

## Honey bee mating biology

(And why you should care about it)



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## Outline of talk

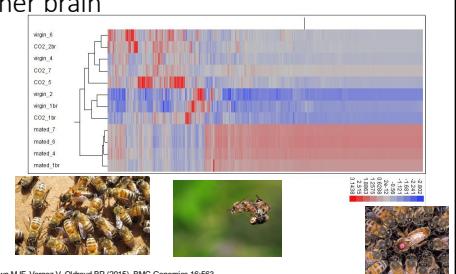
- When and where?
  - How far do drones and queens fly?
    - How can we use drones to assess the number of colonies in an area?
- Why so many?
  - Are our commercial queens mated enough?
- Interspecific matings
  - Lock and key
    - *Apis cerana* in Queensland

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## Part 1. Where and when?

When a queen is five days old, things start to change in her brain

- Attracted to light
- Wants to fly



Manfredini F, Brown MJF, Vergaz V, Oldroyd BP (2015). BMC Genomics 16:563

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Flies to a drone congregation area

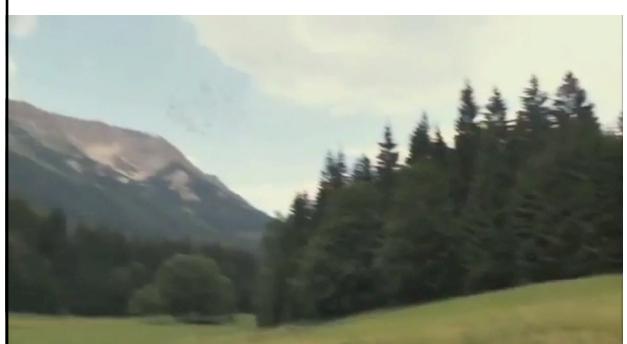
- Mates with 30-50 drones
- Mating is random
- Mating is fatal to males



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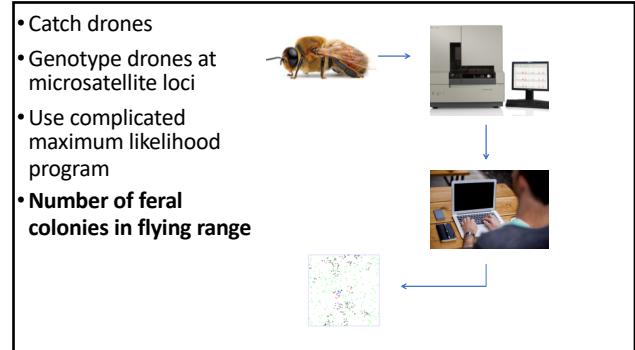
Part 2. How far do drones fly?

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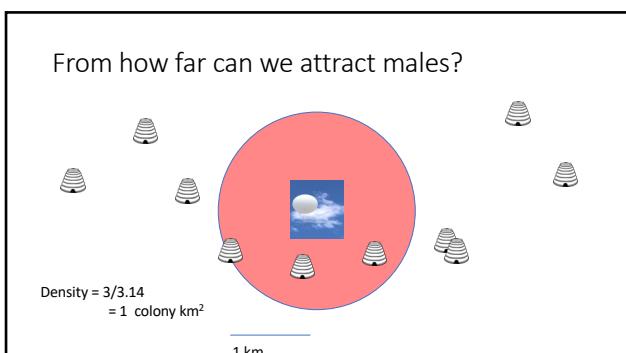
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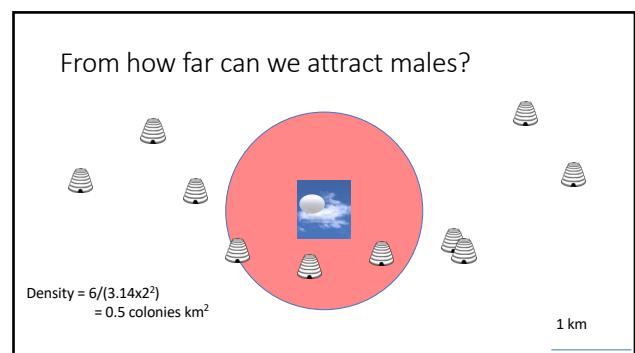
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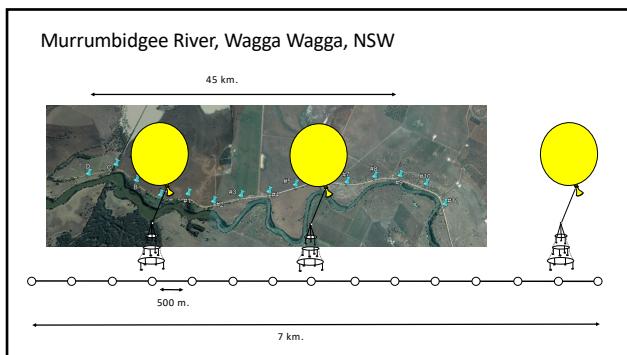
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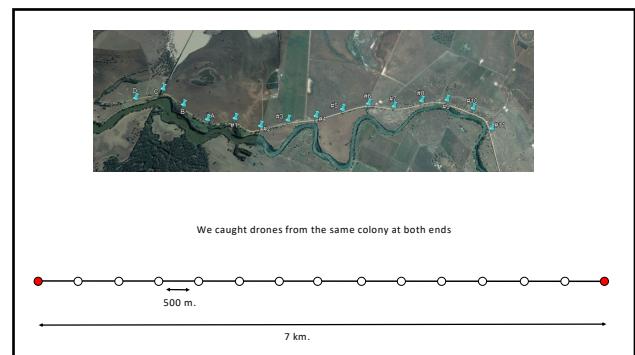
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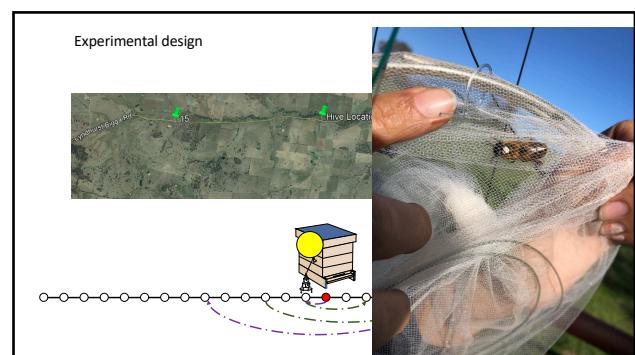
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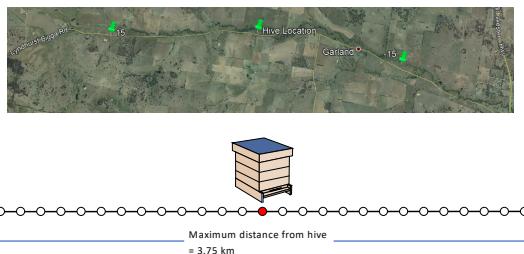
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**Experimental design**

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**Drone flight range**

- 3.75 km is the appropriate flight range for density estimates
- Number of families in the trap/ $\pi * 3.75^2$
- From the Wagga transect data we find 4.04 feral colonies per square kilometer

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**What about mating your queens?**

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**Ben-recommended distances**

- Drone-source colonies should be within 1-2 km from mating nucs
- Isolation can be achieved if mating nucs are more than 7 km from all unwanted drones.



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### Part 3. Why so many?

20+, up to 100. Seems excessive!



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### Why so many?

- Avoid inbreeding and 'spotty brood'
- Sperm need (must mate for life)
- Task allocation
- Disease resistance



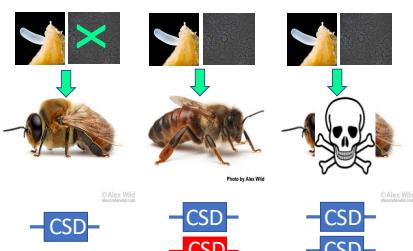
Spotty brood (queen mated to brother)



Nice brood (queen naturally mated)

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### The cause of spotty brood



Beyre, M., et al. 2003. The gene *cisd* is the primary signal for sexual development in the honeybee and encodes an SR-type protein. — Cell 117: 419-429.

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### Task allocation

- The offspring of different drones differ in task



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Are genetically diverse colonies more stable than uniform ones?

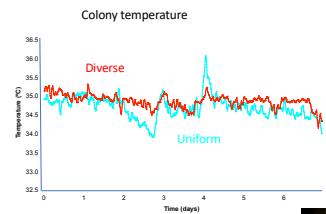


- 4 genetically uniform colonies
- 4 genetically diverse colonies

Jones, J. et al. 2004. Honey bee nest thermoregulation: diversity promotes stability. — Science 305: 402-404.

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DIVERSE VERSUS UNIFORM

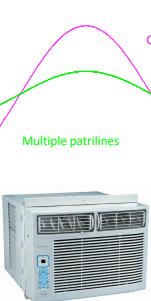


Jones, J. et al. 2004. Honey bee nest thermoregulation: diversity promotes stability. — Science 305: 402-404.

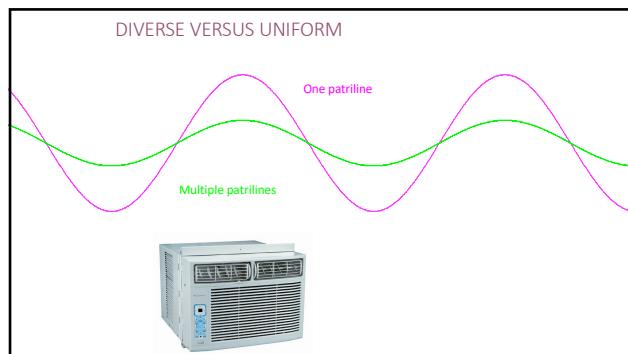
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DIVERSE VERSUS UNIFORM



One patriline  
Multiple patrilines



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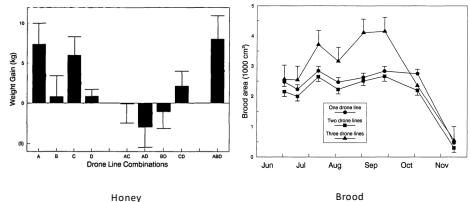
Hygienic Behaviour



Non-hygienic colony      Hygienic colony  
Odeley, P. R. et al. 2010. Six quantitative trait loci influence task thresholds for hygienic behaviour in honeybees (*Apis mellifera*). — Mol. Ecol. 19: 1452-1461.

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### Honey production and brood area



Oldroyd, B. P. et al. 1992. Effects of intracolonial genetic diversity on honey bee (Hymenoptera: Apidae) colony performance. — Ann. Ent. Soc. Am. 85: 335-343.

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One has to wonder if there are enough genetically diverse drones provided by commercial queen producers



- 400 nucs
- 20 drones per queen
- =8000 drones per catch

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Mating quality of early and late season queens

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2015-16

October	April
2 NSW producers	1 NSW producer
2 QLD producers	3 QLD producers



Progeny of 17-20 queens per queen producer.  
96 workers per queen (this was a big project people)

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Early spring 2016

Breeder	Drones	
	Average	Range
1	19.0	12-25
2	17.9	13-26
3	16.5	9-30
4	15.6	8-28



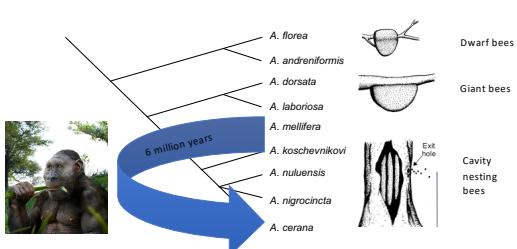
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#### Part 4 Inter-specific matings

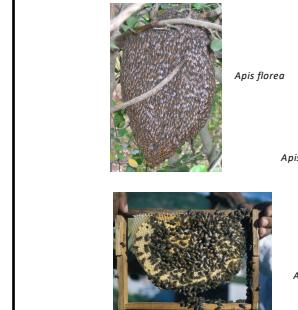
(i.e. when different species mate)

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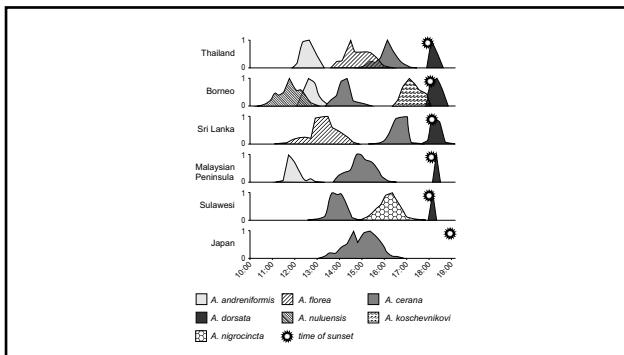
Honey bees of the world



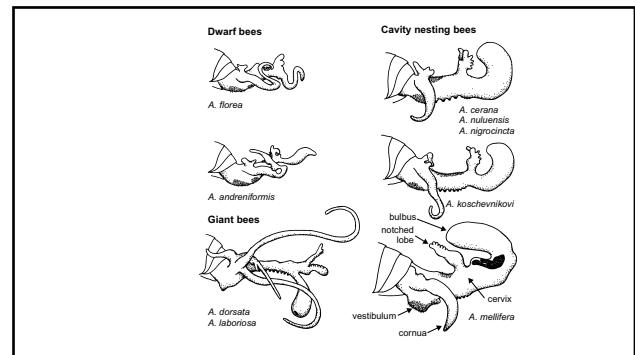
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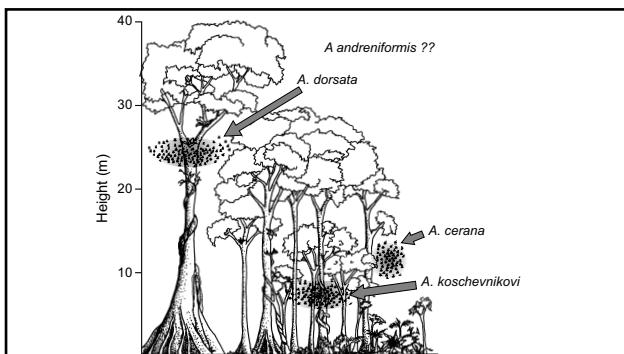
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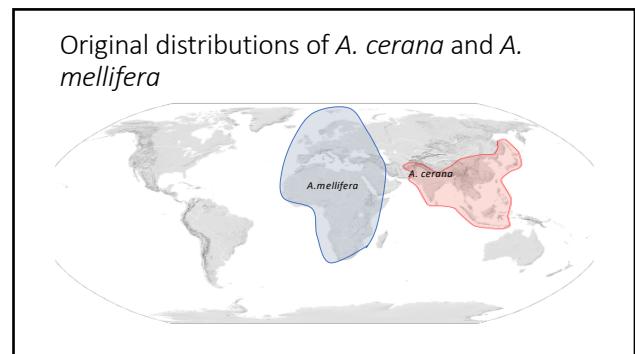
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Current distributions of *A. cerana* and *A. mellifera*



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Can *A. cerana* and *A. mellifera* mate and what happens if they do?



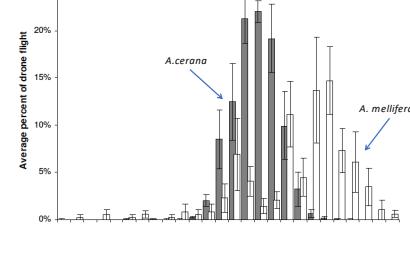
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Mating time: count the drones as they leave the colony



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Drone flight times in Cairns



### Conclude

- Plenty of opportunity for interspecific matings



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### Spermatheca dissections



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### Interspecific matings

Site	Queen species	n	Queens that mated with at least one interspecific male	% interspecific mating
Caoba Basin, Yunnan, China	<i>A. mellifera</i>	42	6	14.0
Cairns, Queensland, Australia	<i>A. cerana</i>	30	0	0
Cairns, Queensland, Australia	<i>A. mellifera</i>	12	4	33.3
	<i>A. cerana</i>	22	0	0

**1/3 of Cairns queens mated with at least one cerana male**

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### So.... Do *A. mellifera* mate with *A. cerana* males?

- Yes! Definitely happens in China and Cairns
- Eggs don't hatch
- Will potentially see a retreat of queen rearing away from *A. cerana* infestation



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