



**Landcare Research**  
**Manaaki Whenua**

# **Prospects for classical biocontrol of paper wasps in New Zealand**

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# Paper wasps in NZ

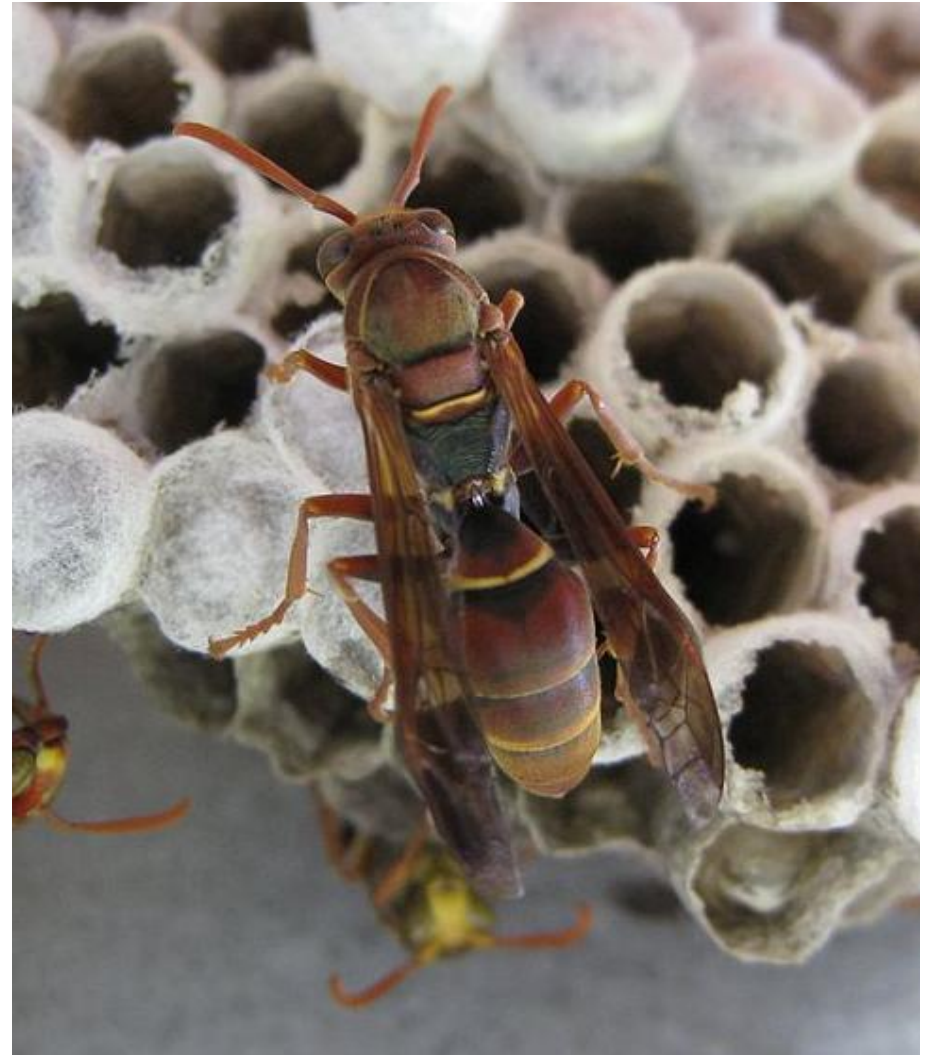


- Exotic predatory social wasps that feed on invertebrates (mainly lepidopteran larvae).
- Two species are established in New Zealand.

# *Polistes humilis* (Fab.)



- Native to southern mainland Australia: southern QLD, NSW, Vic, SA & southern WA.
- Present in NZ since the 1880s.
- Restricted to the upper North Island.



# *Polistes chinensis antennalis*

## Pérez

- Native to E. Asia: Japan, China, Korea & Taiwan.
- 1<sup>st</sup> recorded in NZ in 1979.
- Has spread through much of the NI & SI as far south as Christchurch.
- May not have yet reached its maximum distribution.



# Impacts of paper wasps



- Eat invertebrates (mainly caterpillars) & nectar in late summer/autumn.
- At Lake Ohia, Northland, densities of 20-210 nests/ha consumed 15,000-478,000 prey loads/yr<sup>1</sup>.
- Beneficial impacts:
  - Prey on pests e.g. cabbage white butterfly caterpillars.
- Undesirable impacts:
  - Prey on native Lepidoptera;
  - monarch butterfly larvae;
  - some weed biocontrol agents.



Photo: [http://huia1thegardens.blogspot.co.nz/2012\\_03\\_01\\_archive.html](http://huia1thegardens.blogspot.co.nz/2012_03_01_archive.html)

<sup>1</sup>Clapperton BK 1999. NZ J. Ecol. 23: 11–19.



# Benefits of paper wasps



- An experiment in Wisconsin demonstrated paper wasps significantly reduced *Pieris rapae* larval numbers feeding on cabbages<sup>1</sup>. However:
  - Larval numbers exceeded threshold for pesticide use. Poor yield & plant quality vs pesticide-treated plants
  - Artificially augmented paper wasp populations – realistic?
  - Concluded: paper wasp use impractical for intensive agriculture, but might benefit small organic gardens, home vegetable gardens



<sup>1</sup>Gould WP, Jeanne RL 1984. *Polistes* wasps (Hymenoptera, Vespidae) as control agents for lepidopterous cabbage pests. *Environmental Entomology*, **13**, 150–156.

# Impacts on native Lepidoptera



- Poorly known (identification of minced prey difficult). Known prey includes<sup>1</sup>:
  - kawakawa looper *Cleora scriptaria*;
  - kowhai moth *Uresiphita polygonalis maoralis*;
  - native noctuids including *Graphania* sp.
- Risk to threatened *Dodonidia helmsi* butterfly in northern range<sup>2</sup>
- Prey on NZ copper butterfly (*Lycaena* spp.) larvae<sup>3</sup>



<sup>1</sup>Clapperton BK 1999. NZ J. Ecol. 23: 11–19

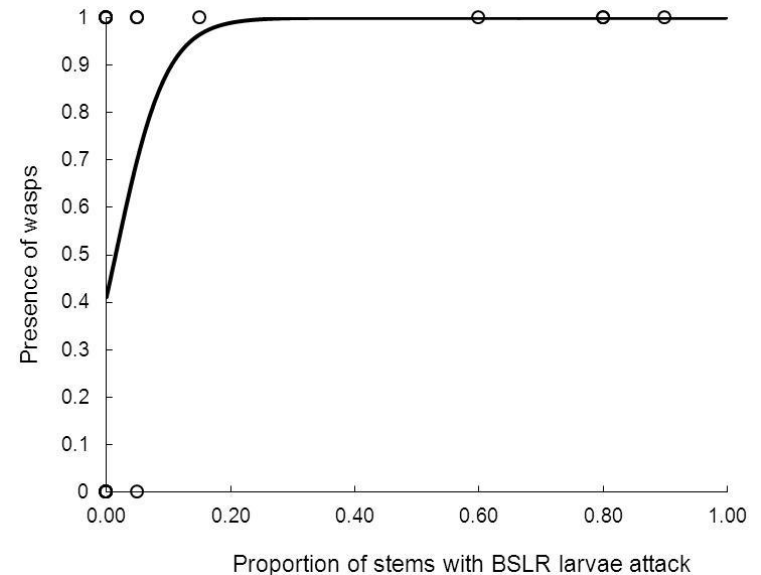
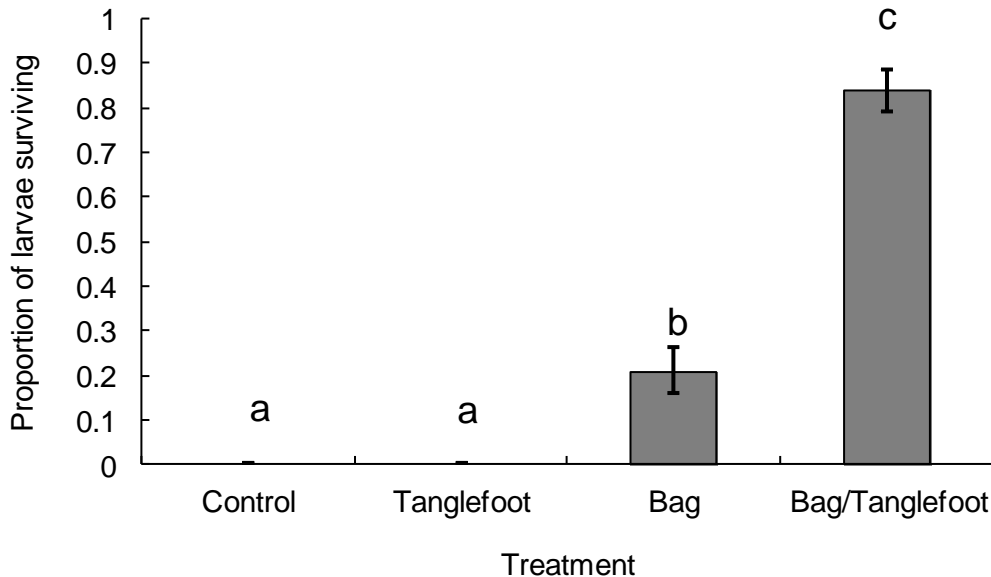
<sup>2</sup>Patrick BH, Dugdale JS 2000. Science for Conservation 136. 34 pp.

<sup>3</sup><http://nzbutterfly.info/>

# Impacts on weed biocontrol



- A survey of Boneseed leafroller release sites, indicated wasps (mainly paper wasps) responded leafroller abundance
- At an Auckland site, leafroller larvae only survived if wasps were excluded

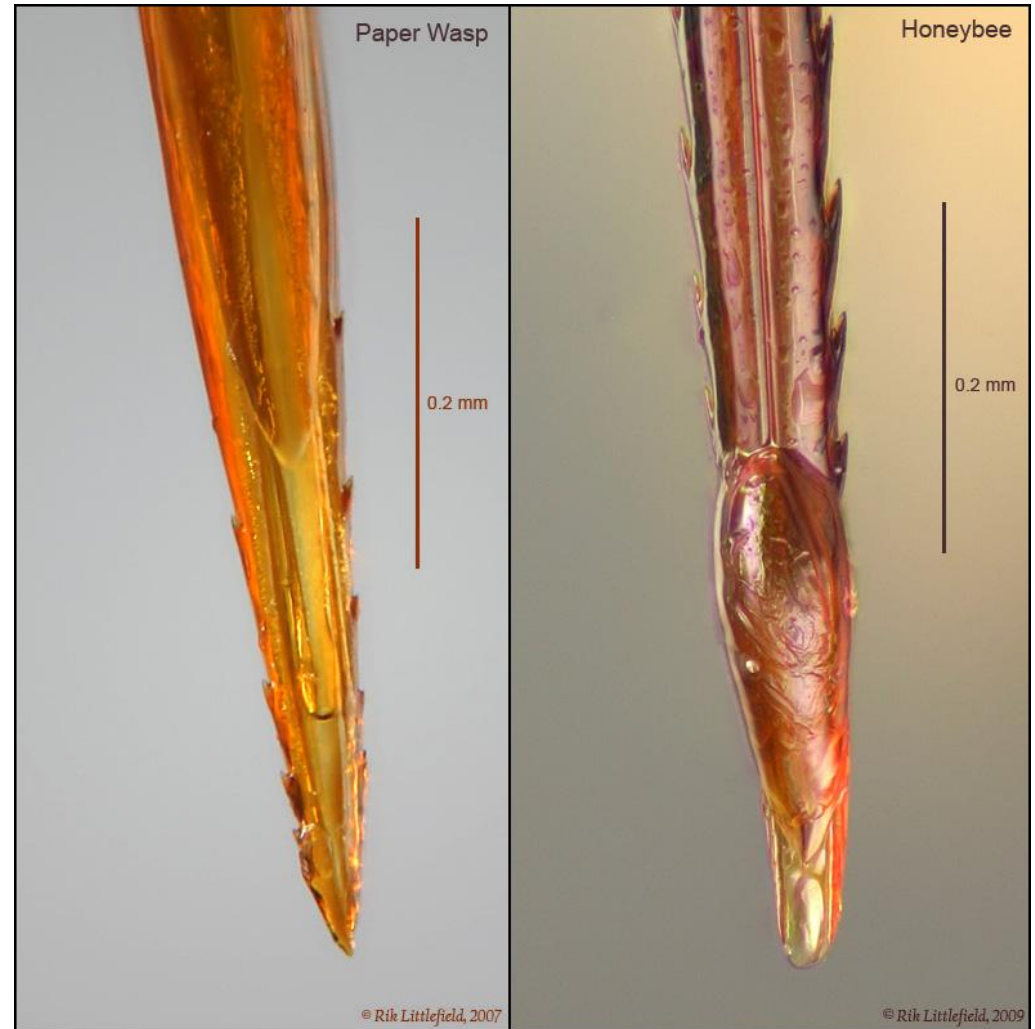




# Social impacts



- Paper wasps accounted for most stings received by Auckland people in a 1992/93 survey
- Anaphylactic deaths rarely occur (4 deaths attributed to bees/wasps in Auckland 1985-2005) <sup>2</sup>



<sup>1</sup>Dymock JJ, Forgie SA, Ameratunga R 1994. NZ Medical Journal 107: 32–33

<sup>2</sup>Low I, Stables S 2006. Pathology 38: 328–332.

# Control options



- *Polistes* not attracted to toxic protein baits developed for poisoning *Vespula* species<sup>1</sup>
- Trapping with sugary baits is insufficiently successful to have a major impact on wasp numbers & risks killing non-target spp. e.g. honeybees
- Manually destroying nests is very successful but is impractical over large areas
- Biological Control?



<sup>1</sup>Toft RJ, Harris RJ 2004. NZ J Ecol. 28: 279–282.

# Biological Control



- We used CAB Abstracts® & Web of Science (ISI) to generate a database of publications regarding the parasitoids, predators & diseases of *Polistes* wasps.
- We only included spp. that are likely to be specific to introduced wasps:
- accounts of nest predation by generalist vertebrate (e.g. birds, mammals) & arthropod predators (e.g. ants & hornets) were excluded.



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# Biological Control



- Little published information on *P. humilis* & *P. chinensis antennalis*.
- Probably reflects a lack of research: better studied spp. (e.g. *P. exclamans* in N America) are known to be subject to significant levels of attack.
- Research has concentrated mainly upon incidence & probable effects of parasitoids belonging to Hymenoptera, Lepidoptera & more rarely Diptera.
- Strepsipteran parasitoids only recently the subject of ecological studies, but may be significant

# Lepidoptera



- Larvae of > 11 moth spp. belonging to four families (Pyralidae, Tineidae, Cosmopterigidae & Gelechiidae) are known to infest nests of 16 *Polistes* spp.
  - Some are scavengers, tunnelling from cell to cell & eating meconia (wasp larval gut waste expelled prior to pupation) & nest material only;
  - Some are primarily scavengers that opportunistically feed on wasp pupae & prepupae
  - Some are purely predaceous



# Lepidoptera: *Anatrachyntis* sp.



- Larvae primarily nest scavengers that opportunistically feed on *P. chinensis antennalis* prepupae & pupae<sup>1</sup>
- They nevertheless exert a major influence on wasp colony longevity. “*Once nests are bored by such moths, they lose structural strength & cannot be used for long*”<sup>2</sup>



<sup>1</sup> Miyano S 1980. *Researches on Population Ecology* 22: 69–88

<sup>2</sup> Yamane S 1996. In: Turillazi S, West-Eberhard MJ eds *Natural history and evolution of paper wasps*. Oxford University Press. Pp. 75–97.

# Lepidoptera: *Chalcoela* spp



- Inflict serious damage on *Polistes* spp. in N America: e.g. *C. iphitalis* killed an average of 13–36% of *P. exclamans* pupae & parasitism levels in individual nests reached 100%<sup>1</sup>
- High infestation rates suggest wasps have insufficient countermeasures against these moths, perhaps because they attack the nests at night when darkness hampers the wasps' visual search for enemies<sup>2</sup>



*Chalcoela iphitalis*  
<http://yardmoths.blogspot.com>



<http://bugguide.net/node/view/29597>

<sup>1</sup>Strassmann JE 1981. Ecology 62: 1225–1233.

<sup>2</sup>Yamane S 1996. In: Turillazi S, West-Eberhard MJ eds Natural history and evolution of paper wasps. Oxford University Press. Pp. 75–97.

# Hymenoptera



- >20 spp. from six families (Eulophidae; Chalcidae; Torymidae; Ichneumonidae; Trogonalidae & Mutillidae) are known to parasitize broods of >26 *Polistes* species
- e.g. >60% of *P. exclamans* nests were infested with *Elasmus polistis* in 1977 & 1978, & they destroyed an average of 4 – 25% of all cells<sup>1</sup>



<http://cache.ucr.edu/~heraty/Eulophidae/Elasmus.html>

<sup>1</sup>Strassmann JE 1981. Ecology 62: 1225–1233.

# Hymenoptera



- 3 species of *Polistes* are social parasites.
- e.g. in S. Europe *P. atrimandubularis* parasitizes *Polistes biglumis* nests – usurping the foundress & taking the nest over.
- *P. b. bimaculatus* emergence reduced by half versus non-parasitized colonies<sup>1</sup>.



[http://www.e-pics.ethz.ch/index/ETH.BIOSYS/ETH.BIOSYS\\_AK\\_11006.tif\\_11009.html](http://www.e-pics.ethz.ch/index/ETH.BIOSYS/ETH.BIOSYS_AK_11006.tif_11009.html)

<sup>1</sup>Lorenzi, M. C., etal. 1992 *Boll. Zool.* **59**, 267–271..

# Diptera



- > six spp. belonging to three families (Tachinidae, Sarcophagidae & Phoridae) are known to attack seven *Polistes* spp.
- A Phorid fly *Megaselia* sp.. had serious impacts on its host wasp *Mischocyttarus* sp. in Colombia (25% of colonies were abandoned following parasitism).
- In temperate regions such a serious event due to dipteran parasitism has not been observed<sup>1</sup>

<sup>1</sup>Yamane S 1996. In: Turillazi S, West-Eberhard MJ eds Natural history and evolution of paper wasps. Oxford University Press. Pp. 75–97.



# Strepsiptera



- 32 *Polistes* spp., including *P. humilis*, are known hosts<sup>1</sup>.
- Subtle non-lethal effects (parasites vs parasitoids).
- Strepsipterans reduce the number of workers available to tend the developing brood: infected wasps leave the nest soon after emergence.
- Competitive advantage of invasive European *P. dominulus* in the USA may be due to an absence of strepsipteran parasites<sup>1</sup>.

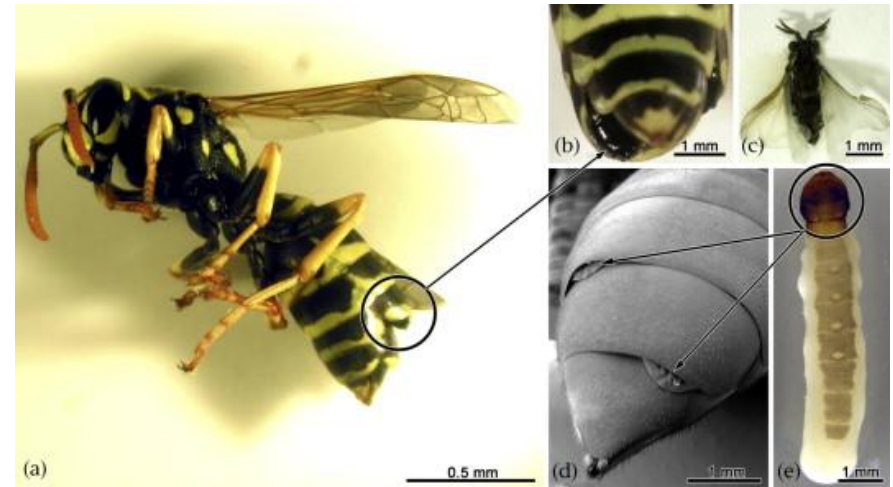


Image: Beani, L. et al. 2011. Animal Behaviour 82, 1305-1312.

<sup>1</sup>Hughes DP, Kathirithamby J, Beani L 2004. Ethology Ecology & Evolution 16: 363–375.

# Pathogens



- Information regarding pathogens of *Polistes* is scant although bacterial & gregarine pathogens & entomopathogenic fungi have been reported
- e.g. Jeanne and Morgan (1992) reported a fatal larval disease that affected most *P. fuscatus* colonies that they were studying.
- Microscopic examination of smears prepared from dying larvae revealed numerous short-chain streptococci similar in form to bacteria causing foulbrood in honey bee larvae

<sup>1</sup>Jeanne RL, Morgan RC 1992. Ecological Entomology 17: 135–141.

# Summary



- *Polistes* wasp impacts are not well understood.
- They possibly benefit organic farming & home vegetable gardens, but these are likely to be relatively minor benefits in economic terms & offset by cost of treating stings/pest removal.
- Evidence that they are threatening native Lepidoptera, but poorly quantified.
- Good evidence they are impacting on at least 1 weed biocontrol agent.

# Summary



- Despite the negligible impact of biocontrol on *Vespula* wasps in NZ<sup>1</sup>, biocontrol of *Polistes* wasps appears to have real potential - they are highly susceptible to some enemies, perhaps because:

Unlike *Vespula*, *Polistes* nests lack an envelope (harder to defend)<sup>2</sup>



<sup>1</sup>Beggs JR, et al. 2008 *Biological Control* 44: 399–407.

<sup>2</sup>Yamane S 1996. In: Turillazi S, West-Eberhard MJ eds *Natural history and evolution of paper wasps*. Oxford University Press. Pp. 75–97

# Summary



- *Polistes* wasps are distantly related from native NZ hymenoptera & valued exotic hymenoptera (e.g. honeybees): the specialist predators & parasites described in this survey pose little risk of direct non-target impacts.
- Work on *Polistes* could be a ‘stepping stone’ towards another attempt at biological control of *Vespula* wasps in NZ.
- One potential barrier to introducing biocontrol agents is objections from people who value paper wasps because they prey on lepidopteran pests.
- Should we proceed with work on *Polistes*?





Thank you

Questions?