Population Interactions between *Sirex noctilio*, *Deladenus siricidicola*, and native parasitoids

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Introduction

The invasive woodwasp *Sirex noctilio*, which has been present in the southern hemisphere since the early 20th century, devastated New Zealand and Australian *Pinus* spp. plantations until a nematode-based biocontrol regime using an egg-sterilizing Hungarian strain of *Deladenus siricidicola* successfully reduced their presence to acceptable levels. This method worked less well for invasions of South Africa and South America, where *S. noctilio* continues to cause significant losses, and has yet to be adapted to the North American context.

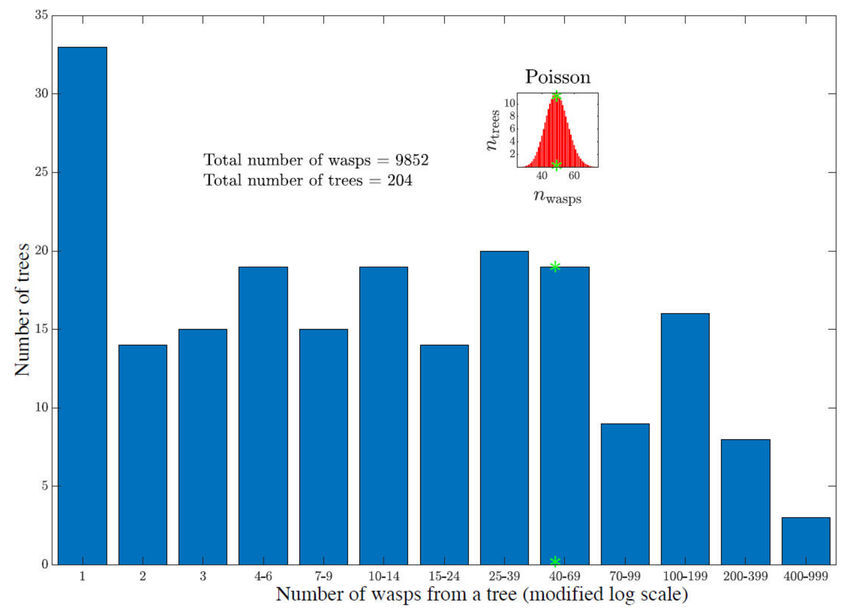
This pest was first detected in North America in 2004, yet no similar widespread loss of pine has occurred. There are several potential reasons for this, not the least of which being that *S. noctilio*'s preferred host is suppressed pines, which many of the southern hemisphere's plantations had in abundance whereas the current invaded range of North America has relatively few. However, another significant element to *S. noctilio*'s modest impact (so far) is that in North America, pines are native and there exist robust communities of other organisms interacting with them. These include a host of parasitoids (and one kleptoparasitoid) associated with several of our native Siricid woodwasps.

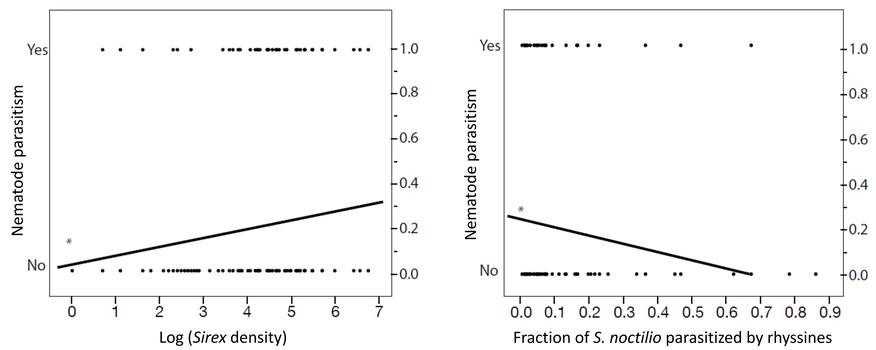
Of particular interest are those parasitoids associated with *Sirex nigricornis*, which include *Ibalia leucospoides ensiger* and five rhyssines (mostly in the genus *Rhyssa*). Our team was able to examine data collected over nine years detailing *S. noctilio* and these parasitoids' emergence from trees collected across the invaded range in NY and PA, as well as nematode parasitism data for same. To the best of our knowledge, this is the first thorough examination of native parasitoids on the invasive *Sirex noctilio* and represents an interesting host-expansion to include novel congeners of the parasitoids' typical host, *S. nigricornis*.

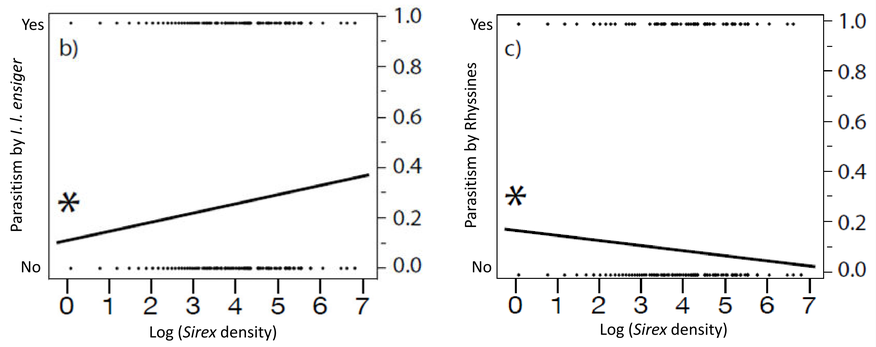
Study Objectives

1. How is *Sirex noctilio* distributed in the landscape?
2. What are the relationships between *S. noctilio* distribution and parasitism by these hymenopteran parasitoids?
3. Is there a relationship between parasitism by *Deladenus siricidicola* and parasitism by hymenopteran parasitoids, on a population level?
4. Is there a relationship among the different hymenopteran parasitoids as they exploit this new resource?

Results







Graphs produced by Saskya van Nouyuys

Materials and Methods

Trees identified to be infested with *Sirex* spp. were cut down at sites in NY and PA, cut into 70cm bolts, transported to Ithaca, NY, then kept in screen-topped barrels over the winter. Barrels were checked every 2-3 days throughout spring and summer, and all emerged *Sirex* spp. and parasitoids were collected and recorded. *Sirex noctilio* were dissected in lab to determine nematode parasitism. A total of 204 trees were collected from 11 sites and 3,154 *S. noctilio* were dissected.

Conclusion

Several significant findings were determined from the analysis of this large data set. With regard to our stated study objectives:

- *Sirex noctilio* distribution across the landscape appears to be highly aggregated. Most trees within a site identified as having been attacked by *Sirex* spp. (presence/absence of characteristic resin beads produced by tree post-oviposition/probing) produced very few woodwasps or parasitoids. Seventeen percent of trees across sites produced 47% of *Sirex*.
- Occasionally, outlier trees were identified producing prodigious numbers of *S. noctilio*, with 854 emerging *S. noctilio* representing the highest occupancy of a single tree in this analysis.
- Higher density of *Sirex* was correlated with higher *Ibalia* parasitism, lower rhyssine parasitism, and higher nematode parasitism.
- Higher fractions of *Sirex* parasitized by rhyssine parasitoids was correlated with lower nematode parasitism.
- There was no obvious correlation between nematode and *Ibalia* parasitism.

This analysis suggests there may be a competitive relationship between *Ibalia* and the rhyssine parasitoids. *Ibalia* is known to emerge earlier in the season than *Rhyssa* spp. and may be able to exploit *S. noctilio* larvae before the rhyssines emerge. Over the 9 years that this data was collected, the presence of North America's native *Sirex nigricornis* decreased to 0 at nearly all sites. We believe it is possible that in addition to *S. noctilio* competing directly with *S. nigricornis* for the somewhat ephemeral resource of dead/dying pine trees, the high density of *S. noctilio* may recruit large cohorts of parasitoids that will utilize both the invasive and native woodwasps.

Acknowledgements

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