



# V. Methods - Plot Coordinates

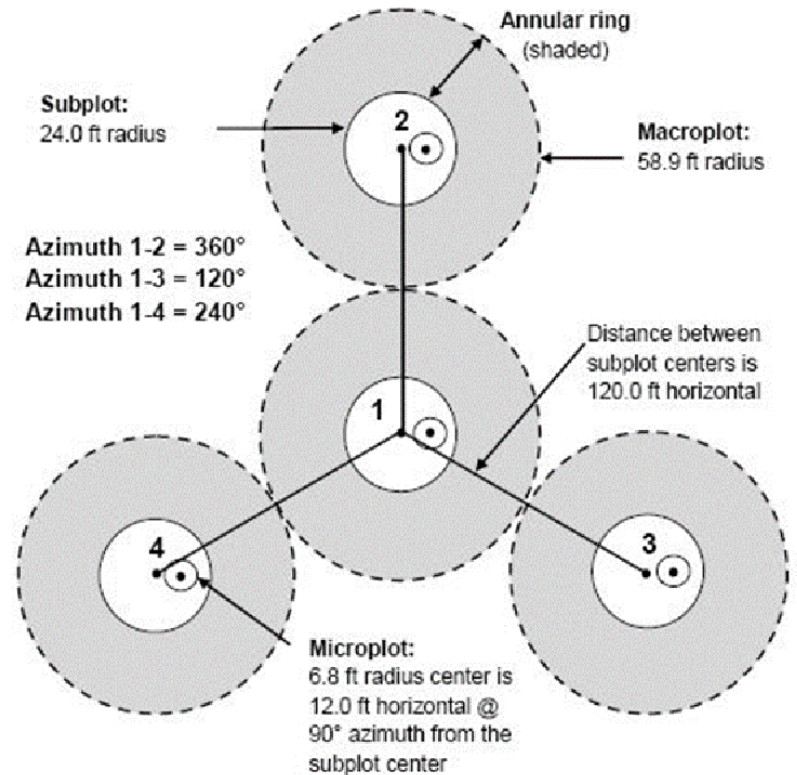
## Field Methods

Plot ID	Longitude	Latitude	Coordinate System
HHSB05G07	-73.180262	44.471785	WGS1984
HHSB13H02	-73.239122	43.612738	WGS1984
HHSC01K07	-72.999441	44.938719	WGS1984
HHSC12F02	-73.096080	43.745383	WGS1984
HHSF01A11	-72.533667	44.932395	WGS1984
HHSG01G10	-72.377292	44.932975	WGS1984
HHSG19A05	-72.558339	43.891018	WGS1984
LBA1400A	-73.083125	43.105024	WGS1984
LBA1400B	-73.035833	43.143587	WGS1984
LBA2300A	-72.976966	43.132473	WGS1984
LBA2300B	-73.041618	43.119081	WGS1984
LBA2300C	-73.045672	43.054726	WGS1984
LEMP5	-72.898624	43.176283	WGS1984
LEMP11	-73.036758	43.849144	WGS1984
LEMP12	-72.894048	43.887779	WGS1984
LEMP13	-73.083944	43.933983	WGS1984
LEMP14	-73.020248	44.093992	WGS1984
LEMP16	-72.929233	43.437375	WGS1984
LEMP17	-72.931326	43.411542	WGS1984
LEMP18	-72.968564	43.289216	WGS1984
LEMP20	-73.024004	42.871901	WGS1984
MMBR1400	-72.864766	44.525709	WGS1984
MMBR2200	-72.838757	44.534433	WGS1984
MMBR3000	-72.822399	44.531130	WGS1984
MMBR3800A	-72.816959	44.522786	WGS1984
MMBR3800B	-72.817302	44.523627	WGS1984
MMRB1400A	-72.780413	44.501790	WGS1984
MMRB1400B	-72.793460	44.502060	NAD83
MMRB2200A	-72.798590	44.491990	NAD83
MMRB2200B	-72.808510	44.512590	NAD83

Plot ID	Longitude	Latitude	Coordinate System
MMRB3000A	-72.811413	44.517562	WGS1984
MMRB3000B	-72.812619	44.517285	WGS1984
MMSB1400	-72.842027	44.505388	WGS1984
MMSB2200	-72.831957	44.506375	WGS1984
MMSB3000	-72.821946	44.516729	WGS1984
NAMP12*	-72.688160	44.588900	
NAMP24*	-72.603250	43.556400	
NAMP27*	-72.907740	44.307690	
NAMP31*	-72.707120	44.063530	
NAMP36	-72.558466	44.077074	WGS1984
NAMP39	-72.294507	44.172933	WGS1984
NAMP5	-72.222242	44.508412	WGS1984
VMC1063	-72.854154	43.909617	WGS1984
VMC1130	-72.450634	43.087253	WGS1984
VMC1235	-73.051855	43.972450	WGS1984
VMC244	-73.137387	42.972450	WGS1984
VMC245	-72.901988	44.334793	WGS1984
VMC495	-72.588301	44.764976	WGS1984
VMC593	-71.716418	44.865207	WGS1984
VMC812	-72.512419	43.774774	WGS1984
VMC919	-73.043956	44.099398	WGS1984

\* = plot not yet established

### PLOT DESIGN



Metric Conversions	
24 ft	7.32 m
120 ft	36.57 m
12 ft	3.66 m
6.8 ft	2.07 m
5 in	12.7 cm

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## V. Methods (5) - Trimble GeoExplorer Field Data Collection Workflow (2)

- c. Click **Create** in the upper-right of the screen
  - A prompt will show the antenna **height** (1.5m) and **measure to** (bottom of receiver), click OK – **note the unit will assume these settings when logging locational data**
- d. Ensure the “**Point\_generic**” option is highlighted, then click the **Create** button with the blue circle in the upper-right
- e. A **red target** now appears in the upper-right with a number next to it – this is the number of satellite “hits” the unit is logging at the point you’ve created
- f. Add any comments about the plot in the **Comment** box if needed
- g. **Let the unit log at least 100 points before clicking the OK button with the red stop square**
- h. Click Ok to confirm you want to close the feature: 1 Point\_generic
- i. **Click Close in the upper right to ensure the data file is closed**
- j. You can check that you’ve successfully created the data file/point by clicking on the “**Existing File**” tab (still under the **Data** options)
  - i. The data file you just created should be at the top of the file list, with the number of positions displayed in the bottom right (e.g. **Positions: 103**). In the bottom left, it should say **Status: Not Transferred** as the file has not yet been downloaded from the unit.
  - k. If you made a mistake naming the file, or simply want to delete a file, you can click on the **File Manager** tab, then in the upper right click **Options, then Delete**—**NOTE:** be careful when deleting files that have not been transferred, as **they cannot be reclaimed!**
- i. To rename a file click **Rename**

## Shutting Down the Trimble

4. Once you’ve collected the point data and are ready to turn off the Trimble, **ensure that:**

- a. **The data file is closed**
- b. **That you’ve exited out of TerraSync**

**IMPORTANT:** Failure to close data files and/or exit out of TerraSync can corrupt the file data/system, which will result in lost data and wasted time/effort!

## V. Methods (4) - Trimble GeoExplorer Field Data Collection Workflow (1)

1. From initial start menu, click the Windows icon in top-left of screen and open **TerraSync**
  - a. Initial screen will show the “**Skyplot**” under the **Status** options, which depicts satellite coverage

### Initial Setup

2. Click on **Status** and navigate to the **Setup** options
  - a. Under “**Coordinate System**” ensure you are collecting data with the following settings, then click OK:  
SYSTEM: **UTM**  
ZONE: **18 North**  
DATUM: **WGS 1984**  
ALTITUDE REFERENCE: **Height Above Ellipsoid (HAE)**  
ALTITUDE and COORDINATE UNITS: **Meters**
  - b. Under “**GPS Settings**” ensure that the Productivity-Precision slider is set all the way to the Productivity end (left), then click OK – this tells the system to log data even when satellite reception is relatively poor and thus locational accuracy isn’t very precise (can be fixed via post-processing)
  - c. Under “**Units**” ensure the Lat/Long format is set to **DD.ddd°** (decimal degrees), then click OK
  - d. Under “**Logging Settings**” ensure antenna height is set to 1.5 meters (**NOTE**: this is the height you want to be holding either the Trimble unit or external antenna at – see below – when logging locational data)
    - i. **If using the external antenna**, ensure **Type** is set to “**Hurricane**” with **Part Number: 50393-50**
    - ii. **If using just the Trimble unit**, ensure **Type** is set to “**GeoXH 2008 Internal**”

### Creating a New Data File (Point) and Logging Location

3. Click on **Setup** and navigate to the **Data** options
  - a. Ensure you’re in the “**New**” tab and that the default settings show:  
**File Type**: Rover  
**Location**: Default  
**Dictionary Name**: Generic
  - b. Rename the **File Name** based on the plot and subplot you are at (e.g. VMC345-1 for subplot 1 in plot VMC345)

## I. Metrics— What you’re measuring

**At each 24’ (7.32m) radius subplot collect the following measurements:**

**For all trees 12.7 cm (5”) or greater DBH:**

- Species (FIA codes on back cover)
- DBH ( FIA protocol, measured at traditional breast height or on painted line)
- Canopy position (FHM protocol)
- Vigor rating (NAMP protocol)
- Crown dieback (FHM protocol)
- Uncompacted live crown ratio (FHM protocol)
- Foliage transparency (FHM protocol)
- Discoloration (NAMP protocol)
- Defoliation (NAMP protocol)
- Special damages (VT FHM protocol)
- Canopy transparency by digital photography (VT FHM protocol)

**Additional metrics for each subplot:**

- Hemispherical photos at subplot center and microplot center (VT FHM protocol).
- Non-native invasive plant abundance (VT FHM protocol)
- Moderate-heavy browse presence/absence (VT FHM protocol)
- Prism counts of live and dead species (VT FHM protocol)

**Measurements on microplots:**

- Seedling (<2.54cm) count by species in two size classes
- Sapling status, species and DBH (DBH>2.54cm and DBH < 12.7 cm )

## II. Trees– Codes

Tree Species	Code
balsam fir	12
black spruce	95
red spruce	97
white pine	129
hemlock	261
striped maple	315
red maple	316
sugar maple	318
mountain maple	319
yellow birch	371
paper birch	375
gray birch	379
beech	531
white ash	541
quaking aspen	746
pin cherry	761
black cherry	762
northern red oak	833
mountain ash	935
basswood	951

*These are the most common tree species, see the supplement for the full code list*

Crown Class	Code
open grown	1
dominant	2
codominant	3
intermediate	4
suppress/overtopped	5

### Tree Crown Vigor Codes

**1—Healthy;** tree crown appears to be in reasonably good health; no major branch mortality; crown is reasonably normal; less than 10 percent branch or twig mortality.

**2—Light decline;** branch mortality, twig dieback present in 10 to 25 percent of the crown; broken branches or crown area missing based on presence of old snags is less than 26 percent.

**3— Moderate decline;** branch mortality, twig dieback in 26 to 50 percent of the crown; broken branches, or crown area missing based on presence of old snags is 50 percent or less.

**4— Severe decline;** branch mortality, twig dieback present in more than 50 percent of the crown, but foliage is still present to indicate the tree is alive; broken branches, or crown area missing based on presence of old snags is more than 50 percent.

**5 — Dead, natural;** tree is dead and still standing ; phloem under bark has brown streaks; few epicormic shoots may be present on the bole; no further entries needed.

**6— Dead, human caused;** tree cut, girdled or removed;

**8— Dead and down:** tree is dead and on the ground or a snag less than 2 m (5').

## V. Methods (3) - Using the Haglof hypsometer

*Each morning the hypsometer should be checked for proper settings and re-calibrated:*

**To turn on the transponder:** Place the receiver against the transponder, press and hold the DME button until you hear two beeps.

**To turn off the transponder:** Place the receiver against the transponder, press and hold the DME button until you hear four beeps.

**To turn on for heights and calibration:** Press and hold the orange **ON** button.

**To turn on for measuring distance:** Press the DME button while unit is off.

**To turn off:** Press and hold DME and IR buttons simultaneously.

### Required Settings

Press the **IR** right arrow button to **SETUP** then press the **ON** button (works as an enter command) and make sure that units are

**METRIC; TYPE 2; P Offset 0.2; T HEIGHT 1.3; M DIST 0.0**

If any of these are not true use the arrow buttons to change settings up or down.

### Calibration

Once setup is complete, hit the **IR** button again to get to the **CALIBRATE** option.

Pre-measure a distance of exactly 10m and have one person standing with the transponder at the far end. Aim the instrument at the transponder (when in Calibrate mode) and press on. The instrument will automatically shut off when complete.

### Measuring Distance

With instrument turned off, press the “DME” button to access the distance function. Place transponder on object and point instrument at it from plot center. Press the DME button to measure the distance.

### Measuring Heights

Put instrument in Height mode (see above). Place the transponder at breast height on the tree of interest where there is a clear line of site to both the transponder and top of the tree. Look through the viewfinder and center the red cross on the transponder. Press and hold the orange on button until you hear a beep. The red cross should begin blinking. Center the cross on the point you want to measure the height of, and press and hold the orange on button again until it beeps. You can measure up to three heights and they will be saved on the instrument display.

## V. Methods (2)- Camera transparency field methods

8. Adjust the aim of the camera so that the trunk at the top of the canopy (as it diminishes into nothing) is just visible at the top of the image. If this is not possible (because too much sky would be visible) it is OK to have more of the trunk in the image.

9. Write down the photo file number as recorded on the camera and the associated quadrant (N, E, S, W) on the field sheet. Record any pertinent notes (such as if there were significant portions of other trees canopies in the photo, or if a 7 zoom wasn't enough to keep all sky out, or if the understory was so thick that is all you see, or if the tree was a leaner so there is lots of trunk in one picture and no canopy visible from the other side, etc).

10. Repeat this for all 4 quadrants of the tree so that each tree has 4 photos. Files will need to be downloaded and batteries charged each night.

### Magellin meridian gold GPS instructions

#### To navigate to plots:

Press and hold the **power** button for 3 seconds

Press **Enter**

Press **Go To User**

Select the **plot** using the up and down arrow keys

Press **Enter** on your plot of choice

Then you should see a screen with a bearing and distance...use your compass to see which direction to go and watch the distance magically decrease as you walk (if you are going in the right direction of course). If you don't see a screen with the bearing and distance, hit the NAV button to get a screen with that info. If you are getting nothing but an hourglass or --- then the satellite Gods are not cooperating and you may need to wait or go on faith.

#### To take new coordinates at plot center:

Press **NAV** until you see a screen with some number N and some other number W right below it. You should see something in this window that says WAAS Avg. with a time below it indicating how long it has been collecting data points.

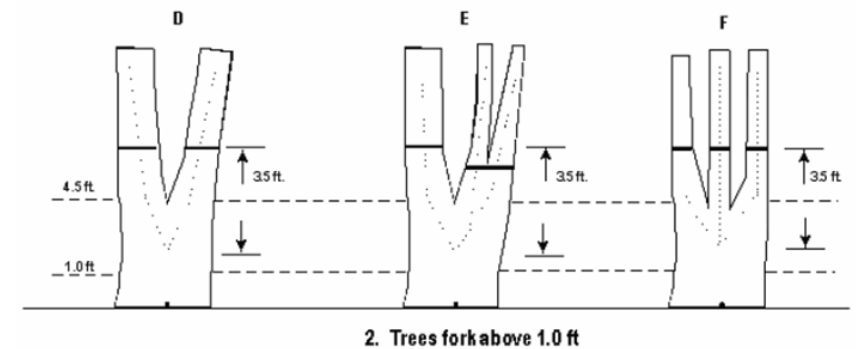
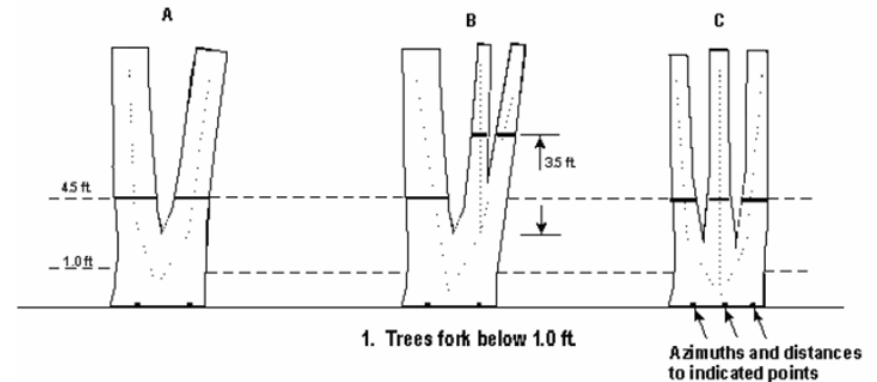
Let this sit at plot center for a while (say at least 5 minutes averaging), then record the coordinates (should say WGS 84 Lat/Long (in decimal degrees). Also record the ft. accuracy estimate.

Notes: If your unit has been averaging during your trek to the plot you may want to reset it (power down and then up again?) at plot center to restart the averaging fresh. The Nav button takes you to different windows with different viewing options. In and out will zoom you around your current location. Use menu to change system settings (you shouldn't have to mess with that). To power down you just hit power (do not hold it down this time) or you may have to hit power (again not holding down) and then enter (safety feature on the Hallett model).

## II. Trees (2)- Codes and Diameter Measurements

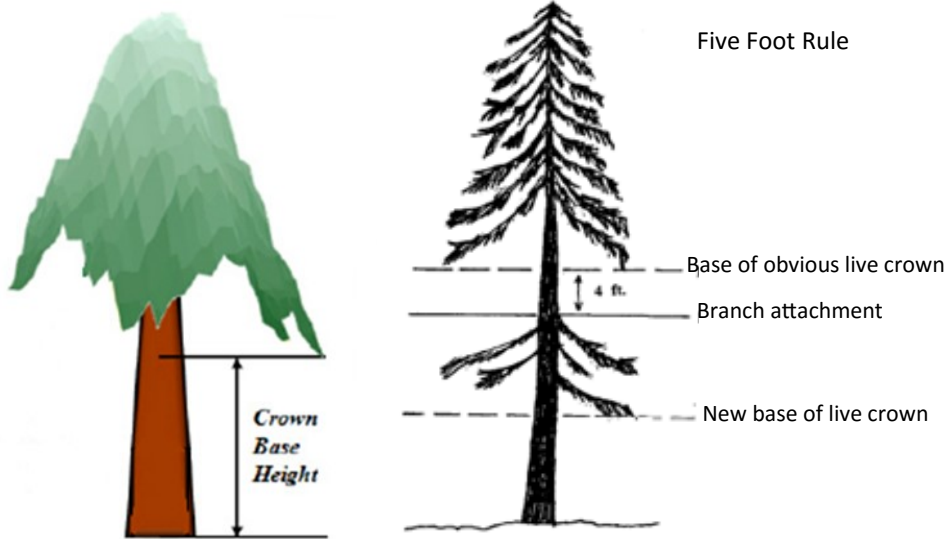
### Diameter Measurements

- Tree diameter is measured at breast height (1.37 m/4.5 ft.) on the uphill side of each tree 12.7 cm/5 inches or greater in diameter.
- If there is a bulge at DBH, measure just above the bulge, where the bole returns to normal.
- If the tree is forked (point where pith separates) below 30 cm/1 ft., consider each fork as a separate tree, and measure at 1.37 m/4.5 ft.
- If the tree is forked at 30 cm/1 ft or greater above ground or at 1.37 m/4.5 ft., measure the diameter up 1 m/3.5 ft. from the pith that joins forks.
- Trees forked above 4.5 ft. are considered one tree.
- Diameters are measured in centimeters.



## II. Trees (3) – Live Crown Ratio

The live crown base is an imaginary horizontal line drawn across the trunk from the bottom of the lowest live foliage of the “obvious live crown.” The “obvious live crown” describes the continuous flow of foliage from the top of the crown extending downward to some point below which there is little to no foliage. Most crown branches/twigs are included, but epicormics, twig/sprigs, and straggler branches (more than 5 ft. (1.52 m) below the crown) that usually do not contribute much to the tree’s growth are excluded. The base of the live branch/twig bearing the lowest foliage may be above or below this line.



### Five Foot Rule

If any live branch attachment is less than 5 feet (1.52 m) below this “obvious live crown” line, a new horizontal line is established as the base of the live crown. The new line is created at the base of live foliage on that branch. This evaluation is continued until no live branches greater than 1 inch (2.54 cm) in diameter at the point of attachment with the trunk are found within 5 feet (1.52 m) of the foliage of the lowest qualifying branch.

## V. Methods (1)– Camera transparency field methods

The object of this exercise is to capture as large an area of the canopy as possible in digital format for later estimation of light vs. dark pixels (i.e. percent transparency). We do this from 4 sides of the tree to ensure that as much of the canopy is captured as possible.

1. Enter set up and
  - a. make sure that the pop up flash is on manual so that it won't pop up and use the flash when lighting is low
  - b. Turn date and time off so that we don't have any text in our pictures
  - c. Turn auto review on so that you can immediately see if any of your pictures are bad and need to be retaken
2. Make sure that the camera is in the M position (on the little dial in the top right of the camera) so that you can adjust zoom and focus manually. (manual focus switch is on the left side, auto zoom in the big part of the lens and the focus is the smaller inner ring.)
3. While under this M setting hit the menu button and make sure that:
  - a. ISO is set to AUTO
  - b. Image size is down to 3MB...this gives us plenty of quality without taking up so much space on the camera and should give us a full days worth of memory before having to download.
  - c. P quality is set to fine
  - d. Record mode is normal
  - e. P effect is in the off position
  - f. Color is in the standard position
  - g. Everything else is set to normal
4. Start on the north side of the tree and continue around the tree at each of the cardinal directions going clockwise.
5. Stand with back to tree, zoom out, look up with back of your head touching the trunk and the camera looking straight up.
6. Zoom in until as much of the canopy as possible is visible without any areas outside of the canopy in the picture at all. You may have to zoom in or out in different amounts to ensure that you capture only the canopy of interest.
7. Manually focus on the top of the canopy and adjust focus. Adjust the aim of the camera so that the trunk at the top of the canopy is just visible at the top of the image. If this is not possible (because too much sky would be visible) it is OK to have more of the trunk in the image.
8. In some cases, it is not possible to get a clear view of the canopy. These photos should be skipped to avoid including incorrect information.
9. Write down the photo file number as recorded on the camera. Record any pertinent notes (such as if there were significant portions of other trees canopies in the photo, or if the maximum zoom wasn't enough to keep all gap out, or if the understory was so thick that is all you see, or if the tree was a leaner so there is lots of trunk in one picture and no canopy visible from the other side, etc).

## IV. Subplot—Animal Browse and Hemispherical Canopy Photography

### Animal Browse

Record evidence of deer/moose browse on vegetation in each subplot as either **Present** or **Absent**.

### Hemispherical Canopy Photography Methods

Goal: Take photos of full plot canopy at exact same location, with camera at same height above ground, exactly level, and top of the camera facing north.

Where to take photos: Center of the **subplot** (3 photos) **and** **microplot** (3 photos).

Where possible place center of tripod directly over plot marking stake to ensure consistent photo location

When to take photos: Under **cloudy conditions or early morning/late afternoon**; try to avoid taking hemispherical photos with the sun shining directly overhead

### Basic Procedure

1. Ensure the camera is set to **AUTO mode** on the left-hand dial
2. Attach camera to tripod. Set the tripod over the subplot/microplot center
3. Tip the camera all the way back so the **lens is pointing upward**
4. With lens cap on, place level on lens, adjust tripod legs until the **camera is level**
5. If hemispherical photos have been taken at this plot before, **adjust the height from ground to lens to match** the height used in the previous visit
6. Rotate the camera so the top of the camera faces magnetic north (0/360°) – ensure this by resting a compass on top of the lens cap and adjusting accordingly
7. **Ensure there are no obstructions to the canopy view** (e.g. shrubbery, low-canopy understory trees, etc.). If the camera view is obstructed, attempt to pull out of the way. If not possible, **do not take pictures** at that location. Still take 3 pictures at the other center point (subplot/microplot)
8. **Duck down**—ensure other people are out of photo by checking the viewer frame.
9. Hold the SHOOT button down halfway at first to ensure the camera is focused and then **take 3 consecutive pictures**
10. **Record** 3 unique picture IDs (file name as stored on camera i.e. DSC01593.jpg)
11. **Measure and record** the height from the ground to the top of the camera lens
12. **Replace the lens cap and return the camera to its carrying case...**

## II. Trees (4) – Crown Dieback

### Crown Dieback

Crown dieback reflects a tree's response to recent stress events. We estimate crown dieback as a percentage of the total live crown area that is occupied by fine twig dieback rounded up into 5% classes. To estimate the percent area occupied by dead twigs, it is helpful to project a two-dimensional outline around the **live crown** and denote the relative proportion occupied by fine twig dieback area. This can only be determined after a full examination of the tree from all sides; it is imperative that 2 or more individuals assess fine twig dieback from different angles of the tree and then discuss their estimates. When two individuals disagree, they discuss, and move around the tree to view it from different angles until an agreement can be reached. Lower and interior limbs are not included as dieback when dead twigs are due to natural pruning or self-shading.



Code	Definition	Code	Definition	Code	Definition
00	No crown	35	31-35%	70	66-70%
05	1-5%	40	36-40%	75	71-75%
10	6-10%	45	41-45%	80	76-80%
15	11-15%	50	46-50%	85	81-85%
20	16-20%	55	51-55%	90	86-90%
25	21-25%	60	56-60%	95	91-95%
30	26-30%	65	61-65%	99	96-100%

Note: Class code is the percentage of the upper limits of the class, i.e., Code 10 is 6% to 10%, etc

## II. Trees (5)— Foliage Transparency, Defoliation and Discoloration

### Foliage Transparency

Foliage size and density are valuable indicators of the current health of trees. Foliage transparency is a rating of the amount of skylight visible through the live, normally foliated portion of the crown, excluding areas occupied by branches. A two-dimensional crown outline is projected around all living branches to estimate foliage transparency in 5% intervals. Two certified raters are required to make the transparency estimates from opposite sides of the tree. Large gaps between branches should not be included in the foliage transparency rating. When foliage transparency in one part of the crown differs from another part, an average foliage transparency is estimated. It is important to check with binoculars to differentiate defoliated branches from dieback areas. Defoliated areas are included in this metric. When defoliation is severe, branches alone will still screen much of the light but are excluded from the foliage outline. Rate the area as if the light was penetrating those branches. A tree that is recently defoliated with only one or two leaves remaining would have a transparency rating of 99.



### Defoliation and Discoloration

Defoliation is an estimate of leaf area reduction caused by a disturbance factor: insect, disease or weather factors, and includes leaves with missing sections or in severe cases leaves with only veins remaining.

<u>Defoliation classes</u>	<u>Discoloration classes</u>
0 None to trace defoliation.	0 None to trace discoloration.
1 Less than 30 percent of crown defoliated.	1 Less than 30 percent of crown discolored.
2 31 to 60 percent defoliation.	2 31 to 60 percent discoloration.

## IV. Subplot— Invasive plant codes

Species Code	Species Name	Latin Name
1	Barberry, Japanese and common	<i>Berberis thunbergii</i> , <i>B. vulgaris</i>
2	Buckthorn: common or glossy	<i>Rhamnus cathartica</i> , <i>R. frangula</i>
3	Bittersweet, oriental	<i>Celastrus orbiculatus</i>
4	Honeysuckle: Bell, Japanese, Amur, Morrow or Tartarian	<i>Lonicera X bella</i> , <i>L. japonica</i> , <i>L. maackii</i> , <i>L. morrowii</i> , <i>L. tatarica</i>
5	Multiflora Rose	<i>Rosa multiflora</i>
6	Norway Maple	<i>Acer platanoides</i>
7	Autumn or Russian Olive	<i>Elaeagnus umbellata</i> , <i>E. angustifolia</i>
8	Japanese knotweed	<i>Fallopia japonica</i> ( <i>Polygonum cuspidatum</i> )
9	Garlic Mustard	<i>Alliaria petiolata</i> ( <i>A. officinalis</i> )
10	Privet	<i>Ligustrum vulgare</i>
11	Tree of Heaven	<i>Ailanthus altissima</i>
12	Wild Chervil (cow parsnip)	<i>Anthriscus sylvestris</i>
13	Burning Bush or winged Euonymus	<i>Euonymus alatus</i>
14	Goutweed	<i>Aegopodium podagraria</i>
15	Amur Maple	<i>Acer ginnala</i>
99	Other (please specify)	

Abundance Code	Description	Invasive Plant Density
1	Infrequent occurrence	1 to a few present
2	Sparsely throughout	1-2 plants together, in a few locations
3	Localized patches	several plants together, occurring in a few locations
4	Frequent in stands	dense areas of plants occurring in a few locations
5	Densely throughout	high populations making up understory and/or regeneration





Other weather damage– 505

Hosts: Any species.  
 Description: Ice, snow, or wind damage such as broken branches, broken or bent boles; drought symptoms such as brown foliage or early color.

### III: Microplot– Seedlings, Saplings and Ground Cover

If possible, record measurements on the microplot before other subplot measurements to avoid any inadvertent trampling. Seedlings and saplings are recorded if the stem emerges from the ground within the radius of the microplot.

#### Seedlings

All established seedlings are tallied by species, excluding this year’s germinants. This includes all established stems with a DBH less than 1 in (2.54 cm). Established hardwood seedlings will have leaves, not just cotyledons. On occasion, multiple seedlings are growing from the same root sprout. Each seedling is counted individually. Seedling species can be difficult to determine as leaf shapes can vary and differ from more mature plants. See Appendix F for photos and identification of common seedling species.

Seedlings are counted in two height classes, which are determined by whether the species is a conifer or a hardwood.

Seedling Type	Class 1	Class 2
Conifer	< 6 in (15 cm) tall	>= 6 in (15 cm) tall
Hardwood	< 12 in (30 cm) tall	>= 12 in (30 cm) tall

#### Saplings

Saplings are 1 in (2.54 cm) up to 5 in (12.7 cm) in diameter. Record the distance and azimuth from the microplot center to the sapling, the species, DBH, and status as living or dead. To avoid confusion with the trees on the larger subplot, sapling ID numbers start at 100. If an existing tallied sapling grows to 5 in (12.7 cm) DBH, it is recorded as a tree, with a new distance and magnetic azimuth measured from subplot center. A sapling retains the same ID number when it moves to being a tree. If a sapling is found to be dead two years in a row, it is removed from the sapling list.

## II. Trees (6) —Special Damage Codes

Bole Damage Code	Bole Damage Agent	
441	Animal browse	<b>Animal Damage</b>
444	Beaver damage	
445	Porcupine damage	
446	Sapsucker damage	
447	Other animal damage	
707	Asian long-horned beetle	<b>Borers and Insects</b>
101	Balsam woolly adelgid	
104	Beech bark scale only	
111	Defoliation > 20%	
103	Hemlock woolly adelgid	
710	Sirex wood wasp	
108	Sugar maple borer	
102	White pine weevil	
110	Other bark beetles	
711	Emerald ash borer	
109	Other borers	<b>Cankers, Conks and Diseases</b>
104	Beech bark scale only	
105	Beech bark necrotia only	
106	Beech bark disease	
201	Butternut canker	
206	European larch canker	
203	Eutypella canker	
204	Hypoxylon canker	
202	Nectria canker	
207	Other canker	
208	Conks and other indicators of decay	
209	Dwarf mistletoe	
210	White pine blister rust	
<i>Human-related</i>		
702	Logging damage > 20% of circumference	
<i>Weather-related</i>		
708	Cracks and seams	
501	Wind-thrown/uprooted	
505	Other weather damage	

## II. Trees (7)—Special Damage Codes



### Animal Browse—441

Hosts: Any species bark & twigs

Description: Missing twigs, multiple stemmed regeneration; torn bark with teeth marks.



### Beaver damage— 444

Hosts: Hardwoods found close to water.

Description: Lower bole with wedge-shaped feeding.

### Porcupine damage— 445

Hosts: Bark and twigs of many species, notably eastern hemlock.

Description: Upper bole with bark missing and obvious feeding.



## II. Trees (16)—Special Damage Codes



### Logging damage > 20% of circumference— 702

Hosts: Any species.

Description: An opening or series of openings where bark has been removed exposing inner wood. Usually on lower bole, but occasionally higher.



### Cracks and seams— 708

Hosts: Any species.

Description: Vertical separations that break out to the surface often called frost cracks >5 feet in length. Seams develop as the tree attempts to heal.



### Wind-thrown/uprooted— 501

Hosts: Any species. "Fir waves" common.

Description: Roots torn from ground along with trunk.

## II. Trees (15)—Special Damage Codes



### Conks— 208

Hosts: Any species.

Description: Fruiting bodies indicating internal decay on the main bole or crownstem.

### Dwarf mistletoe-209

Hosts: Primarily black spruce, occasionally other spruces and larch.

Description: Dense clustering of twigs or branches arising from a common point.

### White pine blister rust— 210

Hosts: Pine species

Description: Symptoms vary with disease stage including red needled branch flag, depressed branch cankers with color contrast, and resin exudate from bole.

## II. Trees (8)—Special Damage Codes



### Sapsucker damage— 446

Hosts: Many species.

Description: Rows of small holes which can surround part of nearly all of tree stem.

### Other animal damage— 447

Hosts: Any species.

Description: Bark removed from horn/antler rubbings.



### Asian long horned beetle— 707

Hosts: Many hardwoods

Description: Bark scars at oviposition sites; circular exit holes; insect is large (ca. 1 inch), black with white spots, but no spot where thorax intersects wings, and long antennae.



## II. Trees (9)—Special Damage Codes



**Balsam woolly adelgid— 101**

Hosts: Balsam fir

Description: Damage symptoms includes gouting, swellings around buds and branch nodes. Insect is tiny, covered with white wool fibers, usually grouped at bark lenticels or around branch and twig nodes.



**Beech bark scale only— 104**

Hosts: American beech

Description: Tiny insects with woollike wax covering often in bark cracks or other protected areas.



**Defoliation > 20% - 111**

Hosts: Any species.

Description: Feeding or loss of leaves or needles that affects more than 20% of the crown.

## II. Trees (14)—Special Damage Codes



**Hypoxylon canker— 204**

Hosts: Quaking aspen and other poplars.

Description: Young cankers appear as sunken bark with yellowish-orange areas. Older cankers become blistered with blackened center.



**Nectria canker— 202**

Hosts: Many hardwoods

Description: Target shaped open wound still actively expanding at outer rim.



**Other canker— 207**

Hosts: Any species.

Description: Obvious mycelium conks.

## II. Trees (13)—Special Damage Codes



**Butternut canker— 201**

Hosts: Butternut.

Description: Sunken bark, oozing brown wounds with internal decay.



**European larch canker— 206**

Hosts: All larch (tamarack) species.

Description: Bulging stem with black, resin exudate.



**Eutypella canker— 203**

Hosts: Maple species, including box elder.

Description: Ugly, irregular shaped bulge on bole with wood exposed in non-uniform pattern.

## II. Trees (10) —Special Damage Codes



**Hemlock woolly adelgid— 103**

Hosts: Eastern hemlock.

Description: Small white fluffy masses covering wingless insects found at base of needles.



**Sirex wood wasp— 710**



**Sugar maple borer— 108**

Hosts: Sugar maple

Description: insect bores diagonally below bark surface leaving a distinct line, but sometimes a sunken area with bark covering.



## II. Trees (12)—Special Damage Codes



**White pine weevil— 102**

Hosts: White pine; sometimes other pines and spruce species.

Description: Insect feeding kills leader; results in trees with multiple stems or irregular shaped stem.



**Other bark beetles— 110**

Hosts: Any species.

Description: Exit holes



**Emerald ash borer— 711**

Hosts: All ash species.

Description: Most obvious symptom is bark blanding, woodpecker activity resulting in bark removal. Small emerald colored beetle emerges from wood in early June.

## II. Trees (11) —Special Damage Codes



**Other borers— 109**

Hosts: Any species.

Description: Symptoms include exit holes and galleries.



**Beech bark necrotic only— 105**

Hosts: American beech.

Description: Tarry spot from necrotic infection; other symptoms include reddish fruiting bodies (perithecia)



**Both beech scale and necrotic— 106**

Hosts: American beech.

Description: Diseased trees with craterlike scars.

# Supplements

Full Species list	- 2
Invasive Species Pictures	- 4
Tree Seedling Pictures	- 9

## Full Species Code List

Code	Species
12	balsam fir ( <i>Abies balsamea</i> )
57	juniper; cedar ( <i>Juniperus</i> )
68	eastern red cedar ( <i>Juniperus virginiana</i> )
71	tamarack ( <i>Larix laricina</i> )
90	spruce ( <i>Picea</i> )
91	Norway spruce ( <i>Picea abies</i> )
94	white spruce ( <i>Picea glauca</i> )
95	black spruce; bog spruce ( <i>Picea mariana</i> )
97	red spruce ( <i>Picea rubens</i> )
105	Jack pine ( <i>Pinus banksiana</i> )
125	red pine ( <i>Pinus resinosa</i> )
126	pitch pine ( <i>Pinus rigida</i> )
129	eastern white pine ( <i>Pinus strobus</i> )
130	Scots pine ( <i>Pinus sylvestris</i> )
241	arborvitae; northern white cedar ( <i>Thuja occidentalis</i> )
261	eastern hemlock ( <i>Tsuga canadensis</i> )
299	dead conifer species
310	maples ( <i>Acer</i> )
313	ashleaf maple; boxelder ( <i>Acer negundo</i> )
314	black sugar maple ( <i>Acer nigrum</i> )
315	striped maple ( <i>Acer pensylvanicum</i> )
316	red maple ( <i>Acer rubrum</i> )
317	silver maple ( <i>Acer saccharinum</i> )
318	sugar maple ( <i>Acer saccharum</i> )
319	mountain maple ( <i>Acer spicatum</i> )
351	red alder ( <i>Alnus rubra</i> )
355	European alder ( <i>Alnus glutinosa</i> )
356	serviceberry ( <i>Amelanchier</i> )
370	birch ( <i>Betula</i> )
371	yellow birch ( <i>Betula alleghaniensis</i> )
372	sweet birch ( <i>Betula lenta</i> )
375	paper birch ( <i>Betula papyrifera</i> )
378	mountain paper birch ( <i>Betula cordifolia</i> )
379	gray birch ( <i>Betula populifolia</i> )
400	hickory ( <i>Carya</i> )
402	bitternut hickory; pignut ( <i>Carya cordiformis</i> )
407	shagbark hickory ( <i>Carya ovata</i> )

## Tree Seedling Supplement—Deciduous cont...



### Basswood

Simple, alternate, heart-shaped leaves, typically with uneven base. Seedlings exhibit unique palmately-lobed cotyledons. This feature distinguishes Basswood from Hobblebush (not shown). Hobblebush also has opposite leaves in pairs, with rust-colored hairs on the undersides and prominent veins.

Similar Species: Hobblebush (not shown—see above)



### Quaking Aspen

Simple, alternate leaves, broadly ovate to nearly round, dark green and lustrous (shiny) above, paler below. Long petiole, often longer than the leaf, that is flattened so that the leaves appear to quake/tremble in the slightest breeze. Finely serrate with somewhat rounded teeth.

Similar Species: Bigtooth Aspen (Not shown)



### Red Oak

Simple, alternate leaves, 5-11 lobed with coarse-toothed, bristle-tipped lobes tapering from broad bases and round, oblique, rounded sinuses. Younger leaves without deep sinuses, but still coarsely-toothed and bristle-tipped. Typically dull green on the upper-side, seedlings turning red in fall.

Similar Species: Black Oak (Not shown), White Oak (Not shown)



## Tree Seedling Supplement—Deciduous cont...



### White Ash

Pinnately compound, opposite leaves usually 7-9 per leaflet. Leaves entire or obscurely serrate near tip, usually with small bumps on the underside (papillose). Stout, grooved petioles.

Similar Species: Mountain Ash , Shagbark Hickory



### Mountain Ash

Pinnately compound, alternate leaves usually 9-17 per leaflet, 3-4x as long as broad. Leaves sessile or nearly so except for the terminal leaf, finely or sharply serrate above the entire base. Stout, grooved petioles.

Similar Species: White Ash, Shagbark Hickory



### Shagbark Hickory

Pinnately compound, alternate leaves almost always 5 per leaflet, terminal leaf almost always larger than the lateral. Leaves finely serrate and fringed with minute, dense tufts of white hair upon most of the serrations in full sunlight. Fragrant when crushed.

Similar Species: White Ash, Mountain Ash

Code	Species
531	American beech ( <i>Fagus grandifolia</i> )
540	ash ( <i>Fraxinus</i> )
541	white ash ( <i>Fraxinus americana</i> )
543	black ash ( <i>Fraxinus nigra</i> )
544	green ash ( <i>Fraxinus pennsylvanica</i> )
600	walnut ( <i>Juglans</i> )
601	butternut ( <i>Juglans cinerea</i> )
602	black walnut ( <i>Juglans nigra</i> )
660	apple ( <i>Malus</i> )
701	eastern hophornbeam; hophornbeam ( <i>Ostrya virginiana</i> )
740	cottonwood ( <i>Populus</i> )
742	Eastern cottonwood ( <i>Populus deltoides</i> )
743	bigtooth aspen ( <i>Populus grandidentata</i> )
746	quaking aspen ( <i>Populus tremuloides</i> )
761	pin cherry ( <i>Prunus pensylvanica</i> )
762	black cherry ( <i>Prunus serotina</i> )
766	American plum ( <i>Prunus americana</i> )
800	oak ( <i>Quercus</i> )
802	white oak ( <i>Quercus alba</i> )
804	swamp white oak ( <i>Quercus bicolor</i> )
823	bur oak ( <i>Quercus macrocarpa</i> )
826	chinkapin oak ( <i>Quercus muehlenbergii</i> )
832	chestnut oak ( <i>Quercus prinus</i> )
833	northern red oak ( <i>Quercus rubra</i> )
837	black oak ( <i>Quercus velutina</i> )
901	black locust ( <i>Robinia pseudoacacia</i> )
920	willow ( <i>Salix</i> )
935	American mountain-ash ( <i>Sorbus americana</i> )
951	American basswood ( <i>Tilia americana</i> )
972	American elm ( <i>Ulmus americana</i> )
975	slippery elm ( <i>Ulmus rubra</i> )
998	unknown dead hardwood spp.
999	unknown live spp.

## Invasive Plant Supplement



Japanese



Common

### Barberry, Japanese and common—1

An armed deciduous shrub in the barberry family growing 8 to 10 feet in height and 6 feet in width. The bark is gray having sharp spines at nodes and the inner wood is yellow. Spines are double- or triple- branched. The arched hanging branches have clusters of leaves that are small, toothed, ovate, alternate, dull green above and grayish below.



Common



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Glossy

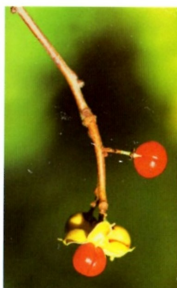
Suzan Campbell, MNFI

### Buckthorn, common or glossy—2

Deciduous woody shrub or small tree that ranges from 3 to 7.5 m (10-25 ft) in height. Leaves: Simple, dark green leaves, with toothed margins and 3 to 5 pairs of prominent leaf veins, which curve as they approach the leaf tip. The leaves are alternate, but some may appear opposite. Twigs often have thorns at their tips, between the terminal buds.



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### Bittersweet, Oriental—3

Leafy, deciduous, sprawling, twining vine. Stems. Vines are many-branched, light brown to gray in color, may be green. Surface of smaller branches dotted with tiny, lighter-colored bumps (lenticels). Leaves. Arranged alternately along the stem, leaves vary widely in shape and can be round, oblong or teardrop-shaped with finely toothed margins and tapering point.



### Paper Birch

Simple, alternate leaves ovate or triangular with coarse, doubly-serrate teeth. Rounded, entire leaf base. Very shade intolerant, typically growing in open, disturbed areas and large canopy gaps. Lacking wintergreen odor/taste of Yellow Birch.

Similar Species: Yellow Birch



### American Elm

Simple, alternate leaves obovate-oblong with coarse doubly-serrate teeth that appear as a smaller tooth on top of a larger one. Often rough to the touch on the upper-side of the leaf, thick and firm. Leaf base is asymmetrical, though this may be harder to notice on very young seedlings.

Similar Species: American Beech



### Black Cherry

Simple, alternate leaves narrowly oval to oblong-lanceolate or acuminate. Dark green and lustrous/shiny on upper-side of leaf, paler beneath with dense, reddish-brown pubescence along both sides of the midrib near the blade base. Finely serrate with incurved teeth. Petioles with small red glands near the blade base. Pin Cherry lacks the pubescence along the midrib.

Similar Species: Pin Cherry (not shown)

## Tree Seedling Supplement—Deciduous cont...



### Mountain Maple

Simple, opposite leaves with 3 very shallow lobes. Leaves coarsely and irregularly serrate, larger teeth than Striped Maple. Soft, whitish pubescence on the underside of the leaf.

Similar Species: Sugar Maple, Red Maple, Striped Maple



### American Beech

Simple, alternate leaves oblong and acuminate (tapering to a point) with coarse teeth regularly-spaced. Leaf veins terminate at each tooth on the leaf margin. American Elm is doubly-serrate with a rough leaf texture on the upper-side.

Similar Species: American Elm



### Yellow Birch

Simple, alternate leaves oval, apex acuminate (tapering to a point) with coarse teeth regularly-spaced. Leaves sharply doubly-serrate with short petioles. Twigs and buds have a wintergreen flavor/odor when chewed/crushed. Often grow on decaying logs, stumps, and moss, also mineral-rich soil.

Similar Species: American Beech, Paper Birch

## Invasive Plant Supplement cont.



### Honeysuckle: Bell, Japanese, Amur, Morrow, Tartarian—4

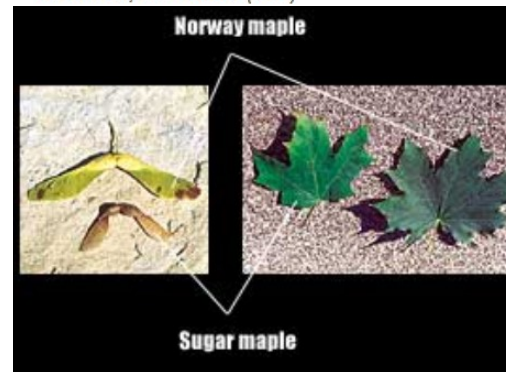
Egg-shaped leaves range from 1 to 3 inches in length and are arranged oppositely along stems. Begin flowering May to June and bear small (< 1 inch), very fragrant tubular flowers creamy white to pink to crimson. *L. morrowii* and *L. tatarica* produce ¼ inch red berries from mid-summer through early-fall; *L. maackii*'s dark-red berries don't ripen until late-fall; *L. japonica* produces dark-purple or black berries in the fall. Stems of all four are hollow.



Bill Johnson, James Miller (inset)

### Multiflora Rose—5

Plant: multi-stemmed shrub, sometimes climbing vine, with arching stems and recurved thorns. Leaves: divided into five to eleven sharply toothed leaflets; leaf stalks with fringed stipules (paired wing-like structures). Flowers, fruits and seeds: clusters of showy, fragrant, white to pinkish, 1 in. wide flowers appear during May; small bright red fruits, or rose hips, develop during the summer and remain on the plant through the winter.



### Norway Maple—6

Large deciduous tree, dense canopy, 60' high when mature. Similar to native sugar maple except: broken leaf emits milky sap, upright green flower clusters, widely spreading winged fruit, regularly grooved bark, fall color always yellow. Leaves: Opposite, five lobed, coarsely toothed, pointed. Flowers: Flat-topped upright cluster, yellowish green, appearing with the leaves, blooming in May.

## Invasive Plant Supplement cont.



Russian Olive



Autumn Olive

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### Autumn or Russian Olive—7

Russian Olive: Large deciduous shrub or small tree, up to 25' tall. Spreading branches form into a dense rounded crown. Thin bark comes off in narrow, elongate, fibrous strips. Twigs are very flexible and bear a terminal spine. Leaves: Alternate, distinctive silver-gray lance shaped. Flowers: Yellow spicy-fragrant flowers are borne either individually or in small clusters in the leaf axils, blooming in late spring.



### Japanese Knotweed—8

Shrub-like, arching perennial herbaceous plant, over 10' high, reddish-brown stems, smooth, stout hollow and swollen at the joint where the leaf meets the stem. Leaves: Alternate broadly oval and pointed at the tip, about 6" long, 3 - 4" wide. Flowers: Greenish-white, branched clusters which grow from leaf axils, near the end of stems, blooming in late summer.

### Garlic Mustard—9

Garlic odor produced when the leaves of the plant are crushed. Basal leaves of an immature plant dark-green, kidney shaped, round teeth along the edges; average size 6 to 10 cm in diameter. The petiole of first year plants are 1 to 5 cm long. In second year, alternating stem leaves become more triangular shaped, 1 to 5 cm long, sharper teeth. Leaf stalks of mature plants are hairy.



## Tree Seedling Supplement—Deciduous



### Sugar Maple

Simple, opposite leaves, usually 5-lobed but sometimes 3-lobed when young; lobes sparingly wavy-toothed with broad sinuses that are rounded at the base. Lobes lacking serrate margins exhibited by the similar species listed below.

Similar Species: Red Maple, Striped Maple, Mountain Maple



### Red Maple

Simple, opposite leaves, usually 3-lobed but sometimes 5-lobed when young; lobes similar to Sugar Maple, but with many serrations around the margins. Leaves typically whitish and glabrous on the underside. Distinguished from Striped and Mountain Maple by deep sinuses similar to Sugar Maple.

Similar Species: Sugar Maple, Striped Maple, Mountain Maple



### Striped Maple

Simple, opposite leaves, 3 shallow lobes above the middle that taper at the end. End lobe broadly triangular. Leaves finely and sharply doubly-serrate, usually with 3 prominent, palmate veins. Distinguished from Mountain Maple by tapering lobes and finer/double serrations on the leaf margins.

Similar Species: Sugar Maple, Red Maple, Mountain Maple

## Tree Seedling Supplement—Conifers cont...



### Black Spruce

Roundish needles sharp and stiff to the touch, spirally arranged around shoot, appearing to spread in all directions. Dark rusty-greyish pubescence on the twigs. Shortest needles (0.5-1.5cm) of the spruces, appearing incurved. Needles exude a menthol odor when crushed. Grows in extremely wet, boggy habitat.

Similar Species: Red Spruce, White Spruce



### White Spruce

Roundish needles sharp and stiff to the touch, spirally arranged around shoot, appearing crowded on upper side of branch due to twisting of bottom needles. Lacking pubescence on the twigs. Dark bluish-green needles that exude a disagreeable odor when crushed ("skunk spruce"). Grows in riparian and alluvial soils and edges of bogs.

Similar Species: Red Spruce, Black Spruce



### White Pine

Needles bundled in clusters of 5, long (7-12cm), slender, straight, soft and flexible. **Red pine similar but with needles in bundles of 2 (not shown).**

Similar Species: Red Pine (not shown—see above)

## Invasive Plant Supplement cont.



### Privet—10

Privets are evergreen shrubs that may reach 30 feet in height. These shrubs have opposite, leathery, oblong leaves that terminate with a pointed tip. The stems are opposite or whorled and red tinged with many raised lenticels and the bark is light gray. Many small, white, and fragrant flowers appear in April to June. Drupes containing 1 to 4 seeds mature from July to March.



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### Tree of Heaven—11

Plant: deciduous tree reaching 70 ft. Twigs with smooth, pale gray bark, and twigs that are light chestnut brown, especially in the dormant season; leaves, stems and some flowers have a strong odor likened to cat urine or rotting peanuts or cashews. Leaves: alternate, large (1-4 ft. long), compound, with 11-25 smaller leaflets, each with one to several glandular teeth near the base. Flowers, fruits and seeds: large showy clusters of small yellowish-green flowers produced during June



### Wild Chervil (cow parsnip) - 12

This is a biennial or short-lived perennial plant in the carrot family. It grows three to four feet on average but sometimes grows over six feet. Stems are hollow, branched and hairy. Fern-like leaves are nearly hairless and compound. Leaves form a basal rosette the first year. White flowers with five petals are produced in umbrella-like clusters that bloom from late May to early July during the plant's second year.

## Invasive Plant Supplement cont.



### Burning Bush/Winged Euonymus—13

Deciduous shrub. Occasionally, four corky ridges appear along the length of young stems. Opposite, dark green leaves < 2 in long, smooth, rounded and tapered. Leaves turn bright crimson to purple in fall. Flowers inconspicuous, greenish yellow, 4 petals. Flowers develop in the spring and lay flat against the leaves. Fruit are reddish capsules that split to reveal orange fleshy seeds.



### Goutweed—14

Most leaves basal, leafstalk attached to underground stem. Leaves divided into three groups of three leaflets. Leaflets toothed, sometimes irregularly lobed. "Wild" type foliage medium green; a commonly planted variegated form has bluish-green leaves with creamy white edges. Small, white, five-petaled flowers produced in mid-summer



### Amur Maple—15

Amur maple is a small tree up to 20' high with a broad crown, but sometimes pruned as a hedge. Twigs are smooth and light colored. Leaves: Opposite, longer than wide and have three shallow lobes and double toothed edges, turning a brilliant red in fall. Flowers: Fragrant flowers appear in loose clusters with young leaves in May and June. Fruit: Numerous reddish, two-winged, inch long fruit mature in late summer.

## Tree Seedling Supplement—Conifers



### Eastern Hemlock

Flattened needles that are soft and flexible, glossy green above and paler green below; 2 white lines on the underside along the midrib. Needles spiraled around shoot, but appearing two-ranked due to twisting of the petiole. Shorter, smaller needles than Balsam fir without the resinous, "Christmas tree" scent when crushed.

Similar Species: Balsam Fir



### Balsam Fir

Flattened needles with white lines underneath, sessile (attached directly to stem) with disc-like appearance where needle meets stem. Longer, larger needles than hemlock, with distinct resinous "Christmas tree" scent when crushed. Needles spiral around shoot, though sometimes appearing two-ranked.

Similar species: Eastern Hemlock



### Red Spruce

Roundish needles sharp and stiff to the touch, spirally arranged, appearing to spread in all directions. Reddish pubescence on the twigs, sometimes whitish pubescence when young. Raised, bumpy appearance where needles attach. Needles exude an orange rind odor when crushed. Generally found in upland/high elevation environments.

Similar Species: Black Spruce, White Spruce