Welcome everyone, thank you for coming. My name is ___. I'm a volunteer with Speaking for Wildlife. *Speaking for Wildlife* is a program by the University of New Hampshire Cooperative Extension that brings wildlife presentations and nature walks to communities throughout the state.

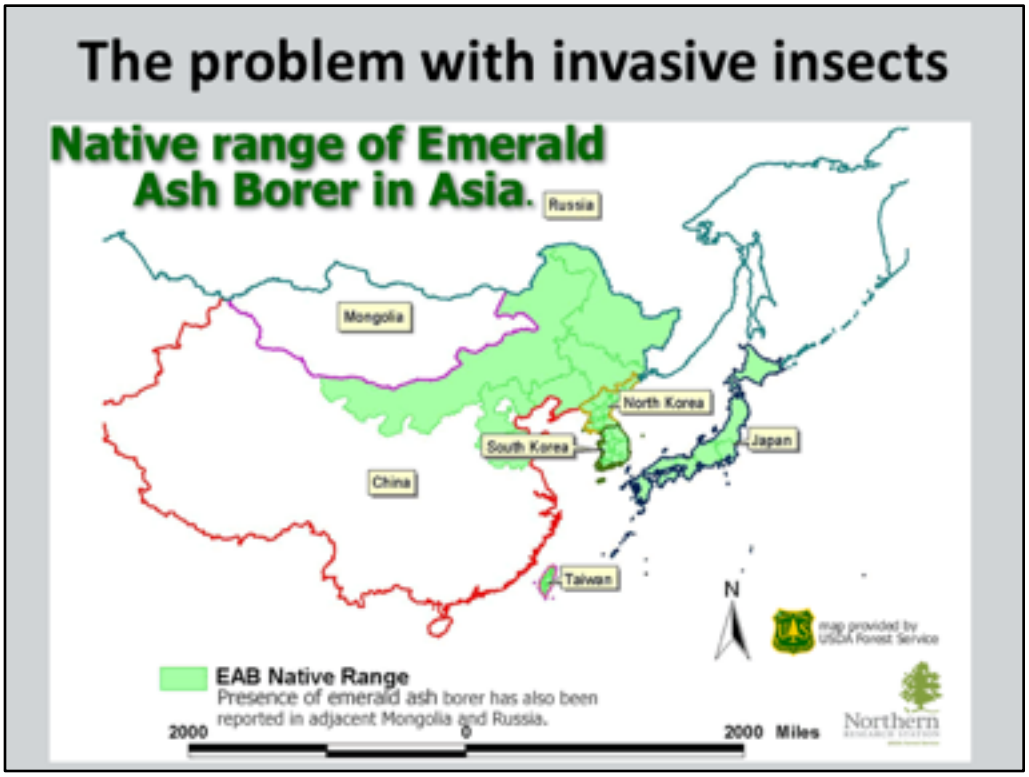
This *Speaking for Wildlife* presentation is about three of the non-native invasive insects that are a risk to New Hampshire's trees and forests, two of which are present in the state: emerald ash borer (pictured at the top) and hemlock woolly adelgid (pictured in the middle), and one not yet known to be in New Hampshire but is certainly nearby, Asian longhorned beetle (pictured at the bottom). We want the public to be aware of these pests and how to identify them. An educated public increases our chances of early detection, which is the best defense in the battle against non-native invasive insects.

In New Hampshire, we have a three-pronged approach to dealing with invasive insects:

1. Regulation and enforcement through state and federal quarantines
2. Education and outreach to the public, and
3. Management of the pests by federal and state agencies, communities and landowners.

The focus of this presentation is reaching out to people like yourselves. Emerald ash borer and hemlock woolly adelgid are already here in New Hampshire, and Asian longhorned beetle isn't. Each of these insects presents their own challenges. There are many other pests impacting New Hampshire's trees and forests that aren't included in this talk, including balsam woolly adelgid, Dutch elm disease, chestnut blight, beech scale complex and oak wilt.

I will be talking for about 35 minutes and then we'll have time for questions, but feel free to ask questions as we go.



Non-native invasive insects aren't native to the area being impacted. For example, the emerald ash borer is native to northern China, North Korea, South Korea, Japan and Taiwan, but it is now found in more than 20 states in the U.S. and two Canadian provinces. We think it was brought into the port of Detroit, Michigan in shipping materials.

The reason non-native invasive insects can have such an impact on our trees and forests is that there are no natural predators to keep their numbers in check and the trees have no natural defenses against them. With nothing feeding on these insects, they can reproduce and their numbers grow very rapidly. Our experience shows that they often have a devastating impact on the trees they infest.

This street in Toledo, Ohio was infested with the emerald ash borer. The photo on the left is from 2006. There is little visible damage to the trees. The one on the right is from 2009. The trees have almost no leaves remaining. They are dead.

Not all non-native invasive insects have as dramatic an effect as shown here. There are impacts that aren't necessarily visible impacts, but that may affect industry, tourism, and economics.

For instance, a study done by the U.S. Forest Service in 2008 estimated that to replace all ash trees found on the streets and in yards and parks of New Hampshire would cost $250 million by 2018 after a significant infestation of emerald ash borer and if no measures are taken to slow the spread of ash mortality. This conservative estimate doesn't include the value of ash trees found in our forests.

Hemlocks are of great value to wildlife, including providing cover for deer in winter and shading valuable cold-water streams for native brook trout. These species are vital to our state's ecotourism.

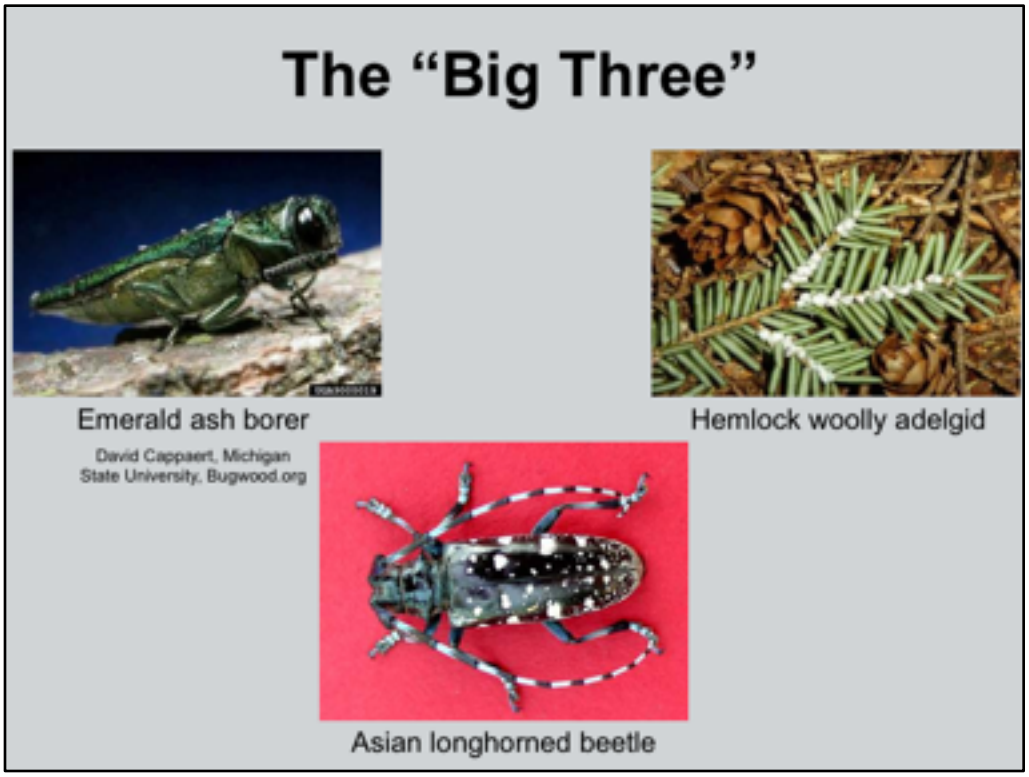
With an Asian longhorned beetle infestation, New Hampshire would see significant impacts to the maple industry as well as declines in tourism during the fall foliage season.

These insects aren't easy to find. We need as many eyes as possible looking for them. An aware person can make all the difference. For example, in 2000, the first hemlock woolly adelgid sighting was made in Portsmouth by a natural resources volunteer. Pictured here is debris in a swimming pool filter. Asian longhorned beetle was first reported in Worcester by a concerned citizen. After that initial detection was confirmed, homeowners reported that they had collected this beetle from swimming pool filters. In New Hampshire, we encourage people to look in their swimming pools in July and August for Asian longhorned beetles. Luckily we haven't found any yet, but we still need your help looking.

Asian longhorned beetles and emerald ash borers spend the majority of their lives hidden under the bark of trees. This makes it difficult to identify an infestation early. If more people know what to look for, it is more likely we will find an infestation early. In fact, both of our first known emerald ash borer infestations in New Hampshire were identified by someone who observed specific damage on their ash trees and reported it - one was a private landowner.

You can take part in helping us slow the spread of these insects. There are some simple steps you can take.

- Learn about forest pests and look for them. I will give you some signs and symptoms for each pest during this presentation.
- Visit NHBugs.org for more information. This website is a joint effort of UNH Cooperative Extension, the NH Department of Agriculture Markets & Food, the NH Division of Forests and Lands, the U.S. Forest Service and the USDA Animal and Plant Health Inspection Service.
- Sign up to receive periodic forest pest updates at NHBugs.org.
- Don't move firewood. Transporting firewood is the main way that many non-native invasive insects are spread.
- Identify and protect your high-value trees. There are treatment options for both emerald ash borer and hemlock woolly adelgid that are effective to control these pests in high-value trees. Doing so probably won't slow the spread throughout the state, but you can take care of the trees that are important to you.
- And, watch for other opportunities to get involved in your community.

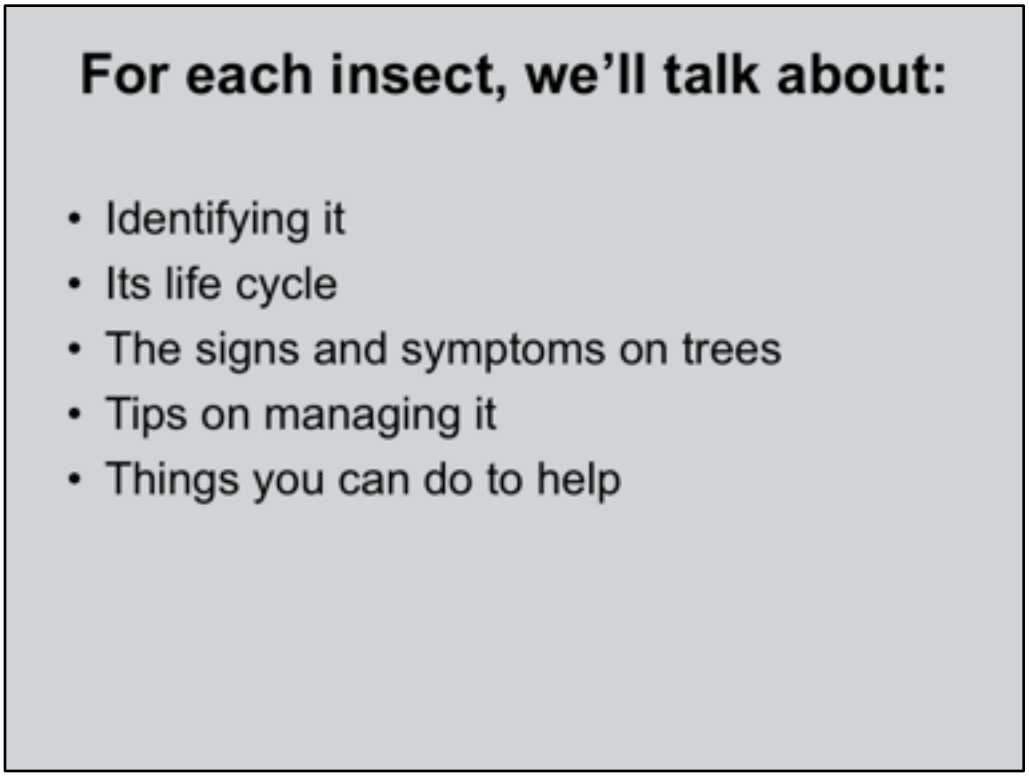


What are the “Big Three” we’ll be focusing on today? Our three guests of dishonor are the emerald ash borer, hemlock woolly adelgid and Asian longhorned beetle.

Emerald ash borer was found in Concord and Bow in the spring of 2013, and since then, has been found in multiple towns in Merrimack, Hillsborough, Rockingham, and Belknap Counties. Hemlock woolly adelgid is in many towns in the southern part of the state and has been present since 2000.

While it hasn’t yet been found in New Hampshire, Asian longhorned beetle is close by in Worcester, Massachusetts.

I’ll start with the emerald ash borer, since that is the pest most recently in the headlines.

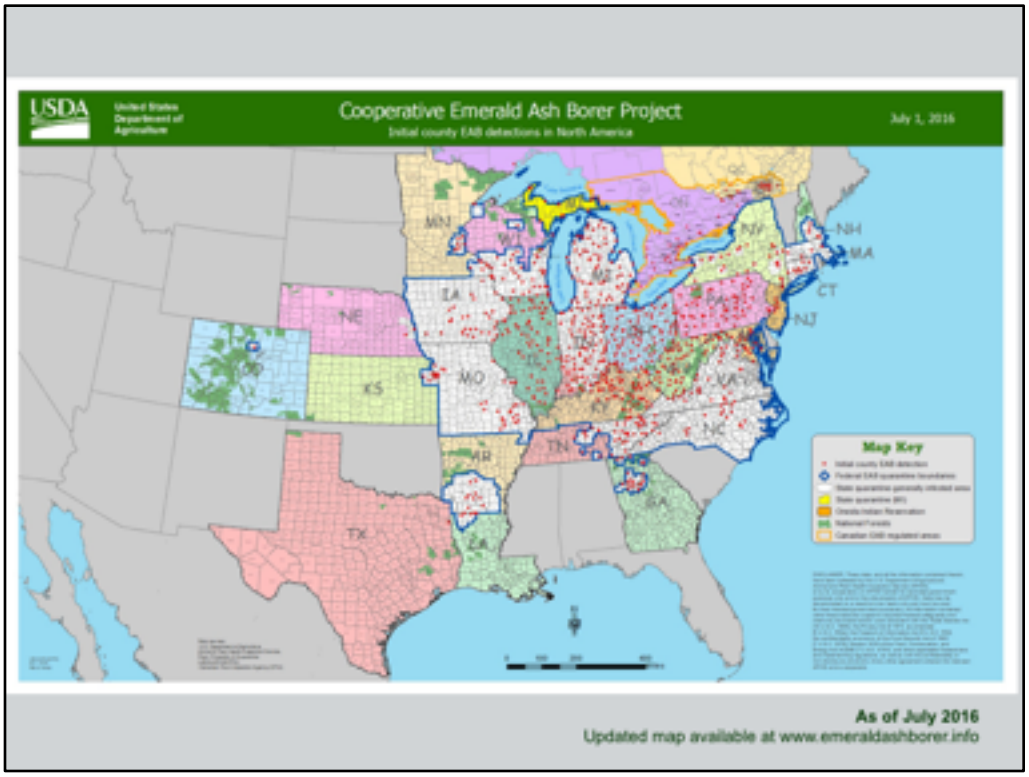


For each insect, we'll talk about:

- Identifying it
- Its life cycle (just briefly--knowing a little about the life cycle will help you to identify it)
- The signs and symptoms on trees
- Tips on managing it
- And, things you can do to help

Emerald ash borer has been found in over a dozen New Hampshire towns and cities. It's commonly said to be the most destructive insect in North America. It infests true ash trees, namely white, green and black ash, all of which grow in New Hampshire. Mountain ash aren't killed by it. Emerald ash borer kills trees not treated with insecticides within 3 to 5 years.

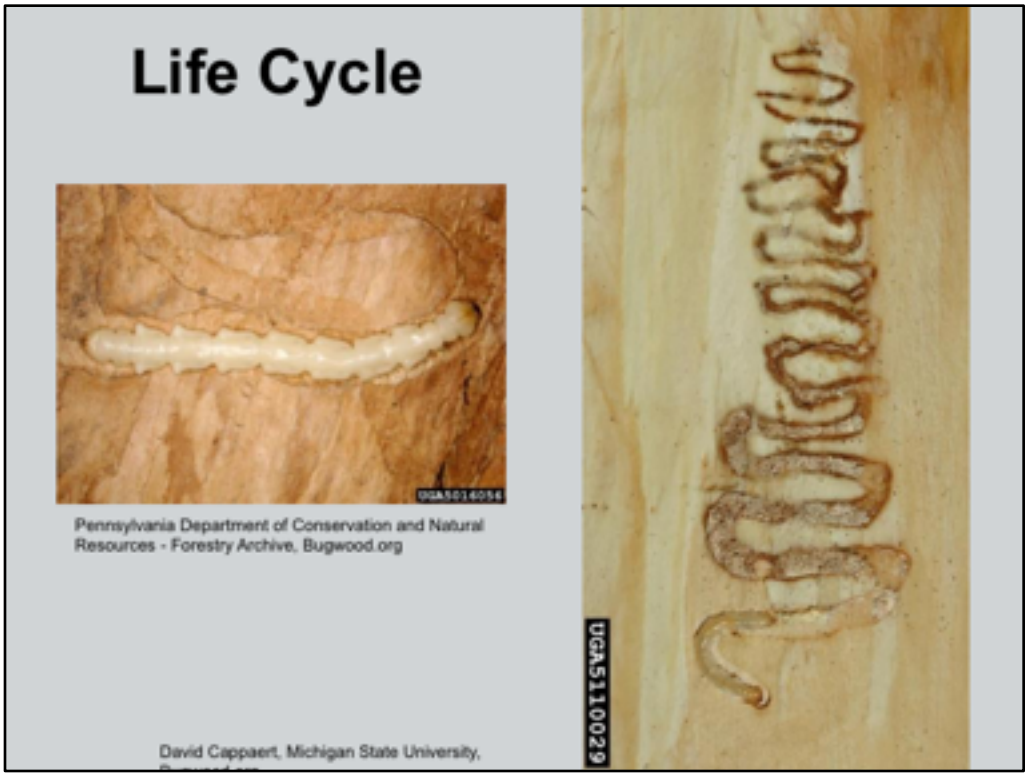
The beetle gets its name from its distinctive emerald green color, as you can see in the picture on the left. There are many insects that can be described that way, however. Later in the talk I'll show you some look-alikes. It's important to know what the beetle looks like, but also how to identify ash trees, and what symptoms of an infestation look like. I'm going to talk more about the symptoms later. If you want to learn more about identifying ash, go to NHBugs.org.



In 1990, emerald ash borer wasn't in the U.S. and now it's in more than 25 states.

It spread this quickly because people moved it, probably in firewood. As a result, there's a quarantine for ash products in counties with infested areas. You can't move hardwood firewood out of any emerald ash borer-quarantined county. Although emerald ash borer only moves in ash, ALL hardwood firewood is regulated because this is the principle way that emerald ash borer has been transported in this country. For up-to-date information about quarantines in New Hampshire, go to NHBugs.org.

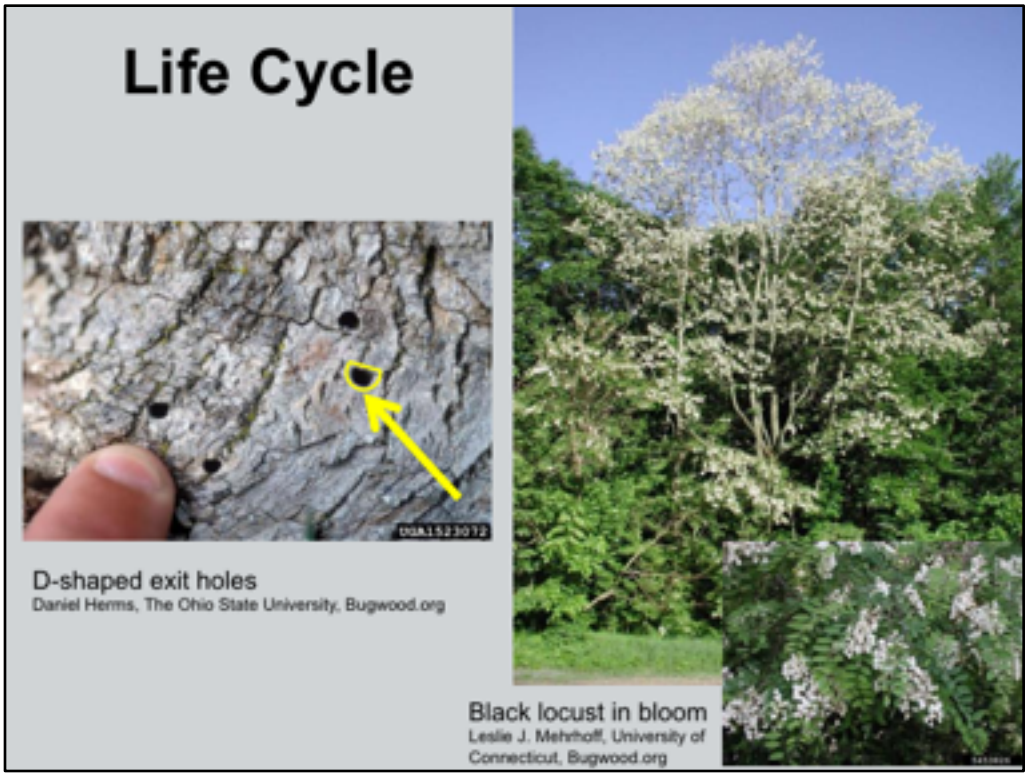
***If you receive questions about where to buy firewood.*
Answer: if you live outside of quarantined counties, check with your firewood supplier to make sure the wood is not coming from quarantined counties. The best bet is to buy from a local supplier—keep the wood as local as possible. Burn it where you buy it!



Emerald ash borer typically lives for 1 year. Adults lay eggs in crevices where branches join, usually high up in the canopies of ash trees. The eggs hatch within 7 to 10 days.

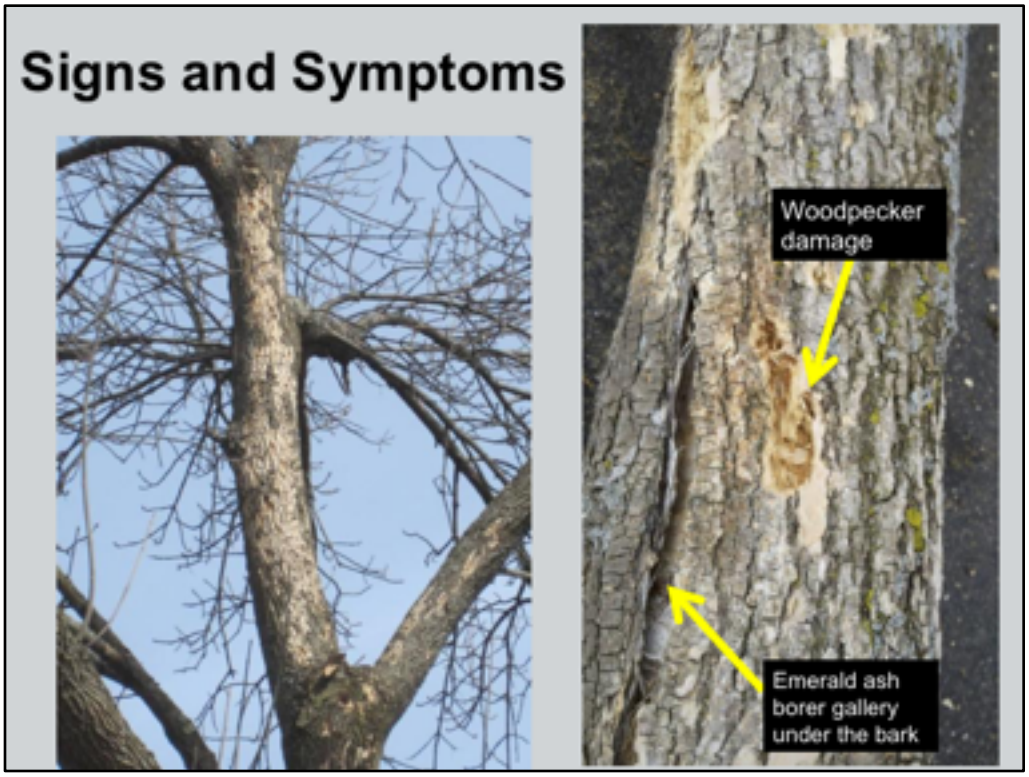
Larvae, shown here on the left, chew through the bark and feed on the tissue that moves nutrients in the tree. The larval stage can last from one to occasionally two years. As the larvae feed, they create s-shaped tracks under the bark, known as serpentine galleries. The serpentine galleries become progressively wider as the larvae grow. This type of beetle is the only type that create these s-shaped tracks in ash trees. This is one of the features that can help us identify the insect. An s-shaped track is shown in the picture on the right. Notice how small the gallery is at the top of the picture and how large it is at the bottom. The top is where the egg was laid. The bottom is where the adult emerged.

***If you receive questions about cold weather killing off pests.*
Answer: extreme cold will kill off some larvae and adults, but not enough to control their numbers. Larvae under the bark are somewhat protected from the cold and aren't affected by wind.



Larvae spend the winter very close to the surface of the bark. In late April or May, the adult begins to form. Adults chew a D-shaped exit hole as they leave the tree, as you can see in the picture on the left *(click for highlight).* Exactly when they emerge depends on the weather. Look for them when the black locusts bloom. They emerge at the same time.

The d-shaped exit hole is very distinctive and helps us identify the presence of emerald ash borer. However, because the eggs are laid high in the tree, the holes are usually too high for us to see from the ground. It's easiest to identify the d-shaped exit holes in firewood—up close and personal.



Unfortunately, a newly-infested tree will have very few external symptoms. However, it's still important to try to find these pests early, and the following signs can be used to identify populations of emerald ash borer.

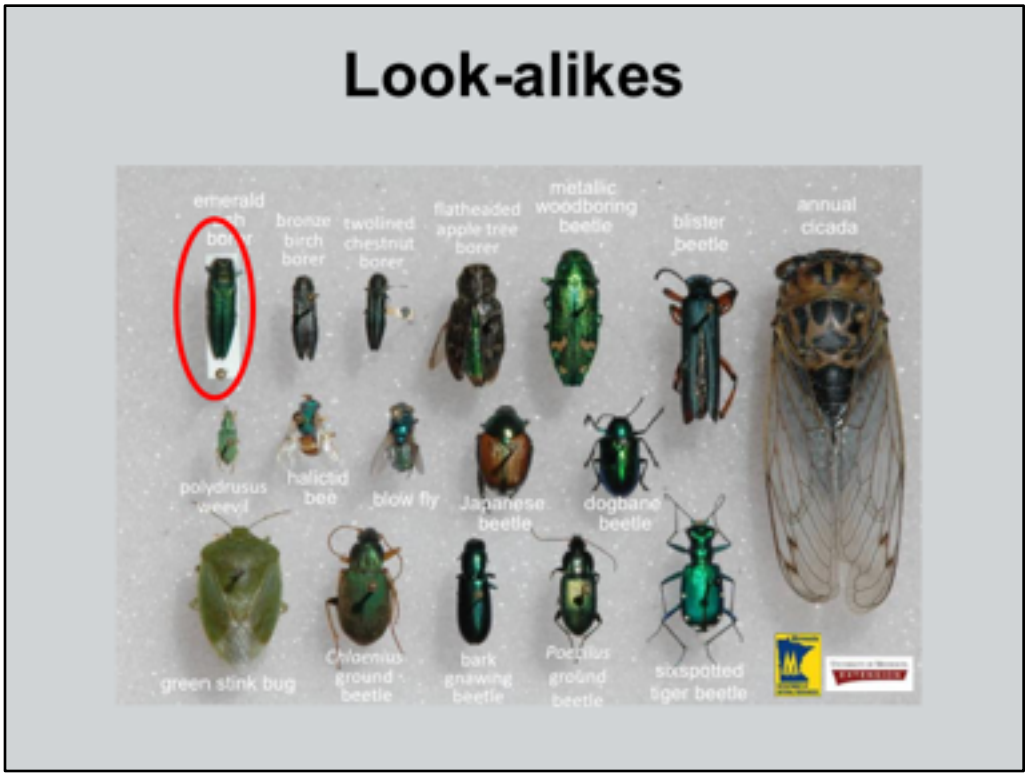
The most obvious symptom is what we call blonding. In the picture on the left, you can see the light color of the bark. Because the larvae live right underneath the bark, woodpeckers forage for them, and in doing so, they lightly scrape the bark and peck holes in it. This is what causes the blonding.

In the middle of the picture on the right, you see some damage from woodpecker activity [*click for arrow and text*]. Just to the left of the woodpecker hole, you can also see a split in the bark [*click for arrow and text*]. Under that split is one of the s-shaped galleries. Bark splits vertically over these galleries.

Over time, an infested tree will lose its foliage, branches will die, and the canopy will thin, like the photo on the left shows. Many trees can lose 30 to 50 percent of the canopy after being infested for only a few years. Untreated ash trees will die within 3 to 5 years of infestation.

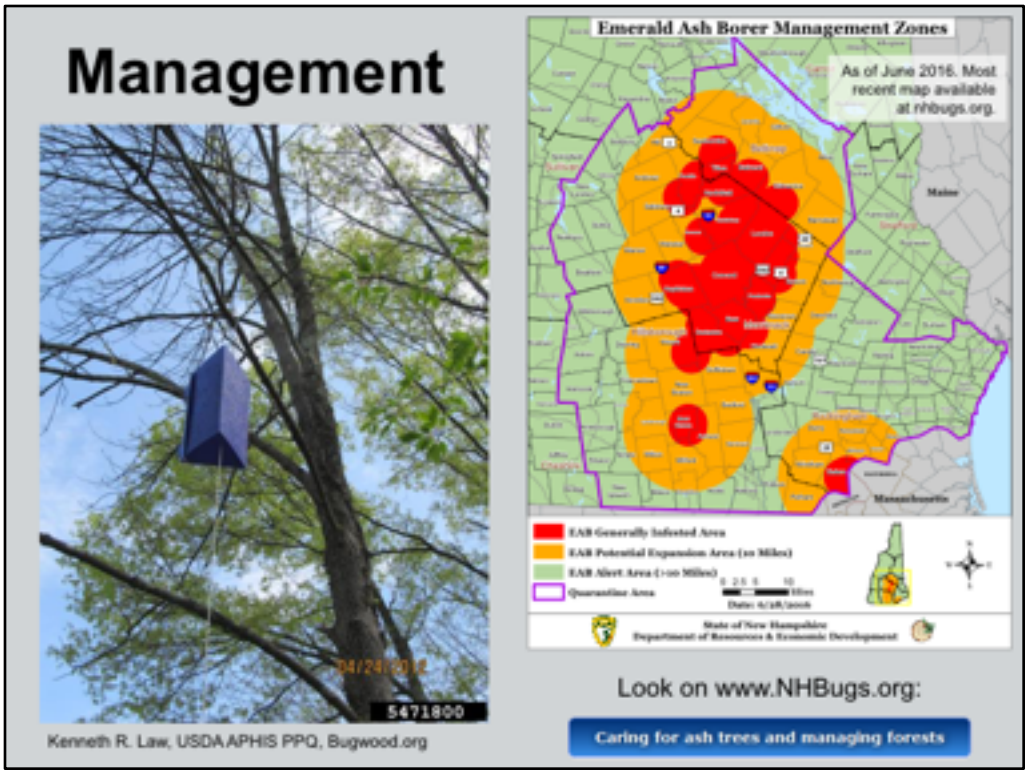
Another symptom is shoots growing at the trunk or on branches of infested trees, seen in the picture on the right. This is a tree's response to the stress of losing leaves at the canopy.

There are diseases such as ash leaf rust, ash yellows, and ash decline that cause similar symptoms in ash trees. To distinguish these diseases from emerald ash borer, look for the tell-tale signs of blonding, serpentine galleries, and d-shaped exit holes. If you suspect anything, report it to NHBugs.org. Pictures are always welcome.



Of course, there are look-alikes. Emerald ash borer is at the top left, but there are other insects that are green and metallic. You have probably seen some of these.

Emerald ash borer adults aren't around all the time. Part of how we identify the insects is when people see them. Adult emerald ash borers are flying between June and September. If you see an insect outside of that time-frame, it may be one of these other insects. However, when in doubt, take a picture and upload it to NHBugs.org.



Known emerald ash borer populations in the state are currently restricted to Merrimack, Hillsborough, Rockingham, and Belknap Counties. Up-to-date information can be found at www.nhbugs.org, or by contacting your county Cooperative Extension office. There are some options for slowing the spread of emerald ash borer. State and federal agencies will have a different approach than a landowner will.

State and federal agencies cooperatively survey for emerald ash borer and manage for it. Some of the surveys have been very visible. For example, you may see purple boxes hanging in ash trees on the side of the road. These traps aren't a control method but are used to monitor for the presence of emerald ash borer. Most surveys have been behind the scenes and not visible to the public. For example, foresters hiking through acres of forest and town streets looking for signs and symptoms in trees; using predatory wasps to look for signs; developing trap trees and sink sites; and a new project using conservation guide dogs that sniff for emerald ash borers (kind of like dogs that look for bed bugs).

There is such a cooperative response because emerald ash borer is a federally-regulated pest. Pests are designated as federally-regulated when they cause great commercial impact, and they're primarily moved by humans and less so by natural means. Restricting human movement of them can make a difference.

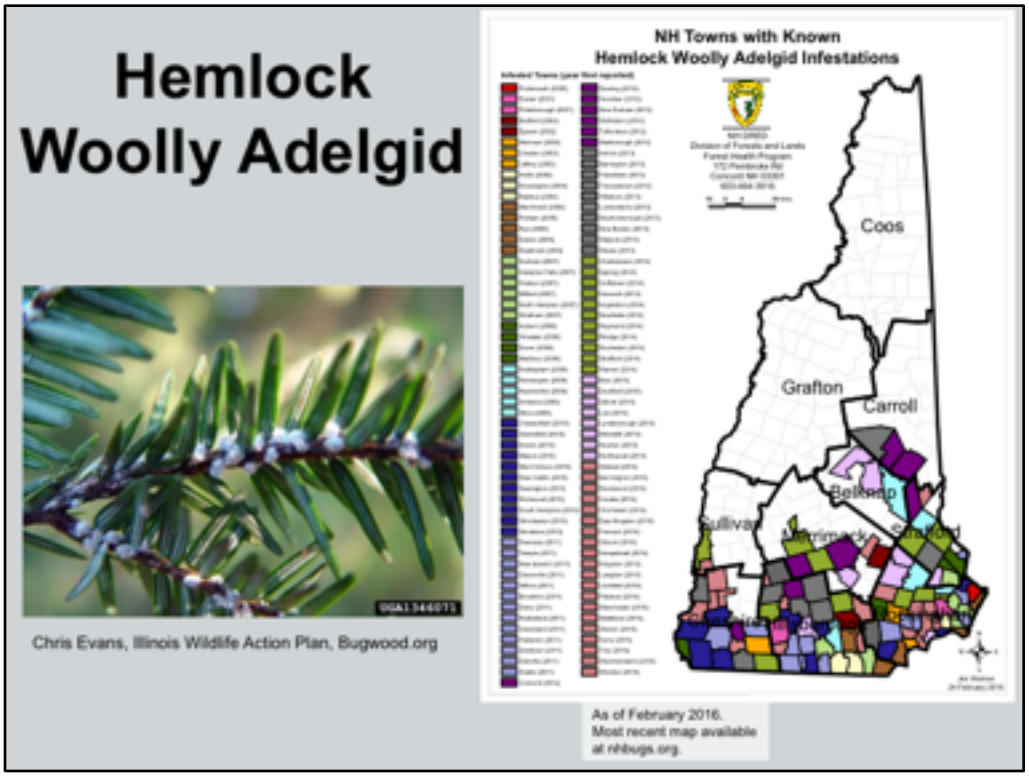
Here are some suggestions for steps landowners can take:

- First, know where your ash trees are.
- Decide if your ash trees are high-value. This will be a personal decision.
- Determine which management zone you are in and follow suggestions by zone. The zone map here is posted on NHBugs.org under the "caring for ash trees and managing forests" button.

And, there are some natural controls that may help in the fight against emerald ash borer. As you saw earlier, woodpeckers are a natural predator of emerald ash borer. While there are few predators now, their impact on emerald ash borer populations may be greater over time. We will just have to wait and see.

If you receive questions for more information about predatory wasps.* ***Answer: *"Cerceris" (ser-ser-es) wasps kill wood-boring insects and bring them back to their nests. Foresters monitor the nests for evidence of emerald ash borer remains.*

If you receive questions about how to get purple traps for their own property.* ***Answer: *Purple traps are scientifically placed. They aren't available to the public. **If you receive questions about how the purple traps work.* ***Answer:*** *The traps contain a scent that attract emerald ash borer and the traps are sticky, which causes the insects to get stuck to them.*



Hemlock woolly adelgid is a non-native insect from Asia. It was first discovered in Portsmouth in 2000 and is now found in a growing list of towns in southern New Hampshire, as seen in this map. Is your town one of them? The colors indicate what year it was found in each town. Up-to-date maps can be found at nhbugs.org.

Hemlock woolly adelgid attacks eastern hemlock and Carolina hemlock trees. Hemlocks can die within 4 to 10 years of infestation. If there are other conditions that are stressing the hemlocks (such as drought, root-rot-disease or elongate hemlock scale), hemlocks will die quicker. Elongate hemlock scale and hemlock woolly adelgid can be a one-two punch to a tree. If both are present, the likelihood that a tree will die is higher.

Fortunately, we haven't seen significant numbers of dead trees from hemlock woolly adelgid yet in New Hampshire, but other New England states have. Cold weather may act as a natural population control in our state.

The hemlock woolly adelgid is tiny—about the size of a pinhead covered in wool, as shown on the left.

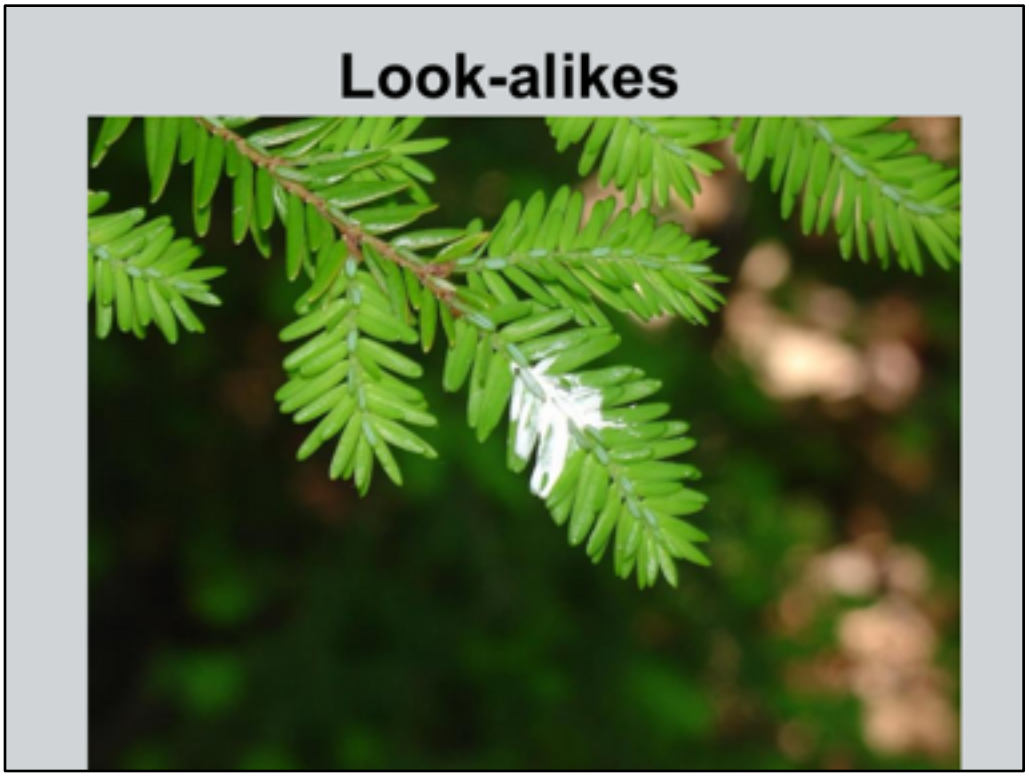
We're learning to live with hemlock woolly adelgid and we have good recommendations for woodlot management and shade tree care, available at NHBugs.org. The state of New Hampshire is interested in knowing of any new sightings north and west of the communities that it's currently found in. If you are in those locations and suspect you have an infestation, you can report it at NHBugs.org.

***If you receive questions about elongate hemlock scale.*
Answer: It is another insect that can affect hemlocks. Information about this insect can be found at NHBugs.org.

Hemlock woolly adelgid is spread by wind and by sticking to the feathers of birds and fur of deer and other forest-dwelling mammals. It is also spread by humans moving infested nursery stock and wood products, like bark mulch and logs.

The life cycle of adelgids is very complicated. I won't go into the details here. If you are truly interested, go to NHBugs.org!

Hemlock woolly adelgid can be recognized by the presence of a dry, white woolly substance on the young twigs of hemlock. This "wool" is most often visible in the late winter and spring when egg masses are present. The wool covers the insect in all but its earliest life stages. As they feed, their woolly covering expands—the "wool" is a waxy material that comes out of pores on the insect's body. The wool is attached to the twig, not the needles.



Like other invasive insects, there are some look-alikes that you might confuse with hemlock woolly adelgid. The most commonly confused look-alikes are:

1. Spittle bugs [*click for next picture*]
2. Pine pitch and [*click for next picture*]
3. Any guesses for what this is? Bird droppings!

Remember … the key to identifying the hemlock woolly adelgid is the woolly material attached to the twig, not the needles. And it doesn't look painted on, like pine pitch or bird droppings.

There are different strategies and control options for managing hemlock woolly adelgid. You need to choose the best option for you, one of which may be to do nothing. The first step is to identify that you have it and NHBugs.org is available to help you.

Homeowners are advised to move bird feeders away from hemlock trees. Remember, birds can carry hemlock woolly adelgid in their feathers.

For woodlots, there are no practical pesticide controls. The best control is maintaining healthy trees through good woodlot management. Also, look for hemlock woolly adelgid so that if it ever infests your trees, you can act quickly, potentially removing it before it spreads. Your county extension forester is a great resource on many woodlot management topics, including hemlock woolly adelgid. If you don't know who your county forester is, call the UNH Cooperative Extension Forestry Information Center at 1-800-444-8978. We'll give you contact information again at the end of this presentation.

For hemlock trees in yards, cemeteries and parks (often known as "shade trees"), there are some chemical control options, including some sprays that use horticultural oils and insecticidal soaps. There are also some insecticides available that can be applied to the soil around the base of a tree or the stem of a tree. Chemical controls for hemlock woolly adelgid, as with other pests, is often a short-term solution that must be repeated year after year. It isn't feasible in forests or sensitive areas.

There are also some biological controls that the state is experimenting with. This picture shows some tiny black beetles (*click for highlight)* feeding on the adelgids.

Asian longhorned beetle is a member of the round-headed wood borer family. Asian longhorned beetle was first discovered in Brooklyn NY in 1996 and has been found since then in other parts of New York City; Chicago; Worcester; Claremont County, Ohio; and Toronto, Ontario. It most likely arrived in the US from Asia in crates and pallets.

Even in its home country of China, Asian longhorned beetle is a serious pest that kills hardwood trees.

The adult Asian longhorned beetle is a large, distinctive-looking insect measuring 1 to 1.5 inches long, not including its antennae. The antennae are as long as the body in females and almost twice the body length in males, hence the common name. The body is shiny black with white spots and the antennae are banded (or striped) in black and white.

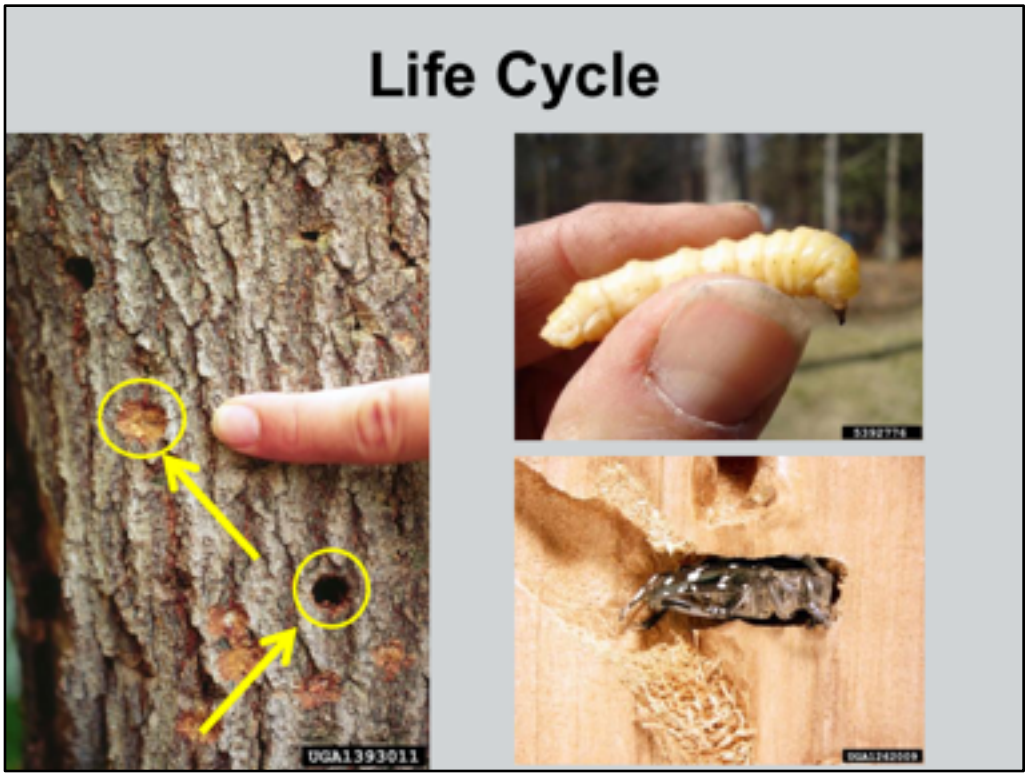
In the US, Asian longhorned beetle mostly attacks maples, which is a problem for a state like New Hampshire where approximately 52% of our forests are dominated by sugar and red maples.

Asian longhorned beetles also feed on other native hardwoods such as birches, elms, willows, poplars, alders and horse chestnut.

Because Asian longhorned beetle infests many kinds of trees, its ecological and economic consequences would be serious.

Asian longhorned beetles fly short distances to a new host tree to feed and reproduce. Their flying abilities don't explain how it has spread so far and wide. What do you think causes Asian longhorned beetle to spread?

You guessed it: people have moved it and firewood is the number one means of movement. Federal and state governments have attempted to limit this type of spreading by establishing quarantines in infested areas. The US Forest Service and many of its partners encourage people to "burn it where you buy it."



Asian longhorned beetle adults are flying from July to the end of August. During that time they feed on tree leaves and mate.

Females lay eggs in “pits” chewed in the bark (one egg per pit). In the picture on the left *(click for highlight)*, the finger is pointing to one of these pits. Eggs hatch and then the larvae tunnel into the tree (*click for pictures*). It tunnels into the dead wood to feed, removing structural wood. The picture on the top right shows a larva.

Larvae feed within the tree for 1 to 2 years, depending on temperature. In colder climates, the life cycle is slowed down to two years.

After the larval stage, the insect develops into an adult and chews its way out of the tree, forming a perfectly round exit hole that is about the size of a dime *(click for highlight)*. Note the round hole in the picture on the left (under the finger).

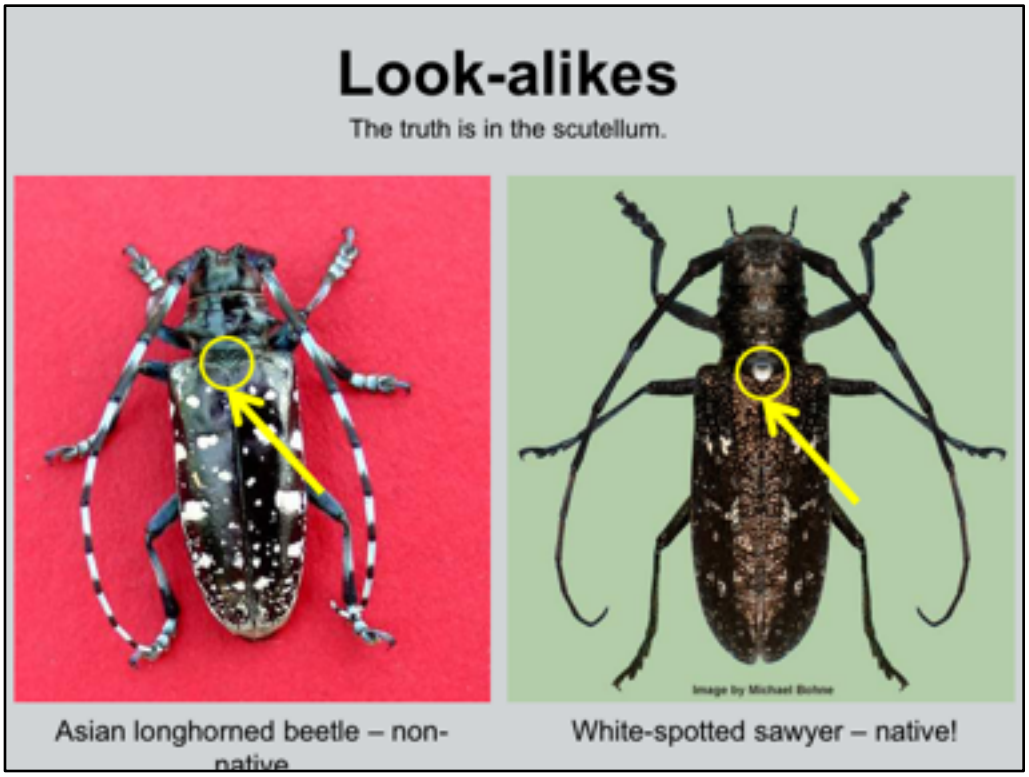
As a beetle emerges, it pushes out sawdust-like material onto the ground or onto tree branches. You will see a picture of this in an upcoming slide.

So what are you looking for? What are the signs and symptoms of Asian longhorned beetle? You have seen a couple already, including the round exit hole and the egg pits shown here.

This first picture shows a heavily infested tree. Notice all of the exit holes. This is an extreme example—you may not see this many holes in one tree, but it is possible. (*click for new picture*)

This second picture shows "frass" –a mixture of insect "droppings" and sawdust. Frass collects at the base of the tree or in tree crotches. This photo is frass being pushed out an exit hole. (*click for new picture*)

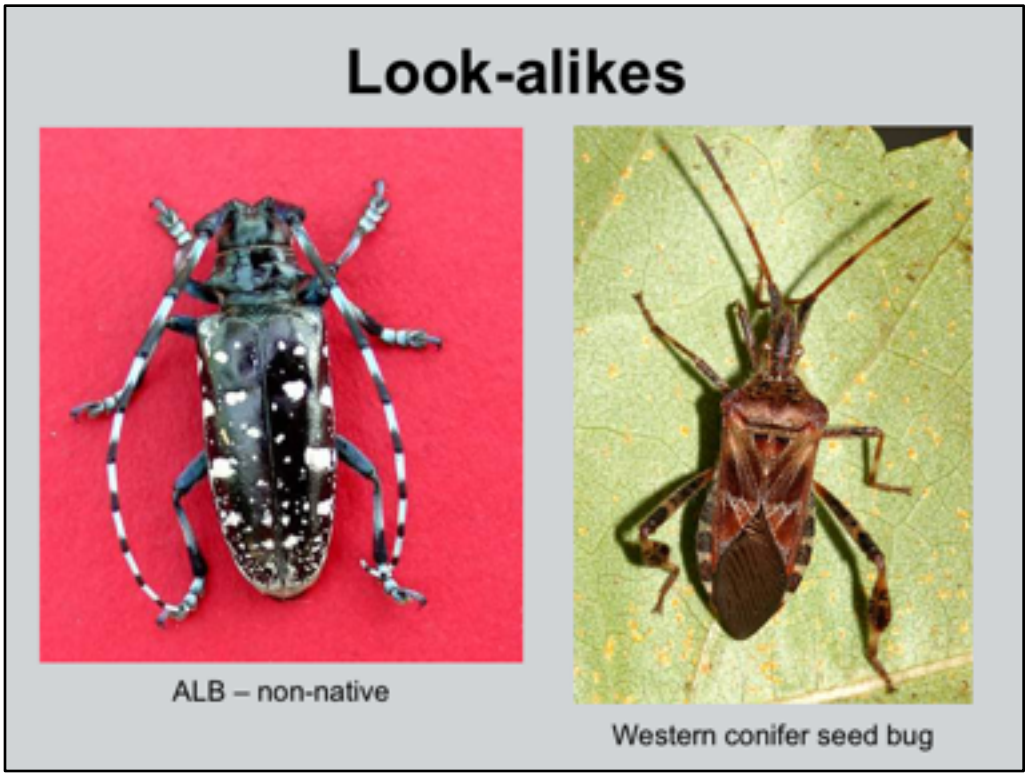
And the last picture shows how adult Asian longhorned beetles feed on small twigs and leaves on their host trees. Adult beetles are only active during the summer and early fall. Sometimes leaves will drop early if they are damaged, before leaves normally fall. This leaf-eating causes minor damage but can be useful to help identify the presence of Asian longhorned beetle.



Asian longhorned beetle is often confused with other beetles, some that are native.

White-spotted sawyer looks remarkably similar to Asian longhorned beetle. This beetle is native, however, and does not attack live hardwood trees. It feeds on dead and dying pine trees. White-spotted sawyer adults also emerge earlier in the year than Asian longhorned beetle adults. White-spotted sawyer adults emerge from May to June, while Asian longhorned beetles are seen from July to the end of August.

They both have lots of white spots but the fool-proof method to tell them apart is to look at the scutellum (*pronounced skew-tell-um*) where the head and wings join. White-spotted sawyer beetle has a white spot (*click for highlight*) on the scutellum. The Asian longhorned beetle doesn't have a white spot there *(click for highlight).*



Asian longhorned beetle is also frequently confused with another native bug – the western conifer seed bug, although when placed side-by-side they are quite different. The antennae of the western conifer seed bug are much shorter and not “striped” like Asian longhorned beetle.

This bug also feeds on conifers or evergreen trees, not hardwoods like Asian longhorned beetle.

These bugs are quite common and we often see them in the fall when the weather cools and they turn up in our homes looking for a place to get cozy for the winter.

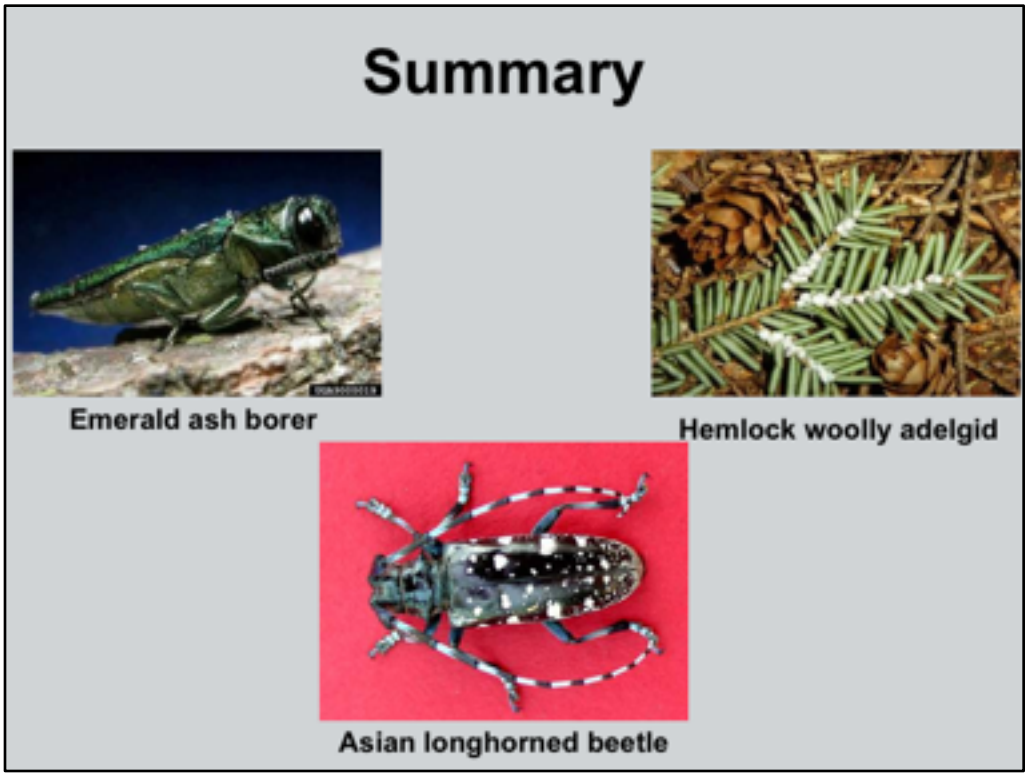
Asian longhorned beetle isn't in New Hampshire and our focus is keeping it out. Because Asian longhorned beetle attacks many different kinds of trees, an infestation would be disastrous.

Quarantines have been established to prevent transporting infested trees, branches and firewood. Early detection and rapid response are crucial to successful eradication of the Asian longhorned beetle. Experiences in other states have shown that it's possible to eradicate Asian longhorned beetle with a lot of money and a lot of effort. The US Department of Agriculture's Animal and Plant Health Inspection Service, a federal agency, designed the program to cut and destroy infested trees in Worcester, Massachusetts.

If Asian longhorned beetle is detected in New Hampshire, federal agencies and state partners will initiate an eradication program. The sooner we find out about its existence in New Hampshire, the easier it will be to eradicate.

The best source of information on management techniques is NHBugs.org.

***Note re: federally-regulated pest, see slide #16 (emerald ash borer management) for a description of what this means.*



I have given you a lot of information in these slides about the big three invasive insects. While it may sound like the future of our trees and forests is bleak, let me assure you that researchers continue to look for new methods of controlling invasive insects.

Before I end this presentation, let me give you a couple more details about what you can do.

You can report any suspicious insects or observed tree damage at www.NHBugs.org. On the menu on the left side of each page, the first option is “Invasive Insect Reporting Form.”

Provide your name and an email address so the site administrators can follow up if they have any questions for you. They also ask for the location of the sighting, including the town. You are encouraged to upload up to 3 pictures. Pictures make a huge difference in helping to identify the insect or cause of damage. Try to get pictures that best represent what you see—if you think you have an emerald ash borer infestation, for instance, take pictures of any noticeable tree damage. Get pictures at different ranges--close up and further away. If you have found a suspicious insect, for example, you think you have an Asian longhorned beetle, get a clear shot of its back showing the white spots and striped antennae.

To repeat from earlier:

- Don’t move firewood. Transporting firewood is the main way that many non-native invasive insects are spread.
- Keep learning about forest pests and keep looking for them. Thank you for coming to this talk.
- Sign up to receive periodic pest alerts at NHBugs.org.
- Identify and protect your high-value trees.
- And, watch for other opportunities to get involved in your community.

On NHBugs.org, you can learn about a number of pests and diseases impacting New Hampshire's forests and trees. You can also sign up to receive bug updates, which are sent periodically. And, you can order handouts to provide at community events.

The staff at the UNH Cooperative Extension Forestry Information Center are happy to answer your questions, guide you to the right place to find answers, or refer you to your county extension forester. Call them or email them using the contact information listed on the slide.

UNH Cooperative Extension hosts many workshops on wildlife and forest topics, including forest pests. Many of the workshops are offered to landowners. Go to NHWoods.org for a list of upcoming workshops.

That's the end of my presentation. Before I take questions, I'd like to thank the organizations who sponsor this Speaking for Wildlife presentation:

- The **New Hampshire Charitable Foundation** and the **Davis Conservation Foundation** for grants that supported the creation of Speaking for Wildlife,
- **UNH Cooperative Extension** for the support of the Speaking for Wildlife volunteers that are the underpinnings of this project, **NH Fish and Game** who continues to support the program;
- And partners at the **New Hampshire Department of Agriculture, Markets and Foods**, the **New Hampshire Division of Forests and Lands**, the **U.S. Forest Service** and **USDA Animal and Plant Health Inspection Service** whose research and work with invasive insects are the basis for this presentation.

Thank you for listening! I'll be glad to take your questions.