

# *Pinus radiata* and *Sirex* *noctilio*, the Pine-killing Wasp



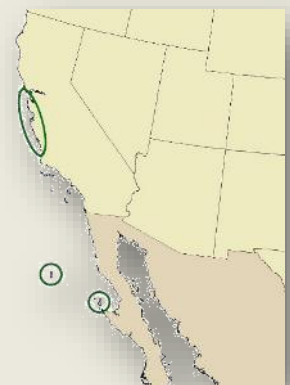
*Pinus radiata*, Monterey Pine.  
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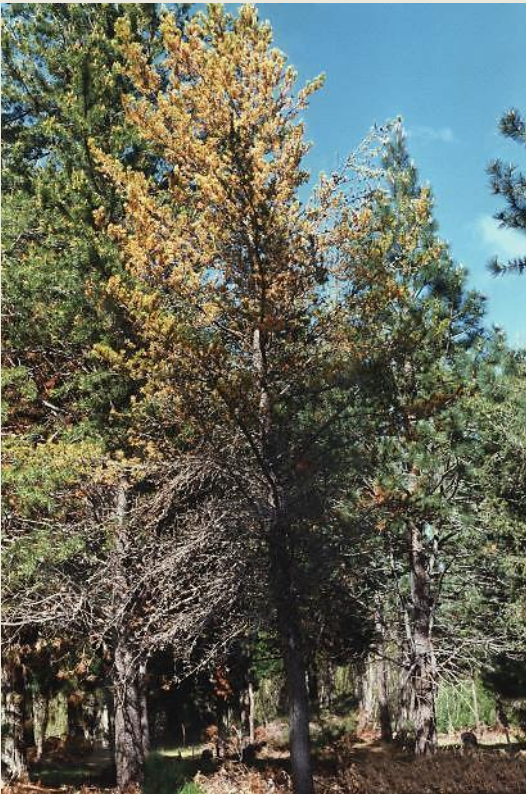
We tend to take Radiata Pine for granted and it is certainly the most important plantation softwood tree species in Australia but forest monocultures are relatively uninteresting. Who would ever guess that within those seemingly endless and uninspiring plantations, there could be a small but opportunistic wasp that wreaks havoc on pine plantations using an arsenal of weapons, including poison, pathogenic fungi and its own parasitic offspring.

Surprisingly, given that Radiata Pine is so widely planted in Australia and elsewhere in the world, the species comes from only three locations, a narrow stretch of coastline in Southern California and two islands off the coast of Mexico. As is often the way with trees, in their natural habitat radiata pines are often stunted and scrawny, contrasting with the tall straight trunks of plantation trees that typically grow to around 35 metres. *Pinus radiata* trees are fast growing, the timber is soft, straight-grained and easy to work. It is used for house construction, flooring,



*Pinus radiata* – Big Sur – California.  
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Sirex Wood Wasp damage to Radiata Pines. Paula Klasmer, Instituto Nacional de Tecnologia Agropecuaria, Argentina, CC BY 3.0 US <<https://creativecommons.org/licenses/by/3.0/us/deed.en>>, via Wikimedia Commons

furniture and plywood and pulped to make newsprint and pine board. Tannins in the bark are used in the production of adhesives.

However, pine plantations can be attacked by a wide range of pests and diseases, and of these, the Sirex Wood Wasp, *Sirex noctilio*, a native of Morocco and Eurasia, is the most destructive pest of radiata pine plantations worldwide.

The way in which the wasps attack the trees is complex and slightly sinister. The wasps drill holes into the trees and inject a toxic mucus together with spores of the pathogenic fungus *Amylostereum areolatum* with which it has a mutualistic symbiotic relationship. The toxin prevents movement of sugars in the phloem from the pine needles: in normal circumstances, these sugars would be converted to a *polyphenol* that would attack the fungus at the site of infection. Because this

defence mechanism is blocked by the toxin injected by the wasp, the fungus is able to grow and further disrupt the tree's vascular system, leading to the eventual death of the trees. Once the fungus is well established in dead or stressed dying pines, eggs laid by the wasps hatch to produce larvae that feed on the fungus as it spreads through the tree, further creating tunnels and degrading the timber. The



*Sirex noctilio* female

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*Sirex noctilio* male

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*Sirex noctilio* larva. Photo: Paula Klasmer, Instituto Nacional de Tecnología Agropecuaria, Argentina, CC BY 3.0 <<https://creativecommons.org/licenses/by/3.0/>>, via Wikimedia Commons

mature larvae pupate and bino, a new generation of adult wasps emerge a few weeks later.

Various methods have been developed to manage attacks by *Sirex* wasps, but the most effective control has been a biological control, almost as remarkable as the way in which the wasp impregnates the trees with its pet fungus, toxins and eggs in the first place.

CSIRO scientists Robin Bedding and Ray Akhurst in the 1960s assessed vast numbers of nematodes from around the

world before eventually selecting the nematode *Deladenus siricidicola* from Hungary, for use as a biological control in Australia. This nematode has two life forms, each capable of disrupting the life cycle of the *Sirex* wasp: firstly, as free-living nematodes, they feed on the fungus; secondly, as parasitic nematodes, they sterilize female *Sirex* wasps by invading the wasp's eggs. Eventually emerging parasitised



*Sirex noctilio* on Radiata Pine tree bark. Photo: H. Dumas, CC BY-SA 3.0 <<https://creativecommons.org/licenses/by-sa/3.0/>>, via Wikimedia Commons

female wasps further disperse the nematodes that go on to sterilise the next generation.

Control methods are complex. In order to inoculate entire plantations, *trap tree plots* are selected and poisoned with weedkiller. The stressed trees attract the wasps which then deposit fungal spores, toxic mucus and eggs that develop into larvae into the trees. The trees are then felled and then inoculated with a suspension of laboratory-cultured nematodes through holes punched into the tree trunks. They then parasitise the *Sirex* larvae.



*Sirex* egg containing nematodes Bedding 1972.

It is necessary to continually identify and introduce new and effective strains of nematodes in the battle to control Sirex Wasp. Most recently, a new strain, *D. siricidicola* Lineage D, that was discovered by biologists Helen Nahrung from the University of the Sunshine Coast in South-eastern Queensland and Angus Carnegie from the NSW Department of Primary Industries, has proved to be a powerful weapon in the control and management of Sirex wasp in radiata pine forests.

Bedding R. 1972. Biology of *Deladenus siricidicola* (Neotylenchidae) and Entomophagous-Mycetophagous Nematode Parasitic in Siricid Woodwasps. *Nematologica* 18: 482-493.

CSIRO and National Sirex Coordination Committee. The Pine-killing Wasp.

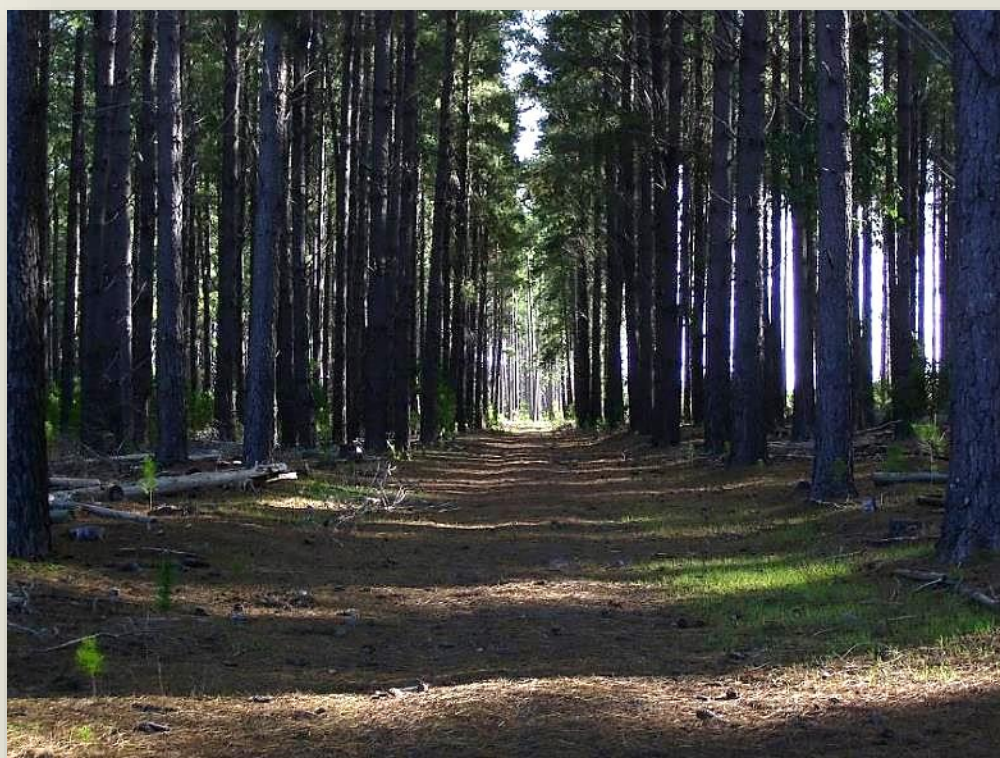
Firehiwot B.E, Barnes I, Nahrung H F, Fitza K N E, Meurisse N, Slippers B. 2023. Unexpected diversity in historical biological control programs: Population genetics of the nematode *Deladenus siricidicola* in Australia and New Zealand. *Biological Control*, Vol. 180, <https://www.sciencedirect.com/science/article/pii/S1049964423000361>

Forestry Corporation: <https://www.forestrycorporation.com.au/sustainability/education/resources-and-publications/wild-forest/woodwork/info/forest-supermodels/radiata-pine/remarkable-pine>

Nahrung H F, Ramsden M, Hayes R A, Francis L P, Griffiths M W. 2016. Performance of *Sirex noctilio*'s biocontrol agent *Deladenus siricidicola* in known and predicted hosts. *Biological Control* Vol. 103: 54-61. (<https://www.sciencedirect.com/science/article/pii/S1049964416301463>)

Queensland Government. Sirex Wood Wasp: <https://www.business.qld.gov.au/industries/farms-fishing-forestry/forests-wood/pests-diseases/trees-timber/sirex-wood-wasp>

University of the Sunshine Coast. 2023. Attack worm may be a new biocontrol method. <https://www.usc.edu.au/about/unisc-news/news-archive/2023/june/attack-worm-may-be-new-biocontrol-weapon>



*Pinus radiata* plantation in South Australia. Photo: Wikipedian, CC BY-SA 3.0 <<https://creativecommons.org/licenses/by-sa/3.0/>>, via Wikimedia Commons

Wikipedia: [https://en.wikipedia.org/wiki/Pinus\\_radiata](https://en.wikipedia.org/wiki/Pinus_radiata)

Wikipedia: [https://en.wikipedia.org/wiki/Sirex\\_woodwasp](https://en.wikipedia.org/wiki/Sirex_woodwasp)

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