

# Hemlock Health Field Assessment Protocol - Draft 2

## [Section A: Description]

This protocol utilizes annual (at least) health observation of a select subset of trees within a treatment area. Health indicators are rated and averaged to give each tree a **Tree Health Index** (THI Scale: 0 - 100). The individual tree indexes can be averaged to provide a **Stand Health Index**. The scores are compared over time to evaluate changes in tree condition attributed to chemical treatment efficacy. The health metrics being assessed are those that are directly affected by established/feeding Hemlock Woolly Adelgid (*Adelges tsugae*), “HWA”, and Elongate Hemlock Scale (*Fiorinia externa*), “EHS”.

### Tree Health Metrics:

1. *Live Crown Ratio (LCR), uncompacted*
2. *Crown Density*
3. *% of Live Branches*
4. *% of New Foliage*

This assessment also takes into account the percentage of observed branches that have extant infestations of HWA and EHS to provide an **Infestation Index** (scale: 0 - 50):

5. *Number of Branches with Living HWA*
6. *Number of Branches with Living EHS*

The number of trees incorporated into the monitoring process should be representative of the entire treatment; the recommendation is that 10 - 20% of the treated trees should be evaluated. *See: Selection of Monitoring Trees.* Monitoring trees must be the same individuals that are evaluated each year. The Tree Health Index produced by this method is only attributed to the treated trees unless an untreated “control” group is incorporated to provide an overall Stand Health Index.

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## [Section B: Metric Definitions]

Each metric is evaluated using a binned five point scale (1-5), with each point representing a range of approximately 20%; i.e. 1 = [1-20%], 2 = [21-40%], etc. With the exception HWA and EHS evaluations, the score values increase with improving canopy health.

1. **Live Crown Ratio (LCR):** the ratio expressed as a percentage (crown ratio =  $x/y * 100$ ) of the length of the tree that is living crown ( $x$ ) relative to the actual tree length ( $y$ ). Lower live branches that are less than 1 inch in diameter and are located more than 5 feet below the bulk of the live crown are not included in the live crown length( $x$ ). The base of the live crown ( $x$ ) is the point on the bole that is perpendicular to the terminal of the lowest live foliage, not the point at which the branch connects to the main bole.

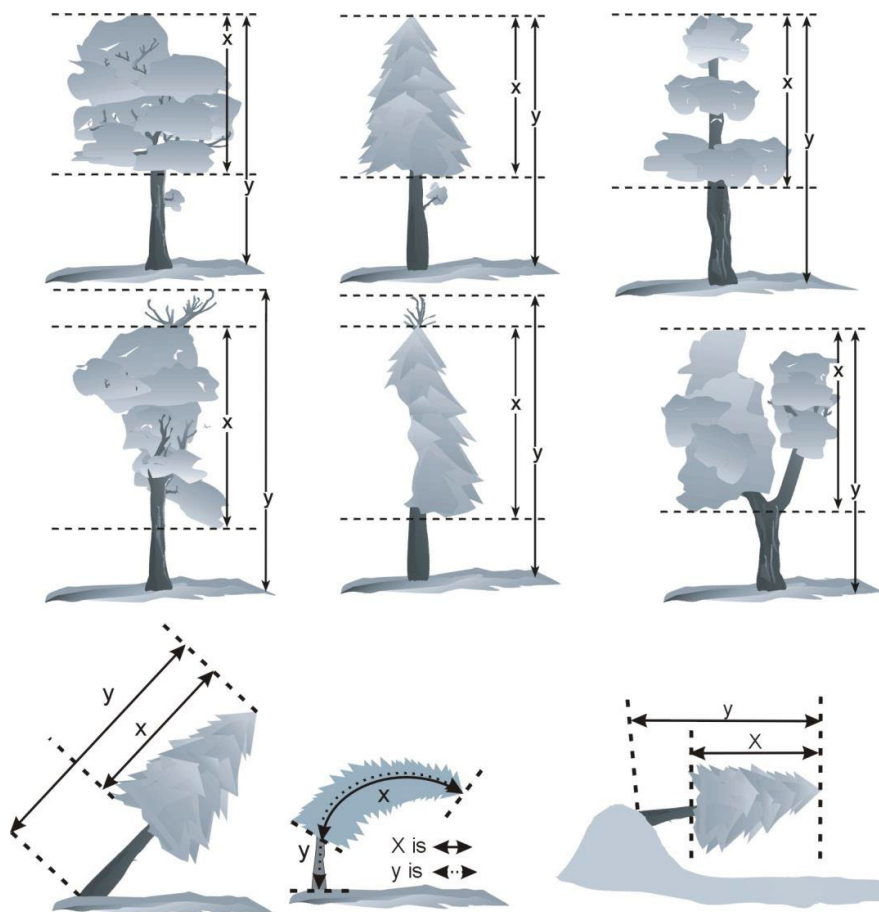


Figure 1 - Live Crown Ratio (LCR), uncompacted

2. **Crown Density:** Presence of crown foliage relative to open sky. The figure below depicts varying tree canopy densities (black) as viewed from beneath the dripline, looking

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upward toward the sky (white). Red lines indicate the binned health scale used in this assessment, with category 5 (81-100%), representing the densest (i.e. healthiest) crown.

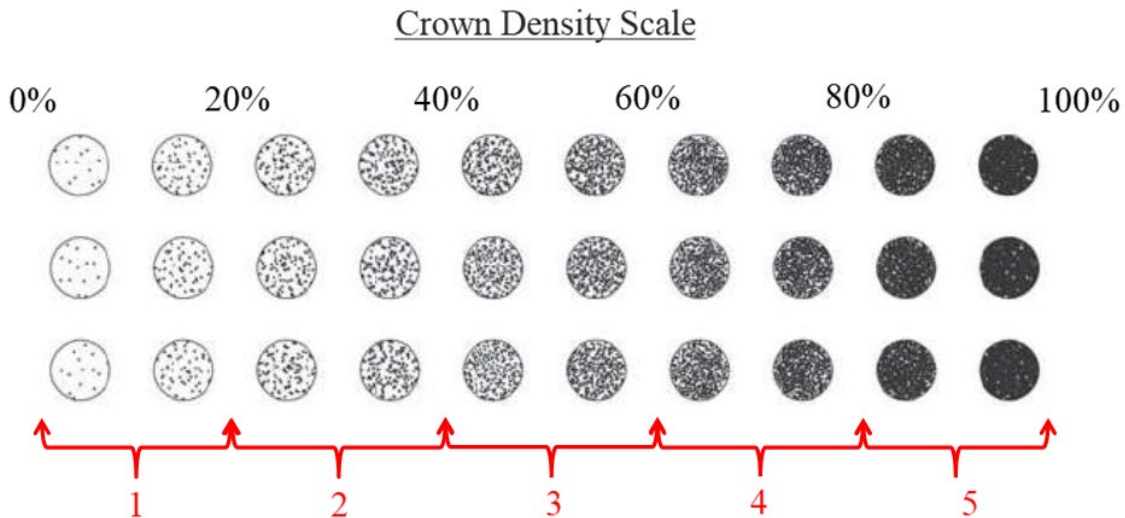


Figure 2- Crown Density Scale

3. **% Live Branches:** determined by estimating the number of branches that have live needles relative to the total number of all branches (live branches plus needleless dead branches). When counting dead branches, consider only branches that have no live needles the entire length of the branch and have been dead for several years.
4. **% New Foliage:** determined by estimating the amount of new growth present on the branch tips relative to the total live branches. This is done while walking around the dripline of the tree and looking up into the perimeter of the tree. Needle and stem growth or flush normally occur from late spring to mid-summer (usually June - July in NYS). New growth can distinguished from old growth as more vibrant yellowish-green, feathery, and flexible in appearance, and will only be present at the terminal ends of branches. The amount of branch tips with new growth divided by the total live branches is the percent of live branch tips with new foliage. This measure is not an FIA metric. New hemlock foliage is a critical food resource for the optimal development of HWA and EHS.
5. **% Branches with HWA:** Proportion of observed branches with extant population of Hemlock Woolly Adelgid. Observers should examine the terminal twigs of five randomly

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selected branches. Apply the binned percentage values if fewer than five branches are reachable for examination.

6. **% Branches with EHS:** Proportion of observed branches with extant population of Elongate Hemlock Scale. Observers should examine the terminal twigs of five randomly selected branches. Apply the binned percentage values if fewer than five branches are reachable for examination.

## **[Section C: Health Assessment Procedure]**

### 1.) Materials Needed

- a.) Hemlock Treatment Monitoring Form - Survey123 -or-
- b.) Field Assessment Data Sheet
- c.) GPS
- d.) Laminant cards w/ canopy health scales; LCR, etc.
- e.) Diameter tape

### 2.) Tree Selection Criteria

McAvoy et al. 2019 recommend an evaluation of at least 10 - 20% of the hemlocks in a select area. The selection of that subset of trees should largely be guided by the overlying management goals for the hemlock resource in that stand. If the goal is to preserve the large specimen trees then those should be the individuals monitored. If the goal is to manage risk in recreational areas, perhaps trees along trails or picnic areas should be prioritized for monitoring. With the goal of maintaining a mixed age class, the monitored trees should represent the full range of all the treated trees within the stand. Monitoring will become more difficult the larger a treatment area is. The extent to which these monitoring protocols are applied should be scaled to match management goals and resources. Selecting a stand for monitoring within the greater treatment area may be necessary.

If the data is available, try pre-selecting trees that will add up to 10-20% of total diameter inches of treated and/or untreated trees.

Individuals that are selected for monitoring should have received identical treatments i.e., the same application method (basal bark, injection), rate of chemical applied, and date of application. The individuals should also be evenly distributed throughout the entire treatment area or defined stand; avoid clumping and grouping wherever possible. Also consider including an array of trees with varying aspects and site conditions e.g., edge vs. interior trees, site drainage, etc.

**Select trees that are accessible. Health evaluations will require the observers to be able to approach and encircle the trees.**

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This method utilizes health assessments of the same trees year after year. Tags with unique identifiers should be installed and maintained to ensure accuracy. Coordinates should be recorded for each tree. Individuals should be selected using the described criteria. If untreated trees are incorporated as a control group, these too must be consistently monitored year to year, should represent 10-20% of the untreated trees, and should be selected in a similar manner to the treatment group.

### 3.) Observation Procedure

Tree health observations should be made in the late spring/ early summer season of each year to coincide with bud break and flush of fresh foliage. The live branch, live branch tips, and new foliage metrics, in particular, are more easily evaluated with the presence of fresh shoots. Observations made at this time also account for time during which HWA and EHS are most conspicuous. **Newly settled, early-instar sistens on new growth should not be considered extant as chemical-induced mortality may not be discernible at this point. Only plump HWA nymphs and adults should be considered “alive”.**

Observations should be recorded using the provided data sheet or application input option. Ideally, two observers will work together on each tree assessment, with each person estimating each health metric independently, and then comparing or averaging their observations for the recorded values. Observers should encircle the tree to consider all sides. With the exception of canopy density, which should be assessed from within the dripline, observers should attempt to stand at least one-half tree length (and no more than one full-length) away from the base of the tree. Observers should also attempt to remain on the same slope contour as the tree when possible.

Observations within a single treatment area should all be made on the same day or in as quick a succession as possible to minimize the impacts of varying weather patterns and tree development. Noteworthy changes in health or site characteristics like stem breakages and adjacent tree-falls should be recorded. Also, make note of the presence of any additional pests.

If the observers are equipped, they should include canopy photos of each monitoring tree, one from under the tree and one from afar, to be paired with the Crown Density metric. For the “under view” image, the observer should stand with their back against the tagged side of the tree and take a skyward photo of the canopy; the resulting image should be comparable to the crown density scale (Fig.2). The second photo, “side view”, should be taken at one tree length distance from the base of the tree, again on the tagged side of the tree, and should attempt to capture the entire tree, base to crown tip. Every effort should be made to capture these images in consistent perspectives year after year so comparisons can be drawn.