

Study for the Presence of Invasive Hemlock Woolly Adelgid in Epping, New Hampshire

Isabella G

Abstract:

An invasive species is a non-native species that causes great economic or environmental harm to a new area. There are many types of invasive species found all around the world. One of these is hemlock woolly adelgid, an insect found in New England that kills hemlock trees. This investigation focused on hemlock woolly adelgid, where it could be found next, and if winter temperatures affect the spread of its population. To do this, students in Mrs. Lapointe's science class chose a total of twenty-one trees in Epping, New Hampshire. Following the Gulf of Maine Research Institute's protocol, four pictures were taken to prove the tree was a hemlock. The students then searched ten one-meter branches for the presence of hemlock woolly adelgid. If it was found, it was reported through extra pictures. After this, we examined the data collected alongside evidence from other sources. Our discovery was that Epping has a mild infestation of hemlock woolly adelgid. We also found that the hemlock woolly adelgid population spreads, partly as a result of warming winters. By learning more about hemlock woolly adelgid and why it spreads, we may be able to find a way to stop this invasive species from causing more harm.

Introduction:

Hemlock trees are a native tree to New England. Being a foundation species, they play a crucial role by creating the ecosystem they live in. This ecosystem has multiple animals relying on hemlock trees for food, shelter, or other key habitat features. Some of these animals are migrating birds, moose, porcupines, and brook trout. Additionally, hemlocks are important for water quality. According to the *New York State Hemlock Initiative*, "Their shallow, branching root systems help filter agricultural runoff and keep water clean along stream corridors and other water bodies. Hemlocks make up much of the forest along shorelines and streams, and are critical for preventing sedimentation and filtering out pollutants" (cm933, 2017). As a result, hemlock trees are an extremely important species to have in our ecosystems.

Unfortunately, hemlock woolly adelgid is killing these crucial trees at an alarming rate. Hemlock woolly adelgid is an invasive species of insect. It is a problem because it creates wounds in hemlock trees, killing them in four to ten years. According to City Forester Jeanne Grace, "Once the tiny bug makes its way to a hemlock tree, it sticks its mouthparts into the branch, hides in this coating and essentially sucks the life out of the tree. 'So when you have millions of these on a single tree, that's making millions of little wounds in the tree that the tree then tries to wall off... And then it just kind of plugs up the whole vascular system of the tree'" (Whyte, 2017). Worse, the hemlock woolly adelgid's population increases with mild winters. This causes those millions of hemlock woolly adelgid to harm hemlock trees at an even faster rate. "He [Mark Whitmore] says hemlock woolly adelgids are sensitive to cold. But last winter, one of the warmest on record, populations went through the ceiling" (Whyte, 2017). Because of warmer winters, the population of the hemlock woolly adelgid is rapidly spreading.

The research questions of this study are “Where is hemlock woolly adelgid now, and where might it spread next? Are winter temperatures affecting how hemlock woolly adelgid spreads?” (GMRI, 2020). There are two parts to this study. First, the trend of minimum winter temperatures was studied for Rockingham County, New Hampshire. Second, a selection of trees were surveyed for hemlock woolly adelgid. This study helps to answer the research questions, which simultaneously helps to raise awareness of the insect killing the vital hemlock tree. Additionally, it contributes to the knowledge already discovered. Hemlock woolly adelgid has been reported by students in years past. According to GMRI, areas including Freeport Library, Robinson Woods, Thomas College Trails, and Epping’s outdoor classroom were found to have an infestation in years past. In Epping, 22 of the 166 branches surveyed had hemlock woolly adelgid. Both this year and last year, many branches that were found to be infested were near each other, such as those in Epping’s outdoor classroom. Overall, this year’s data brings more evidence to answer the research questions.

Methods:

This study took place from April 22-24, 2020 in Epping, New Hampshire.



Figure 1. This shows the location of Epping, New Hampshire. It was in Epping where this study took place.

Mrs. Lapointe’s science class students chose a total of twenty-one trees to survey. They followed a protocol from Gulf of Maine Research Institute. First, they chose a hemlock tree and took four photos to prove it was a hemlock. These photos are of the entire tree, the bark, the underside of the needle, and the attachment of the needle to twig.

protocol



Figure 2. This shows Mrs. Lapointe teaching her class how to take the four hemlock pictures through a YouTube video.

After taking these pictures, ten branches that were at least a meter long were searched for the presence of hemlock woolly adelgid. If one couldn't reach ten branches of this length, it was noted. For those that did find hemlock woolly adelgid, additional photos were taken as evidence. The data of the twenty-one trees was reported through a Google Form to GMRI and Mrs. Lapointe.

To make sure we collected accurate data, previous science assignments tested our ability to distinguish the hemlock tree from others. This was also done through a Google Form. Mrs. Lapointe would record a video showing different types of trees. For each tree, the Google Form had a question asking if it was a hemlock. To know this, we learned the key features of hemlocks, such as the two white stripes on the bottom of each needle and the attachment of the needle to the branch. These features were also the features we took pictures of to prove what we were surveying was truly a hemlock tree. By doing this identification practice before the study, we were more prepared and collected more accurate data.

✓ Which of the following are characteristics of the eastern hemlock tree? 1/1
Check all that apply.

- Flat needles ✓
- Round needles
- Evergreen - Does not lose leaves in fall ✓
- Two white stripes on the bottom side of needle ✓
- Long needles (10 cm long)
- Short needles (1.5-2 cm long) ✓
- Needles attach to twig with small stem ✓
- Needles attach to twig directly (no small stem)

✓ Tree #1: Hemlock or Not? 1/1

- Hemlock
- Not Hemlock ✓

Figure 3. This shows one of the Google Forms completed to demonstrate understanding of hemlock trees.

The GMRI website's protocol recommended a peer check to make sure the tree surveyed was a hemlock tree. Due to social distancing, however, this peer check could not happen. To make up for it, I showed my dad the tree and explained the features that should be found. After we both agreed the tree was a hemlock, I surveyed ten branches. My dad, who had seen multiple pictures of hemlock woolly adelgid evidence, double-checked those branches. Completing two thorough checks in this way helped me to submit better data. However, it also meant that the step was enacted differently than in years past, as other years required a peer check from another fieldwork team. Social distancing changed how the study was run, which possibly changed the results.

Results:

Investigation data showed the presence of hemlock woolly adelgid in Epping, New Hampshire. It was found that there is a mild infestation, as 8.5% of the branches were found to have hemlock woolly adelgid. We also examined a graph showing the average minimum winter temperatures in Rockingham County. This graph's trendline shows the temperature has increased over time. In a matter of 20 years, the average minimum temperature increased by over five degrees Fahrenheit.

Average Minimum Winter Temperature for Rockingham County, NH

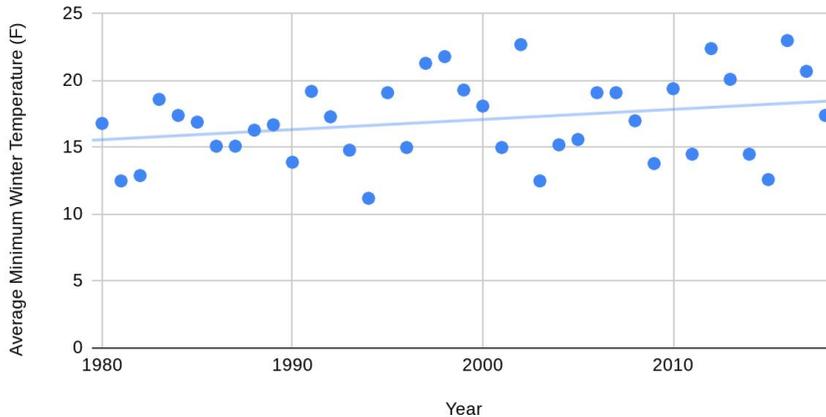


Figure 4: This shows that the average minimum winter temperatures in Rockingham County have increased over time. In 1990, the average minimum temperature was less than 15 degrees Fahrenheit. However, the average minimum temperature in 2010 was almost 20 degrees Fahrenheit. In only 20 years, the temperature increased notably.

Branches Surveyed in April 2020 in Epping, NH for the Presence of Hemck Woolly Adelgid

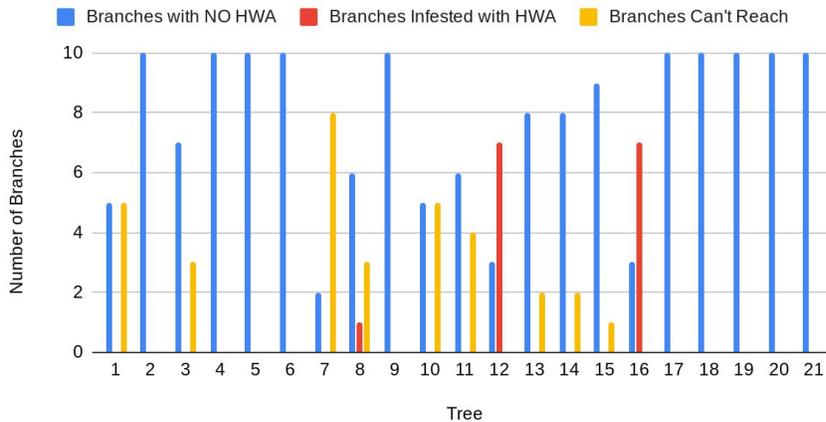


Figure 5. This shows that some trees in Epping have hemlock woolly adelgid, but many trees are not yet infected. Out of a total of 177 branches surveyed, only 15 were found to have hemlock woolly adelgid. This results in finding infestation on 8.5% of the branches.

Conclusion:

There is a mild infestation of hemlock woolly adelgid in Epping. For example, tree 16 was found to have it on seven branches. However, the majority of branches surveyed did not have hemlock woolly adelgid. On trees 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 13, 14, 15, 17, 18, 19, 20, and

21, no hemlock woolly adelgid was found. As a result, we do have hemlock woolly adelgid in Epping, but it is not yet a severe infestation as it hasn't been found on many branches.

Over time, the average minimum winter temperature has increased. In 1990, it was 14°F. However, in 2010, it was 19°F. This increase affects how hemlock woolly adelgid spreads. In New Hampshire, hemlock woolly adelgid has been found. Out of the 177 branches surveyed this year in Epping, 15 were found to have hemlock woolly adelgid. This may not seem like many, but the population has increased along with warmer winters. *The Department of Environmental Conservation* says, “Native to Asia, the hemlock woolly adelgid, or HWA, is an invasive, aphid-like insect that attacks North American hemlocks” (NYSDEC, n.d.). It is an invasive species originating in Asia. This means that hemlock woolly adelgid used to not be in New Hampshire at all. However, partially because of the increase in temperature, they have come here and are rapidly spreading their population. As a result, they are entering ecosystems where they weren't living before. *Eagle Times* also says, “Unfortunately, warmer winter temperatures caused by climate change bode well for HWA – and poorly for eastern hemlocks. Hemlock woolly adelgids begin to die on days when the sustained temperature is below freezing, known as ‘kill days.’ The fewer kill days there are, the more likely it is that HWA will maintain high populations throughout the winter. Warmer temperatures could also allow HWA to exist in more northern locations” (Box, 2020). Because winter temperatures have increased over time, there have been fewer kill days. As a result, hemlock woolly adelgid has grown in population. This growth of population is seen on another link from *The Department of Environmental Conservation*.

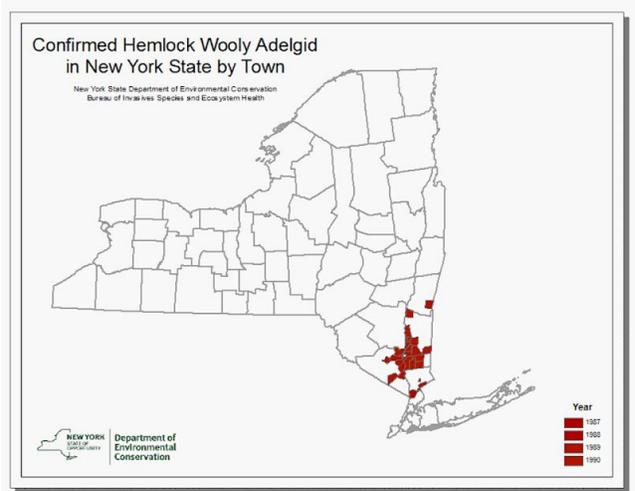


Figure 6. This shows how many towns in New York were affected in 1990. As shown, hemlock woolly adelgid was only found in certain places in the southeast.

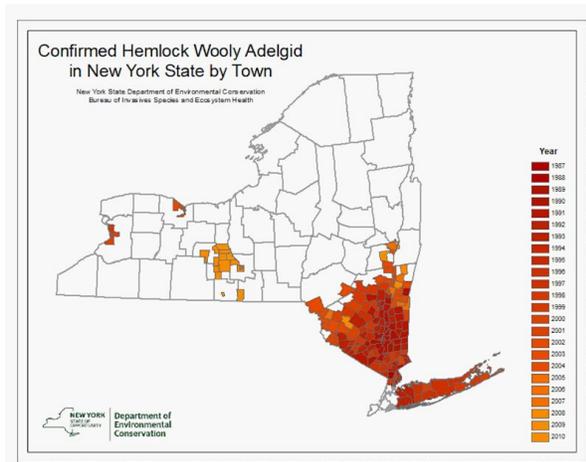


Figure 7. This shows how many towns in New York were affected in 2010. Hemlock woolly adelgid covered the entire southeast and started to spread to the western part of the state.

There were a few errors in this study. More research needs to be done to support the claim that winter temperatures are causing hemlock woolly adelgid to spread. By continuing to collect data on a yearly basis for both the temperature and hemlock woolly adelgid, scientists can find more evidence to prove causation. If findings for the hemlock woolly adelgid increase as the temperature increases, this could be used to prove the research question. Future Epping students could be part of this plan by continuing to be educated and increasing their awareness of hemlock woolly adelgid. It is beneficial to track and report it whenever possible. Additionally, the GMRI protocol for collecting this data says, "3. Check in with another fieldwork team, peer reviewing the tree identification" (GMRI, 2020). To keep in line with social distancing recommendations, this step had to be skipped, which creates a difference from the previous times hemlock woolly adelgid data was collected in Epping. There were a few errors in this study, but it was successful overall.

BIBLIOGRAPHY

Works Cited

- Box, Olivia. "The outside Story: Warming Winters Benefit Hemlock Pests." *Eagle Times*, 11 Apr. 2020,
www.eagletimes.com/lifestyles/the-outside-story-warming-winters-benefit-hemlock-pests/article_173d286b-1f4d-5776-9fbf-d0d228782079.html. Accessed 7 May 2020.
- Cm933. "Ecosystem Services: Remembering Why We Do What We Do." *New York State Hemlock Initiative*, 1 Dec. 2017,
blogs.cornell.edu/nyshemlockinitiative/2017/12/01/ecosystem-services-remembering-why-we-do-what-we-do/. Accessed 21 May 2020.

Confirmed Hemlock Woolly Adelgid in New York State by Town. Department of Environmental Conservation, www.dec.ny.gov/animals/95656.html. Accessed 7 May 2020.

"Epping, NH." *BestPlaces*, Sperling's Best Places, www.bestplaces.net/city/new_hampshire/epping. Accessed 6 May 2020.

"Hemlock Woolly Adelgid." *Department of Environmental Conservation*, www.dec.ny.gov/animals/7250.html. Accessed 6 May 2020.

"Hemlock Woolly Adelgid." *Ecosystem Investigation Network*, Gulf of Maine Research Institute, beta.citsci.gmri.org/project/hemlock_woolly/. Accessed 6 May 2020.

"Hemlock Woolly Adelgid Mission Datasheet." *Microsoft Word*, citsci-beta-media.sfo2.cdn.digitaloceanspaces.com/media/documents/HWA_detailed_protocol_042319.pdf. Accessed 6 May 2020.

"HWA Protocol." *YouTube*, uploaded by Lindsey Lapointe, 19 Apr. 2020, www.youtube.com/watch?v=aVhTcZzMqWA&feature=youtu.be. Accessed 6 May 2020.

"Why Conserve Hemlock Trees?" *New York State Hemlock Initiative*, blogs.cornell.edu/nyshemlockinitiative/hemlock-woolly-adelgid/why-hemlock-trees/. Accessed 21 May 2020.

Whyte, Caitlin. "Hemlock-Killing Bug Getting Help from Warmer Winters." *WOSU Radio*, WOSU Public Media, 5 Dec. 2017, radio.wosu.org/post/hemlock-killing-bug-getting-help-warmer-winters#stream/0. Accessed 6 May 2020.