



Pest note

Hemlock Woolly Adelgid

No. 5

The hemlock woolly adelgid (HWA, *Adelges tsugae*) is a native pest of hemlock trees in eastern Asia and northwestern North America. Although it attacks western hemlock (*Tsuga heterophylla*) and mountain hemlock (*Tsuga mertensiana*) in the Pacific Northwest and Alberta, it does not pose a threat to these hemlock species. Predation of the HWA, predominantly by flies and beetles, is effective in keeping HWA populations under control in western Canada.

The HWA was first detected in eastern North America in Virginia in 1951, though it was likely introduced there in the 1920s. The HWA attacks and kills eastern (*Tsuga canadensis*) and Carolina (*Tsuga caroliniana*) hemlocks in eastern North America.

Since its introduction, the HWA has rapidly spread throughout half the range of eastern hemlock in the United States. Increasingly warmer winter temperatures have allowed the HWA to move northward, and it can now be found in eastern Canada.

The first infestation in Canada was detected near Toronto, Ontario, in 2012. Following this find, several infestations were detected on the Niagara Peninsula. As well, a large infestation was detected along the north shore of Lake Ontario near Grafton, Ontario, in 2022.

In 2017, it was first found Nova Scotia in Yarmouth County. Follow-up surveys confirmed its presence in four additional southwestern counties that year. By 2022, it had spread to seven counties in the southwestern part of the province (Figure 1). Although the HWA has not been detected in New Brunswick, the southwestern part of the province is a likely location for introductions in the near future because of its climate and its proximity to infestations in Maine.

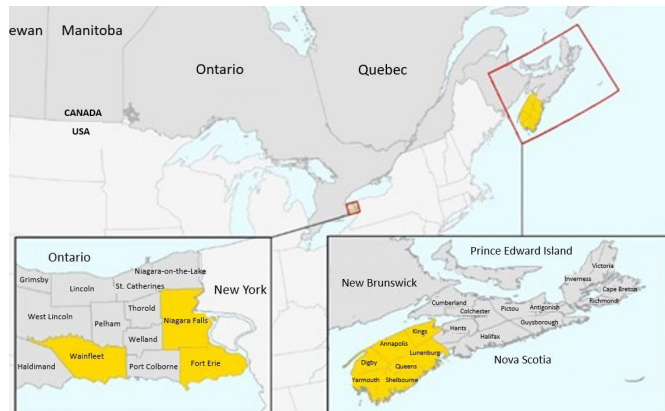


Figure 1. Areas infested with hemlock woolly adelgid in eastern Canada

Source: Canadian Food Inspection Agency, 2022

The presence of HWA on hemlock is confirmed by the occurrence of white woolly material that is secreted by the adelgids and covers the eggs (ovisacs) (Figure 2).

These clusters look like fake snow on the underside of hemlock twigs. When populations are high, ovisacs occupy the entire length of the twig and can be found on young as well as old hemlocks.

The HWA kill trees by inserting a feeding tube called a stylet to feed on sugars inside the twigs. The HWA are extremely small – adults are less than 1.5 mm long and very difficult to see without magnification.



Figure 2. Ovisacs on the underside of a hemlock twig (left); close-up of egg sacs (centre); first-instar HWA nymphs (crawlers) on a hemlock twig (right)

LIFE CYCLE

In most insect species, males and females complete their life cycle in a single year and are dormant during winter. However, the life cycle of the HWA differs in two important areas.

First, in North America, the HWA life cycle consists of two all-female generations each year: sistens and progrediens, whose stages can overlap considerably. We illustrated this in Figure 3. The timing of these two generations also varies with location.

Second, the HWA is active during winter when the temperature is above freezing.

SISTENS GENERATION

In Nova Scotia, the sistens generation occurs from early July to mid-June of the following year and consists of only wingless adults. Egg hatching is spread over several weeks in July. It is at this stage of their life cycle that the young adelgid nymphs, called crawlers, are most likely to spread to new areas where they can infest other hemlock trees. They are most likely moved or transported by wind or by animals such as birds.

The HWA crawlers insert their stylet into the new hemlock shoots, but rather than starting to feed, they enter a dormant phase from August to mid-October (aestivation). Upon breaking dormancy in fall, the adelgid nymphs start feeding and continue feeding throughout the winter when the temperature in the hemlock canopy is above 0°C. Sistens mature in late spring and lay eggs that will produce a wingless and a winged form.

The wingless form lay eggs on hemlock in July. These eggs hatch shortly thereafter and produce a new sistens generation. The winged form requires a spruce host to complete development. In Asia, their offspring initiate a gall on spruce and, when mature, produce male and female adelgids. After mating, the females return to hemlock trees to complete the all-female part of the life cycle. The winged form of HWA cannot complete its life cycle in North America despite the presence of native and Asian spruces.

CAN OUR HEMLOCK BE SAVED?

Our hemlock can be saved if forest managers in Canada adopt the successful techniques used in the United States. Our native hemlock trees are very susceptible to the HWA because their natural enemies are not present in eastern North America. Consequently, the HWA remain almost unchecked and can cause incredible damage in a short period. The reproductive capacity of the HWA is extremely high, with millions of HWA being produced from a single female after only four years.

Another factor that must be considered is that the HWA has two generations each year. Therefore, we need an effective protection strategy to successfully target both generations. Researchers are developing two main options to protect hemlock trees: insecticides and biological control. These tactics are well developed and successful in the United States for saving hemlock trees and are being adapted for the Canadian context.

INSECTICIDES

Because the HWA feed by sucking sugars and nutrients inside the tree, traditional spray programs are ineffective. To be effective, insecticides must be inside the tree so that the HWA consume them while they are feeding. Treatment programs focus on the use of stem injections and basal bark application to deliver the insecticide inside the tree (Figure 4).

Stem injections with TreeAzin® (azadirachtin) and IMA-Jet® (imidacloprid) are being tested to determine their efficacy and risk to the environment in eastern Canada. The protection period is one to two years for TreeAzin and four to five years for IMA-Jet. Both products are broad spectrum insecticides, so research is needed to determine the environmental risks of these products.

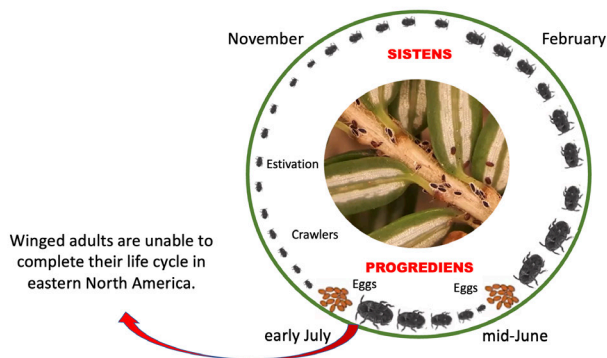


Figure 3. Two life cycles of hemlock woolly adelgid

WINGLESS AND WINGED GENERATIONS

The wingless (progrediens) and winged (sexuparae) forms develop rapidly by comparison to the sistens, usually from mid-May to mid-July in Nova Scotia (six to eight weeks, Figure 3). Crawlers are active from mid-May until early July and are spread the same way as the sistens crawlers.

A major difference is that these crawlers are active when birds are migrating north each spring. This can result in the HWA being moved great distances and, because all HWA are female, only one is required to start a new infestation. The abundance of the winged form is related to tree health, with their proportion increasing as tree health decreases.



Figure 4. Stem injection (left) and basal bark application (right)

Basal bark application is another method that is being tested. Xytect 2F is an imidacloprid product while Starkle 20 SF contains dinotefuran. Both products are broad spectrum insecticides. Research to assess the risk these products pose to the environment is also being conducted. Because HWA is moving rapidly in Nova Scotia and causing tree damage in a short period after invasion, Starkle 20 SF and TreeAzin are the only two formulations that work on HWA-damaged trees.

BIOLOGICAL CONTROL

Biological control is believed to be the only viable landscape-level solution to protect hemlock forests. Predatory beetles and silver flies have been released in the United States and are showing positive results. Release of biological control organisms in Canada is regulated by the Canadian Food Inspection Agency, and permits must be obtained to import and release biological control agents from outside Canada.

Researchers are planning to collect predatory beetles and silver flies from western Canada (Figure 5) and introduce them into Nova Scotia to help manage HWA populations. The predatory beetles and silver flies target only adelgid species and are therefore unlikely to affect other species. The predatory beetles attack all life stages of the sistens generation while the silver fly larvae consume all life stages of both HWA generations. Researchers are also exploring the possibility of introducing a predatory beetle from Asia that is larger than our native one and that is proving effective in the United States. Some predators will do well in some environments where others will do poorly. A group of predators ensures that HWA will be managed in all areas.



Figure 5. Predatory beetles (*Laricobius nigrinus*, left) and predatory silver flies (*Leucotaraxis* spp., right)

Much work remains to be done to ensure that hemlock can continue to be a vital component of the Acadian Forest and continue to provide the ecological, social, and environmental benefits that we value.

References

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