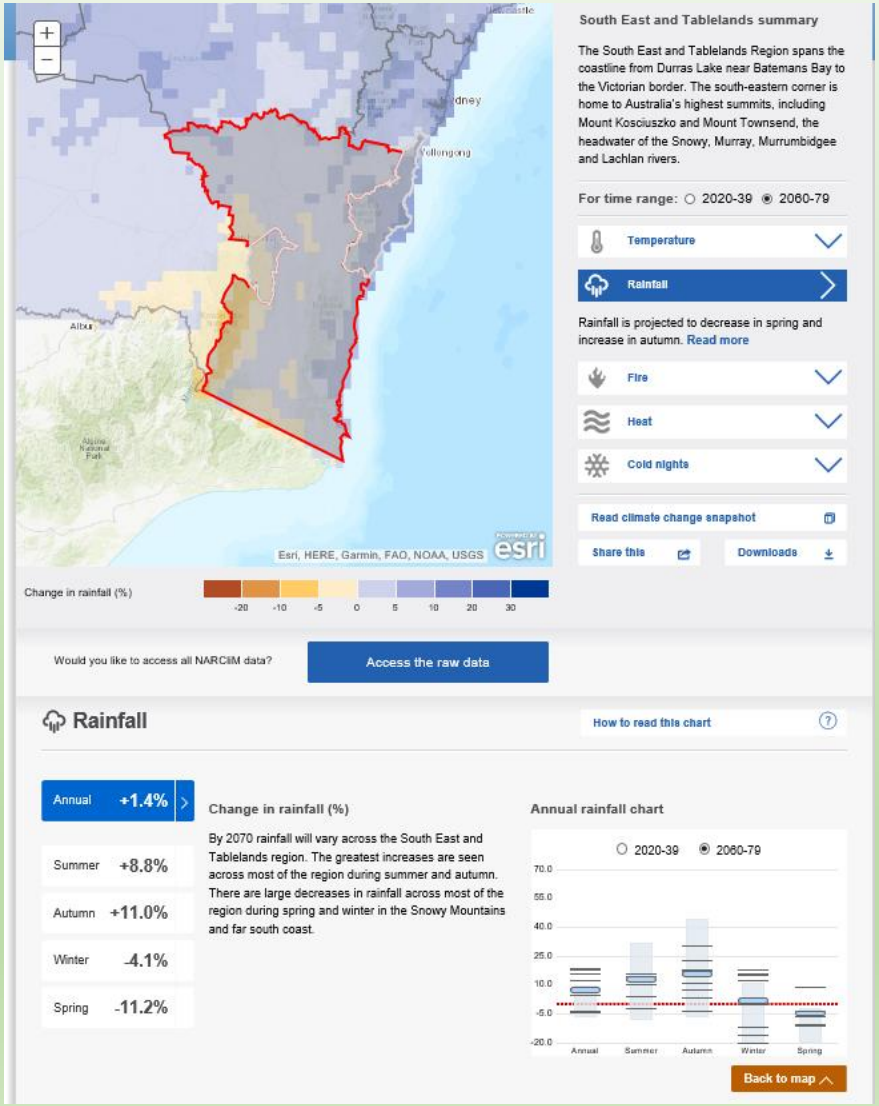
‘Flavour’ of process…

Annual Climate for Yass – current and projections for 2070

(we also look at hottest, driest, coldest and wettest 3 mths of the year)

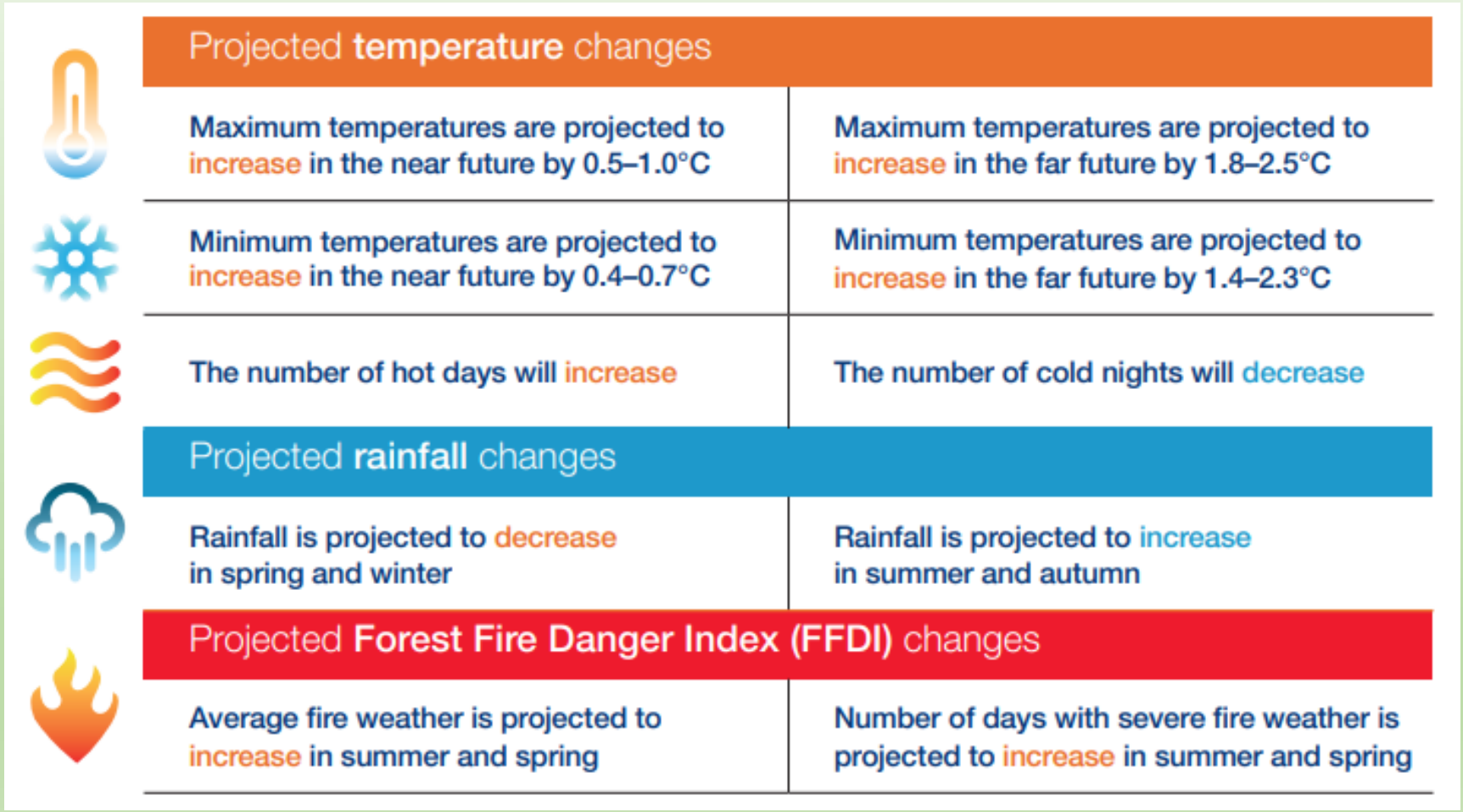
Species’ climate envelopes: Example, Kurrajong *Brachychiton populneus*

Context of Yass climate change: projections for Tablelands and SE region



https://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/Climate-projections-for-your-region/South-East-and-Tablelands-Climate-Change-Downloads

Context of Yass climate change: projections for the Tablelands and SE region



https://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/Climate-projections-for-your-region/South-East-and-Tablelands-Climate-Change-Downloads

We're Moving……
Yass climate change analogue sites

Yass+40km:
2070 climate change projections

Annual average temp

Current	13.6C		
Projected	15.9C	Approx Range	12.1-17.9C

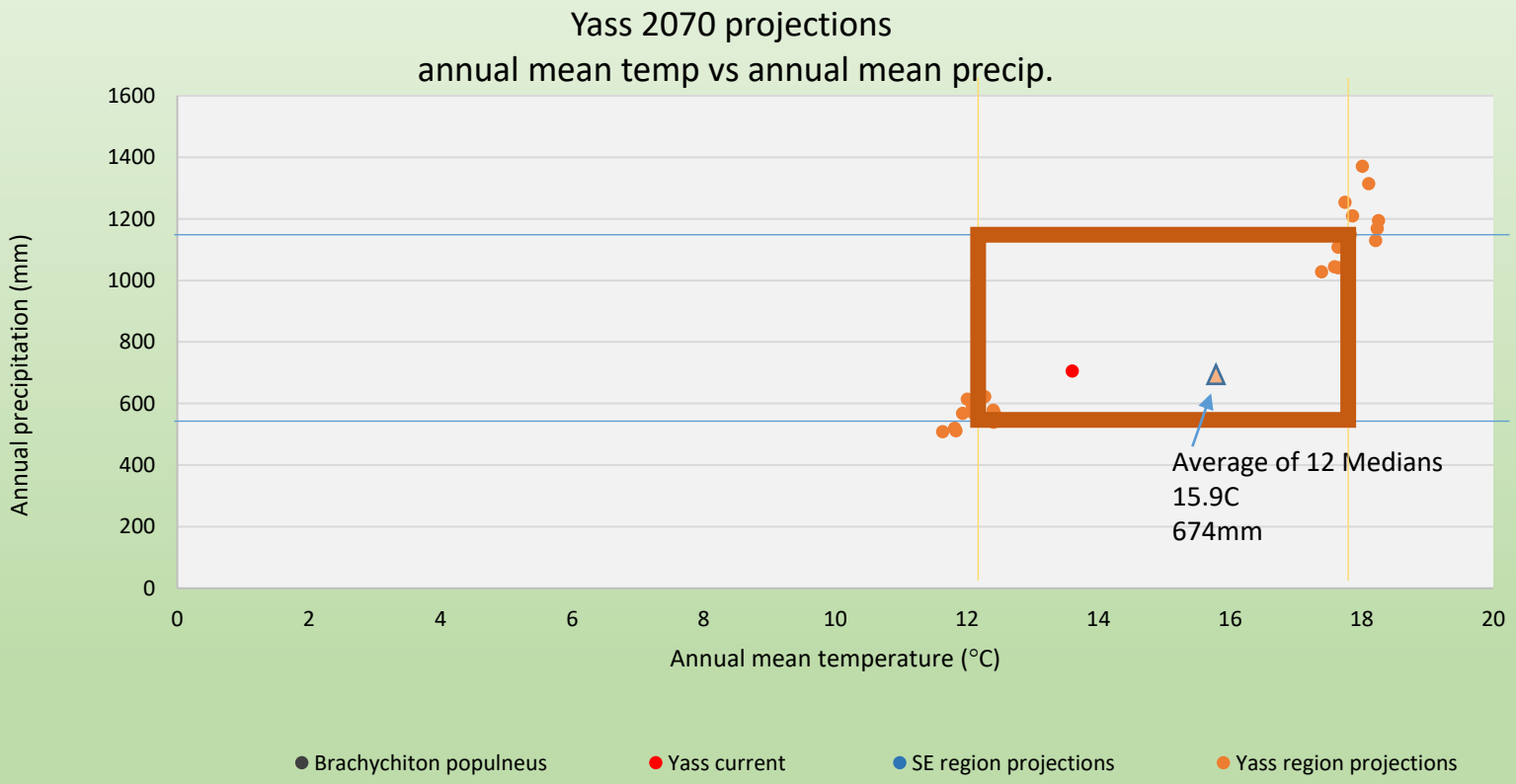
Annual average precipitation

Current	706mm		
Projected	674mm	Approx Range	571-1168mm

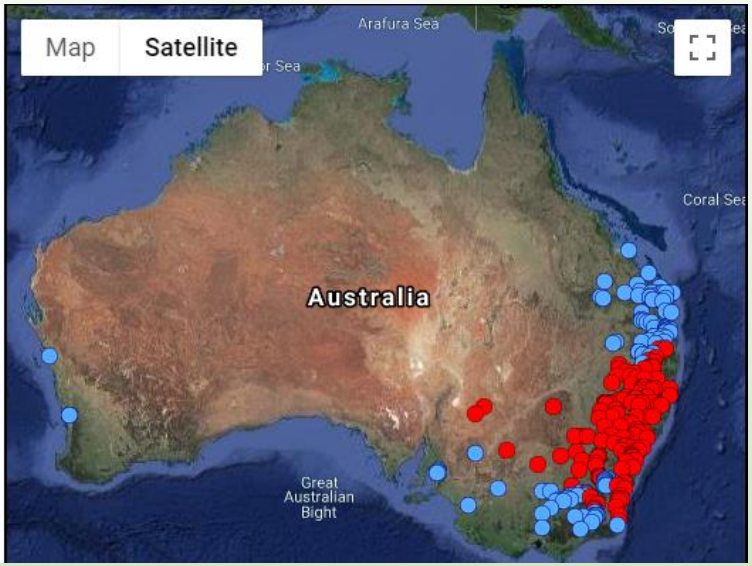
Current is Worldclim data

Projections are simulations from NARClim data using 12 models based on the A2 CO_2 emissions scenario (provided by DPIE)

Yass Climate Projections from 12 models
(ANUCLiM data derived from NARCLiM projections).

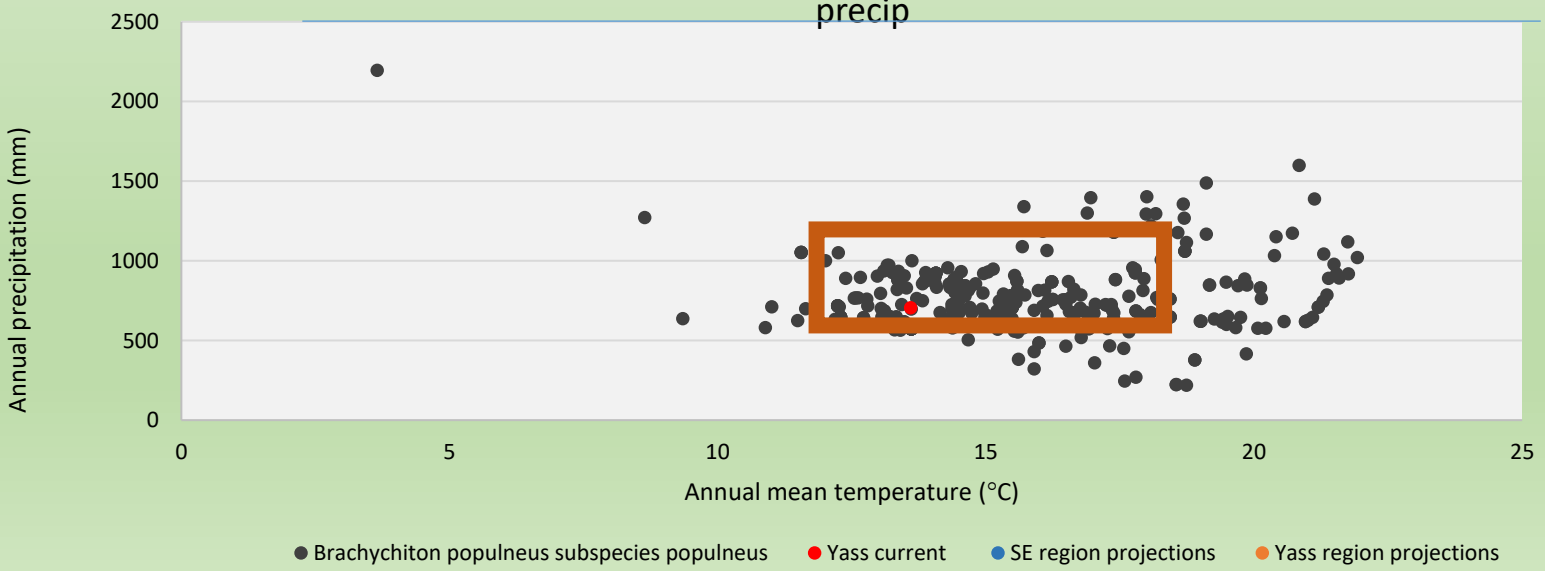


Brachychiton populneus subspecies populneus ***Climate tolerance Yass region 2070***



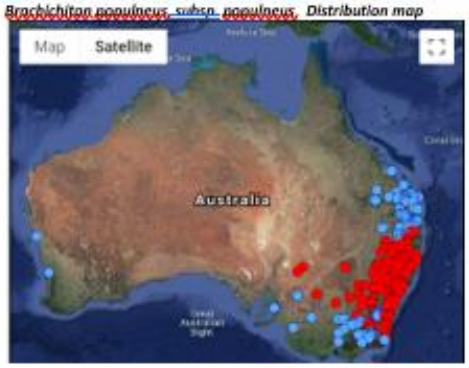
Conclusion: Yes likely to be tolerant to climate change Yass region (temp and rainfall)

Brachychiton populneus subspecies populneus annual mean temp vs annual mean precip



Brachychiton populneus subspecies populneus Climate tolerance Yass region 2070

Brachychiton populneus subsp. populneus Distribution map



General notes: Brachychiton populneus (Kurrajong)

Evergreen tree to 20 m high.

Leaves ovate to lanceolate, lamina usually 5–10 cm long, entire or 3–5-lobed, lobes very narrow, especially on saplings; petiole usually 5–10 cm long.

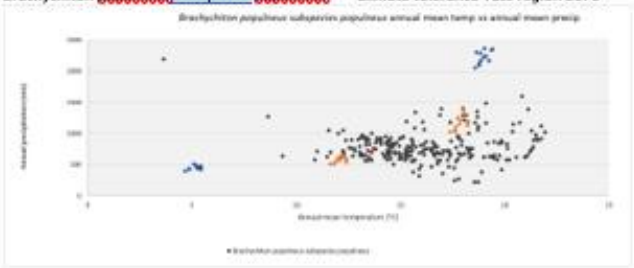
Flowers 10–20 mm long, creamy-white and speckled dark red in throat. Carpels pubescent.

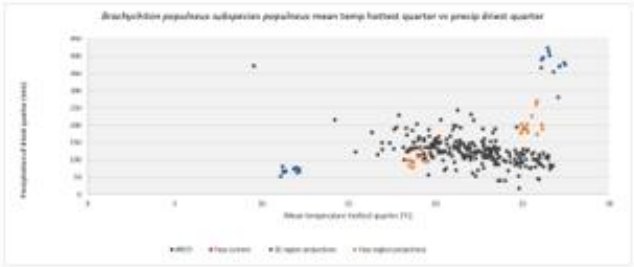
Follicles 2–7 cm long on stalks 2–6 cm long; outer layer of seed hirsute with irritant hairs below, above.

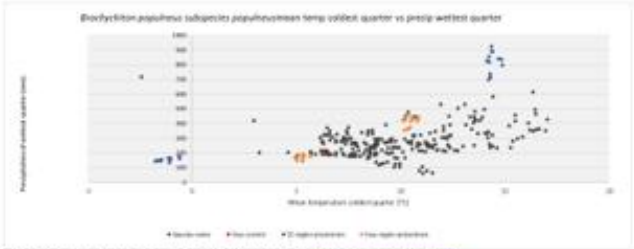
Illustration

Widespread in forest and woodland, especially on the Western Slopes. Often grown for shade and fodder.
NSW subdivisions: NC, CC, SC, NT, CT, NWS, CWS, SWS, NWP, SWP

Brachychiton populneus subspecies populneus Climate tolerance Yass region 2070







Conclusion re tolerance to 2070 (Yass +40km) climate projections

Brachychiton populneus	Annual temp	Annual rain	Hottest Quarter temp	Driest Quarter rain	Coldest Quarter temp	Wettest Quarter rain	Overall Tolerance
	Yes	Yes	Yes	Yes	Yes	Yes	**Yes +**

70 species on nursery lists being assessed currently

Common name	Species	Preferred site
Eucalypts		
White Box	Eucalyptus albens	Not local. South west slopes.
Blakely's Red Gum	Eucalyptus blakelyi	Lower slopes, flats.
Apple Box	Eucalyptus bridgesiana	Lower slopes, flats, drainage lines.
River Red Gum	Eucalyptus camaldulensis	Southwest slopes.
Argyle Apple	Eucalyptus cinerea	lower slopes, flats, poor soils
Silver Gum	Eucalyptus crenulata	Rare, from Victoria.
Broad Leaved Peppermint	Eucalyptus dives	Upper and mid-slopes.
Long Leaved Box	Eucalyptus goniocalyx	upper slopes.
Red Stringybark	Eucalyptus macrorhyncha	upper and mid-slopes.
Brittle Gum	Eucalyptus mannifera	Hill tops, upper slopes.
Yellow Box	Eucalyptus melliodora	lower slopes, flats.
Snow Gum	Eucalyptus pauciflora	Higher altitudes, frost hollows.
Red Box	Eucalyptus polyanthemos	mid and lower slopes
Inland Scribbly Gum	Eucalyptus rossii	hill tops, upper slopes.
Candlebark	Eucalyptus rubida	lower slopes, flats, drainage lines.
Mugga Ironbark	Eucalyptus sideroxylon	2 subspecies, one to werst, one to east
Ribbon Gum/Manna Gum	Eucalyptus viminalis	wet, well drained sites.
	E.dealbata	
	E. microcarpa	

5. Using an ‘admixture’ provenance strategy determine where to request seed from. Once obtained, assess the adequacy of admixture provenances

- Admixture provenance strategy is being used for all species
- builds evolutionary resilience by mixing a wide variety of provenances from sources across a species’ range, including local seed sources
- allows a range of genotypes from widely distributed populations to establish at sites, providing the opportunity for recombination and adaptation in future plant generations
- appropriate when changes in conditions are expected but there is a degree of uncertainty about the specific conditions

5. Using an ‘admixture’ provenance strategy determine where to request seed from. Once obtained, assess the adequacy of admixture provenances

- Greening Australia is an important collaborator here
  - Expertise
  - Already have collection networks
  - Record keeping, databases

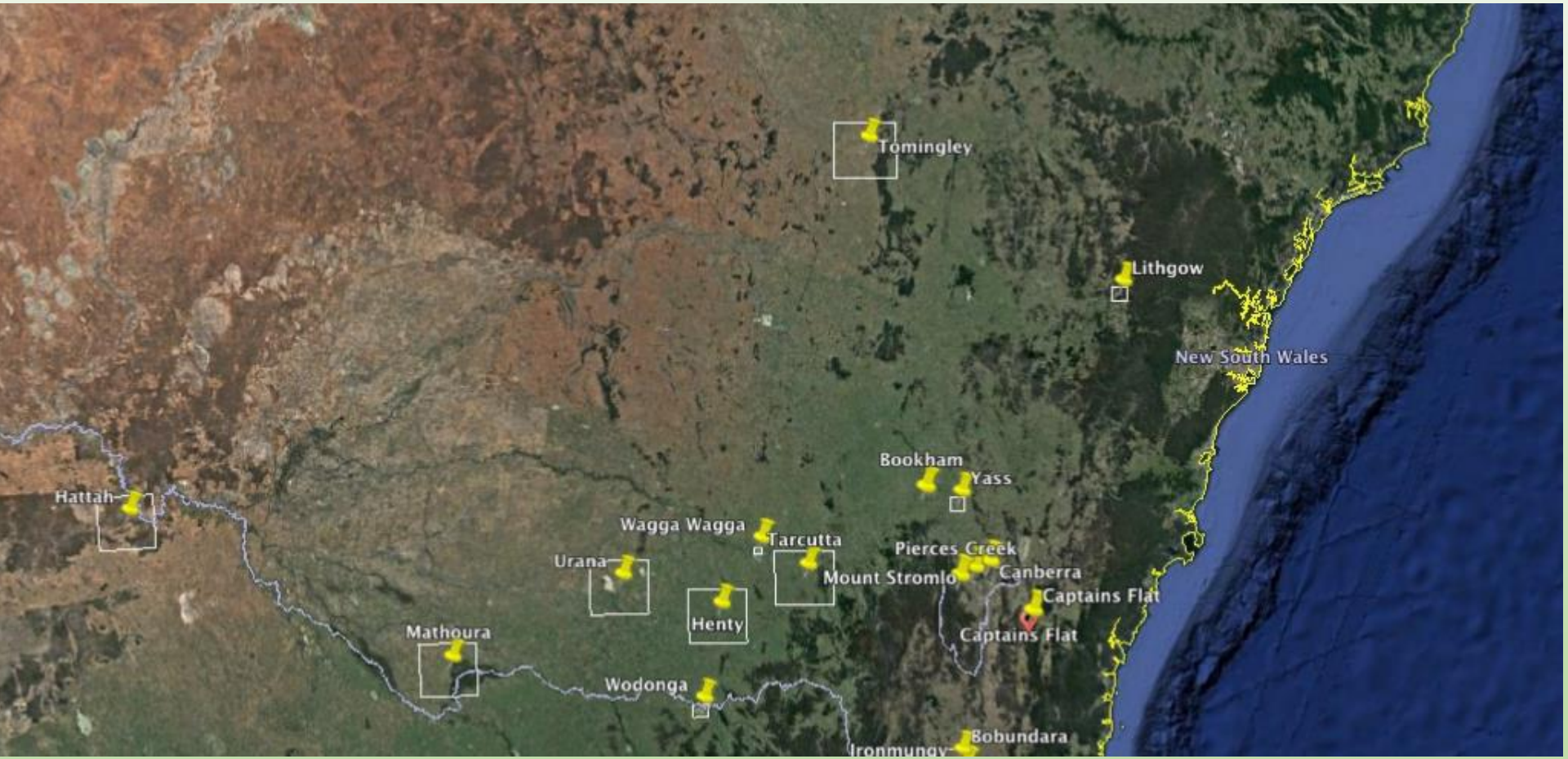
- Have provided seed for 4 species so far

Eucalyptus melliodora	*9 provenance sites*
Acacia deaneii subsp. paucijuga	*4 provenance sites*
Dodonaea viscosa subsp. Angustissima	*7 provenance sites*
Chrysocephalum semipapposum	*1 provenance site*

- Assess for geographical and climatic range across provenance sites

- 13 more species requested so far

Some of the seed provenance locations giving a gene mix so far



:

Eucaluptus Melliodora (tree)

Acacia deanei subsp. paucijuga (small tree/shrub)

Dodonaea viscosa subsp. angustissima (shrub)

2. Nursery practices

Incorporate *climate ready* strategies into standard nursery and revegetation practices

- 4 YAN nurseries, all taking part
- Nursery meetings established to share experiences and knowhow
- Bulk buy of materials
- Sharing of admixture seed
- Sharing of nursery practice training materials and guidelines
- Improved record keeping
- Taking part in the trial growing tubestock
- Aim to improve monitoring of plant survival and growth after distribution

Need interested landholders with sites suitable for viable revegetation and ongoing plant regeneration

3. Experimental trial

Background:

Our core concern is whether admixture plantings can provide a seedling establishment rate that is comparable with local plantings, and could thus launch a wider array of genotypes into the landscape than that provided by local plantings.

We are not trying to assess the success of specific provenances.

Research question: Is there a difference in short-term outcomes of plants from local compared with admixture seed provenances?

3. Experimental trial

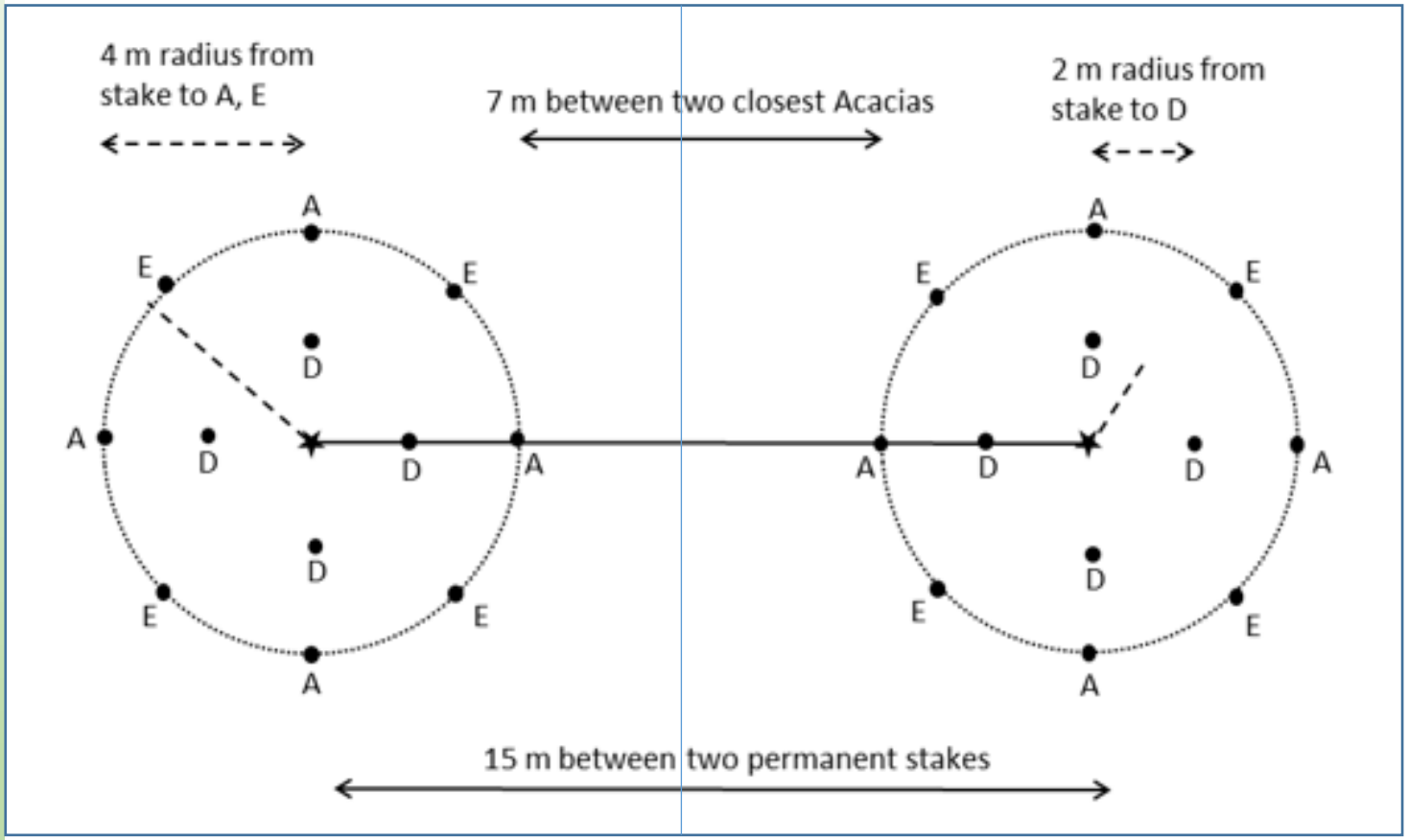
Methods:

- Main outcome measure will be 5 year survival
- Design*
  - 2 sites have been selected
  - 25 blocks at each site with 2 plots per block (local plot and admixture plot)
  - 4 plants of each of 3 species in each plot
- Some funding provided by DPIE for materials

* statistical power sufficient to detect 0.5 compared with 0.7 survival for the two provenance sources.

3. Experimental trial

DESIGN 1. FOR FOUR PLANTS per plot (25 BLOCKS MINIMUM REQUIRED)



✶ = permanent stake
E = Eucalyptus melliodora
D = Dodonaea viscosum
A = Acacia deaneii

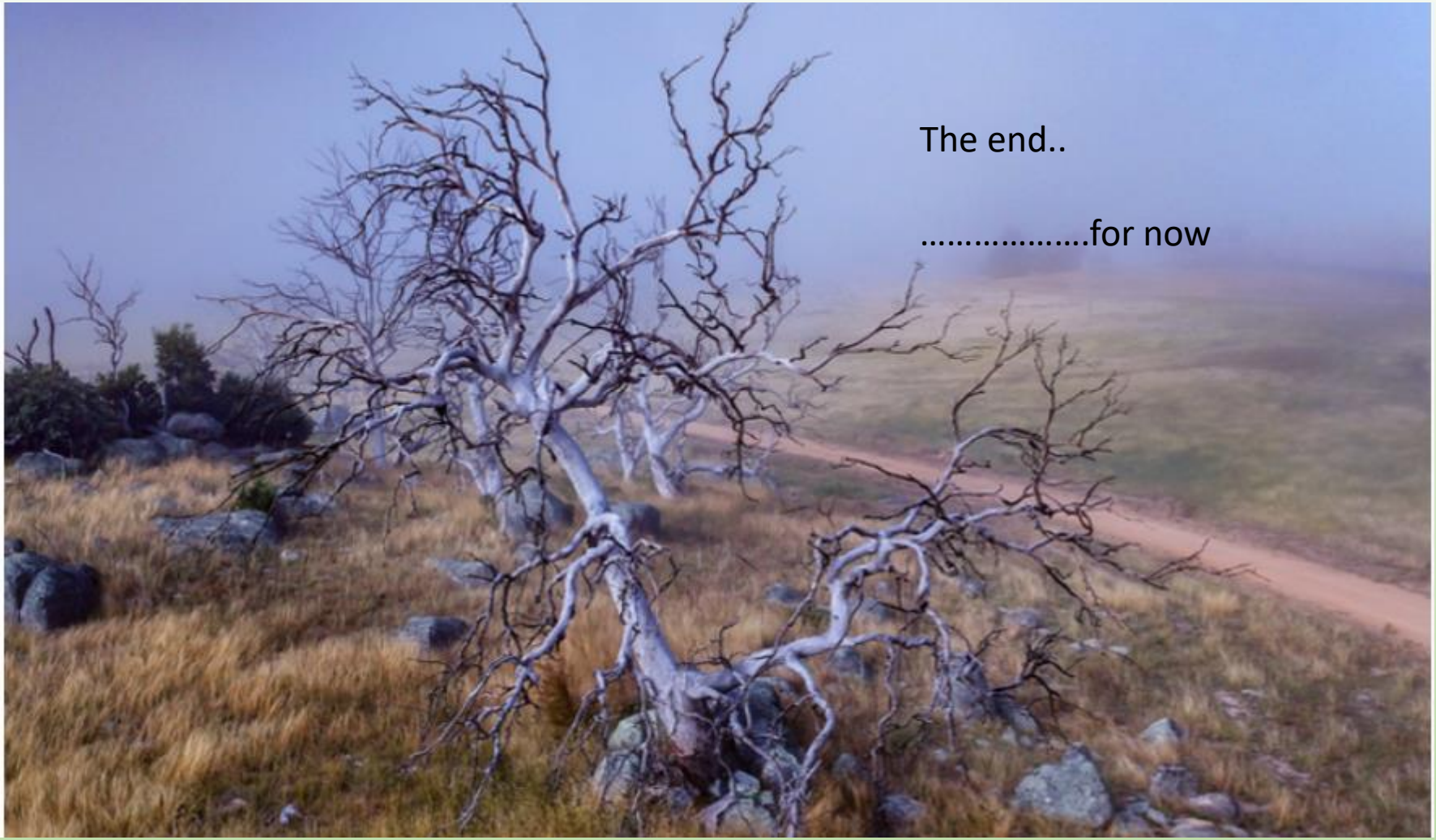
Experimental trial and nursery practice

- Trial is leading to enhanced nursery practice
  - Detailed documentation of best practice to be followed for trial seedlings
  - Germination test of all provenances underway
  - Sowing will occur first week of October

- Staking out sites around Xmas
- Planting next autumn
- Ongoing data collection for 5 years

Extension projects

- Seed collectors group
  - Training in collecting seed from YAN region
  - Can contribute seed to ongoing climate ready reveg
- Let's try project
  - Community engagement
  - Revegetation, grazing component
- Michael King grant
  - Funding for admixture seed



Greening Australia

Great Southern Landscapes

Monaro Comeback

https://www.greeningaustralia.org.au/projects/monaro-comeback/