Which Plant Where

MACQUARIE University

WESTERN SYDNEY UNIVERSITY

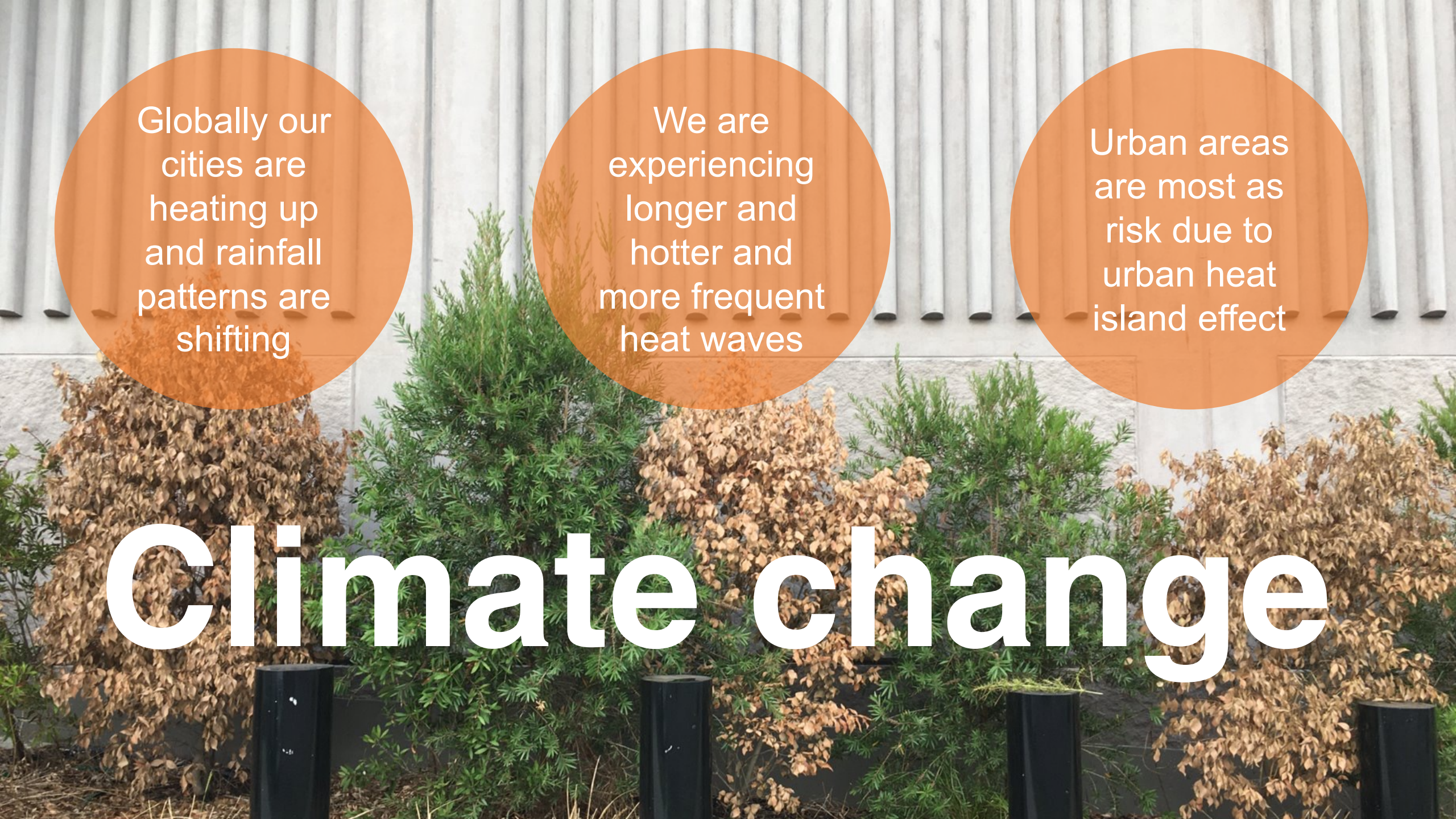
hort frontiers Strategic partnership initiative | GREEN CITIES FUND

NSW GOVERNMENT


Which Plant Where
Climate ready plant selection tool to enable resilient urban landscapes

Why do we need this?

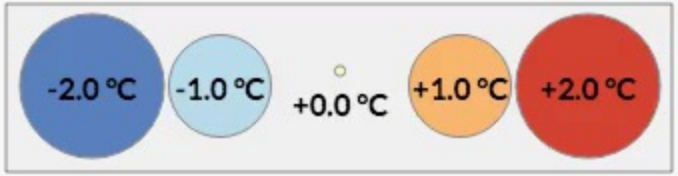
Our climate is changing and some species that have thrived in the past may not continue to do so in the future


Globally our cities are heating up and rainfall patterns are shifting
We are experiencing longer and hotter and more frequent heat waves
Urban areas are most as risk due to urban heat island effect
Climate change

TEMPERATURE CHANGE

Years 1900–2018 & Projections 2020s–2090s

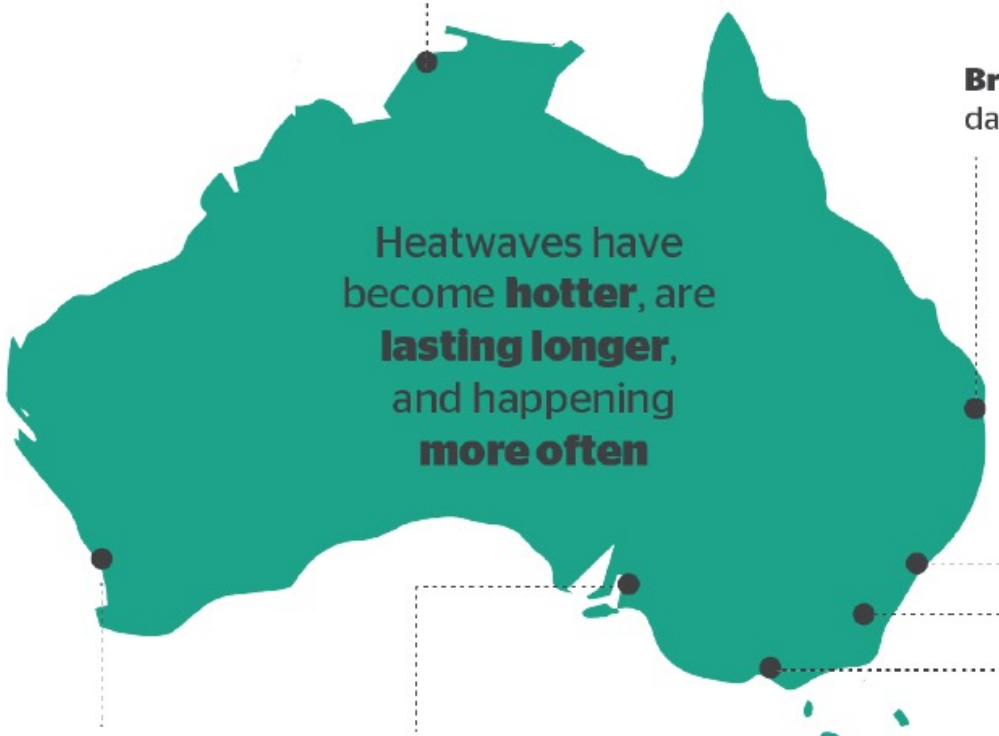
1900



Afghanistan
Albania
Algeria
Andorra
Angola
Argentina
Armenia
Australia
Austria
Azerbaijan
Bahamas
Bahrain
Bangladesh
Barbados
Belarus
Belgium
Belize
Benin
Bhutan
Bolivia
Bosnia and Herzegovina
Botswana
Brazil
Brunei
Bulgaria
Burkina Faso
Burundi
Cabo Verde
Cambodia
Cameroon
Canada
Central African Republic
Chad
Chile
China
Colombia
Comoros
Congo Dem. Rep.
Congo Rep.
Costa Rica
Côte d'Ivoire
Croatia
Cuba
Cyprus
Czechia
Denmark
Djibouti
Dominica
Dominican Republic
Ecuador
Egypt
El Salvador
Equatorial Guinea
Eritrea
Estonia
Eswatini
Ethiopia
Fiji
Finland
France
Gabon
Gambia
Georgia
Germany
Ghana
Greece
Grenada
Guatemala
Guinea
Guinea-Bissau
Guyana
Haiti
Honduras
Hungary
Iceland
India
Indonesia
Iran
Iraq
Ireland
Israel
Italy
Jamaica
Japan
Jordan
Kazakhstan
Kenya
Kiribati
North Korea
South Korea
Kosovo
Kuwait
Kyrgyz Republic
Lao PDR
Latvia
Lebanon
Lesotho
Liberia
Libya
Liechtenstein
Lithuania
Luxembourg
Macedonia FYR
Madagascar
Malawi
Malaysia
Maldives
Mali
Malta
Marshall Islands
Mauritania
Mauritius
Mexico
Micronesia
Moldova
Monaco
Mongolia
Montenegro
Morocco
Mozambique
Myanmar
Namibia
Nauru
Nepal
Netherlands
New Zealand
Nicaragua
Niger
Nigeria
Norway
Oman
Pakistan
Palau
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Poland
Portugal
Qatar
Romania
Russian Federation
Rwanda
Samoa
San Marino
Sao Tome and Principe
Saudi Arabia
Senegal
Seychelles
Sierra Leone
Singapore
Slovak Republic
Slovenia
Solomon Islands
Somalia
South Africa
South Sudan
Spain
Sri Lanka
St. Kitts and Nevis
St. Lucia
St. Vincent
Sudan
Suriname
Sweden
Switzerland
Syrian Arab Republic
Taiwan
Tajikistan
Thailand
Timor-Leste
Togo
Tonga
Trinidad and Tobago
Tunisia
Turkey
Turkmenistan
Uganda
Ukraine
United Arab Emirates
United Kingdom
Uruguay
USA
Uzbekistan
Vanuatu
Venezuela
Vietnam
Yemen
Zambia
Zimbabwe

Data sources:
Berkeley Earth temperature analysis (1900-2018)
The 'rcp45' experiment of the CMIP5 (2020–2100)
Base period 1951–1980.

Australia



Darwin: number of heatwave days have more than doubled

Brisbane: heatwave days start 8 days earlier

Canberra: number of heatwave days have more than doubled

Sydney: heatwave days start 19 days earlier

Melbourne: hottest heatwave day is now 2°C hotter; heatwaves start on average 17 days earlier

Hobart: number of heatwave days have more than doubled

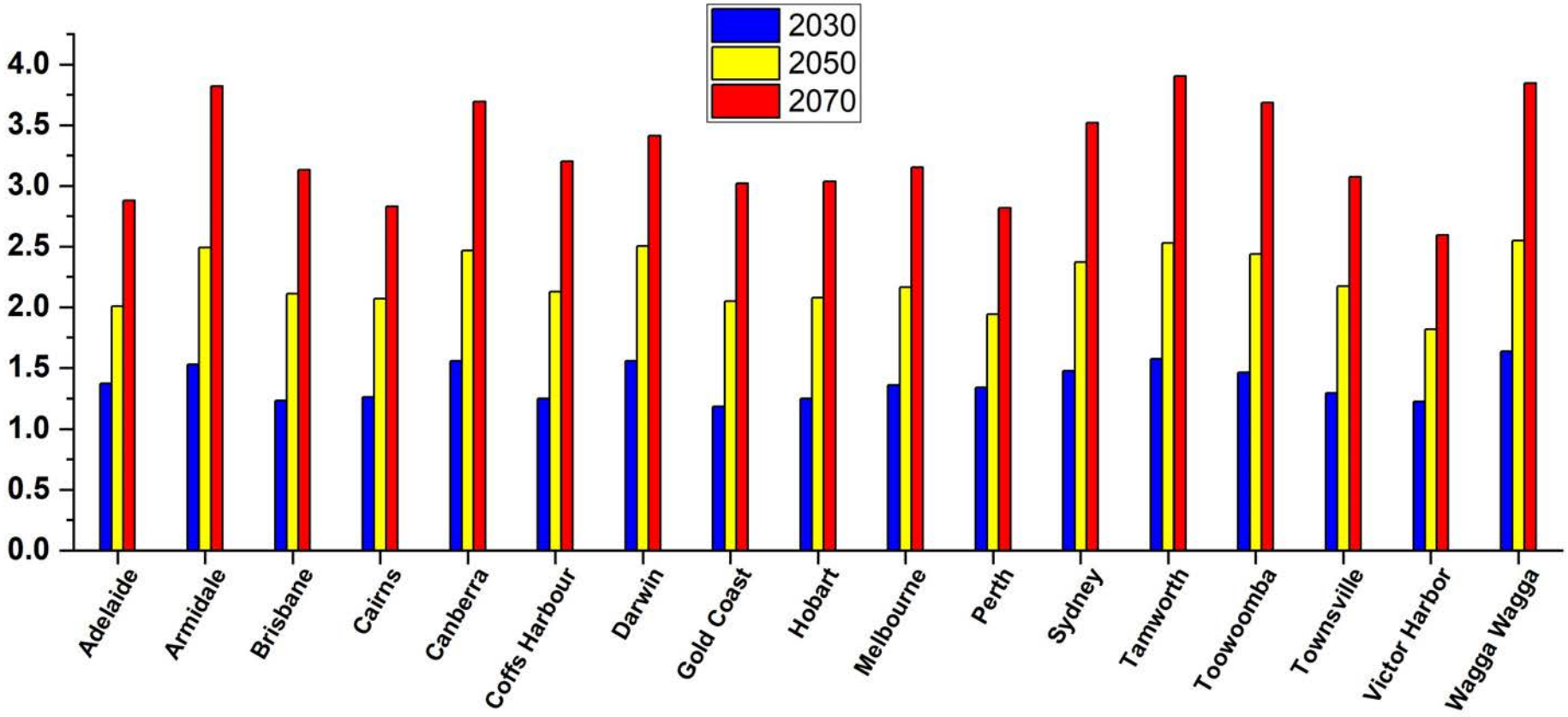
Perth: number of heatwave days have increased by 50%

Adelaide: hottest heatwave day is 4.3°C hotter; number of heatwave days have almost doubled

Australian cities

Based on RCP 8.5 projections

(worst case scenario)

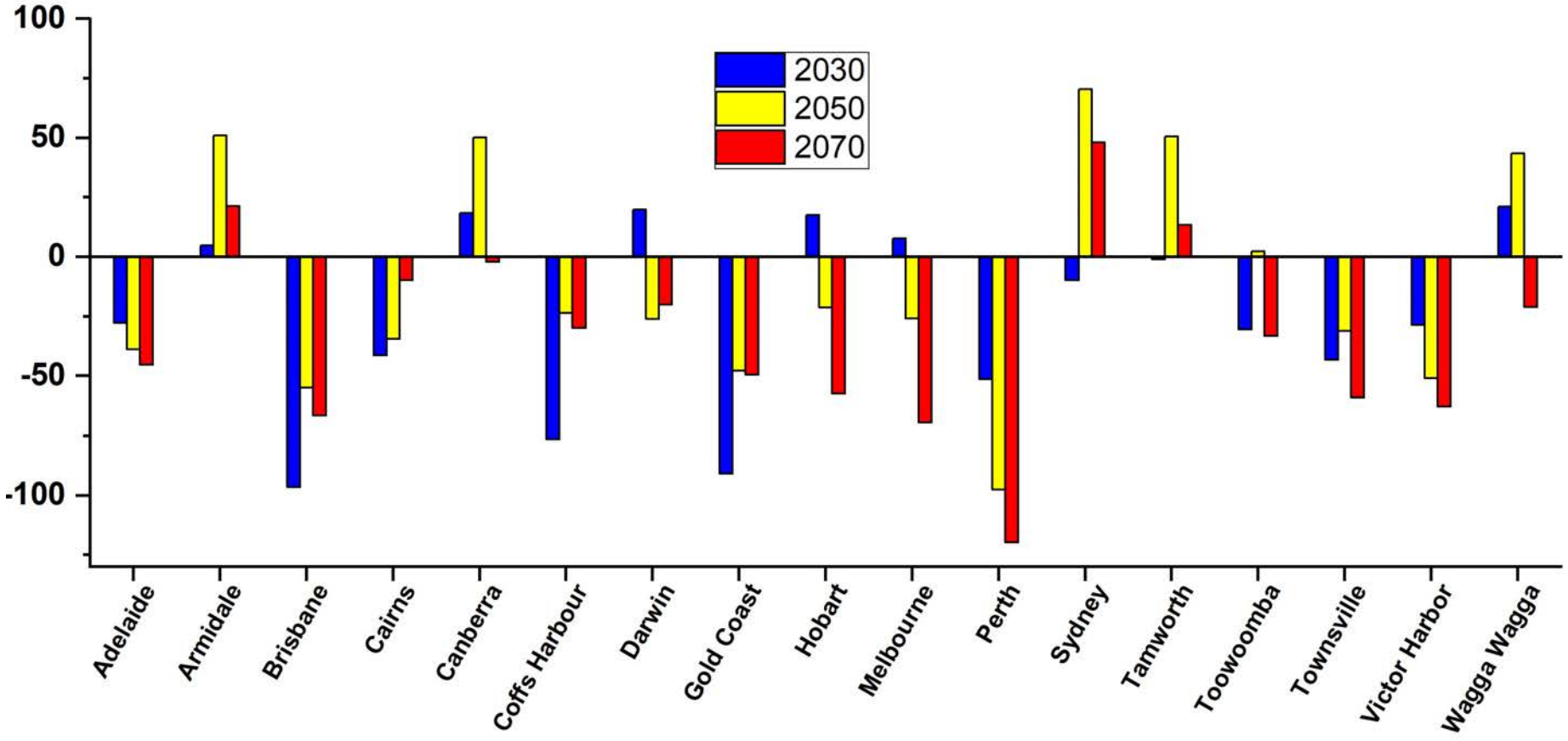


TEMPERATURE

Australian cities

Based on RCP 8.5 projections

(worst case scenario)

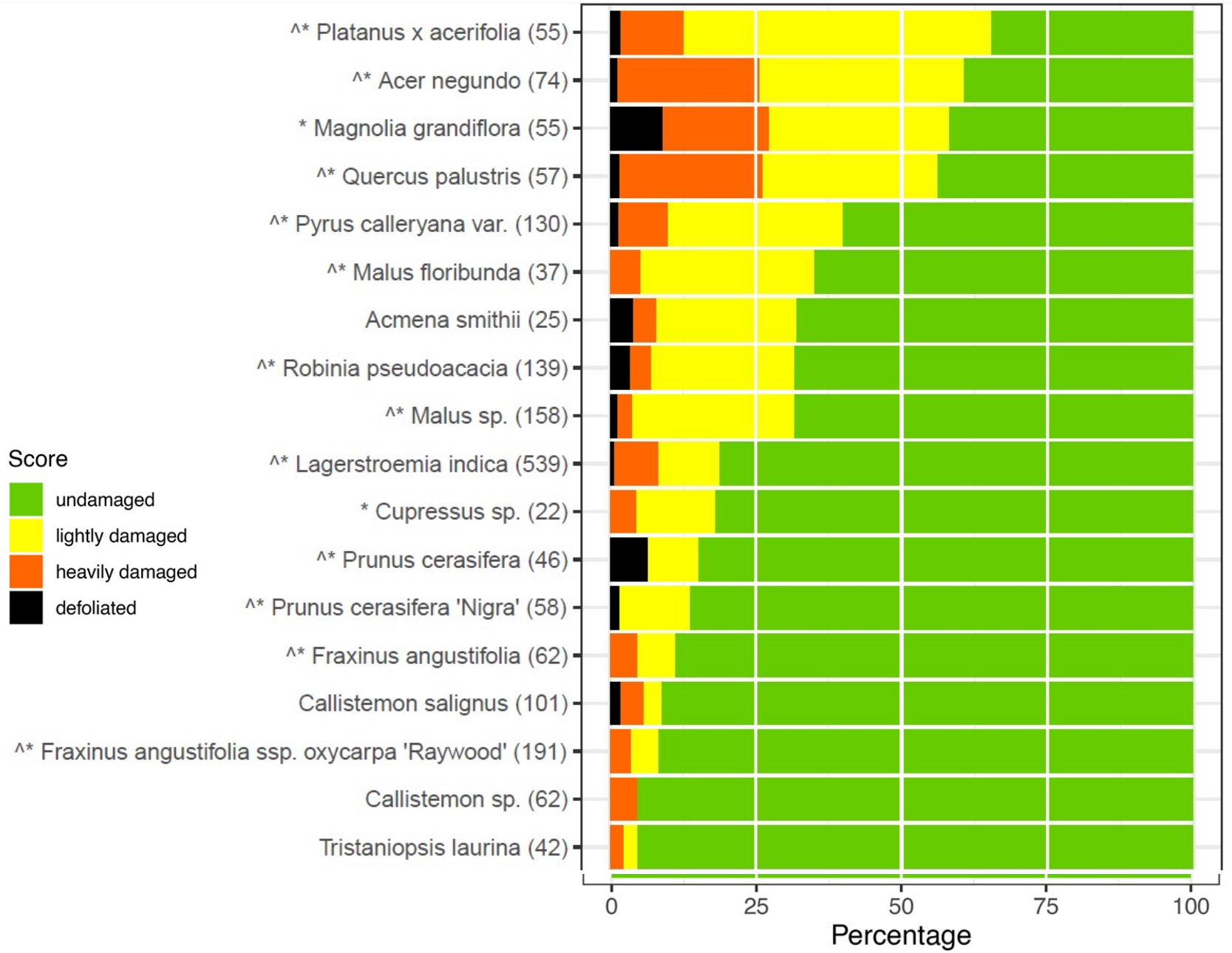


RAIN FALL

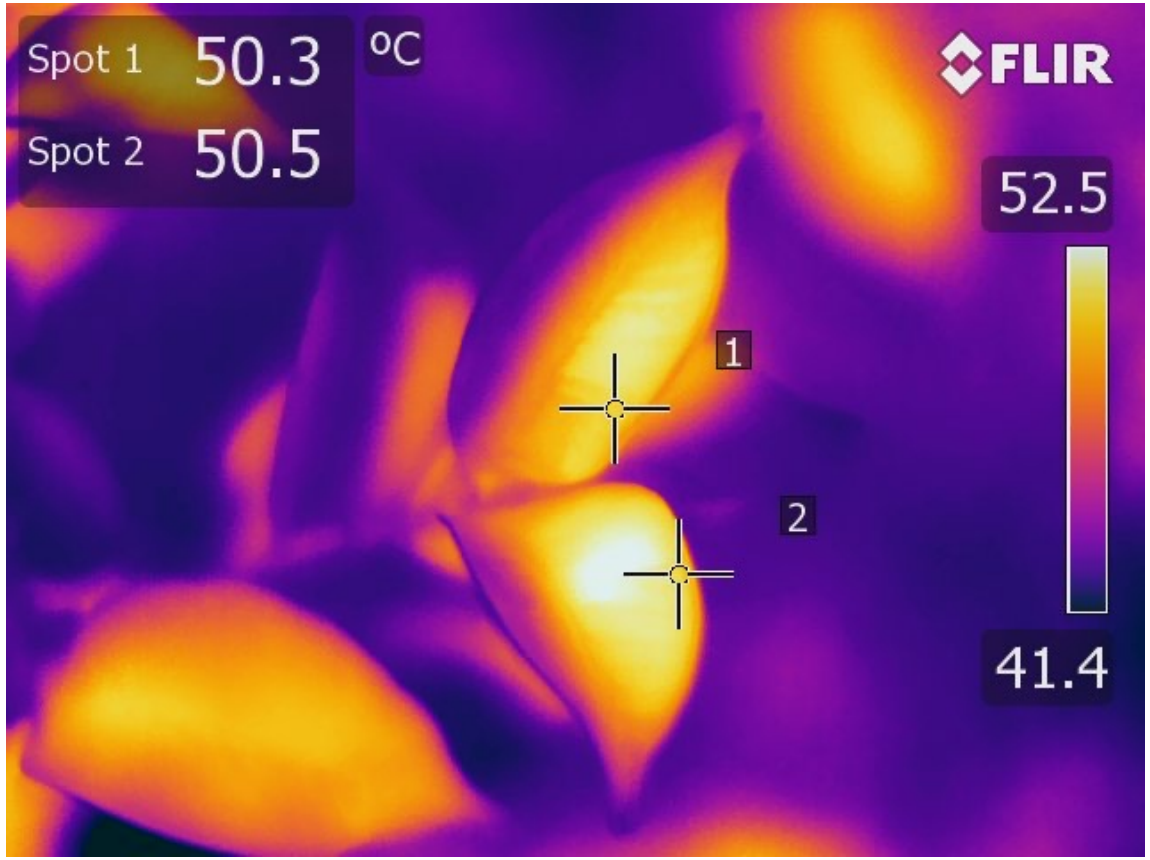
What is the impact on our urban green space?

Field study of 5500 existing street trees (Penrith area) during the 2019 - 2020 heat wave

Study: Tabassum et al., 2021

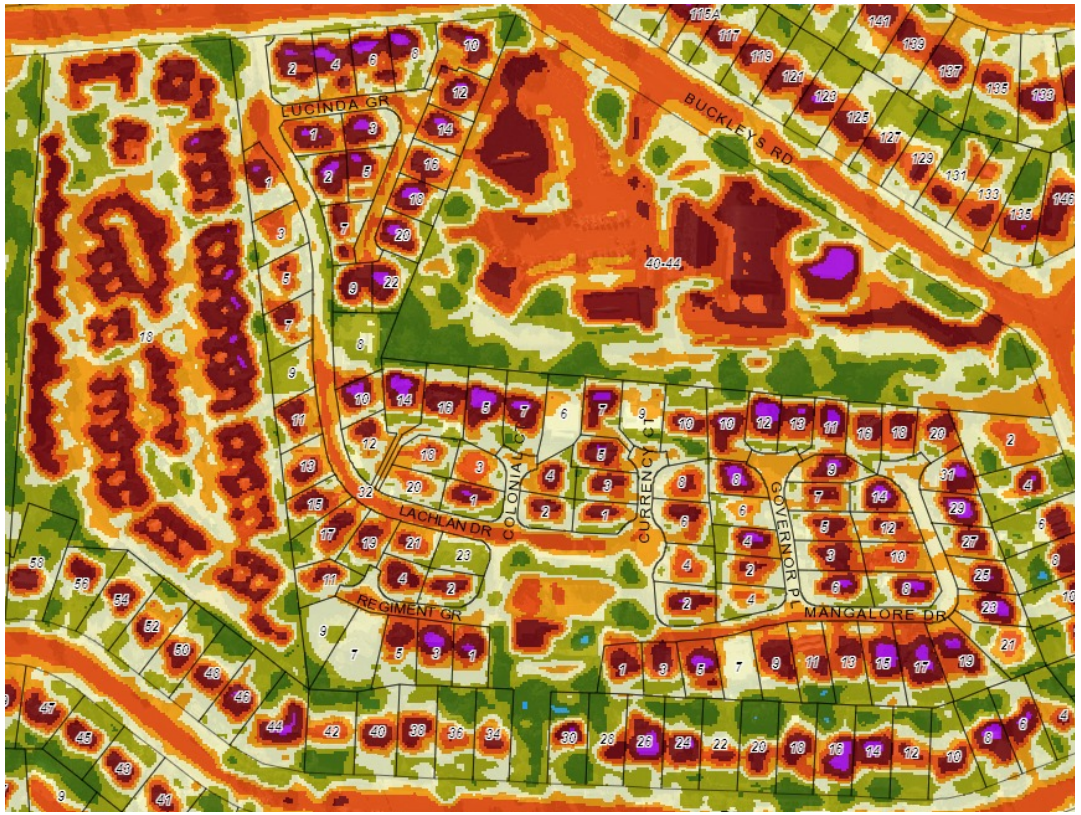


Extreme temperature can result in leaf scorch



Over **10%** of street trees experienced critical leaf damage

Urban green space provides cooling



Source: Parramatta Heat Map

Urban green space are essential to the liveability of our cities, now more so than ever before primarily due to cooling benefits

Choosing climate ready species will be key to ensure our urban forests are resilient to climate change

The nursery industry in Australia is worth **$2.6** billion annually


How do we solve this problem?


THE
RESEARCH

Module One

Species attributes

Module Two

Success and failures Living Labs

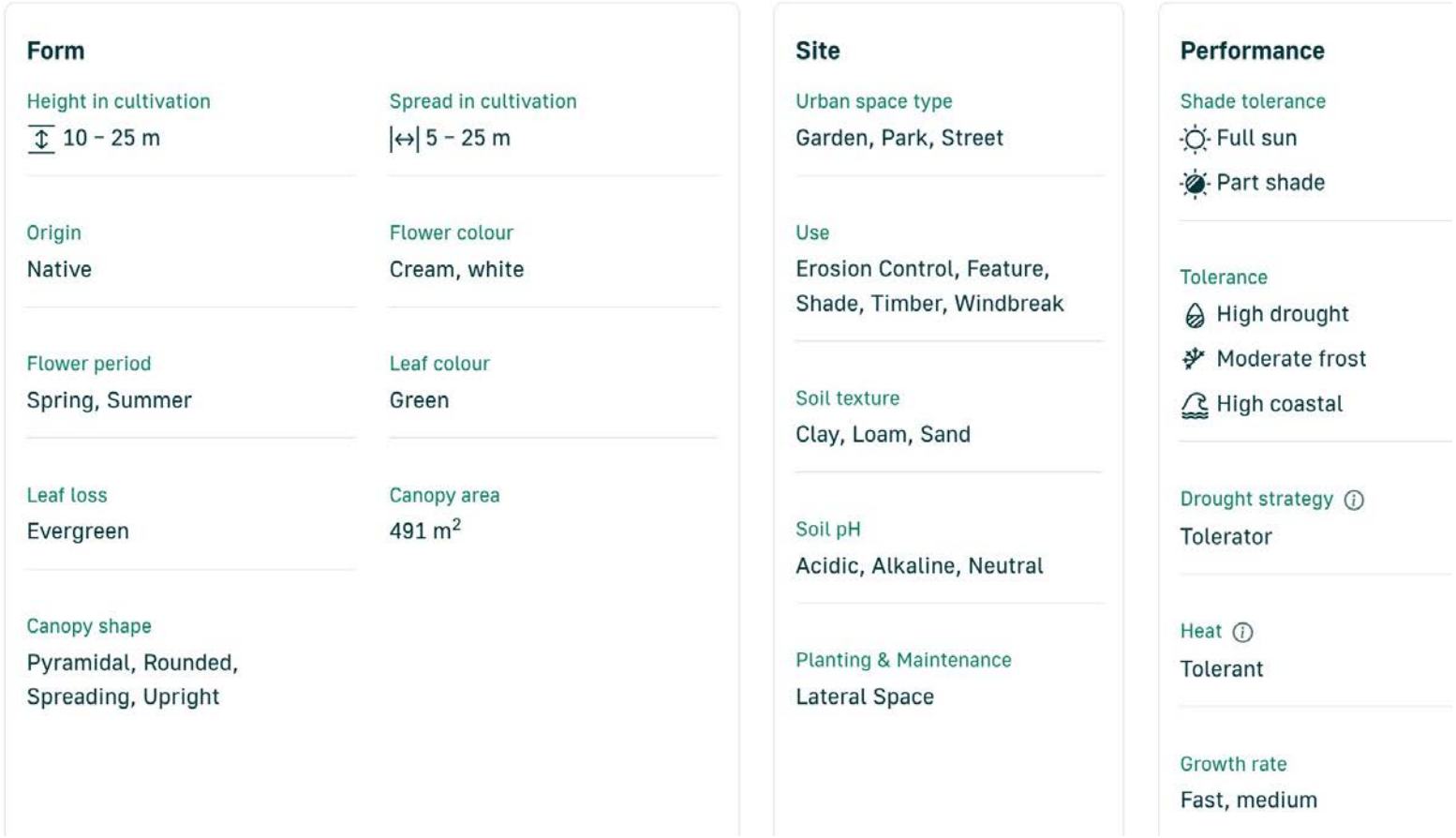
Module Three

Heat and drought tolerance

Module ONE

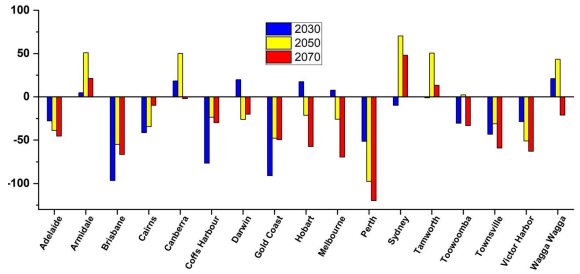
Species attributes and climatic tolerance

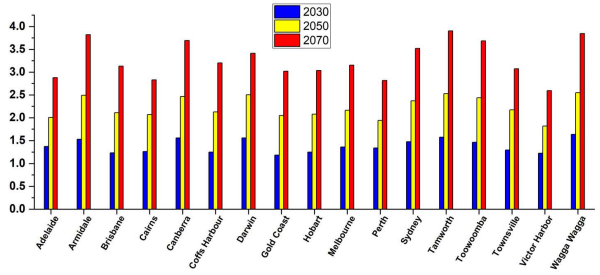
In this module we collated a database of over 2600 species, hybrids and cultivars and defined their **traits** including, climactic tolerances, form, soil types etc.

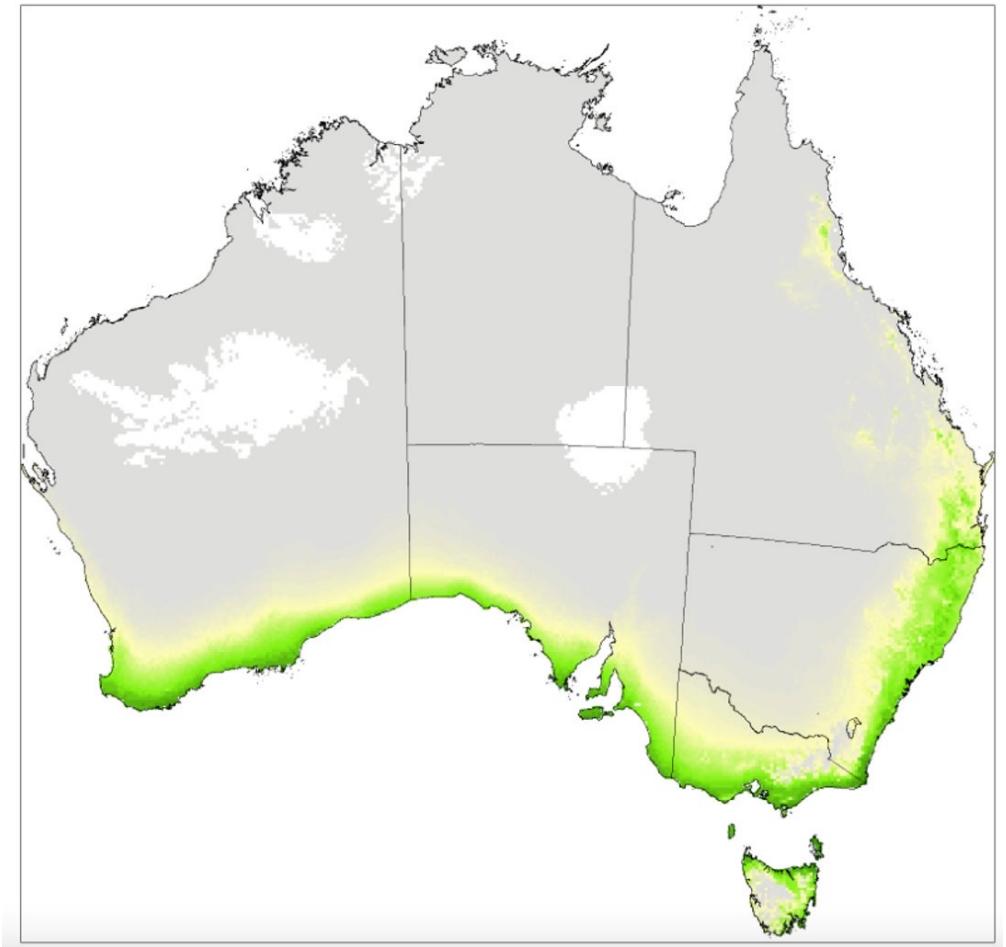


Module ONE

Species attributes and climatic tolerance







Bioclimatic modelling was undertaken for all species, resulting in the development of national-level maps of climatic suitability for each species.

Bioclimatic models = estimated areas of climatic suitability for each species under a changing climate in 2030, 2050 and 2070.

Module Two

Success and failures with Living Labs

This module accessed success and failures of urban tree plantings in relation to local conditions as well as variables such as planting and management techniques.

12 **'Living Labs'** were established across Australia

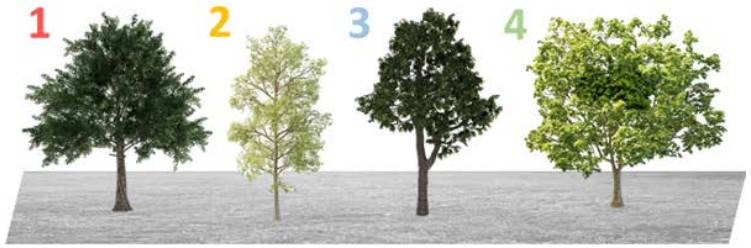
Module Two
Success and failures with Living Labs

The ’Living Labs’ tested three different planting scenarios to test co-benefits.

Mix tree and shrub planting creates the best resilience.

Highlighted the importance of recording success and failures of trees on an ongoing basis – not many Council’s do this.

TREE DESIGN (4 trees)



15 m

SHRUB DESIGN (16 shrubs)

15 m

TREE & SHRUB DESIGN (4 trees and 16 shrubs)

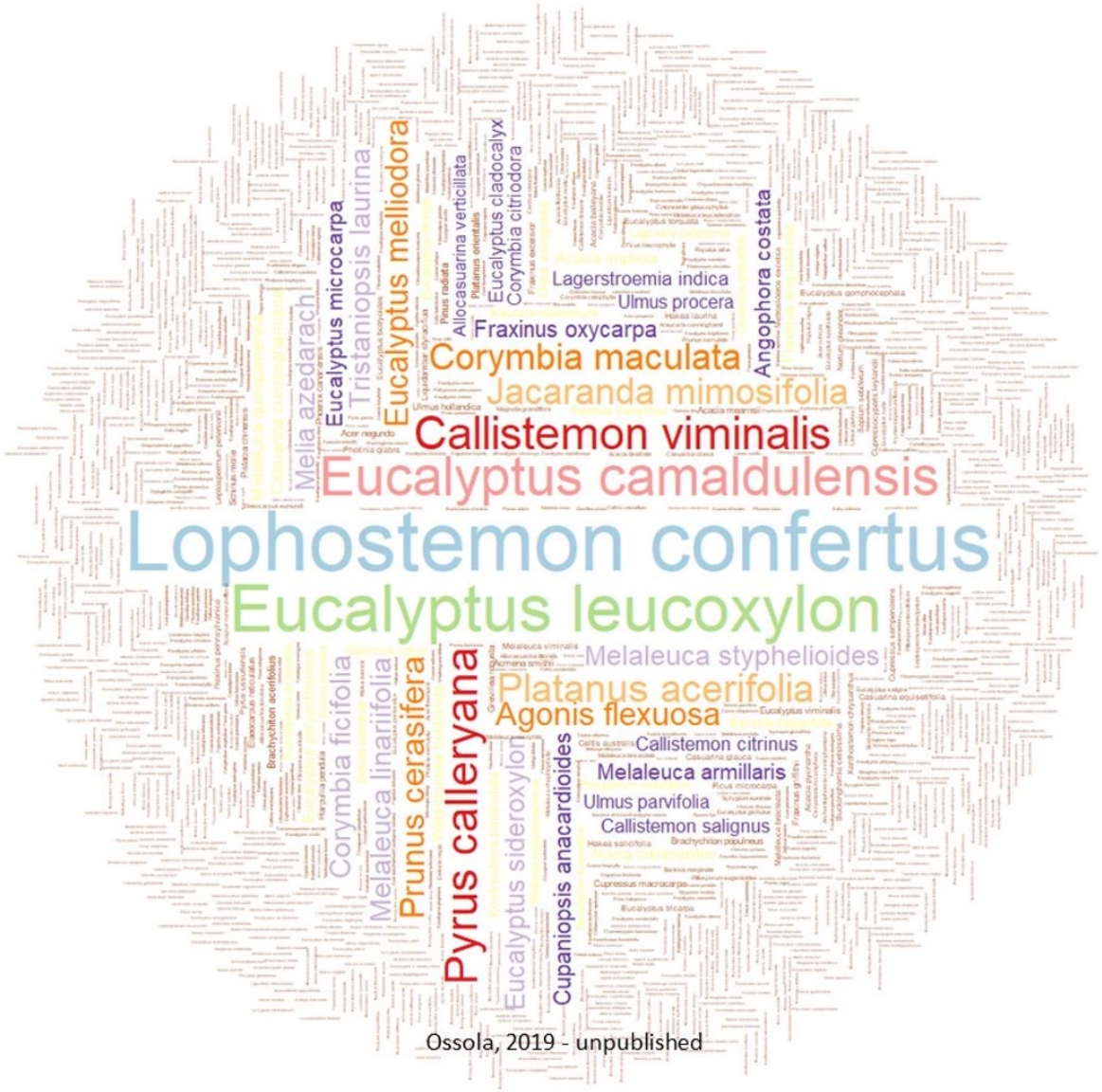
15 m

Module Two

Success and failures with Living Labs

As part of this module **60** Council tree inventories were analysed.

- 30 of the most common species make up 53% of urban forest across Australia.
- Species diversity is important for resilience
- Urban landscapes are becoming increasingly vulnerable to climate change.



Module Three

Heat and drought tolerance

This module subjected a sample of 113 species to controlled heatwave and drought conditions in glasshouses to assess the abilities of different species to withstand:

- Drought tolerance
- Heat tolerance
- Plant stress indicators

Module Three

Heat and drought tolerance

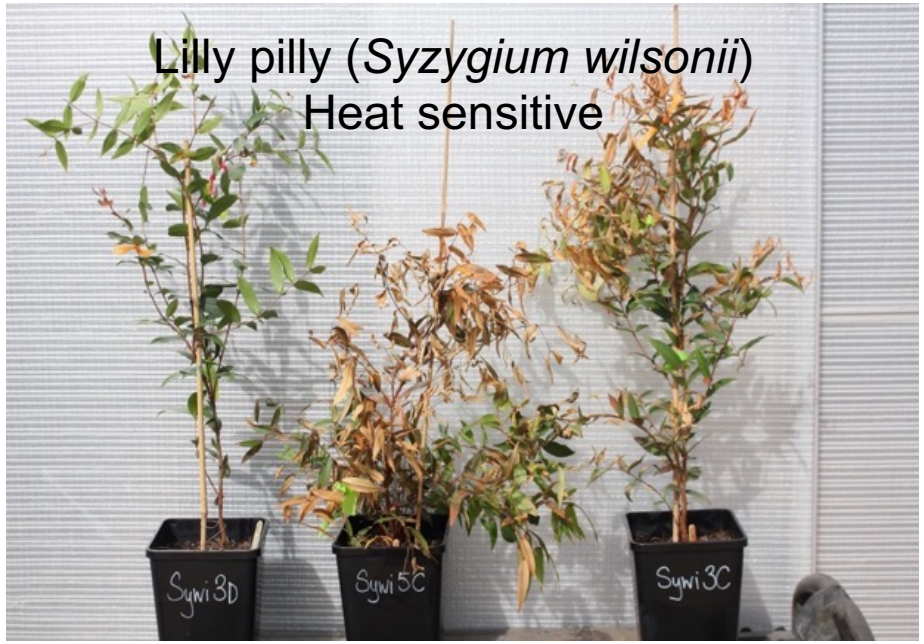
Traits such as wilting point, leaf critical temperature, leaf thickness and leaf area were measured to help predict which species will be heat and drought tolerant.

Tolerators – thicker, tough, small leaves, low surface area, hairy, architectural adaptations, stomatal control

Avoiders – deep root systems, will drop leaves, succulent, draw moister from leaves

Module Three

Heat and drought tolerance



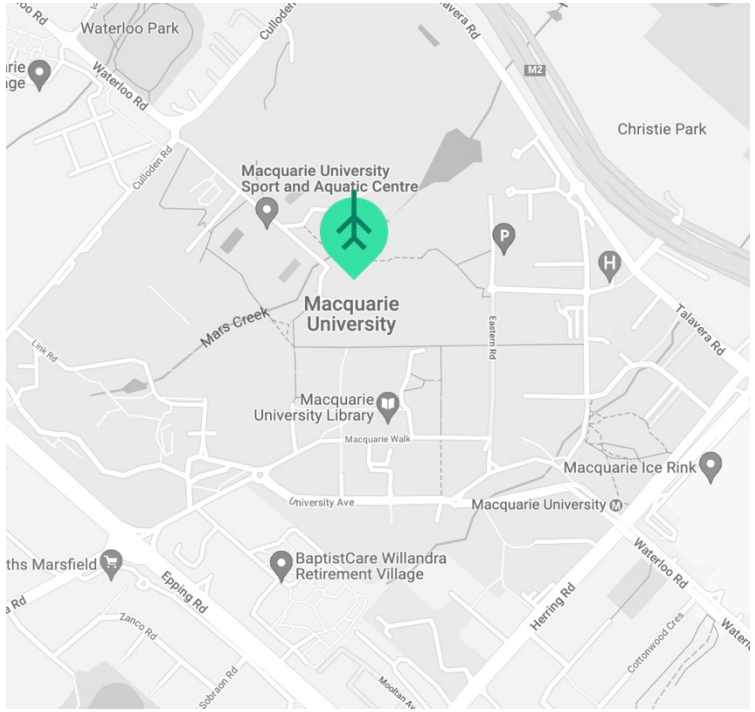
The Which Plant Where project aims to

Provide the evidence-base for species selection to enable resilient urban forests.

Identify drought and heat tolerant species under future climates.

Increase planting success by identifying the right species for the right location.

WhichPlantWhere



Which Plant Where was developed by a team of scientists and researchers from Macquarie University and Western Sydney University. The program delivery and implementation phase and future development of the project will be led by Macquarie University.

THE TEAM

Gwilym Griffiths
Program Manager

Michelle Leishman
Lead Researcher

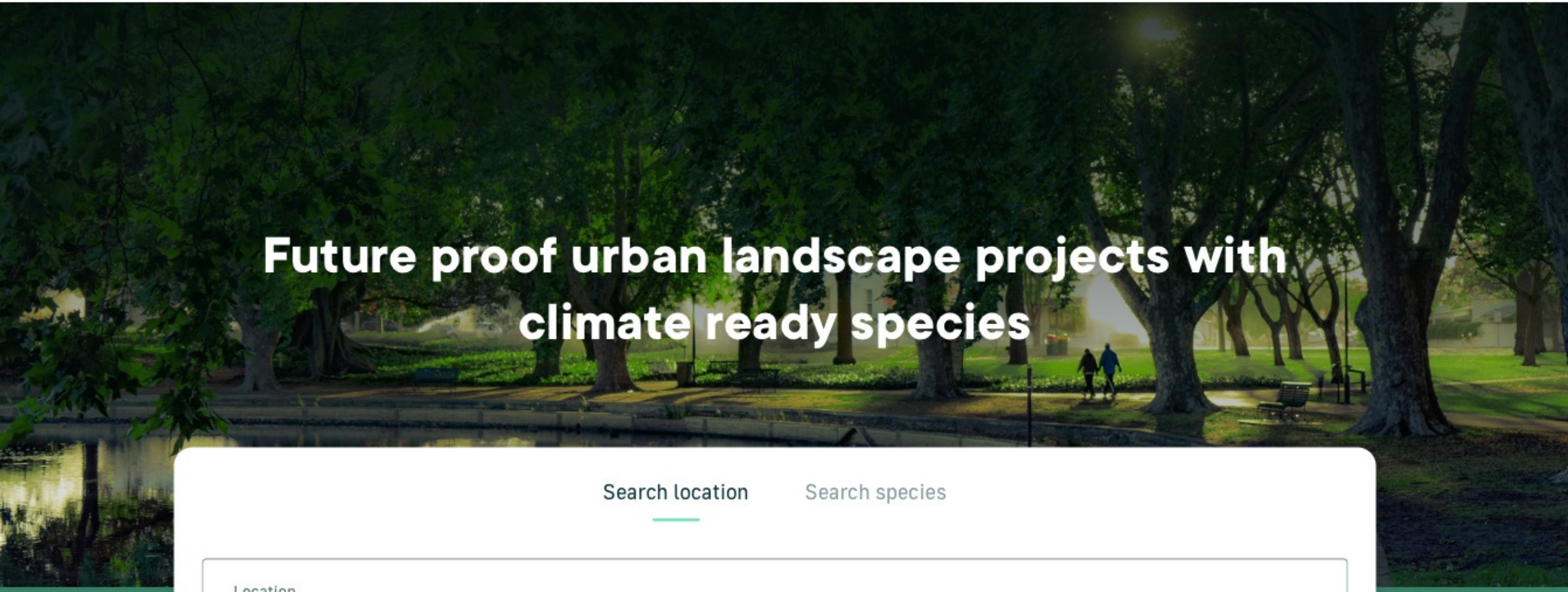
Samiya Tabassum
Researcher

www.whichplantwhere.com.au

This website is in beta stage and not all data and functionality is final. Let us know what you think with this short survey.

Which Plant Where

Search | The Science | Features | Pricing | Resources



Future proof urban landscape projects with climate ready species

Search location | Search species

Location

Search for location or postcode

Urban Space Type: Garden | Park | Street | WSUD