Biology and Silvicultural Management of Sirex Woodwasp

Cornell University Cooperative Extension,
Department of Natural Resources, Ithaca, NY
www.ForestConnect.info

Forest Connect
Fact Sheet Series

Introduction

In 2005, *Sirex noctilio* (Hymenoptera: Siricidae) was found infesting trees in central New York (Figure 1). While generally considered a secondary species colonizing dying or weakened trees in its native range, as an invasive species Sirex has caused economic losses in countries where it became established on North America pine species (e.g., Monterey Pine, loblolly, etc.). Because it has successfully attacked North American pines and has a history of economic damage in other parts of the world, Sirex has been considered a high risk species for our pine forests. Previously known North American hosts include jack, lodgepole, Monterey, pitch, ponderosa, longleaf, shortleaf, loblolly, and slash, but all pines are likely susceptible to Sirex infestation. In New York, Scots, red, and white pine are confirmed hosts. Jack pine has also been recorded as a host from southern Ontario. Based on experience from other countries and initial observations in North America, Sirex poses a threat to unmanaged or otherwise stressed pine stands. Unfortunately, eradication of this pest will not be possible.

Sirex Biology

Sirex are strong fliers and able to disperse over large distances seeking suitable host trees. Suppressed, overtopped, or otherwise weakened trees are favorable oviposition sites for female Sirex. Females arrive at a host tree and drill through the bark into the sapwood to assess a tree's condition. If a tree is healthy and resin pressure is high, Sirex females will only inoculate the fungus and inject mucus. If a tree is in poor condition, females will lay eggs along with inoculating a symbiotic wood decay fungus (*Amylostereum areolatum*) and injecting a phytotoxic mucus through the ovipositor. The interaction of the fungus and mucus weaken and typically kill host trees. However, a vigorous tree's defensive system can effectively respond to Sirex attack and counter the effects of the mucus while containing fungal growth. If oviposition is successful, larvae develop and tunnel the sapwood while feeding on the symbiotic fungus. The larva is white with a brown head and prominent spine at the tip of the abdomen (Figure 2). Adult emergence usually occurs within a year and females then begin the cycle again. Adult Sirex can be seen flying from the beginning of July through September in New York.

Figure 1. *Adult female* ***(A)*** *and male* ***(B)*** *Sirex. Females can be seen on the boles of pine trees, while males are rarely observed. Photo B: Kelley E. Zylstra, USDA APHIS.*

Figure 2. *A Sirex larva removed from a pine tree. Note the prominent spine on the posterior of the larva. Larvae are only found within wood, never on the surface of the wood. Photo: Kelley E. Zylstra, USDA APHIS.*

Cornell University
Cooperative Extension

Development and distribution was supported by USDA Forest Service Northeastern Area State and Private Forestry and NYS Department of Environmental Conservation.

Sirex Habitat

There are several stand features that increase the likelihood Sirex will colonize trees in a forest (Figure 3). The presence of weakened trees growing in a stand substantially increases the likelihood Sirex will become established. Sirex initially concentrate attacks on overtopped slow-growing suppressed trees with poor crowns.

Figure 3. *A Sirex-infested Scots pine stand in New York. Note the overstocked growing conditions and presence of suppressed trees.*

Trees with broken tops or crown damage, stem damage, or multiple stems are also very susceptible to Sirex. Occasionally, larger dominant trees are attacked, but this occurs less frequently than attacks on smaller suppressed trees.

Identification of Infestation

When surveying a stand for the presence of Sirex, it is important to focus special attention to trees that have recently died or those which are living but in poor condition. If fading crowns (yellow, red, brown) are present in the canopy, these trees should also be examined. Dying and recently dead trees become apparent in late summer or early fall.

Visible tree symptoms include resin beads formed at oviposition sites (Figure 4A) and round, often grouped, exit holes often near branch nodes (Figure 4B). Resin flow should be noticeable throughout the latter parts of the summer, beginning in late July and continuing into September. Copious resin flow may not always be observed, but instead only small resin droplets may be present along the length of tree boles. Resin beads may be densely concentrated or may appear randomly and sparsely along the tree bole. Care should be taken to examine the entire length of the tree bole with and without binoculars to check for resin beading. Sirex galleries will only be visible if the wood is split. The larval gallery is packed with fine frass of chewed wood

Figure 4. *Symptoms of Sirex infestation include* ***(A)*** *resin beads along the tree bole, and* ***(B)*** *round exit holes often grouped at the nodes.*

and droppings (Figure 5A) This frass is distinctly different from the excelsior produced by some common native woodborers (e.g., *Monochamus*) (Figure 5B). Adults from trees that were attacked during the summer will most likely emerge the following summer, creating distinct round exit holes 1/8 to 5/16 inches in diameter.

Figure 5. (A) *Sirex larva removed from its sapwood gallery that is packed with fine frass.* ***(B)*** *Native woodboring insects also inhabit sapwood of pine trees. Some of these species feed in the phloem and sapwood, but produce excelsior compared to the fine sawdust of Sirex galleries. Photo A: Kelley E. Zylstra, USDA APHIS.*

Integrated Pest Management

The combination of biological control and silvicultural practices to increase stand vigor have been effective at reducing damage from Sirex.

Biological Control

Biological control using a nematode, *Deladenus siricidicola*, that is specific to Sirex has been successful in several countries and is used as the primary biological control option. This nematode has a complex life cycle, in one phase it feeds on the fungus inoculated by the woodwasp and in another phase in infects Sirex larva by penetrating the insect's body, where it completes development and moves into the reproductive organs of the adults. In female Sirex, the nematodes move into the eggs and effectively sterilize the female woodwasp. The sterilized female continues to develop, emerges from the tree, and disperses to find a suitable tree to colonize. However, instead of laying fertile eggs the female lays eggs that are filled with nematodes, which move into the tree to feed on the fungus and attack the next generation of Sirex larvae.

In addition to the nematode, parasitic wasps that attack Sirex eggs or larvae are already present in North America and have been seen on Sirex attacked trees. The ibaliid parasitoid, *Ibalia leucospoides* (Figure 6A), has been commonly seen in infested stands and lays its eggs in Sirex eggs or early larvae. The ichneumonid *Rhyssa persuasoria* (Figure 6B) has also been observed ovipositing into Sirex infested trees where it lays an egg onto woodwasp larvae. Several other North American species of parasitoids are recorded to attack woodwasp larvae and may also be using Sirex as hosts. These species of beneficial wasps have been exported into other countries for use as biological control organisms for Sirex management. It is currently unknown what impact parasitoids will have on Sirex populations in North America, but they could be an important contributor to population regulation of the woodwasp.

Stand Management

Stand management focused on improving individual tree health and vigor will help reduce the potential for damage caused by Sirex. In addition, increasing tree vigor improves the overall health of a forest and makes it more resistant to other mortality causing agents (e.g., bark beetles, pathogens, etc.). Proper forest management will reduce stand susceptibility to Sirex

Figure 6. *Various parasitoids are present in New York and have been seen on Sirex-infested pine trees.* Ibalia leucospoides ***(A)*** *and* Rhyssa persuasoria **(B)** *are parasitoids that use Sirex eggs/early larvae or larvae, respectively, as hosts. Photos: Kelley E. Zylstra, USDA APHIS.*

infestation by decreasing the number of available unhealthy host trees. Landowners who follow recommendations outlined in this document will help reduce the susceptibility of their pine stands to Sirex. However, there is no guarantee that properly managed stands will be immune to tree losses from Sirex or other organisms. Even in stands managed properly, other factors (i.e., drought, stand disturbance, other insect outbreaks on pine) may stress trees and predispose them to attack by Sirex or other organisms.

From observations in New York and elsewhere managed pine stands are less susceptible to Sirex compared to unmanaged stands. Consequently, stand management recommendations vary depending on the current condition of pine stands.

Managed Pine Stands

To date, there has been little observed Sirex damage in managed pine stands. Under normal climatic conditions, managed pine stands should not be considered high-hazard for Sirex colonization. Even though managed stands are not highly susceptible to Sirex attack, frequent surveys for the insect should be conducted. Stand and tree conditions change and over time resources may become available for Sirex within a stand. Vigilant surveys and assessment of stand conditions could preempt Sirex becoming established.

Mature Unmanaged Pine Stands

Observations from Sirex infested stands in New York and southern Ontario suggest that Sirex is most common in suppressed trees. While trees in the dominant and codominant crown classes may be attacked by Sirex, it has not been observed as frequently as in weaker trees. Consequently, thinning activities should:

1. Target suppressed/overtopped trees present in the stand
2. Remove injured, diseased, or otherwise unhealthy trees. This would include trees with damaged crowns and/or multiple stems.
3. Remove any Sirex-infested or recently dead trees.
4. Maintain thinning regimens and remove overtopped and suppressed trees.
5. Occur before there is any sign of a problem. Thinning practices are stand-level disturbances that stress individual trees. It will take the stand at least a year to recover from this stress.
6. Be scheduled during periods when Sirex is not active (November-April).
7. Reduce damage to residual trees

Thinning activities focused on suppressed trees has a two-fold impact on stand susceptibility to Sirex. By removing suppressed trees, landowners reduce the amount of suitable breeding material for Sirex. Thinning from below also reduces competition for resources and results in healthier, more vigorous residual trees. Residual trees are then more capable of defending themselves against attack from Sirex or other organisms.

What should you do with Sirex-infested trees? If you have located Sirex-infested trees in your stands (Figure 4) and decided to take action it is important that this infested material not be moved off site. Ideally, infested material will either be chipped or burned on site to kill any developing Sirex within the trees and reduce the chance of emergence and attacks on local trees. If chipping or burning is not possible, bucking this material into smaller pieces may increase Sirex mortality as smaller logs will dry more quickly than intact trees, but it is unknown at this time how this affects developing brood.

For More Information in New York:

Contact your local Cornell University Cooperative Extension office in your county of residence. Or contact: NYS Department of Environmental Conservation, NYS Department of Agriculture & Markets, APHIS, USDA Forest Service, Northeastern Area State and Private Forestry.

Authored by Kevin J. Dodds, USDA Forest Service, Northeastern Area State & Private Forestry, Durham, NH.
Layout and design by Diana Bryant.
Suggested citation: Dodds, K.J. 2009. Biology and silvicultural management of Sirex woodwasp. Cornell University Cooperative Extension ForestConnect Fact Sheet. P. Smallidge, ed. 4 pgs.