INVESTIGATING THE SIREX NOCTILIO (HYMENOPTERA: SIRICIDAE) - PARASITOID COMPLEX IN CENTRAL NEW YORK

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INTRODUCTION

The Problem

• *Sirex noctilio* F. (Hymenoptera: Siricidae) (fig. 1-A) is an invasive wood-boring wasp detected in 2004 in Fulton, New York.
• In its native range, Europe and Asia, *S. noctilio* is considered a minor pest, but in other countries where it has been inadvertently introduced it has proven extremely damaging to pine plantations, causing millions of dollars of damage.
• Females inject a mucus and fungus along with eggs which ultimately kill infested trees
• Pines infested with *S. noctilio* show characteristic damage, including wilting and reddening of needles (fig. 1-B, C) and resin beads caused by oviposition (fig. 1-D).

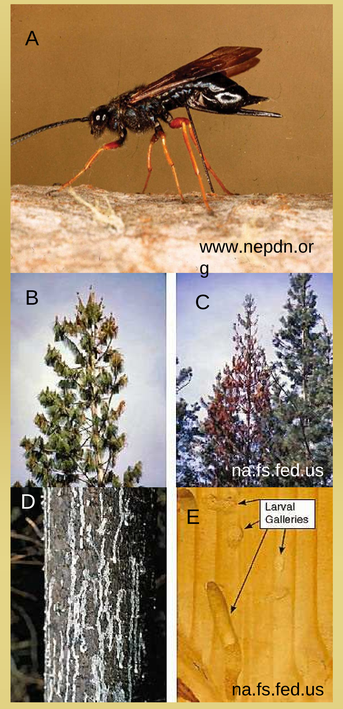

Figure 1. A, adult female *Sirex noctilio.* B and C, characteristic foliage damage due to *S. noctilio* infestation. D, resin beads characteristic of tree defense against *S. noctilio* oviposition. E, galleries created by *S. noctilio* larvae in an infested tree.

Figure 2. A, an adult *Rhyssa persuasoria* ovipositing. B, an adult *Ibalia leucospoides* ovipositing. C, an adult *Megarhyssa nortoni.* D, a *Megarhyssa or Rhyssa* larva and the remnants of a siricid larva that it emerged from.

The Solution (at least in part)

•A suite of parasitoids native to North America, including *Ibalia leucospoides* (Hymenoptera: Ibaliidae) (fig. 2-B), *Megarhyssa nortoni* (fig. 2-C) and *Rhyssa persuasoria* (Hymenoptera: Ichneumonidae) (fig. 2-A) have been used as biological control agents where *S. noctilio* has been introduced, and it is likely these parasitoids will play a role in combating the spread of *S.noctilio* in New York.
• These parasitoids lay eggs either in or on siricid eggs, larvae or pupa, and larval parasitoids develop inside siricid larvae, eventually killing the siricid before it emerges (fig. 2-D).

The Objectives

• To quantify levels of *S. noctilio* infestation and associated parasitoid levels in the central New York corridor, from the Pennsylvania border to the northernmost area of *S. noctilio* infestation.
• To elucidate possible geographical differences in species densities.
• To determine within tree distributions of siricids and determine if it was possible to characterize whole tree siricid density using certain bolts.

METHODS

•To quantify densities of *S. noctilio* and its associated parasitoids, 19 Red and Scots pines, *Pinus resinosa* and *P. sylvestris*, were harvested in July 2008 from 5 sites in northern, central and southern New York known to be infested by *S. noctilio* (fig. 4-B).
• Each tree was cut into half meter bolts and stored in a cold room at 7^0 Celsius to retard larval development.
•Trees were dissected via a log splitter and parasitoid and siricid larvae were located and recorded to quantify species densities and within-tree distributions. 13 of the 19 trees have been dissected thus far, 8 Red pines and 5 Scots pines.
•Larvae of all species (fig 3-A-C).were placed in vials with a strip of blotting paper to reduce moisture in order to complete development (fig. 3-D).
•*Sirex noctilio* larvae (fig. 3-C) are indistinguishable from native siricid larvae, therefore we cannot claim that all larvae found were *S. noctilio.* Adults are distinguishable, so we monitored all vials for adult emergence to establish whether any larvae were native siricids.

Figure 3. A, larva of *I. leucospoides. B, Megarhyssa* or *Rhyssa* larva. C, pupa (L) and larva (R) of *S. noctilio.* D, vials containing larvae and pupae of siricids and parasitoids in our laboratory at SUNY-ESF.

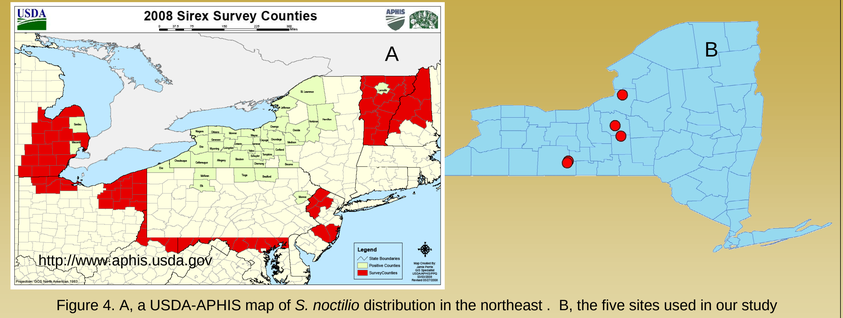

Figure 4. A, a USDA-APHIS map of *S. noctilio* distribution in the northeast . B, the five sites used in our study

RESULTS

•There was a trend of decreasing siricid and parasitoid density along a north to south gradient, although there were no significant differences between populations of either siricids or parasitoids across geographical regions (fig. 7).
• For the 7 Red pines in the southern region there is a strong correlation (R^2 =0.92) between siricid density in bolts taken at 3, 6, and 9 meters and the tree as a whole (fig. 6).
• There is an apparent bi-modal distribution of average siricids per bolt, with more siricids at the higher and lower portions, and less siricids in the middle portion of infested trees (fig. 5).
• Overall we found 1,134 siricid wasp larvae/pupae, 333 *Ibalia leucospoides* larvae/pupae, and 163 *Megarhyssa* or *Rhyssa* larvae.

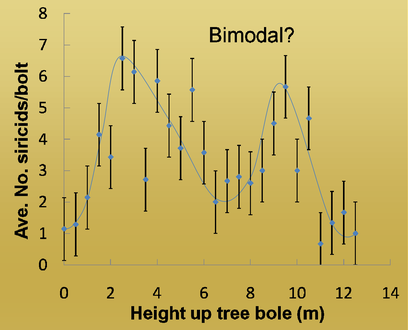

Figure 5. Scatterplot of height up tree and the average number of siricids per bolt.

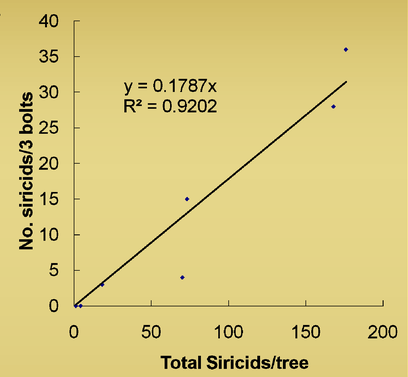

Figure 6. Correlation between siricids in bolts at 3, 6, and 9 meters up the tree and whole tree siricid density.

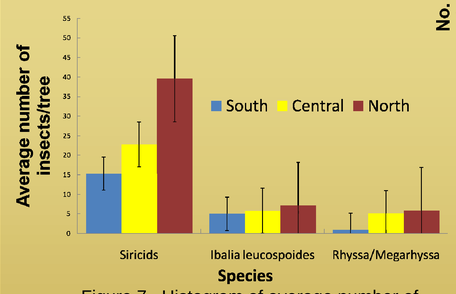

Figure 7. Histogram of average number of insect species per tree per region.

DISCUSSION

• At this time there are no molecular or morphological characteristics differentiating larval siricids, however, all larvae have been placed in vials for evaluation and of 178 siricid larvae or pupae that have emerged as adults, all were *S. noctilio*. This may mean that *S. noctilio* makes up a majority of the larvae in these trees or that native siricids do not rear out well via the methods used.
• There is a strong correlation between siricid density in bolts taken at 3, 6, and 9 meters and the tree as a whole. However, a larger sample size is needed to verify the strength of this relationship.
• A larger sample size is needed to better evaluate geographical variations in siricid and parasitoid density.
• Knowing the extent of parasitism of *S. noctilio* by native parasitoids will elucidate how these invasive insects are integrating into pine forest communities of New York as well as the parasitoids potential to inhibit spread of this invasive insect to commercially valuable southern and western pine forests.

ACKNOWLEDGEMENTS

We would like to thank the USDA-APHIS office in Mattydale, NY, specifically Kelley Zylstra and Robin Tait, as well as Vic Mastro. We would also like thank the DEC office in Bath, NY, specifically Joel Fiske. Thanks also to Jeremy Dalton, Tim Day, Peter Rockermann, and Paul Bryant.