

Managing stingless bees for crop pollination, playing to their strengths and weaknesses

11B: Symposium on the pollination contribution of stingless bees - what are the key impediments to developing a successful industry?



Tim Heard,
Sugarbag Bees, Brisbane, QLD
and University of Sydney,

Strengths of stingless bees for pollination

- Harmless to humans and domesticated animals
- Preservation of biodiversity
- They are resistant to the diseases and parasites of honey bees
- Compatible with honey bees
- Short flight ranges keeps them in crops
- Can recruit nestmates to rewarding sources
- Can be managed in hives
- Colonies are unable to abscond
- Can be kept on farms permanently
- Can be reared in large numbers in urban areas

Weaknesses of stingless bees for pollination

- Lack of availability of large numbers of hives
- Climatic limitations
- Some species fight when placed in close proximity
- Homing behaviour is limited
- Host plant flower preferences
- Pollen grains packed into corbicula
- Cannot buzz pollinate

Strength:

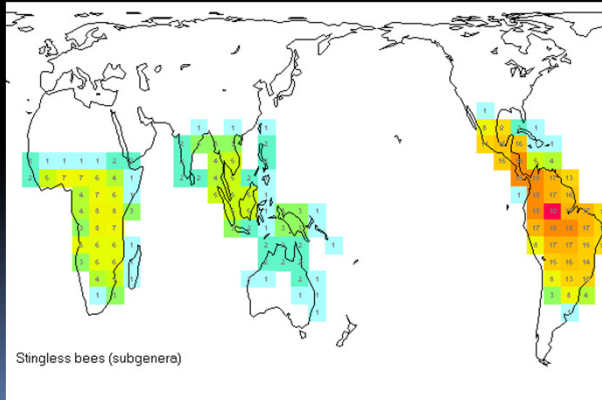
Harmless to humans and domesticated animals



Strength:

Their use motivates preservation of biodiversity

C. 500 species globally



Case study, coffee in Costa Rica

- Estimated the value of tropical forest in supplying pollination services to coffee production
- Forest-based pollinators increased coffee yields by 20%
- Pollination services from two forest fragments to one farm worth US\$60k per year
- This value exceeds expected revenues from competing land uses for those land fragments
- Double benefits of keeping forest: for biodiversity and agriculture.



(Ricketts et al. 2004)

Strength:

They are resistant to the diseases and parasites of honey bees



Compatible with honey bees



Diversity of pollinators

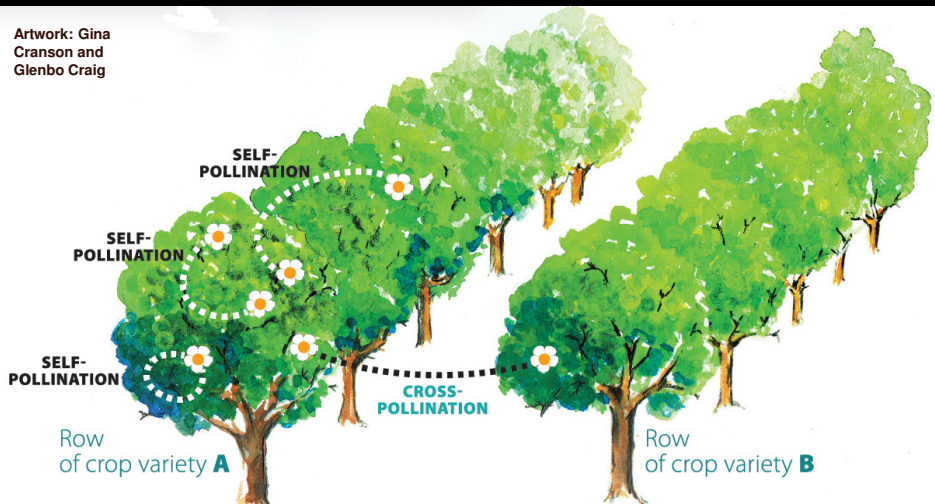
Compatible with honey bees



Photo: Tobias Smith

Cross-pollination, and different types of self-pollination, in crop plants

Artwork: Gina Cranson and Glenbo Craig



Strength:
Short flight range
(maximum 500 m)

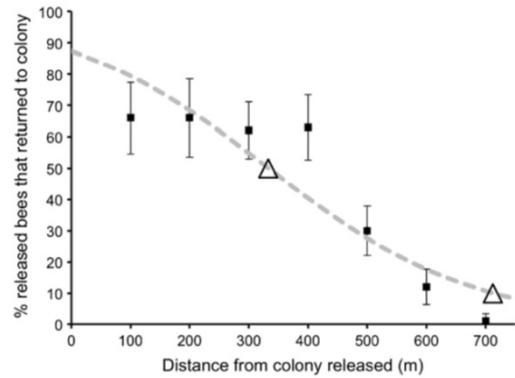


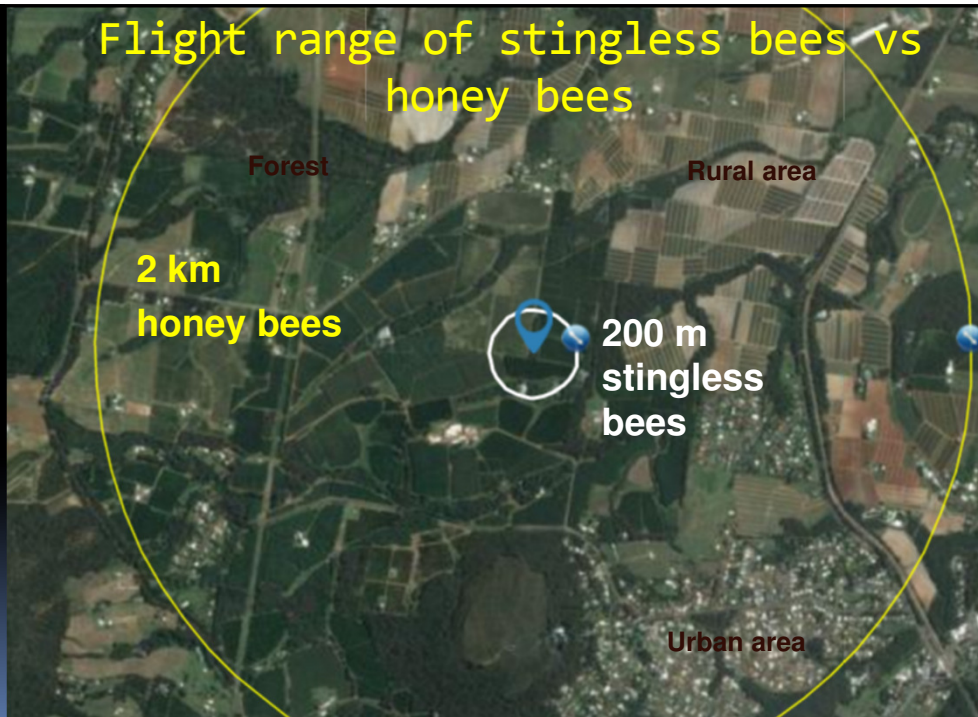
Fig. 3. Mean percentage of bees ($n=100$ bees per distance) that returned to the colony when released between 100 and 700 m from the colony (error bars indicate \pm one standard deviation).

Austral Entomology (2016) **, **--**

Flight range of the Australian stingless bee *Tetragonula carbonaria*
(Hymenoptera: Apidae)

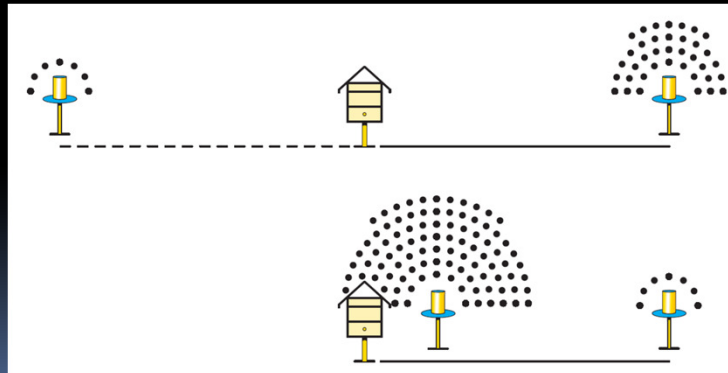
Jordan P. Smith,¹ Tim A. Heard,² Madeleine Beekman¹ and Ros Gloag^{1*}

**Flight range of stingless bees vs
honey bees**



Strength:

Can recruit nestmates to rewarding sources



Communication of food sources -honey bees

- The “waggle dance”
- Foragers follow the scout and feel her movement

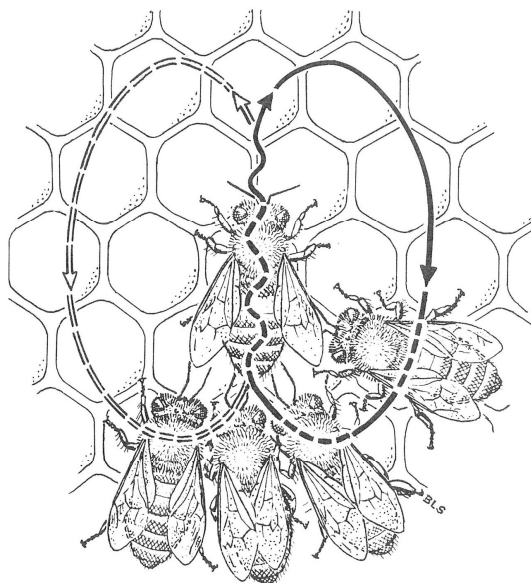


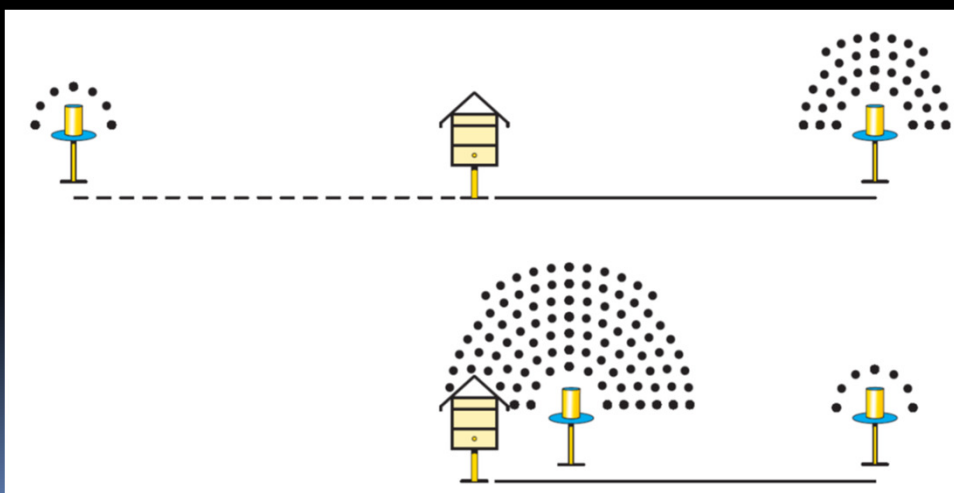
FIGURE 15.11. The tail-wagging dance of *Apis mellifera*. The upper worker is dancing in the pattern indicated; she is followed and antennated by other workers. (From Frisch, 1967a.)

Communication of food sources - stingless bees

- Different species show diversity of ability to recruit to distance and direction of food source
- Many mechanisms involved: contact, vision, smell and sound
- Greater diversity of recruitment systems

Communication of food sources -stingless bees

Tetragonula carbonaria can communicate direction but not distance
(Neih et al 1995)



Strength:

Can be kept on farms permanently



Strength:

Can be managed in hives



Photo: James Dorey

Introducing hives of stingless bees to farms

Stingless bee hives in macadamia orchard



Photo: Giorgio Venturieri



Strength:

Colonies are unable to abscond



Photo: James Dorey

After first mating flight,
reproductive queens lose
ability to fly

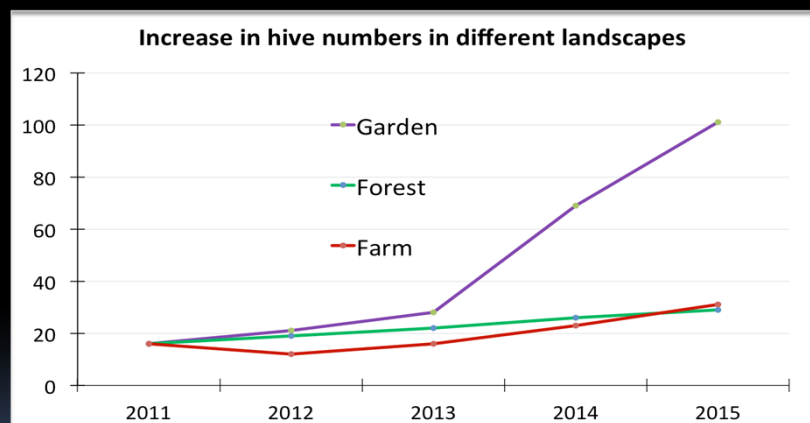
Natural colony multiplication in stingless bees involves new queen



Strength:

Can be reared in large numbers in urban areas

Performance
of colonies
in diverse
environments



Ecology and Evolution

Open Access

Urban gardens promote bee foraging over natural habitats and plantations

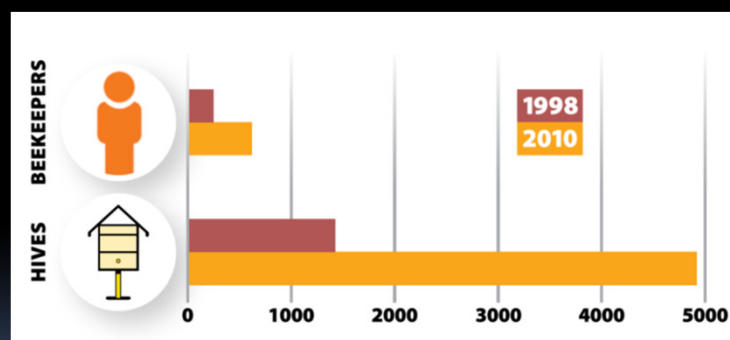
Benjamin F. Kaluza^{1,2,3}, Helen Wallace², Tim A. Heard⁴, Alexandra-Maria Klein⁵ & Sara D. Leonhardt³

Weaknesses of stingless bees for pollination

- Lack of availability of large numbers of hives
- Climatic limitations
- Some species fight when placed in close proximity
- Foragers practise site fidelity
- Homing behaviour is limited
- Host plant flower preferences
- Pollen grains packed into corbicula
- Cannot buzz pollinate

Weakness:

Lack of availability of large numbers of hives



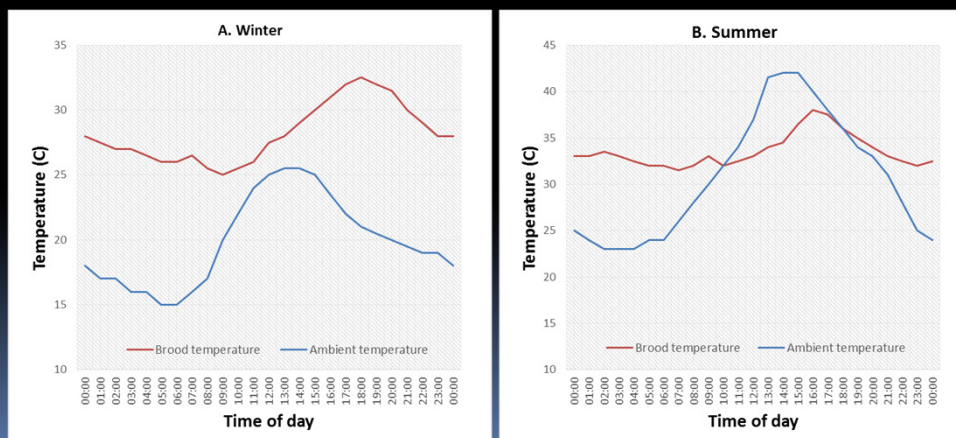
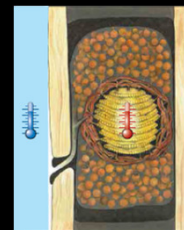
2018?

Weakness: Climatic limitations

- Foragers are not active at low temperatures
- Thresholds for activity:
 - *T. carbonaria* 18 °C
 - *T. hockingsi* 19 °C
 - *A. australis* 22 °C

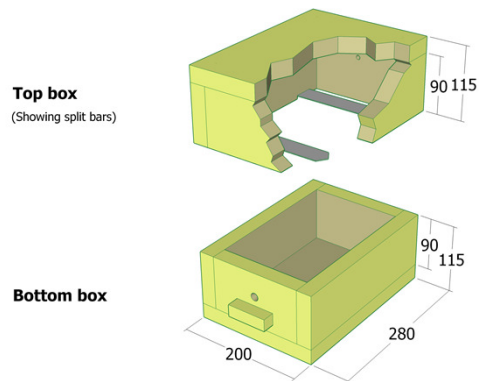
Weakness: Climatic limitations

- Hives perish at low and high temperatures



Weakness: Climatic limitations

- Hives perish at low and high temperatures
- Hive design critical, esp wall thickness and composition



Overheating hive

Bees fanning wings
outside entrance



Overheating hive

Use a wet towel to cool hive



Hive placement critical

Morning sun to encourage foraging, shade from midday to protect against heat

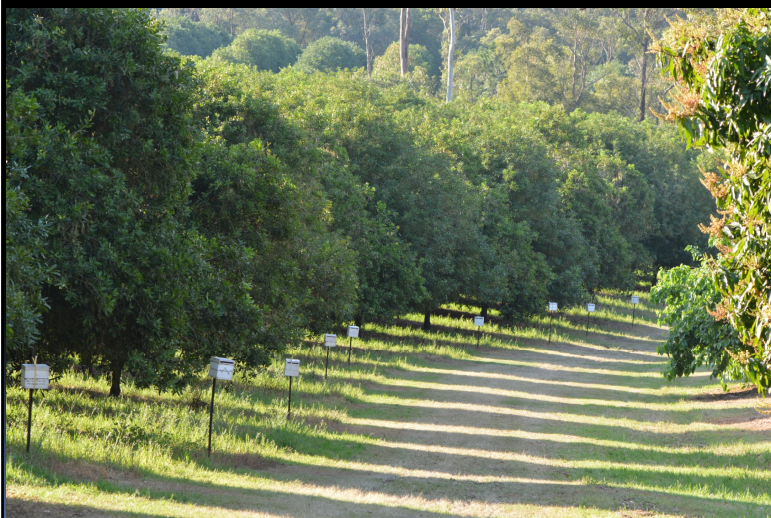


Photo: Giorgio Venturieri



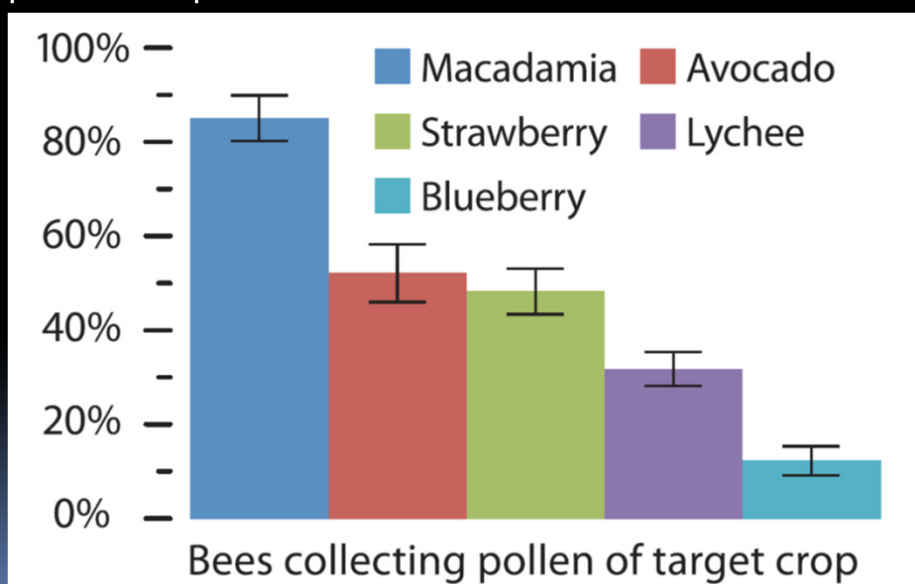
Weakness:

Some species fight between colonies



Weakness:

Host plant flower preferences



Competition
between crops:
Strawberry vs
macadamia



Weakness :
Pollen grains packed into corbicula



Photo: Tobias Smith

VS



Photo: Giorgio Venturieri

Weakness: Homing behaviour is limited

J Comp Physiol A
DOI 10.1007/s00359-016-1100-5

ORIGINAL PAPER

Resources or landmarks: which factors drive homing success in *Tetragonula carbonaria* foraging in natural and disturbed landscapes?

Sara D. Leonhardt¹ · Benjamin F. Kaluza^{1,2,3} · Helen Wallace² · Tim A. Heard⁴



Most bees returned in the natural forests and gardens, but in farm landscapes many never made it home. This information gives us insight into how stingless bees navigate. WE propose they use a combination of visual objects and olfactory landmarks.

Weakness: Cannot buzz pollinate

×



Photo: Tobias Smith

✓

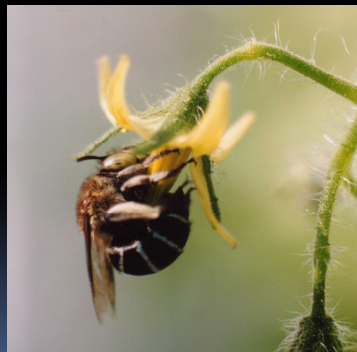
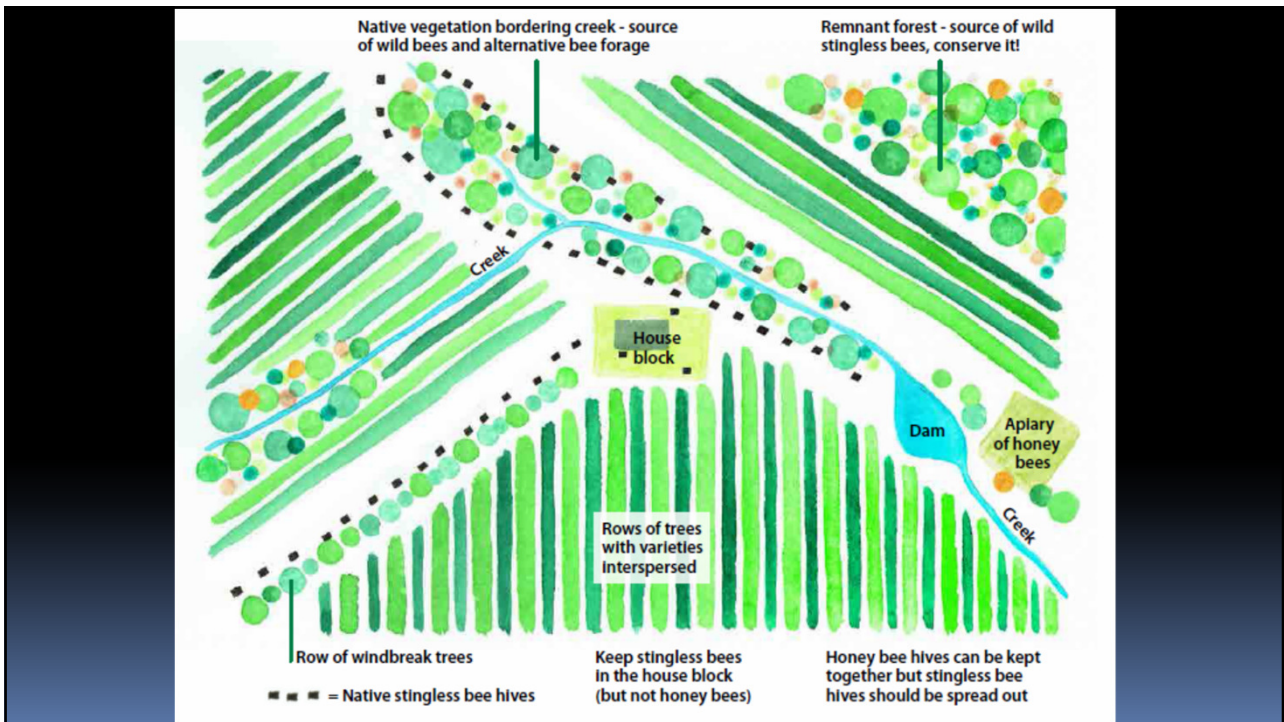


Photo: Melissa Bell

✓



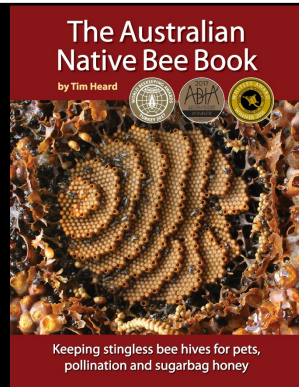
© Giglio Ventrone



Thank you!



tim@sugarbag.net
www.sugarbag.net
Facebook: Sugarbag Bees



1ST AUSTRALIAN Native Bee CONFERENCE

01+ 02 JULY 2018

GOLD COAST • QUEENSLAND