Bee biodiversity: Safeguards for pollination services

Background

Bees are the primary pollinators for most flowering plants - an ancient mutual relationship that has persisted for over 100 million years. Australia is home to more than 1,600 described native bee species (~10% of global bee diversity), which perform important pollination services for our native flora and therefore play an active role in broader ecological processes (Fig 1a &2b).

Similarly, many horticultural crops depend on the cross-pollination services provided by bees and other insects to obtain effective yields. The majority of the world's food supplies are derived from ~100 crops and more than two-thirds of these are pollinated by bees that are largely unmanaged.

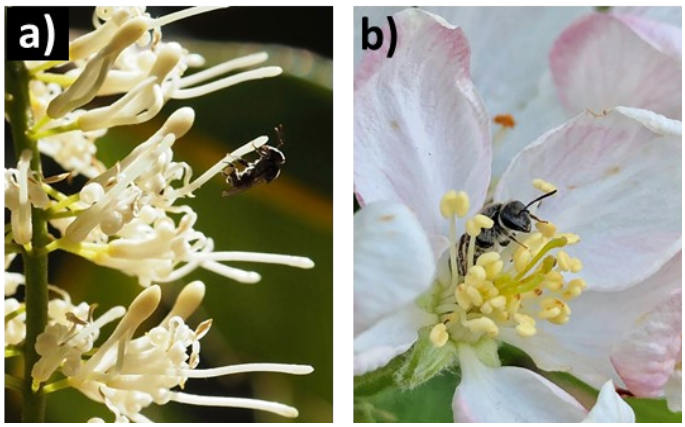

Figure 1: a) Native stingless bee, *Tetragonula carbonaria* foraging on native *Macadamia* (credit: Chris Fuller), **b)** Native halictine sweat bee (genus *Lasioglossum*) foraging on apple (credit: Simon Tierney).

Australians currently depend heavily on the pollination services provided by introduced European honey bees for food production. Yet, we are relatively ignorant of the pollination potential that native bee species and other insects are contributing to the Australian food basket (Fig 1 & 2a).

The importance of understanding native bee biology and pollination behaviour is further emphasised by disease and other threats to the health of managed colonies of European honey bees across the globe and raises the question: **can Australian native bees and other insects pick up the pollination slack?**

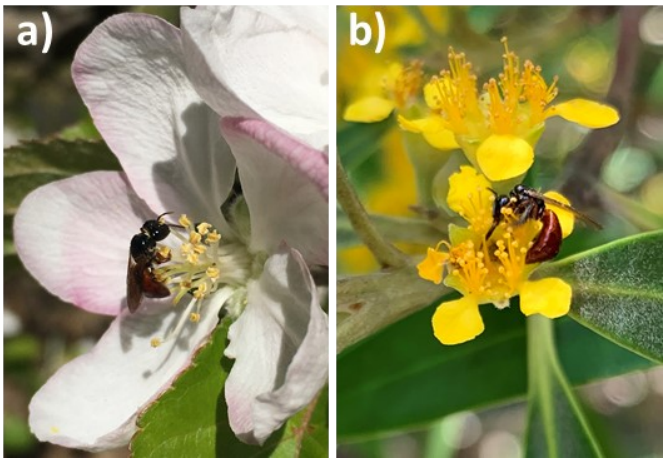

Figure 2: Native allodapine bee, *Exoneura robusta* foraging from **a)** apple and **b)** the native water gum *Tristaniopsis laurina* (credit: Olivia Bernauer).

Objectives

To determine:

- What pollinators are present on horticultural farms— **species diversity and abundance.**
- Which species visit different horticultural crop flowers— **species specificity.**
- Which visiting insects are productive pollinators—**species effectiveness.**
- Influence of contrasting natural resources on floral visitors—**communities of species.**

WESTERN SYDNEY UNIVERSITY

hort frontiers Strategic partnership initiative | POLLINATION FUND

Results

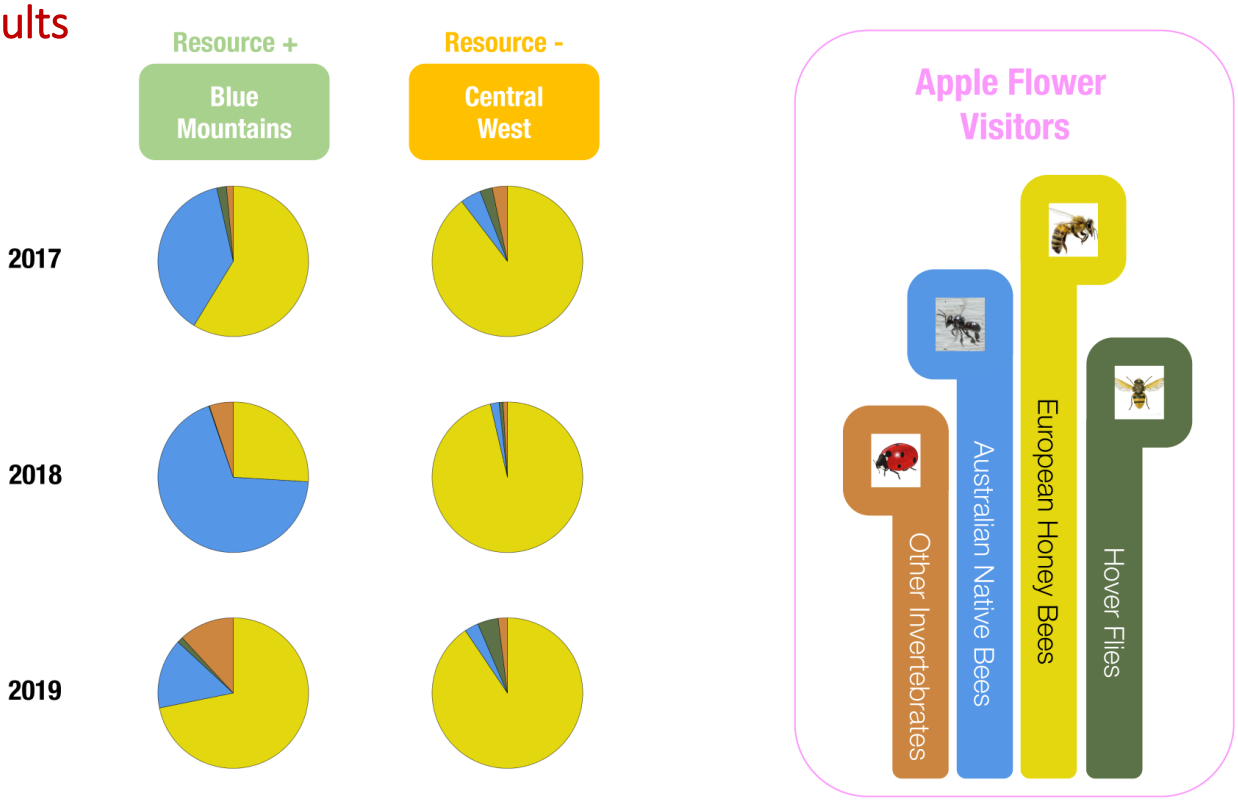

Figure 3: Pie charts indicate proportions of common visitors to apple flowers in NSW fruit growing regions that are rich or poor in surrounding natural resources, surveyed over a three-year period. Blue Mountains orchards are surrounded by World Heritage sandstone sclerophyll forests - rich in natural resources. In contrast, the upland eucalypt forests of the Central West were cleared for agricultural land use in the previous century and are therefore comparatively poor in natural resources - representative of Australian agricultural landscapes more broadly.

Research findings

- Apple flower visitation by native bees fluctuated considerably from year to year in the resource-rich Blue Mountains (Fig 3). Native bees, particularly stingless bees, significantly outnumbered honey bees in 2018. European honey bees were the predominant apple flower visitors in the resource-poor Central West region across all 3 years.
- Land-use may account for differences in proportions of native bees observed between regions, while local climate and insect demographics likely influence variation from year to year.
- Flower visitation does not necessarily equate to pollination – results (Fig 3) are now being used to understand how effectively native bees are contributing to fruit yield.

Advice

- Support a diverse range of pollinators via maintenance of natural habitats and floral resources around farms. Loss of pollinator species has potentially unfavourable consequences from both an ecological and a food security perspective.
- Improved knowledge of native bee biology is a high priority - we may need to rely on these species increasingly for crop pollination.

References and Acknowledgements:

FAO United Nations. 2005. http://www.fao.org/ag/magazine/0512sp1.htm; Hamm A. 2009. *Caring for Pollinators*; Michener CD. 2007. *Bees of the World*; Cardinal S & Danforth BN. 2013. *Proc R Soc B* 280: 20122686; Misof B *et al*. 2014. *Science* 346: 763-767.

Healthy bee populations for sustainable pollination in horticulture is funded by the Hort Frontiers Pollination Fund, part of the Hort Frontiers strategic partnership initiative developed by Hort Innovation, with co-investment from Western Sydney University, Bayer CropScience, Syngenta Asia-Pacific and Greening Australia, and contributions from the Australian Government.

Fact-sheet prepared by Simon Tierney and Robert Spooner-Hart, Western Sydney University. Photo credits: Chris Fuller (Kin Kin Native Bees); Simon Tierney (WSU), Olivia Bernauer (WSU); Irin-K (Shutterstock); Didier Descouens, Vega Asensio (Wikimedia Commons).