Lingering Hemlock Tree Candidate Definition

[Note: This definition of a potential lingering hemlock tree is designed to be used when training individuals to conduct searches. It is intended to flag potential candidate trees in the field, for which detailed data will then be recorded. Once a candidate tree is identified, the searcher will gather specific data about the tree and the surrounding trees in the TreeSnap app and flag the tree as a potential lingering tree. As more is learned about hemlock resistance, this definition may be refined.]

A lingering hemlock is a tree that persists in a moderately healthy condition when the vast majority of surrounding trees have died or are dying due to pest pressure. A lingering hemlock is/has all of the following characteristics:

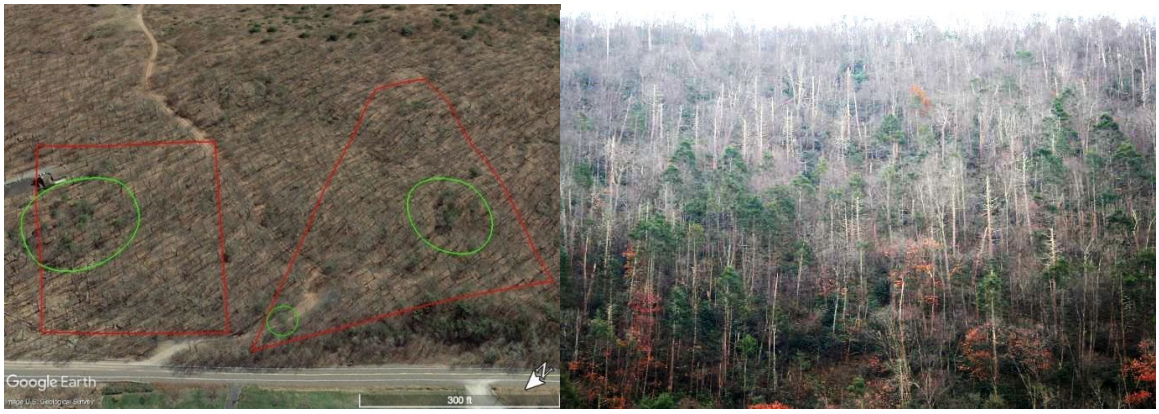
- At least 4" (10cm) in diameter
- Growing in a forest, not in a lawn or landscaped setting
- In an area where more than 80% of surrounding hemlocks are dead and/or are dying due to pests and pathogens
- Deep green needles—compared to surrounding hemlock trees
- Thick, full branches—compared to surrounding hemlock trees
- Less sky visible when looking up through tree canopy—compared to surrounding hemlock trees
- Not been treated with pesticides or horticultural oils for at least 10 years (to your knowledge)

Lingering Hemlock Tree Search Protocol

[NOTE: The developers of TreeSnap may adjust the format or questions slightly when refining the app.]

Protocol Purpose

- To identify individual (or groups of) lingering hemlock tree candidates, in areas that are infested with HWA and/or EHS, where there is already high hemlock mortality due to pests and pathogens.



Images. Lingering tree candidates. Left photo is of two small groups of trees remaining after the rest of the trees have died. Right photo is of scattered, very healthy, surviving hemlocks on a hillside where the majority of hemlocks have died. Photos by Ian Kinahan.


Image: Dead and dying hemlock. Photo by David Orwig.

Step 1: Lingering Tree Search Record

- What are you reporting?
  - A single lingering hemlock tree, surrounded by dying or dead hemlocks. [Please complete the "Candidate Tree" and "Surrounding Tree Assessment."]
  - A small, localized group of lingering hemlocks, surrounded by dying or dead hemlocks. [Please complete the "Candidate Tree" and "Surrounding Tree Assessment."]
  - Multiple living hemlocks throughout the area, and no-obviously lingering trees in comparison to nearby trees (>20% of hemlocks in the area are alive). [Thank you, your data is complete.]
  - No hemlocks in area because:
    - Area logged
    - All hemlocks found were dead and/or dying
    - No hemlocks here, either alive or dead
    - Time spent searching: ___ (record time in minutes)
    - Comment Field [Please describe the area you searched.]

    [Thank you, your data is complete.]

Step 2: Candidate Tree Record

- Number of Lingering Trees
  - One
  - 2-10
  - More than 10
  - Comment Field [If you are reporting a group of more than 10 trees, about how many? How different are they from the surrounding forest?]

  Photo Candidate Tree(s)

- Species
  - Eastern hemlock (Tsuga canadensis)
  - Carolina hemlock (Tsuga caroliniana)
  - Other hemlock species
  - I'm not sure

- Tree Diameter
  Please enter the diameter of this tree. Measure trunk diameter about 4.5' above the ground. Choose the largest stem if the tree has multiple stems or if you are reporting a group of trees.
  - _____ [inches/centimeter checkbox]
  - _____ [compute from circumference checkbox]

  Is this an estimate or a precise measurement?
  - Measured checkbox
  - Estimated checkbox

- Hemlock Woolly Adelgid (HWA)
  Do you see HWA on this tree?
  - Yes, H = Heavily infested
  - Yes, M = Moderately infested
  - Yes, L = Lightly infested
  - No = 0% infested
  - I'm not sure (e.g., cannot see the branches from the ground)

  Photo: Hemlock Woolly Adelgid

Heavy	Moderate	Light
		

Images: HWA infestation levels. Left and right photos by Cornell University NYS Hemlock Initiative staff; middle photo by TNC Adirondack PRISM.

Additional Instructional Photos of HWA

Image: HWA in summer as wool is starting to form. Photo by New York State Department of Environmental Conservation Forest Health Lab.

Image: HWA wool in the winter/spring. Photo by Margot Wallston.

Additional Instructional Photos of Elongate Hemlock Scale

Images: Elongate hemlock scale. Left photo by PA Dept. of Conservation and Natural Resources – Forestry; Right photo by Eric R. Day. Both via Bugwood.org.

- Elongate Hemlock Scale (EHS)
  Do you see EHS on this tree?
  - Yes, H = Heavily infested
  - Yes, M = Moderately infested
  - Yes, L = Lightly infested
  - No = 0% infested
  - I'm not sure (e.g., cannot see the branches from the ground)

  Photo: Elongate Hemlock Scale

Heavy	Moderate	Light
		

Images: EHS infestation levels. Left photo by Joshua Harkness, center photo by Lindsay Dombroski, right photo by Nicole Campbell.

- Other Stressors
  Do you see signs of other potential stressors on this tree (e.g., spongy moth damage, hemlock borer, sapsucker feeding, beaver damage, physical damage)?
  - Yes
    - Comment Field

    Photo: Other Stressors
  - No

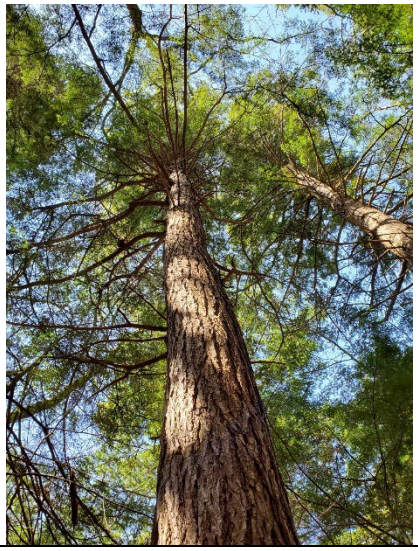
- Cones
  Does this tree have cones present?
  - Yes

    Photo: Cones
  - No
  - I'm not sure

Image: Hemlock cones, before and after seed release. Closed cone image by Richard Webb, via Bugwood.org. Open cone by Cornell University NYS Hemlock Initiative staff.

- Canopy Health
  How healthy is the canopy of the candidate tree (or the largest tree if reporting a group of trees)? Your best estimate of this is fine.
  - H = Healthy (>80% healthy canopy; deep green, dense foliage; skylight is mostly blocked when you look at the tree)
  - I = In Decline (<80% - >20% healthy canopy; foliage beginning to thin; foliage green-to-greyish; some skylight visible when looking at the tree)
  - S = Severe Decline (<20% canopy; many limbs dead, foliage sparse; skylight very visible when looking at the tree) [Note: This option would not generally be chosen for a lingering hemlock tree, unless this tree/group of trees are the only ones alive after all others have died.]
  - I'm not sure
  - Comment Field

Hemlock Canopy Health Rating Guide

Health Class	Distance view	Looking up under tree view
Healthy		
In Decline		

Health Class	Distance view	Looking up under tree view
Severe Decline /Dying		

Images: Healthy hemlock: photos by Cornell University NYS Hemlock Initiative (NYSHI) staff. Declining hemlock: distance photo by Margot Wallson, upward photo by Cornell University NYSHI staff. Severe decline: distance view photo by Shenandoah National Park staff.

- Treatment Status
  Has the tree (or group of trees) been treated with pesticides?
  - Yes
  - No
  - I'm not sure
  - Comment Field (e.g., treated five years ago, treated with imidacloprid soil application in year X)

- Canopy Position
  What is the canopy position for the candidate tree (or the largest tree if reporting a group of trees)?
  - Dominant, this tree's crown extends above other nearby trees
  - Codominant, this tree's crown is level with or slightly below other nearby trees
  - Overtopped, this tree's crown is entirely below other nearby trees
  - Not applicable (e.g., tree is isolated, tree is on the forest edge)
  - I'm not sure
  - Comment Field

- Canopy Closure
  How "closed" would the total (hemlock and non-hemlock) forest canopy around the tree/group of trees you are reporting be in the summer? [The degree of closure helps assess how much sunlight is available to the hemlock trees.]
  - Very closed (>70% canopy closure, very little light would reach the lingering tree's foliage in the summer)
  - Medium (>30% - < 70% canopy closure, patches of light would reach the lingering tree's foliage in the summer)
  - Open (<30% canopy closure, abundant sunlight would reach the lingering tree's foliage in the summer)
  - I'm not sure
  - Comment Field

- Recent Growth
  Is the tree (or the largest tree if reporting a group of trees) putting on new growth?
  - Branch tips are healthy, with green new growth present
  - Some branch tips are discolored or are missing new growth
  - No new growth present
  - No branches low enough to assess
  - I'm not sure

Image: Branch tips healthy and green. Photo by Mark Whitmore of Cornell University's NYS Hemlock Initiative.

Image: Branch tips dead. Photo by Nick Dietschler of Cornell University's NYS Hemlock Initiative.

- Tree Markings
  Is the tree marked, tagged, or flagged in any way?
  - Yes
     Photo: Tree Marking
  - No
  - I'm not sure

- Habitat
  Click all that apply.
  - Forest
  - Wetland
  - Field
  - Roadside, urban, suburban, or park
  - Riparian area
  - Steep slope
  - Comment Field [Describe the habitat in the area (e.g., wet seep, dry ridge top, moderate slope, flat).]

- Have you completed a lingering hemlock search training?
  - Yes
  - No

Step 3: Surrounding Trees Record (This section is optional but encouraged.)

- Nearby Hemlock Assessment
  Assess the health of each nearby hemlock tree (at least ten hemlock trees if they can be found nearby and up to forty hemlocks for a fuller mortality assessment).
  - Three category "clicker" for each tree assessed
    - Dead, downed hemlock log
    - Dead/dying hemlock tree, still standing (*e.g.,* <20% of the tree canopy remains)
    - Living hemlock tree (*e.g.,* >20% of the tree canopy remains)

- Canopy Health
  Assess the average canopy health of the nearby trees.
  - H = Healthy (>80% healthy canopy; deep green, dense foliage; skylight is mostly blocked when you look at the tree)
  - I = In Decline (<80% - >20% healthy canopy; foliage beginning to thin; foliage green-to-greyish; some skylight visible when looking at the tree)
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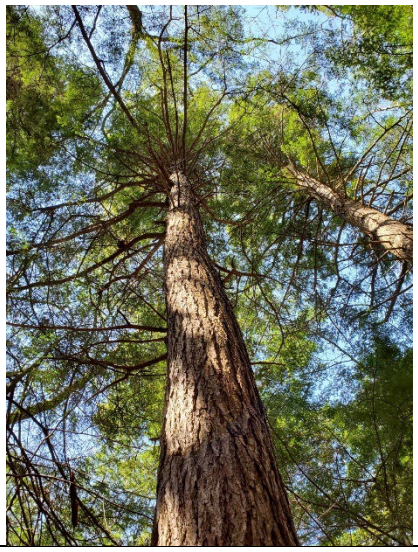
In Decline		

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- Forest Management
  Do you see signs of active forest management (e.g., recently cut stumps, flagging, disturbance, active road/track)?
  - Yes
    📷 Photo: Management
  - No
  - I'm not sure
  - Comment Field

- Nearby HWA
  What percentage of the hemlock trees nearby the lingering tree(s) have HWA?
  - 0%
  - 1-25%
  - 25-50%
  - 50-75%
  - 75-100%
  - I'm not sure
  - Comment Field [Please include information if stressors other than HWA are present.]