The infamous Varroa mite
What does it do and what can be done about it?
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Varroa

First described from *Apis cerana* in Indonesia in 1904

Ignored until early 1980s when it was found to cause damage on *Apis mellifera*


**Varroa life cycle**


Varroa sex life

Mother mite produces one son only

He will be the first born

Male patiently waits for his sisters to grow up

Waiting for his sisters……

Varroa sex life

Just like bees, females and males are different

Females: two sets of chromosomes
Diploid

Males: one set of chromosomes
Haploid
**Varroa sex life**

Unlike bees, females need to mate to produce sons *(pseudo arrhenotoky)*

![Males: one set of chromosomes](image)

![Females: two sets of chromosomes](image)

That means that if she fails to produce a son, her daughters will be infertile

![image](image)
Why doesn’t *Varroa* harm *Apis cerana*?

Because the mother mite continues to produce daughters, the longer the bee’s developmental time, the more daughters are produced.
Why doesn’t *Varroa* harm *Apis cerana*?

Brood developmental time for *A. cerana* and *A. mellifera*

<table>
<thead>
<tr>
<th>Species</th>
<th>Worker</th>
<th>Queen</th>
<th>Drone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Egg</td>
<td>Larva</td>
<td>Pupa</td>
</tr>
<tr>
<td><em>A. cerana</em></td>
<td>3  5  11</td>
<td>3  4-5.5  6-7.5  3</td>
<td>6  14</td>
</tr>
<tr>
<td><em>A. mellifera</em></td>
<td>3  6  12</td>
<td>3  5  5  3</td>
<td>7  14</td>
</tr>
</tbody>
</table>

2 Moritz and Southwick (1992)

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Could it be that simple?

Indeed, *Varroa* only reproduces in drone cells in *Apis cerana*, and not in worker cells.

As a result, mite numbers never build up significantly.
However…..

Varroa enters *Apis cerana* worker cells, but does not reproduce

Boot, W. J., et al. 1999 Natural selection of *Varroa jacobsoni* explains the different reproductive strategies in colonies of *Apis cerana* and *Apis mellifera*. Experimental and Applied Acarology 23: 133-144

Well, that seems weird…..

Modelling studies have shown that ‘hiding’ in worker cells, when there are no drone cells available, can be a wise strategy

**Apis cerana** grooming behaviour

When mites stay on bees, they might die


In addition....

Cells with more than one mite (eg reproducing mite) are removed

In the meantime in PNG and Indonesia

Varroa present in *Apis mellifera* colonies were found not to reproduce

*A. mellifera* colonies showed low levels of mite infestation, probably due to mites coming in from nearby *A. cerana*


How one mite became two

Moving mites from *A. cerana* to *A. mellifera* and vice versa

Boot, W. J., et al. 1999 Natural selection of *Varroa jacobsoni* explains the different reproductive strategies in colonies of *Apis cerana* and *Apis mellifera*. *Experimental and Applied Acarology* 23: 133-144
How one mite became two

Reproduction of *V. jacobsoni* in naturally and artificially infested worker cells

<table>
<thead>
<tr>
<th></th>
<th>Total number of cells</th>
<th>Brood removed</th>
<th>Mites lost</th>
<th>Without offspring</th>
<th>With offspring</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Mites from A. mellifera colonies</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Naturally infested cells</td>
<td>77</td>
<td>--</td>
<td>--</td>
<td>16</td>
<td>61</td>
</tr>
<tr>
<td>Artificially infested cells of <em>A. mellifera</em></td>
<td>104</td>
<td>33</td>
<td>21</td>
<td>9</td>
<td>41</td>
</tr>
<tr>
<td>Artificially infested cells of <em>A. cerana</em></td>
<td>131</td>
<td>38</td>
<td>36</td>
<td>13</td>
<td>44</td>
</tr>
<tr>
<td><em>Mites from A. cerana colonies</em></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Naturally infested cells</td>
<td>13</td>
<td>--</td>
<td>--</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Artificially infested cells of <em>A. mellifera</em></td>
<td>57</td>
<td>14</td>
<td>3</td>
<td>38</td>
<td>2</td>
</tr>
</tbody>
</table>

Boot, W. J., et al. 1999 Natural selection of *Varroa jacobsoni* explains the different reproductive strategies in colonies of *Apis cerana* and *Apis mellifera*. Experimental and Applied Acarology 23: 133-144

The birth of *Varroa destructor*

How does *Varroa* damage bees?

By drinking bee blood *Varroa* transmits viruses from bee to bee in the same way as that mosquitoes transmit diseases.

Studies seem to indicate that *Varroa* is associated with more harmful (virulent) viruses.

Currently main damage assumed to be linked to more virulent viruses.

More in other talks later today.

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What can we do?

Many European researchers have been or are selecting for tolerance to *Varroa*.

Colonies are kept isolated from other apiaries and not treated against *Varroa*.

Colonies deemed strong enough after winter are kept.

What can we do?

Two separate populations:

- **One population**: bees remove reproducing mites from brood cells
- **Other population**: mites do not reproduce in worker cells
- Mite numbers similar to those in control (treated) colonies


And in the woods of upstate New York…

- **Key**: colonies produce swarms each year
- **Result**: period without brood, thus breaking the mite’s reproductive cycle
And in South Africa.....

The Cape honeybee *Apis mellifera capensis* became *Varroa* tolerant within 3-5 years after the arrival of *Varroa*

*Apis mellifera scutellata*: 6-7 years

Evolving towards a less destructive relationship?

Natural selection is a powerful force

Interesting that the tolerance mechanisms seem to mirror mechanisms found in *Apis cerana*
Evolving towards a less destructive relationship?

There are different means by which bees can keep mite numbers low

But selection will only act when the mites are present
Evolving towards a less destructive relationship?

There are different means by which bees can keep mite numbers low

But selection will only act when the mites are present

Impossible to select for tolerance mechanisms in the absence of Varroa

Thank you