

The pathway to new classical biocontrol of invasive *Vespula* in NZ



Manaaki Whenua
Landcare Research

Bob Brown
brownb@landcareresearch.co.nz

Wasp biocontrol project committee

- Funded by MPI Sustainable Farming Fund
- Top of the South Island
- Contributors from:
 - Nelson Forests Management
 - The Landcare Trust
 - Friends of Rotoiti
 - Federated Farmers
 - DOC St Arnaud
 - Entecol
 - National Beekeepers Association
 - Rural Women NZ
 - Environment Bay of Plenty
 - Greater Wellington Regional Council
 - Beef and Lamb New Zealand

Funded by Sustainable Farming Fund

Ministry for Primary Industries
Manatū Ahu Matua



- Tasman District Council
- NZ Wine
- Forest & Bird
- ECAN
- Waikato Regional Council
- Marlborough Wine Research Centre
- Marlborough District Council
- And several others



Why are *Vespula* so invasive in NZ?

- Life cycle
 - Long overwintering diapause
- Biology
 - Social, generalist predators
- NZ environment
 - Mild conditions
 - Honeydew!
- Open niche
- **No natural enemies**





Pneumolaelaps niutirani



- Discovered in NZ, but subsequently found in UK
- Normally harmless to wasp colonies
- Likely vector diseases such as *Aspergillus*, viruses, etc.



Melittobia sp.

- Uncommon parasitoids of Vespids
- Primary hosts are leaf cutter bees (*Megachile*) and mason wasps (*Pison*)
- May also attack *Bombus* spp.





Sphecophaga spp.

- 3 spp introduced to NZ
1980s – 1990s
- Specific to social wasps
- Many generations per year
- Considered to be unsuccessful
 - Low genetic diversity
 - Range disparity
 - wrong ecotype?





How & where to find new agents?

- **Origin:** Both *Vespula* species from southern UK (Lester et al 2014 & Brenton-Rule et al 2018)
- **Literature review:** - compiled list of likely BC candidates
- **Host range**
 - Taxonomy of closest relatives (centrifugal phylogeny)
 - Similar ecology (social, ground/cavity nesting)
- **Range:** UK naturalists have great records of species & ranges covering a long period of time
- **Survey:** Which candidates are actually found in nests



Nearest relatives of targets in NZ

VESPIDAE

Ancistrocerus gazella (Panzer, 1798)

Polistes chinensis (Fabricius, 1793)

Polistes dominula (Christ 1791) **recent addition to NZ**

Polistes humilis (Fabricius, 1781)

Vespula germanica (Fabricius, 1793)

Vespula vulgaris (Linnaeus, 1758)

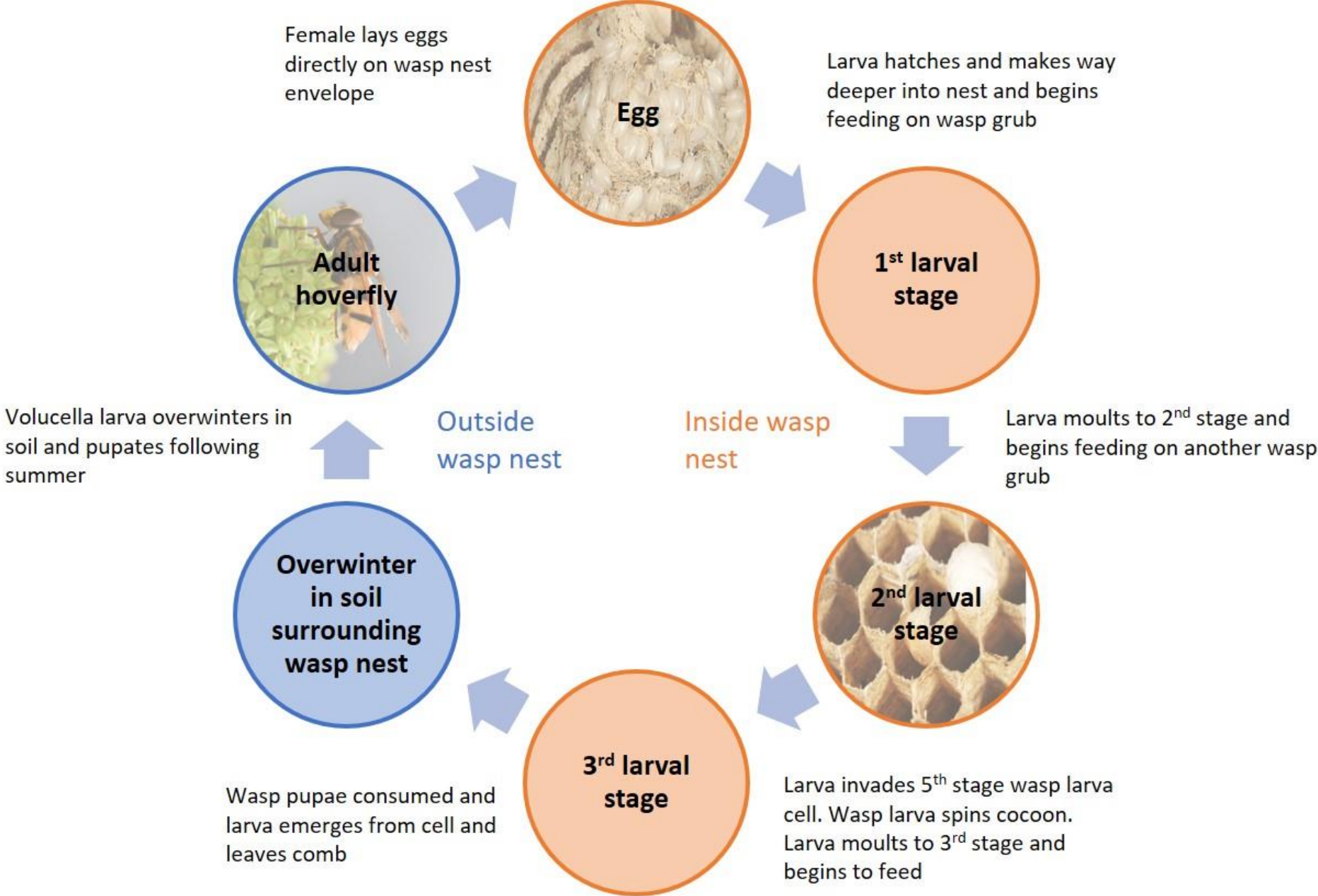
- **No native species in this family**
- **Bumblebees nearest relatives with similar colony & nesting ecology**
 - *Bombus terrestris*



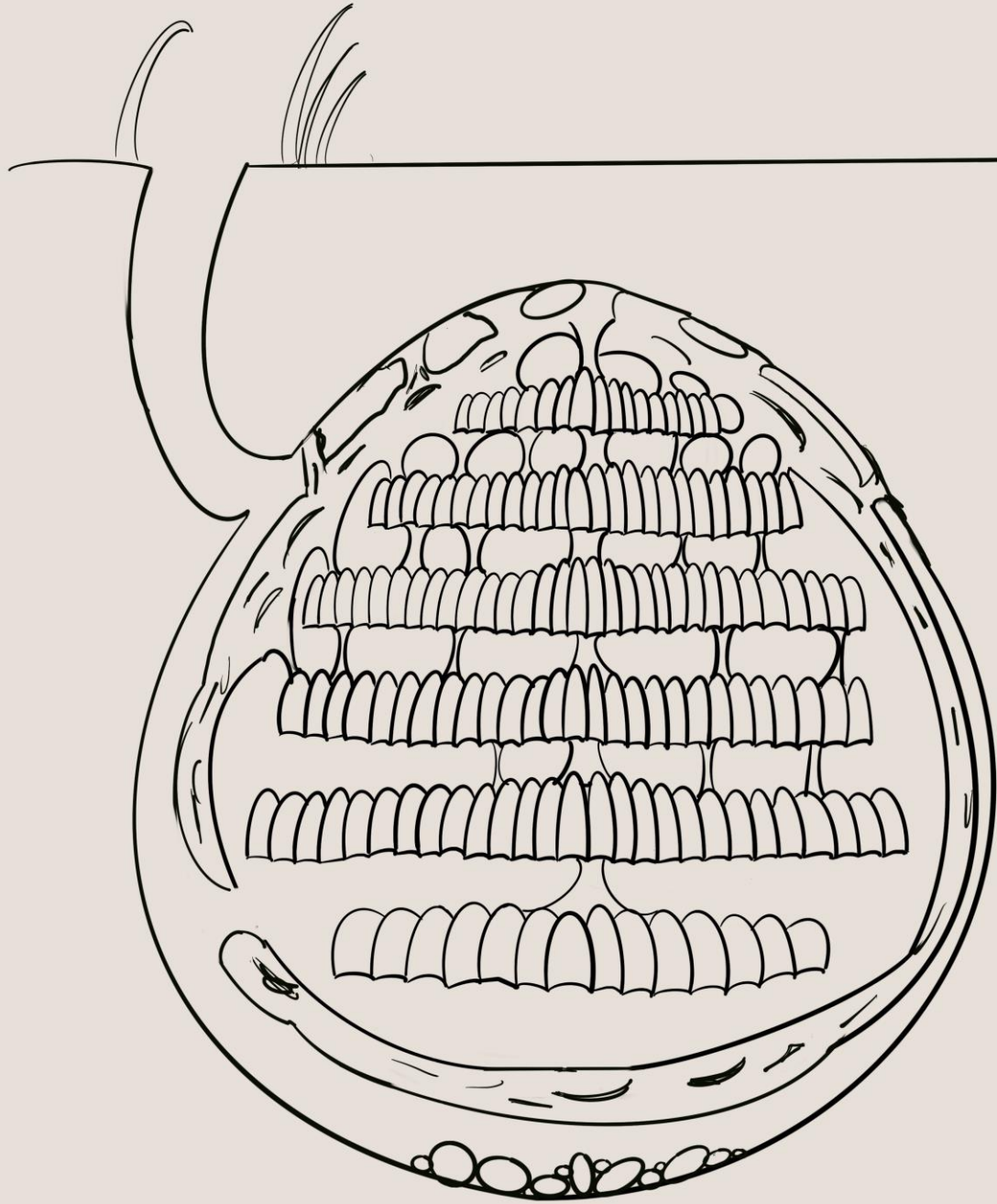
#1 *Volucella inanis*

- Excellent range match for both wasp species
- Brood parasite of *Vespula*
- Found in most nests in 2016 – 2019 UK surveys
- High fecundity (>600 eggs)
- Excellent fliers...should disperse rapidly





Adapted from Rupp 1989







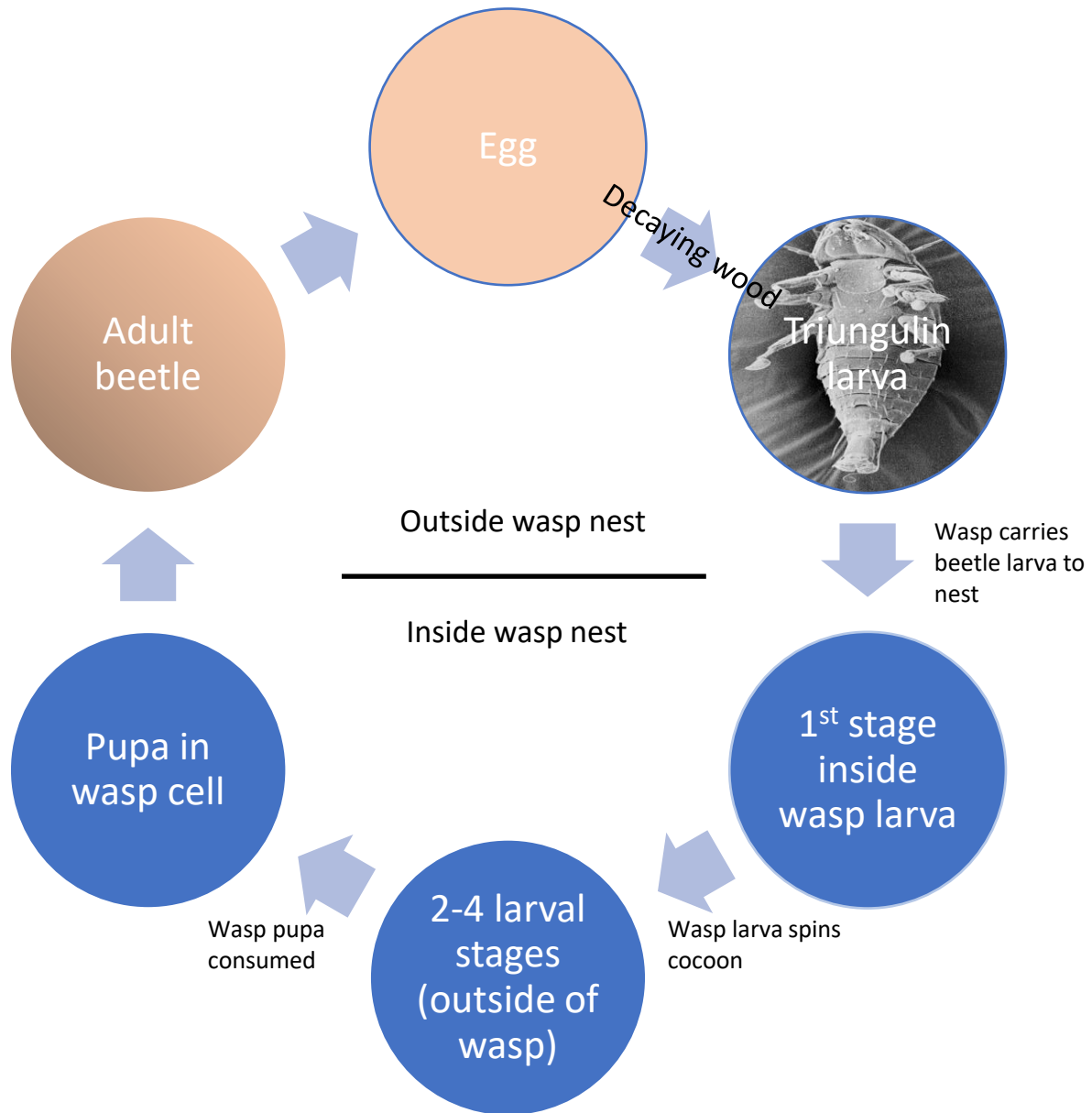




#2 *Metoecus paradoxus*

- Brood parasite of *Vespula* (prefer *V. vulgaris*)
- Also found in many nests in 2016 – 2098 UK surveys
- High fecundity (up to 700)
- Somewhat complex life history

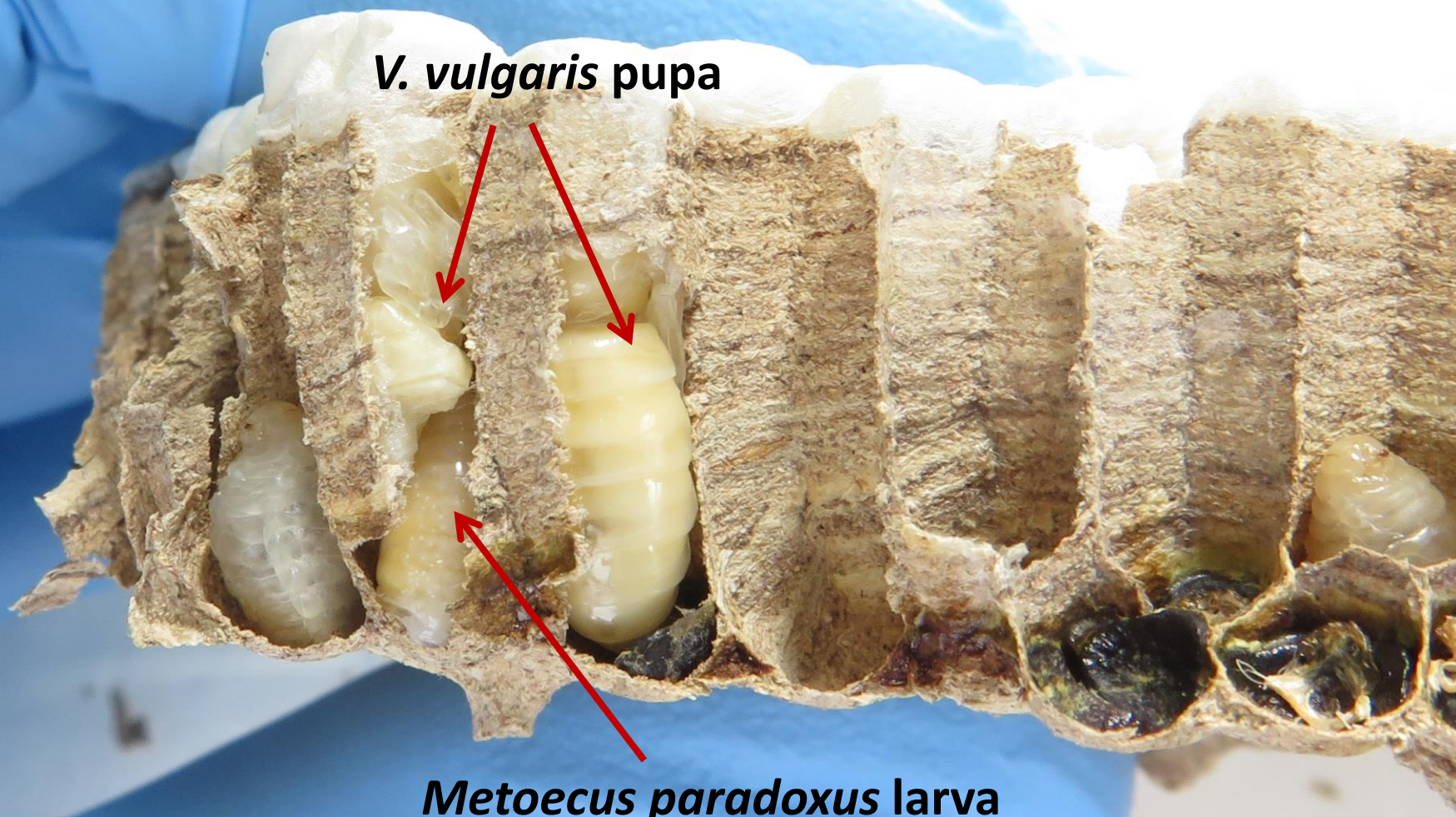




Adapted from Edwards 1980

V. vulgaris pupa

Metoecus paradoxus larva





What actually occurs in the nests?

- UK nest survey 2018 - 2019

Wasp species	Nest surveyed (total)	# Parasitized	% Parasitized	# <i>V. inanis</i>	% <i>V. inanis</i>	# <i>M. paradoxus</i>	% <i>M. paradoxus</i>	# <i>S. vesparum</i>	% <i>S. vesparum</i>
<i>V. vulgaris</i>	26	24	92.3	23	88.5	13	50.0	2	7.7
<i>V. germanica</i>	6	6	100.0	5	83.3	0	0.0	0	0.0

- *Combined* survey results from Carl & Wagner 1982, Van Oystaeyen et al 2015, and unpublished 2018-2019 UK nest surveys

Wasp species	Nest surveyed (total)	# <i>M. paradoxus</i>	% <i>M. paradoxus</i>
<i>V. vulgaris</i>	329	174	52.89
<i>V. germanica</i>	86	7	8.14



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Native range tests and surveys

- National Bee Unit (NBU) part of Animal & Plant Health Agency (APHA) UK
 - Surveys of bee hives since 1950's
 - Averaging 35,000 hives/year since 2010
 - <http://www.nationalbeeunit.com>
 - No reported detection of *Volucella inanis* or *Metoecus paradoxus*
- Host tested *Bombus terrestris audax*
 - No attack on brood



Next steps

- Application to the EPA
- Develop rearing methods
- Release

- Investigate other biocontrol agents



The stages for processing HSNO applications that are publicly notified

