Biological control of giant pine scale *Marchalina hellenica* in Australia

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

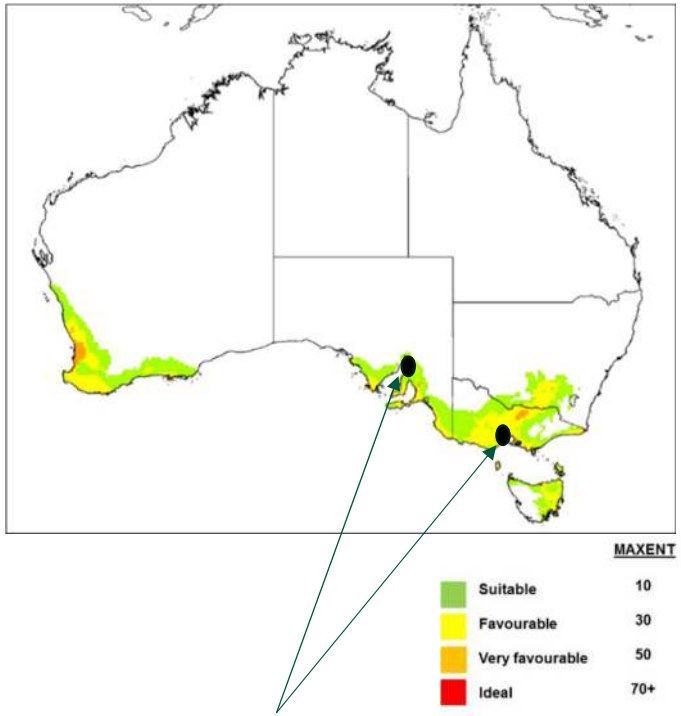
- GPS is a sap-sucking insect native to the eastern Mediterranean region
- GPS was detected in 2014 in Melbourne and Adelaide
- GPS damages the novel host *Pinus radiata*
- *P. radiata* makes up 70% of Australia's softwood plantations

GPS infested pines, Victoria

Status of GPS in Australia

- GPS is considered non-eradicable in Australia
- It is contained to urban & peri-urban trees in Melbourne
- GPS was not detected in Adelaide for several years however new infestations were reported in 2023
- Control of GPS relies heavily on tree removal and hygiene

Potential and current distribution of GPS



Current distribution of GPS

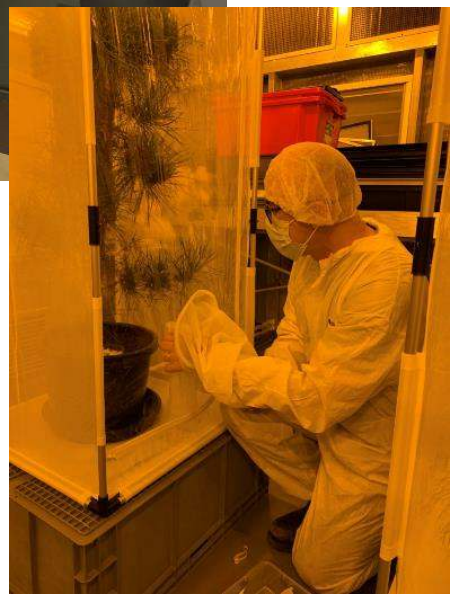
From Lubanga et al. 2018

Potential for biological control of GPS

A case study from Ischia, Italy (above), showed that *Neoleucopis* can be highly effective biocontrol agents of invasive populations of GPS

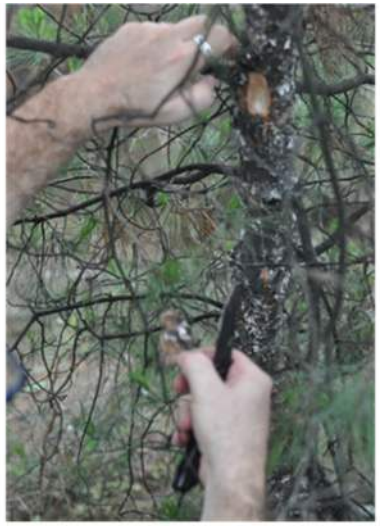
- A biocontrol feasibility study was initiated in 2017-2018 in Greece, Italy and Australia.
- Surveys in Greece confirmed that predatory silver flies have potential for biological control of GPS.
- The silver fly *Neoleucopis kartliana* (Diptera: Chamaemyiidae) was the most promising biocontrol agent for GPS in Australia.

Biocontrol agent risk assessment



Importing *Neoleucopis* into quarantine at AgriBio, Melbourne (above), and Dr Greg Lefoe preparing GPS cultures in quarantine (right).

- Risk assessment is required before the introduction of a new biocontrol agent to Australia
- Biocontrol agent introductions decision making is at arms-length from industry and researchers
- Submissions are received from all States/territories, stakeholders, and the general public
- Final decisions made by the Australian government and are based on Australia's Appropriate Level of Protection (ALOP)



Biological control research overview

Assess risks of introduction to native & beneficial species through:

- field and lab studies in Greece,
- studying the systematics of agent, target and non-target species in Greece and Australia,
- rearing and ecological studies of prospective agents and Australian scales, and
- quarantine laboratory experiments and behavioural studies.

Above left; Dr Dimitrios Avztis, Dr Marc Kenis, and (above right) Nicole Eleftheriadou (PhD candidate) conducting field surveys in Greece

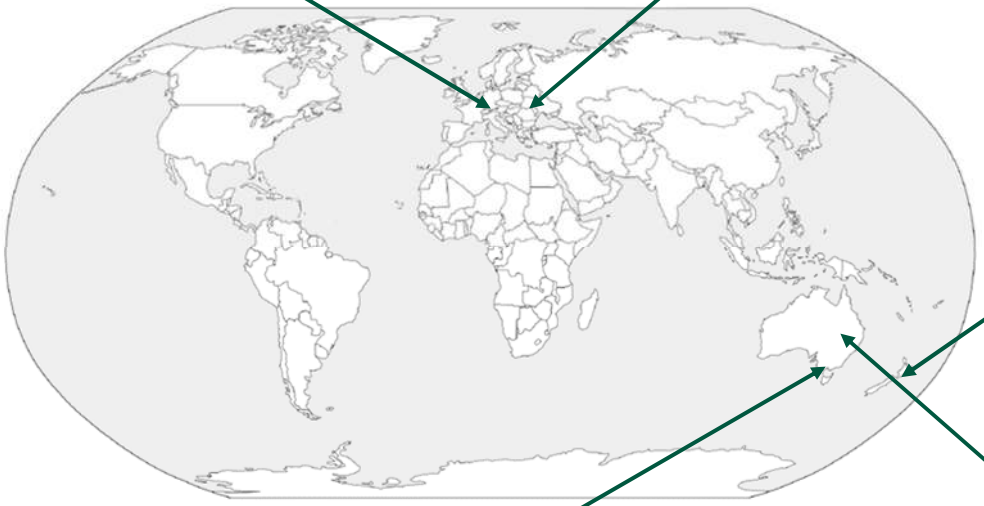
Biological control of giant pine scale research team

Native-range forest entomologists

European biological control support

CABI-Switzerland
Dr Marc Kenis
Dr Lukas Seehausen

HAO-Greece
Dr Dimitrios Avtzis
Nikoleta Eleftheriadou (PhD candidate)



Plant & Food Research-NZ
Dr Jacqui Todd

PRONTI (non-target species selection) expertise

Project leadership and coordination.

Agriculture Victoria
Dr Greg Lefoe (Project Leader)
Dr Umar Lubanga

The University of Queensland
Dr Penny Mills

Australian native scale specialist

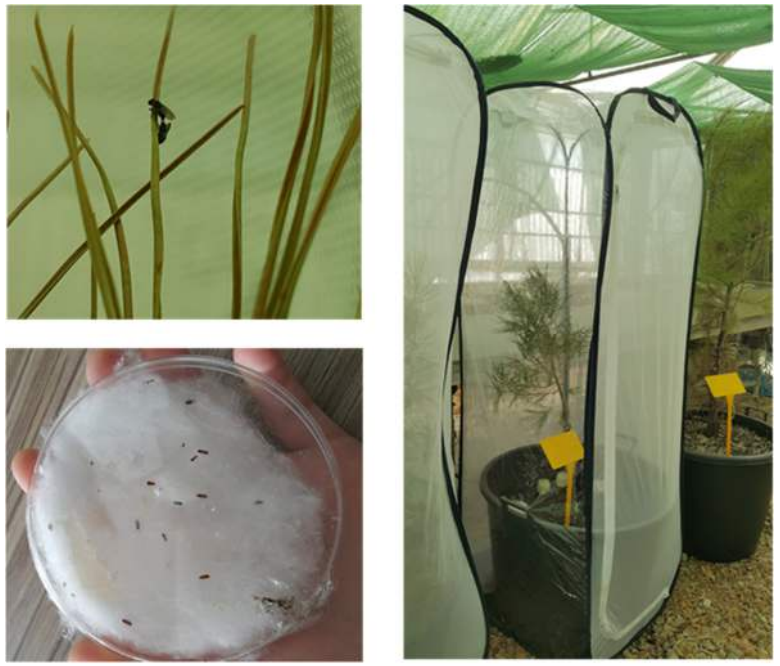
Assessing risk to non-target species

- Over 850 species of native scales.
- Divided into two major informal groups:
    1) Neococcoid
    2) Archaeococcoid
- GPS belongs to the Archaecoccoid in a monotypic family and genus
- A ‘test list’ is typically compiled as part of the risk assessment process.

Australian scale insect diversity

Assessing risk to non-target species

- Extensive surveys and phylogenetic studies of Australian scales conducted (in prep)
- ‘Test species’ were selected and rearing methods developed in preparation for quarantine prey range studies.
- Rearing methods developed in Greece for *Neoleucopis* spp.



Neoleucopis kartliana mating adults (top left), pupae in the cotton/artificial food substrate (bottom left) and rearing cages (right) at HAO, Thessaloniki, Greece

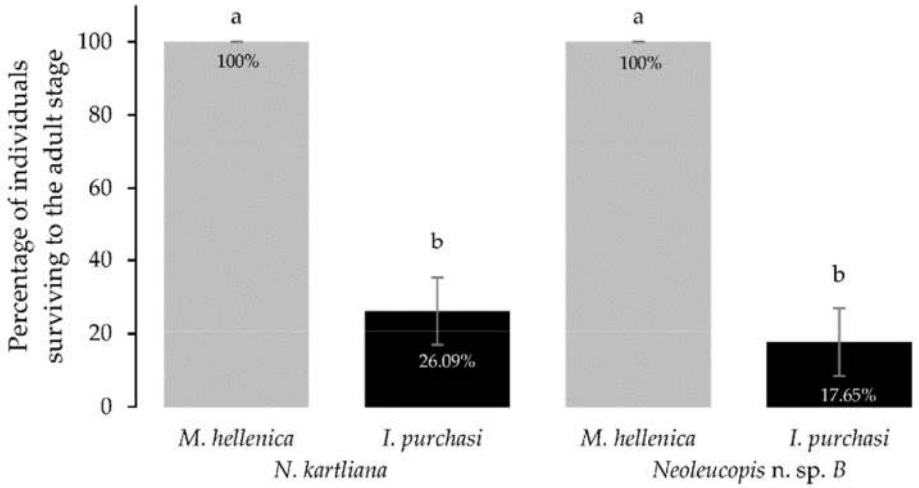
Field surveys in Greece

Dr Lukas Seehausen (CABI) and Nicole Eleftheridou (HAO) sorting natural enemies, Greece.

- Found three silver fly taxa/species associated with GPS in Greece (not one), including *N. kartliana, N.* nov. sp. A, and *N*. nov. sp. B (*paper in prep)
- These three taxa have not been observed on other scales in Greece

*Eleftheriadou, N, Seehausen, L, Kenis, M, Lefoe, G, Lubanga, U, Gaimari, S, Havill, N, Garonna, A, Kavallieratos, N, Avtzis, D. Genetic diversity and morphological variation within the genus *Neoleucopis* associated with *Marchalina hellenica* in Greece and Italy. In prep.

Prey-range studies in Greece with an Australian non-target species



- Specificity of *N. kartliana* and *N.* nov. sp. B tested in lab experiments in Greece
- Reduced survival of predators on *Icerya purchasi* compared to *M. hellenica* ovisacs in no-choice experiments
- *Neoleucopis* not observed or recovered from *I. purchasi* in systematic field surveys in Greece

Eleftheriadou N, Kavallieratos NG, Malesios C, Seehausen ML, Kenis M, Lefoe G, Lubanga U, Avtzis DN. Assessing the Prey Specificity of *Neoleucopis* spp. against *Marchalina hellenica*. *Sustainability*. 2024; 16(7):2756.

Next steps

- *Neoleucopis* have considerable potential as a long-term, cost-effective and environmentally-friendly management option for GPS in Australia.
- *N*. nov. sp. B pupae were recently imported into quarantine at AgriBio, Melbourne, and testing of Australian non-target scales will commence when adults emerge,
- Further research on *N*. nov. sp. A, and on the interactions between all three taxa is required,

Acknowledgements

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FWPA, Hancock Victorian Plantations Pty Limited, ACT Parks Conservation And Lands, AKD Softwoods, Norske Skog, Forico Pty Ltd, Green Triangle Forest Products (PTC) Ltd, The Trust Company (Australia) ANZOF Sub 1, Green Triangle Forest Operating Sub Trust, Hume Forests, OneFortyOne Plantations Pty Ltd, HQ Plantations Pty Ltd, Forestry Corporation of NSW, Forestry SA