Professor Michelle Leishman

Head of Department

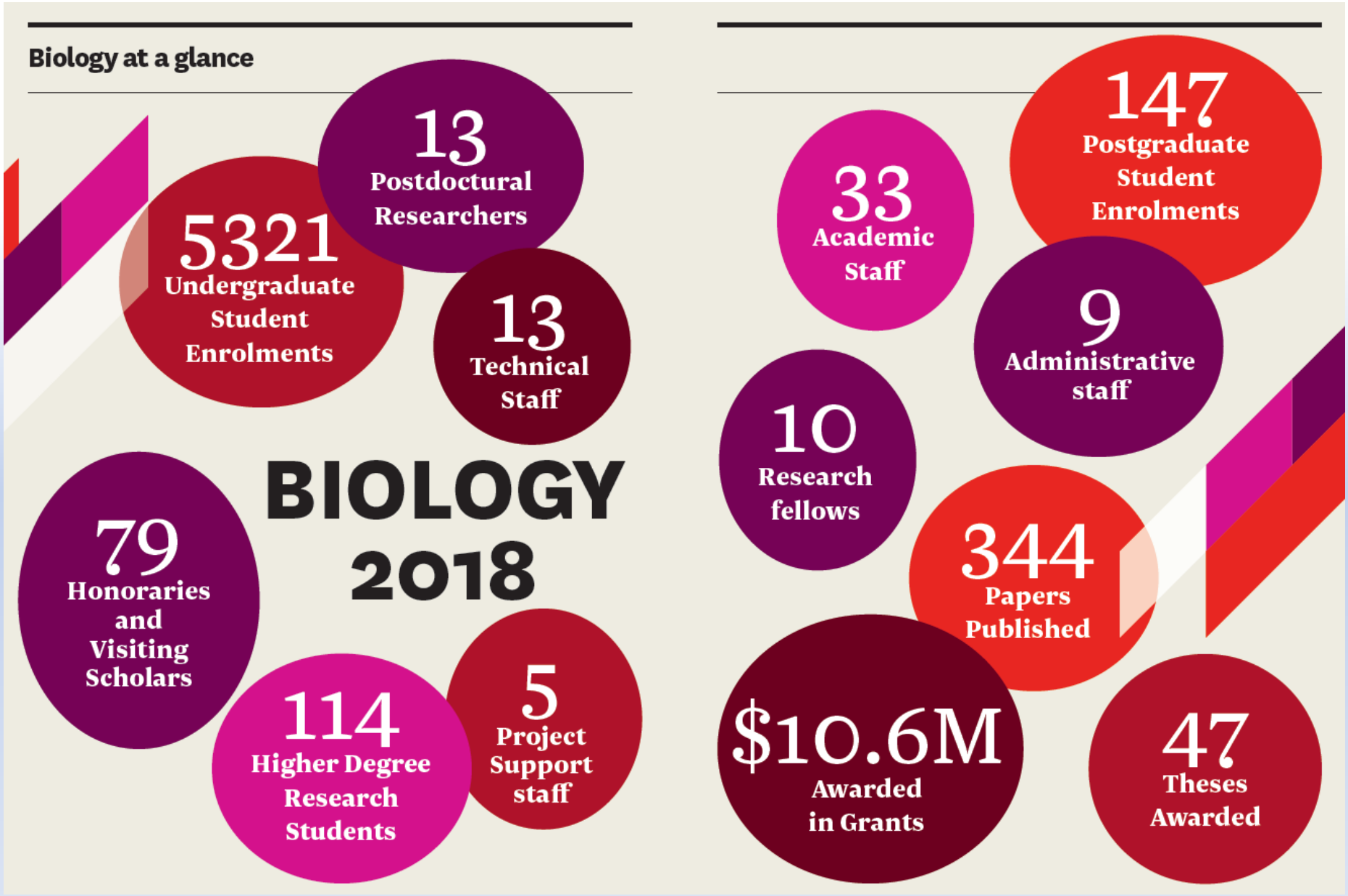
Department of Biological Sciences

Faculty of Science and Engineering

Department of Biological Sciences

MACQUARIE University

We are an integrative department of biological sciences working across disciplines including animal behaviour, climate change, conservation, ecology, evolution, genetics and genomics, paleobiology and physiology


Biology at a glance
13
Postdoctural Researchers
5321
Undergraduate Student Enrolments
13
Technical Staff
BIOLOGY 2018
79
Honoraries and Visiting Scholars
114
Higher Degree Research Students
5
Project Support staff
147
Postgraduate Student Enrolments
33
Academic Staff
9
Administrative staff
10
Research fellows
344
Papers Published
$10.6M
Awarded in Grants
47
Theses Awarded

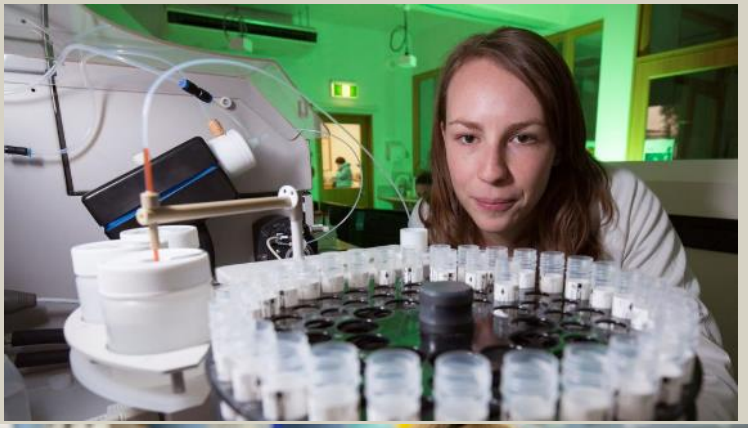
Department of Biological Sciences

MACQUARIE University

- Undergraduate coursework
- Postgraduate coursework
- Research training
- Higher degree research

Learning & Teaching

- Focus on providing a broad knowledge base of contemporary biology
- Research-led teaching to inspire a passion for lifelong learning
- Practical hands-on experiences in lab and the field
- Strong foundations for a diversity of career paths in biology and related fields



Learning & Teaching

MACQUARIE University

Outstanding facilities - laboratories

Learning & Teaching

MACQUARIE University

Outstanding facilities – field studies

Learning & Teaching

MACQUARIE University

Undergraduate coursework

- Bachelor of Science with specialisations in Biology, Human Biology, Paleobiology
- Bachelor of Medical Sciences
- Bachelor of Biodiversity & Conservation
- Bachelor of Marine Science

Learning & Teaching

MACQUARIE University

Postgraduate coursework

- Master of Conservation Biology
- Master of Marine Science & Management

Research training

- Master of Research (MRes)
- Doctor of Philosophy (PhD)

Department of Biological Sciences

MACQUARIE University

A research-intensive integrative biology department

Research strengths

- Animal behaviour
- Conservation biology
- Ecology
- Evolution

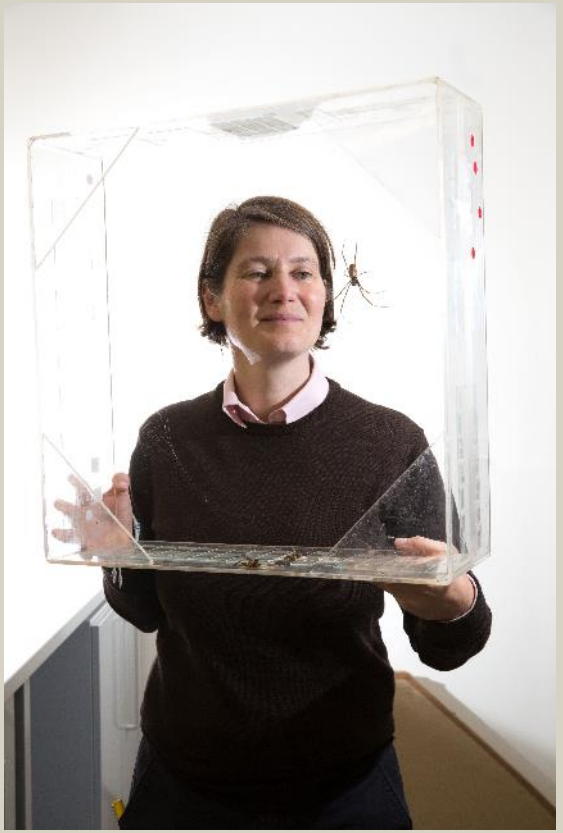
Animal behaviour

Integrative and transdisciplinary

- behavioural ecology, sociobiology, comparative neurobiology, performance physiology and behavioural genomics

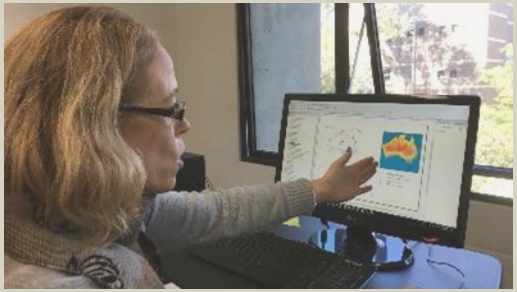
Animal behaviour

MACQUARIE University

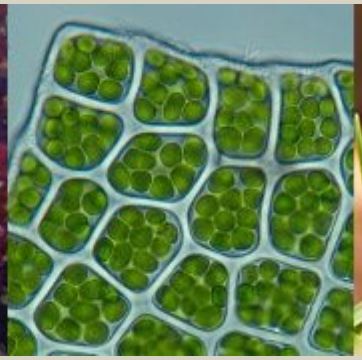


Conservation Biology

- Leaders in conservation biology nationally and internationally
- Engaged with government and industry – invasive pests and pathogens, threatened species management, human impacts, climate change impacts and adaptation.






Conservation Biology

MACQUARIE University

Ecology

- Terrestrial, aquatic and marine environments
- Internationally recognised in plant ecology (3 highly cited researchers)

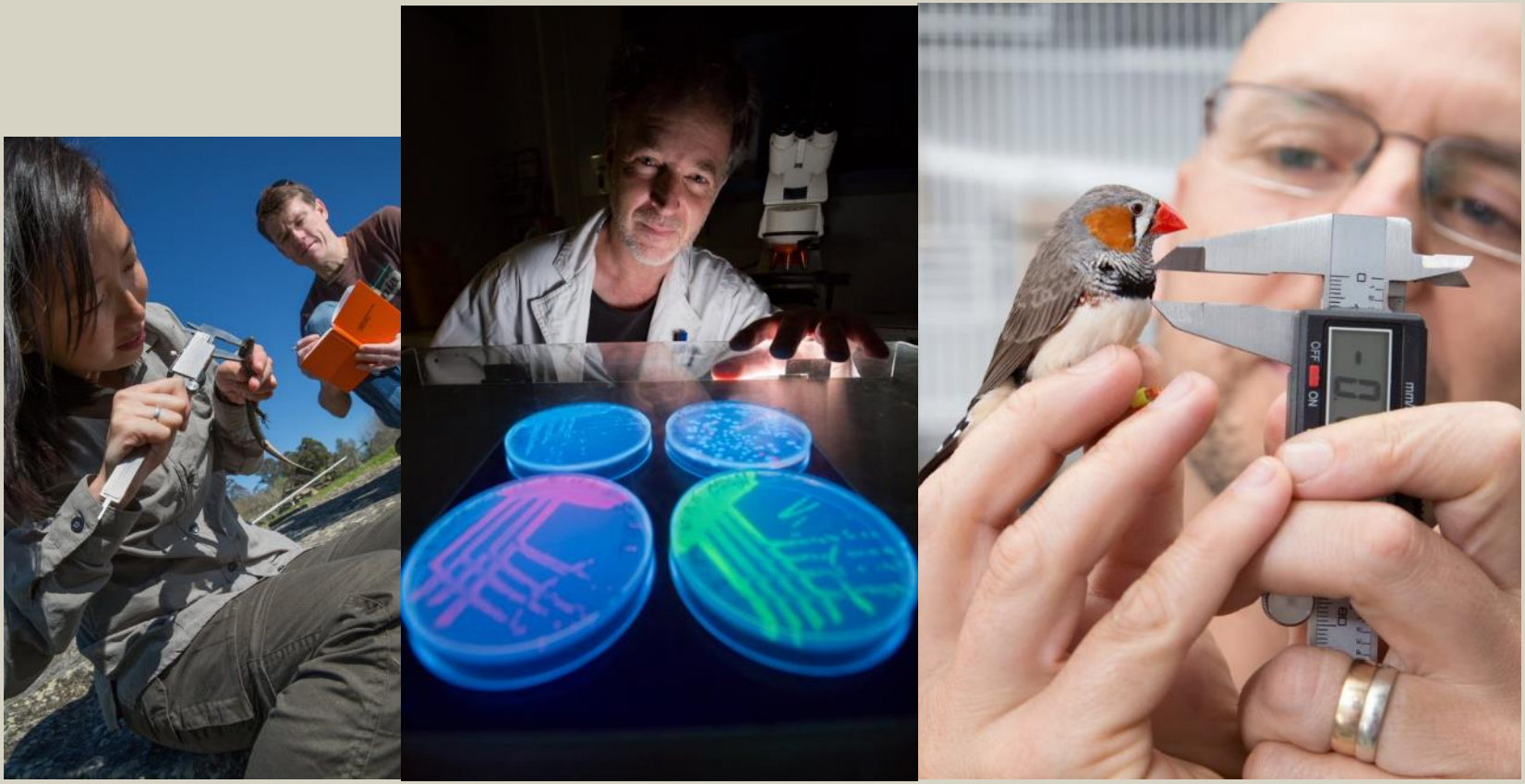






Evolution

- Evolution and adaptation across multiple taxa
- Microbial evolution to evolution of behaviour



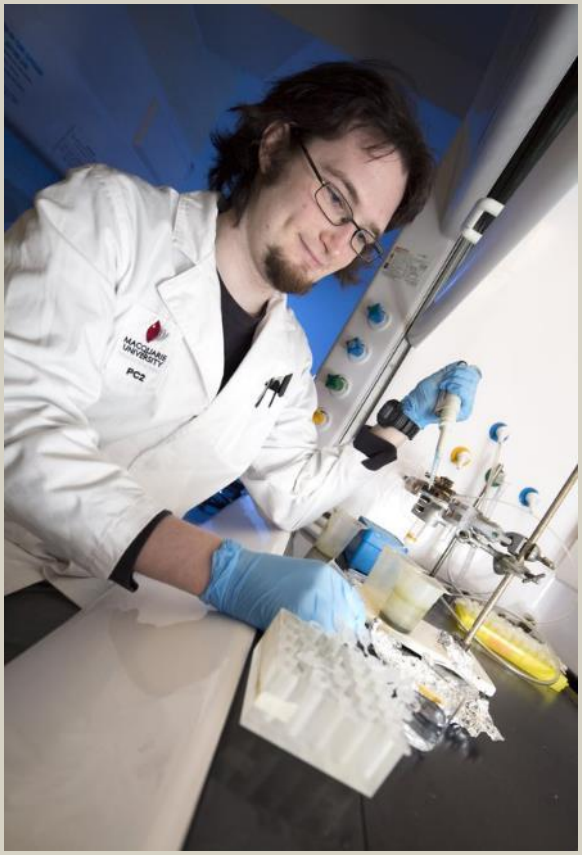
Food security and biosecurity

MACQUARIE University

Research Centres

- Centre for Marine Research
- Centre for Smart Green Cities
- ARC ITTC for Fruit Fly Biosecurity Innovation

Research facilities – Molecular labs



Research facilities – Aquatic Facility

MACQUARIE University

Research facilities – Plant Growth Facility

MACQUARIE University

Research facilities – Fauna Park

MQ Centre for Smart Green Cities

Sustainable energy solutions

Green infrastructure

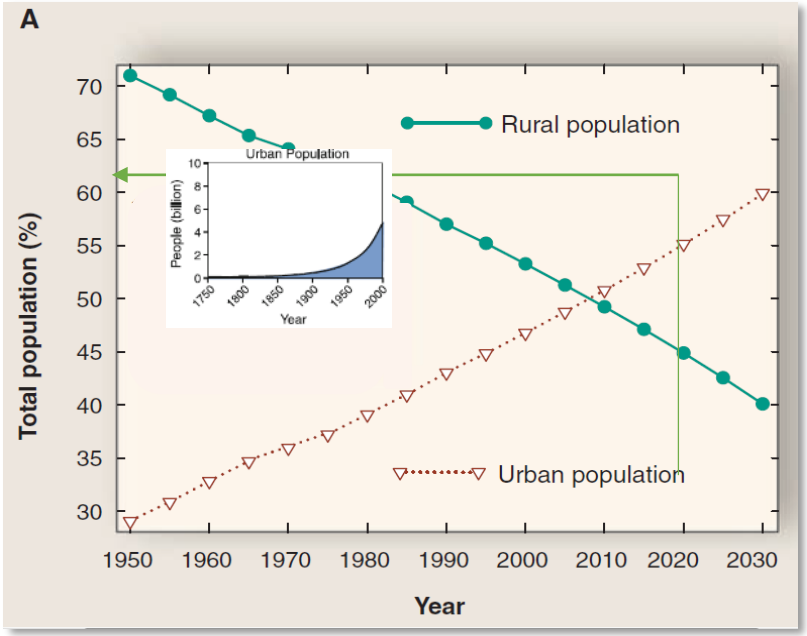
Smart technologies

The value of urban green spaces in an increasingly urbanized and hot world

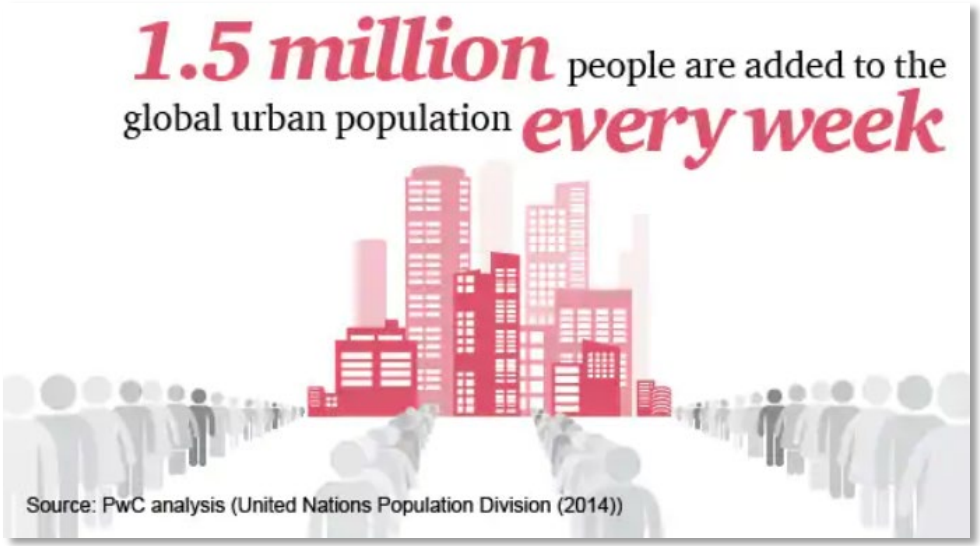
Professor Michelle Leishman
Centre for Smart Green Cities
Department of Biological Sciences, Macquarie University

Green Street
(Photograph: Sydney Olympic Park Authority)

The great global challenges - urbanisation



Changes in world's urban and rural population (%) from 1950 to 2030 (projected)



https://www.pwc.co.uk/issues/megatrends/rapid-urbanisation.html#new-urban-agenda

"THE FUTURE IS URBAN"

The great global challenges - urbanisation

The world

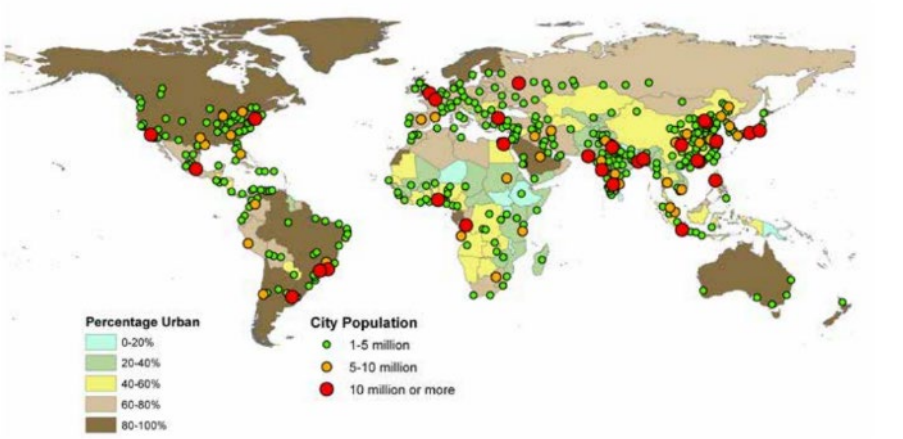
- Nearly 60% of the global population (>4 billion people) live in urban areas and increasing

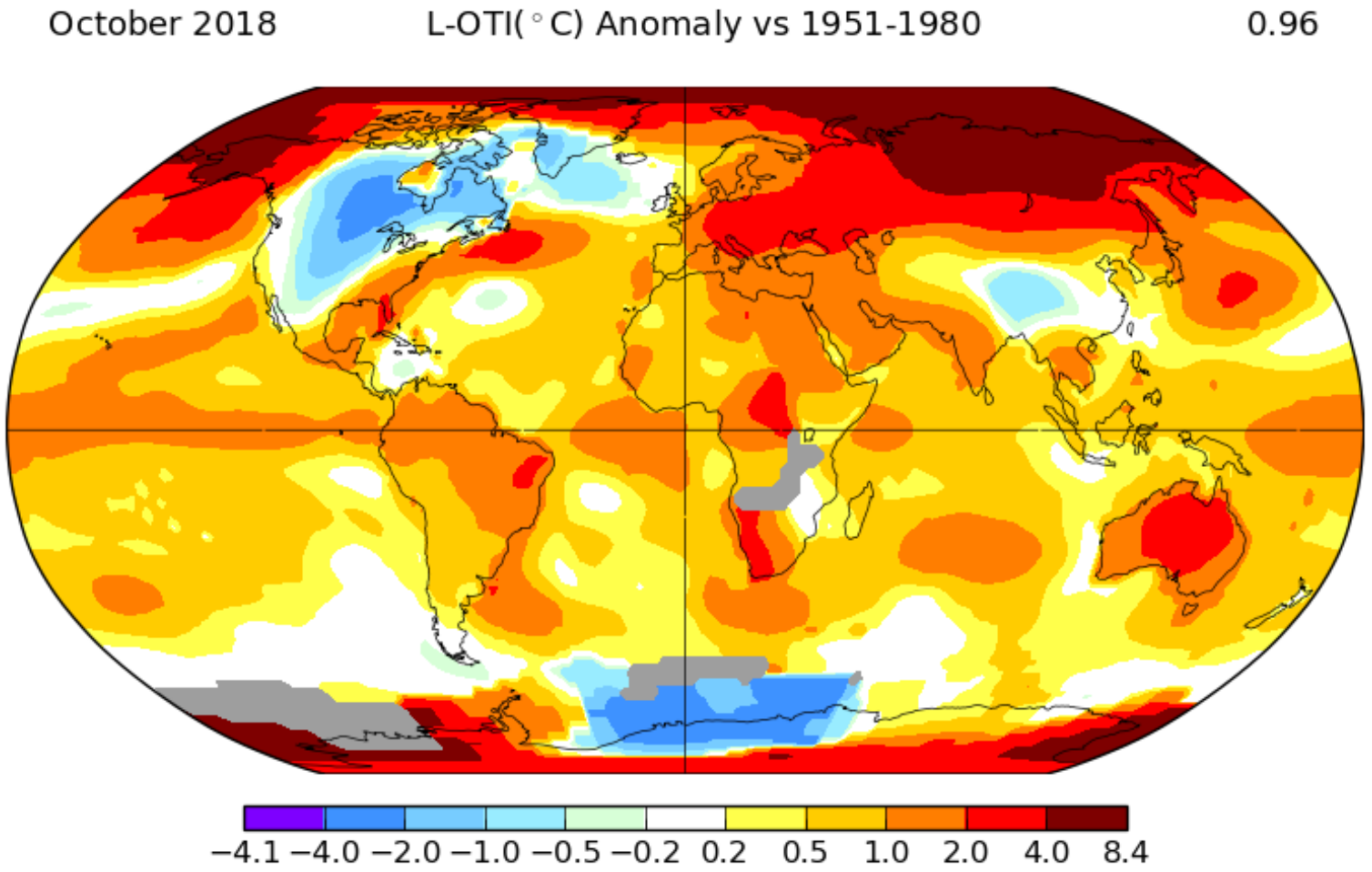
Australia

- nearly 70% of the population live in a capital city
- ~40% of the population live in Sydney and Melbourne
- 85% live within 50 km of the coast

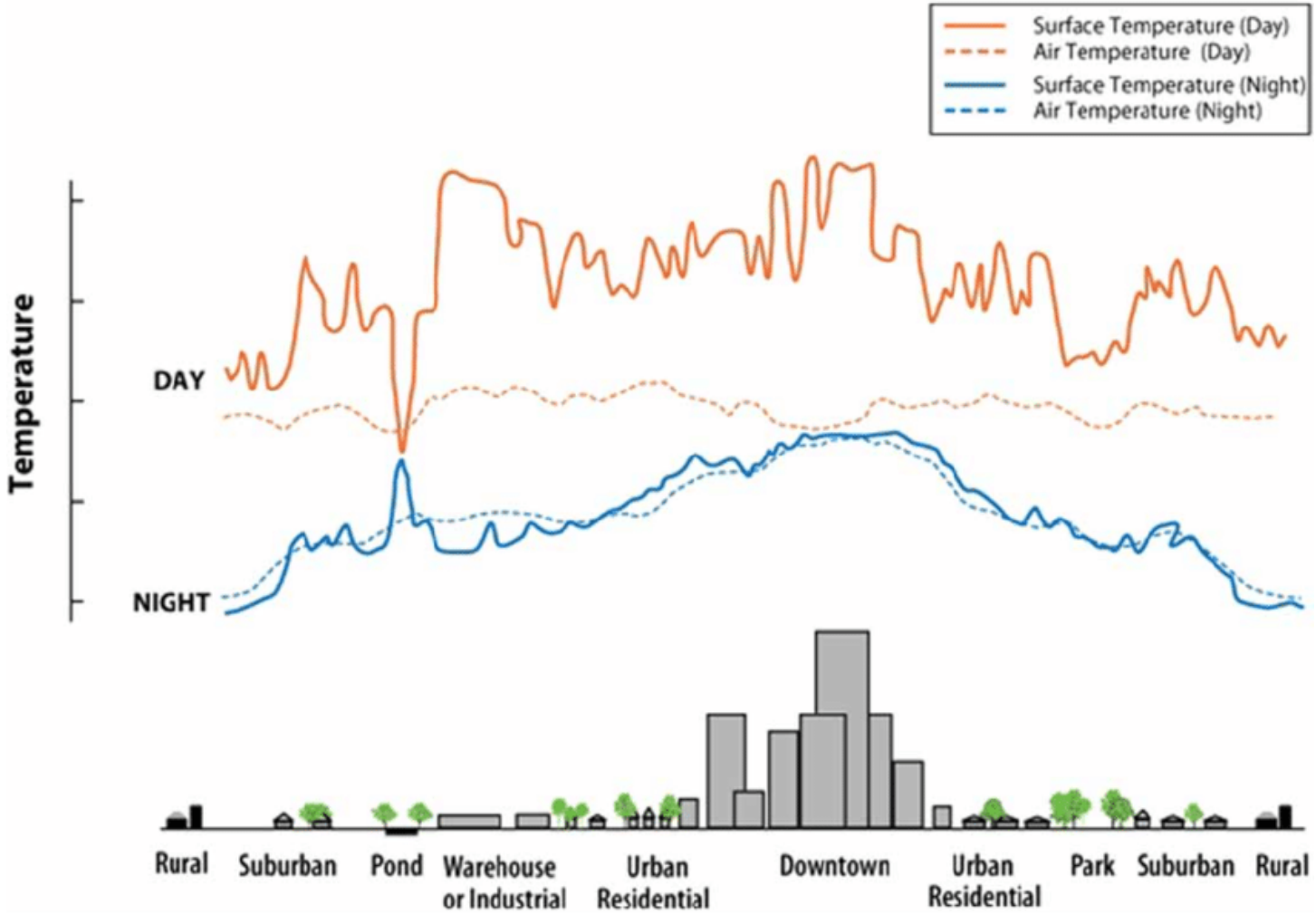
Figure 1.3: **Global patterns of urbanization, 2015**

Source: Based on United Nations, 2014b.





This global anomaly map compares temperatures in October 2018 to the 1951 to 1980 base period. (Source: NASA GISTEMP)


Surface Temperature (Day)
Air Temperature (Day)
Surface Temperature (Night)
Air Temperature (Night)
Temperature
DAY
NIGHT
Rural
Suburban
Pond
Warehouse or Industrial
Urban Residential
Downtown
Urban Residential
Park
Suburban
Rural

WHY WE FOCUS ON URBAN TREES

Trees bring benefits to communities, wildlife and the environment. In cities, they can...

Conserve Energy
Carefully positioned trees can cut heating and cooling requirements in buildings, providing shade in the summer and blocking wind in the winter.

Add Character & Charm
Trees add beauty to their surroundings. They bring colour, soften harsh lines of buildings, screen unsightly views and enhance the character of an area.

Improve Air Quality
Trees improve air quality and counteract the greenhouse effect by absorbing pollutants and intercepting harmful particulates.

Support Environmental Education
Tree-planting projects, school gardens and Edible Playgrounds can help children develop their environmental awareness, conservation skills and knowledge of sustainable food.

Enable Urban Foraging
Trees provide fruits and nuts for wildlife and humans. Community orchards offer health, social and environmental benefits.

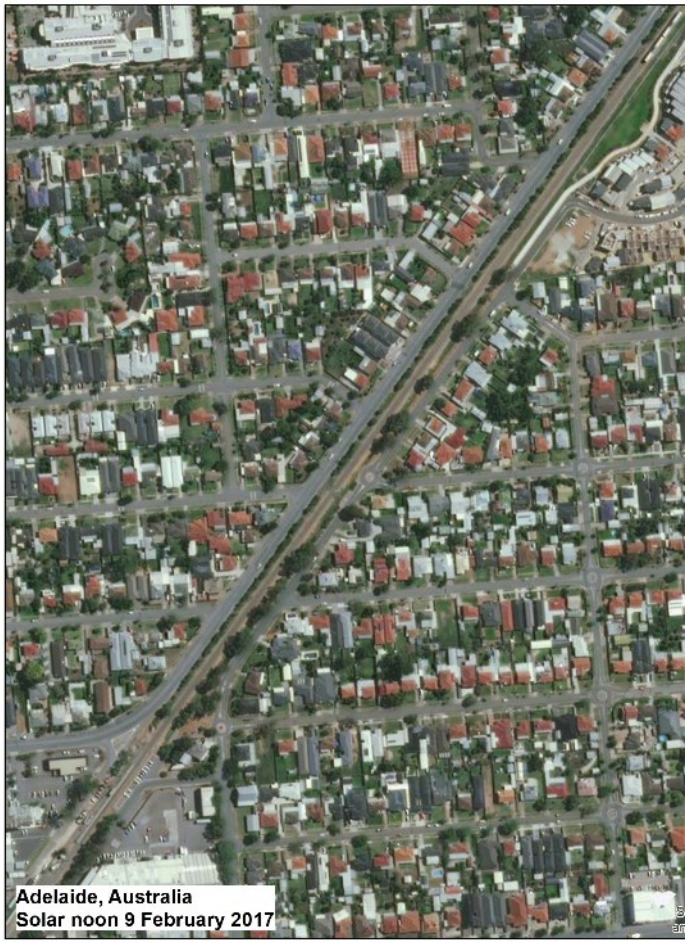
Enrich Habitats & Biodiversity
An increase in tree diversity benefits a host of insects, birds and mammals that rely on trees for food and protection. For example, they are an important source of nectar for bees.

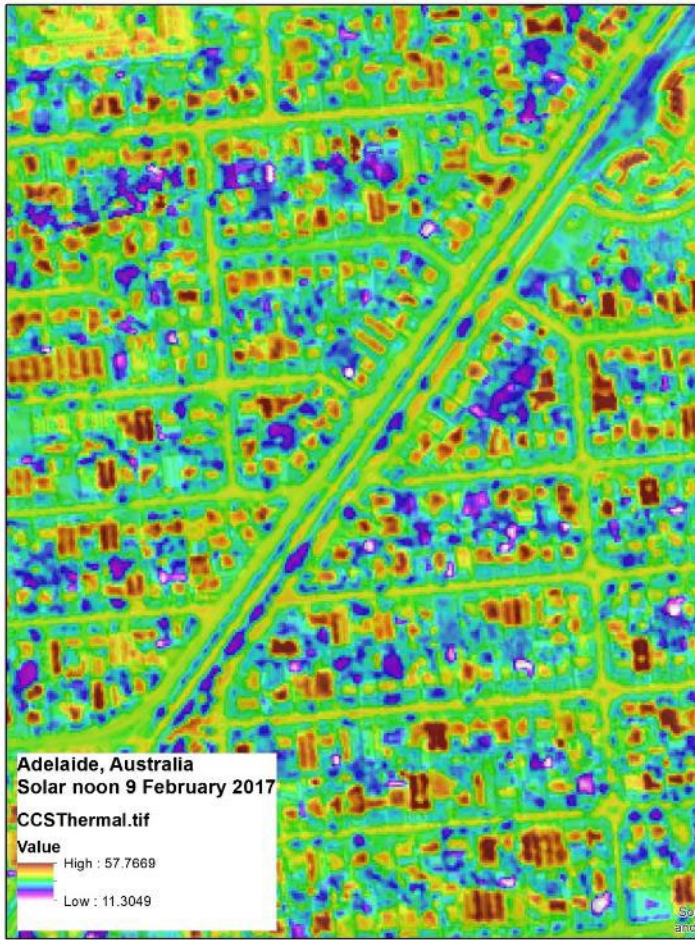
Reduce Flood Risk
Trees absorb water, lowering stress on storm water drains and mitigating flood risk. They also improve soil quality and prevent erosion, so more water is held in the ground.

Strengthen Communities
Creating and caring for green spaces helps people reconnect with their neighbours and their surroundings.

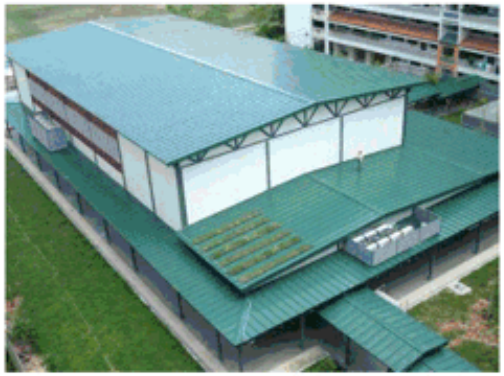
Enhanced Health & Well-being
Trees and green spaces can improve recovery times from illness, reduce stress and boost mental health.

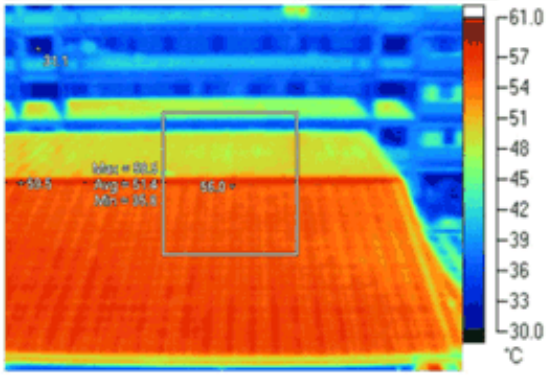
Green spaces are cooler





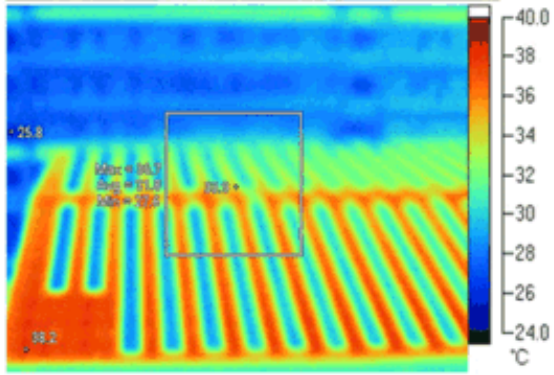
Greening works at the building level too





Name	Temperature	Emissivity
Centerpoint	56.0° C	0.95
Hot	59.5° C	0.95
Cold	31.1° C	0.95

Prior laying of Green Roof System - (56.0ºc)



Name	Temperature	Emissivity
Centerpoint	30.3° C	0.95
Hot	41.4° C	0.95
Cold	26.7° C	0.95

After laying of Green Roof System - (26.0ºc)

Greenroofs.com

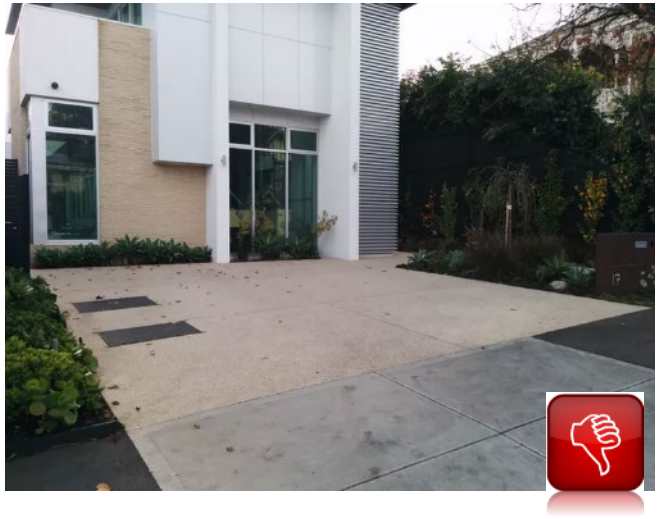
Urban green spaces reduce stormwater runoff

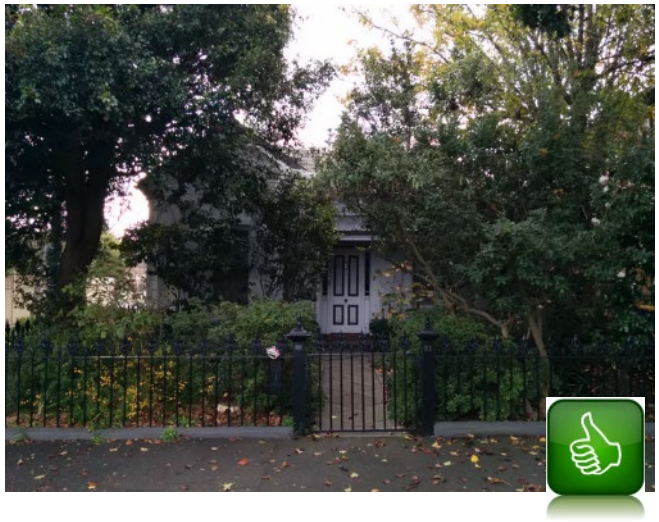
Hard surfaces increase the risk of urban flooding. Chesapeake Bay Program/Flickr, CC BY-NC

How your garden could help stop your city flooding

May 10, 2016 1.11pm AEST

Alessandro Ossola and Matthew Burns





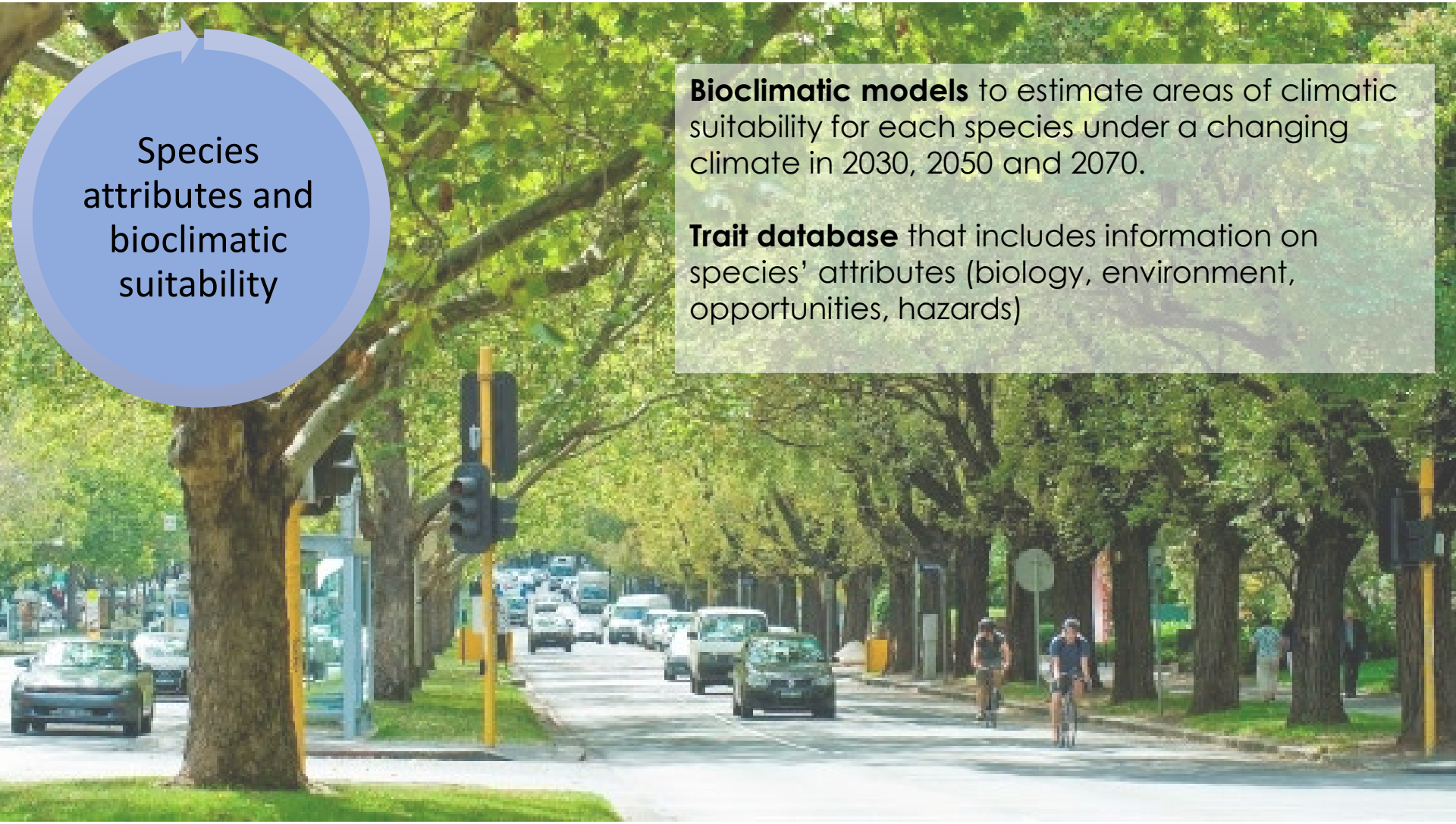
Urban green spaces support biodiversity

Platanus acerifolia
London planetree, Richmond
9th Jan. 2018

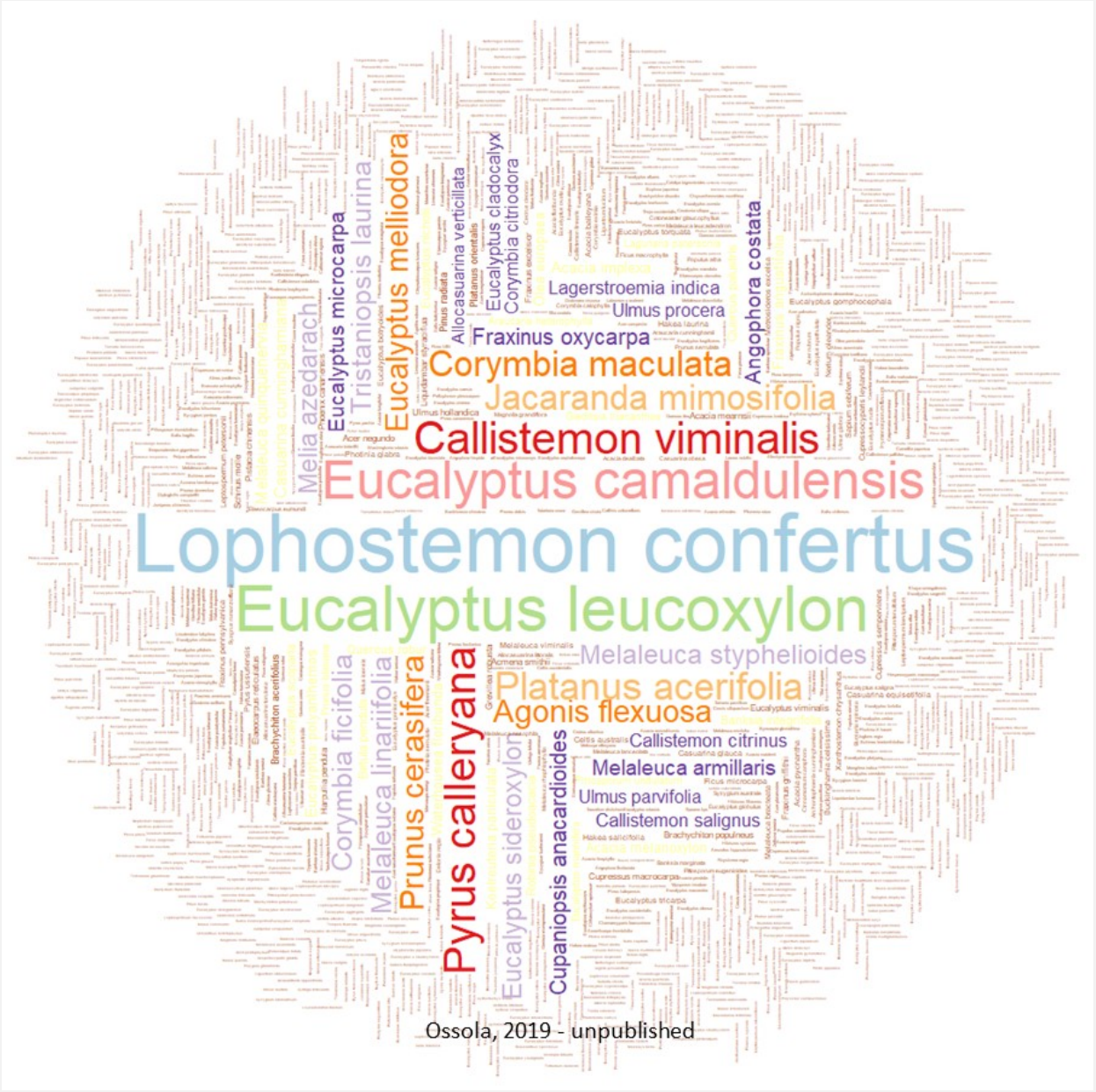
Banksia serrata
Old Man Banksia, Sydney
10th Mar. 2019

The Which Plant Where project

- Increase the species diversity in our landscapes.
- Identify drought and heat tolerant species under future climates.
- Develop best practice guidelines for the management of new and existing plantings.
- Develop a decision-support tool for a wide range of end-users.

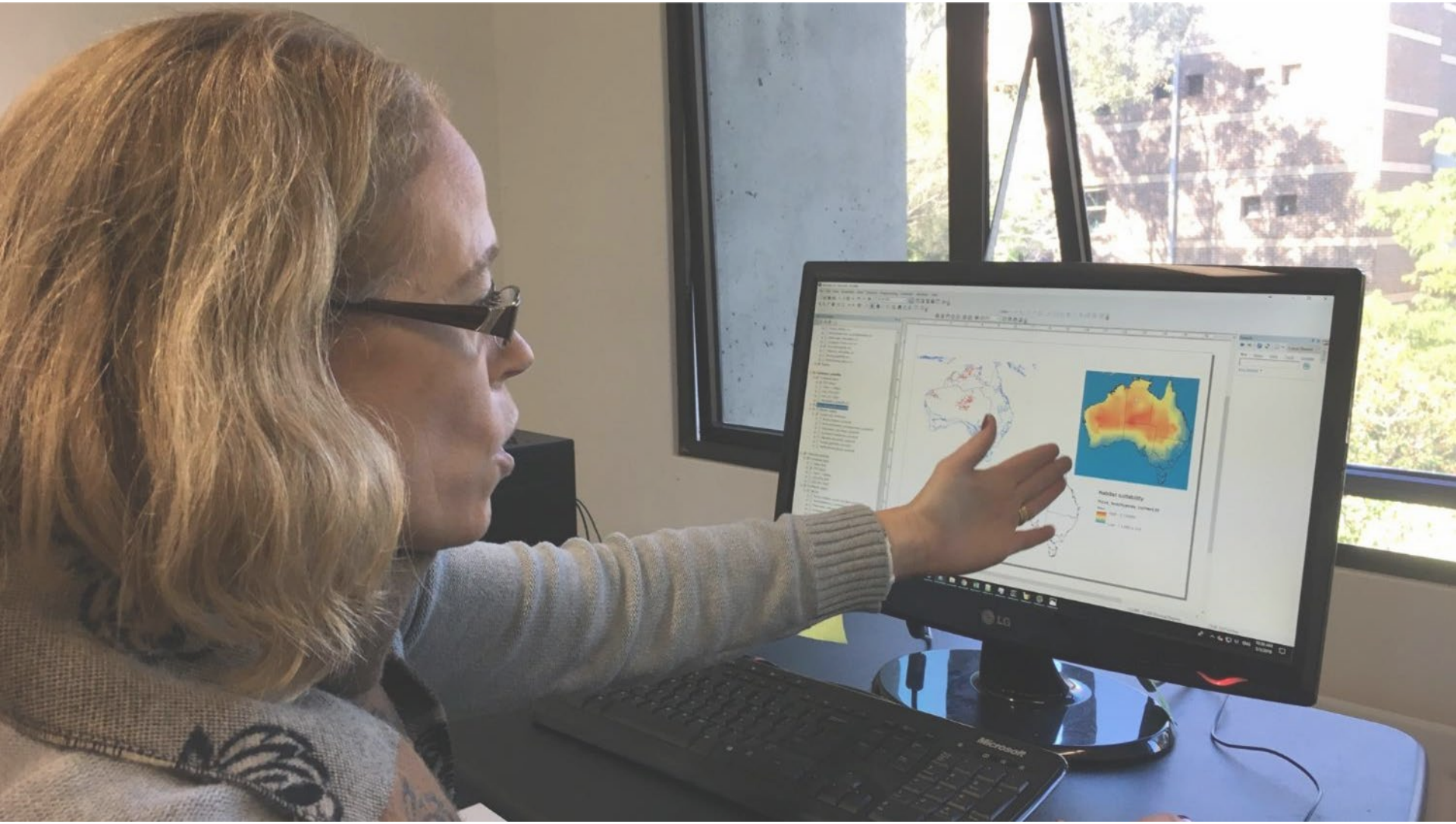

Species attributes and bioclimatic suitability
Bioclimatic models to estimate areas of climatic suitability for each species under a changing climate in 2030, 2050 and 2070.
Trait database that includes information on species' attributes (biology, environment, opportunities, hazards)

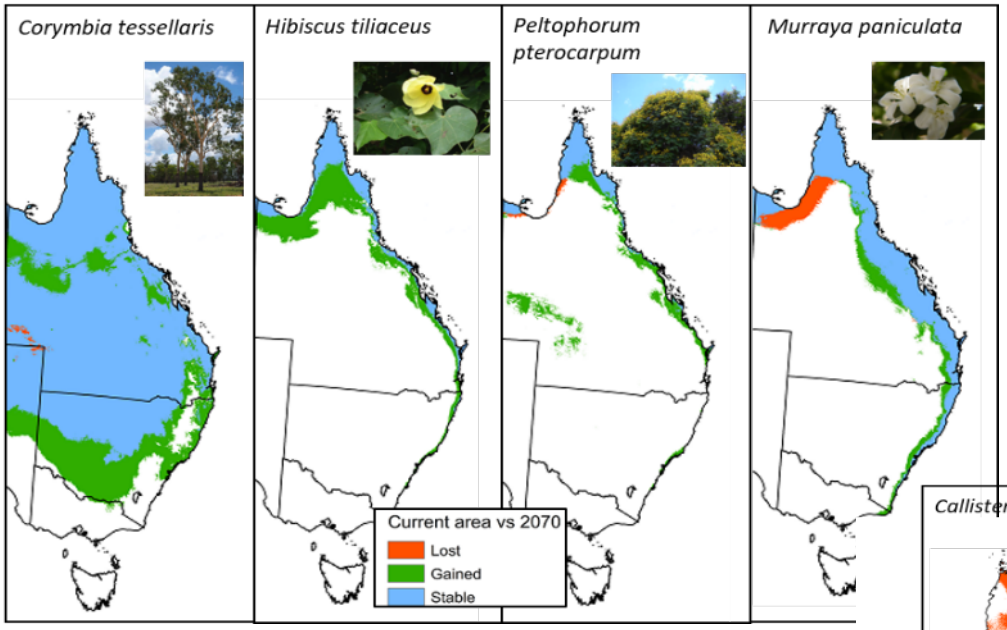
Australia's Urban Forest



1.2 million trees
60 Local Government Areas

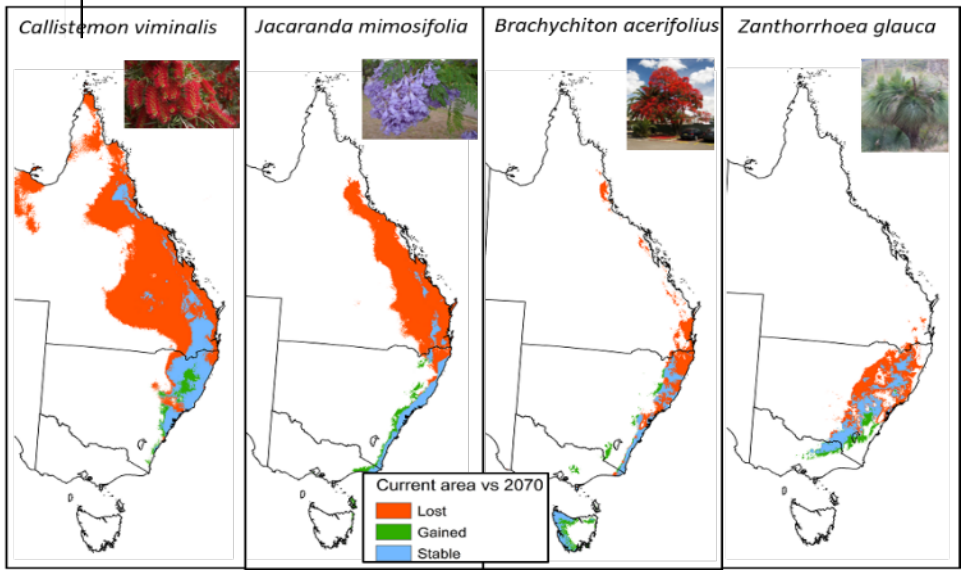
1,200+ species
30 most common species make up 53% of urban forest

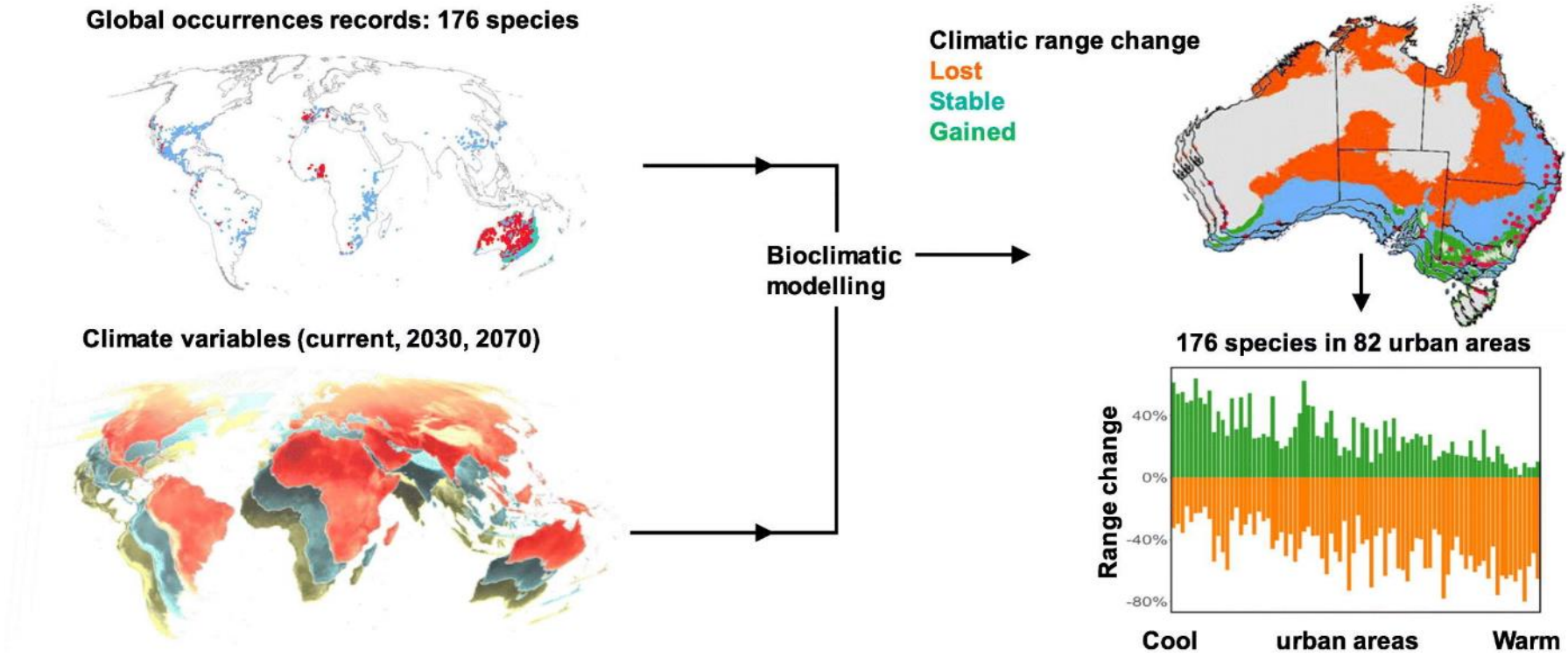




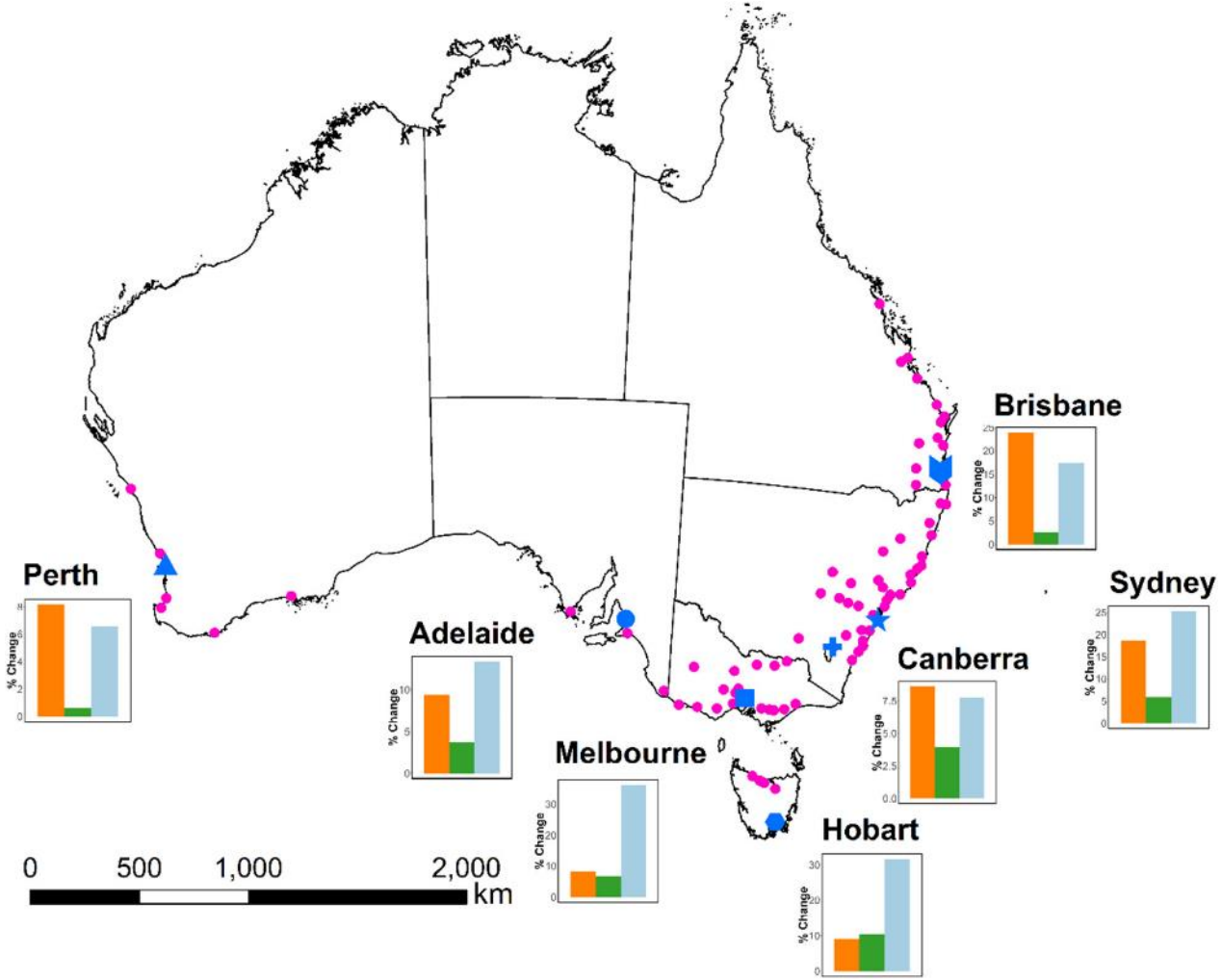
WINNERS!

LOSERS…





Burley, Hugh, et al. "Substantial declines in urban tree habitat predicted under climate change." *Science of The Total Environment* 685 (2019): 451-462



Burley, Hugh, et al. "Substantial declines in urban tree habitat predicted under climate change." *Science of The Total Environment* 685 (2019): 451-462


Bioclimatic modelling
Successes & Failures
Survive & Thrive


We are testing
1. Drought tolerance
2. Heat tolerance
3. Plant stress indicators


Soil VWC (%)
40
30
20
10
0
HEAT
WAVE
Control
Drought
Mar 19 Mar 26 Apr 02 Apr 09 Apr 16
Date
Air T (°C)
45
40
35
30
25
20
35 °C
27 °C
0
5
10
15
20
Hour

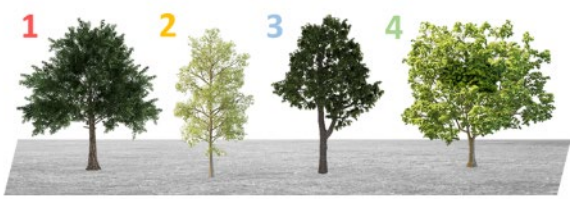
Toechima erythrocarpum

Buckinghamia celsissima

Hakea salicifolia

Which Plant Where Living Labs

TREE DESIGN (4 trees)



15 m

SHRUB DESIGN (16 shrubs)

15 m

TREE & SHRUB DESIGN (4 trees and 16 shrubs)

15 m

Trees

1) *Lagerstroemia indica* (Crepe myrtle) (exotic/deciduous/8 m)

2) *Liriodendron tulipifera* (Tuliptree magnolia) (exotic/deciduous/20 m)

3) *Elaeocarpus reticulatus* (Blueberry ash) (native/evergreen/15 m)

4) *Lophostemon confertus* (Queensland brush box) (native/evergreen/20 m)

Shrubs

1) *Melaleuca citrina* (Red bottlebrush) (native, 3 m) *synonym *Callistemon*

2) *Westringia fruticosa* (Coastal rosemary) (native, 1.5 m)

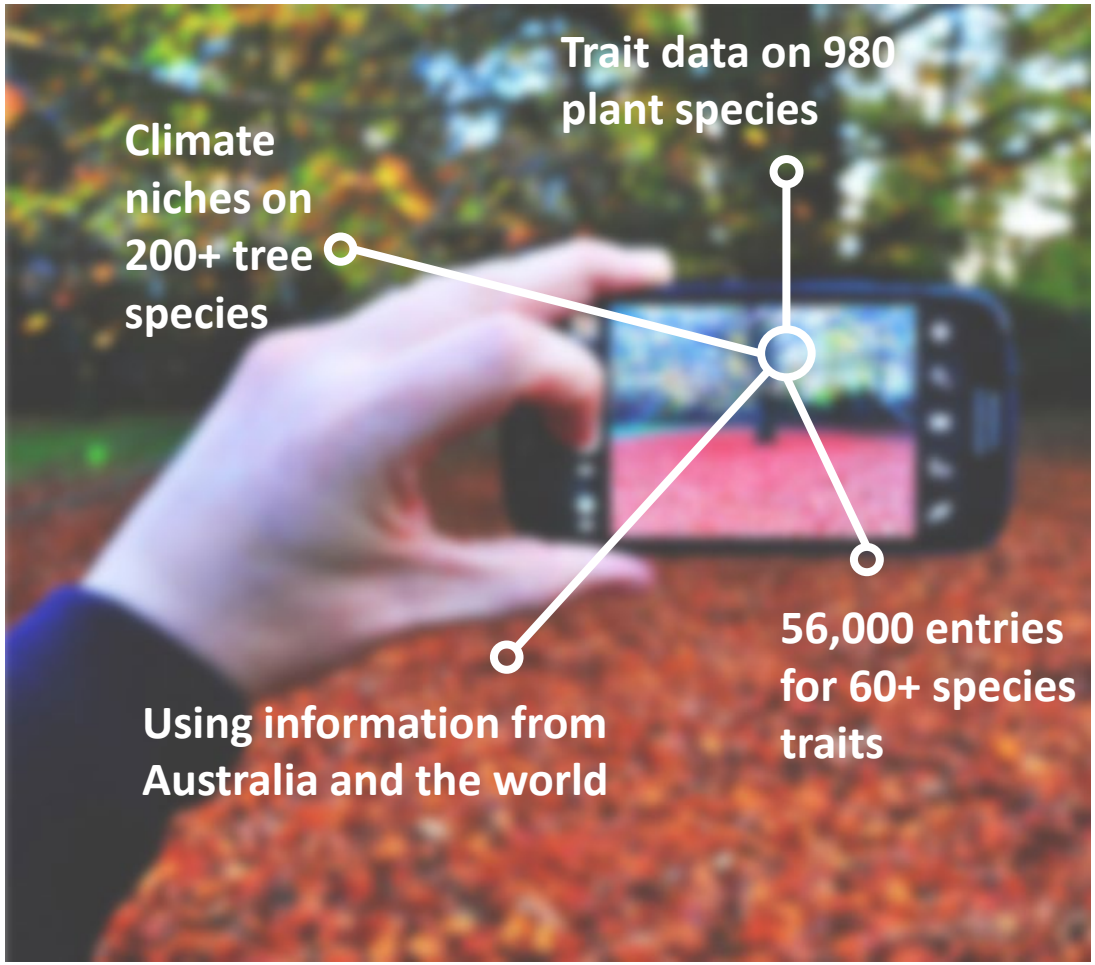
3) *Baeckea virgata* (Dwarf Baeckea) (native, 1.5 m) *synonym *Sannantha virgata*

4) *Hibbertia obtusifolia* (Hoary Guinea-flower) (native, 1 m)

The WPW Plant Selection Tool

- Assist practitioners with plant selection
- Incorporate results of climate change modelling and risk scenarios
- Draw on grey and scientific literature, practitioner and horticulturalist knowledge to assess species traits and benefits
- An innovative tool to guide species selection for current and future climates

PROGRESS TO DATE…




MACQUARIE
University
WESTERN SYDNEY
UNIVERSITY
NSW
GOVERNMENT
Office of
Environment
& Heritage
WHICH
PLANT WHERE?
Hort
Innovation
202020™
VISION