Climate-ready revegetation

A guide for natural resource managers

Gunning Landcare Conference
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NSW GOVERNMENT Office of Environment & Heritage

MACQUARIE University

ACE CRC ANTARCTIC CLIMATE & ECOSYSTEMS COOPERATIVE RESEARCH CENTRE

CSIRO

Ku·ring·gai Council

Farming & native vegetation

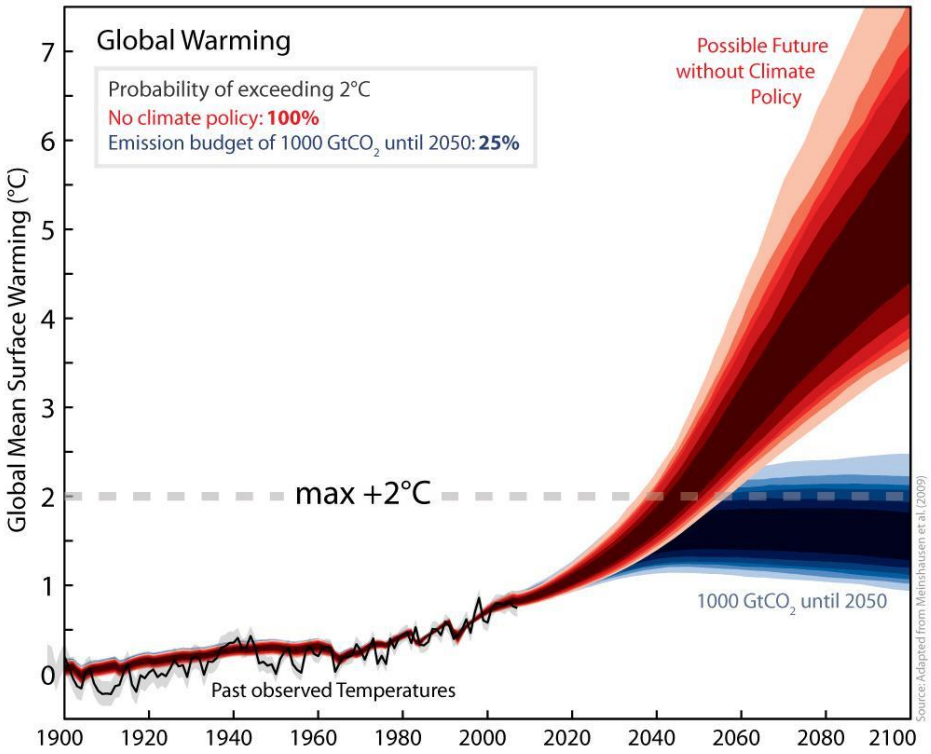
Native vegetation/revegetation used for:

- Agricultural; managing ground water and salinity, erosion control and riverbank stabilization, shelter for stock
- Natural resource management / ecology: protecting threatened species, planting corridors for wildlife, multi purpose

Climate change is happening now

- Uncertainties – future & effects
- Temperature
- Rainfall
- Extreme weather events: frequency / intensity
- trends to continue

but extent uncertain- e.g. GHG



Uncertainty and vulnerability of species to climate change

Species differ in their vulnerability to climate change. Coping mechanisms:

- **Stay & tolerate or genetically adapt**
- **Move**
- **Locally extinct**

AND their ability to keep pace with climate change.

Uncertainty and vulnerability of species to climate change

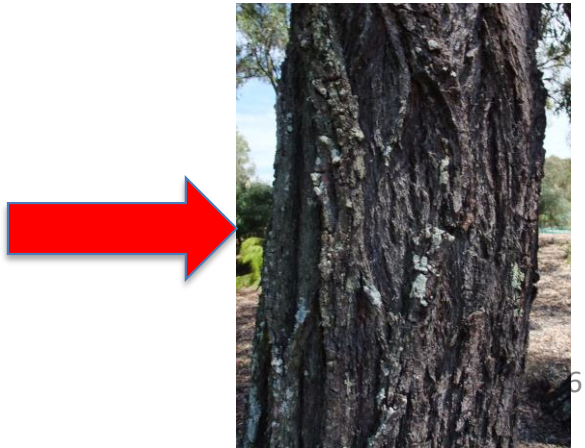
Generally, those advantaged:

- Can tolerate, adapt or move
- Keep pace with climate change
- Have wide distributions

Balance urgency / perfect knowledge

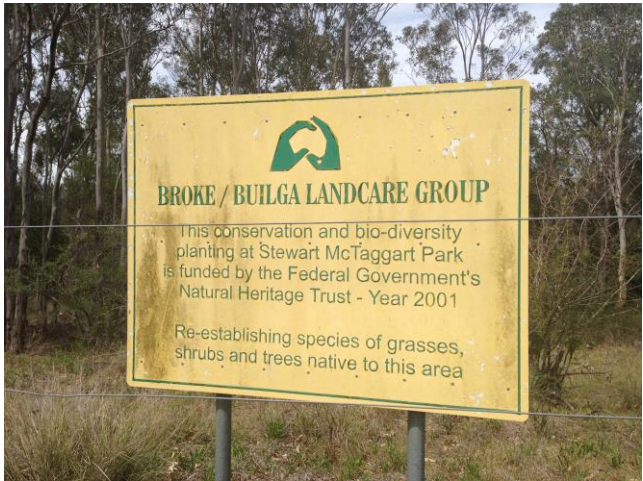
Prediction is very difficult, especially if it is about the future. **Nils Bohr, Nobel Laureate Physics**

- Models imperfect but consistently show a reduction in species' distributions
- Whole veg communities to disappear
- Failed plantings = lost effort time & money



Practical decisions now

- Continue to revegetate in the manner that we have done in the past?
- Plant the same species?
- Use the same seed source (local or a different provenance strategy)?
- Time of planting?
- Change the way we have been doing things?



What is the Guide?

- Origins
- Accessible, useable, available
- Online tools (tool box)
- Step by step instructions



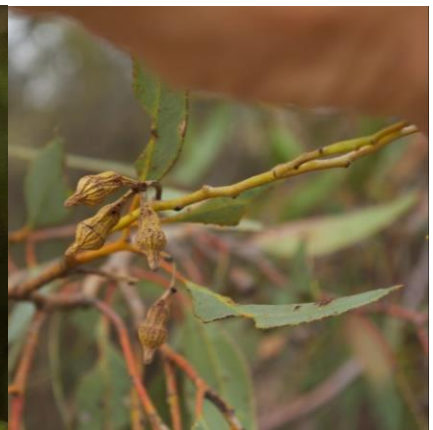
What is the Guide?

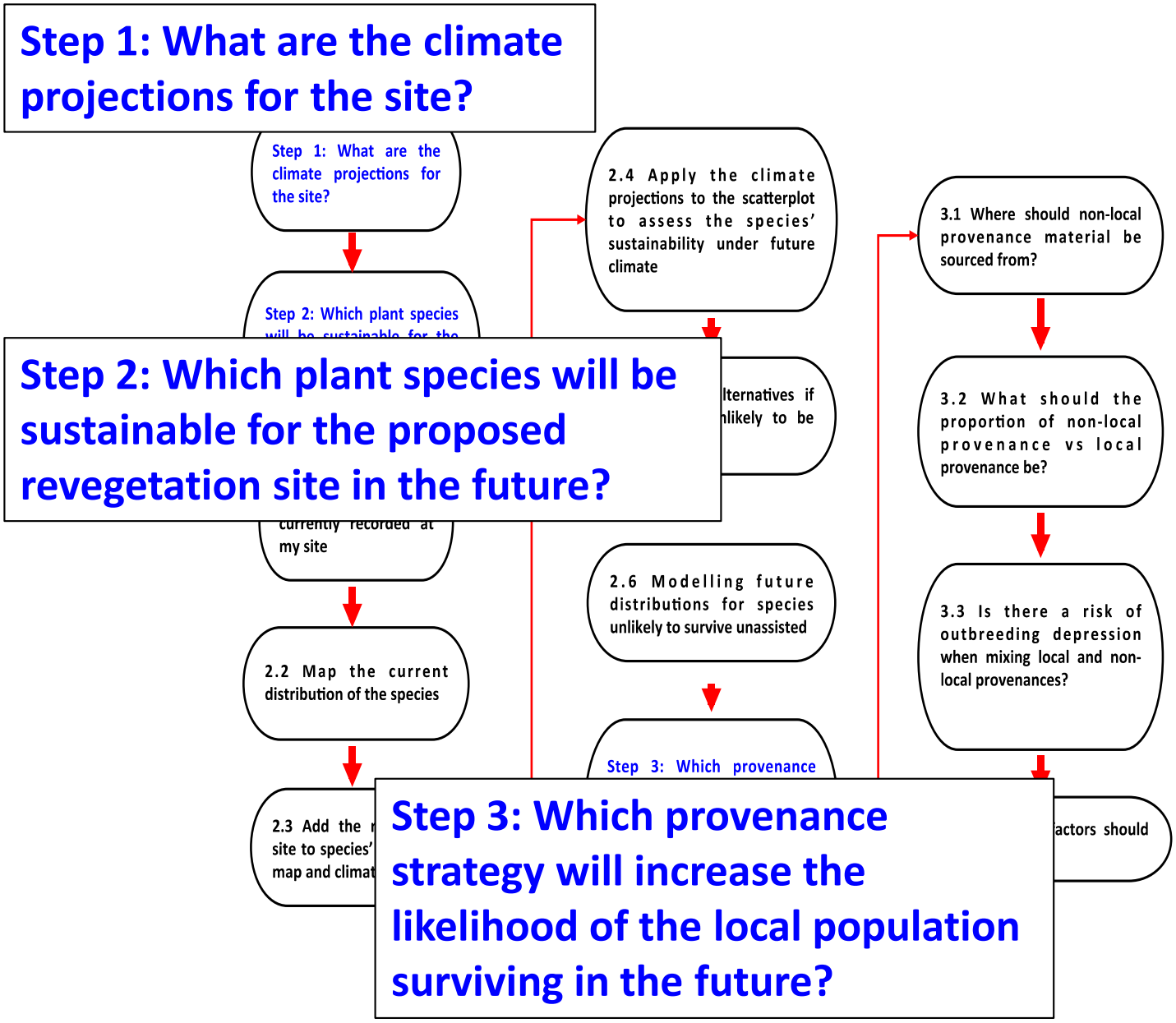
- Considers climate change only
- Does not provide specific recommendations
- Booklet and website with downloadable pdf:

http://www.anpc.asn.au/resources/climate_ready_revegetation

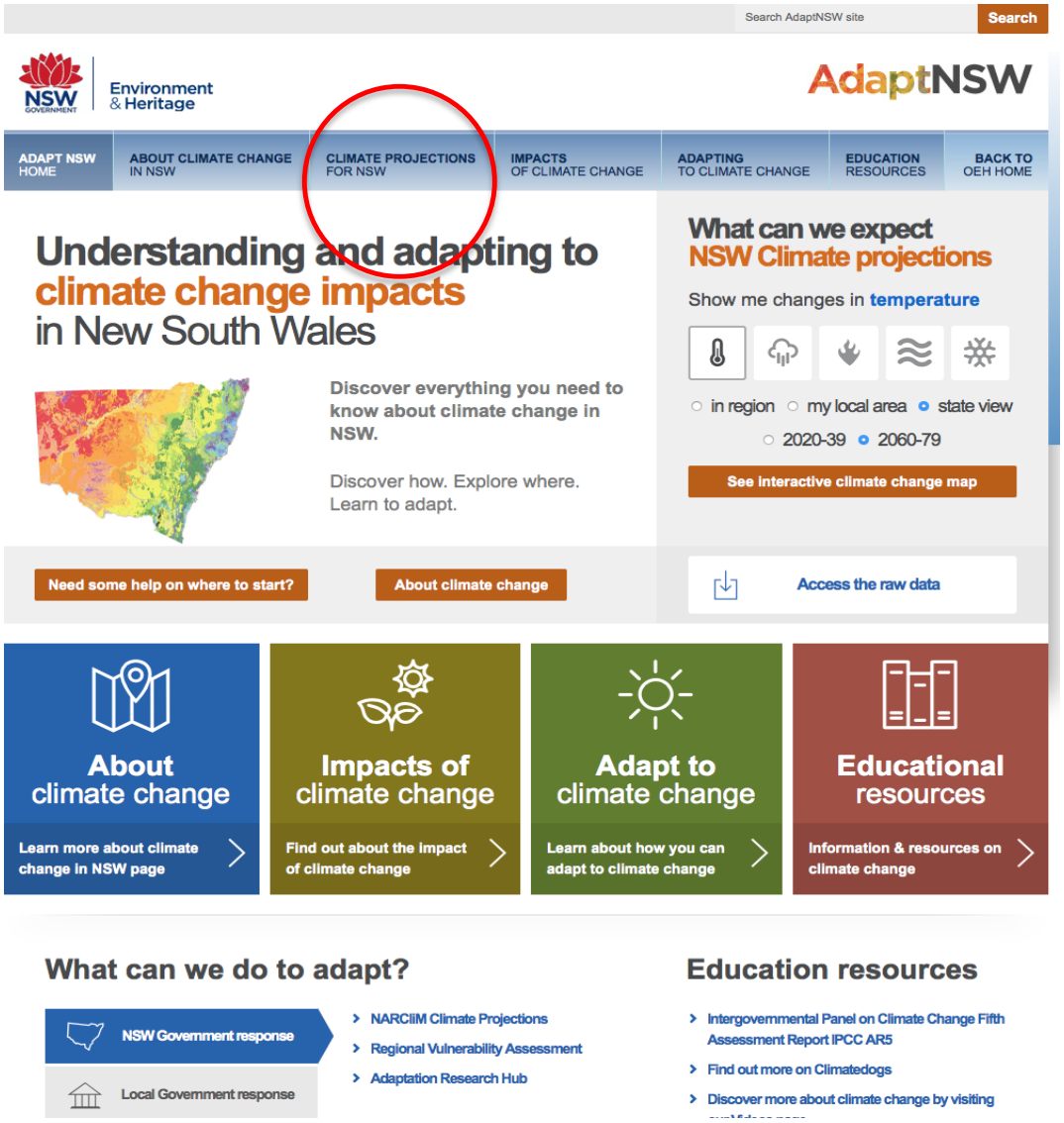
- Updated V2






Step 1: What are the climate projections for the site?
Step 1: What are the climate projections for the site?
2.4 Apply the climate projections to the scatterplot to assess the species' sustainability under future climate
3.1 Where should non-local provenance material be sourced from?
Step 2: Which plant species will be sustainable for the proposed revegetation site in the future?
Step 2: Which plant species
lternatives if
nlikely to be
3.2 What should the proportion of non-local provenance vs local provenance be?
currently recorded at my site
2.6 Modelling future distributions for species unlikely to survive unassisted
3.3 Is there a risk of outbreeding depression when mixing local and non-local provenances?
2.2 Map the current distribution of the species
Step 3: Which provenance
2.3 Add the
site to species'
map and climat
Step 3: Which provenance strategy will increase the likelihood of the local population surviving in the future?
actors should

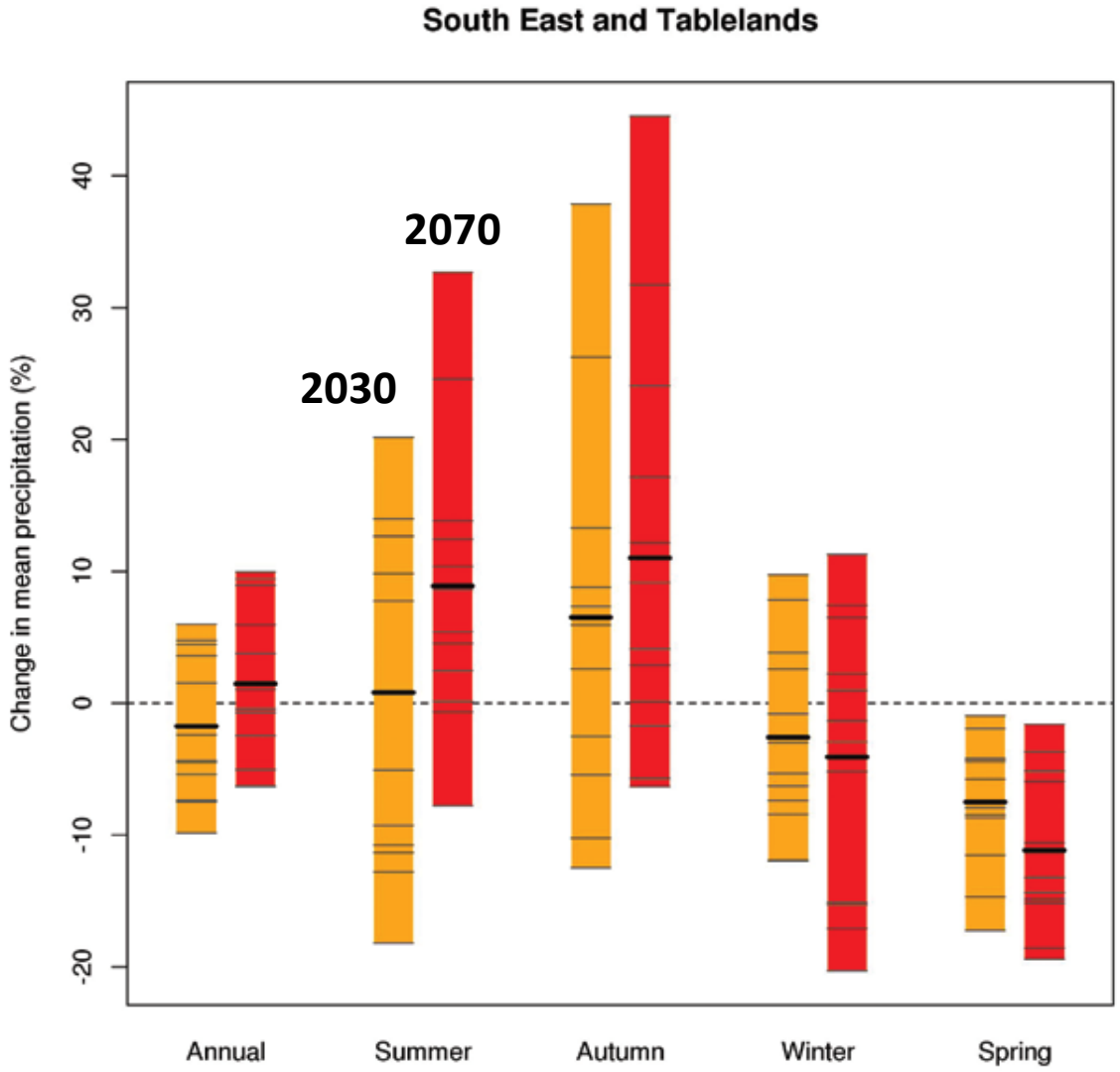
NSW State regions: NARCLiM



Near future 2030
(2020 – 2039)
&
Far future 2070
(2060-2079)
vs
1990 -2009

http://www.climatechange.environment.nsw.gov.au

Projected changes in av. rainfall



Note:

- Directions
- Annual - little change
- Seasonal -

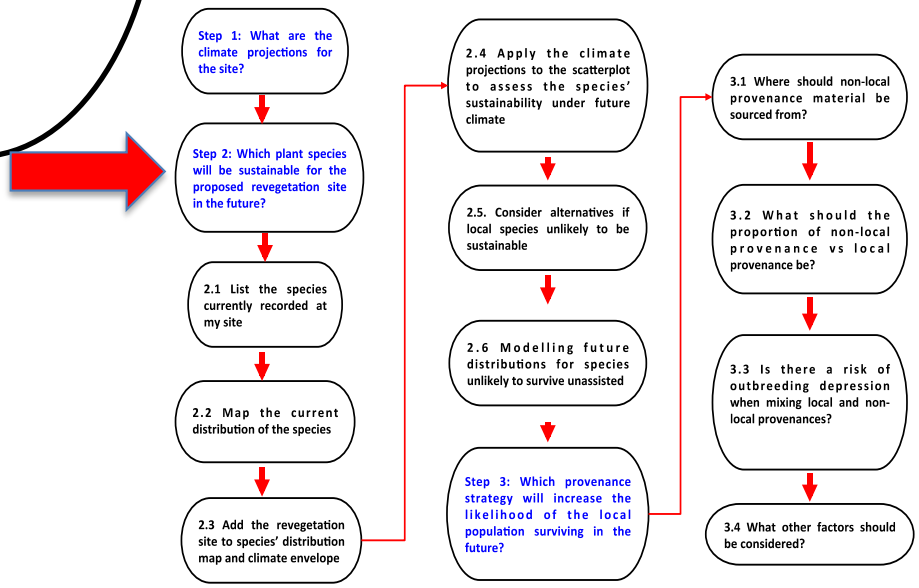
i.e.

spring ↓

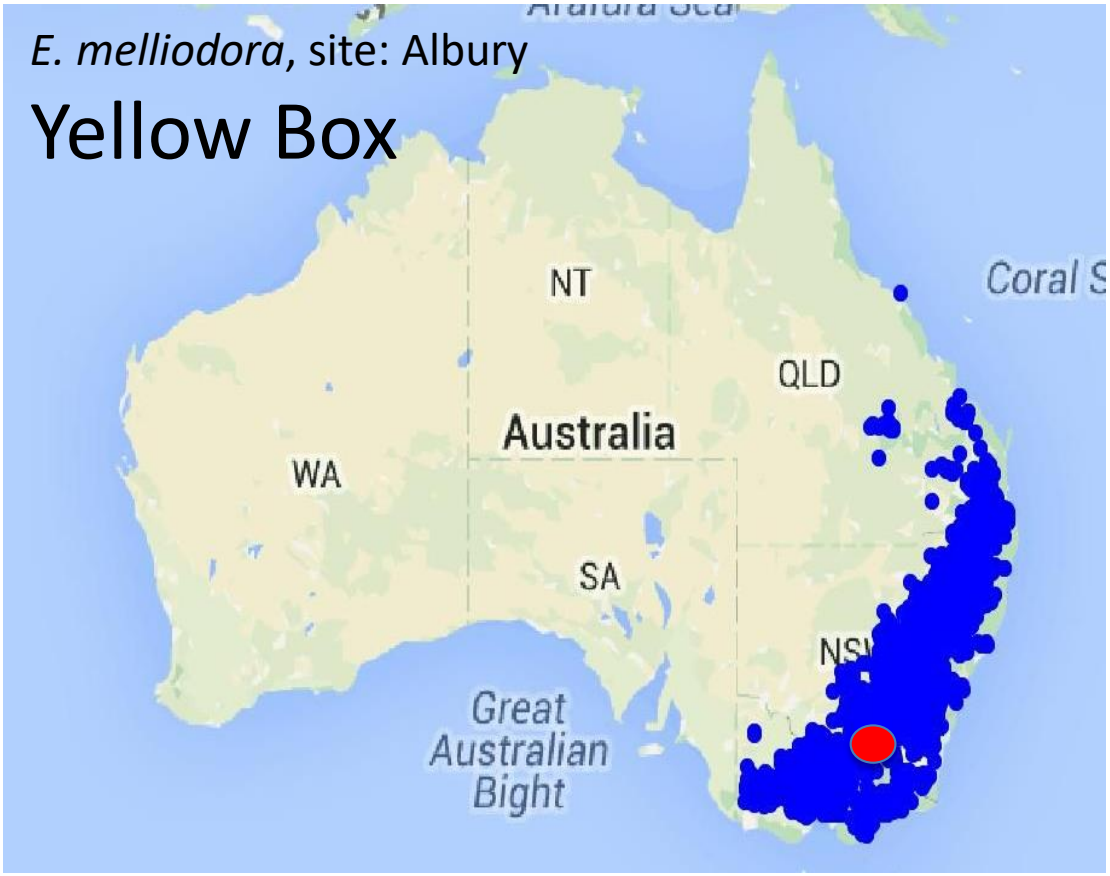
autumn ↑

NARCliM

Step 2: Which plant species will be sustainable for the proposed revegetation site in the future?

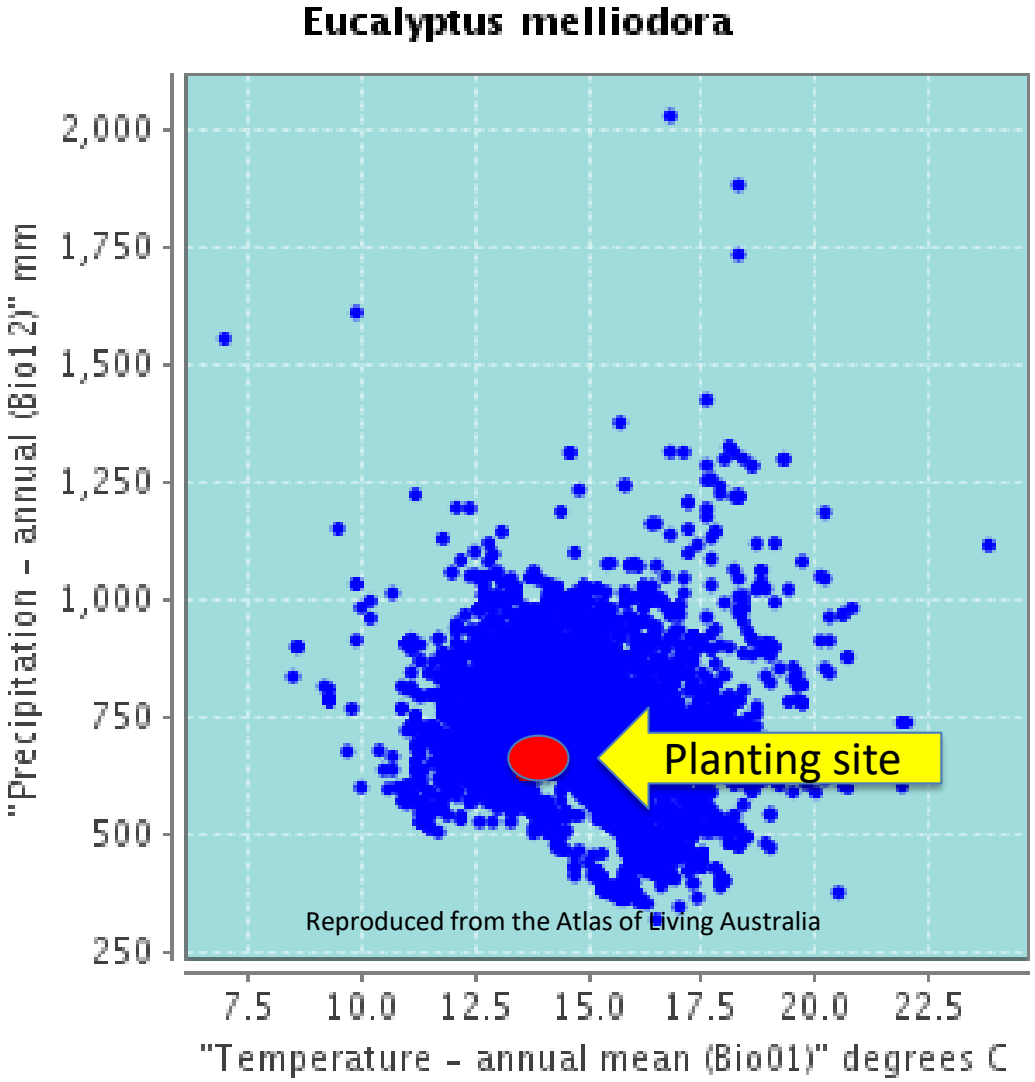


Map the current distribution of the spp. Find location of planting site

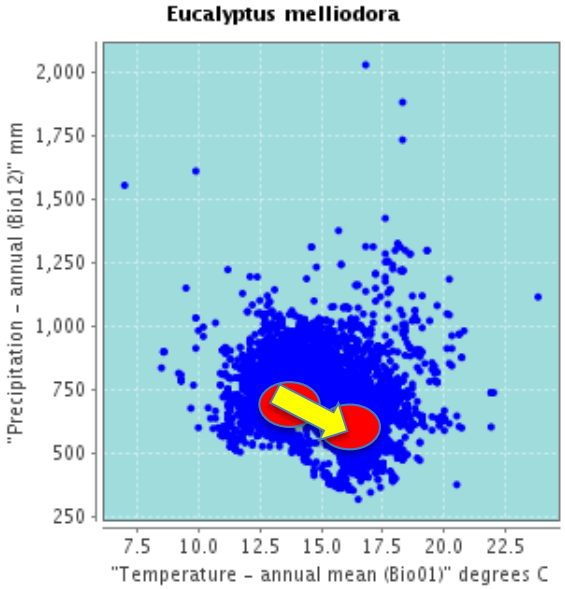


Reproduced from the Atlas of Living Australia

Species' climate envelope & site location (Gunning)

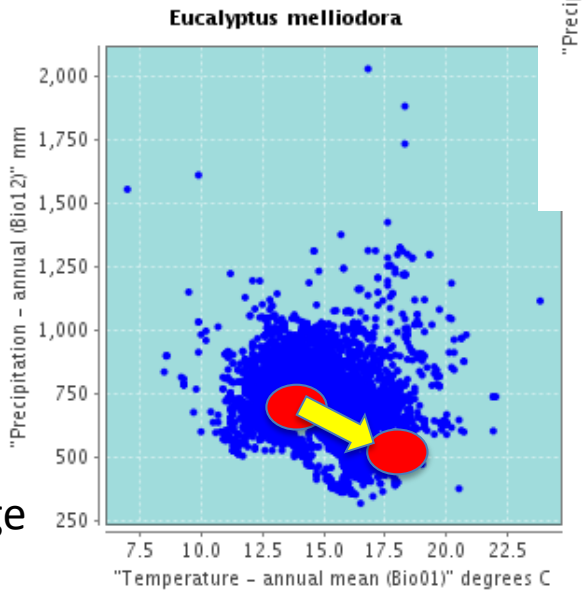


Visualize climate projections to the scatterplot – 3 possible scenarios

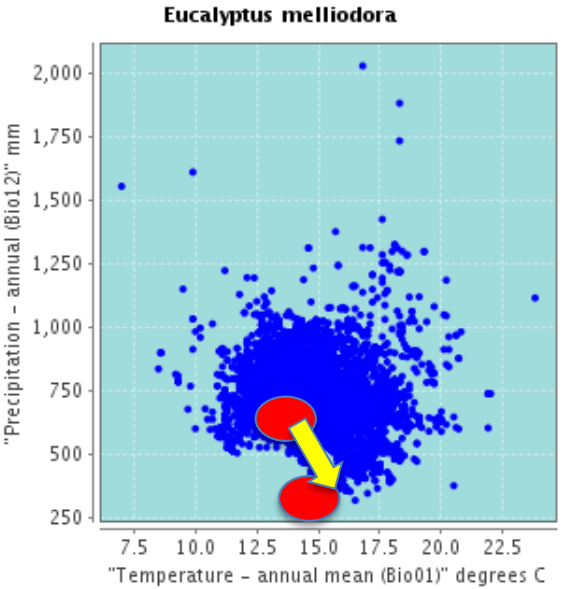


(1) Species ok to plant

Best
Worst
Average



(2) At edge



(3) Uncertain

ALA or nswnichefinder

Eucalyptus blakelyi

Myrtaceae

X-Axis variable:

Annual mean temperature

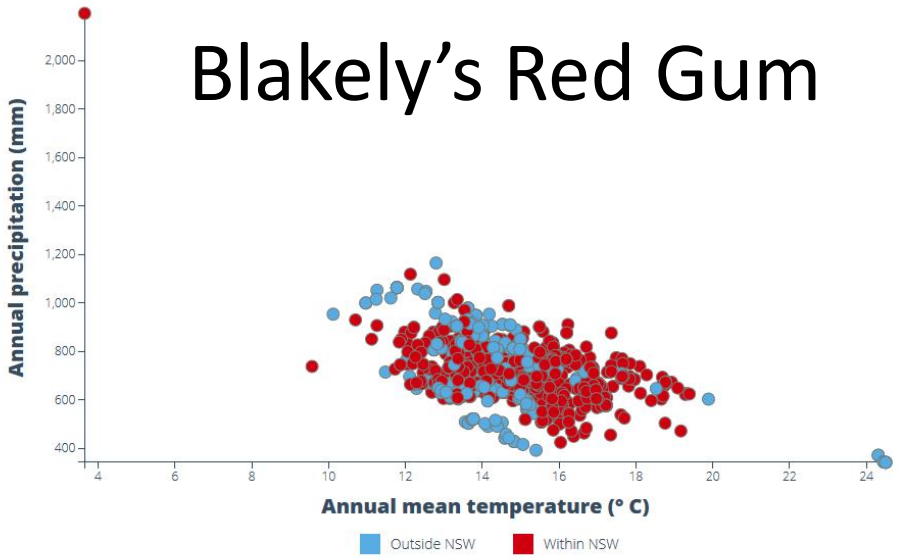
Y-Axis variable (for scatter plot):

Annual precipitation

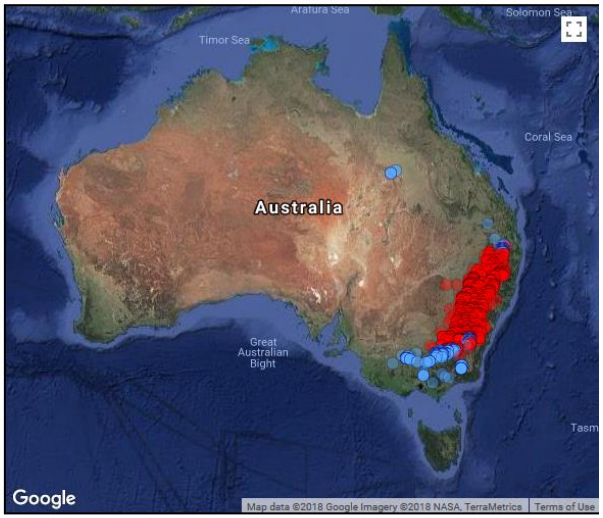
Flip scatterplot axes

Download data as CSV

Return to species profile



Blakely's Red Gum

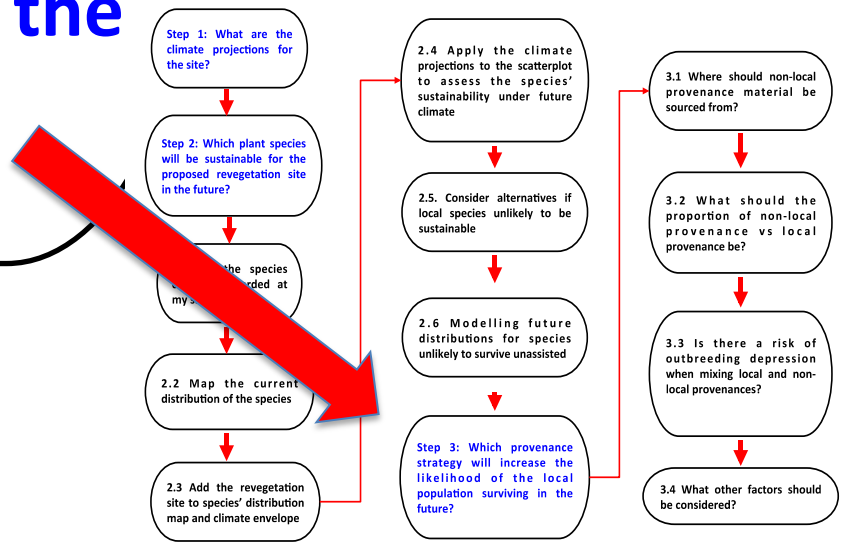


Easy

Cleaned data

No site located

Step 3: Which provenance strategy will increase the likelihood of the local population surviving in the future?



Vulnerability to climate change

- Wide distributions advantaged but survival of local populations not guaranteed
- Other factors e.g.

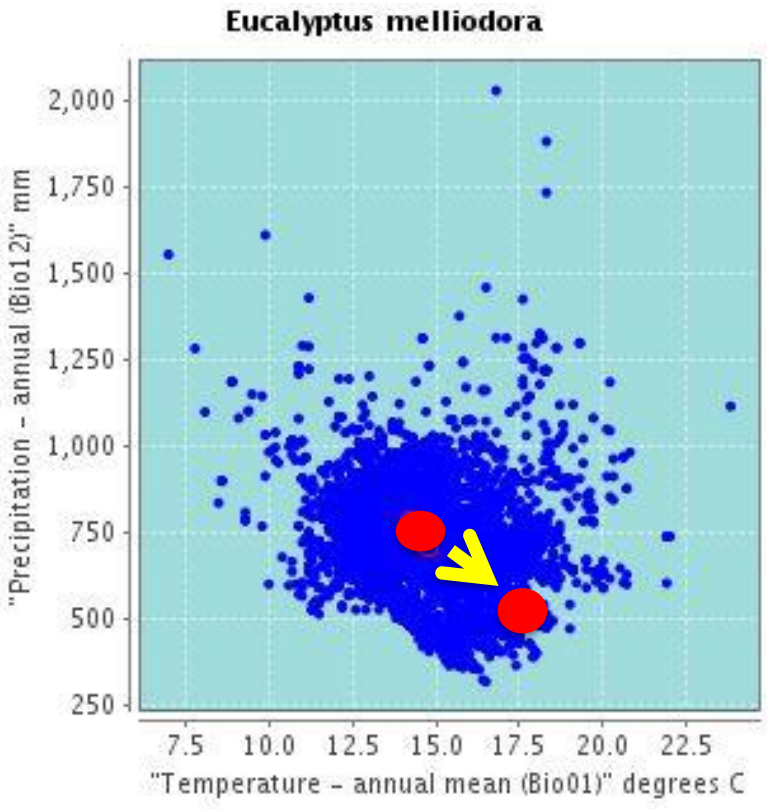
➢ genetic diversity / inbreeding) Unknown

➢ adaptive capacity)

- Use Step 2 process



Local provenance – traditional practice



Reproduced from the Atlas of Living Australia

- Models overstate vulnerability
- Traditional practice
- Local now no longer local in future
- Balance urgency / perfect knowledge
- Consider supplementation with non-local provenance(s)

Provenance strategies:

Traditional ‘local’
and
new strategies

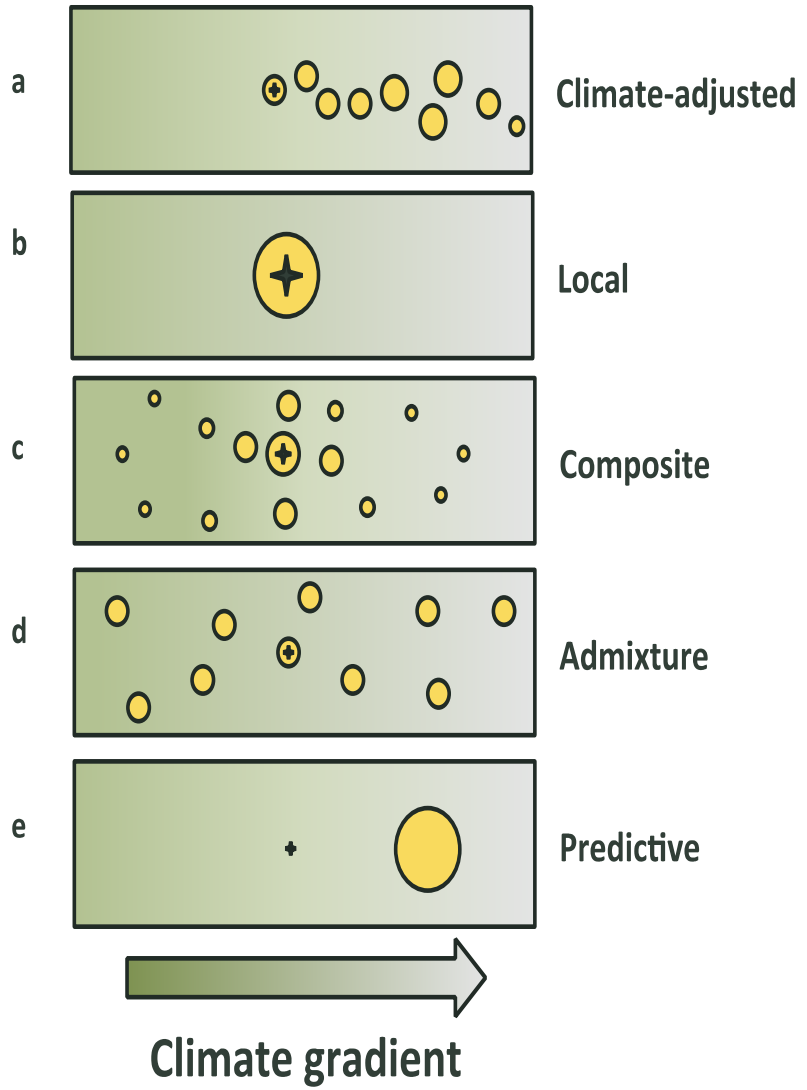


Figure modified from Prober *et.al.* 2015

Provenance strategies: Local

- Seeds sourced within a certain geographical distance to the planting site

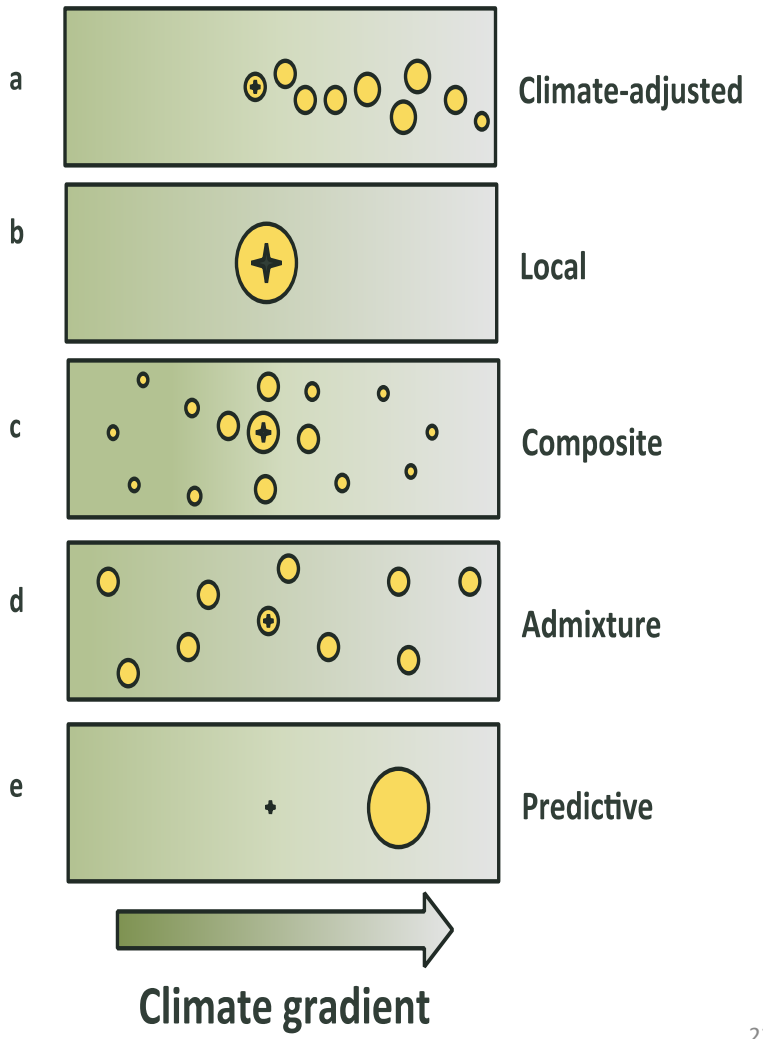
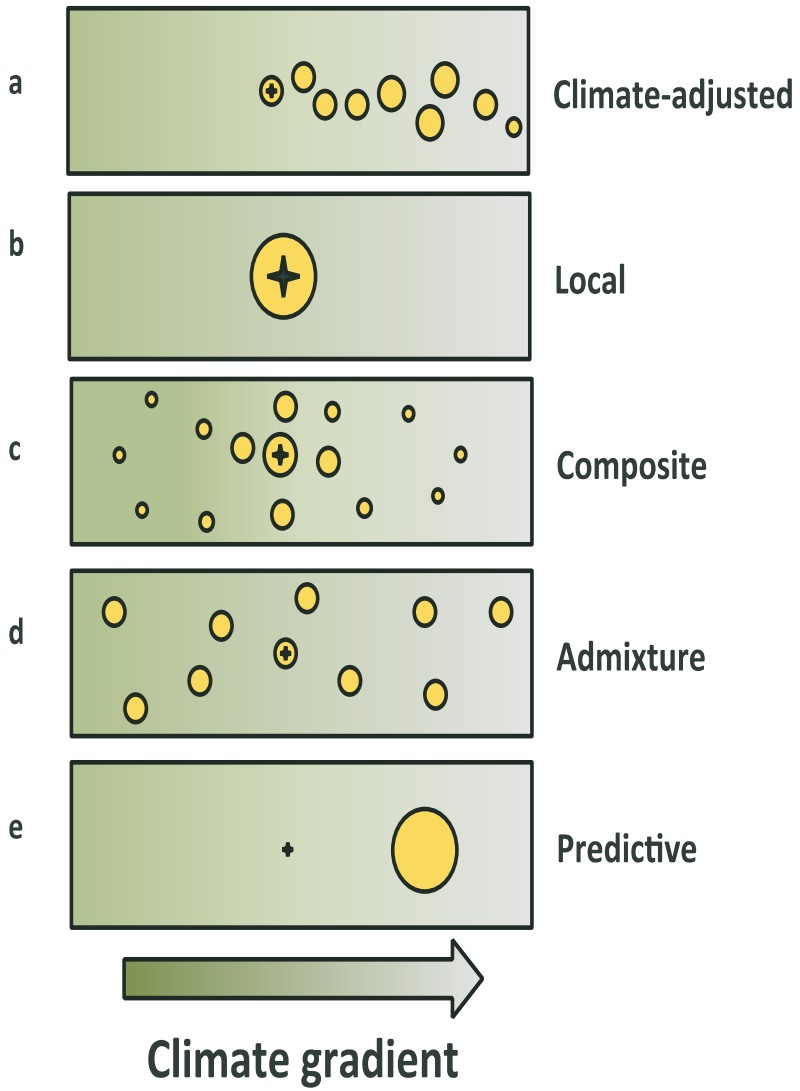


Figure modified from Prober *et.al.* 2015

Provenance strategies: Composite

- Mix a small % of seed from non-local high quality & genetically diverse populations
- Reinstate historical gene flow
- Address potential inbreeding & adaption issues



Broadhurst et al 2008

Figure modified from Prober *et.al.* 2015

Provenance strategies: Admixture

- High uncertainty re scale & rate of change
- Source seeds from wide variety of locations
- Predicted to build evolutionary resilience

Breed et al 2013

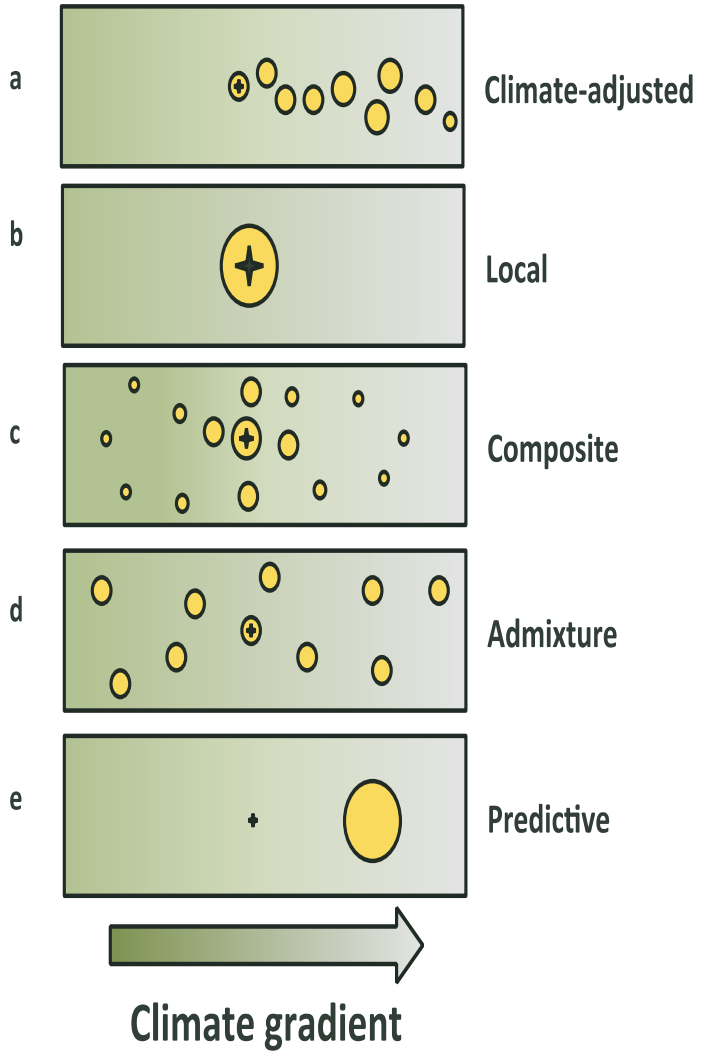


Figure modified from Prober *et.al.* 2015

Provenance strategies: Climate-adjusted

- Promotes resilience in a changing climate
- Seed sourcing biased towards the direction of predicted climate change (but not exclusive)

Prober et al 2015

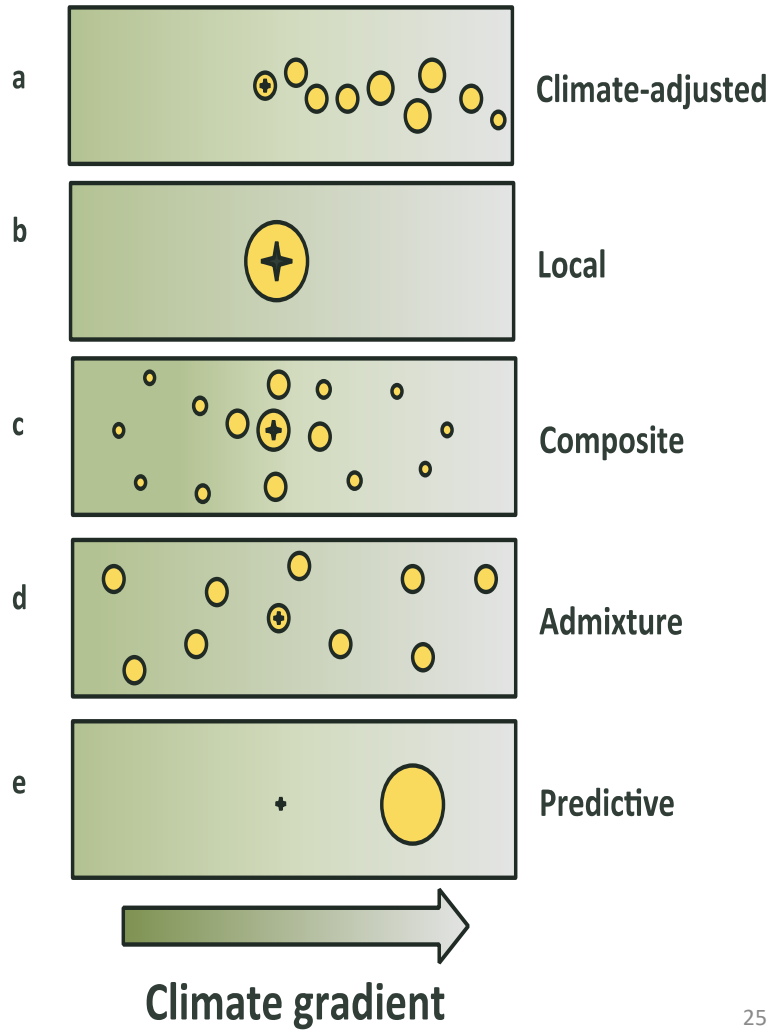


Figure modified from Prober *et.al.* 2015

Provenance strategies: Predictive

- Source seeds solely from location experimentally determined to be the best match for the site
- Doesn't allow for gradual shifts

Crowe & Parker, 2008

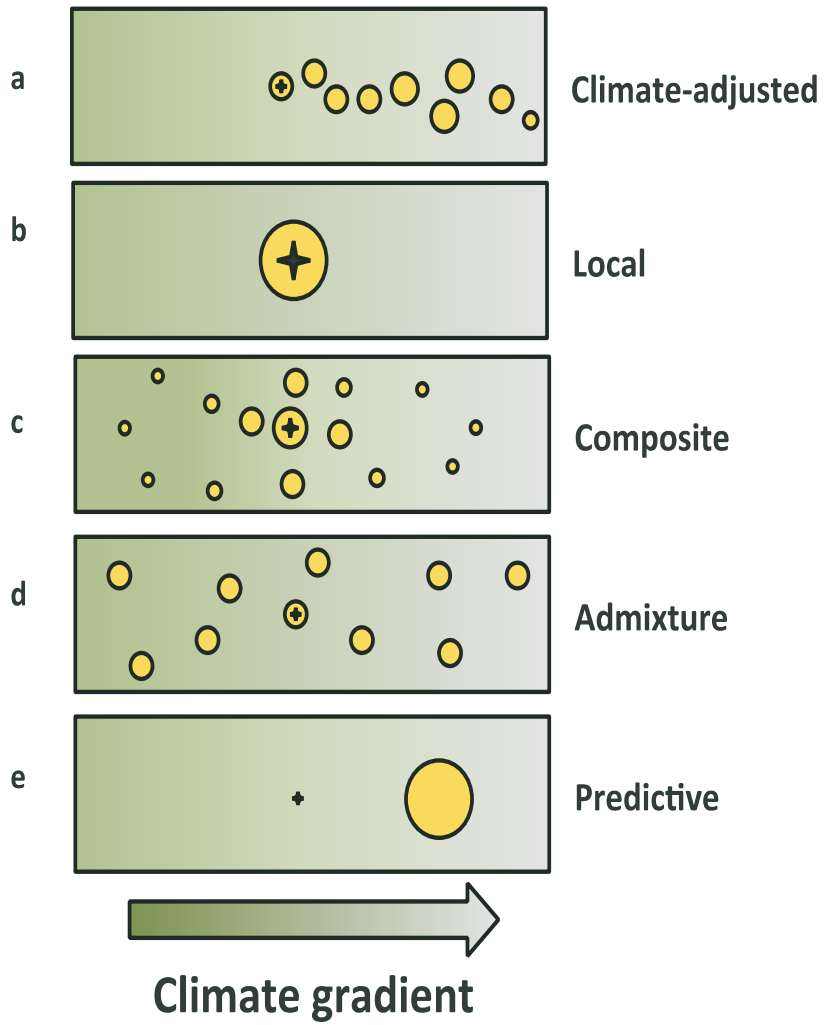


Figure modified from Prober *et.al.* 2015

Strategies for uncertainty

Change is occurring and will continue:

- Decisions effective under a range of possible future climates
- Populations need to be genetically diverse
- Identify / rectify constraints & barriers
- Manage / reduce existing stressors

Thank you

Gunning Landcare; NSW Adaptation Research Hub – Biodiversity Node; Ku-ring-gai Council; ANPC; Trevor Booth, CSIRO; Atlas of Living Australia.

Images: Andy Burton, Nola Hancock, North Sydney Council Bushcare, Hornsby Community Nursery.

Blue Cockatoo. Artist William Burton

Earlier emergence in butterflies

Altered community composition in freshwater macroinvertebrates

Earlier & longer pairing in sleepy lizards

Reduced body size in passerines

Some species are responding *in situ*

Earlier arrival of migratory birds

Increased growth rates

BUT SOME ARE NOT

south west of Western Australia, forest spp dying / changing

Bramble Cay Melomys

2017 heatwave kills ~45,500 flying foxes s.e. Qld

6% of the Gulf of Carpentaria mangrove forest died 2015-16

WA kelp forests before & after dieback 2011

Coral reef bleaching GBR

Images: The Conservation