PROGRESS IN UNDERSTANDING THE ECOLOGY AND DETECTION OF *SIREX NOCTILIO*

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ABSTRACT

We have been developing techniques for detecting the presence of *Sirex noctilio* and studying the ecology of *Sirex noctilio* in North America with the goal of anticipating the trajectory of the *Sirex* invasion. A challenge for detection efforts is the low efficiency of trapping. Fortunately, it has been possible to develop guidelines for identifying the presence of *Sirex* based on examination of emergence holes in host trees. The key diagnostic features are easy enough to use with little experience: (1) location of feeding galleries within the tree, (2) shape of emergence holes, (3) hole size, (4) patterning of holes within trees, and (5) form of feeding galleries and insect frass within the wood. An advantage of this identification technique is that the emergence holes remain easily detectable for many years. A weakness is that holes alone cannot distinguish between *S. noctilio* and native *Sirex* spp. *S. noctilio* is indicated by the presence of resin drops or drippings from infested trees, but the absence of detectable resin does not rule out *S. noctilio*. We are developing techniques for isolating and identifying the species of fungal associate (by sequencing of the ITS region of ribosomal DNA) and thereby identifying the species of woodwasp.

A key to anticipating the consequences of *S. noctilio* in North America is an understanding of why the species has perpetually low abundance in its native Europe while being capable of catastrophic outbreaks in the Southern Hemisphere. We suggest that the population dynamics of *S. noctilio* may be characterized by alternate attractors, which tends to regulate populations at low levels unless abundance exceeds some escape threshold that permits populations to grow to epidemic proportions. We have been testing for evidence of positive density dependence in North American populations, which would suggest the potential for outbreaks. There is enormous variation in adult fecundity and therefore potential population growth. Adult size seems to be largely unrelated to nutrition. *S. noctilio* grows as large or larger in red pine as in Scots pine. Adult size varied among sites in upstate New York but was unrelated to local abundance. *S. noctilio* progeny per trap varied among sites without obvious spatial structure. Sex ratios were highly male biased but unrelated to abundance. Emergence of *S. noctilio* was highly aggregated within individual trees, which suggests destabilized positive feedback in population dynamics. Parasitism by *Ibalia leucospoides* decreased

with local abundance, which indicates destabilizing positive feedback (numerical escape from an important natural enemy). The presence of blue-staining Ophiostomatoid fungi was negatively correlated with the success of *S. noctilio* within and among trees, perhaps because the bluestain fungi interfere with the establishment of *Amylostereum areolatum*, the mutualistic symbiont of *S. noctilio*. Our studies of *Sirex* nutritional ecology indicate that *Sirex* assimilate about 31 percent of the cellulose they consume, which is presumably what permits their development within a nutritionally challenging environment (pine xylem) and is possible only because of their fungal symbiont.

Continuing work will include studies of insect-mediated interactions between native Ophiostomatoid fungi and *A. areolatum* (in collaboration with Daniel Gruner, University of Maryland) and studies of attack rates in suppressed and vigorous trees, including comparisons of Scots vs. red pine in the U.S., and pines in the U.S. vs. Spain (in collaboration with Maria Lombardero, Universidad de Santiago, Spain).