

# Primer on Eastern Hemlock Forest and Hemlock Woody Adelgid

## Eastern Hemlock: Ontario's Forest Cathedrals

When we think of old-growth forest in Ontario, we tend to think of white pine, or ancient cliff-growing cedars – but we should also be thinking about hemlock forest. Eastern hemlock is a very long-lived climax species that is common in old-growth forests south of the boreal. Because it doesn't recover well after disturbance, hemlock is often found in areas that have been continuously forested since before European settlement hundreds of years ago.

Although it has declined in southern Ontario, hemlock is still a relatively common dominant tree in parts of Central Ontario, and the trees are often much older than we realize. In Algonquin Park alone there are more than 20,000 hectares of hemlock dominated forest aged over 180 years old, and hemlock trees over 400 years old have been found in widely disparate corners of the province, including the Niagara Gorge, Burnham Woods near Peterborough, and several places in Algonquin Park. We will probably find many more if we look for them; old hemlock trees are often overlooked because they may not be that large. Trees over 300 years old are commonly under 80 cm diameter, and may be less than 50 cm!

Eastern hemlock is a tree of shorelines and river valleys. It shades the north slopes of the ravines and waterfalls of the Niagara Escarpment, and is an iconic tree of Muskoka and Algonquin Park shorelines. Hemlock is known as a foundation species, because it exerts such a strong influence on the ecosystems where it grows. The dense shade of hemlock groves cools streams throughout the summer – streams that run through hemlock valleys average about one to two degrees Celsius cooler than in nearby hardwood forests, creating important habitat for cold-water fish species such as brook trout. Hemlock also helps maintain summer water levels in streams by holding spring snowpack longer, and reducing summer evaporation.

If you're not sure how to recognize eastern hemlock, [the Morgan Arboretum has a great post to help you.](#)

Join the Eastern Hemlock Project [on inaturalist](#) to upload locations of hemlock from your smartphone.

## Hemlock Woolly Adelgid: A Threat to Our Hemlock Forests

Hemlock is threatened by a sucking insect called hemlock woolly adelgid (HWA) that kills hemlock trees. HWA is an introduced pest from Japan which has been rapidly spreading in the Eastern United States since the 1990's, and is now found over more than half of the geographic range of Eastern Hemlock. Within a decade or more of its arrival HWA kills most of the hemlock trees in forest stands. The eastern hemlock project aims to document remnant hemlock forests in southern Ontario and encourage citizen engagement in their stewardship.

HWA appear as small white woolly masses attached to the twigs near the base of the needles. Enclosed inside each woolly mass is a tiny sucking insect that has attached permanently to the branch, and as the insect develops it lays a cluster of up to 100 eggs which will hatch into a temporarily mobile crawler stage. All of the HWAs in North America are female and reproduce asexually, because the alternate tree host for the sexual stage of the insect are Japanese spruces -adelgids can't survive on North American spruces. This limitation may have slowed down their spread slightly as the sexual stage is winged, whereas the stage we know here is flightless; but it's a minor point at best, as both crawlers and the woolly cases full of eggs may be carried between trees by birds or humans (including on nursery stock) which can move adelgids many kilometers – or by wind which commonly moves them tree to tree.

Once the adelgids get onto a tree it may take a few years for numbers to build to the point where they're noticed. "The problem with this insect is it likes to get into the middle-upper crown more often than not," says Jeff Fidgen, a Canadian Forest Service scientist. "That population can sit up there and spread for a while before it is evident at ground level." The chronology of hemlock decline following arrival of the adelgids is muddled by a few factors, not least of which is the uncertainty of how long woolly adelgid was present on many sites before being detected. Climate can also play a big role in severity of HWA outbreaks – both broad climatic gradients, in which outbreaks spread and kill trees more rapidly at the southern end of hemlock's range than the north; and seasonal variation that affects mortality year-to-year on a site.

Two things are clear: once a hemlock forest is infested, tree mortality only trends up over time; and sometimes adelgids kill whole forests extremely quickly. The insect was discovered in Great Smoky Mountains National Park in 2002 and within a decade an estimated 80% of the hemlocks in the park were dead. Significant drought in 2007-08 accelerated the process. In Shenandoah National Park, Virginia, it was found in 1988; five years later many of the hemlocks were dead and today eastern hemlock has been virtually extirpated from the park. On the other hand research in the Delaware Water Gap National Recreation Area found that after ten years of monitoring hemlock survival was 73%.

Keep an eye out for it while hiking, because early detection can help save our hemlock forests.

## HWA Moves North

At first it was thought that cold winters would limit the spread of the insect in the north of hemlock's range, but as it moves north it has – amazingly, for an insect with no sexual reproduction – steadily adapted to colder climates. Mark Whitmore, at Cornell University, has been studying cold tolerance of the adelgid in upper NY state. His research over the last two winters has shown that at the north end of the range, even during the past two unusually cold winters, survival has remained high enough to sustain adelgid populations. "Last winter everyone talked about the 'polar vortex', and it was a pretty cold winter; I did get around 90% mortality," says Whitmore, "but by the beginning of this fall I had densities that were remarkably similar to those before the cold mortality occurred." Two generations per year, each with a high reproductive potential, allows HWA to bounce back almost immediately

from even high levels of mortality. And Whitmore adds that “the scary part is that research has indicated cold tolerance is a genetically linked trait, so that populations developing from the survivors of the past couple cold winters may make for even harder HWA in the future.”

Whitmore worries that the cold winters may have made forest managers complacent; with a few warm seasons mortality of hemlocks might climb significantly. In any case there’s little indication that cold will inhibit the spread of the adelgid. “I have no question it will go through zone 5,” says Whitmore. “Maybe when you get up into the Algonquin area, maybe you’ll get a change, but down lower I don’t think there’s any question about its capacity to spread.”

In 2012 Hemlock Woolly Adelgid was detected in Ontario for the first time. It was found at two locations: Etobicoke, where it likely came in on some infected nursery stock; and in 2013 in the Niagara Gorge, an important old-growth forest known to have 435 year-old hemlock trees. The Etobicoke find, in a residential area, was easily dealt with; the infected trees were cut and burned, the neighbourhood was surveyed for further signs of adelgid. It probably stopped there. The Niagara gorge is trickier, because it’s nearly impossible to fully survey the tall hemlocks to determine the extent of an infestation. Adelgid was once again found in the gorge in 2014, and it would be optimistic to think that taking out a couple of trees removed the insect. “There’s a good probability that the insect is somewhere in that gorge, hidden in the tops of trees,” says Taylor Scarr, Ontario’s provincial forest entomologist. The best way forward may be to try to eliminate the population with systemic insecticide application, an approach that Scarr says is being considered by the province.

It’s also an approach that Mark Whitmore advocates, and that he used in the Zoar Valley old-growth forest near Buffalo. “I was giving a lecture nearby and I contacted them and got the preserve steward to give me a tour. And within a half hour I found one tree that was infested,” says Whitmore. “We spent the rest of the day looking and we didn’t find any others. I still can’t believe we were fortunate enough to find just this one infested tree. We treated not just that tree but 600 trees all around it thinking we needed a buffer because HWA wasn’t likely to be on just that one tree. It was a very rapid response, we got in there and hopefully we took down that population, buying time for biological control to develop. I think that kind of strategy could be used effectively in Ontario with adequate early detection.”



## HWA Early Detection in Ontario

In 2012 HWA was detected for the first time in Ontario, with subsequent detections in the old-growth forest of the Niagara Gorge in 2013, 2014 and 2015. HWA can be carried by birds or humans, and may have already spread – now that it has been found in Ontario, it is important to focus on early detection of its arrival and spread.

Early detection of HWA is essential for slowing its spread and preserving high value trees and forests. Management options include the use of highly effective systemic insecticides, and release of specialized HWA predators from western North America. Waiting until signs of infestation and tree decline are obvious commonly results in many trees dying before measures can be implemented. In Ontario it's particularly important to document the arrival and spread of HWA so we can mount an effective and rapid Provincial response to it.

Old-growth hemlock forest should be a conservation priority. Preserving old-growth forest areas is the best way to preserve the genetic diversity of the species, and maintain local seed sources for recolonization of the landscape once effective biological control is established.

## Monitoring for HWA: How and When

### Season

Hemlock woolly adelgid (HWA) is visible anytime from November to July, but is most obvious in late winter through early summer. HWA is nearly invisible after mid summer, when the insect is in a resting stage.

### What to Look For

Look for white woolly masses (ovisacs) on the underside of twigs at the base of needles in winter/spring through early summer. In the early stages of the infestation, there may only be a few of the woolly masses, typically on the new growth. As the population grows HWA will also occur on older twigs, and at the base of nearly every needle. Flip over and inspect the underside of twigs on the lower branches of hemlock trees; walk around the tree inspecting several branches at different points. Note that HWA is always on the twig, not the needle – and while it's possible there could be only one HWA on a twig, it's more likely that there will be several, which helps distinguish it from spider ovisacs that are usually solitary.

Any monitoring effort is worthwhile, even if you only have time to inspect one tree. If you have limited time, focus your efforts around streams and water bodies where birds are more likely to land and spread the insect. Anecdotally this is where infestations seem more likely to start, and also there are often low branches along shorelines that are easier to inspect. Record your search efforts using the inaturalist app, and adding observations to [the Eastern Hemlock Project](#).

When walking through the stand watch the ground for fallen twigs or branches and inspect them; HWA often starts high in the canopy, so fallen twigs are a valuable opportunity to see what's happening above you.

We've produced a handout which you may [download as a pdf](#). Paper copies are available on request. If you're watching for HWA, even on just a few trees, please let us know ([info@ancientforest.org](mailto:info@ancientforest.org)).

In larger stands if you're feeling serious you can use the sampling methodology from the US Forest Service to randomly distribute your efforts. Inspect multiple trees at different locations, since infestations are initially patchy. As a guideline, in mid-sized stands sampling 100 trees gives you a good probability of detecting HWA even at light infestation levels, and 10-20 trees would be needed to detect moderate infestations. But if 500 people each inspect one tree, across a wide geographic range, it is likely to be better than one person inspecting 100 trees (and ideally, all of the above!) – so whatever you can find time to do will help.

## Look Alikes

- Spider sacs: are made of much stronger fiber than the wool of the HWA and are usually not closely appressed to the twigs.
- Spittlebugs are found on twigs but make watery, white foam and are not found in winter.
- Scale insects are found on the needles, not on the twigs
- Other potential look-alikes are bird droppings and pine pitch.

If in doubt consult this [look-alike fact sheet](#). HWA will usually (though not always) have multiple egg sacs on the same branch, often in a row, which can help differentiate it from look-alikes such as spider egg sacs.

## How You Can Help

The first detection of HWA in Ontario was by an arborist, who recognized the pest on a tree in Etobicoke and reported it to authorities. This triggered a survey by the Canadian Food Inspection Agency, which subsequently detected HWA in the Niagara Gorge. We believe that citizens with a passion for trees should be working in parallel with professionals on the front lines of monitoring for HWA invasions; the more people who are looking for the pest, the better. You can start looking for it in late winter or spring before leaf-out; if you're going for a walk in a hemlock forest, check some branches.

Take a look at our "Monitoring for HWA" information above to learn more about how and when to survey. A great tool for learning about and reporting invasive species in Ontario, including HWA, is [EDDMapS Ontario](#), which is available as a free phone app from Google Play or the AppStore.

A group of land managers and other stakeholders in Ontario are collaborating to prepare and plan for the arrival of HWA in Ontario. Contact Kathleen Ryan at [Silvecon](#) to learn more.

## Locating Eastern Hemlock Forests

An important step in monitoring for HWA is to locate stands of Eastern Hemlock near likely points of arrival or spread, and also to ensure that old-growth hemlock forests are being

monitored. Please let us know about any old-growth hemlock forests you have discovered by sending us an email at [info@ancientforest.org](mailto:info@ancientforest.org) or by adding hemlock sites to our [inaturalist project](#).

## The Value of Eastern Hemlock

Eastern Hemlock is considered a foundation species because it is a dominant species that has a controlling influence on ecosystem function. Hemlock forests are often noted as valuable for their role as deer yards, for creating aquatic habitat by regulating stream flow and moderating temperature, and for their unique aesthetic value.

Hemlock is also one of Ontario's longest-lived trees, capable of living over 500 years, with numerous individual trees in Ontario known to exceed 400 years. Hemlock is an important component of old-growth forests on the landscape.

## Resources

### If You've Think You've Found Hemlock Woody Adelgid

If you've found something that looks like HWA, you can compare it to its [look-alikes](#). Then if you think you've found Hemlock Woolly Adelgid, in Canada contact the [CFIA Plant Health Surveillance Unit](#), call 1-800-442-2342, or contact your regional [CFIA office](#). Sightings in Ontario can also be verified and reported online or using your smartphone via [www.eddmaps.org/ontario](http://www.eddmaps.org/ontario). Or call the invading species hotline at 1-800-563-7711 or email [info@invadingspecies.com](mailto:info@invadingspecies.com).

In NY State, you may contact your local Cornell Cooperative Extension office or the New York State Department of Environmental Conservation at: 1-866-640-0652, e-mail [foresthealth@dec.ny.gov](mailto:foresthealth@dec.ny.gov). In Vermont call 802-879-5687, in New Hampshire 603-464-3016, and in Maine 207-287-2431.

Take photos of suspected infestations and detailed notes, including GPS coordinates, and the date. Don't go from a suspected HWA-infected site to any other hemlock forest without first showering and washing your clothes.

### Learn More

[HWA in Ontario webinar](#)

[CFIA fact sheet](#)

[US Forest Service HWA Resources](#)

[A death in the forest \(New Yorker\)](#)

[Invasiveinsects.ca](http://Invasiveinsects.ca)

[Blazing Star article](#)