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\textsuperscript{st} 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/yr¹.

- Beneficial impacts:
  - Prey on pests e.g. cabbage white butterfly caterpillars.

- Undesirable impacts:
  - Prey on native Lepidoptera;
  - monarch butterfly larvae;
  - some weed biocontrol agents.

Benefits of paper wasps

• An experiment in Wisconsin demonstrated paper wasps significantly reduced *Pieris rapae* larval numbers feeding on cabbages\(^1\). 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

Impacts on native Lepidoptera

- Poorly known (identification of minced prey difficult). Known prey includes:
  - kawakawa looper *Cleora scriptaria*;
  - kowhai moth *Uresiphita polygonalis maorialis*;
  - native noctuids including *Graphania* sp.

- Risk to threatened *Dodonidia helmsi* butterfly in northern range

- Prey on NZ copper butterfly (*Lycaena* spp.) larvae

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1 Clapperton BK 1999. NZ J. Ecol. 23: 11–19
3 [http://nzbutterfly.info/](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) ²

Control options

- *Polistes* not attracted to toxic protein baits developed for poisoning *Vespula* species\(^1\)

- 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?

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.
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\(^1\)

- 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*"\(^2\)

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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%.

- 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.

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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

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

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\(^1\).

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\(^1\)

Strepsiptera

- 32 Polistes spp., including P. humilis, are known hosts\(^1\).

- 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 \(^1\).

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.

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\(^1\), 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)\(^2\)

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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?