St. Lawrence Eastern Lake Ontario Partnership for Regional Invasive Species Management

Special Note

This report is to be considered as an addendum to the field reports from 2015 and 2016. The previous reports are attached to the end of this report.

2017 Field Survey
Addendum to

Hemlock Woolly Adelgid (*Adelges tsugae*) Surveillance

Figure 1: Stand of Eastern Hemlocks at Salmon River Falls. Photo taken by Alicia Wood.

SLELO-PRISM Early Detection Surveillance

August 31th, September 5-7th & 11-12th, 2017

Report prepared by Bryna Daykin and Alicia Wood, 9/15/2017

Introduction and Background[1]

Hemlock woolly adelgid (*Adelges tsugae*), native to Asia, is a small aphid-like insect that threatens the health and sustainability of eastern hemlocks (*Tsuga canadensis*). Hemlock woolly adelgid (HWA) was first discovered in the United States in 1951 near Richmond Virginia, and has since spread throughout the northeastern U.S. and into the Midwest. Decline and mortality of hemlock after an infestation typically occurs between 4 and 10 years. Hemlocks stressed by drought, poor site conditions, disease, and other insect pests will show accelerated rates of mortality. [2,3]

[1] Introduction and Background edited from the 2015 SLELO-PRISM Hemlock Wooly Adelgid Survey, by Ben Hansknecht and Caitlin Muller: http://www.sleloinvasives.org/wp-content/uploads/2017/06/HWA-2015-Report-PDF.pdf

[2] Information obtained from the United States Department of Agriculture Forest Service: https://www.na.fs.fed.us/spfo/pubs/pest_al/hemlock/hwa05.htm

[3] Information obtained from the St. Lawrence Eastern Lake Ontario Partnership for Regional Invasive Species Management SLELO-PRISM: http://www.sleloinvasives.org/about-invasives/prevention-watch-list-species-in-slelo-region/hemlock-woolly-adelgid/

Figure 2: From left to right: HWA eggs, HMA crawler, HWA nymphs in dormancy on the bases of the needles on an Eastern Hemlock tree, adult HWA. Photos from left to right taken by: Shimat Joseph, University of Georgia, Bugwood.org; Kelly Oten, North Carolina Forest Service, Bugwood.org; Ashley Lamb, Virginia Polytechnic Institute and State University, Bugwood.org; Michael Montgomery, USDA Forest Service, Bugwood.org.

HWA is active in cooler months and dormant during the summer, producing two generations per year. HWA can only reproduce sexually on specific species of spruce trees which are not present in North America. Due to this, reproduction only occurs here asexually by parthenogenesis. This means that all HWA in North America are females, and that it only takes one HWA to create an infestation on a tree. There are six developmental stages for HWA: the egg, four nymphal instars (crawler) stages, and the adult (**Figure 2; Figure 3**). The crawlers are a dark reddish-brown to purple-black in color and are typically found along the branches of hemlocks. These crawlers will attach to the bases of Eastern hemlock needles by mid-July and become dormant. These immatures remain dormant until mid-October, at which point they resume feeding. As they feed they produce waxy "wool" like filaments that are secreted out of their pores, which serve as a protective cover to prevent the insect from drying out. Adults produce reddish eggs within these masses from March-June (**Figure 2; Figure 3**). The sticky, woolly covering allows the eggs to spread by attaching to deer, birds, other forest dwelling mammals, and by the wind. The woolly masses are present from October-June, and are the easiest way to detect a HWA infestation (**Figure 4**). [2,3,4,5,6]

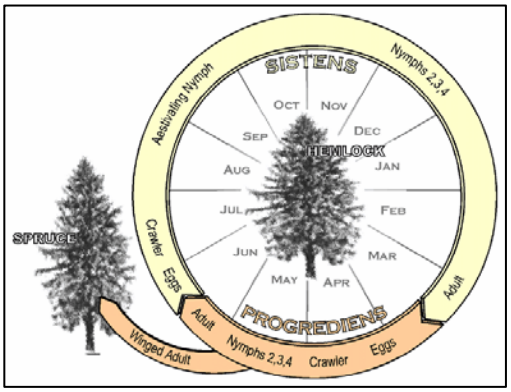

Figure 3: Hemlock Woolly Adelgid annual life cycle. Photo obtained from the United States Department of Agriculture, https://www.nrs.fs.fed.us/disturbance/invasive_species/hwa/additional_resources/.

[4] Information obtained from the University of Massachusetts at Amherst Extension Services: https://ag.umass.edu/landscape/fact-sheets/hemlock-woolly-adelgid-frequently-asked-questions

[5] Information obtained from Maine's Department of Agriculture, Conservation and Forestry: http://www.maine.gov/dacf/mfs/forest_health/insects/hemlock_woolly_adelgid_fact_sheet.htm

[6] Information obtained from the Encyclopedia of Life: http://eol.org/pages/7669301/details

Figure 4: Hemlock Woolly Adelgid masses on Eastern Hemlock tree branches. Left photo taken by Steven Katovich, USDA Forest Service, Bugwood.org. Right photo taken by Pennsylvania Department of Conservation and Natural Resources - Forestry, Bugwood.org.

Look-alikes of HWA woolly masses include spittlebug (*Aphrophora saratogensis*) foam, oak skeletonizer (*Bucculatrix ainsliella*), elongate hemlock scale (*Fiorinia externa*), drops of pine sap, bird feces, and spider egg sacs (**Figure 5**). To distinguish these, note that the HWA woolly masses resemble cotton balls, are immobile, are not silky or stretchy but rather waxy, and don't appear painted on as pine sap and bird feces do. Additionally, placement of the HWA woolly masses can help distinguish the species, as HWA masses are always found on the branches at needle bases, while spider eggs are often laid on the needles. Additionally, spider eggs will never appear as clumped as HWA masses (**Figure 4; Figure 5**). [8]

Figure 5: HWA look-alikes. From top left to top right: elongate hemlock scale[7], oak skeletonizer[8], spittlebug foam[7]. The bottom left photo is pine sap[8] and both the bottom middle and bottom right photos are spider eggs[9]. Note the placement of the spider eggs on the needles, a characteristic that distinguishes them from HWA woolly masses.

[7] Photos obtained from Ohio Department of Natural Resources: http://ohiodnr.gov/hemlock-woolly-adelgid-in-ohio/learn-more-about-hwa/post/hwa-or-not-look-alike-pests

[8] Photos obtained from University of New Hampshire Extension Services: https://extension.unh.edu/resources/files/Resource002109_Rep3114.pdf

[9] Photos taken by Alicia Wood and Bryna Daykin

This insect feeds directly from the storage cells of hemlocks, causing needle death and progressing to twig and branch death. The needles lose color becoming yellow and grey, dry out, and fall off branches. As the insects' feeding progresses the terminal buds die, preventing new shoot growth. Within two years this dieback can be observed in major limbs. The decline in health typically occurs first from the bottom limbs before continuing upward toward the top of the tree. HWA infestations cause death to mature hemlock trees within 3 to 10 years. [3,4,5,6,10]

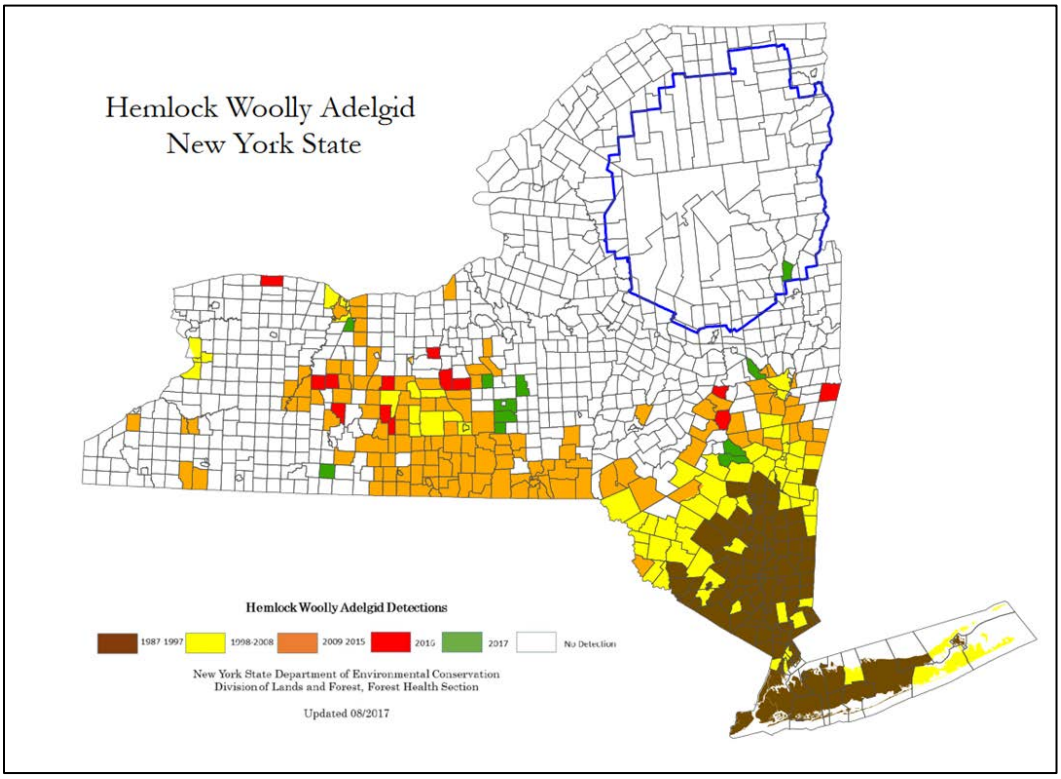

Figure 6: Map of Hemlock Woolly Adelgid detections in New York State. Map created by the NYS Department of Environmental Conservation, http://www.dec.ny.gov/animals/86382.html. The blue line on the map outlines the Adirondack region.

HWA has been observed in Cayuga and Onondaga Counties, which borders the SLELO-PRISM (**Figure 6**). This species is considered a 'Prevention "Watch-list" Species', whose arrival could be detrimental to the ecosystems found within the PRISM. One area of special concern is the southern Tug Hill region. Eastern Hemlock is ecologically important, as it is frequently found along exposed slopes, protected gorges, and streams. Hemlock creates a cool, damp, and shaded environment which supports a wide variety of organisms, including salamanders. Throughout the winter hemlock provides shelter and food for wildlife. Studies of forests damaged by HWA in the southern U.S. have shown that a decline in hemlock populations can cause a decline in other plant and animal populations, producing drastic changes to ecosystem processes. [3,10]

[10] Information obtained from Cornell University Cooperative Extension: http://www.nyis.info/index.php?action=invasive_detail&id=24

Survey Methods and Objectives

The priority conservation area for this survey was the southern Tug Hill region, on the southern-most side of the SLELO-PRISM. This section of the SLELO-PRISM is considered more likely to contain HWA as this species has been found in other southern regions of the state (**Figure 6**). The eleven sites surveyed in 2015 and 2016 were resurveyed in 2017. These sites were selected based on their high abundance of eastern hemlock stands, and included Salmon River Falls, Chateaugay State Forest, Selkirk Shores State Park, Mexico Point State Park, Happy Valley Wildlife Management Area, Mad River State Forest, Forest Park, Buck Hill State Forest, Clark Hill State Forest, Penn Mountain State Forest, and Trenton Greenbelt (**Figure 7; Figures 9-19**). These sites were surveyed for points with dense stands of eastern hemlock trees, consisting of at least 20 trees. Additionally, the Early Detection Team assessed the overall health of the eastern hemlock trees at each point. Signs of poor health including dieback, loss of needles, and needle discoloration (**Figure 8**) can indicate tree infestation by the HWA species. However, these symptoms can also be a result of other issues, such as nutrient deficiency.

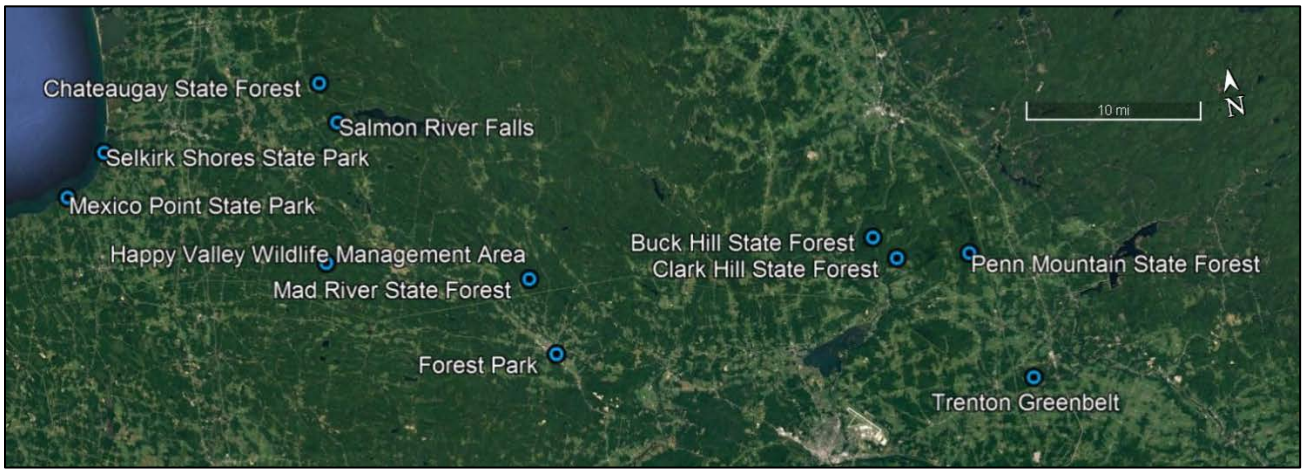

Figure 7: Areas surveyed for Hemlock Woolly Adelgid within the SLELO-PRISM.

To locate and mark new points at each of the survey sites, a handheld Garmin GPSmap 60CSx was used. Unlike previous years, the 2017 survey did not involve an extensive examination of the trees at each stand, as the survey was conducted in late summer when the cotton-like masses were not yet present on branches. However, samples were taken from trees at each point and were closely examined under microscopes by the Early Detection Team for nymphs. At this time of year, HWA nymphs are found in dormancy on the bases of eastern hemlock needles (**Figure 2; Figure 3**). **No HWA nymphs were found on any of the branches examined.** The purpose of this survey was to determine priority areas for volunteers to come back to and survey in mid-October, when the woolly masses are visible, as shown in **Figure 4**. Sites of higher priority are those with trees of poorer health or trees with a few white cotton-like masses that appeared suspiciously similar to HWA woolly masses.

Figure 8: Signs of poor health on an Eastern Hemlock tree. Left photo shows needle discoloration, middle photo shows partial needle loss, right photo shows complete needle loss. Photos taken by Alicia Wood.

Below are maps and GPS locations of each survey site visited (**Figures 9-19**). Light blue lines on maps indicate walking paths, while dark blue lines indicate routes that can be driven. Sites are listed in order of priority, and should be visited by volunteers accordingly. Order of priority was based on site location (more southern regions = higher priority) and tree health (poor tree health = higher priority). Points that are starred are of higher priority compared to other points within a site.

Sites Listed in Order of Priority

1) Happy Valley Wildlife Management Area
2) Trenton Greenbelt
3) Forest Park
4) Selkirk Shores State Park
5) Buck Hill State Forest
6) Clark Hill State Forest
7) Mad River State Forest
8) Penn Mountain State Forest
9) Mexico Point State Park
10) Salmon River Falls
11) Chateaugay State Forest

1) Happy Valley Wildlife Management Area

Point	Latitude	Longitude	Location	Eastern Hemlock Health Observations
1	43.43392	-75.96511	Along Britton Rd	
2	43.43688	-75.95046	Along Britton Rd	Total needle loss on many bottom branches
3	43.41106	-76.00191	Along Happy Valley Rd	Total needle loss on many bottom branches
4**	43.42667	-75.95216	Off of Stone Hill Rd	Total needle loss on many bottom branches, partial needle loss throughout trees, needle discoloration

Figure 9: Driving routes at Happy Valley Wildlife Management Area.

Access for Points 1, 2, 4: Off of Stone Hill Road, Williamstown, NY.

Access for Point 3: Happy Valley Road (off route 26), Williamstown, NY.

2) Trenton Greenbelt

Point	Latitude	Longitude	Location	Eastern Hemlock Health Observations
1	43.24519	-75.21046	Yellow Trail	A little discoloration, partial needle loss on bottom branches
2	43.24559	-75.20864	Orange Trail	Partial needle loss on bottom branches
3**	43.24350	-75.20242	Blue Trail	Some dieback on bottom branches, a little discoloration
4*	43.24390	-75.20592	Blue Trail	Partial needle loss and dieback on bottom branches, some dead young trees

Figure 10: Walking route at Trenton Greenbelt.

Access for Points 1-4: Parking lot off of Wood Road, Barneveld, NY.

3) Forest Park

Point	Latitude	Longitude	Location	Eastern Hemlock Health Observations
1	43.33189	-75.73717	Along Forest Park Loop	
2	43.33046	-75.73612	Along Forest Park Loop	
3	43.32906	-75.73340	Along Forest Park Loop	
4	43.32610	-75.73022	Along Forest Park Loop	
5	43.32837	-75.73637	Along Forest Park Loop	
6	43.32730	-75.73111	Along Forest Park Loop	

Figure 11: Driving route at Forest Park.

Access for Points 1-6: Loop (Costello Ave) off of Ripley Road, Camden, NY.

4) Selkirk Shores State Park

Point	Latitude	Longitude	Location	Eastern Hemlock Health Observations
1**	43.56243	-76.20030	Red Fox Trail	Some dieback, many trees only with needles at the crown
2	43.55806	-76.20747	Near Cabins Along Selkirk Shores State Park Road	
3	43.55703	-76.20370	Yellow Forest	A little needle discoloration
4	43.56139	-76.20100	Yellow Forest	
5	43.55117	-76.20810	White Leaf	
6	43.55170	-76.20520	Green Frog	
7	43.55117	-76.20675	White Leaf	
8	43.55201	-76.20811	Green Frog	Some dieback, some needle discoloration
9	43.55159	-76.20644	Green Frog	

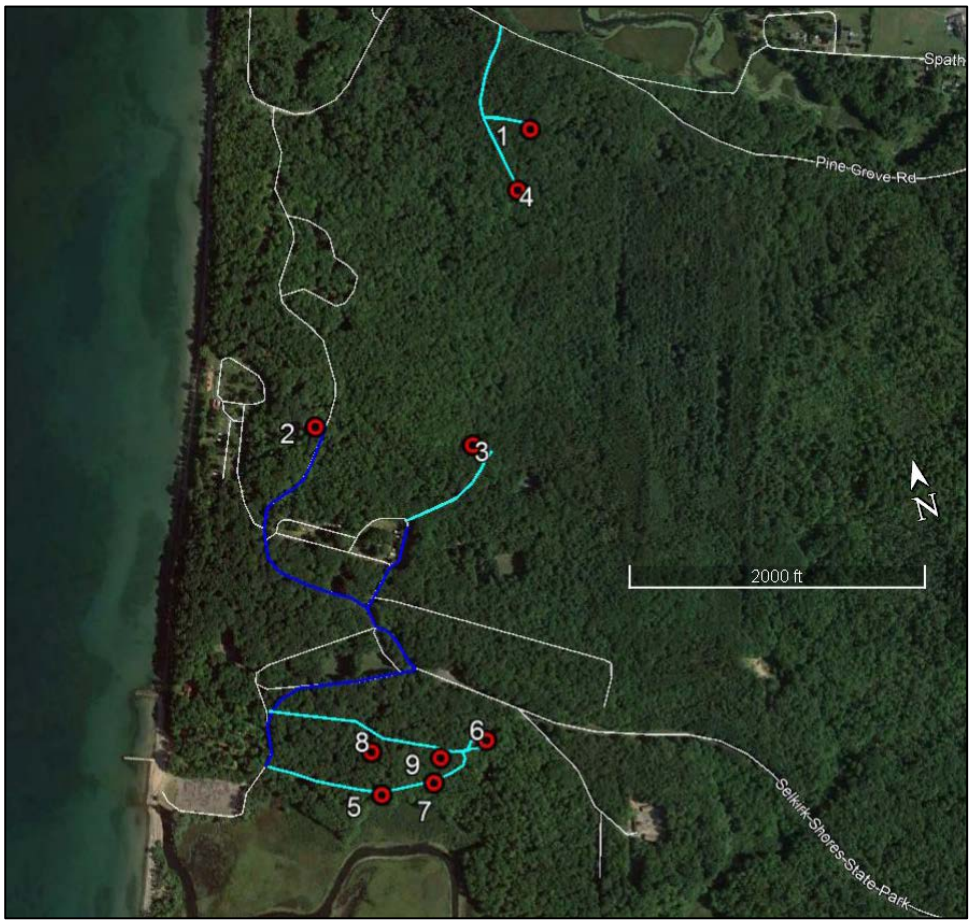

Figure 12: Driving and walking routes at Selkirk Shores State Park.

Access for Points 1 & 4: Off of Pine Grove Road, Pulaski, NY.

Access for Points 2, 3, 5-9: Off of Selkirk Shores State Park Road, Pulaski, NY.

5) Buck Hill State Forest

Point	Latitude	Longitude	Location	Eastern Hemlock Health Observations
1	43.38232	-75.36503	Along Hertz Rd	Some needle discoloration
2	43.38032	-75.36469	Along Hertz Rd	Partial needle loss
3	43.36833	-75.37165	Along Buck Hill Rd	A little needle discoloration, partial needle loss on bottom branches

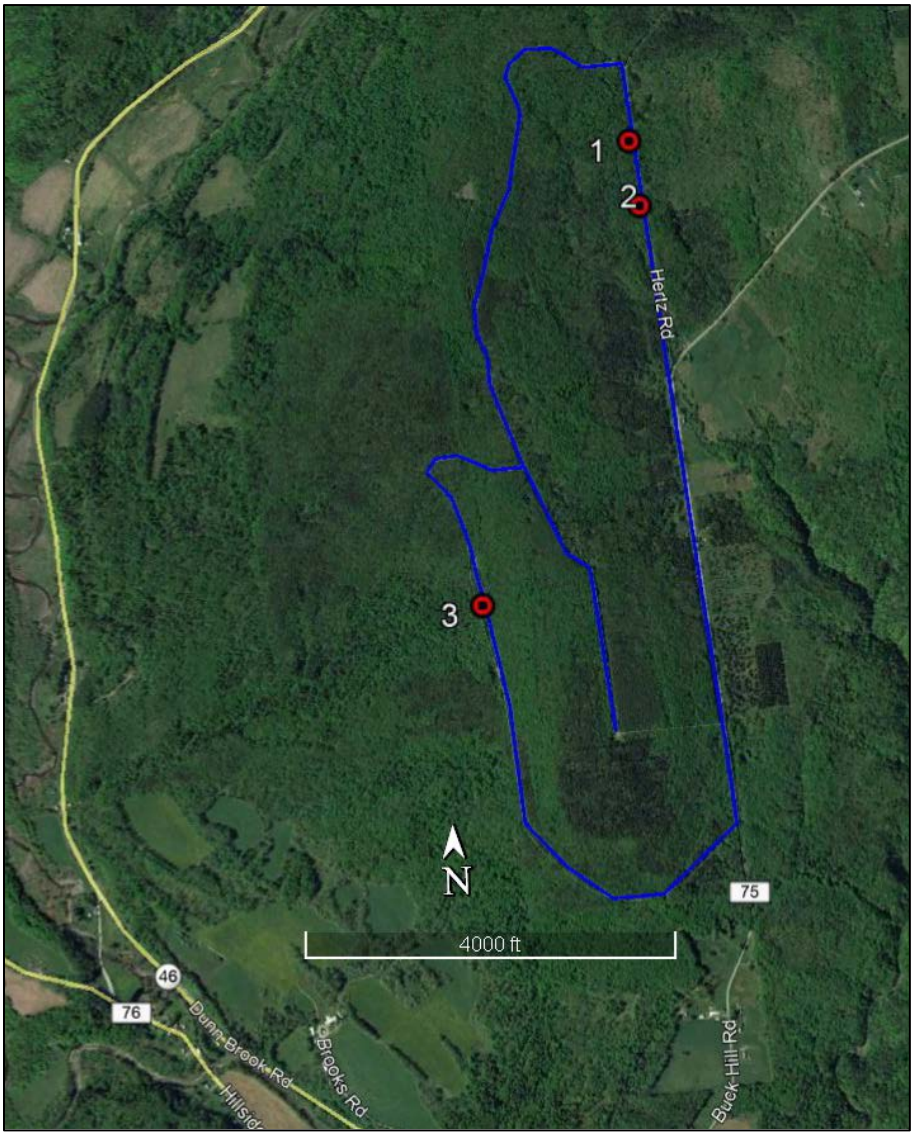

Figure 13: Driving route at Buck Hill State Forest.

Access for Points 1& 2: Hertz Road, Westernville, NY.

Access for Point 3: Buck Hill Road, Westernville, NY.

6) Clark Hill State Forest

Point	Latitude	Longitude	Location	Eastern Hemlock Health Observations
1	43.35786	-75.31100	Along Boody Hill Rd	Some needle discoloration
2	43.35956	-75.31038	Along Boody Hill Rd	Partial needle loss, a little needle discoloration
3	43.36398	-75.31328	Along Boody Hill Rd	

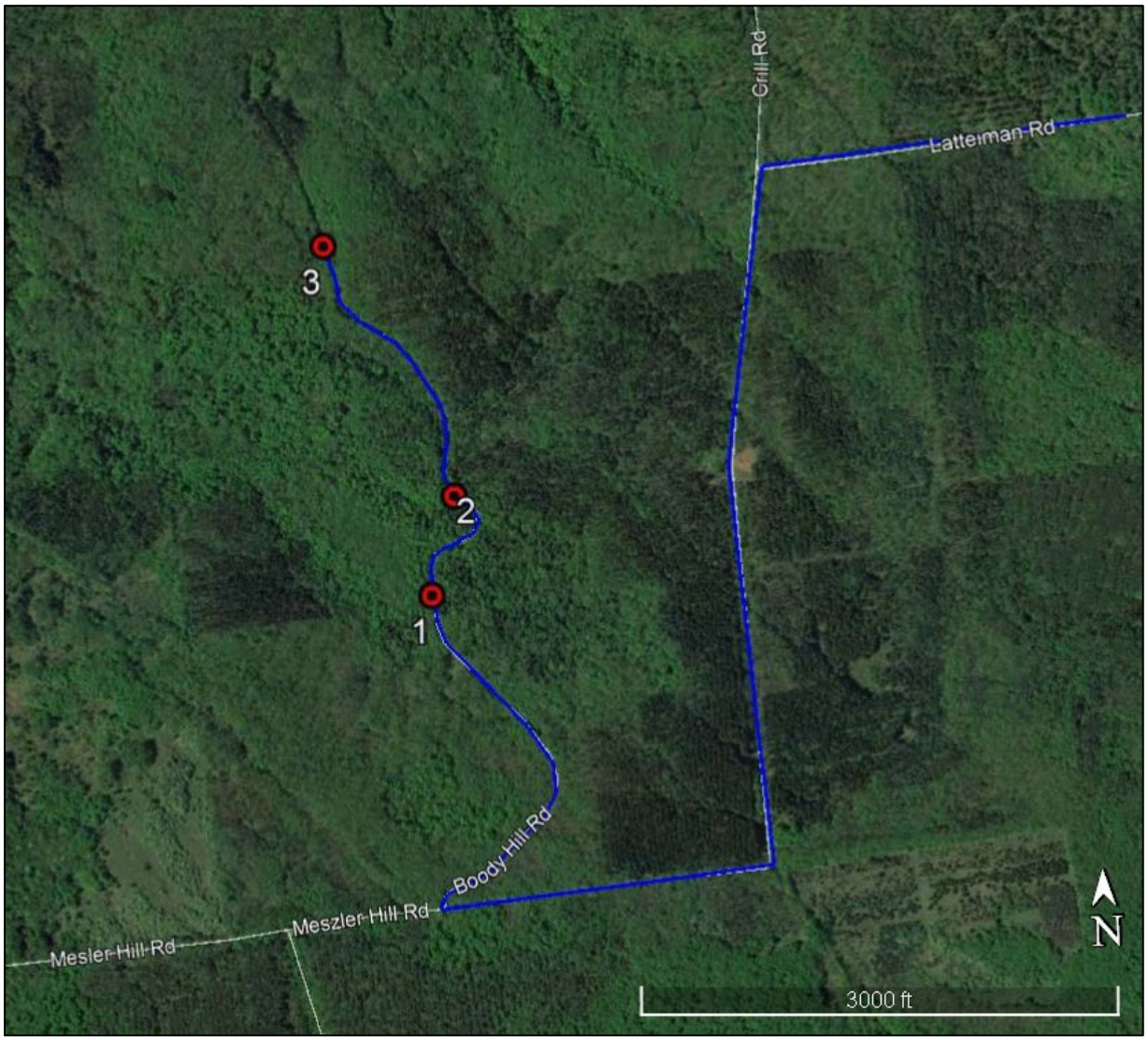

Figure 14: Driving route at Clark Hill State Forest.

Access for Points 1-3: Boody Hill Road, Westernville, NY.

7) Mad River State Forest

Point	Latitude	Longitude	Location	Eastern Hemlock Health Observations
1	43.40336	-75.76483	Along McSpirit Rd	
2	43.40884	-75.75922	Along McSpirit Rd	
3	43.40942	-75.74877	Along Rehm Rd	
4	43.40554	-75.76733	Along McSpirit Rd	

Figure 15: Driving routes at Mad River State Forest.

Access for Points 1, 2, 4: McSpirit Road, Camden, NY.

Access for Point 3: Rehm Road, Camden, NY.

8) Penn Mountain State Forest

Point	Latitude	Longitude	Location	Eastern Hemlock Health Observations
1	43.35899	-75.25090	At the end of Duck Pond Trail	

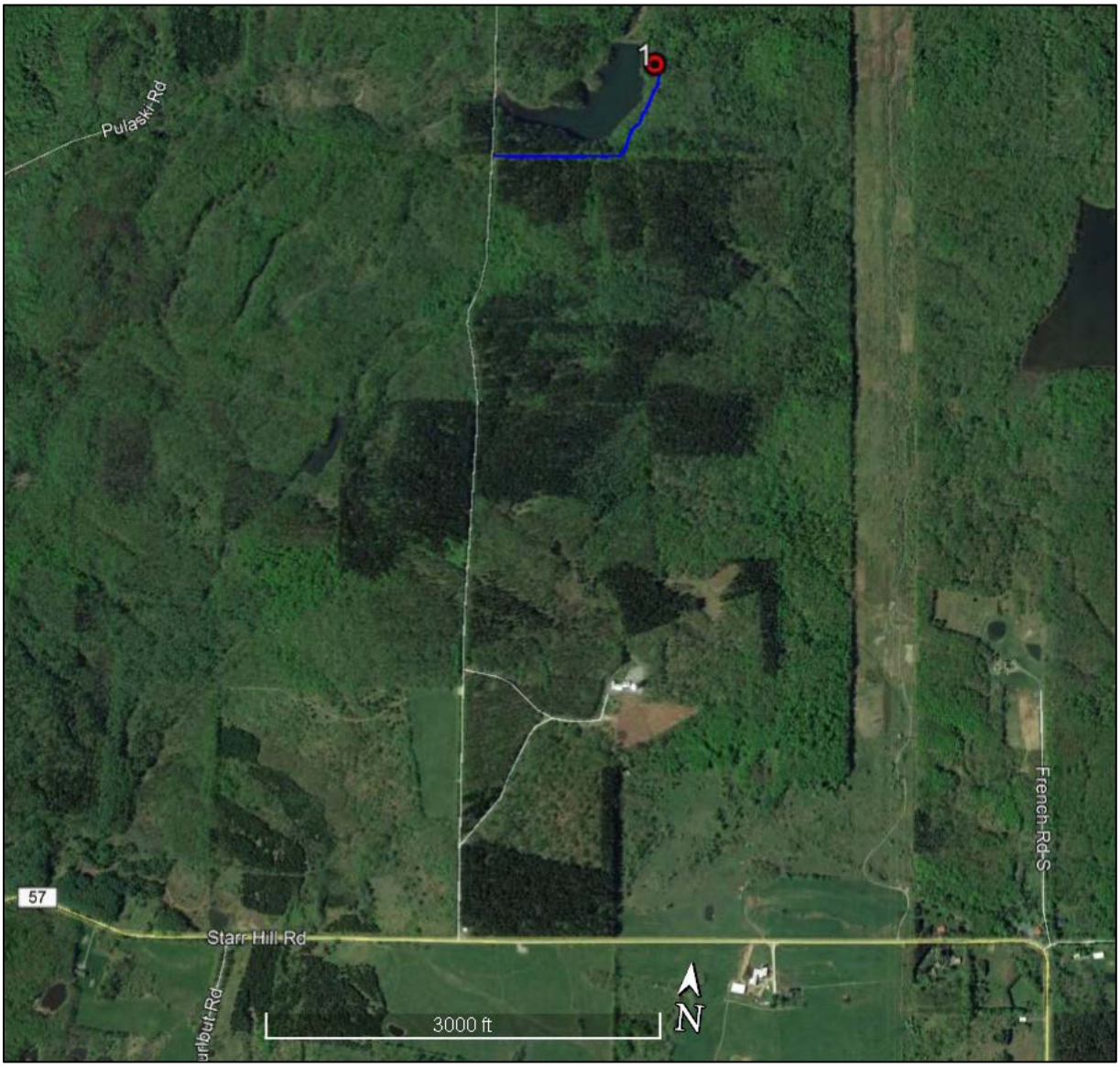

Figure 16: Driving route at Penn Mountain State Forest.

Access for Point 1: Duck Pond driving trail off of Penn Mountain Road, Remsen, NY.

9) Mexico Point State Park

Point	Latitude	Longitude	Location	Eastern Hemlock Health Observations
1	43.52245	-76.25920	Along Roops Loop	A lot of dead baby trees
2	43.52183	-76.25930	Along Roops Loop	A little discoloration
3	43.52060	-76.25860	Along Roops Loop	
4	43.51999	-76.25658	Along Roops Loop	
5	43.52064	-76.25680	Along Roops Loop	

Figure 17: Walking route at Mexico Point State Park.

Access for Points 1-5: Parking lot off of Mexico Point Drive West, Mexico, NY. Roops Loop trail is across the street from the parking lot.

10) Salmon River Falls

Point	Latitude	Longitude	Location	Eastern Hemlock Health Observations
1	43.54902	-75.94275	By Trailhead	
2	43.54764	-75.93579	Along Trail	
3	43.54770	-75.93427	Along Trail	A little needle discoloration
4	43.54610	-75.92666	Along Trail	A little needle discoloration
5	43.54574	-75.92408	Along Trail	
6	43.54513	-75.92193	At end of Trail	Partial needle loss

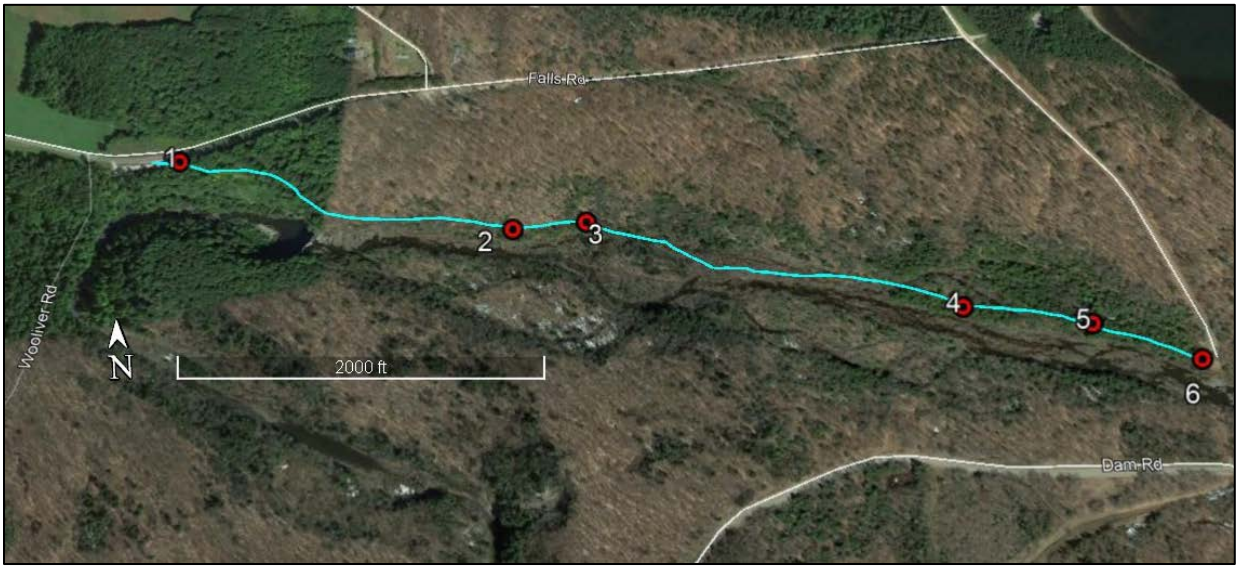

Figure 18: Walking route at Salmon River Falls.

Access for Points 1-6: Parking lot off of Falls Road, Richland, NY.

11) Chateaugay State Forest

Point	Latitude	Longitude	Location	Eastern Hemlock Health Observations
1	43.57239	-75.94892	Old Hobbit & Elf Trails (Trail 4)	Some needle loss
2	43.57198	-75.94806	Old Hobbit & Elf Trails (Trail 4)	
3	43.58815	-75.96411	Along Trail 1	
4	43.59459	-75.96341	Off Trail 1	Slight needle discoloration on bottom branches
5	43.58818	-75.96255	Along Trail 7 (Foot Trail)	Some needle discoloration

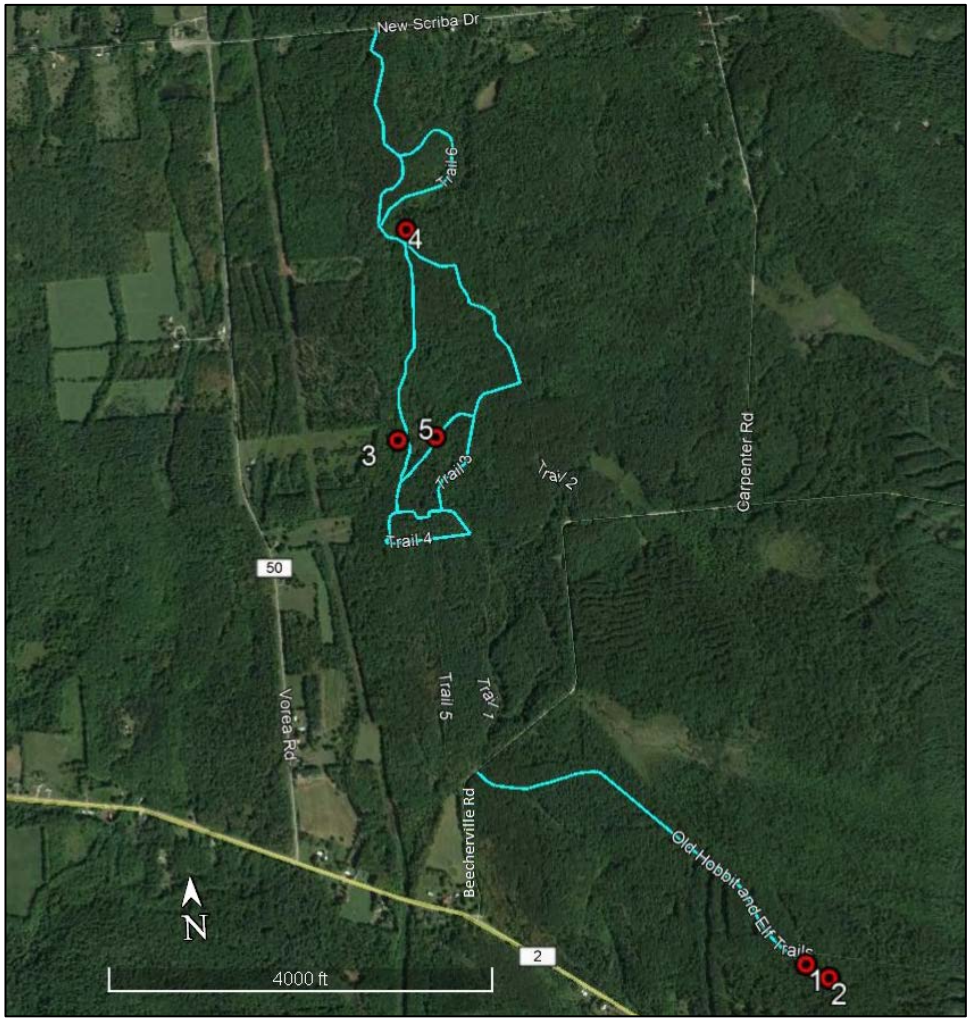

Figure 19: Walking routes at Chateaugay State Forest.

Access for Points 1 & 2: Trail off of Beecherville Road, Richland, NY.

Access for Points 3-5: Trail off of New Scriba Drive, Richland, NY.