Overview of approaches to plant conservation for regional botanic gardens

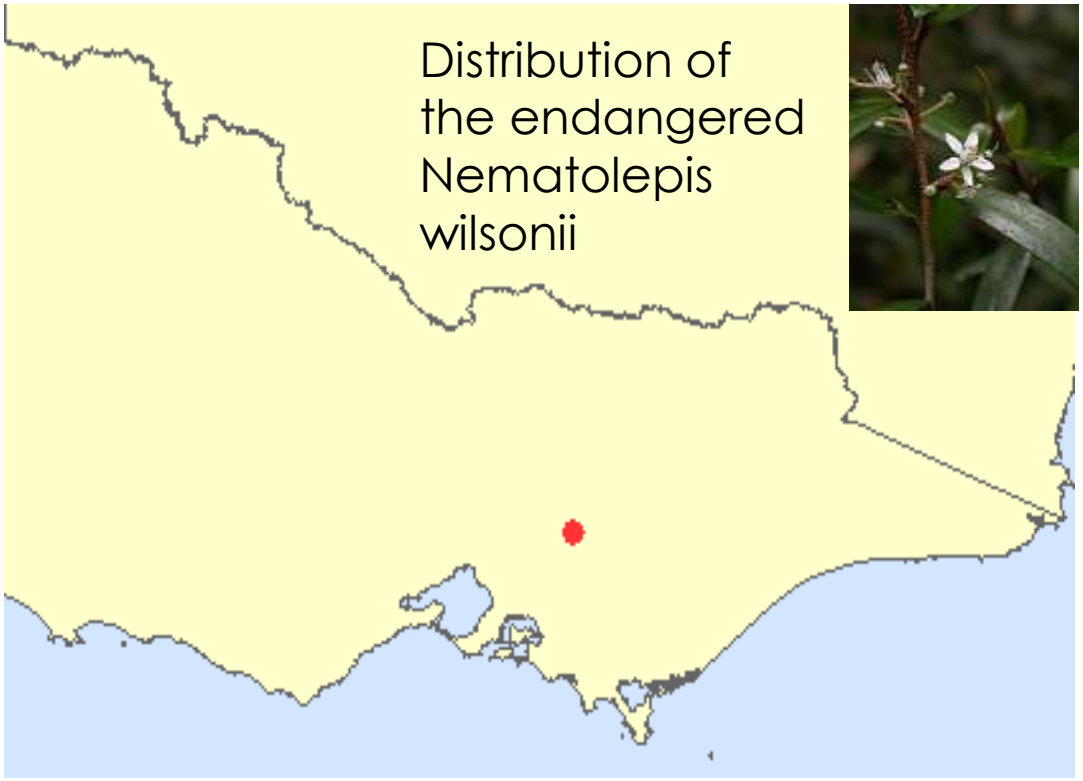
John Arnott – Royal Botanic Gardens Victoria

Overview

- Some definitions
- Victorian regional botanic gardens case studies
- BGANZ Vic – *Care for the Rare* project

Rare plant – classification systems

- ROTAP (Rare or threatened Australian Plants – Briggs & Leigh 1979-1996). Five categories:



Definitions:

- **Endangered: E e –**
- At serious risk of disappearing from the wild within one or two decades if present threats continue

Definitions:

- **Vulnerable: V v –** Not presently endangered but at risk of disappearing from the wild over a longer period (20 – 50 years)

Definitions:

- **Rare: R r –** Rare overall but not considered endangered or vulnerable
- large populations in a restricted area or…
- smaller populations across a wider range
- Limited threats to populations

Definitions:

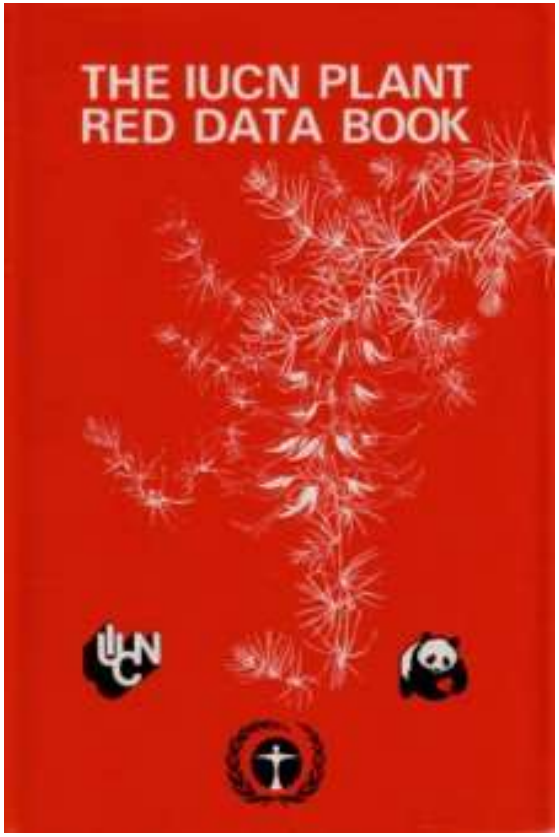
- **Poorly Known K k** – Suspected to have higher conservation status but accurate field distribution information is inadequate

Definitions:

- **Presumed Extinct: X x** – despite thorough searching no records of the plant since 1950

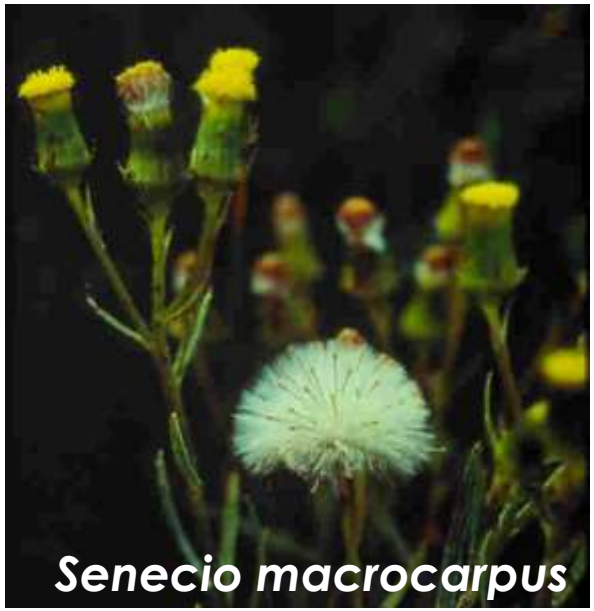
Plant Conservation Status

- IUCN (International Union for the Conservation of Nature 2013). Six categories:
- **Least Concern** (LC);
- **Near Threatened** (NT);
- **Vulnerable** (VU);
- **Endangered** (EN);
- **Critically Endangered** (CR);
- **Extinct in wild** (XW);



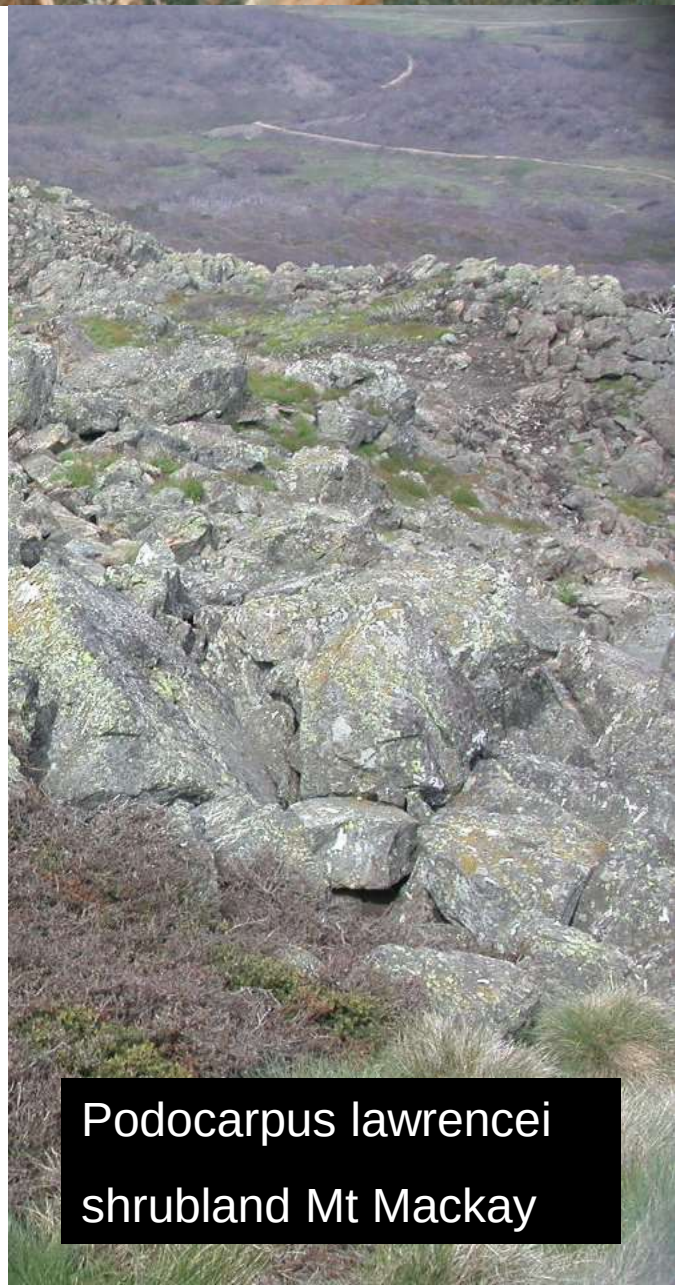
Victoria's rare plant 'score card'

- Extinct (x): 43 (0.9%)
- Endangered (e): 280 (5.8%)
- Vulnerable (v): 447 (9.2%)
- Rare (r) : 704 (14.6%)
- Poorly known (k) 168 (3.5%)
- **34% of the states flora** with conservation significance
- Walsh & Stajsic



Why plants are rare

- Land modification – habitat loss
- Edge of range
- Disjunct occurrences
- Specialised environments
- Taxonomy
- **Climate Change**
- *Neville Walsh will cover this in much more detail tomorrow*



Podocarpus lawrencei shrubland Mt Mackay

- Over geological timeframes climate (and associated flora's) have been extraordinarily dynamic
- Fossil evidence of over **40 different groups of seed plants** – in todays modern flora there are **5**!

Nothofagus and Coymbia fossil 45MYA

Wilson Botanic Park Berwick

Angiosperms
Conifers
Gneophytes (*Ephedra*, *Welwitschia*)
Cycads
Ginkgo

- So **climate** is **dynamic** and in response…**entire floras** are also **dynamic**
- Plants adapt, evolve… proliferate, decline become extinct etc
- The issue at hand is about the pace of climate change…

*Banksia margina (*Black Mt, Victoria) a co-dominant shrub in the 1980's…today it almost completely absent

- **Meg Hirst: climate change adaptation research – Melb Uni/RBG Victoria**
- Worked on a significant number of Brachyscome spp.
- Water deficit and warmer growing media *(simulating different selection pressures)*
- Observed traits such as predation/penology/growth and survivorship
- A number of species were highly adaptive…others not

- Calperum Station/Chowilla – Mid 1990's
- Observed thousands of Euc. seedlings - a hybrid of *Eucalyptus largiflorens* x *gracilis* growing on salt- and drought affected floodplains
- Evolution before our eyes!

- Climate change as a threatening process - *Abrotanella nivigena - Asteraceae*

A canary in a coal mine!

Is there a role for regional gardens in plant conservation?

- **34% of the state flora with conservation significance - Yes!**
- A range of approaches, techniques, and opportunities exist

Plant Conservation

Two main groups of plants associated with plant conservation collections in botanic gardens

Garden Plant Conservation
(Cultivated Plants)

Species Conservation
(Wild Plants)

Anigozanthus hybrid

Prostanthera lasianthos var. *subcoriacea*

Garden Plant Conservation

- The conservation of cultivated plant material
- *Ornamental Collections*

  (including species and varieties that may...or may not have formal conservation status in the wild)

Species Conservation

- The conservation of plants with conservation significance *in the wild*
- Rare and Threatened species

Conservation Strategies

- ***Integrated Plant Conservation***
- "The setting of plant conservation targets, using a range of methods and techniques to achieve these targets"

- 1991Don Falk Centre Australian Network for Plant Conservation Conference, "Protective Custody?"

Integrated Plant Conservation

- A multidisciplinary approach
- Four key components
- ***In situ*** conservation
- ***Ex situ*** conservation
- **Research**
- **Community education**

In situ conservation

- The conservation and maintenance of plants **in the wild**…in their natural habitat
- **Habitat protection** - (minimising threatening processes)
- **Translocation** – (actively increasing population size/s)
- **Recovery Programs**

RBGV Senior Conservation Botanist Neville Walsh

Ex situ conservation

- The conservation and maintenance of plants **outside their natural habitat**….
- In the form of **whole plants, seed**, pollen, vegetative propagules, tissue or cell cultures.

adapted from
http://www.bgci.org/ourwork/ex_situ/

Ex situ conservation programs

- Are the most likely programs for regional gardens involvement
- Conservation through cultivation!

- ***Ex situ* conservation**

- Conservation collections and displays
- Indigenous gardens
- Rare plant propagation programs
- Seed production
- Seed storage

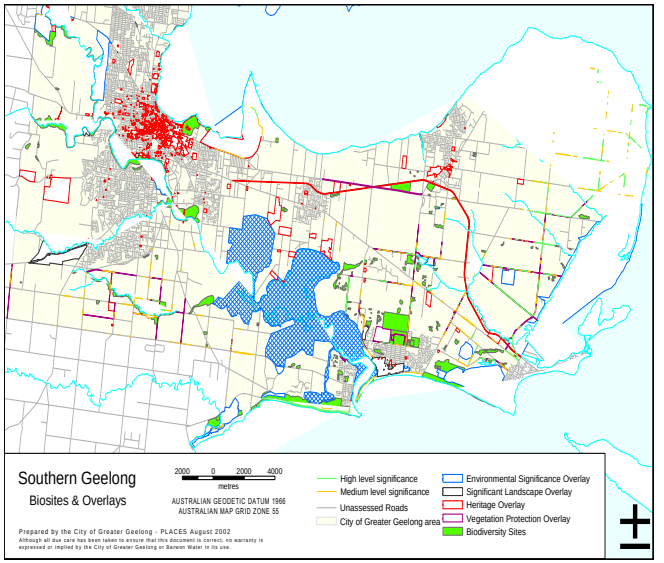
- Horticultural Research
- Monitoring and understanding plant tolerances
- Plant rescues
- Production for reintroduction or translocation programs

Ex situ Case Study One: GBG

- Conservation programs facilitated through collaborations

Geelong Botanic Gardens

- 2000 Biodiversity Study *Carr et al*
- Mapped and documented remnant indigenous vegetation
- 1804 plant taxa recorded
- 62% indigenous species (1119) 32% of the Vic flora



Geelong Botanic Gardens

- Biodiversity Study
- 42 EVC's (plant communities)
- < 10% Cover of indigenous vegetation
- Numerous species of conservation significance – local – state - national

Geranium carolinii

Geelong Botanic Gardens

- 21st Century Garden *emphasis* on indigenous plant displays
- 21st CG aims: to capture the **diversity and horticultural potential** of the regions flora
- Display some of the regions **threatened plant** species

Geelong Botanic Gardens

- A number of "collections"
- Local coastal plants
- Brisbane Ranges
- Anglesea Heathlands
- Buckley's Falls
- Threatened plant species display
- Mayfield collection

Threatened species bed GBG

Conservation through association

- Very few of the plants (in the conservation collection) were wild collected by GBG staff
- Utilised the network of indigenous plant growers, individuals and community groups

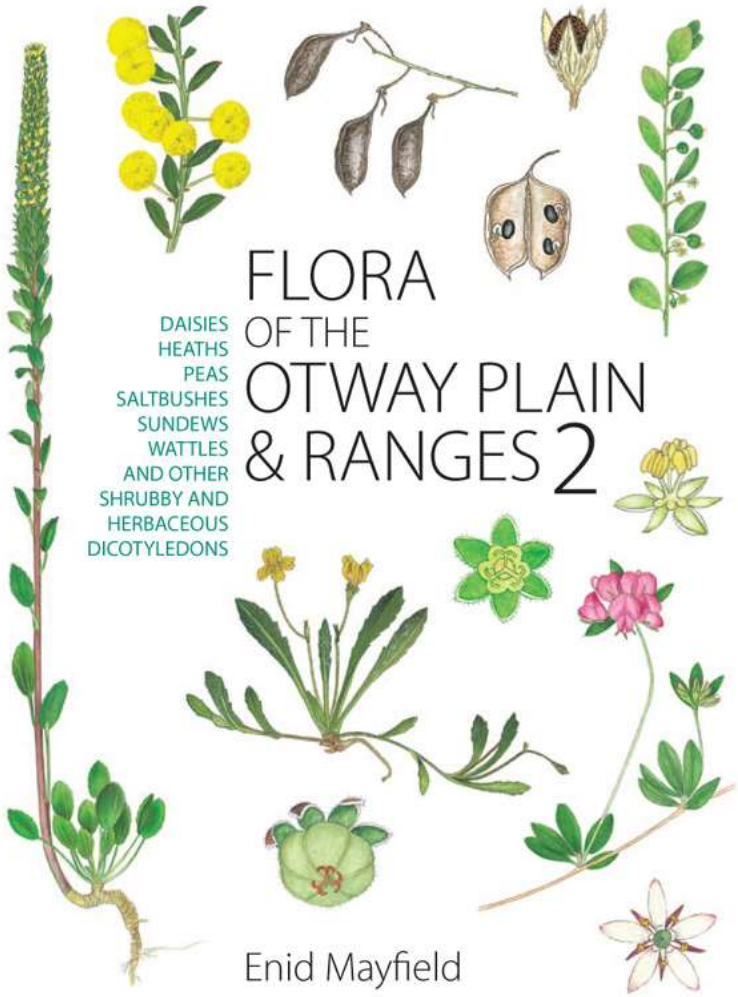
Enid Mayfield and Piet Vorster

Mayfield Collection

Wildflowers of the Otway Plain and Ranges

Established a reference collection at the GBG in support of Enid's work

Some of that material made available to living collection



Seed Production

- Grassy Ground Cover Research Project (2005)
- Established a conservation seed orchard in support of his project
- Assisted with seed collection in the field

Seed Production

- GBG with Greening Australia developing a major (in ground) seed orchard in GBG annexe
- Focus on plains species and a number of R&T species
- Production for restoration – revegetation – reintroductions and translocation

Conservation seed orchard – Goolwa - SA

Little River Earth Sanctuary

- Reintroduction of 4 threatened grassland species
- GBG approached to propagate seedlings for a reintroduction project
- Conservation partnership

News

theonline.com.au

Threatened species get back home

By Christine Aubert

'These flora species were so tasty to sheep and rabbits that they've literally been eaten to death.'

Neville Scarlett

Eastern Park

- COGG Continuing to manage the remnant indigenous vegetation
- Managing threatening processes – Chilean needle grass eradication
- A number of R&T species

Dianella perfragrans – Eastern Park Geelong

GBG Approach

- A “horticultural” approach – ‘conservation through cultivation’
- Conservation through partnerships and associations
- Tapping into existing environmental and conservation networks

Case Study 2 – Colac BG

- Colac Otway Shire
- Otway *ranges* and *plains* bioregions
- Showcasing 2 "habitat" gardens
- Displaying a number of VROT's

Colac Botanic Gardens

- Heathland Bed

Leucopogon ericoides

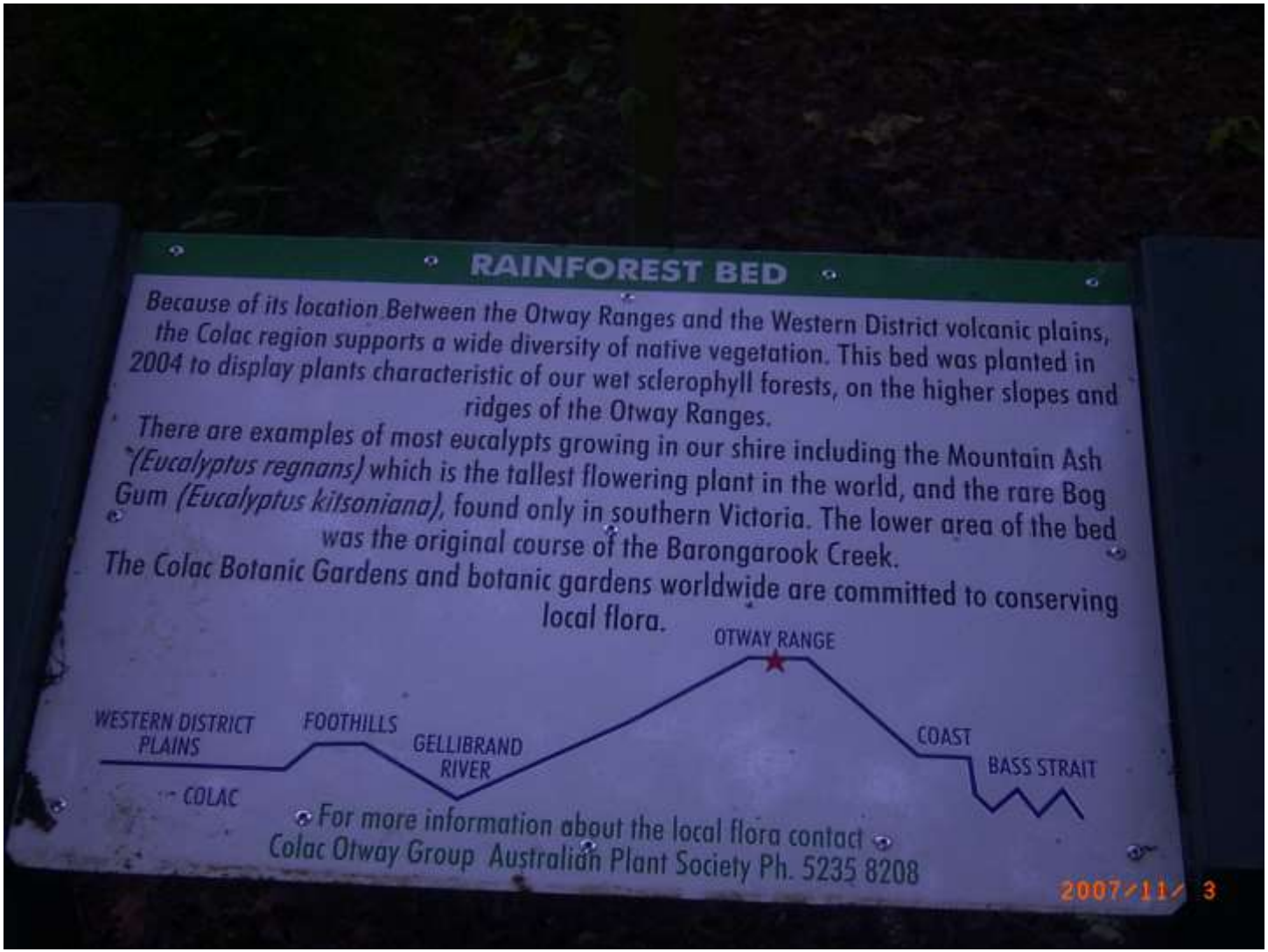
Acacia verticillata

Xanthorrhoea australis

Colac Botanic Gardens

Royal Botanic Gardens Cranbourne

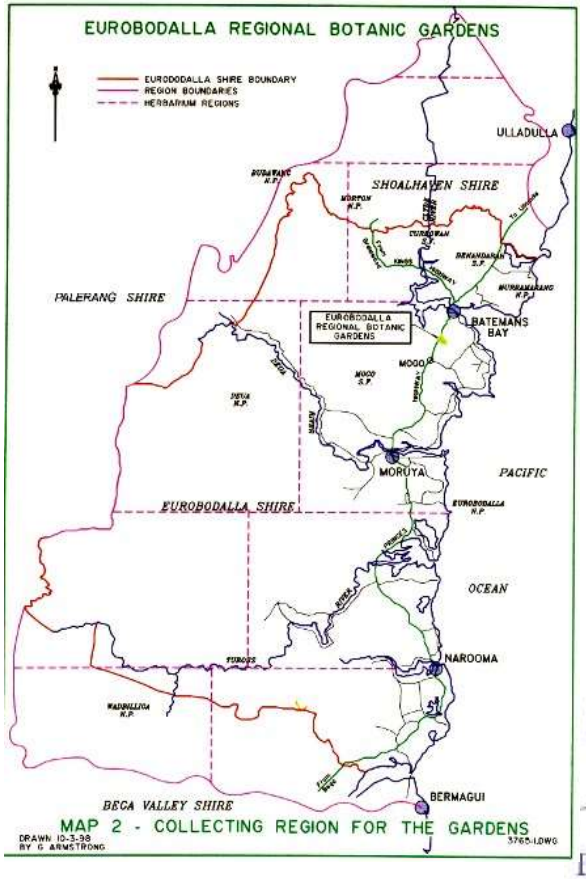
Colac Botanic Gardens



Royal Botanic Gardens Cranbourne

Case Study 3 – Eurobodalla Regional Botanic Garden

- Batemans Bay NSW
- 42 hectares
- 3 permanent staff - over 100 volunteers
- Focus on the regional flora - Clyde, the Deua and the Turos catchments
- 2500 species in catchment



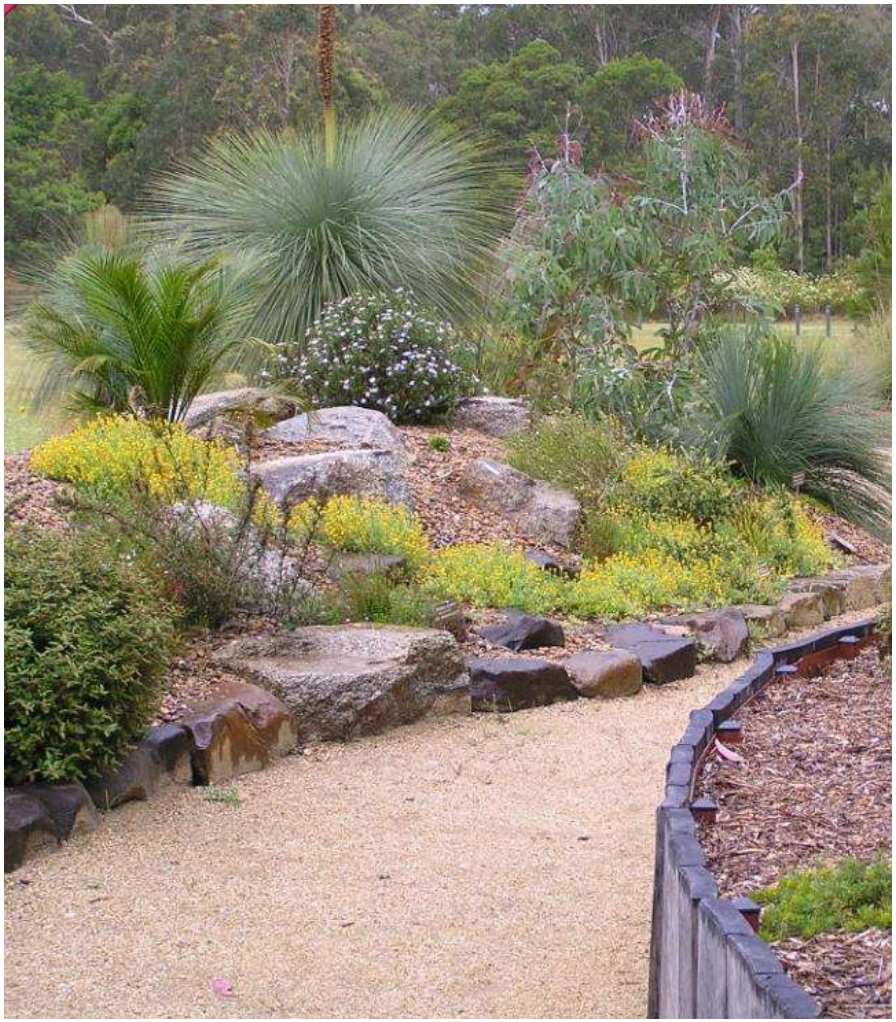
Royal Botanic Gardens Cranbourne

Eurobodalla

- Exclusively an indigenous plant garden
- Three “types” of collections
- Living Collection
- Herbarium Collection
- Seed Store

Eurobodalla

- **Living Collections**
- Horticultural collections
- Ecological collections – “habitat” gardens



Eurobodalla

- **Herbarium collections**
- A “unique” element
- Staffed by volunteers
- Focus on distribution of species within the region
- Vouchering threatened flora of the region

Eurobodalla

- Herbarium holds;
- 12619 + Specimens,
- 168 Families,
- 716 Genera,
- 1741 Species,
- 197 Fungi
- Wild origin plants with accurate provenance data

Eurobodalla

- Recently established a regional conservation seed store

Case Study 4 – Melton Botanic Gardens

Melton BG

…a combination of horticulture (living collections) and active landscape management (restoration and revegetation)

Photo herald sun

Ryans Creek

Volcanic Grassy Creekline

Creekers

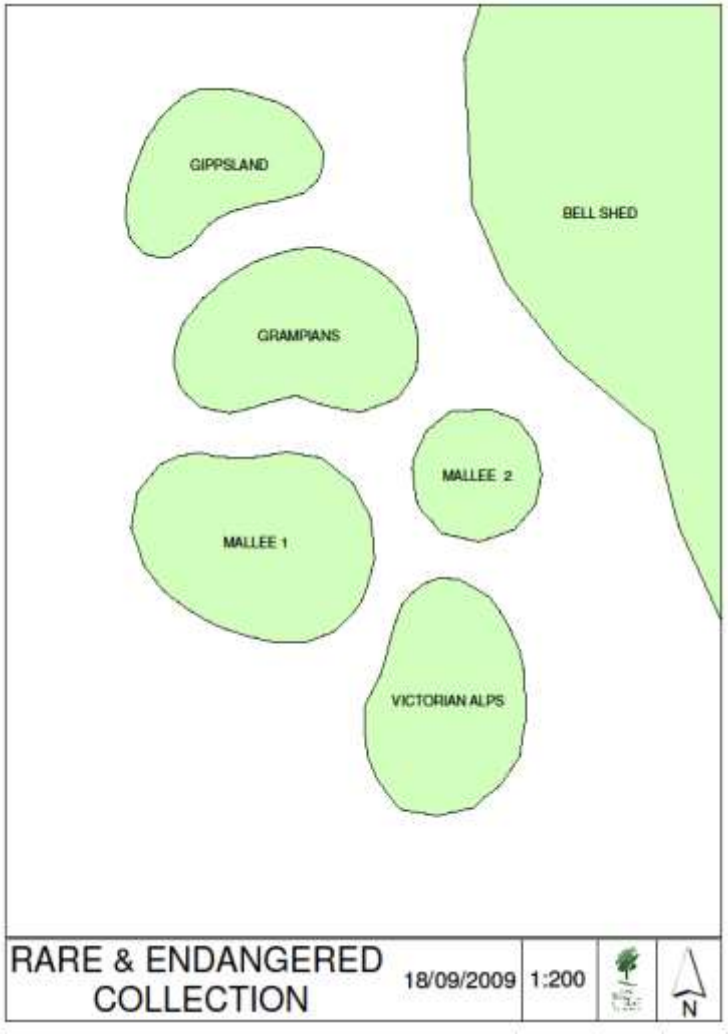
Lake Project

Lakers


Koori Student
Garden

Case Study 5 - RBG Victoria

- Rare and Threatened Collection
- Established 2008/9
- A bioregional approach
- Alps, Grasslands, Grampians, Mallee and Eastern Ranges



RBG Victoria

- Ran in parallel with the Victorian Conservation Seedbank and Millennium Seed bank project
- Global conservation program
- Numerous field trips
- Emphasis on wild collected material

Millennium Seedbank – Wakehusrt Place

RBG Victoria

- Valuable resource for the network – Over 200 species
- Opportunities for material to be made available to the network
- Opportunities for involvement in collecting trips

RBG Victoria

- Draws together the common elements of all case studies
- Display garden
- Linked to education and interpretation
- Horticultural approach
- A “partnership” project

Integrated Conservation Case Study

- *Nematolepis wilsonii* — Shiny Nematolepis Recovery Project
- Restricted to a known single population ~ 80k Melbourne CBD

Nematolepis wilsonii

- Active RBGV involvement in species recovery plan/s
- Threatening processes – Sambar Deer & ringbarking
- Weeds

Nematolepis wilsonii

- Entire known population burnt out on black saturday (Feb '09)
- Possibility of natural post-fire regeneration - *uncertain*
- Hot fire - A horizon (surface/organic soil layer) affected

Nematolepis wilsonii

- A target species for the Victorian Conservation Seed Bank
- 18,000 seeds "in store"
- RBG Melb established prop protocols (seeds and cuttings)
- An ex *situ* population established @RBG

Cranbourne Gardens Nursery

Nematolepis wilsonii

- Plants for RBG Nursery translocated back into the wild in April 2009
- Regeneration did occur
- There was a “backup” In the absence of natural regeneration

Garden Plant Conservation

- Conservation of cultivated plants
- A relevant means of participating in plant conservation activities for regional gardens
- Many opportunities for regional gardens to participate


Telopea collection
Karwarra gardens


Boronia collection
Karwarra gardens

Garden Plant Conservation

- Formally facilitated though OPCAA –

  GPCAA = Garden Plants Conservation Association of Australia

  = Plant Trust Australia

GARDEN PLANT CONSERVATION ASSOCIATION OF AUSTRALIA

Garden Plant Conservation

- Exactly the same principles as ex situ species conservation
- Conservation through cultivation
- Focus on cultivated plants

GPC – BGANZ Collaboration

- Working on duplicating existing GPC collections into public gardens

Correa collection (Katandra)

- Correa collection (Katandra)
- Superb collection of Correa
- Katandra sold
- Duplicated at Maranoa/ Karwarra and the GBG

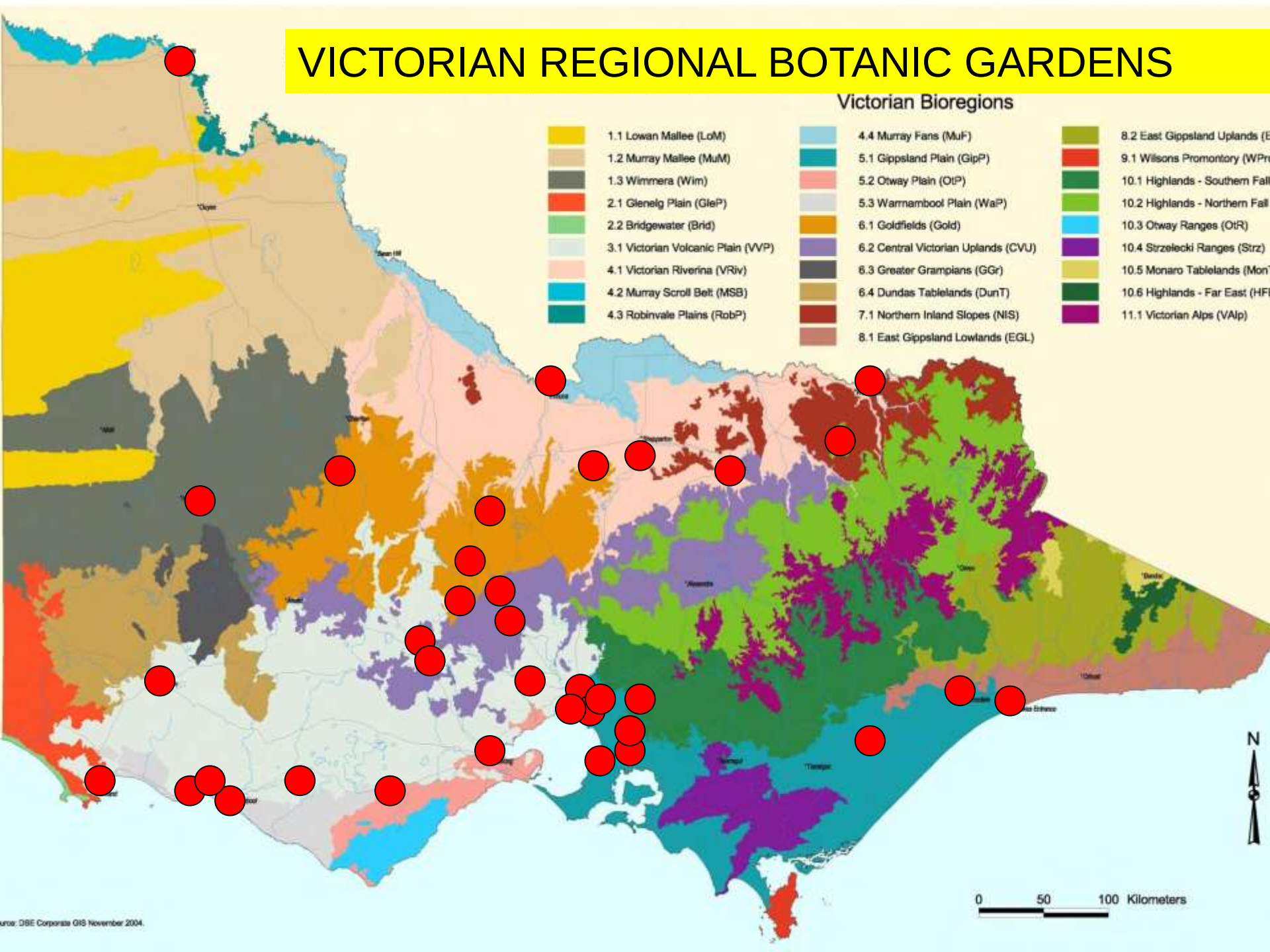
GPC – BGANZ Opportunities

- Many regional botanic gardens have limited access to a diverse range of plant material/s
- Most GPC Collections have no “back up” (risk of loss of valuable living collections)
- Opportunities to link GPC collectors with regional gardens

Care for the rare – BGANZ Vic project

- BGANZ Vic initiative
- Establish a multi site conservation collection of Victorian R&T plants
- Working group established in 2015
- Project scope and plan prepared

VICTORIAN REGIONAL BOTANIC GARDENS



Care for the rare – BGANZ Vic project

- Four staged project
- Stage One: Assessment of the Victorian threatened flora for inclusion in the project

Care for the rare – BGANZ Vic project

- Stage Two: Seek expressions of interest from regional botanic gardens to participate in the program
- Undertake an assessment of the capacity for individual gardens to participate

Care for the rare – BGANZ Vic project

- Stage Three: the development of living collections plans for each participating garden
- Include interpretation planning as a topic in Novembers plants forum

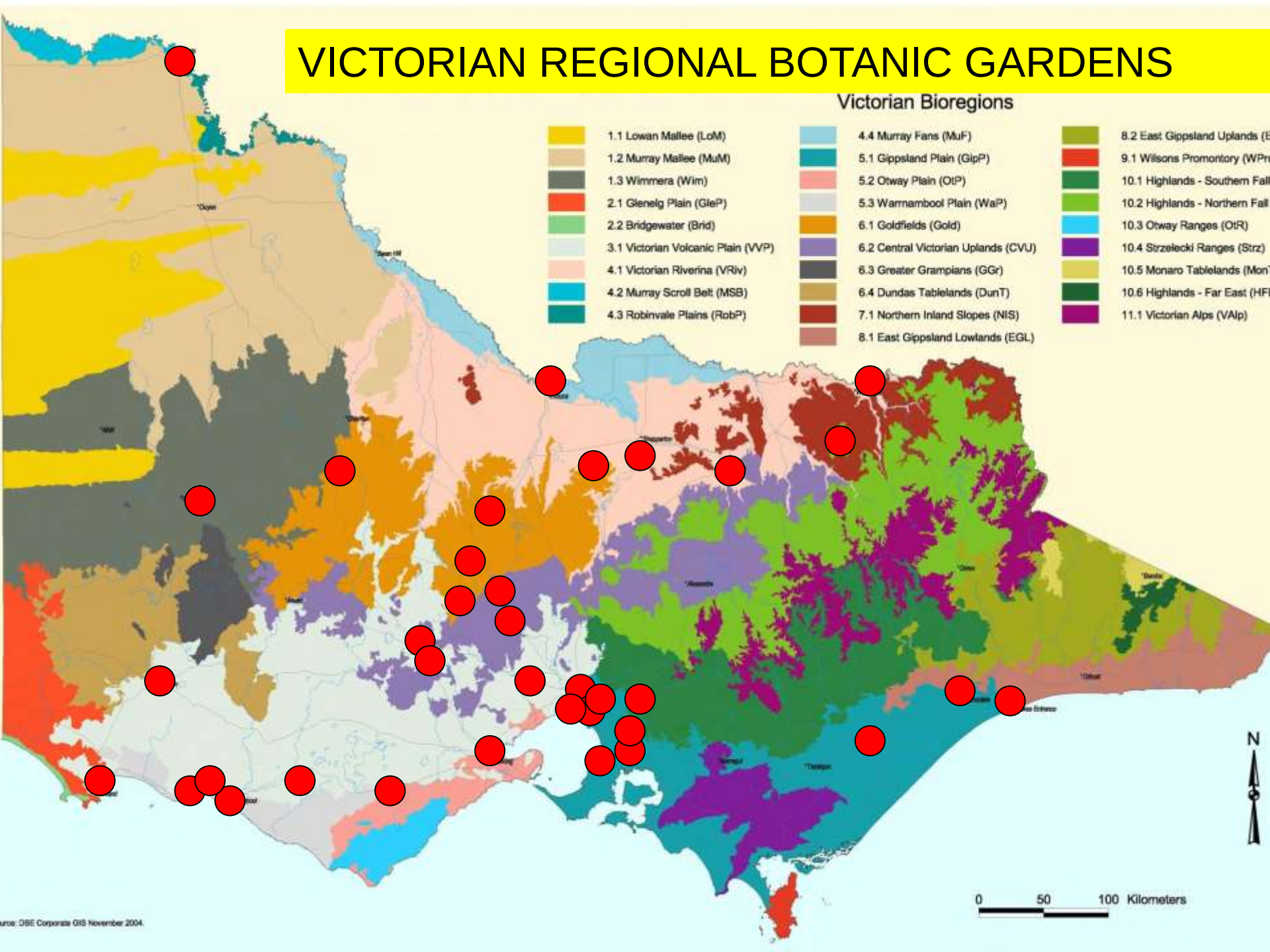
Care for the rare – BGANZ Vic project

- Stage Four: Seek funding support to undertake propagation and production of plants

Care for the rare – BGANZ Vic project

- Stage Five: Distribution of plant material to regional botanic gardens

VICTORIAN REGIONAL BOTANIC GARDENS



Landscape Succession Planning

A term we need to start to adopt beyond tree planting - Melbourne Gardens Landscape Succession Strategy was launched recently

Projected Climate

UN Climate Conference | Weather | Climate Change | Whale Watch | Animals | Conservation

You are here: Home » Environment » Climate Change »

'True shocker': February spike in global temperatures stuns scientists

March 14, 2016

29 reading now

Projected Climate

Increases in mean daily maximum and minimum temperatures; hotter and more frequent hot days	Very high confidence	Changes to optimum temperature ranges for plant species and the likely loss of diversity
		Increased impacts on visitor health and comfort
		Increased energy consumption for cooling
		Loss of employee productivity from excessively hot days
		Increased evapotranspiration and subsequent water use

Projected Climate

Increased evaporation rates with largest rate of increase in summer	**High confidence**	**Increased evapotranspiration and subsequent water use**
		Increased draw down in lake levels over summer
Increased solar radiation and reduced relative humidity in winter and spring	High confidence	Increased evapotranspiration and subsequent water use
		Increased proportion of irrigation water use in winter- spring

Projected Climate

Increased intensity of heavy rainfall	High confidence	Possible increases in opportunistic use of stormwater volumes
		Reduced efficiency of wetland treatment increased suspended solids and nutrient loadings
		More flooding and breakages of infrastructure
		Increased risk of soil erosion
		Storm surges and risk of saltwater intrusion from Yarra River

Projected Climate

Frequency and duration of extreme droughts	Medium confidence	Possible increases in Increase salinity of lake storages
		Increase use of potable sourced water
		Possible environmental flow restrictions on use of rainfall dependant water supplies (or similar)

Projected Climate

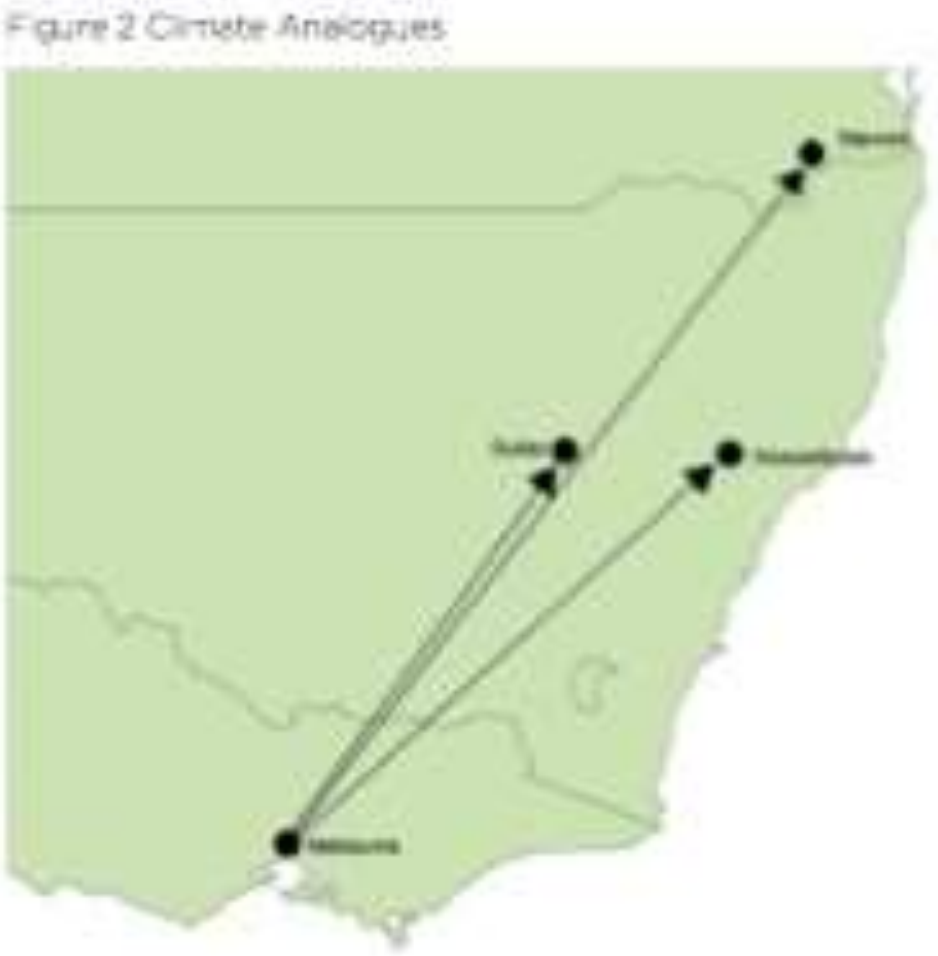
Increased intensity of heavy rainfall*	High confidence	• Possible increases in opportunistic use of stormwater volumes • Reduced efficiency of wetland treatment – increased suspended solids and nutrient loadings • More flooding and blockages of infrastructure • Increased risk of soil erosion • Storm surges and subsequent risk of saltwater intrusion from Yarra River.
Higher sea levels and more frequent sea-level extremes	Very high confidence	• Increased storm surges and risk of saltwater intrusion into Melbourne Gardens freshwater lake system; possible loss of freshwater biodiversity.
Frequency and duration of extreme droughts	Medium confidence	• Increased salinity of lake storages • Increased risk of extended cyanobacterial blooms • Increased use of potable-sourced water. • Possible environmental flow restrictions on use of rainfall-dependent water supplies (or similar).

Melbourne's Future Climate - Predictions

- *3 likely scenarios for matched climate*
- *Dubbo in NSW*
- *Muswellbrook* in *NSW*
- *Warrick in QLD*

- *Climate analog information*

www.climatechangeinaustralia.gov.au/en/climate-projections/



- The Landscape Succession Strategy guides the transition from existing plantings to a composition more suited to the projected climate and environmental conditions of 2090, while retaining the Gardens' heritage character, landscape qualities and species diversity for future generations.

RBGV Landscape Succession

The task - maintain the Gardens' heritage character while transitioning the landscape using a different palette of climate-suited plant species.

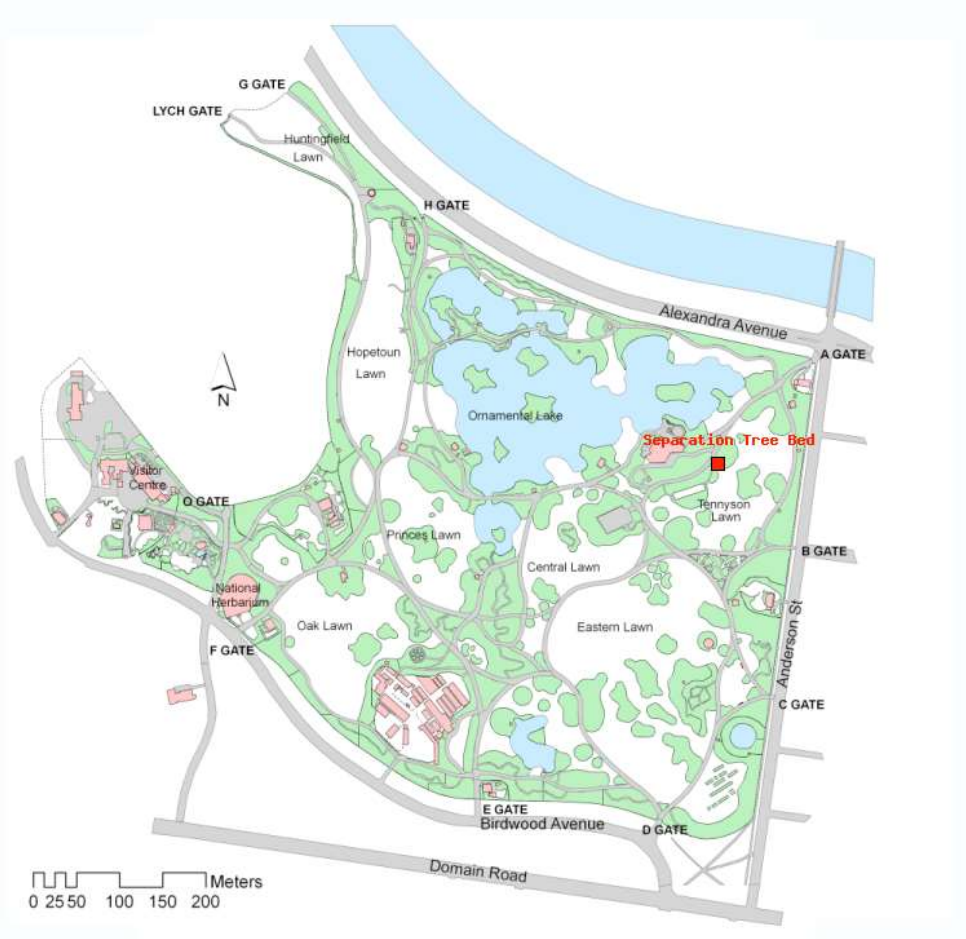
This is an opportunity to replace susceptible plant species with alternatives that possess the necessary resilience to thrive in a future climate. .

RBGV Landscape Succession

Strategy 1: Actively manage and transition the Melbourne Gardens landscape and plant collections
Target: By 2036, 75% of taxa in the Gardens are suited to the projected climate of 2090.

RBGV Landscape Succession

Strategy 2: Establish a mixed-age selection of plants composed of a diversity of taxa Target: By 2036, plant diversity is equal to or greater than 8,400 distinct taxa of mixed-age with greater than 35% wild provenance-sourced plants.

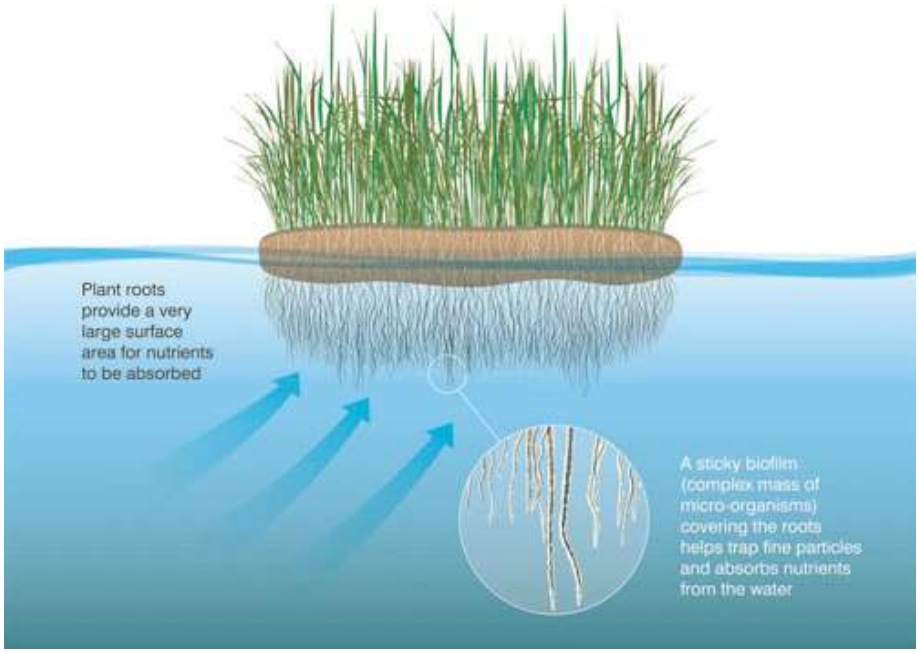


RBGV Landscape Succession

Strategy 3: Maximise sustainable water availability and use Target: By 2020, 100% of landscape irrigation needs are provided by sustainable water sources.

RBGV Landscape Succession

Strategy 4: Maximise the benefits of the green space and built environment through landscape design Target: Improve green and built infrastructure capable of mitigating and withstanding predicted climatic extremes.

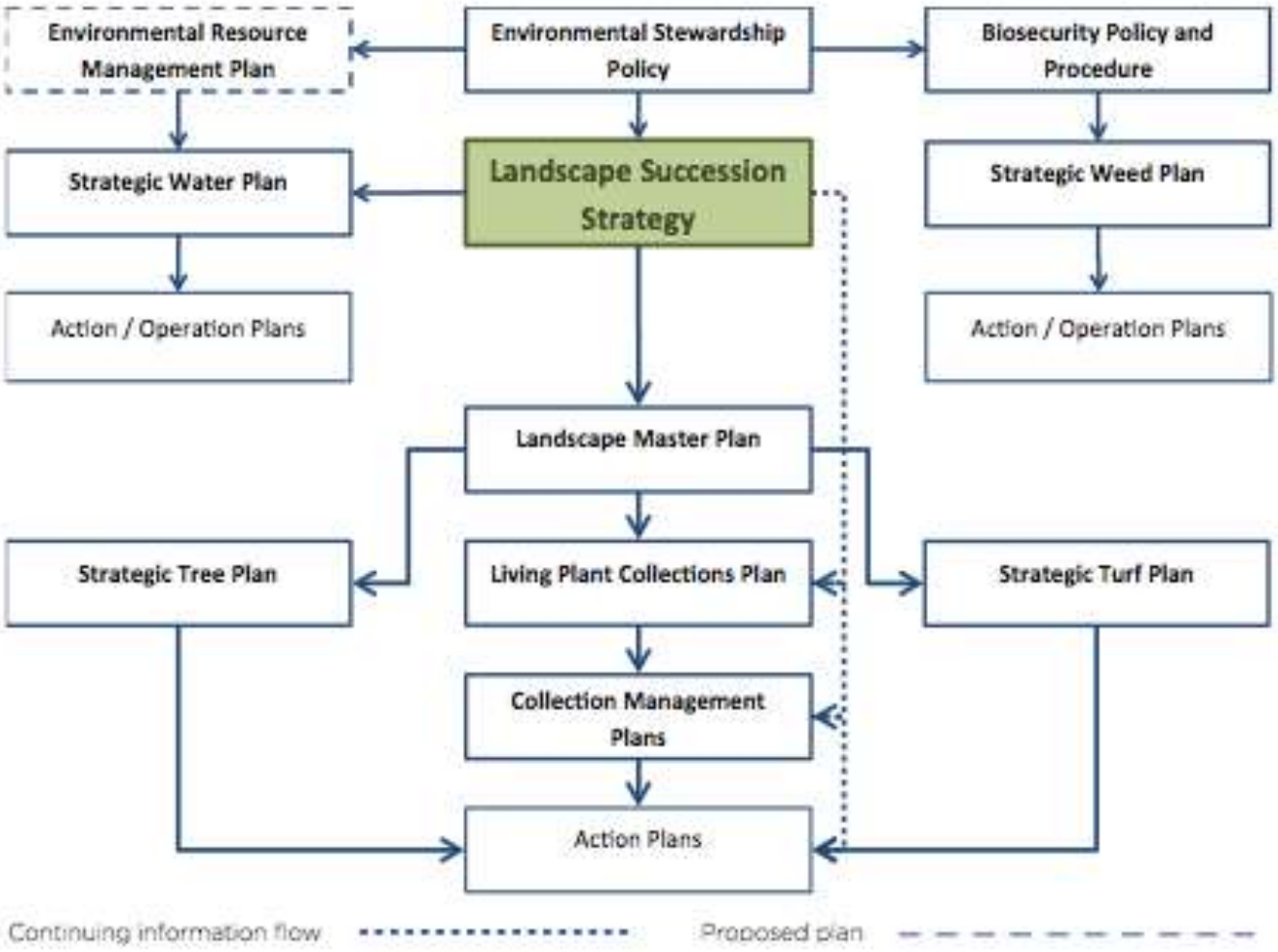


RBGV Landscape Succession

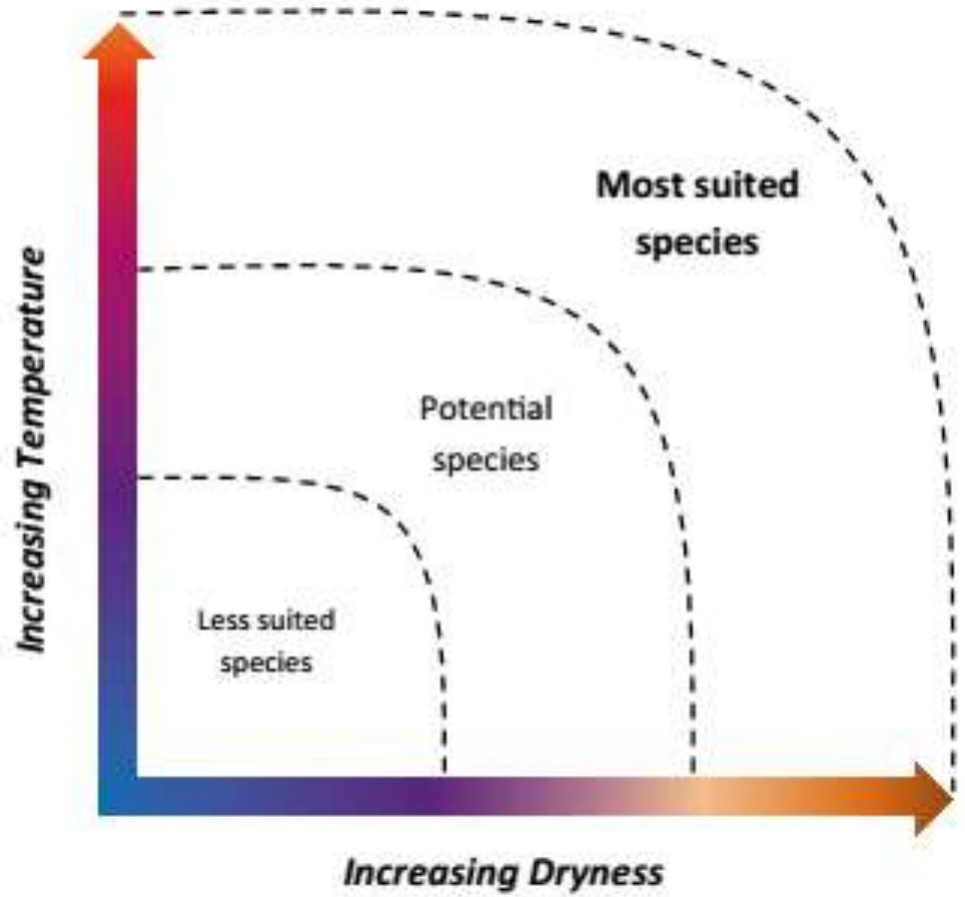
Strategy 5: Improve understanding of the impacts of climate change on botanical landscapes Target: Effectively communicate with the botanical and general community on the interactions between climate change, green spaces and plant benefits.

RBGV Landscape Succession

The How!


Environmental Resource Management Plan
Environmental Stewardship Policy
Biosecurity Policy and Procedure
Strategic Water Plan
Landscape Succession Strategy
Strategic Weed Plan
Action / Operation Plans
Action / Operation Plans
Landscape Master Plan
Strategic Tree Plan
Living Plant Collections Plan
Strategic Turf Plan
Collection Management Plans
Action Plans
Continuing information flow
Proposed plan

RBGV Landscape Succession



Climate matching

Two main ways – One based on climate modeling and looking for analogs….

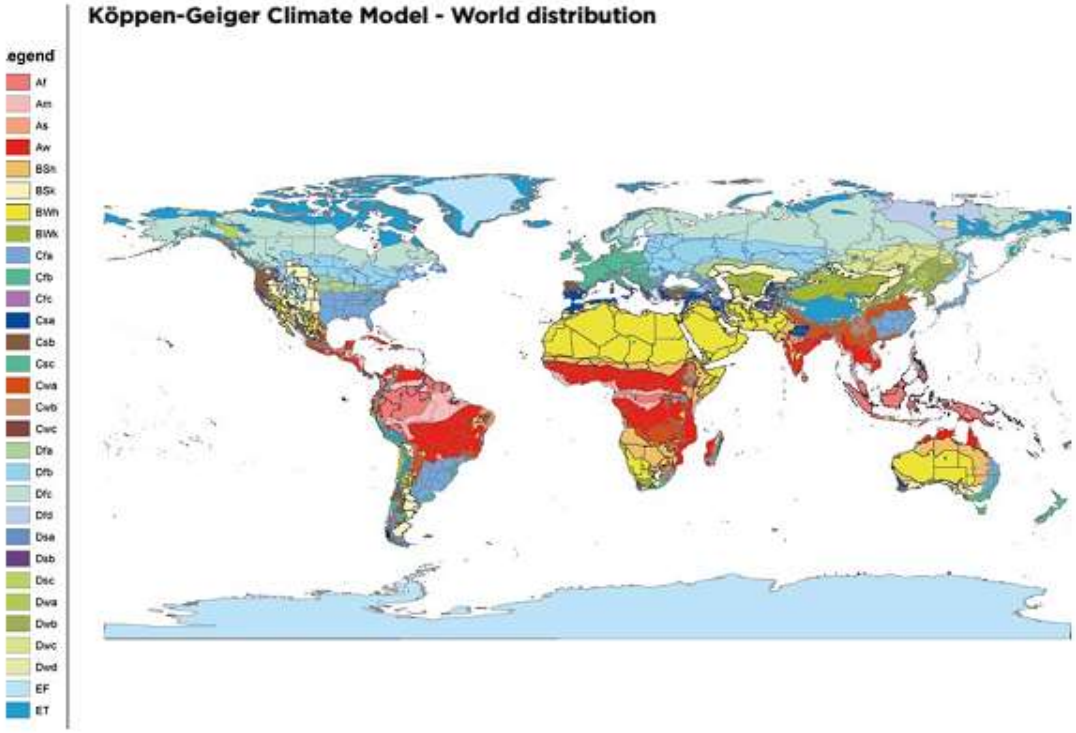


Figure 28 World Map of the Köppen-Geiger climate classification

Projected Climate

Location	Climate Period	M1 (Win)	M2 (Win)	M3 (Spr)	M4 (Spr)	M5 (Spr)	M6 (Sum)	M7 (Sum)	M8 (Sum)	M9 (Aut)	M10 (Aut)	M11 (Aut)	M12 (Win)	Annual Average
Adelaide (Kent Town)	1986-2005	11.5	12.3	14.4	16.5	19.2	21.1	22.7	23.1	20.6	17.6	14.7	12.4	17.2
Dubbo, Australia	1993-2012	9.2	10.4	13.6	16.9	20.9	23.4	25.5	24.6	21.5	17.4	13.2	10.3	17.2
Montevideo, South America	1961-1990	11.1	12.0	13.6	16.0	19.0	21.4	23.2	22.7	20.9	17.5	14.4	11.4	16.9
Lisbon, Portugal	1961-1990	11.4	12.3	13.8	15.1	17.4	20.2	22.4	22.8	21.7	18.5	14.5	11.9	16.8
Cape Town, South Africa	1961-1990	12.3	12.7	14.0	16.0	18.4	19.9	20.9	21.1	19.8	17.5	14.9	13.0	16.7
Gawler, South Australia	1986-2005	10.3	10.8	12.7	15.0	18.4	20.9	22.5	23.0	20.2	17.0	13.8	11.3	16.3
Melbourne City, Australia 2030 RCP4.5	1986-2005	11.4	12.2	14.1	16.0	18.0	20.1	21.6	21.9	19.9	17.1	14.4	12.2	16.6
Santa Barbara, USA	1981-2010	13.1	13.8	14.4	15.8	16.7	18.0	19.8	20.1	19.6	18.1	15.3	13.2	16.5
Melbourne City, Australia (1986-2005)	1986-2005	10.8	11.6	13.4	15.3	17.3	19.3	20.8	21.1	19.2	16.4	13.7	11.6	15.9
Barcelona, Spain	1971-2000	8.9	10.0	11.3	13.1	16.3	20.0	23.1	23.7	21.1	17.1	12.6	10.0	15.6
Santiago, Chile	Unknown	9.4	10.8	12.6	15.3	17.8	20.2	21.4	20.8	18.8	15.6	12.5	9.8	15.4
Kunming, China	1961-1990	8.3	10.0	13.0	16.3	19.3	20.1	20.4	19.9	18.4	15.9	12.1	8.8	15.2
Marseille, France	1971-2000	7.1	8.3	10.7	13.1	17.4	21.1	24.1	24.0	20.4	16.0	10.8	8.1	15.1
Santa Rosa, USA	1981-2010	9.5	11.3	12.7	14.2	16.3	18.8	19.6	19.8	19.6	17.3	12.7	9.4	15.1
Washington, USA	1961-1990	1.4	3.1	8.4	13.7	19.2	24.3	26.7	25.8	21.8	15.4	9.9	4.1	14.5
San Francisco, USA	1981-2010	10.7	12.1	12.9	13.4	14.3	15.3	15.7	16.4	17.0	16.4	13.7	10.9	14.1

Climate matching

Location	Climate Period	M1 (Win)	M2 (Win)	M3 (Spr)	M4 (Spr)	M5 (Spr)	M6 (Sum)	M7 (Sum)	M8 (Sum)	M9 (Aut)	M10 (Aut)	M11 (Aut)	M12 (Win)	Annual Average
Adelaide (Kent Town)	1986-2005	11.5	12.3	14.4	16.5	19.2	21.1	22.7	23.1	20.6	17.6	14.7	12.4	17.2
Dubbo, Australia	1993-2012	9.2	10.4	13.6	16.9	20.9	23.4	25.5	24.6	21.5	17.4	13.2	10.3	17.2
Montevideo, South America	1961-1990	11.1	12.0	13.6	16.0	19.0	21.4	23.2	22.7	20.9	17.5	14.4	11.4	16.9
Lisbon, Portugal	1961-1990	11.4	12.3	13.8	15.1	17.4	20.2	22.4	22.8	21.7	18.5	14.5	11.9	16.8
Cape Town, South Africa	1961-1990	12.3	12.7	14.0	16.0	18.4	19.9	20.9	21.1	19.8	17.5	14.9	13.0	16.7
Gawler, South Australia	1986-2005	10.3	10.8	12.7	15.0	18.4	20.9	22.5	23.0	20.2	17.0	13.8	11.3	16.3
Melbourne City, Australia 2030 RCP4.5	1986-2005	11.4	12.2	14.1	16.0	18.0	20.1	21.6	21.9	19.9	17.1	14.4	12.2	16.6
Santa Barbara, USA	1981-2010	13.1	13.8	14.4	15.8	16.7	18.0	19.8	20.1	19.6	18.1	15.3	13.2	16.5
Melbourne City, Australia (1986-2005)	1986-2005	10.8	11.6	13.4	15.3	17.3	19.3	20.8	21.1	19.2	16.4	13.7	11.6	15.9
Barcelona, Spain	1971-2000	8.9	10.0	11.3	13.1	16.3	20.0	23.1	23.7	21.1	17.1	12.6	10.0	15.6
Santiago, Chile	Unknown	9.4	10.8	12.6	15.3	17.8	20.2	21.4	20.8	18.8	15.6	12.5	9.8	15.4
Kunming, China	1961-1990	8.3	10.0	13.0	16.3	19.3	20.1	20.4	19.9	18.4	15.9	12.1	8.8	15.2
Marseille, France	1971-2000	7.1	8.3	10.7	13.1	17.4	21.1	24.1	24.0	20.4	16.0	10.8	8.1	15.1

Climate matching

…the other is observations!

Genetic differences in water deficit and/or heat tolerance (Perth, March 2011)

Platanus X acerifolia

Delonix regia

Genetic differences in water deficit tolerance (Melbourne Northern suburbs, September 2009)

Grevillea

Hebe

Genetic differences in water deficit and/or heat tolerance (Richmond, March 2009)

Acer rubrum X

Lagerstroemia X

Best performers, Waite Arboretum (unirrigated, Adelaide)

- *Acacia pendula*
- *Acer monspessulanum, A. obstusifolium*
- *Beilschmiedia berteroana*
- *Brachychiton spp.*
- *Cassia brewsteri*
- *Ceratonia siliqua*
- *Euclea pseudebenus*
- *Ficus rubiginosa*
- *Flindersia australis*
- *Harpephyllum caffrum*
- *Jaquinia liebmannii*
- *Pistacia chinensis*
- *Quercus canariensis, Q. douglasii, Q. ithaburensis*
- *Schotia brachypetala*
- *Vepris lanceolata*

Data provided by Dr. J Gardner