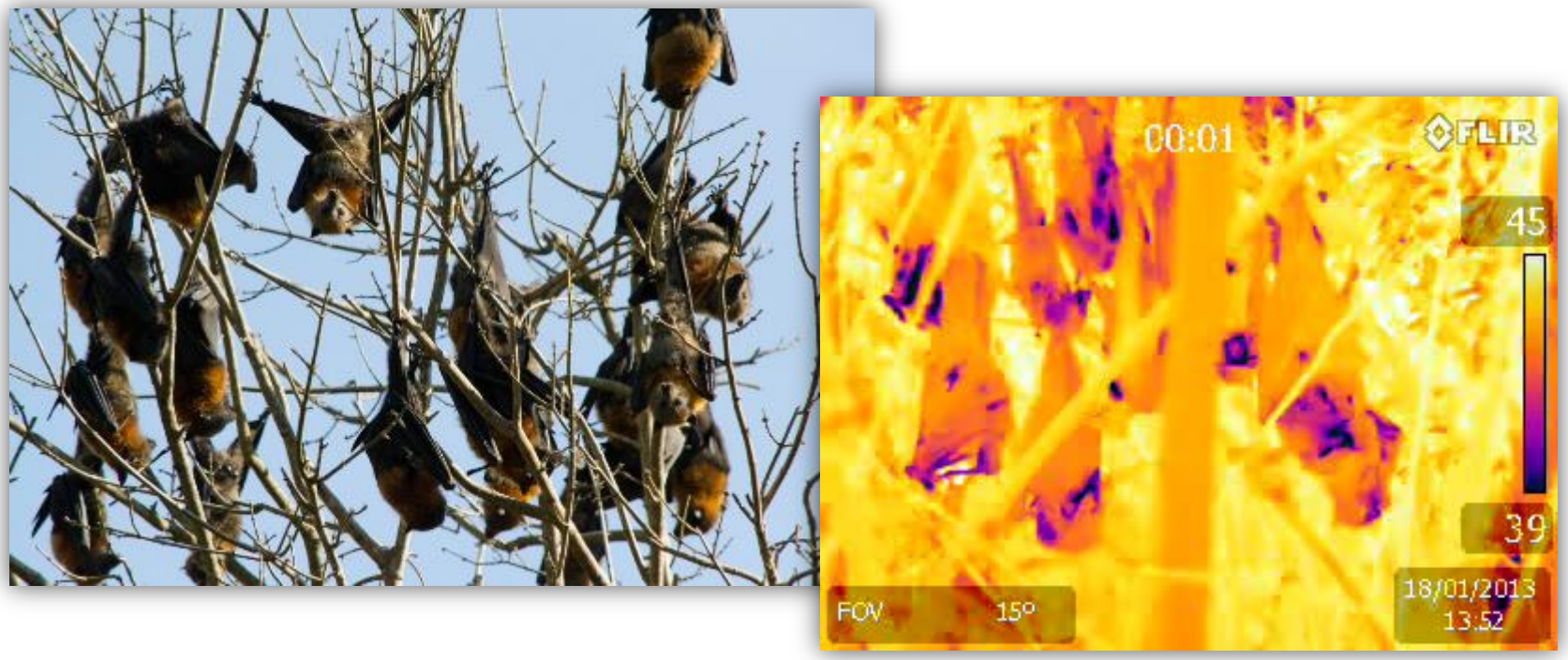
Modelling flying-fox heat stress vulnerability

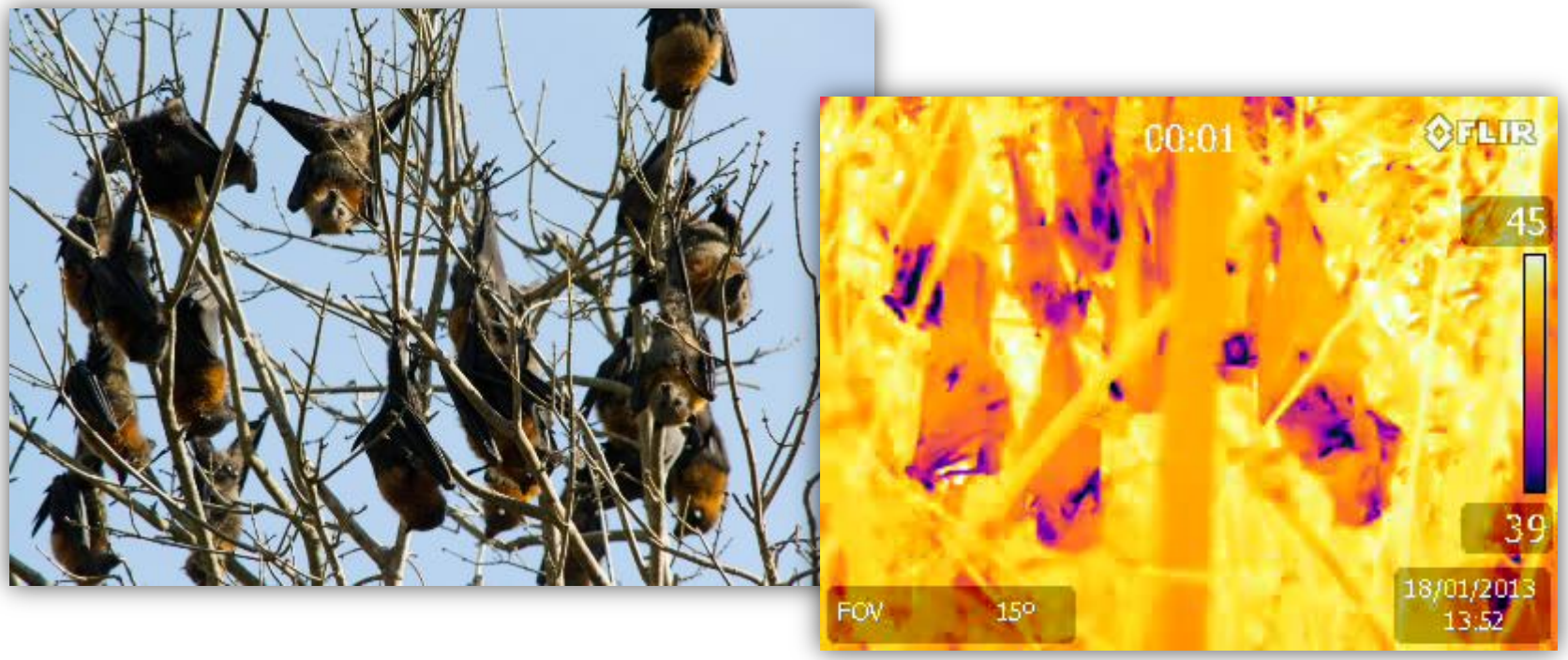


Himali Ratnayake[1]

Supervision: A/Prof Michael Kearney[1], Dr Justin Welbergen[2], Dr Christopher Turbill[2] & A/Prof Rodney van der Ree[1]

Affiliations: [1]School of BioSciences, The University of Melbourne; [2]Hawkesbury Institute for the Environment, Western Sydney University

Understanding how extreme heat events affect the heat budget of Australian flying-foxes (*Pteropus* spp.): roles of physiology, morphology and behaviour



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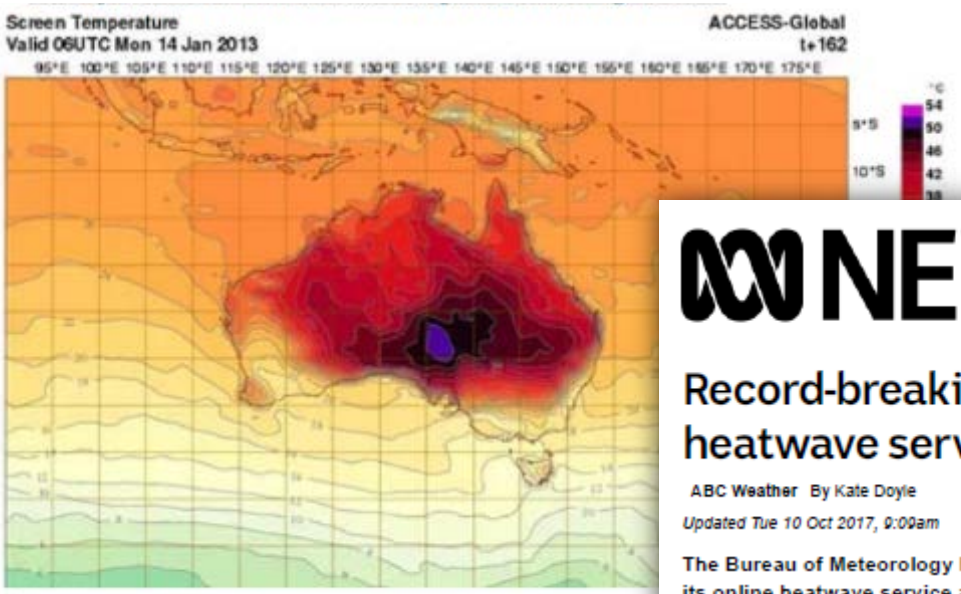
Australia adds new colour to temperature maps as heat soars

Forecast temperatures are so extreme that the Bureau of Meteorology has had to add a new colour to its scale. It is a sign of things to come



Australian Bureau of Metereology temperature map - with a new colour for 5

image to see a larger version

ABC NEWS

Record-breaking temperatures prompt BOM to launch heatwave service early

ABC Weather By Kate Doyle

Updated Tue 10 Oct 2017, 9:09am

The Bureau of Meteorology has brought forward the annual launch of its online heatwave service after months of record-breaking temperatures.

The service normally runs from November 1 to the end of March.

National heatwave project director John Nairn said the bureau had noticed increasing heat episodes in northern Australia and parts of the east coast, prompting it to bring the service forward by three weeks.

He said starting the service early was unusual.

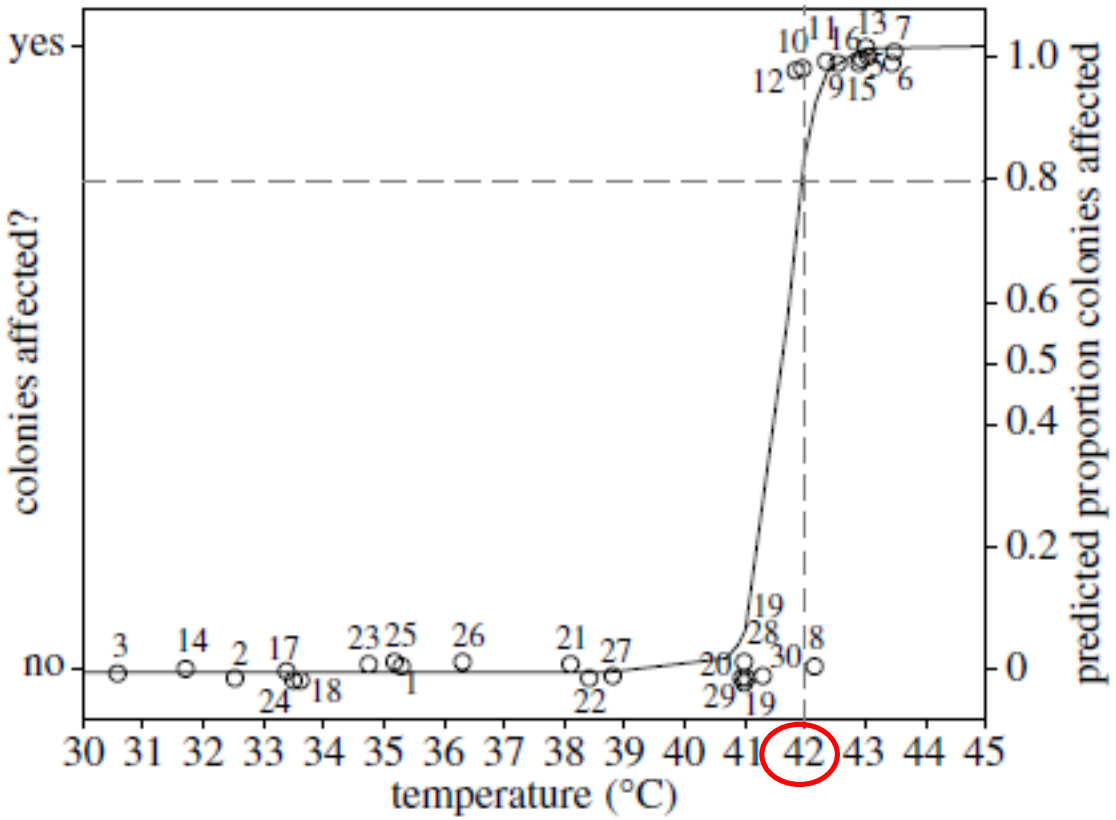
"It won't happen every year. On occasion, particularly if you have sections of the country being affected by drought, it is likely that we will see some earlier heat events," he said.

PHOTO: A heatwave is defined as three or more days of high maximum and minimum temperatures. (Supplied: Andrew Reid)

RELATED STORY: September was a scorcher according to BOM special memo

Solution: Predict beforehand when and where flying-fox heat stress events may occur

Assumption: Heat stress related die-off events occur in flying-foxes when the air temperature is **42°C or above**

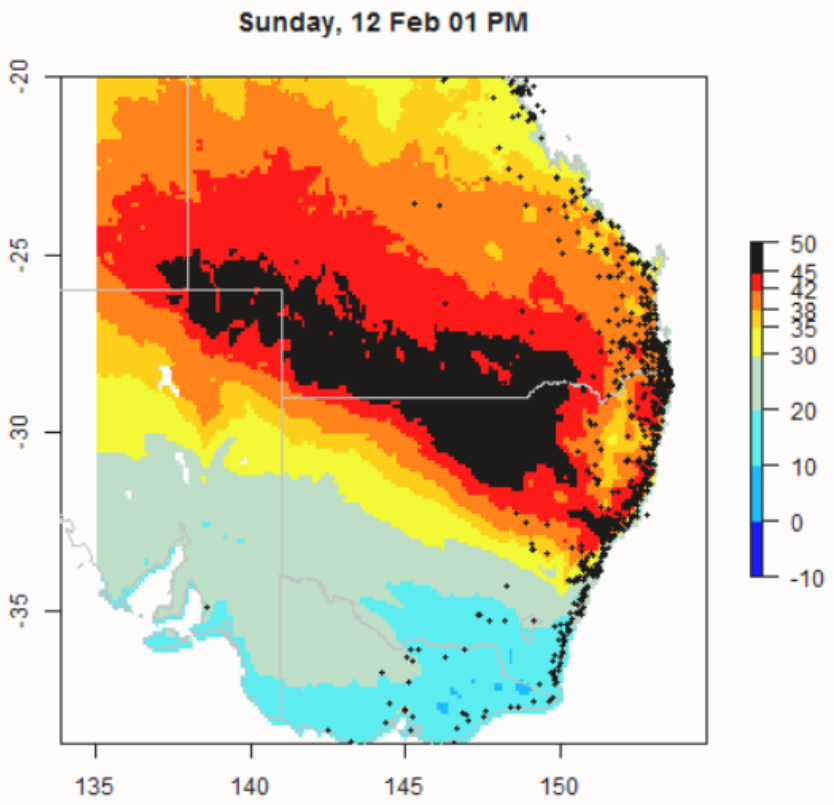


(Welbergen *et al* 2008)

Flying-fox heat stress forecaster

- Weather data from the Bureau of Meteorology (ACCESS-R NWP system)
- Occupied camp data from the National Flying-fox Monitoring Program

Current temperature forecasts for southeastern Australia



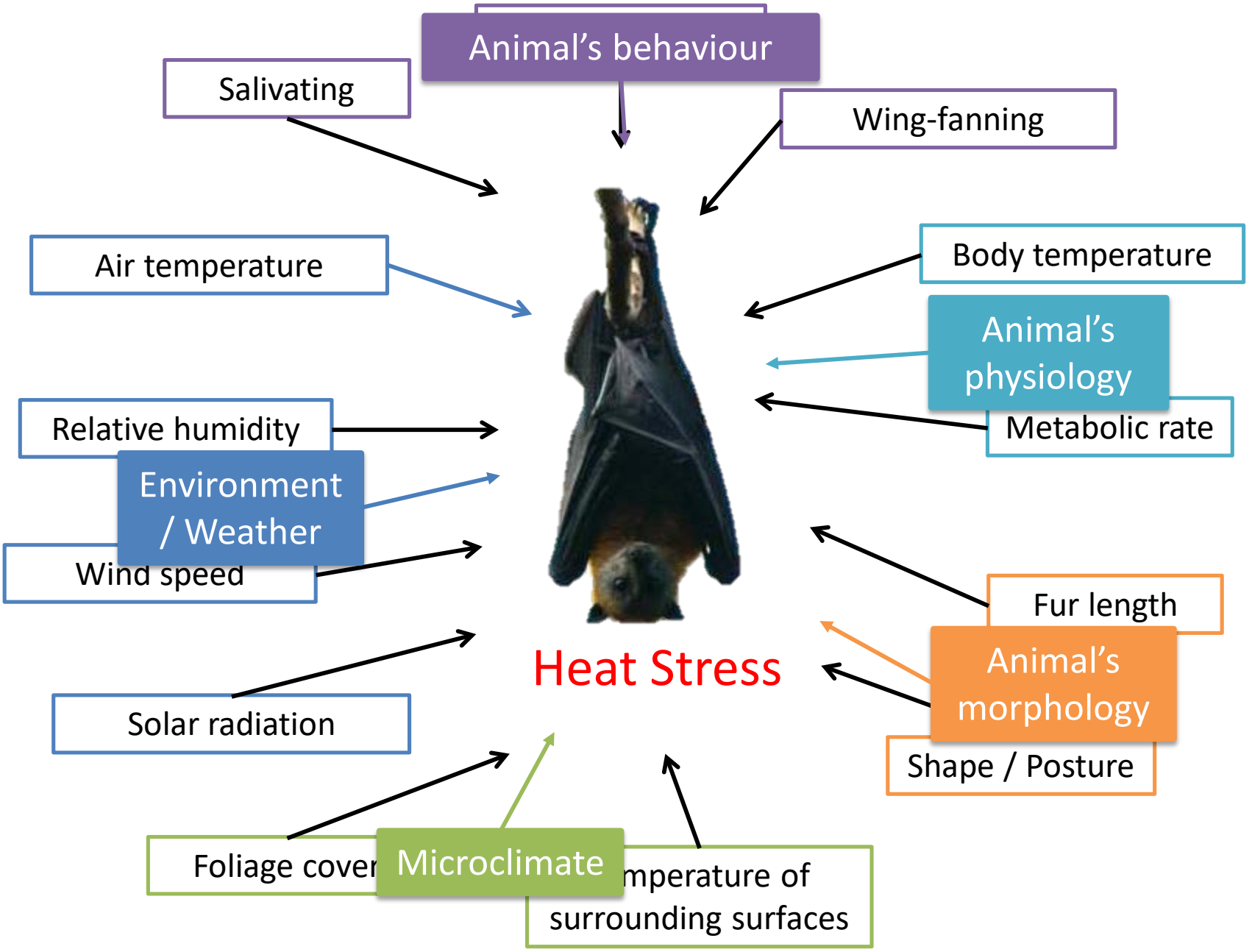
Heat stress alert status

HIGH

When this reads "HIGH", temperatures >42°C are likely in flying-fox camps in SE Australia in the next three days.

CLICK HERE FOR EMAIL ALERTS

http://ausbats.org.au/ff-heat-stress-forecaster/4593634561


Animal's behaviour
Salivating
Wing-fanning
Air temperature
Body temperature
Animal's physiology
Metabolic rate
Relative humidity
Environment / Weather
Wind speed
Fur length
Heat Stress
Animal's morphology
Shape / Posture
Solar radiation
Foliage cover
Microclimate
mperature of surrounding surfaces

Environmental Conditions

Panting

Salivating

Animal Characteristics

Wing-fanning

Air temperature

Body temperature

Relative humidity

Metabolic rate

Wind speed

Fur length

Heat Stress

Solar radiation

Shape / Posture

Foliage cover

Temperature of surrounding surfaces

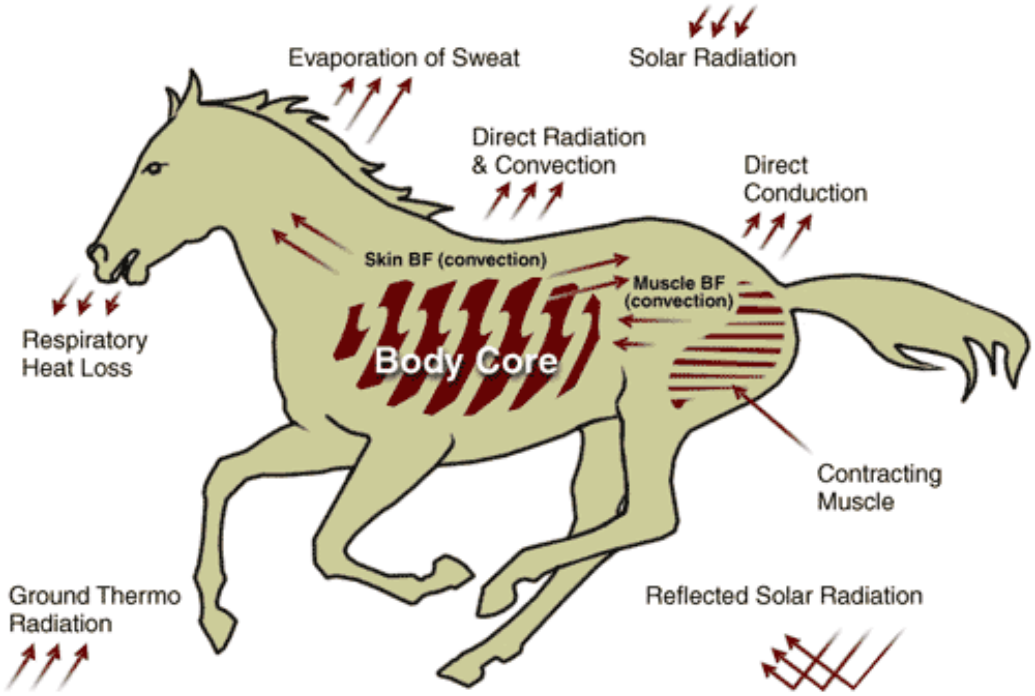
Environmental conditions

Animal Characteristics

Biophysical Model
Mathematical validation of physical properties

Simulate biological system

Predict influences of biological and physical factors on biological system



Environmental Conditions

- Air temperature
- Relative humidity
- Wind speed
- Solar radiation
- Foliage cover
- Temperature of surrounding surfaces

Heat Stress

Animal Characteristics

- Salivating
- Panting
- Wing-fanning
- Body temperature
- Metabolic rate
- Fur length
- Shape / Posture

Environmental Conditions

- Air temperature
- Relative humidity
- Wind speed
- Solar radiation

Weather

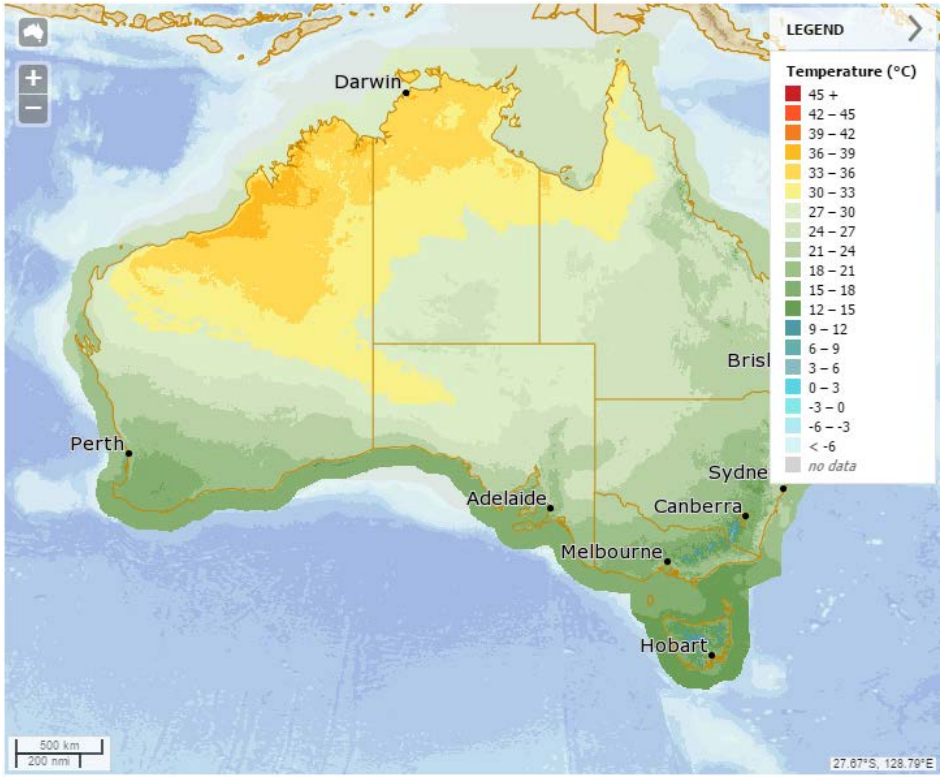
- Foliage cover
- Temperature of surrounding surfaces

Microhabitat conditions

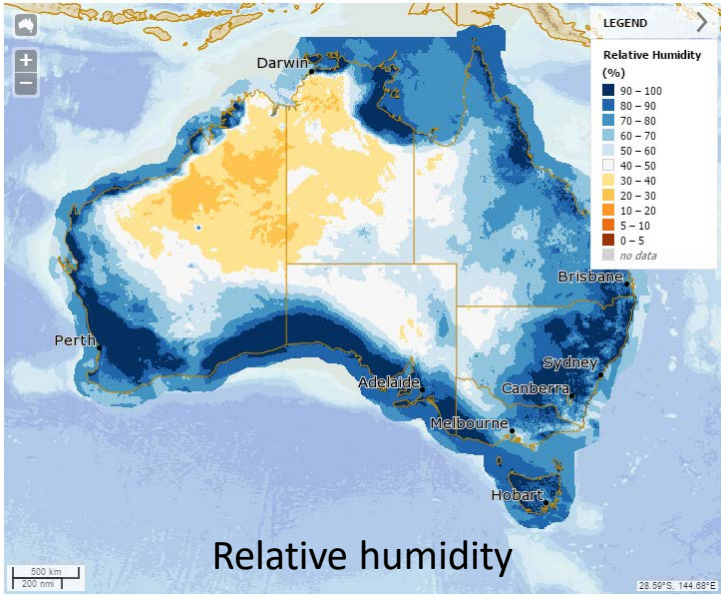
Animal Characteristics

- Salivating
- Panting
- Wing-fanning
- Body temperature
- Metabolic rate
- Fur length
- Shape / Posture

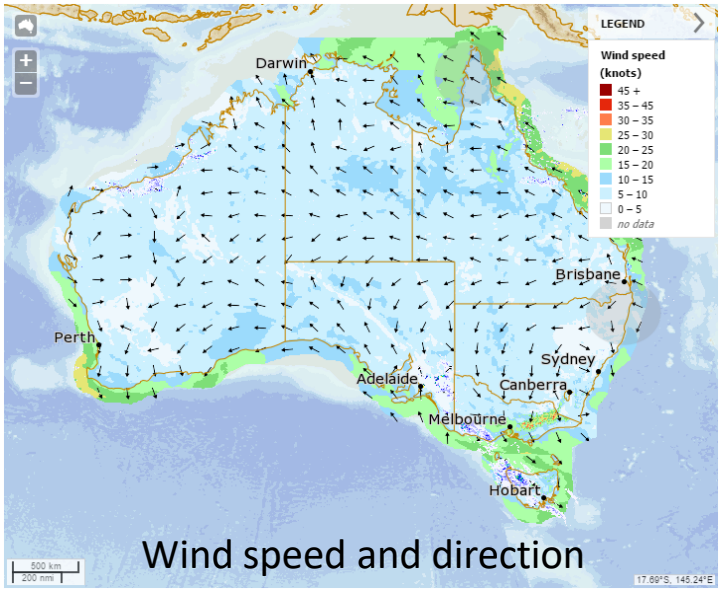
Weather: Australian Bureau of Meteorology databases



Air temperature



Relative humidity



Wind speed and direction

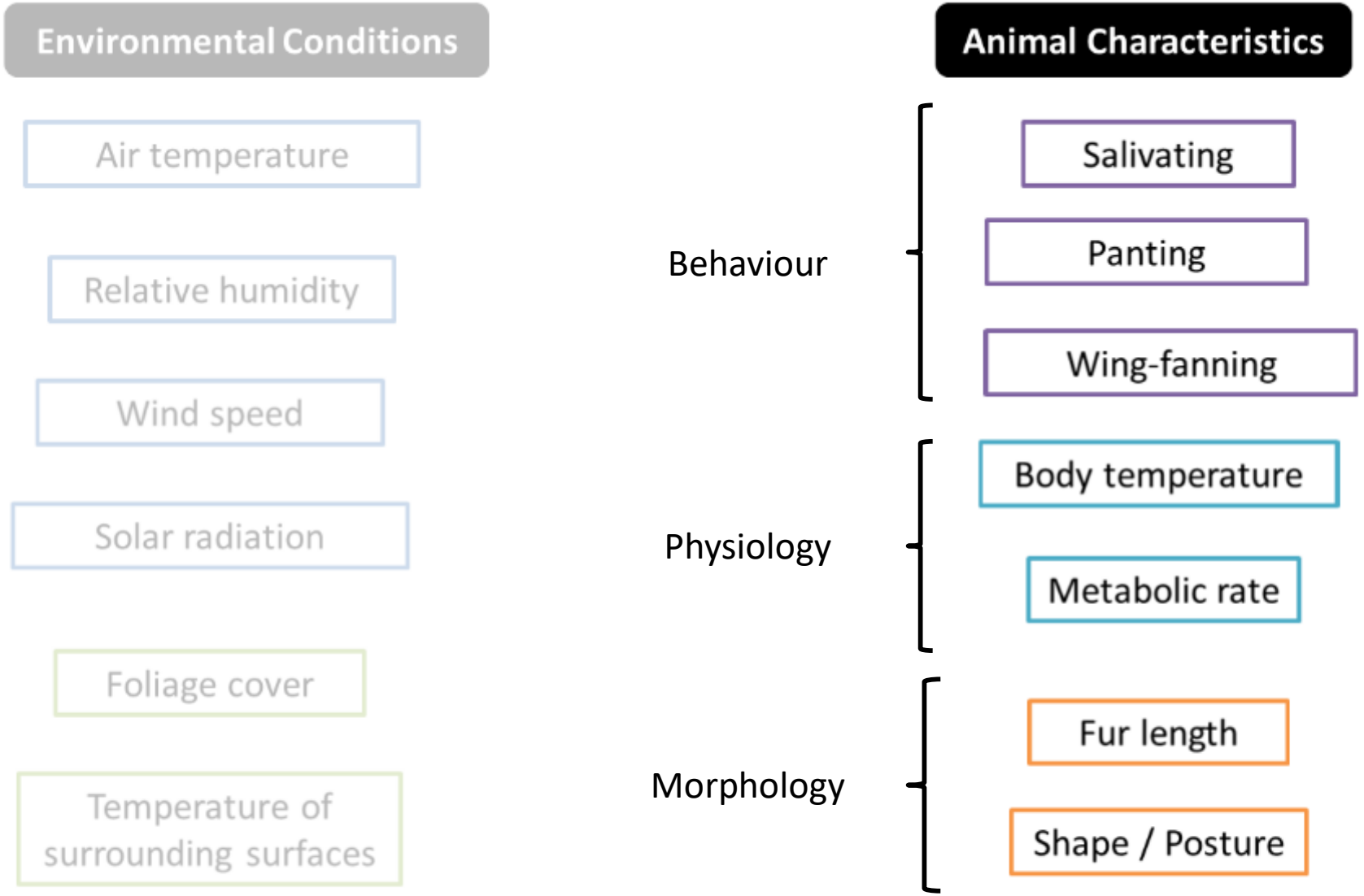
Microhabitat

Hygrochron - iButtons

Thermal Camera

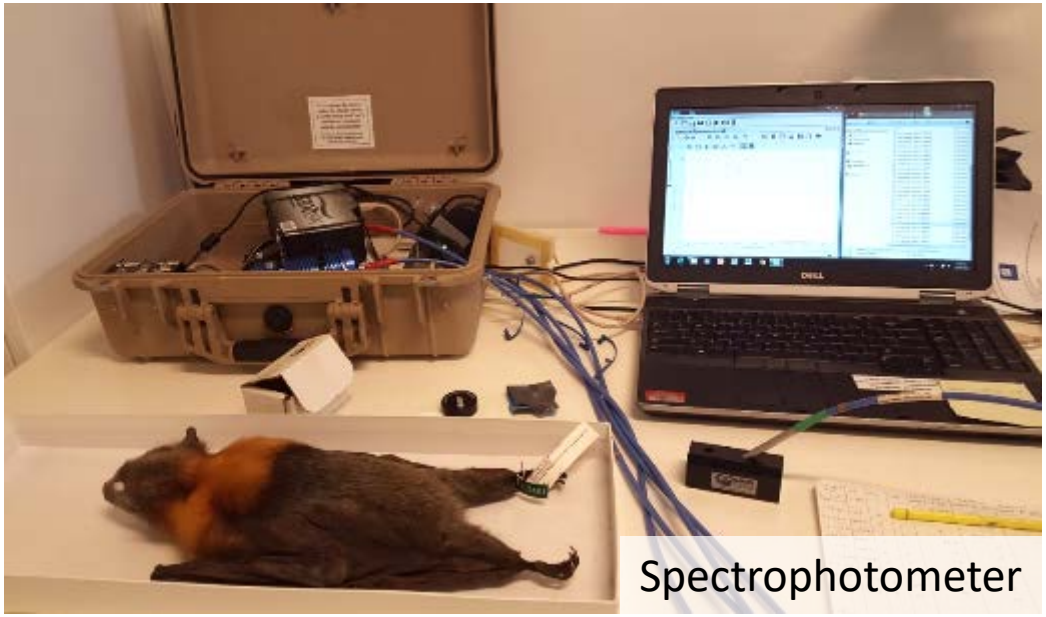
iButton holders

Weather Station

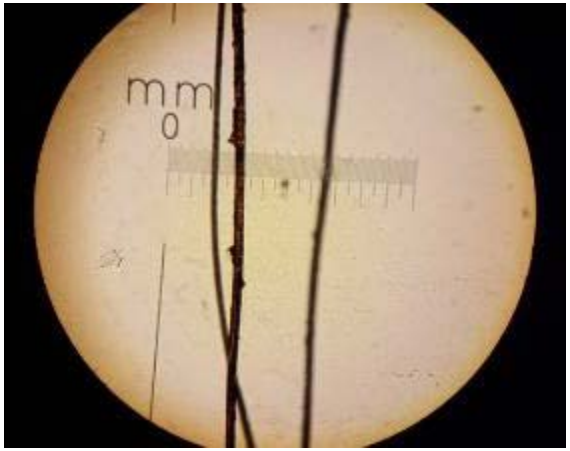

Environmental Conditions
Air temperature
Relative humidity
Wind speed
Solar radiation
Foliage cover
Temperature of surrounding surfaces
Animal Characteristics
Behaviour
Salivating
Panting
Wing-fanning
Physiology
Body temperature
Metabolic rate
Morphology
Fur length
Shape / Posture

Morphology

Length and width of body



Spectrophotometer

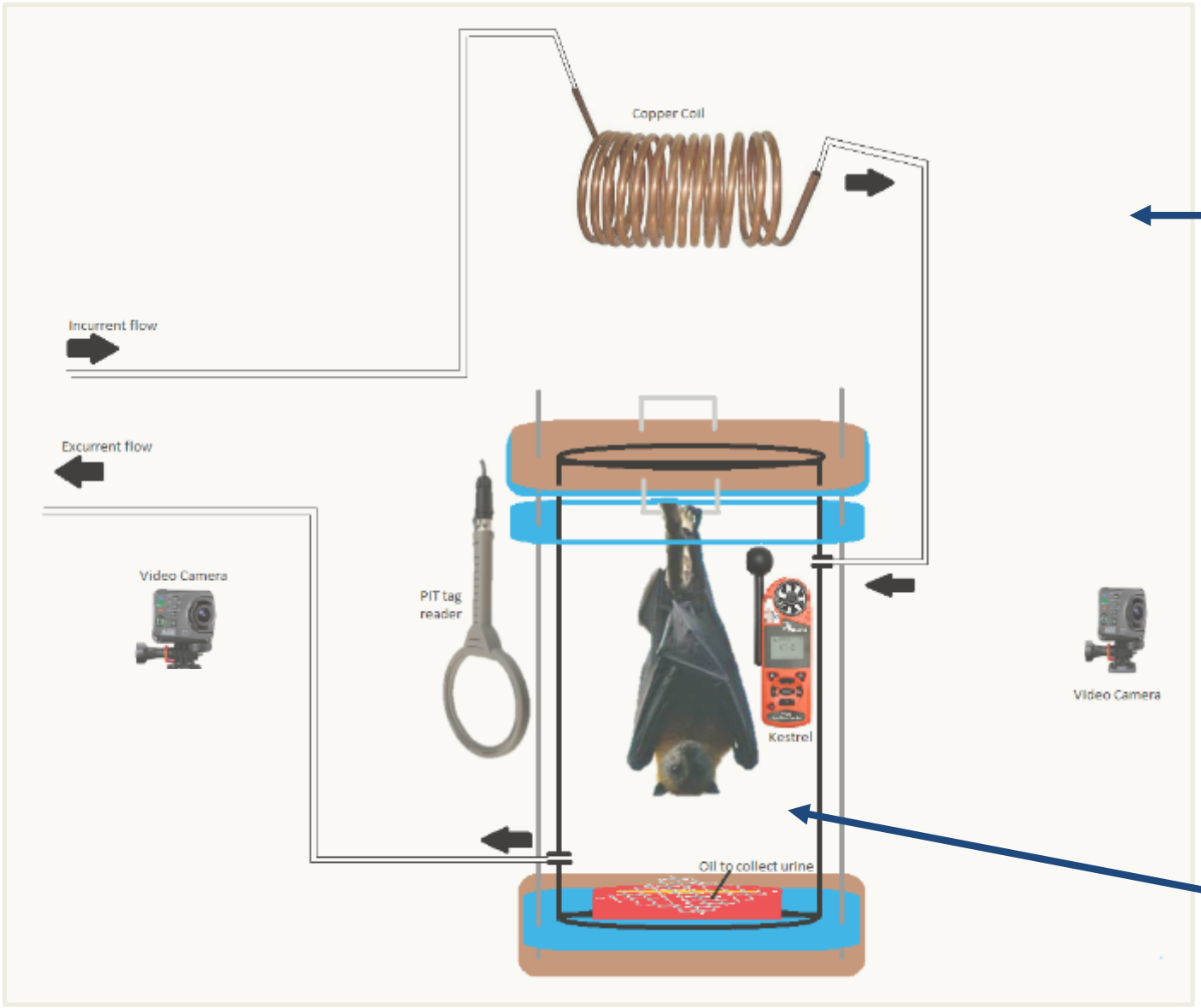


Thickness of hair

Fur length and depth

Illustration: Elia Pirtle

Thermophysiology



Controlled ambient temperature and humidity inside incubator

Measure oxygen consumption, water loss and body temperature

Thermoregulatory behaviours

Wing-fanning

Shade-seeking

Salivation

Panting

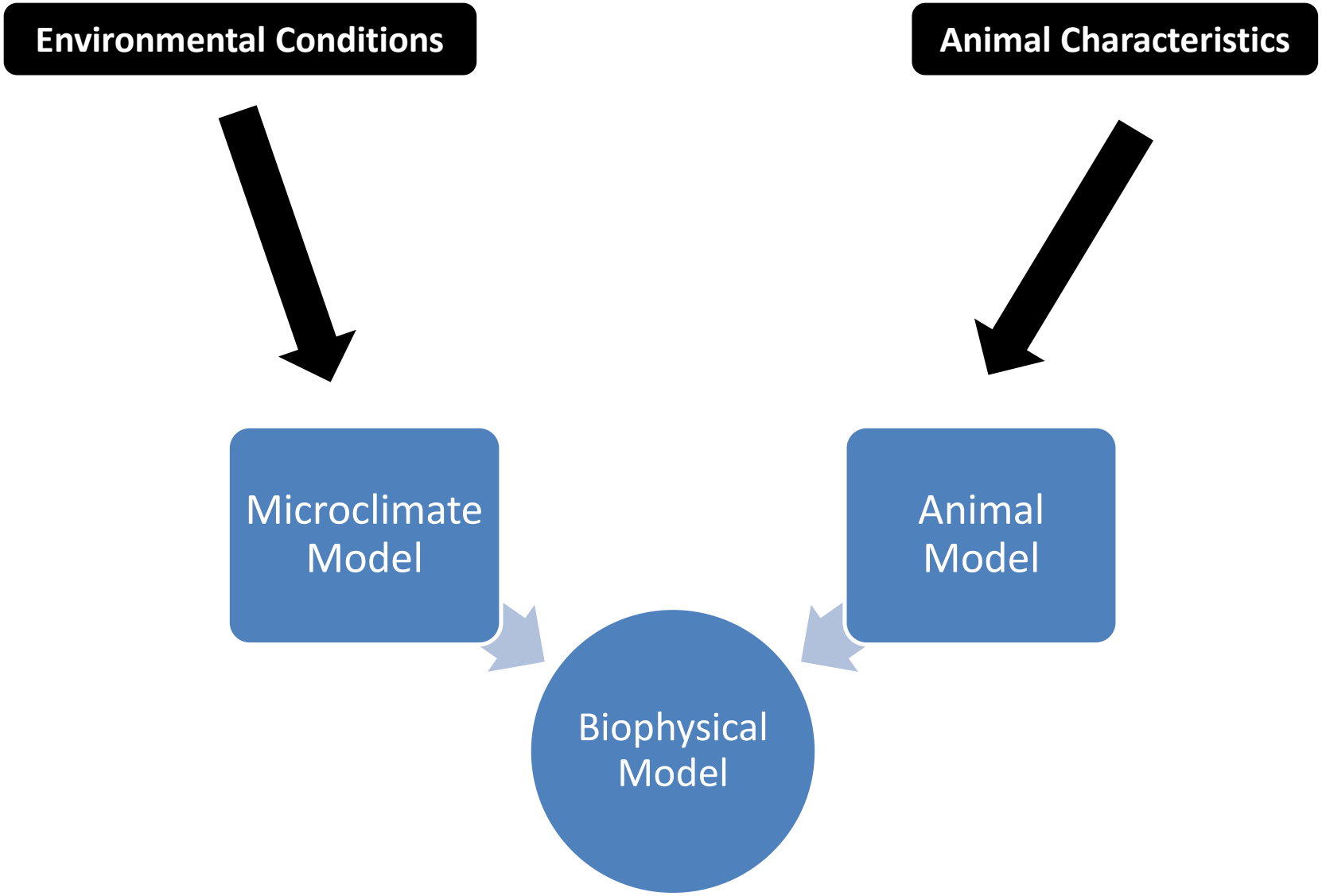
Photo credit: Justin Welbergen

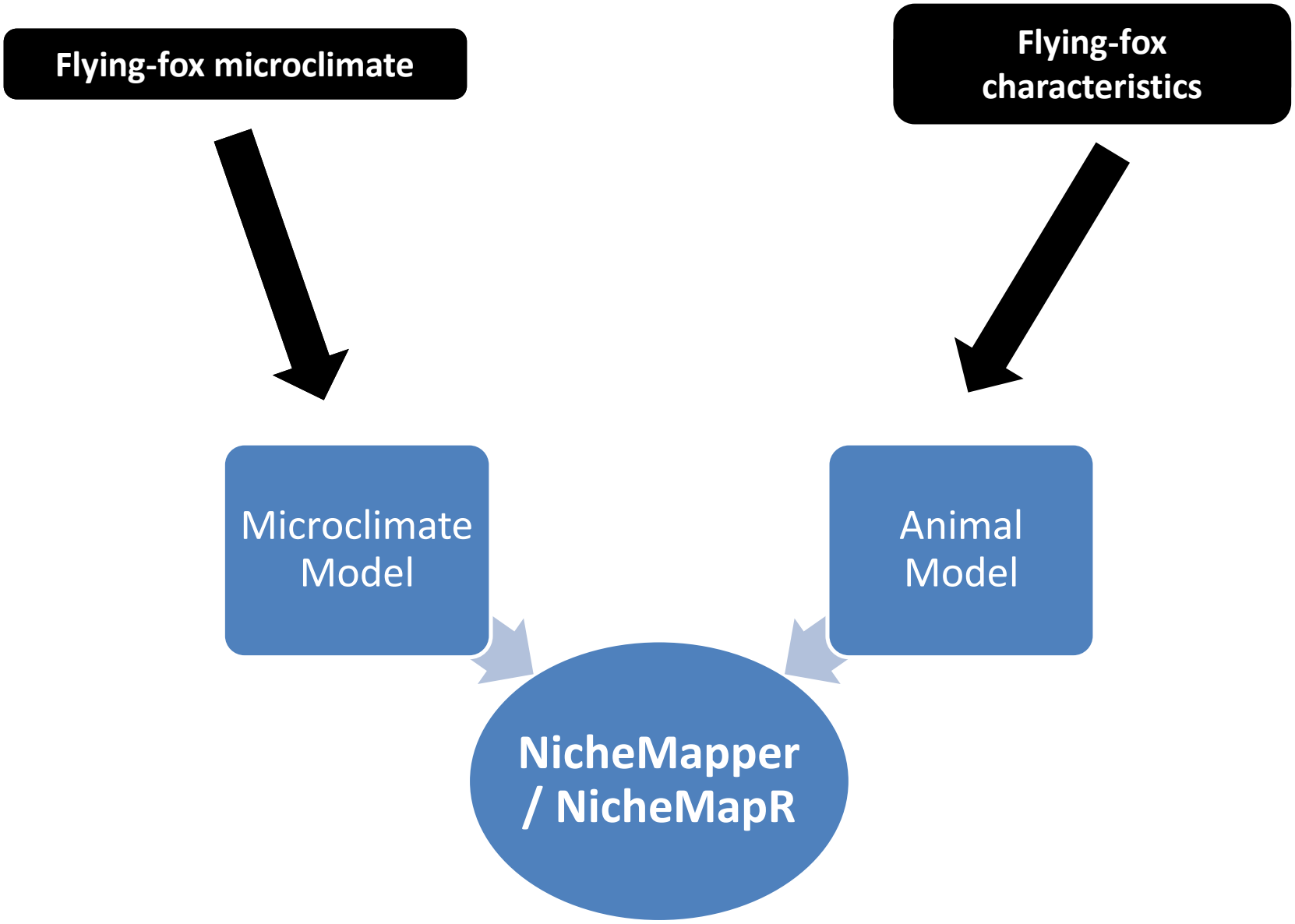
Death…






Welbergen, 2012 ISBN: 978-84-87790-69-0
Welbergen, et al 2008 *Proc Roy Soc B,* 275, 419-425
Welbergen et al*, in prep*

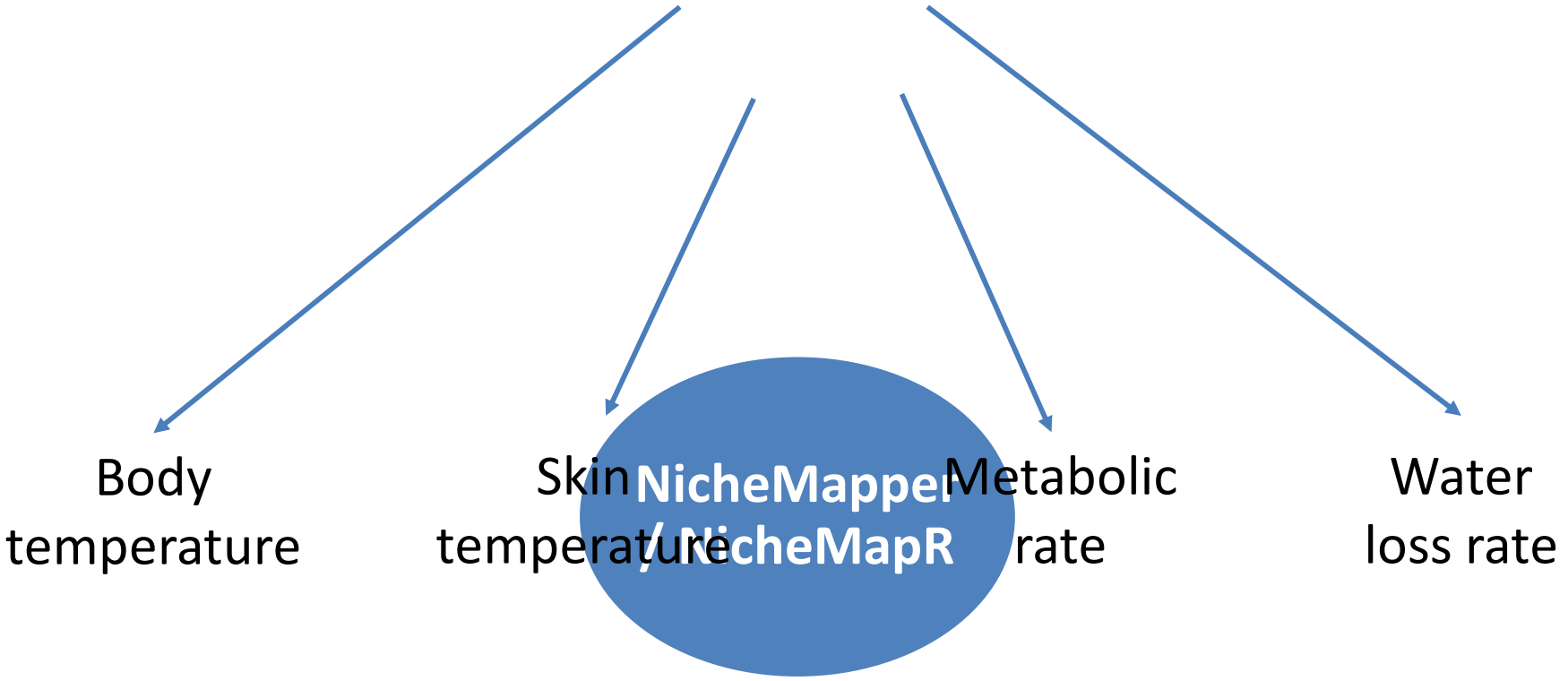

Environmental Conditions
Animal Characteristics
Microclimate Model
Animal Model
Biophysical Model



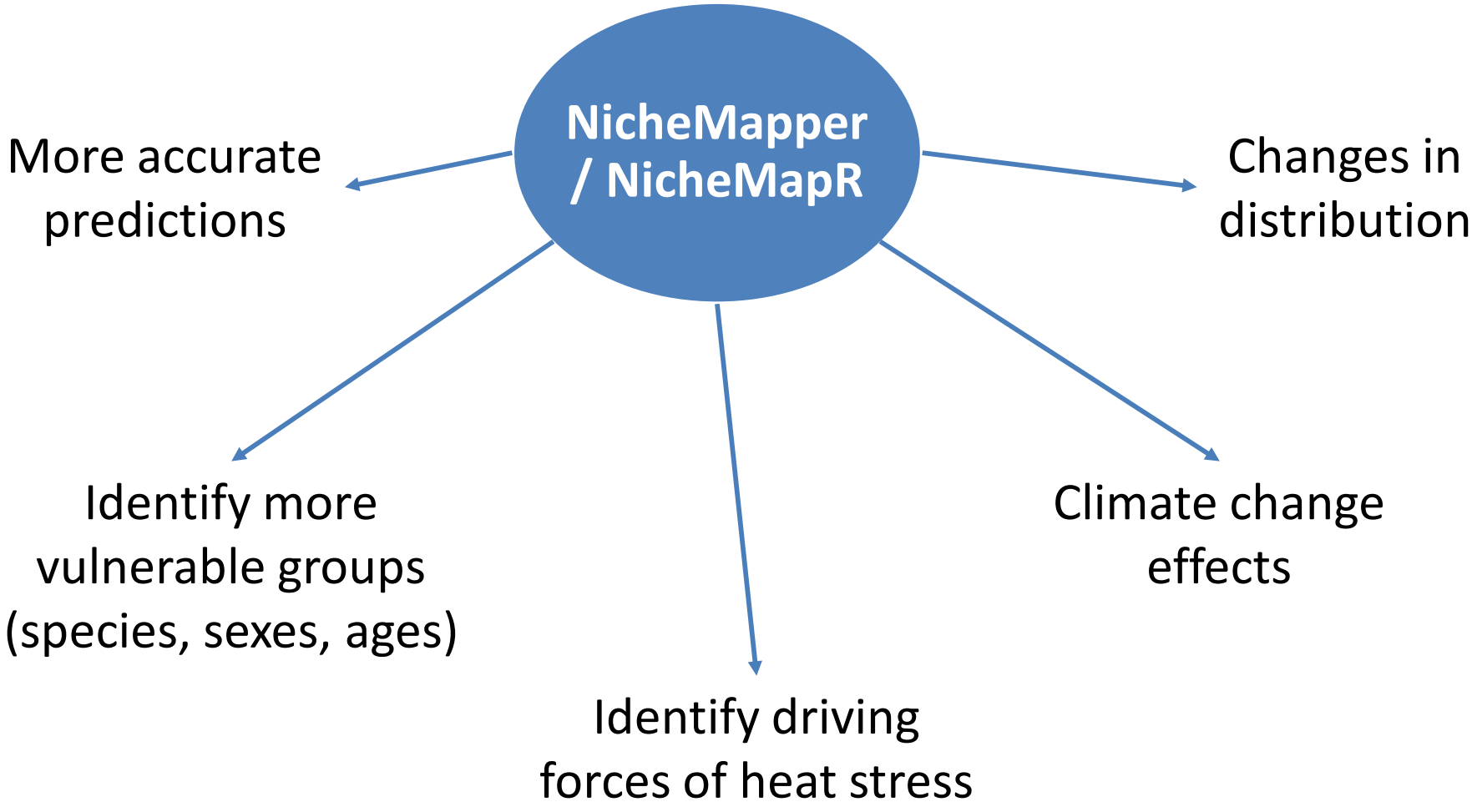
http://niche-mapper.com/

Kearney and Porter (2016) *Climate Change Responses*, **3**, 1

Main model outputs



Benefits of a biophysical model



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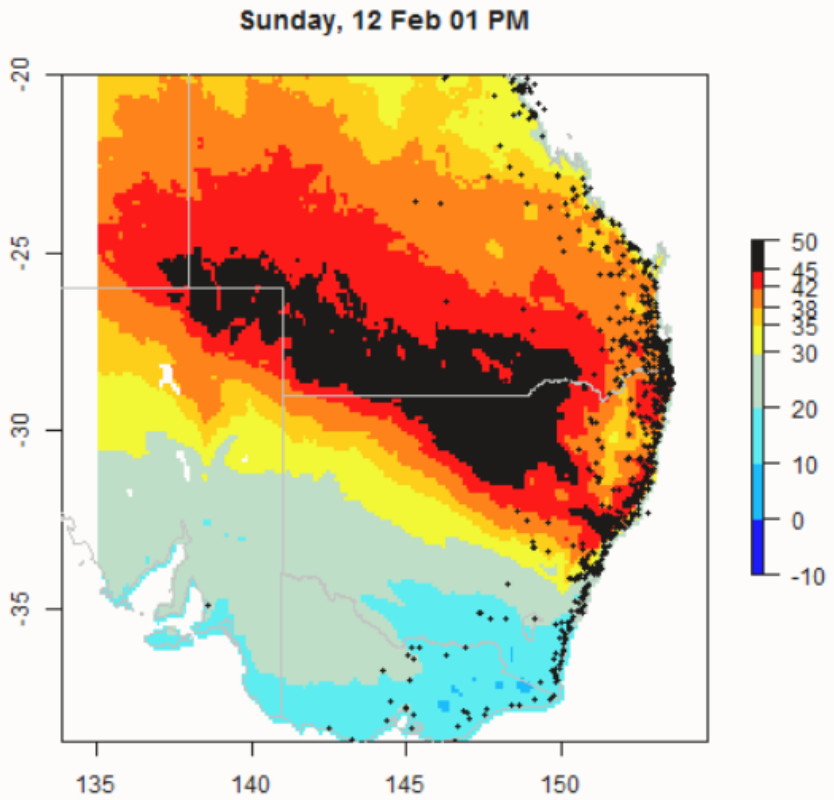

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Acknowledgements

- Holsworth Wildlife Research Endowment
- NESP Threatened Species Recovery Hub
- Bureau of Meteorology – Kamal Puri
- National Flying-fox Monitoring Program
- Melbourne Museum
- Australian Museum
- Royal Botanic Gardens Sydney
- Yarra Bend Park - Parks Victoria & DEWLP
- David Karoly and Pallavi Govekar
- John Martin
- Natalie Briscoe
- Numerous volunteers

The Royal Botanic Garden Sydney

Australian Government
Bureau of Meteorology

Threatened Species Recovery Hub
National Environmental Science Programme

MELBOURNE MUSEUM

AUSTRALIAN MUSEUM

Questions?