

Biological control of giant pine scale in Australia.

Umar Lubanga & Greg Lefoe



Giant pine scale (GPS) *Marchalina hellenica* (Hemiptera: Marchalinidae)

- GPS is native to mainland Greece and Turkey
- Was detected in Adelaide and Melbourne in late-2014
- GPS is attacking a novel host in Australia *Pinus radiata*
- A threat to Australia's softwood plantation estate estimated at \$1.16b.
- Eradication by removal and destruction of infested trees has been attempted
- Biological control offers an effective, sustainable, and environmentally friendly approach



GPS infested branches

Is biological control a feasible option?

In 2018, Agriculture Victoria conducted a feasibility study for biological control of GPS that included;

- literature review,
- survey of the native-range in Greece, and
- survey and case study of the Italian island of Ischia

The study concluded that;

- biological control was a feasible option for managing GPS, and
- the predatory fly *Neoleucopis kartliana* was the most promising biocontrol agent for GPS.



Dr Dimitrios Avtzis (HAO-Greece) and Dr Marc Kenis (CABI-Switzerland) examining GPS-infested branchlet in Greece.

Biological control foundational research

European biological control research specialists.

CABI-Switzerland

Dr Marc Kenis
Dr Lukas Seehausen

HAO-Greece

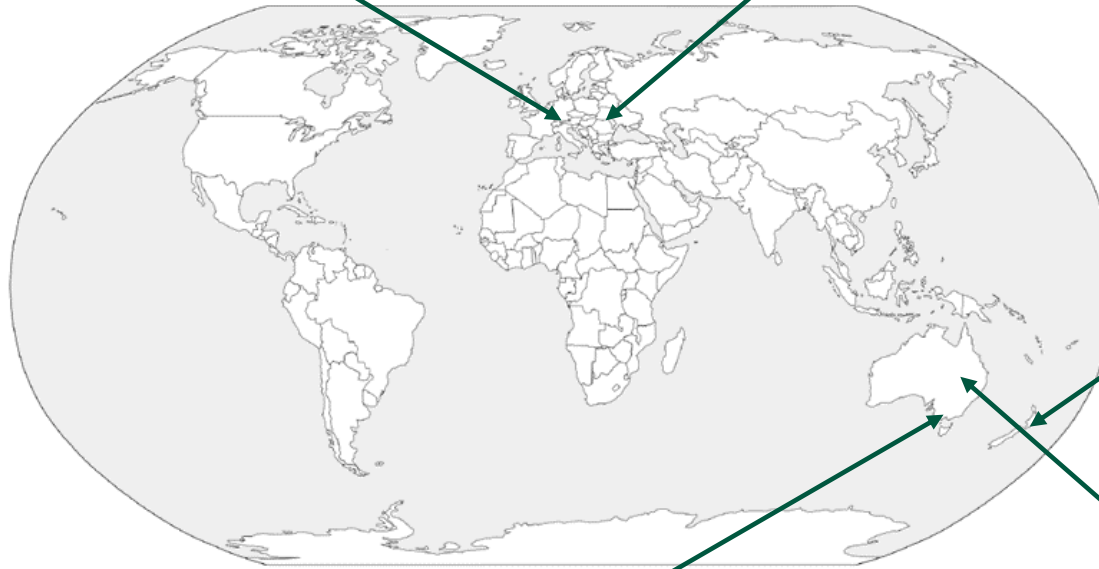
Dr Dimitrios Avtzis
Nikoleta Eleftheriadou (PhD candidate)

In-country partners – Biocontrol agent taxonomy, biology, field surveys & collections, initial testing.

Plant & Food Research-NZ

Dr Jacqui Todd

NZ model for prioritising non-target invertebrates adapted for Australia.



Project leadership. Biocontrol agent importation, testing & risk assessment.

Agriculture Victoria

Greg Lefoe (Project Leader)
Dr Umar Lubanga

The University of Queensland

Dr Penny Mills

Australian native scale taxonomy, surveys & collections.

AGRICULTURE VICTORIA

Forest & Wood
Products Australia

Risk analysis: Is *Neoleucopis* a safe biological control agent?

Prey-specificity studies assess risks to non-target scale insects in Australia, however:

- Australian scale insect fauna is large with more 850 species
- This posed a challenge when prioritizing insects to include in prey-specificity studies.

To address this challenge, we:

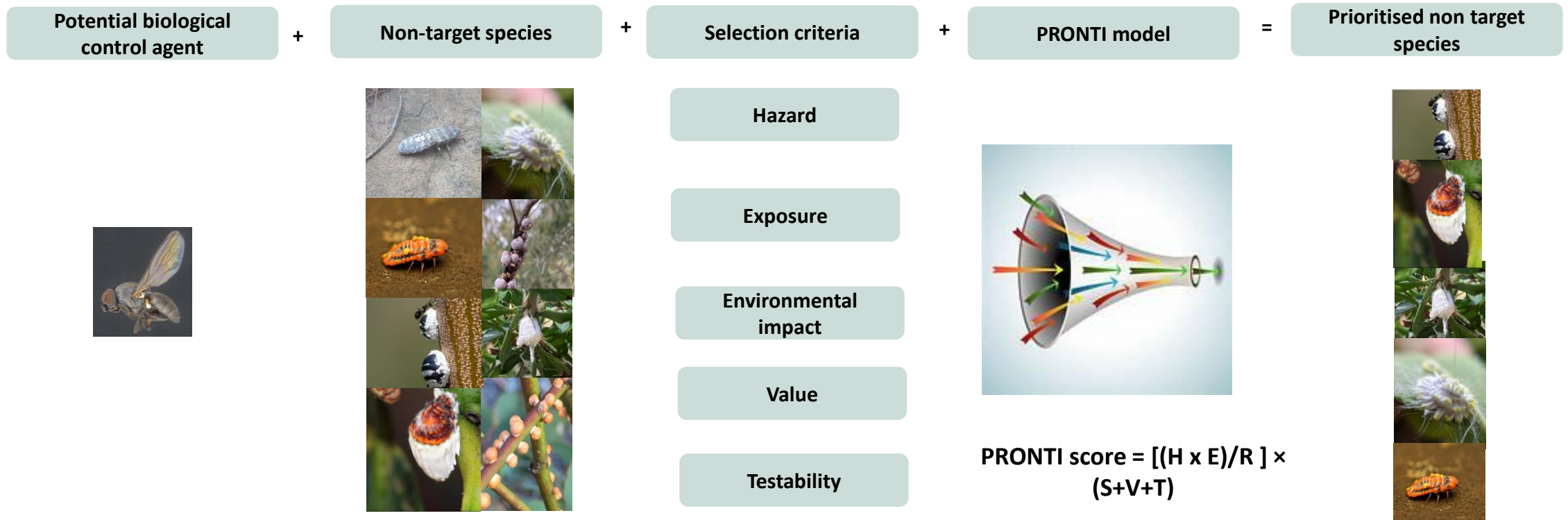
- Partnered with native scale specialist Dr Penny Mills (UQ) to update the phylogeny of Australia's scale insects
- Applied a decision-support tool (PRONTI) to prioritise non-target species for testing.



Australian scale insect diversity and phylogenetic relationships

Prioritising non-target species using PRONTI

PRONTI (Priority Ranking of Non-target Invertebrates) is an automated tool



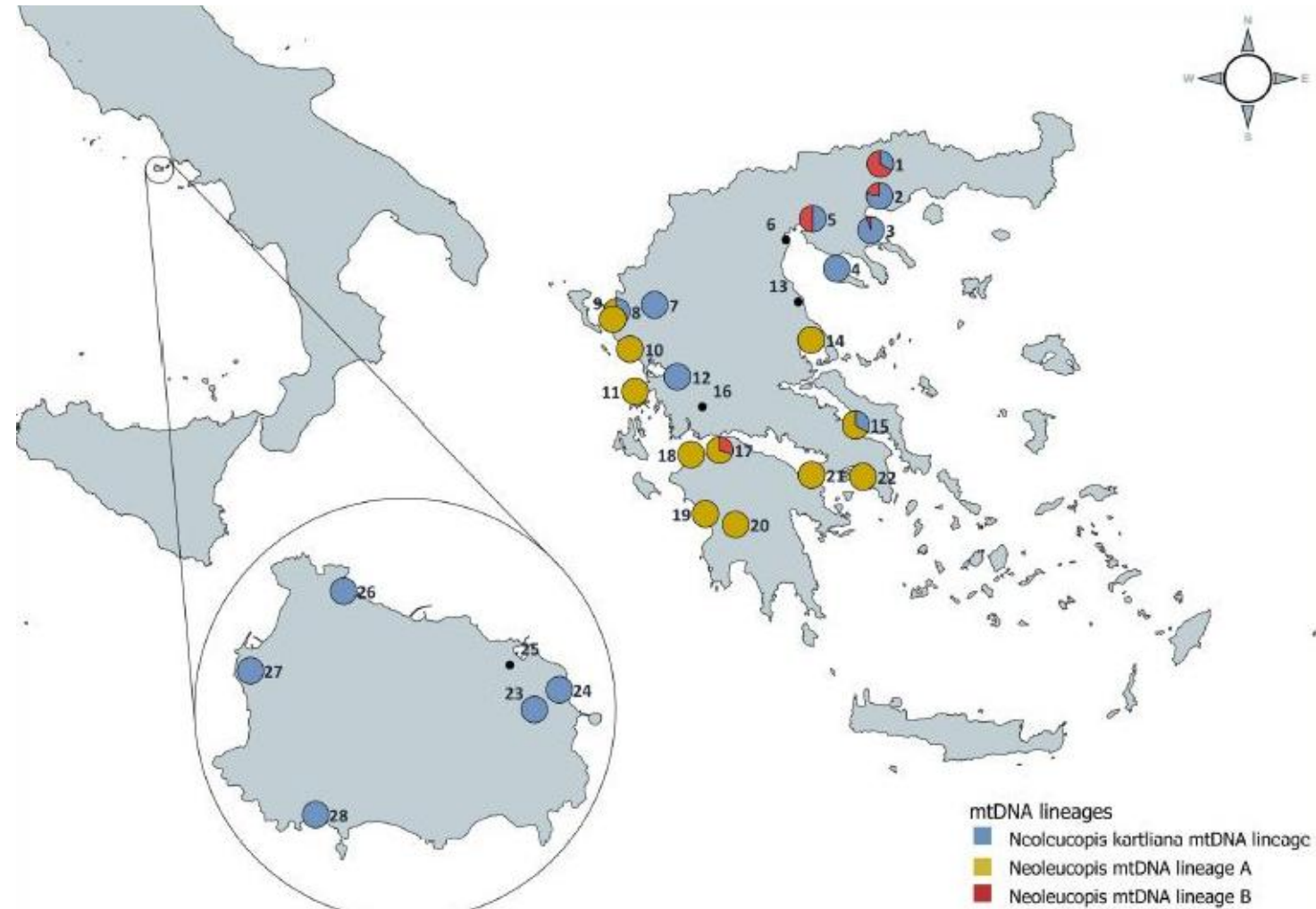
PRONTI: Test list

Rank	Family	Species Name	Status
1	Marchalinidae	<i>Marchalina hellenica</i>	Target species
2	Pseudococcidae	<i>Melanococcus viridis</i>	Native
3	Diaspididae	<i>Poliaspis syringae</i>	Native
4	Pseudococcidae	<i>Pseudoripersia brevipes</i>	Native
5	Coccidae	<i>Cryptes baccatus</i>	Native
6	Eriococcidae	<i>Callococcus acaciae</i>	Native
7	Eriococcidae	<i>Lobimargo</i> spp.	Native
8	Eriococcidae	<i>Acanthococcus coriaceus</i>	Native
9	Monophlebidae	<i>Icerya purchasi</i>	Native
10	Pseudococcidae	<i>Nipaecoccus aurilanatus</i>	Introduced
11	Eriococcidae	<i>Fragorbis pseudopustulans</i>	Native
12	Coccidae	<i>Parasaissetia nigra</i>	Introduced
13	Monophlebidae	<i>Icerya acaciae</i>	Native
14	Eriococcidae	<i>Tanyscelis maculata</i>	Native
15	Monophlebidae	<i>Icerya seychellarum</i>	Native
16	Eriococcidae	<i>Opisthoscelis beardsleyi</i>	Native
17	Monophlebidae	<i>Icerya</i> sp.	Native
18	Coccidae	<i>Ceroplastes rubens</i>	Unknown
19	Pseudococcidae	<i>Pseudococcus calceolariae</i>	Introduced
20	Diaspididae	<i>Poliaspis callitris</i>	Native
21	Eriococcidae	<i>Apiomorpha conica</i>	Native
22	Monophlebidae	<i>Monophlebulus pilosior</i>	Native
23	Eriococcidae	<i>Tanyscelis tripocula</i>	Native
24	Eriococcidae	<i>Cylindrococcus spiniferus</i>	Native
25	Pseudococcidae	<i>Rastrococcus stolatus</i>	Native
26	Coccidae	<i>Parthenolecanium corni</i>	Unknown
27	Pseudococcidae	<i>Alecanopsis casuarinae</i>	Native

Native range studies

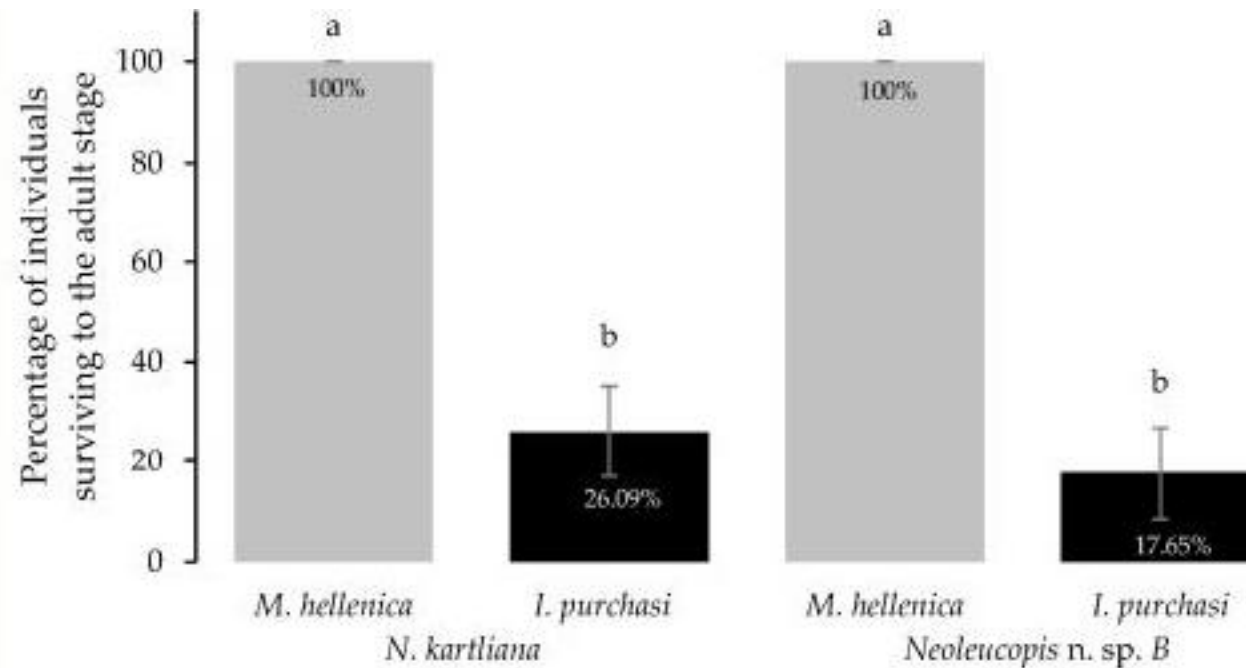
Biology and ecology *Neoleucopis* spp:

- *N. kartliana* occurs as a species complex comprising three species, two of which are undescribed.
- All three species *N. kartliana*, *N. sp. A* and *N. sp. B* are morphologically similar & prey on GPS.



Native range studies

Lab prey specificity studies



Neoleucopsis kartliana and *Neoleucopsis*. sp. B. found to be specific to GPS in Greece (Eleftheriadou et al. 2024).



Article

Assessing the Prey Specificity of *Neoleucopsis* spp. against *Marchalina hellenica*

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Abstract: *Marchalina hellenica* Gennadius (Hemiptera: Marchalinidae) is a scale insect native to Greece and Turkey and presently invasive in Australia, where it damages pine plantations. The silver fly, *Neoleucopsis kartliana* Tanasijtshuk (Diptera: Chamaemyiidae), is the most abundant predator of *M. hellenica* in Greece and is presently being investigated as a potential biological control agent following the scale's introduction in Australia. This study, conducted in Northern Greece, revealed the presence of a second lineage, closely related to *N. kartliana*, referred to as *Neoleucopsis* n. sp. B. Field surveys and laboratory experiments were conducted on *M. hellenica* and a taxonomically related scale insect, *Icerya purchasi* Maskell (Hemiptera: Monophlebidae), to test the larval growth and survival of the flies on the two prey species and assess their specificity for *M. hellenica*. The results suggest that both *Neoleucopsis* spp. exhibit a high preference for *M. hellenica* when compared to *I. purchasi*. Larval growth was higher on *M. hellenica* than on *I. purchasi* but the difference was significant for *N. kartliana* only. Survival was significantly higher for both predators when provided *M. hellenica* compared to



Citation: Eleftheriadou, N.; Kavallieratos, N.G.; Malesios, C.; Seehausen, M.L.; Kenis, M.K.; Lefoe, G.; Lubanga, U.; Avtzis, D.N. Assessing the Prey Specificity of *Neoleucopsis* spp. against *Marchalina hellenica*. *Sustainability* 2024, 16, 1234. <https://doi.org/10.3390/su16081234>

Native range studies

The Australian non-target scale *Icerya purchasi* is established and common in Greece.

Three surveys conducted over two seasons in northern Greece examined (1) egg sacs of GPS on pines, and (2) *I. purchasi* on nearby citrus and *Pittosporum tobira*.

Neoleucopis spp. were recovered in large numbers from GPS egg sacs on pine trees. No *Neoleucopis* spp. were observed on the nearby non-target scale species or non-pine host plants.



Above: Non-target *Icerya purchasi* collected from *Citrus x aurantium* in Thessaloniki, Greece, June 2024.

Prey specificity studies in Australian quarantine



Conclusions and recommendations

- The three *Neoleucopis* species likely complement one another to control GPS in the native range.
- Introducing all three species could benefit the Australian program
- There is a need to understand;
 - how the three species interact to control GPS in the native range.
 - complete prey-specificity studies of *Neoleucopis* species in Australia.

Future research

- Re-assess the current spread and impact of GPS in Australia,
- Complete prey specificity studies for at least one biocontrol agent species and initiate studies for the other two species.
- Examine how all three *Neoleucopis* species interact to suppress GPS populations in the native range.

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