




Biosecurity lessons from honey bee invaders: *Apis cerana* and their Varroa hitchhikers

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<https://www.daf.qld.gov.au/>

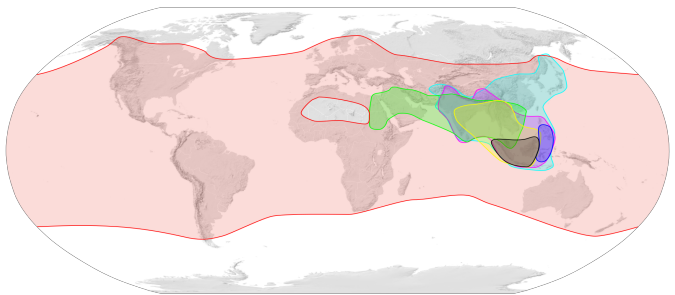


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AHB	EHB
Asian honey bee	European honey bee
<i>Apis cerana</i>	<i>Apis mellifera</i>

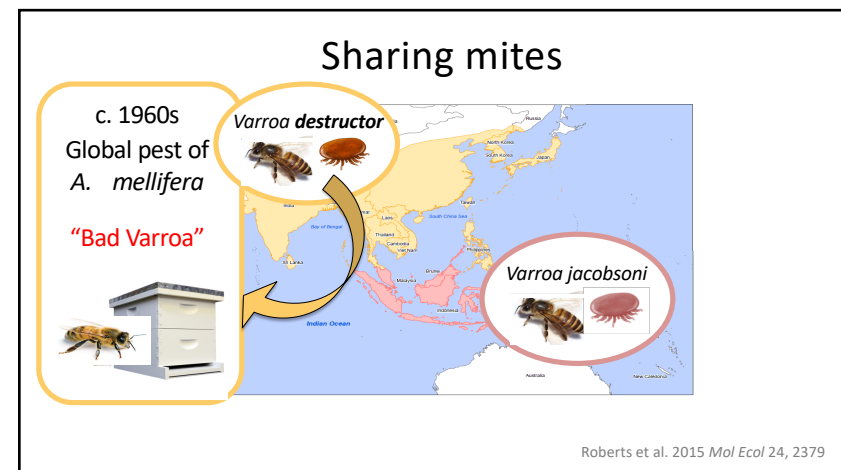
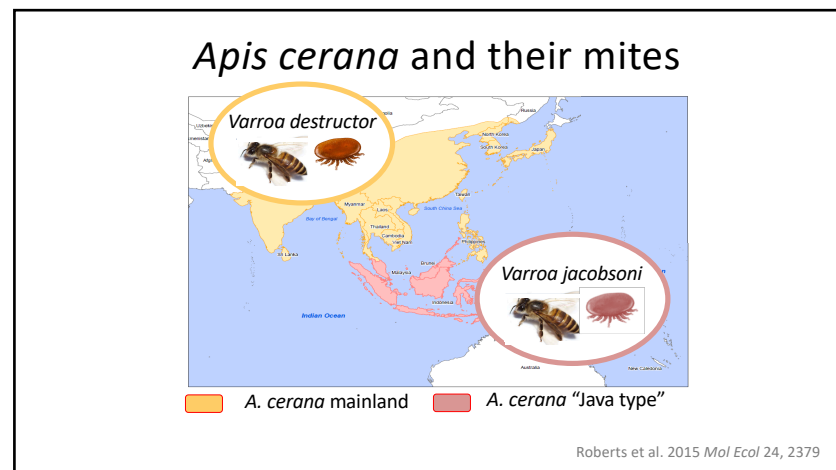
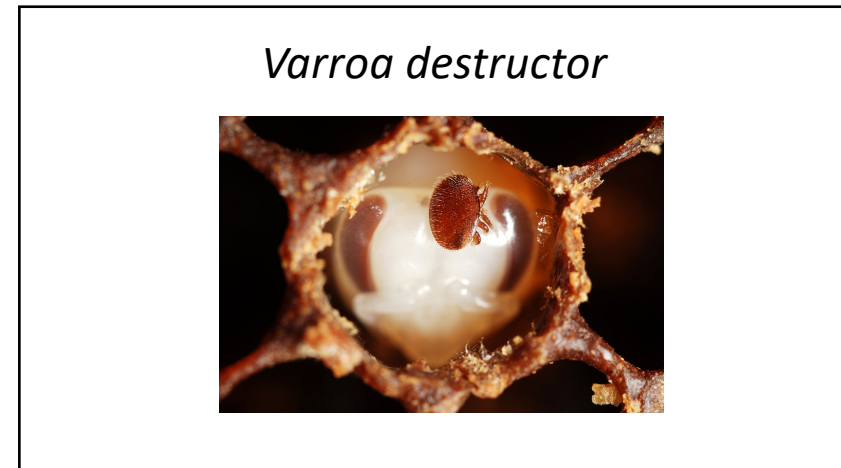
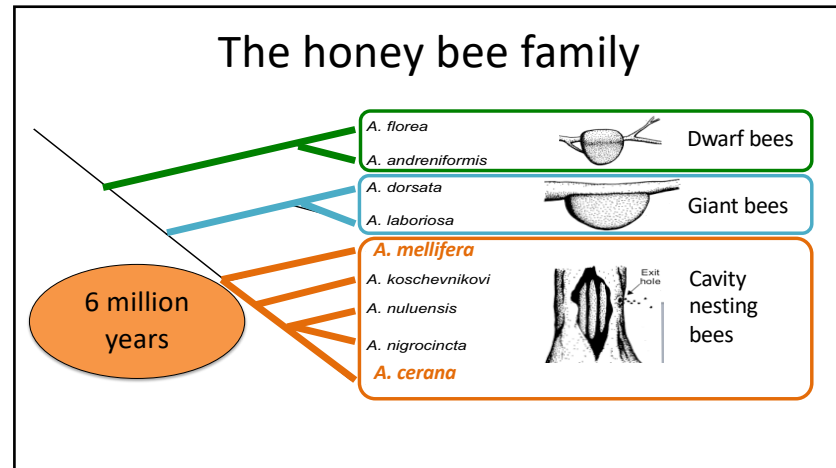
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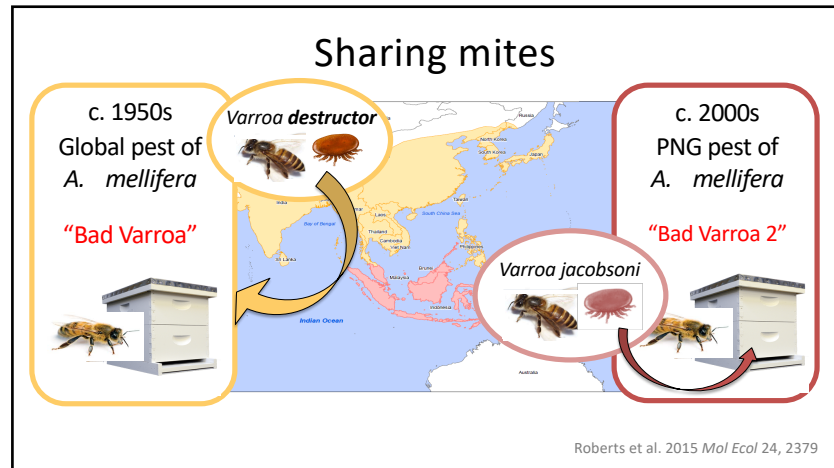
The honey bee family



The "European" honey bee
Apis mellifera

The Asian honey bees



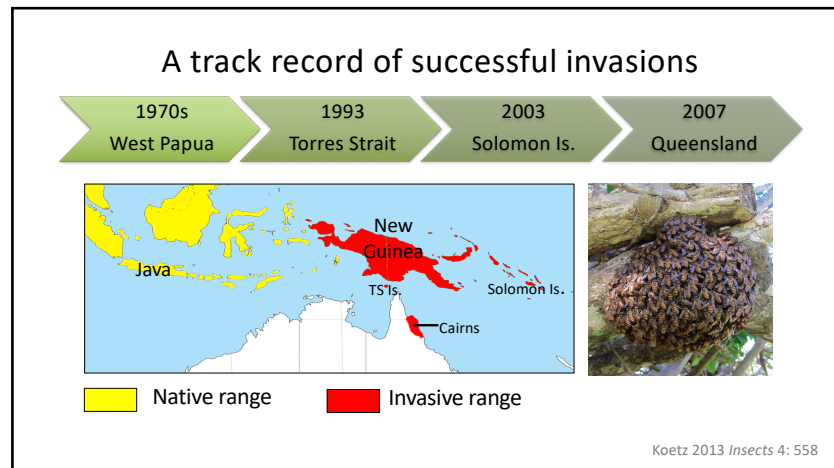


Australia remains Varroa-free.

But each new *A. cerana* incursion risks bringing Varroa



What do past incursions tell us about the risk of new incursions?




Good stowaways




Queensland's invasive *A. cerana*

Genetic markers indicate:

- highly inbred population
- likely origin is New Guinea



Cairns

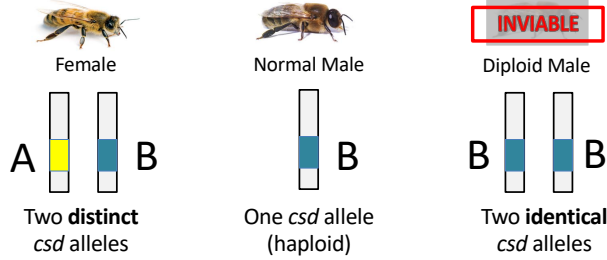


One founding colony?

<https://www.daf.qld.gov.au/>

But...inbreeding is a problem for honey bees

Because sex (male or female) is determined by a single gene, *csd*



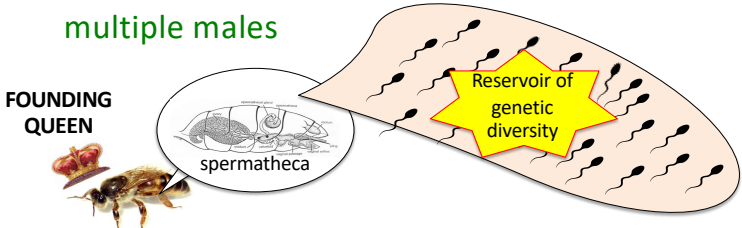
Female: Two distinct *csd* alleles (A and B)

Normal Male: One *csd* allele (haploid) (B)

Diploid Male: Two identical *csd* alleles (B and B) - **INVIABLE**

***A. cerana*'s 3-step solution to avoid the worst effects of inbreeding**

Step 1: Store sperm of multiple males



FOUNDING QUEEN

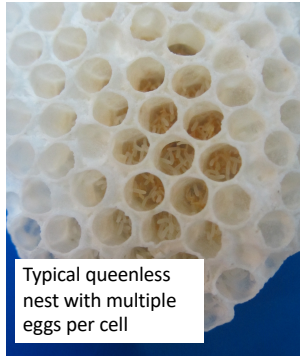
spermatheca

Reservoir of genetic diversity

Ding et al. 2017 *Heredity* 119: 381

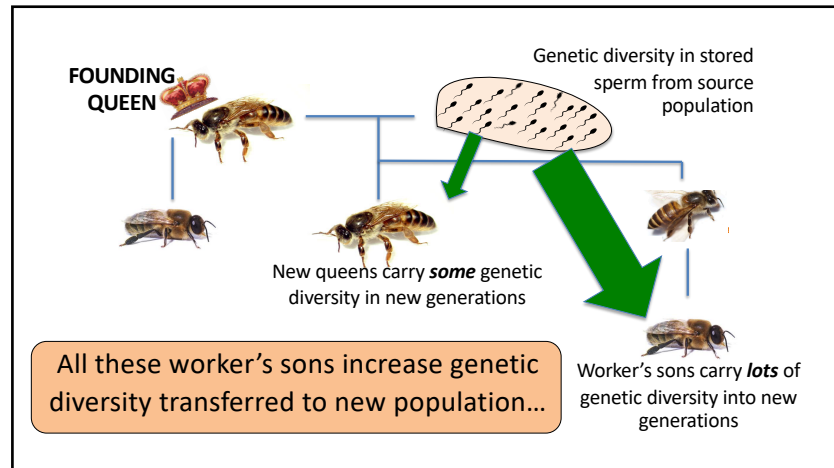
Step 2: Workers produce sons

38% of nests in Cairns are queenless workers rearing drones

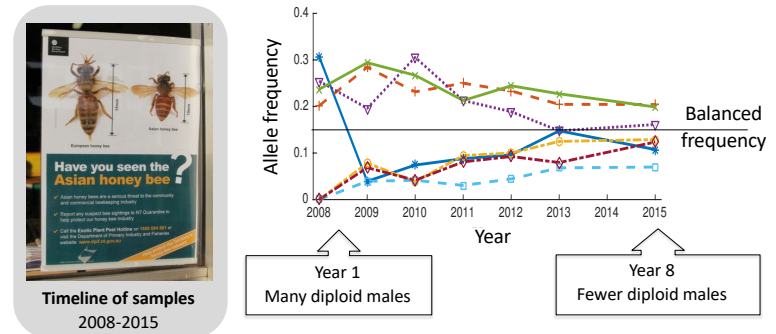


Typical queenless nest with multiple eggs per cell

Gloag, Ding, Christie, Oldroyd et al. unpubl.



Step 3: Natural selection lends a hand



Gloag et al. 2017 *Nature Ecology Evolution* 1, 001

Lessons from past invasions

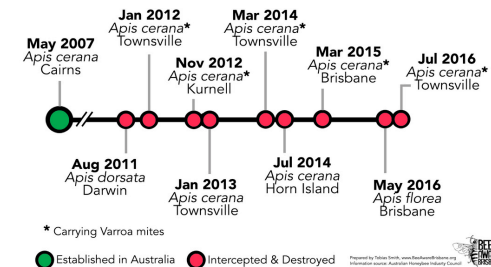
Just one swarm can found a population

"Invasive traits" of *A. cerana* are shared by other Asian honey bee species

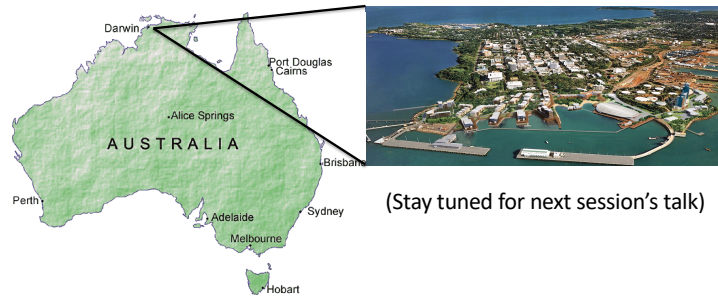
Not all incursions are equal → inbred incursions may spread more slowly than outbred incursions



Recent honey bee incursions to Australia



16 May 2018: *A. cerana* swarm found in Darwin....



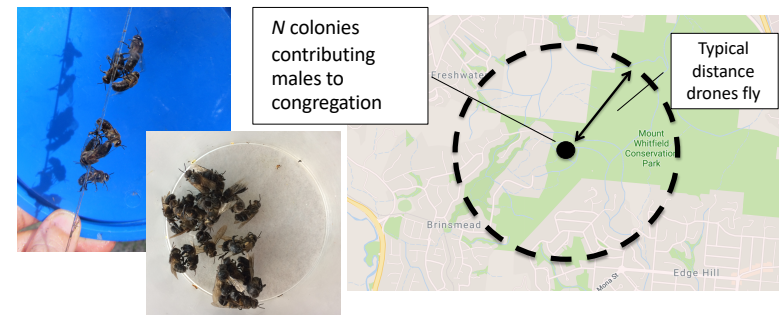
(Stay tuned for next session's talk)

Without Varroa, are *A. cerana* in Australia a problem for beekeeping?

Using drones to estimate population size

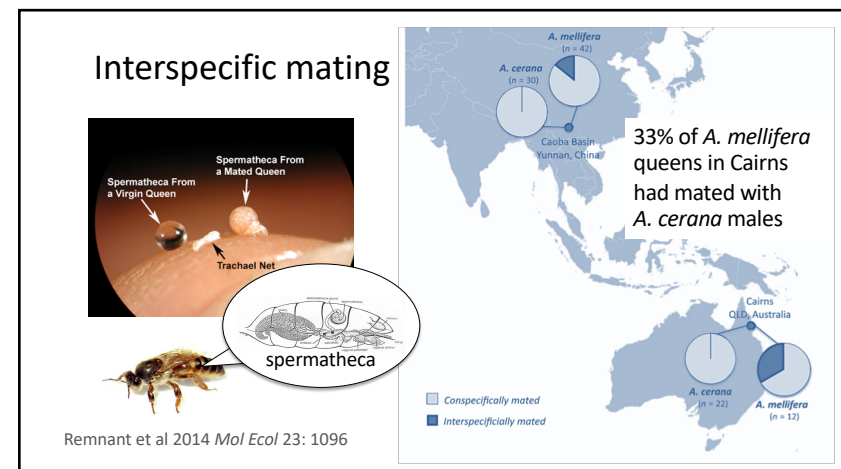
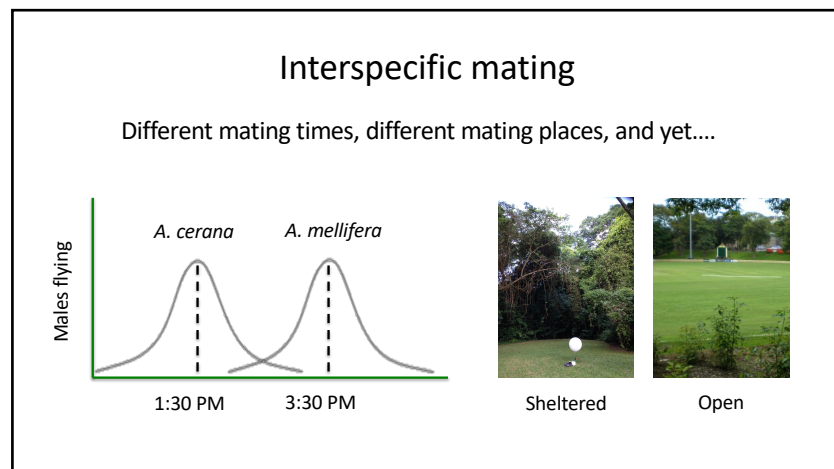
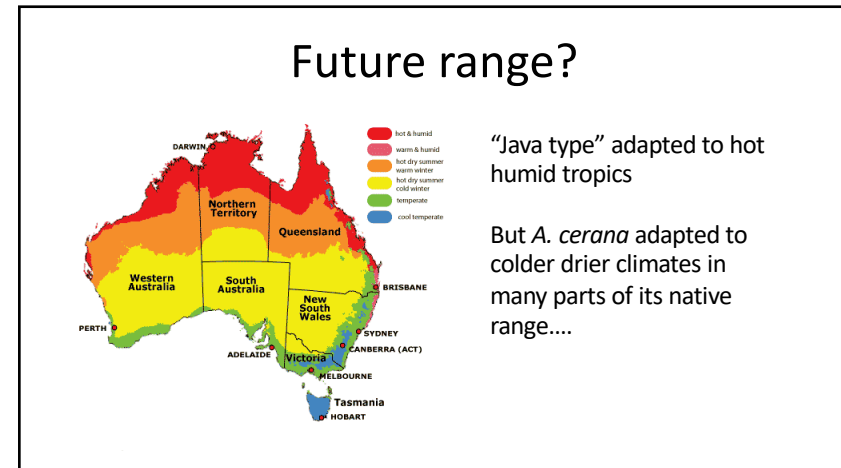
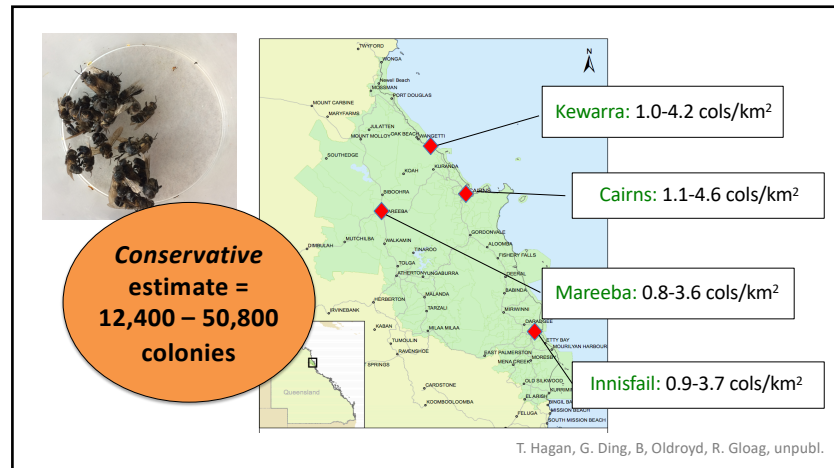


Using drones to estimate population size



N colonies
contributing
males to
congregation

Typical
distance
drones fly

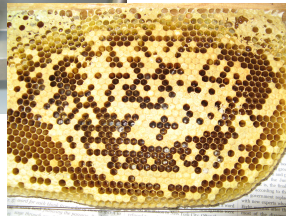


Interspecific mating



Interspecific mating leads to:

- Unfertilized eggs (males)
- Hybrid offspring that fail to develop beyond larval stage
- Regicide in *A. cerana*?



Remnant et al 2014 *Mol Ecol* 23:1096; Gloag et al 2016 *Ins Soc* 64:241

Other impacts on industry and environment

- Competition for nest sites
- Competition for food
- Reservoir of disease



Other impacts on industry and environment

Crop pollination?

Important pollinator in native range



More lessons from past invasions

- Genetic tools can aid monitoring and detection of incursions
- Informed beekeeper community and public essential
- *A. cerana* might impact beekeeping industry even in absence of Varroa.





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