Forests
Distant Past to Future Challenges

Professor Lyn Beazley AO FAA FTSE

WA Chief Scientist 2006-2013

WA Australian of Year 2015

GOLDEN VALLEY TREE PARK
BALINGUP

A heritage listed site with a collection of trees that was begun over one hundred years ago, and is now the largest arboretum in WA

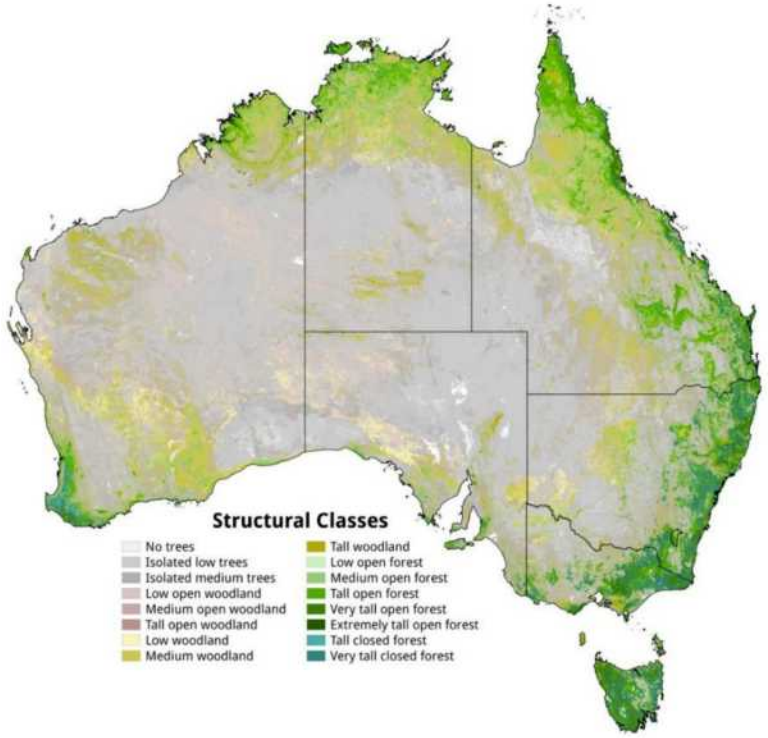
What Makes A Forest?

- Everything in it: all living and non-living components
- Mature trees ≥ 2 metres high
- At least 20% crown cover

Ref. National Forest Inventory

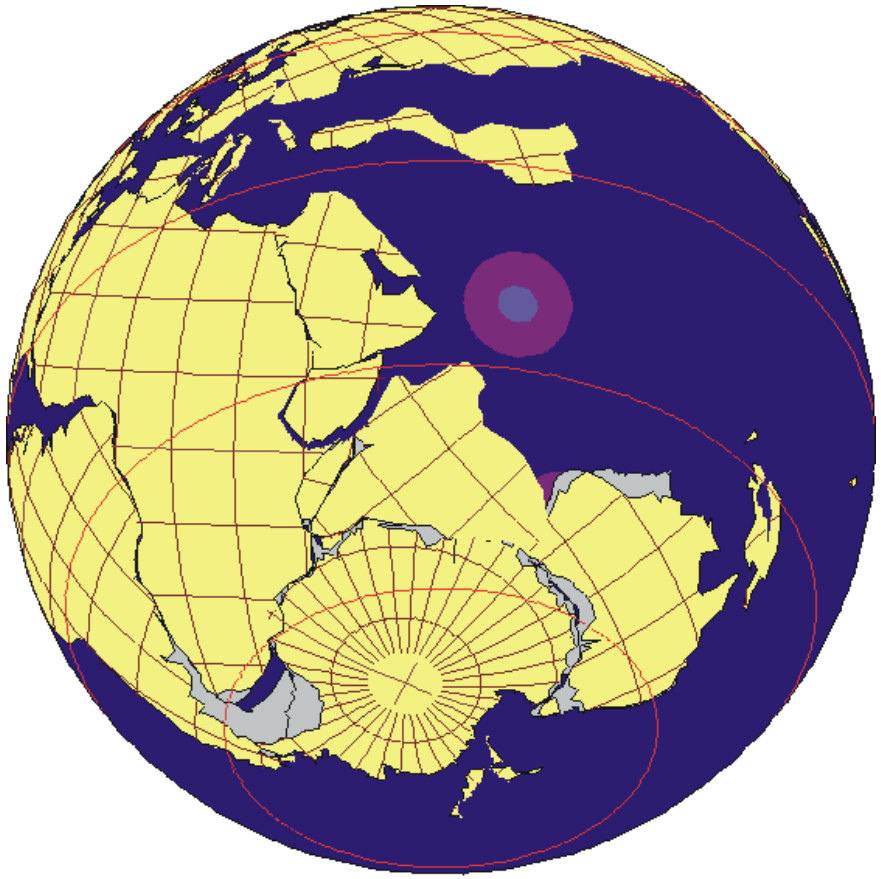
Australian Forests Are Significant To Us and Globally

- 16% of Australia's land area is forest
- Australia is 3% of the world's forest area



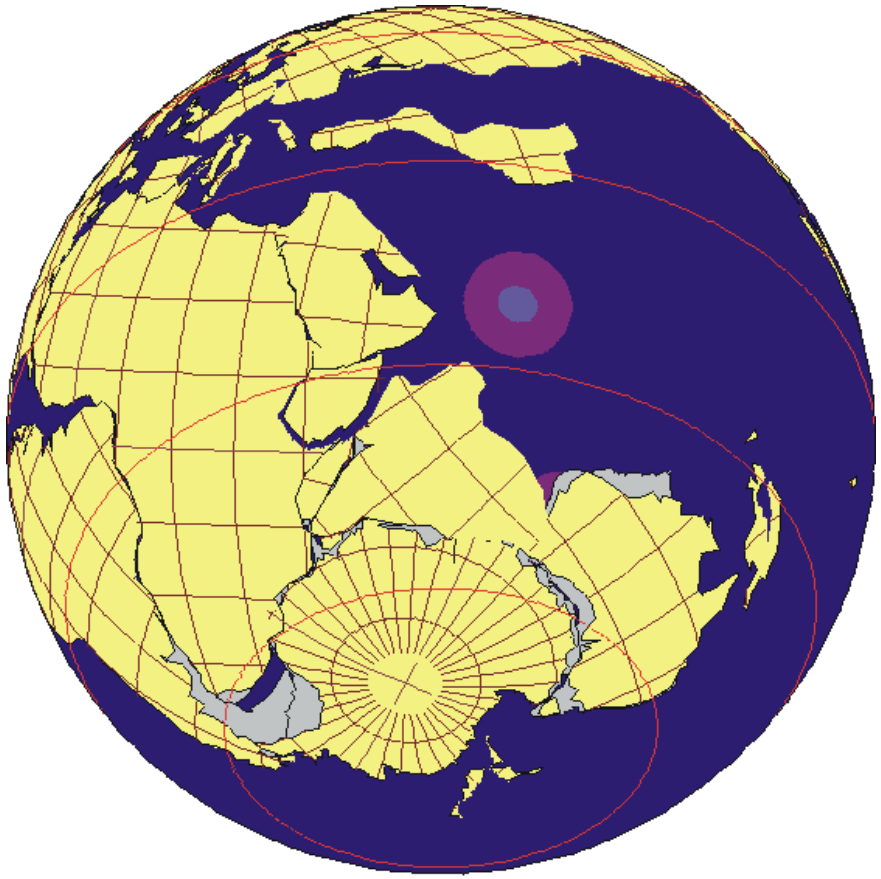

TURN
BACK
THE
CLOCK

Evolution Of Our Unique Eucalypt Forests



- Australia was part of the ancient continent Gondwana
- Began to break up more than 154 million years ago

Evolution Of Our Unique Eucalypt Forests

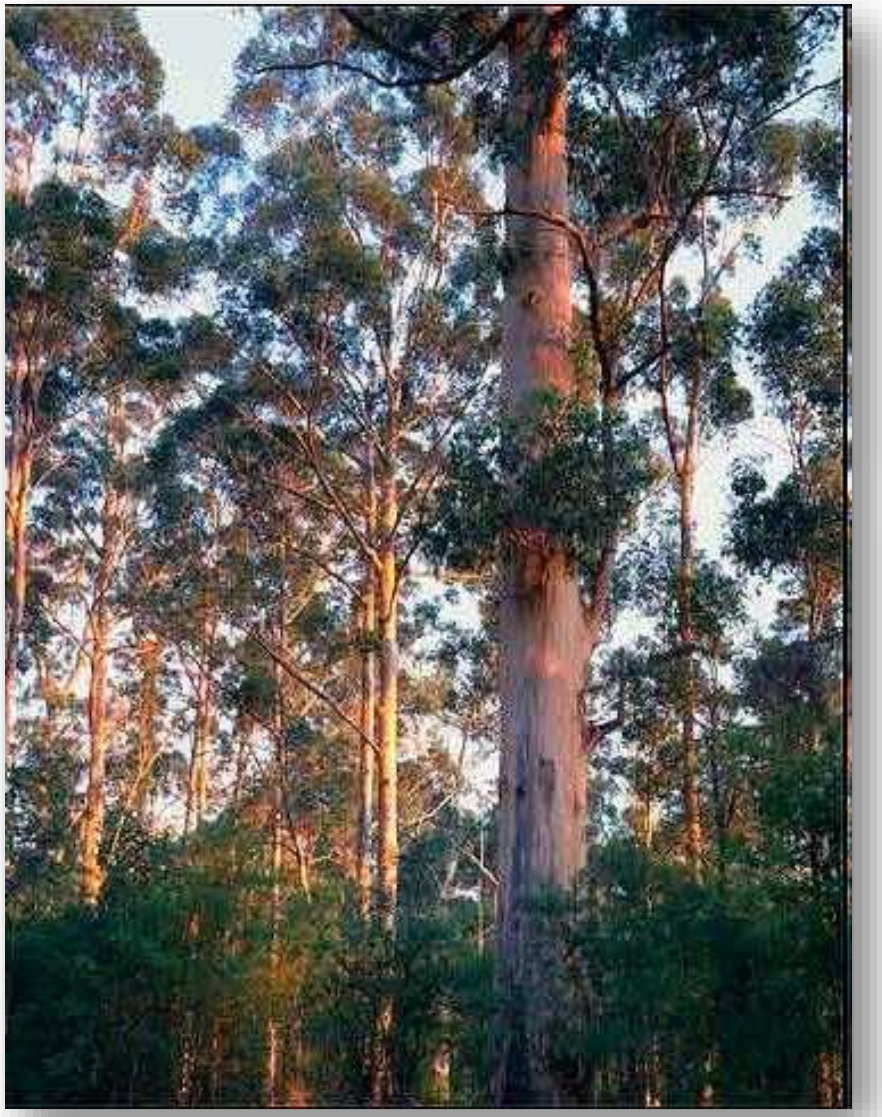


- Australia: Geologically undisturbed for tens of millions of years
- An old landscape with no glaciers for more than 200 million years
- Allowed species to evolve without major extinctions

Evolution Of Our Unique Eucalypt Forests

- 3 million years ago climate became drier and more fire-prone
- In south-west of WA, rainforest species became extinct
- Drove the ecosystem to evolve into one dominated by giant eucalypts

Karri, Jarrah and Tingle Forests

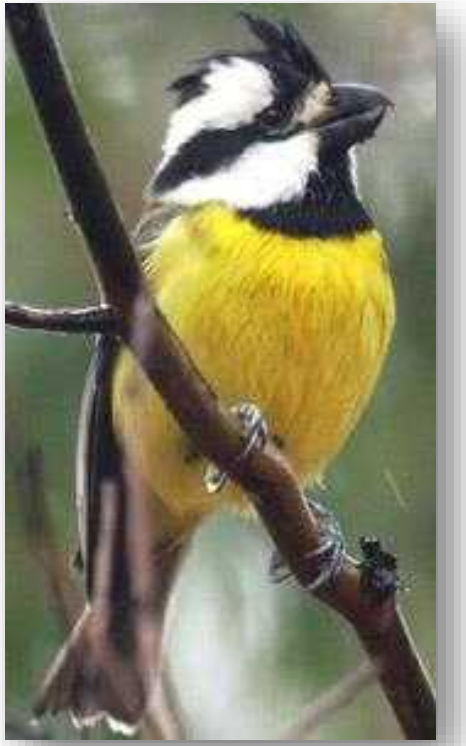


Great Western Woodlands

Internationally recognised as one of the most biologically significant and intact regions left on Earth

Great Western Woodlands: Haven for 150 species of birds

Purple-crowned Lorikeet



Crested shrike-tit

Forests are ‘under the pump’

Forest Pressures Occur Singly Or Together

- Climate change
- Extreme weather events
- Unstable seasons

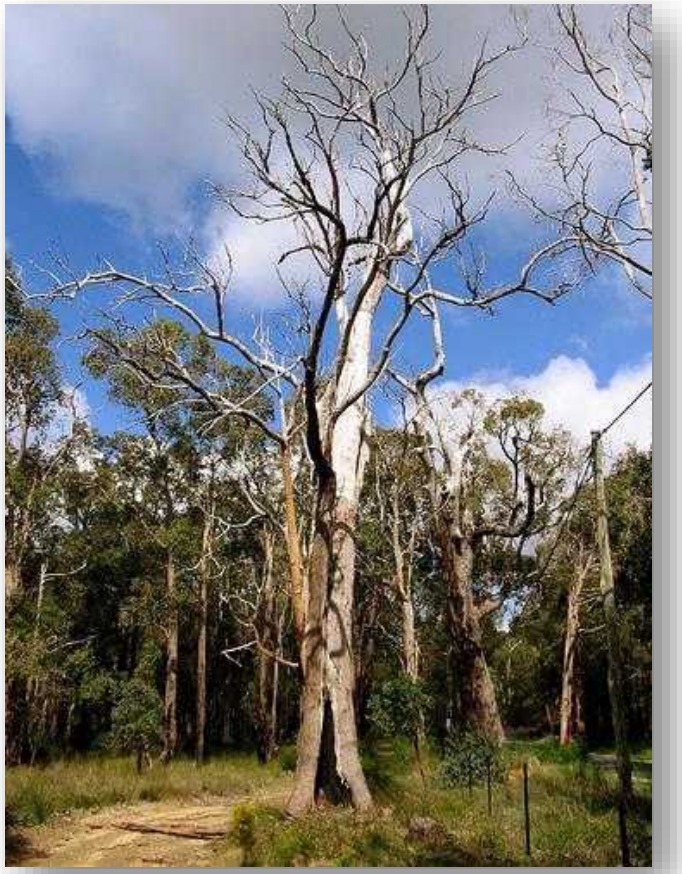
- More droughts mean more trees dying
- In extreme cases, so many trees may die that the ecosystem may enter a ‘state change’ – e.g., woodlands are converted to grasslands

Other Forest Pressures

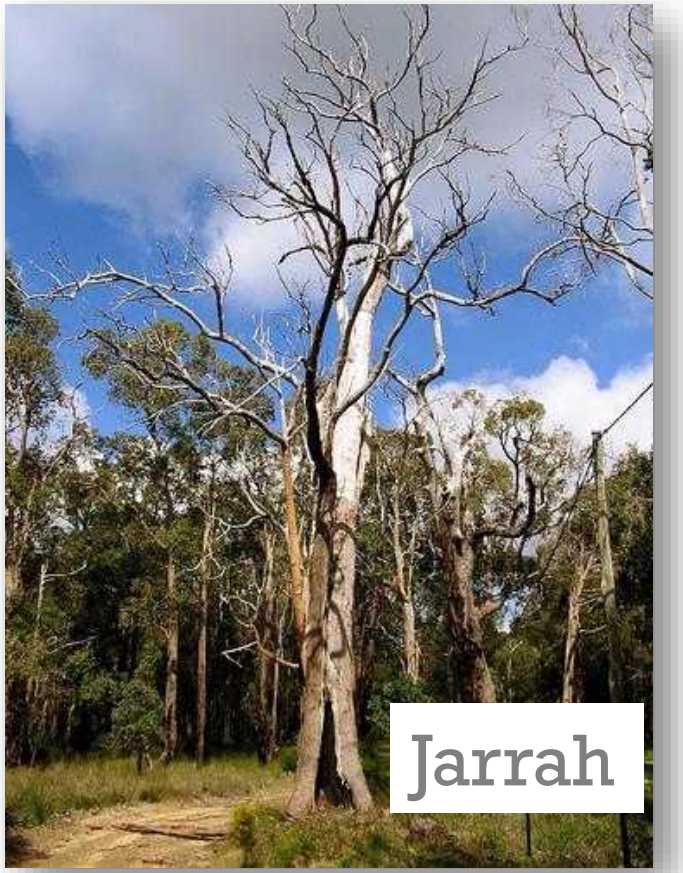
- Urban development
- Mining
- Agricultural management practices
- Legacy of previous land management practices

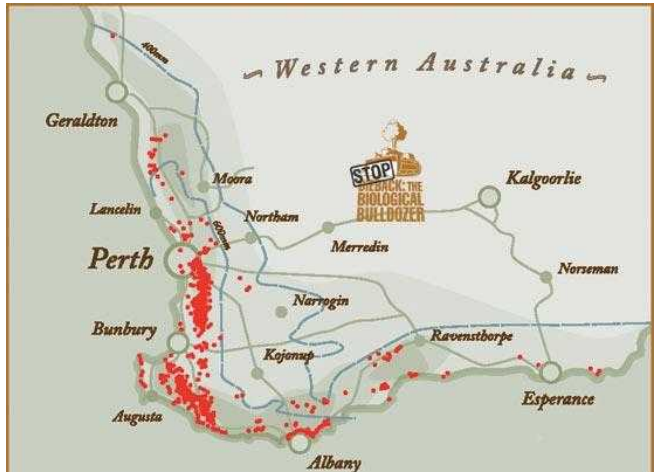
Yet More Forest Pressures

- Invasive weeds
- Pests and diseases
- Changed fire regimes



900 plant species affected directly by Phytopthora





Indirect Effects

Banksia occidentalis, Red Swamp Banksia

Caladenia brownii Hopper

Many Unique Species are Endangered

Woylie
Bettongia penicillata

Western Swamp Tortoise
Pseudemydura umbrina

Quokka
Setonix brachyurus

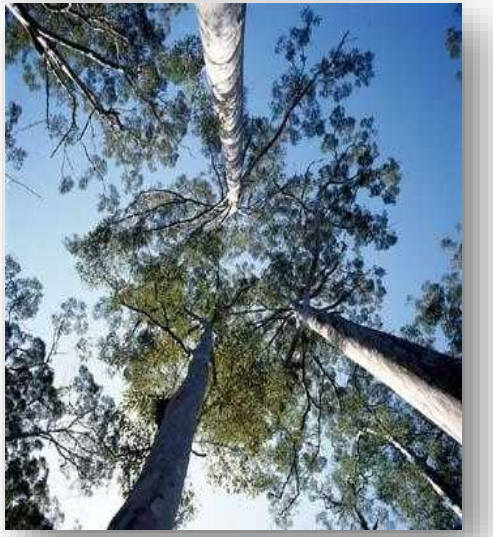
Western Quoll
Dasyurus geoffroii

Bearded Bird Orchid
Pterostylis turfosa

Sunset Frog
Spicospina flammocaerulea


Can We Save Them?

Forests Help Protect Our Unique Biodiversity



Translocations of Endangered Species

Banksia brownii translocation

Storing for the Future: Seed Banks

Royal Botanical Gardens at Kew
The Millennium Seed Bank

- Largest plant conservation project in world
  - Stores seeds from all over the world
- Already banked 13% of the world's plants
  - Collaborate to store WA seeds

Dr Anne Cochrane DPAW

Kew 250th
PLANTS PEOPLE POSSIBILITIES

Botanic Gardens & Parks Authority

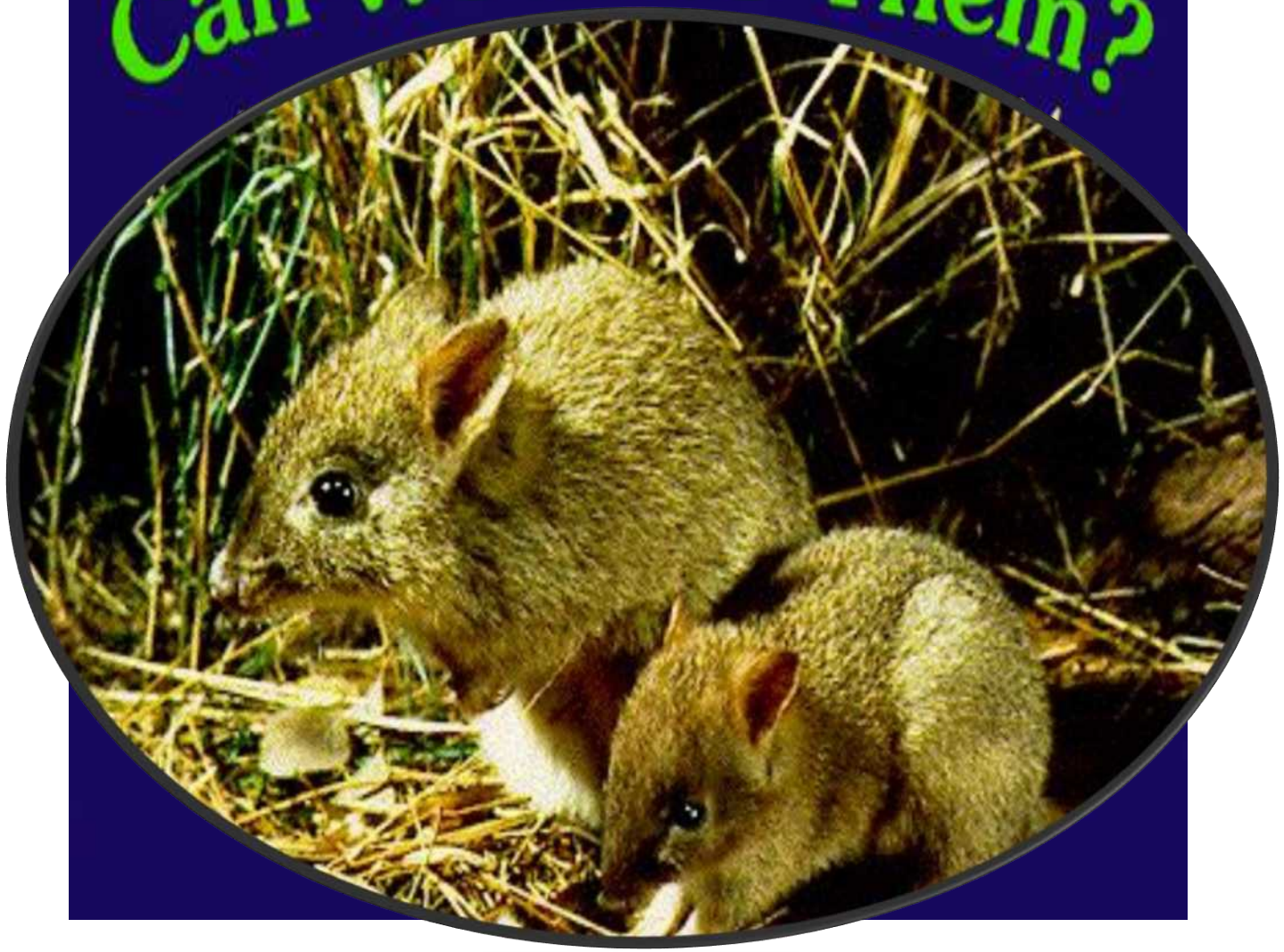
WA Biologist: First non-UK Director Royal Botanical Gardens at Kew

Professor Stephen Hopper AC

- Internationally acclaimed plant conservation biologist
- Major contribution to preserving WA's biodiversity

Kew
ROYAL BOTANIC GARDENS

Can We Save Them?



Tracking Down Endangered Species: Dog Squad

- Even Located Baw Baw frog under snow

Protecting Endangered Species: Reserves such as Perup

- Baited for control of foxes since 1992
- Now totally fenced

Kanyana Park Breeds Endangered Species For Release

June Butcher AM

Other reasons to Save Our Forests

Because Our Forests Are Places To Cherish

- Cultural, aesthetic and heritage values and to just enjoy


Welcome to the Valley of the Giants
Tree-Top Walk

“Every child loves nature”

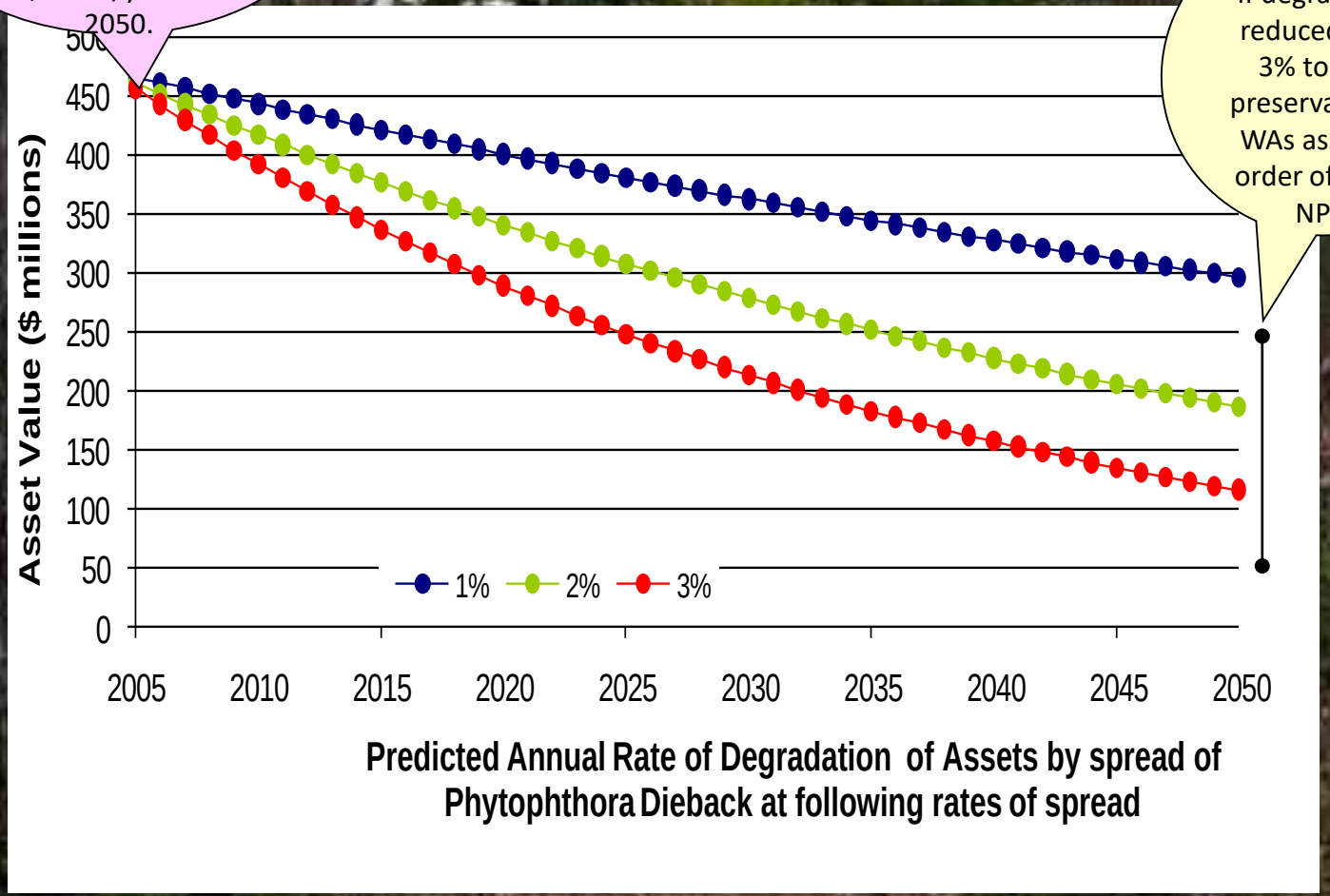
Because Our Forests Work Hard For Us

- Produce wood, fibre and honey, protect soil and water
- Store CO_2, fighting climate change

$1.1b saved by 2050 if Phytophthora degradation is reduced from 3% to 1%

Assets at risk from PD *conservatively* estimated at NPV **$6.4b**, equivalent to $470m/yr until 2050.

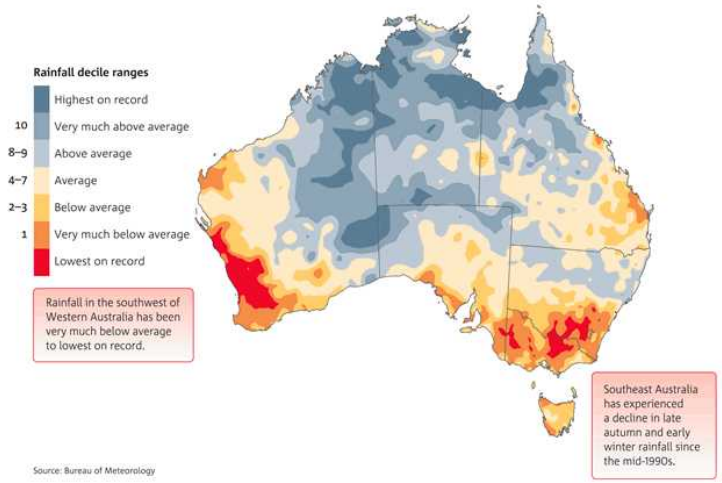
If degradation reduced from 3% to 1% - preservation of WAs assets in order of **$1.1b** NPV.

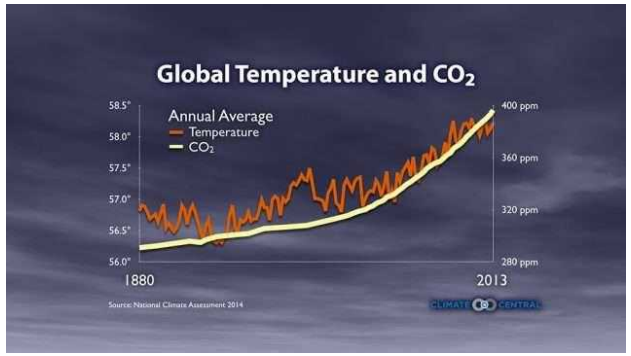


NPV = net present value until 2050 using a 7.5% discount rate

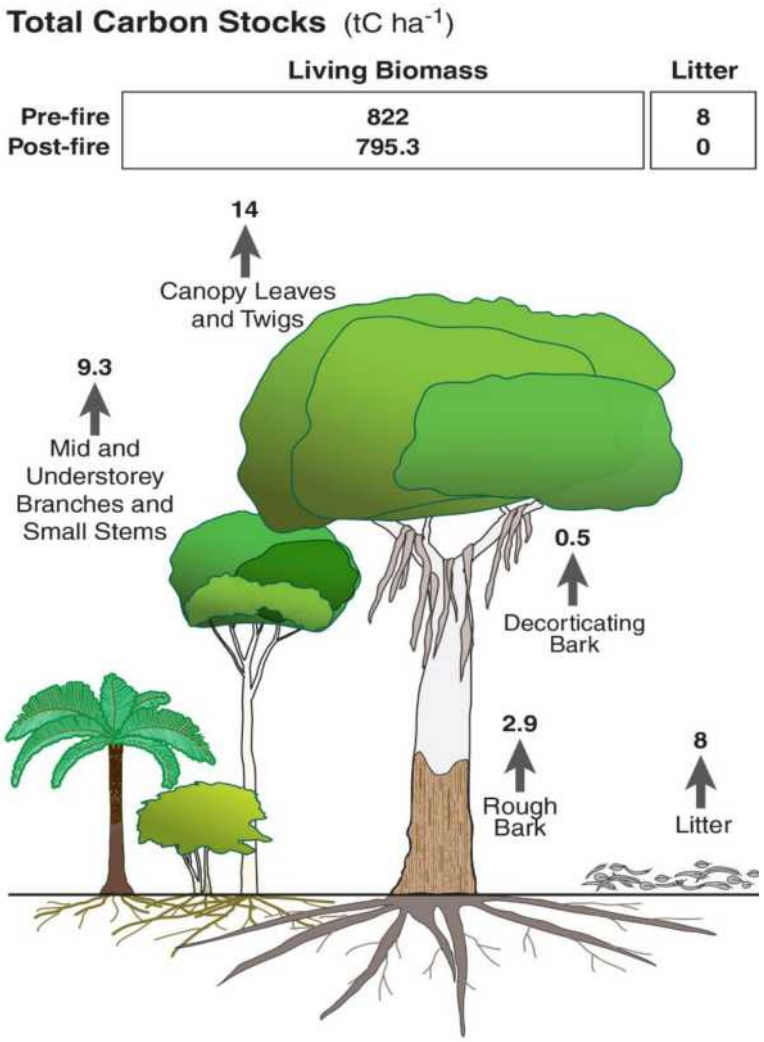
Forests Fight Climate Change

- Australia has warmed over 1°C since 1910
- Significantly less rainfall in Southwest WA
- Predicted to become increasingly hotter and drier, with more droughts (and more extreme)
- CO_2 levels and warming on same track
- Forests store CO_2, their loss would exacerbate increases in CO_2 levels

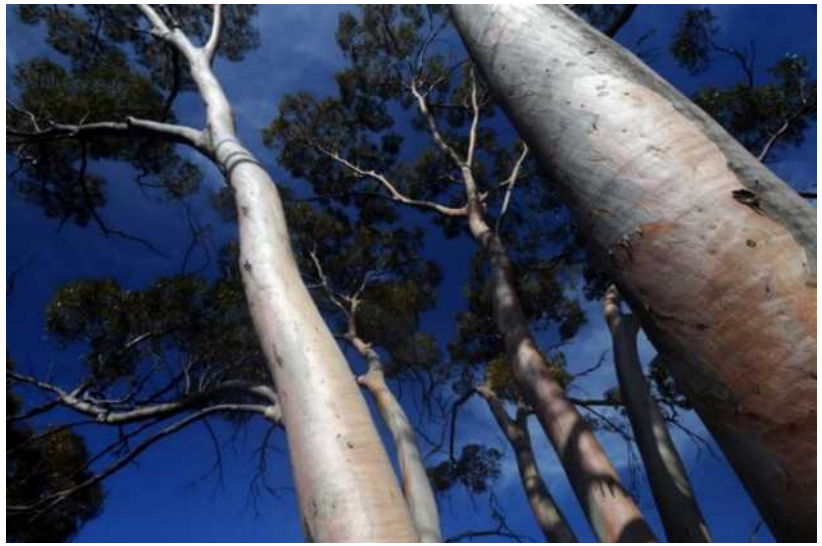




Locking away CO_2



Can Australian Forests Work Harder To Remove More CO_2 From The Atmosphere As Levels Rise?



- CO_2 levels will keep rising
- Can forests sequester more CO_2 as levels rise?
- Being studied for Northern Hemisphere trees
- Need to know for our forests

EucFACE: A Mega-Experiment

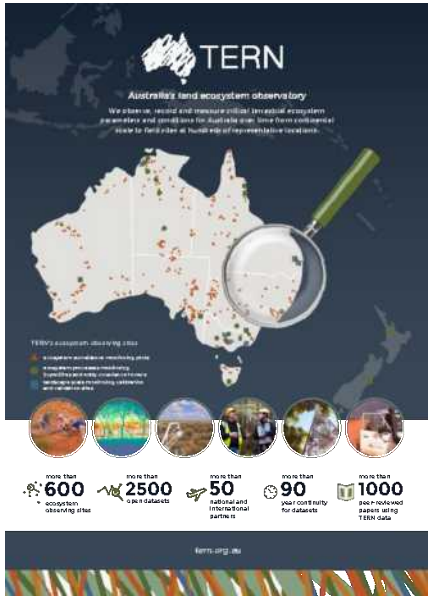
- Near Sydney, six carbon-fibre rings each 25 metres in diameter
- Three continuously release CO_2 (supplied by local fertiliser manufacturer)
- Three act as controls, do not release CO_2
- 40+ researchers are measuring how much CO_2 the trees sequester away

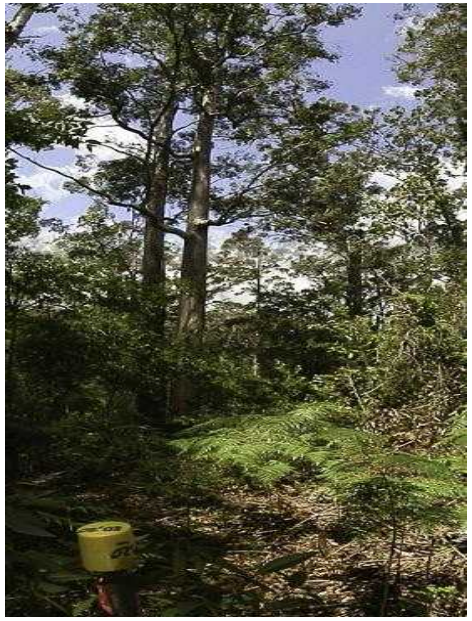
EucFACE = Eucalyptus Free Air Carbon Dioxide Enrichment


So we need to know what is happening in our forests


But forests are big, really big and this means we need to be smart to study them

Lots of Study Sites at Key Locations

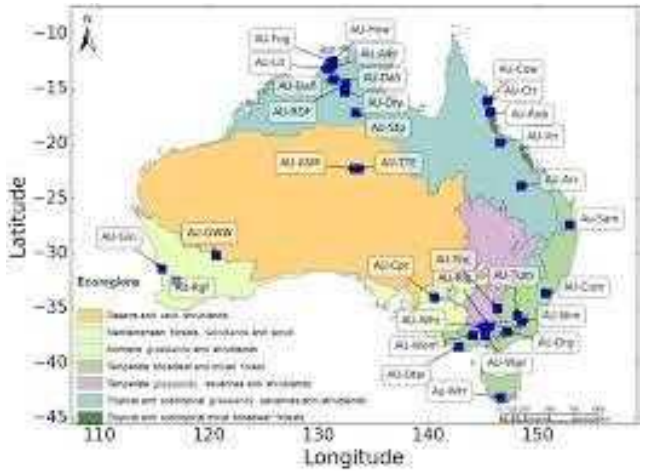




Forest of tall (60m+) karri (*Eucalyptus diversicolor*) in the Warren region of WA

- Network = proxy for the whole continent
- Regularly measure tree growth, species present, canopy cover and what is dying
- Allow predictions on how forests will respond to further climate change


Hooray for OzFlux

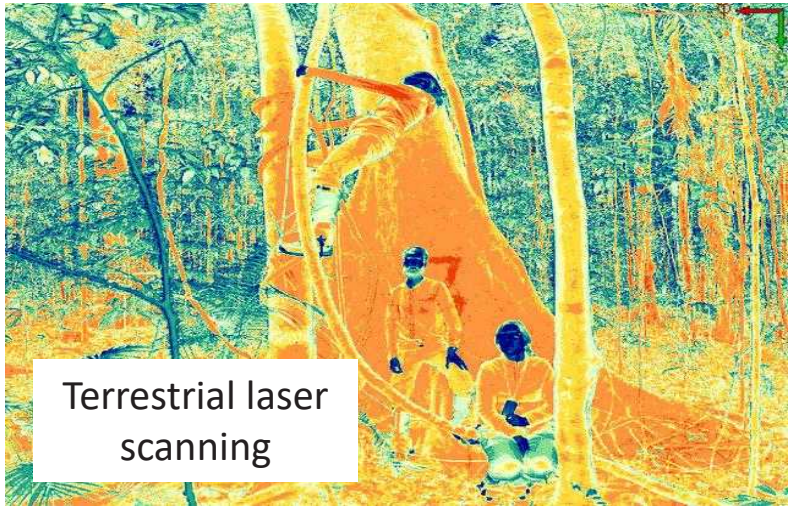


🌳 Close to 30 flux towers in Australia and New Zealand: 24/7, 365 days a year

🌳 Member of the global FluxNet community

Remote Sensing Estimates How Much CO_2 Is Stored

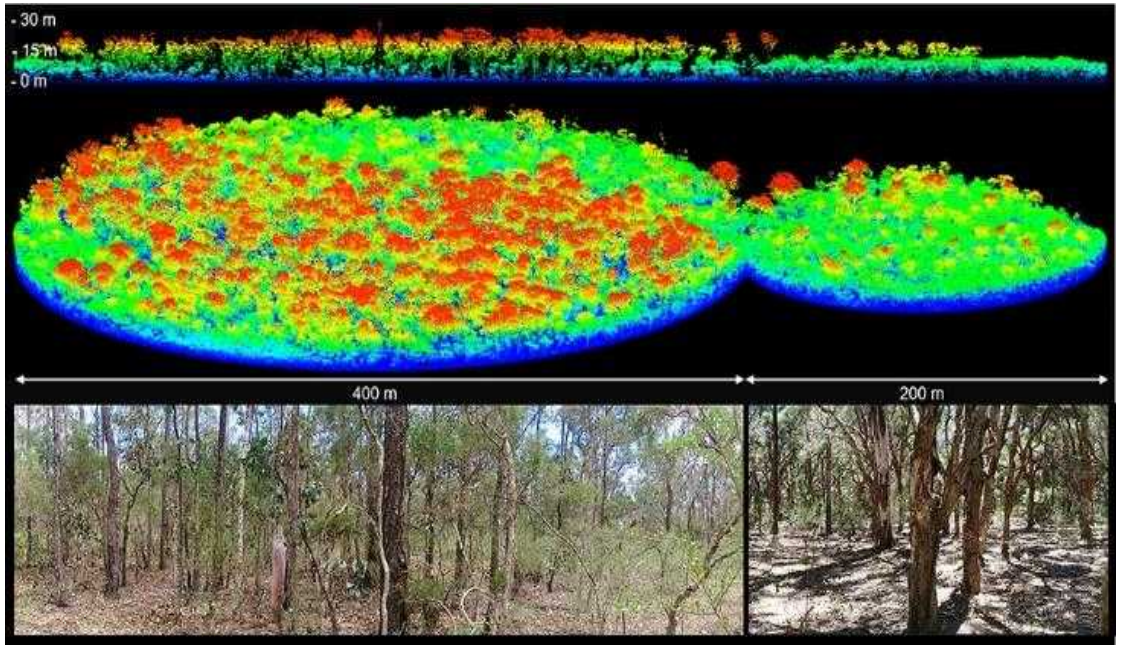
- Forests store more CO_2 than any other terrestrial ecosystems
- Just how much, though, is hard to know without cutting them down
- 'Virtual harvesting', a non-destructive remote sensing technique based on OzFlux and drone data



Terrestrial laser scanning

Species for the Future
Which Are Resilient To Climate Change?

- Using data from TERN flux towers and drones
- In forest stands dominated by melaleuca or eucalypts
- Under ‘typical’ conditions and when soil water levels low
- Help to predict best forests for future

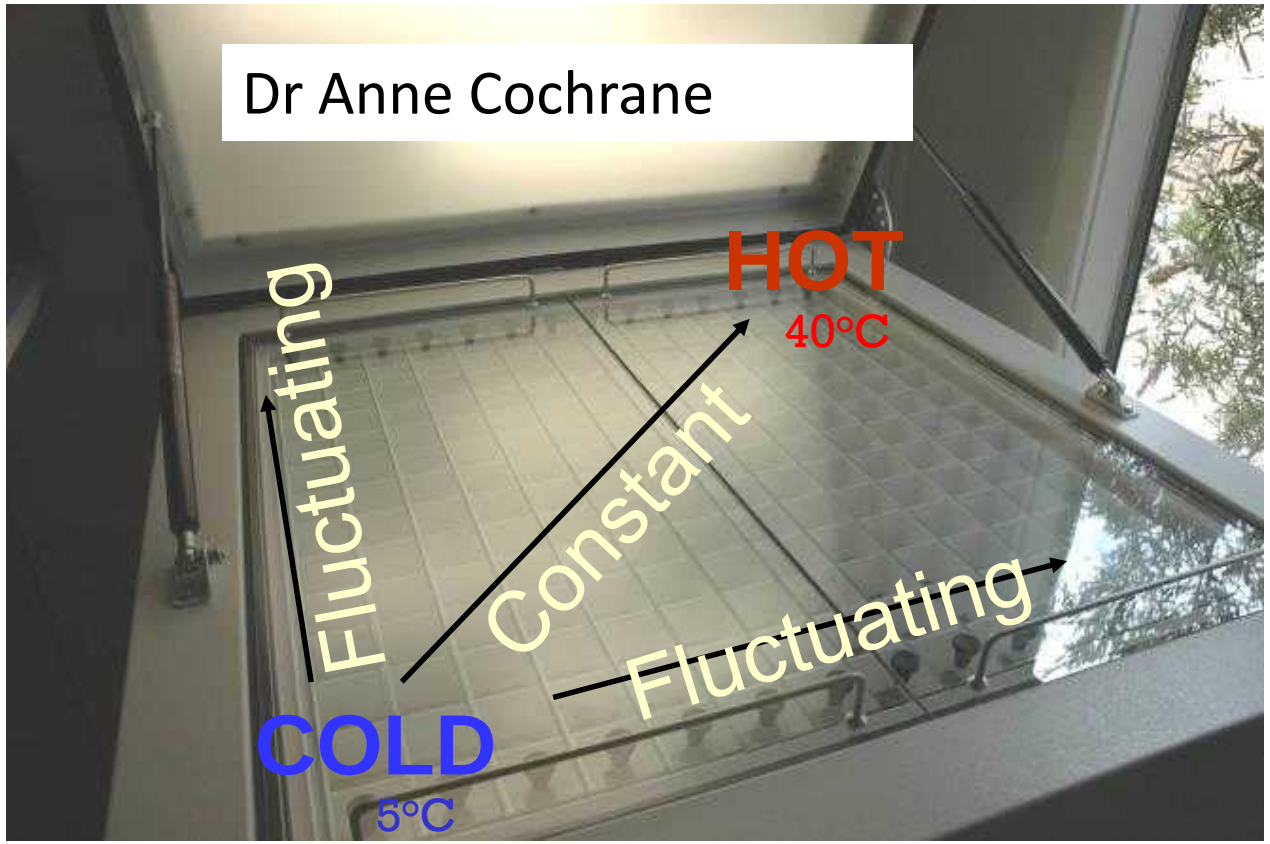


Red = Eucalypt Trees, Green = Melaleuca
Blue = low vegetation

Cumberland Plain Woodland

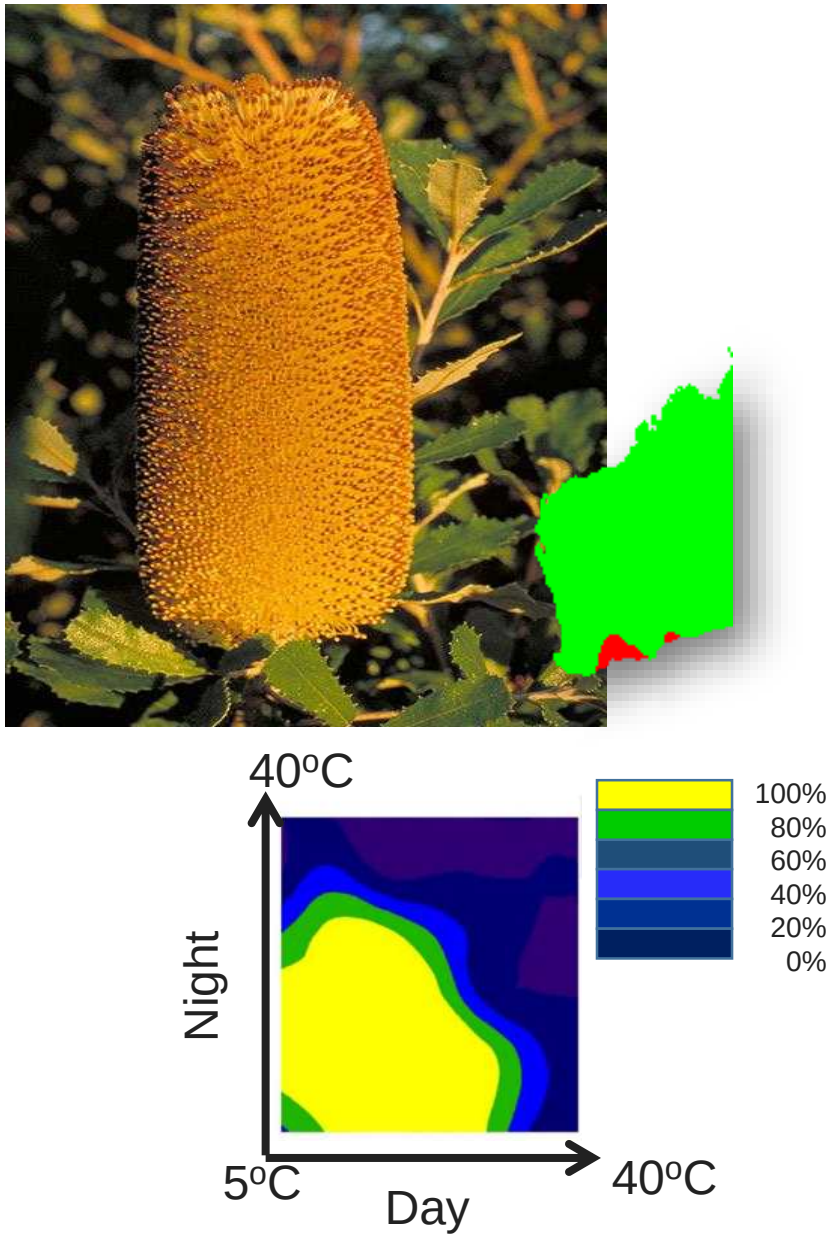
- There are ‘hot spots’ of tree mortality in Australia – places where forest ecosystems are particularly susceptible to drought and extreme temperatures
- By mapping these locations, ecosystem managers and researchers can focus their efforts on developing adaptation mechanisms to make it more likely that Australia’s natural and managed forests will survive

Which Species Will Survive Climate Change?
Conditions to Germinate

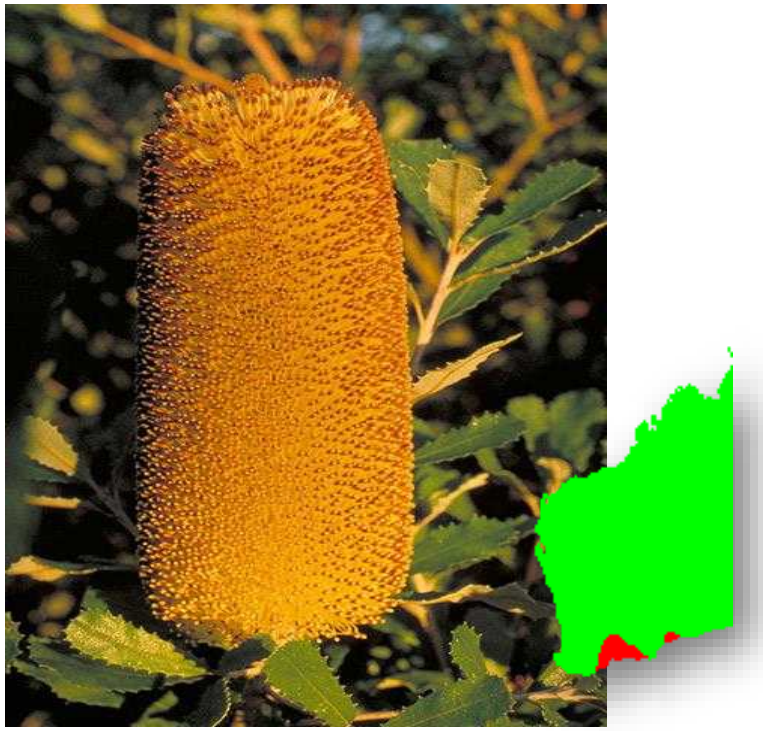


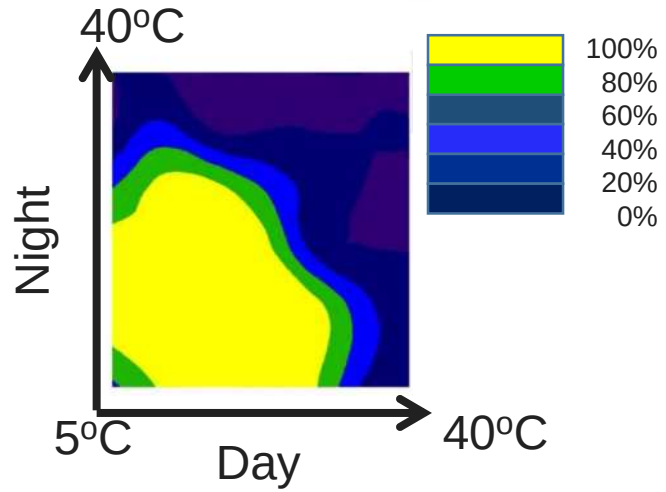
196 different day/night temperature combinations

Banksia media

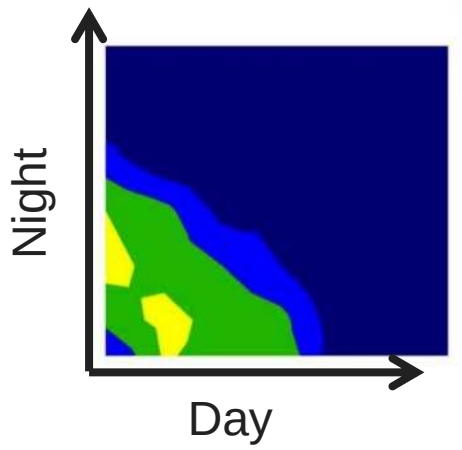


Banksia media





Banksia dryandroides



Satellite Data

Found “Lost Forests” Of The Drylands

- Drylands make up 40% of earth’s land mass
- Examined with high-resolution satellite imagery
- Found 467M hectares of previously unreported forest

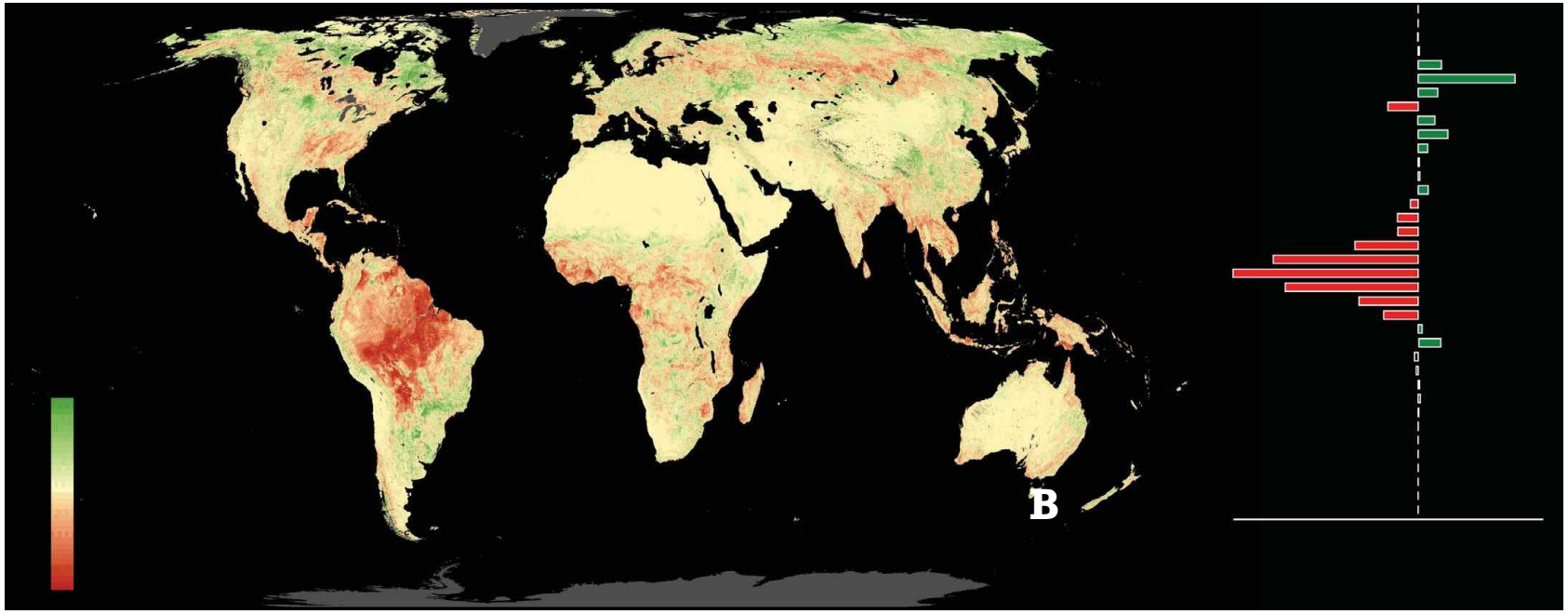
Coolabah forest (*Eucalyptus victrix*) in the Pilbara

Can Conservation of “Lost Forests” Help Fight Climate Change?

- Equivalent to 60% of the size of Australia
- Increases current estimates of global forest cover by almost 10%
- Published in Journal *Science* and now incorporated into international protocols

Coolabah forest (*Eucalyptus victrix*) in the Pilbara

Predictions of Future Canopy Loss



Risk assessment of future changes in potential tree cover by 2050

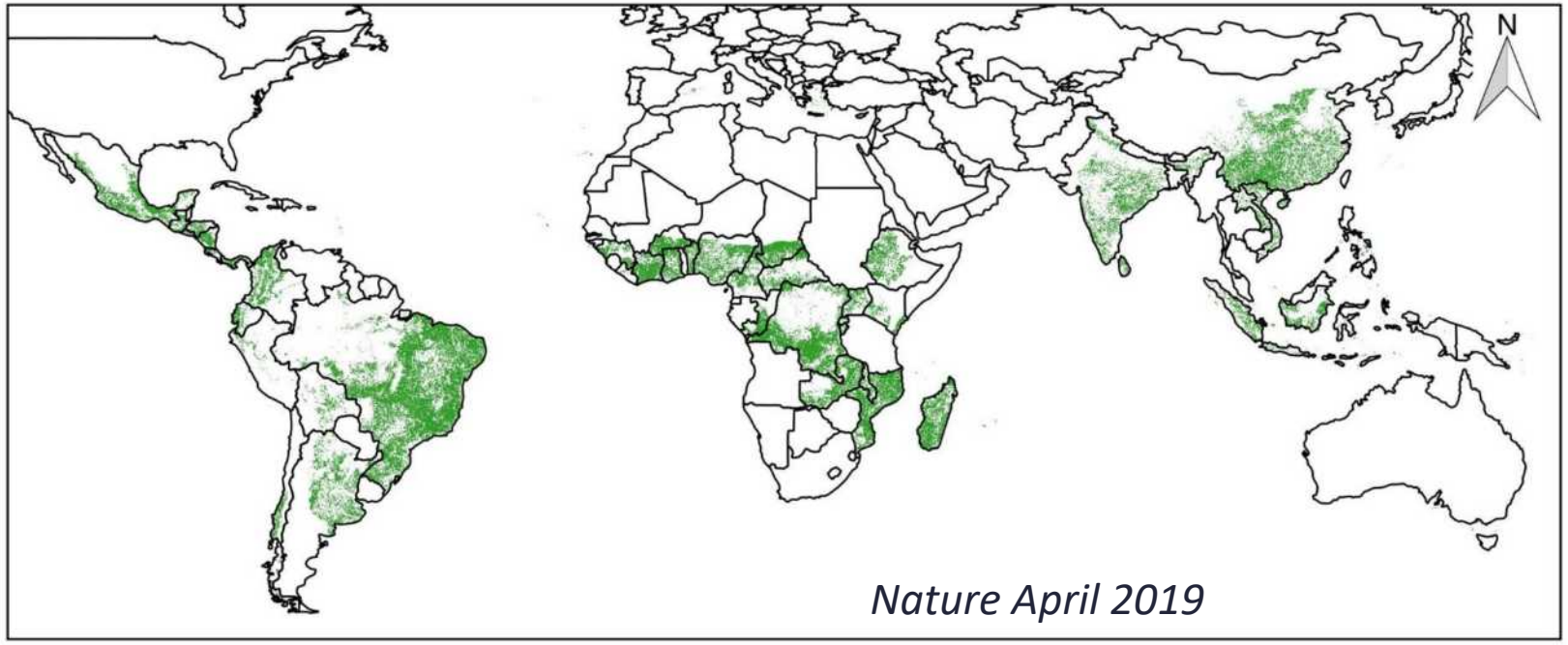
Green = Potential gain
Red = Potential loss

Bins show there are more losses than gains

- If things continue as they are going, the global canopy cover may shrink by ~223 million hectares by 2050
- Vast majority of losses will occur in the tropics

Bastin et al., Science 365, 76–79 (2019) 5 July 2019

Areas with Greatest Potential For Tree Restoration



- Restoration of trees is considered the best way to mitigate against climate change
  - 4.4 billion hectares of canopy cover could exist under the current climate
  - An extra 0.9 billion hectares of canopy cover could store 205 gigatonnes of CO_2

Pro-forestation: Helping Natural Forests To Regrow To Their Full Potential

- Allow trees to regenerate naturally, using nearby remnants of primary forests and seed banks in the soil of recently cleared forests
- More likely to result in a resilient and diverse forest than planting heaps of seedlings
- Instead of planting new areas, research suggests it is better to restore edges of forest, reconnect forested areas and protect their mature cores

Pro-forestation: Helping Natural Forests To Regrow To Their Full Potential

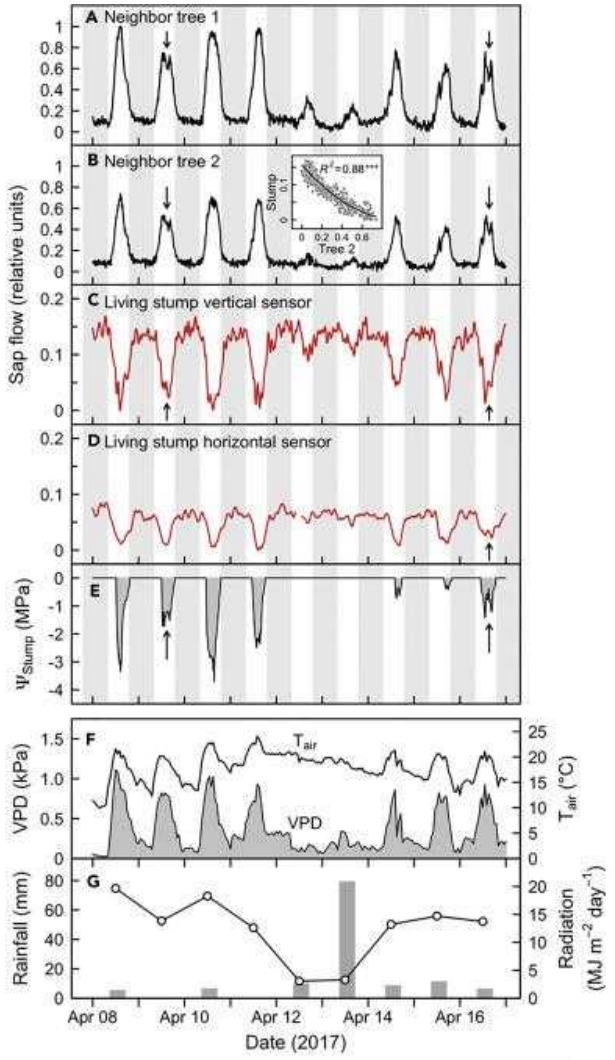
- Predicted result: forests will be more resilient and longer-lasting
- More effective, immediate and low-cost method in the long-term than tree planting
- Can be used across many different kinds of forests around the world

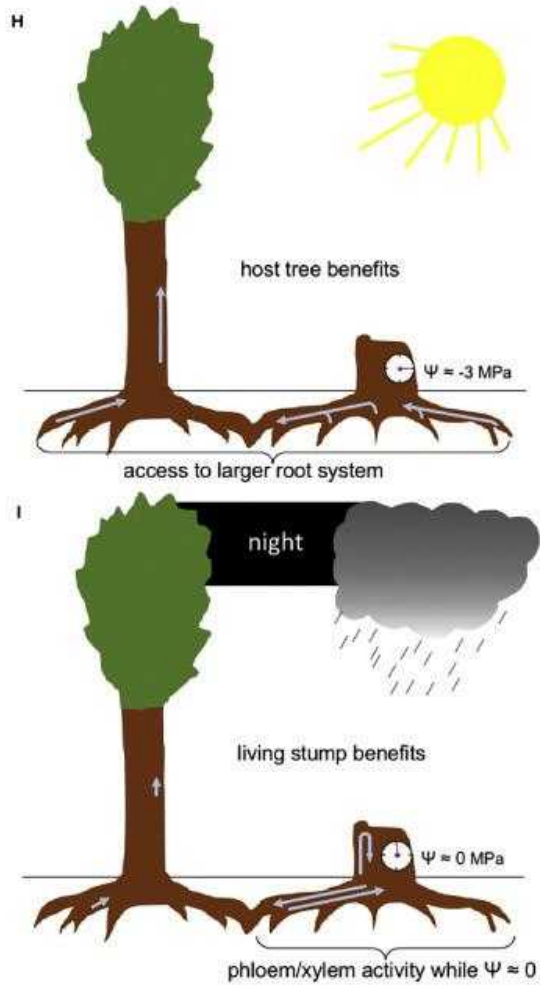
One Reason Why Pro-forestation Could Work

Kauri tree stump (*Agathis australis*)

- Researchers were on a hike in rainforest
- In Waitakere Ranges on New Zealand's North Island
- Surprised that tree stump was alive despite having no branches or leaves

- Found flow of water and nutrients between stump and neighbouring trees
- Do so via root grafts that form naturally
- Now found in close to 150 tree species



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GOLDEN VALLEY TREE PARK
BALINGUP