Natural Areas Conservancy

Upland and Forest Ecological Assessment

Protocol

Acknowledgements:

This sampling design was developed by Natural Areas Conservancy staff with help from Natural Resources Group and USDA Forest Service. Standard methods were adopted and adapted to best suit an urban environment. See reference list for a full description of adopted methods.

Funding

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Introduction

This document includes the field protocol for sampling the upland and forest ecological assessment method. This method includes metrics for sampling forest structural layers, including the soil, forest floor, coarse woody material, herbaceous and woody vegetation, forest canopy, and human and ecological impacts.

Project Focus

The Natural Area Conservancy's forest and upland ecological assessment was designed to create an unbiased, standardized and replicable methodology to evaluate the health and condition of forest and upland areas that results in quantitative measures. The study area for this assessment includes all upland forest, meadow, woodland and scrublands in New York City parkland Forever Wild Boundaries. Using this protocol across the landscape, we will create a range of values for each of the metrics and habitat types. The synthesis of these results will define the overall condition of the natural spaces within our forest and uplands. This quantitative information about the conditions of natural systems in NYC will be used to create strategies to manage, restore and preserve parkland and enable us to measure change over time, and evaluate and adapt our practices.

The ecological assessment is a study to determine baseline conditions for forest and uplands in New York City. A subsample of the plots established are marked permanently so they can be re-measured later in time to assess change in conditions. This assessment does not specifically evaluate current management or result in a management decisions, although it is intended to provide management direction in the future by describing the range of conditions of the system which could be used to identify goals and objectives for metrics.

Study Areas

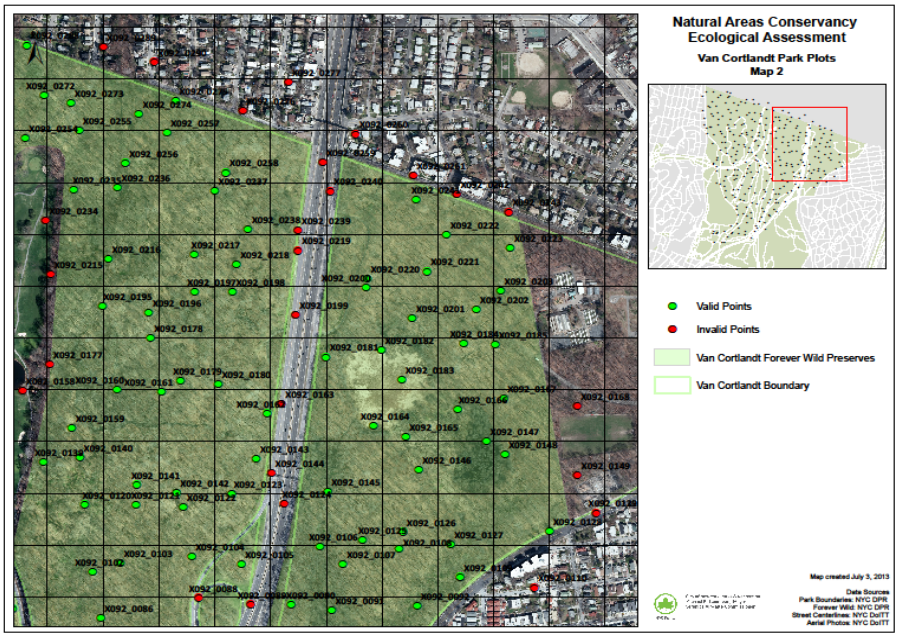
New York City Parkland designated *Forever Wild* was sampled using the NAC Ecological Assessment protocol during the months of May-October 2013-2014. Forever Wild Nature Preserves were identified by NYC Park ecologists and experts based on size, shape, connectivity and proximity, soil, ecological integrity and floral and faunal rarity. The 51 Forever Wild Nature Preserves located within New York City's parks represent more than 8,200 acres of natural areas throughout the City, and include a variety of habitat types, roughly 5,600 acres are forest and upland.

Sampling Design

Using ArcGIS, a two hectare grid was laid over all of New York City using *Create Fishnet*. One random point was generated in each hectare grid cell using *Create Random Points*. After a point was generated in each grid cell any points that were not located within the predefined study areas (New York City Parkland, Forever Wild Preserve and Natural Areas) were removed using the *Erase Tool*. Points within

tidal wetlands (according to boundaries set by the NRG/NAC wetlands team) were also removed. Each remaining point within the Forest/Upland sampling area was then given a unique plot ID. The aerial images, plot locations and park boundaries were uploaded to the Trimble GPS. Each team will use the Trimble GPS to navigate to the plot center (within 1 meter accuracy). At each point a 10m radius circular plot will be established where a variety of vegetation and ecological metrics will be sampled.

Picture 1. Map showing the 2 hectare grid and random sampling point in Van Cortlandt Park (Bronx).



Metrics Collected

The metrics chosen to sample in the forest and upland assessment cover a variety of ecological layers and attributes within a forest and upland including forest structure, species richness, canopy health, understory, midstory and overstory composition, down woody material and human impacts. This type of plot level data is meant to be averaged for a habitat type or site boundary so an average of the conditions found within a habitat type or site can then be described.

Table 1. Metadata for the upland and forest data metrics.

Metric	Description	Units
Plot ID	Unique number associated with the random sampling point (plot center)	text
Park ID	Unique code associated with a NYC park	text
Date	Date data was collected	mm/dd/yyyy

Plot Personnel	Staff who collected the data	initials
Start/End Time	Start and end time of data collection	HH:MM
Site Photo ID	PlotID and Image number for a photo taken at each plot facing North	PLOTID_1234
Canopy Transparency Canopy Photo ID	Plot ID and image number for the four canopy photos taken at 5m from plot center at the cardinal directions. Canopy photos will be analyzed to show % light transparency through the canopy.	PLOTID_1234
Downed trees	Raw count of any trees >10cm DBH fallen or uprooted within the 10m radius plot	Count
Overstory tree metrics	Each tree > 10cm DBH within plot the following data is collected: Species, Diameter at Breast High (DBH), health metrics (Dieback, Discoloration, Defoliation, Vigor), vine species and stage of growth.	Species, cm, % class
Midstory tree metrics	Each woody species 2-10cm DBH within the plot measured. The following data is collected: Species, vine stage of growth, deer or mammal herbivory, leaf defoliation.	Species, cm, % class
Vine Class	Any herbaceous or woody vine that is latched onto a midstory or overstory tree is recorded. Species and stage of growth are recorded. Three stages of growth are considered: 1) Below DBH 2) Above DBH but below canopy 3) In the Canopy	species, class 1, 2, 3
Groundcover	Percentage of vegetation, bare soil, rock, dumping/trash, course woody material, fine woody material, leaf litter/organic matter, path/impermeable surface. Measured as a % out of 100 in 1m x 1m x 1m subplots (4 subplots/plot).	%
Herbaceous species cover	Percentage of individual species within 1m x 1m subplot.	% species
Soil Sample	A top soil sample is collected and air dried. In the lab it will be analyzed for pH, texture, organic matter. A sub-sample of soils are sampled differently and analyzed for soil microbe community abundance and composition. A check box is selected once the sample has been collected.	yes or no
Coarse Woody Debris	Any dead and downed woody material >10cm. Measure the length and diameter (of both ends) of each piece that crosses a 20m line intercept.	cm
Fine Woody Debris	Any dead and downed woody material 0.25-10cm. Three categories are measured, small, medium, large. Tally each piece as it crosses the line intercept (5m for small and medium, 8m for large)	count
Leaf Litter Depth	Measured at 4 points along the CWD/FWD line transect.	cm
Impacts	Any human (i.e. path, trash, infrastructure) or ecological impacts (canopy gap, wildlife) found within the plot are identified and a %class of the space they take up within the 10m radius plot. Impacts are recorded within plot and within a 20m buffer outside the plot. If a impact is outside the plot no %class is recorded, just the presence of the impact.	presence, % class
Additional Species	Any species not captured in the overstory, midstory, herbaceous, or vine classes are recorded from a 5 minute survey of the plot.	Species

Field Protocol

The text below is a manual for field staff to reference when sampling data. All staff should be trained prior to implementing data collection. During the 2014-2014 NAC field staff used an electronic data form for all data collection. Paper datasheets could also be used.

Navigating and Setting up Plot

In the field, navigate to plot center (PC) using the Trimble GPS. Locate the PC (<1m accuracy) with less than one meter accuracy by zooming to the PC until the scale is one meter and the location is stable over the PC. Insert a chaining pin into the ground to mark the PC location.

If the PC is valid, record the plot as “visited”. If the plot is not accessible, unsafe, or not in a natural area as defined below, do not and record as visited but “invalid”. A plot is considered invalid if more than 50% of the plot is in standing water, landscaped lawn, or a paved road. Make a note in the GPS of the reason the plot is invalid and move to another plot center. Record the pre-determined plot ID and begin collecting data.

Establishing Plot Center

All metrics associated with overstory (trees), tree saplings and shrubs will be collected in one, 10 meter- radius circular plot centered on each PC. Establish the plot boundaries by measuring 10 meters from PC using a meter tape and marking with pin flags.

Measure the 10 meter horizontal distance to account for topography and relief within the plot. Mark the cardinal directions with two pin flags, establishing four overstory quadrants (NE, SE, SW, and NW).

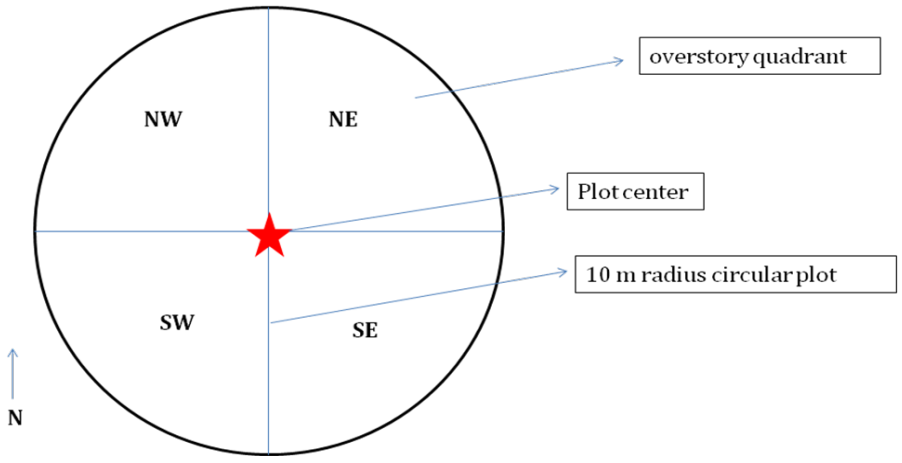


Figure 1: Fixed Area Plot

General Plot Information

Plot Layout and Site Information

To begin each plot, record the pre-determined plot ID, the field staff collecting the data and the time you arrived at PC (refer to the data entry protocol for how to enter information into the toughbook or datasheet).

Take a general site photo by standing at the (south cardinal boundary mark) plot boundary facing north. If an obstacle makes the photo un-representative, move clockwise to the next cardinal direction. Record the image number (along with the plot ID) and final cardinal direction you are facing taking the photo. Record the Image number using the plot id and last 4 digits of the photo ID (X092_0021_0342).

To determine slope, stand at the highest point at the plot edge, facing (down) the slope. Two crew members stand at the high and low end of the plot and use a clinometer to determine the slope (%). A helpful tip if the slope is not evident is to imagine in which direction a flow of water would go. If the slope is undulating and not apparent, do not adjust your measure, collect the slope from the plot boundaries. To determine the aspect of the plot (cardinal or sub-cardinal direction of the slope), use the compass.

Canopy and Site Pictures

Measurements of canopy closure can provide information on the growth conditions of seedlings, saplings and sub-dominant trees, and can be used to guide the level of canopy manipulation necessary for successful natural regeneration and enrichment planting.

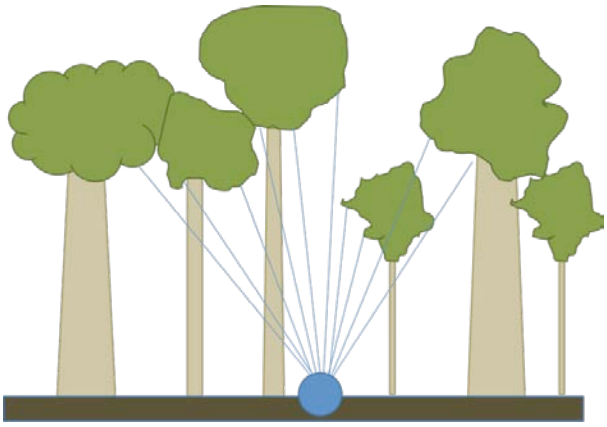
Take four canopy photos at 5m in cardinal directions. All photos should be taken facing the forest canopy. There are several sources of variation that can be introduced during image acquisition that can affect the calculation of transparency.

Picture2. Canopy photo

- Hold the camera horizontally on top of the DBH stick (1.5 m) with the shutter release button towards you.
- Hold the camera and make sure it is not tilted
- Stand facing towards the center of the plot.
- In order to avoid glare from direct light (especially important during sunny midday) check each picture immediately after taking it. If you see glare, reshoot the picture and make a note on your field datasheet about the presence of glare. If you cannot avoid the glare, make a note and move on to the next task.
- Label each photo with the plot ID and image number on the camera. (X092_003_0345)

Visual Estimate

As an additional metric of canopy closure to supplement the photographs, we will also visually estimate canopy closure. The canopy closure is the proportion of the sky hemisphere obscured by vegetation when viewed from a single point. The term canopy openness is frequently used in the ecological literature, which is the complement of canopy closure (openness = 100 – closure, i.e. the proportion of the sky hemisphere not obscured by vegetation).



To visually estimate the canopy closure look up at the sky into your canopy closure PVC tube and estimate what percentage of your visual cone of the view is obstructed by tree branches and leaves.

This is your estimate of canopy cover. (10-39% of the sky is obstructed by tree canopies), moderately closed (40-69% of the sky is obstructed by tree canopies) or closed (70-100% of the sky is obstructed by tree canopies). Record the visual estimate at 5m from plot center in cardinal directions.

Overstory

Metrics

Trees are considered single or multi-stemmed woody plants greater that 10 cm DBH (1.30 m ~4.5 feet above the ground). Trees have the potential of reaching the canopy. All stems, dead or alive greater than 10 cm at DBH will be recorded in the 10 m radius plot. Trees are alive if they have any living parts (leaves, buds, cambium) at or above the point of diameter measurement. Trees that have been temporarily defoliated could be still alive. If the stem is broken and still attached below DBH, the stem is tallied as a live tree where DBH would occur if the tree was intact. Therefore as long as the stem is attached and the tree is live at DBH, it is tallied. A tree that is dead but leaning >45 degrees from the perpendicular axis to the ground is no longer considered a standing dead tree.

Begin your overstory measurements in the northeast plot quadrant and move clockwise measuring each individual stem > 10 cm DBH. If trees or saplings are rooted on the plot edge, the tree is considered 'in' the plot if more than 50% of the bole is inside the plot. The following metrics will be collected for each tree:

Species

Record the four-letter USDA code for each individual tree. If the species is unknown, record as "Unknown" and collect a sample (see Appendix A) to identify later. See the data entry protocol.

Unknown, Unlisted, Dead Herbaceous Plants

If there is an unknown species record unknown and make notes on the closest taxon you are able to identify. Collect the species following the protocol to press an unknown specimen. If the tree is dead and you can identify the species, record the species and record vigor 5 (described in the canopy metrics section below) and NA for all other canopy metrics.

Vines

If vines are present on any portion of the tree, record the vine species and the Class as below. List all vine species that are on the tree. If the code is unknown, record "Unlisted" and record the genus, species, or common name in the data form. If the species is unknown, record as "Unknown" and collect a sample to identify later (see Appendix A).

If you are unable to determine the species because it is in the crown, list as unknown in the dropdown and Crown Vine in the taxon and take a picture. Note the photo number in plot notes if you think it will be possible to identify.

The stage of growth is classified into three classes (Figure 2: Vine's growth stage classes)

Class 1: Vine present below (DBH)

Class 2: Vine present above DBH

Class 3: Vine present in the tree canopy. If no tree canopy is present (a snag) record the canopy is considered 50% of the main bole height.

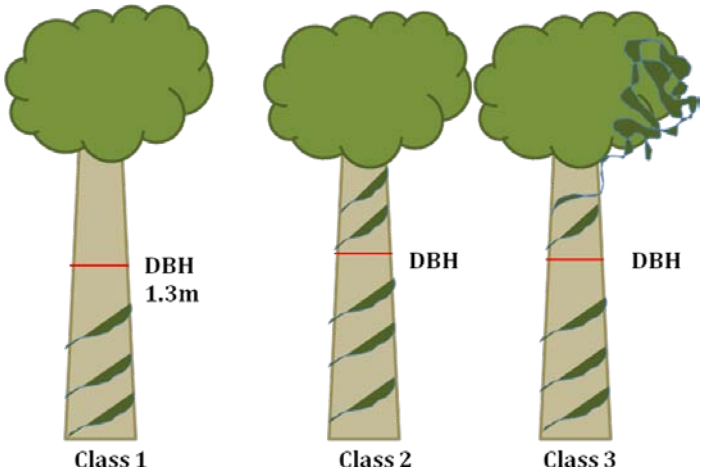


Figure 2: Vine's growth stage classes.

Tree Diameter

Using a DBH tape measure the tree diameter at 1.3 m above the ground on the uphill side of the tree. Record the diameter of each tree to the nearest 0.1 cm, rounding down. If a tree is split into 2 or more stems, record each stem separately and assign a rank (primary stem, secondary, etc.) based on descending size. Sprouts are measured in the overstory if they arise from the from the base of the primary stem and are ≥10 cm diameter at the point of measurement. If a sprout is <10cm DBH but still greater than 1/3 the diameter of the primary stem it is considered a midstory stem (secondary). Use the guidelines below to determine what to do in cases where there are irregularities in the formation of the tree or bole or growth situation.

Special growth situations

Slope (Figure 3(A): Measure diameter at 1.3 m from the ground along the bole on the uphill side of the tree.

Obstruction e.g. a pile of woody material or other obstruction that would impact the height at which DBH is measured. Measurement remains at 1.3m. (Figure 3 (B)).

Rooted on Rock: (Figure 3(C)): Measure DBH at 1.3 m from the root collar.

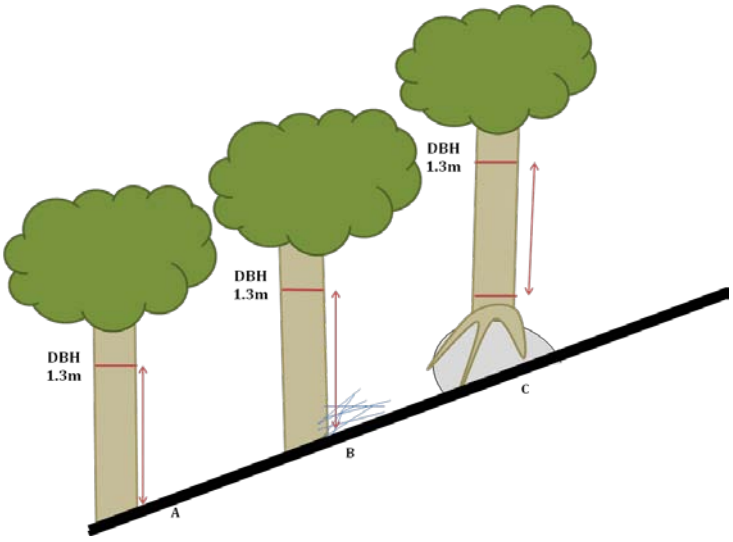


Figure 3: Special growth situation: Slope, Obstruction, and Rooted on rock

Leaning tree: (Figure 4: Leaning tree Measure diameter at 1.3m. from the ground along the bole. The 1.3m. distance is measured along the underside face of the bole.

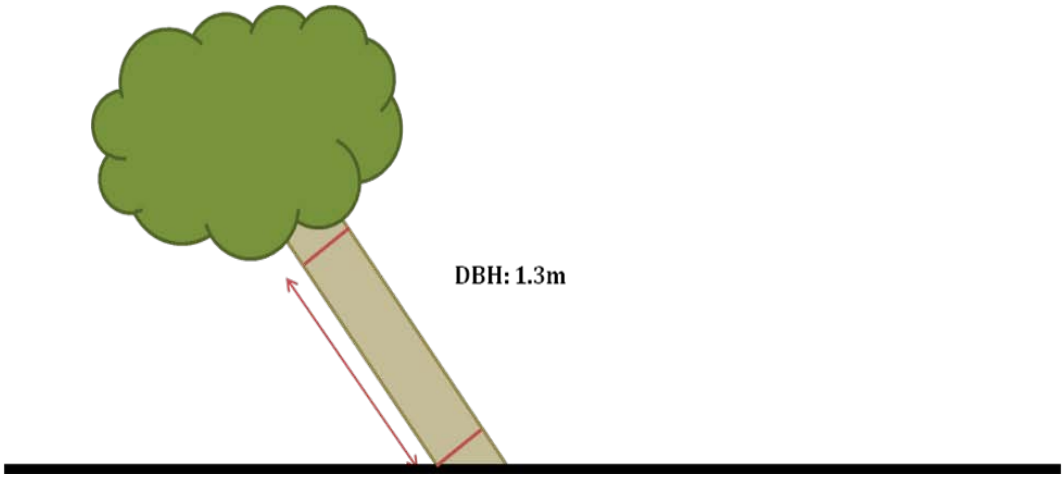


Figure 4: Leaning tree

Trunk Swell: If a trunk swell is found at DBH height, measure at 0.5 m above the end of the swell or bottleneck. (Figure 5 A). If at point of measurement the diameter is less than10 cm, record the average between the diameters 0.5 m above and below 1.3 m.(Figure 5 B)

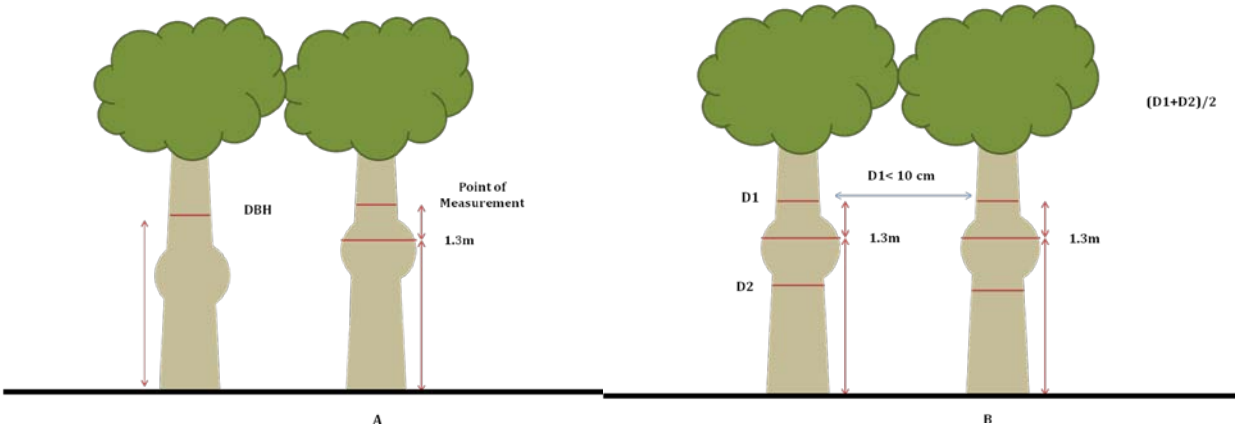


Figure 5: Trunk swell

Trees with small irregularities at DBH: On trees with small bumps, depressions, and branches at DBH, measure the diameter immediately above the irregularity at the place it ceases to affect the normal stem form.

Forked trees: All forking rules for overstory apply to midstory. Treat stems and forks the same. If the fork occurs below DBH but above the ground each fork is listed as a secondary stem. In order to qualify as a fork, the stem in question must be greater than one third the diameter of the main stem and must branch out from the main stem at an angle of 45 degrees or less. Forks originate at the point on the bole where the piths intersect. For secondary stems or forks follow all rules for measuring DBH for the primary stem. Only one major fork is considered for each tree, additional branching or forking on secondary stems is not considered.

A. Forked trees below DBH If the pith intersection of the fork is above ground (but still below 1.3m) the stems are considered one tree with multiple stems or forks. The stem with the largest diameter is considered the primary stem, the second largest is considered secondary stem and so on. DBH for each stem is taken at 1.3 meters. Health metrics and vine classes are taken for each stem (Figure 6A).

B. Multiple forks are possible if they all originate from approximately the same point on the main stem. In such cases, measure the DBH on all stems at 1.3 meters if the fork occurs below DBH. If the stem is less than 10cm DBH but still >1/3 the DBH of the primary stem count the individual as a midstory (secondary) stem. Any forks that originate below DBH but <1/3 the DBH of the primary stem are not

considered a forked tree, and should be included as part of the primary stem for all other measurements. Any forks that originate below DBH but >45 degrees are not measured as an additional stem but included in the crown metrics for the overstory tree. For trees with low branches >45 degrees or wide leaning forks make a note in your plot notes.

Table 1 DBH of any tree forks must be >1/3 DBH of the primary stem. Below are examples of DBH meausrements of forked trees.

DBH Overstory or Midstory Primary stem (cm)	To qualify as a secondary the stem/fork in question must be > than 1/3 the diameter of the main stem (cm)
2	>2
3	>2
4	>2
5	>2
10	> 3
15	> 4.5
20	> 6
25	> 7.5
30	> 9
35	> 10.5
40	>12
50	>15

C. Trees forked at or above 1.3 m (Figure 5: Trunk swell are counted as a single tree. If a fork occurs at or immediately above 1.3 m, measure diameter below the fork just beneath any swelling that would inflate DBH (Figure 6 C).

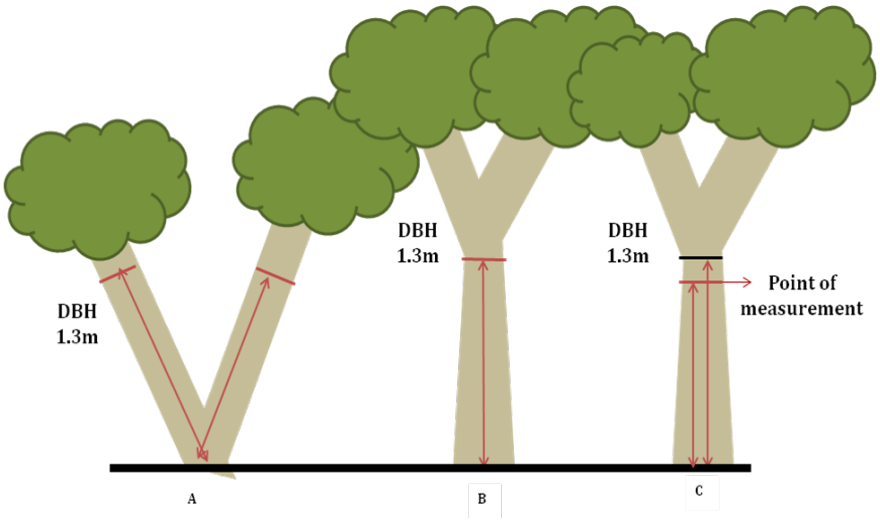


Figure 6: Forked trees

Stump sprouts: Stump sprouts originate between ground level and 1.3 m on the boles of trees that have died or been cut. Stump sprouts are measured at DBH (Figure 7). If the sprout originates at 1.3m measure the diameter 0.5m above the origin of the sprout. Stump sprouts are handled the same as

forked trees, with the exception that stump sprouts are not required to be 1/3 the diameter of the dead bole (must be 10 cm or greater).

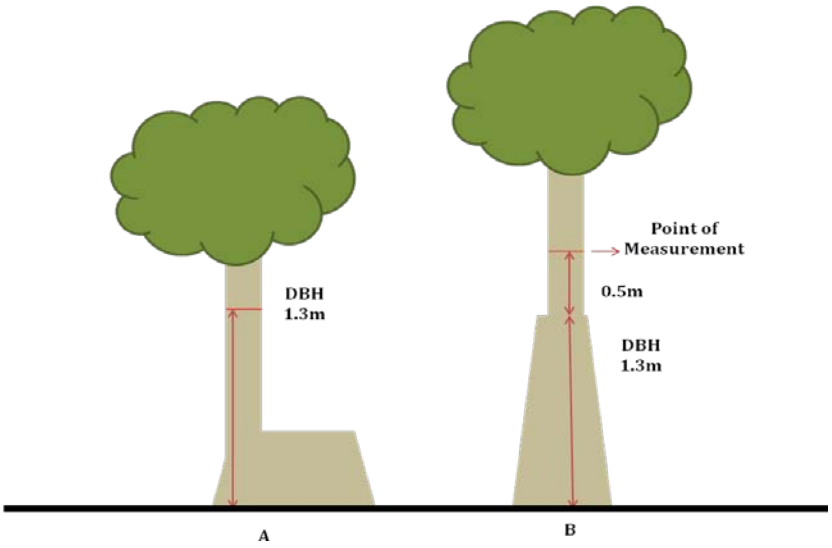


Figure 7: Stump sprouts

Independent trees that grow together: If two or more independent stems have grown together at or above DBH, continue to treat them as separate trees. Estimate the diameter of each.

Missing wood or missing bark: Do not reconstruct the DBH of a tree that is missing wood or bark at the point of measurement. Record the diameter, to the nearest 0.1 centimeter, of the wood and bark that is still attached. If the tree has a localized abnormality at DBH, apply the procedure of measuring an irregular DBH.

Live windthrown tree: A tree touching the ground. Measure from the top of the root collar along the length to 1.3 meter (Figure 8: Live windthrown tree). Note: this situation is different from a leaning tree as it is measured from the root collar. If the tree forks follow all the rules accordingly as if the tree were vertical.

Tree like branches coming off a downed tree. When downed trees (touching the ground) have vertical tree like branches coming off the main bole. Tree-like branches must be less than 45 degrees from the vertical axis to the ground coming off the main bole.

a. If the main bole of the tree is touching the ground and pith of the main bole is above the litter/duff layer and the main stem is alive at or above DBH consider the main bole a live windthrown tree along with any tree-like branches above DBH. Use the same forking rules specified for a forked tree, and take all measurements accordingly.

b. For any live downed trees with tree-like branches at or below DBH treat each tree-like branch as a secondary stem. Each tree is measured 1.3 m from the root collar. Take independent health metrics for each tree-like stem.

c. If the pith of the main tree bole is below the litter and duff layer at DBH treat each tree-like branch as a separate tree regardless of where along the main stem the tree like branch originates; take DBH from the ground, not necessarily from the top of the down bole. However, if the top of the main tree bole curves out of the ground towards a vertical angle, treat that portion of that top as an individual tree originating where the pith leaves the duff layer.

13. Curved bole: Measure along the bole on the uphill side of the tree

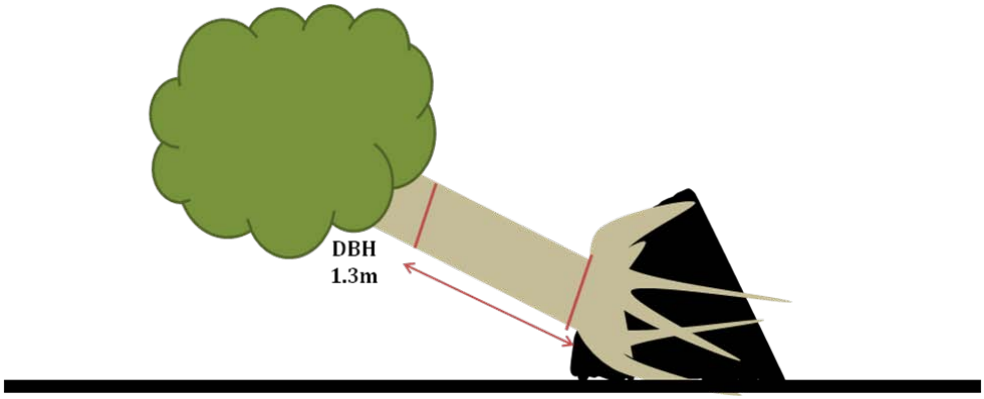
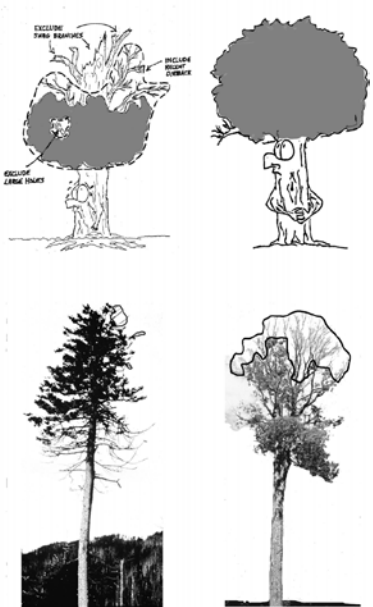


Figure 8: Live windthrown tree

Health metrics

For all metrics, two staff will independently determine a value for each metric from different vantage points. Staff should be half to a full tree-length from the base of the tree to obtain a good view of the canopy. If staff disagree about a measurement, they should discuss the reasons for their ratings until an agreement is reached, or use the methods below to resolve the situation. All metrics were based on USFS tree health methods.

Crown Dieback



CROWN DIEBACK reflects the severity of recent stresses on a tree. Dieback is recent mortality of branches with twigs, which begins at the terminal portion of a branch and proceeds toward the trunk. Dieback is only considered crown dieback when it occurs in the upper and outer portions of the tree. When whole branches are dead in the upper crown, without obvious signs of damage such as breaks or animal injury, consider it crown dieback. Dead branches in the lower portion of the live crown are assumed

to have died from competition and shading. Dead branches in the lower live crown are not considered as part of crown dieback, unless there is continuous dieback from the upper and outer crown down to those branches. The crown base is the lowest live foliage not including sprigs or leaves below on the main stem. Be sure to eliminate vine foliage when determining the crown area. Assume the perimeter of the crown is a two-dimensional outline from branch-tip to branch-tip, excluding snag branches and large holes or gaps in the crown. Estimate CROWN DIEBACK as the percentage of dieback the live crown area using the following classes: 0%, 1-5%, 6-15%, 16-25%, 26-35%, 36-45%, 46-55%, 66-75%, 76-85%, 86-95%, 96-100%.

Leaf Discoloration

CROWN DISCOLORATION is abnormal change in leaf tissue color (i.e., not from change in season) that reflects the severity of recent stresses on a tree. Estimate the percentage of leaf discoloration from the amount of live leaf tissue in the crown (using the same percentage scale as the dieback): 0%, 1-5%, 6-15%, 16-25%, 26-35%, 36-45%, 46-55%, 66-75%, 76-85%, 86-95%, 96-100%.

Leaf Defoliation

Defoliation is defined as loss of leaf foliage due to insects, disease, or other stressors. Estimate the percentage of leaf defoliation from the amount of live leaf tissue in the crown. From the estimate record the appropriate class from the DROPDOWN. Please note defoliation differs from dieback because does not look only at the crown but at the entire live leaf tissue.

The following classes are used to define leaf defoliation:

Defoliation Class	Defoliation
0	none to trace
1	< 30% defol
2	31 to 60% defol
3	> 60% defol

Crown Vigor

This is a USFS method that that cumulatively incorporates dieback, twig mortality, defoliation, and missing crown into one metric. Vigor rating is determined for all trees > 10 cm DBH. All metrics will be looked at independently and ultimately a final crown vigor rating will be determined based on the cumulative score of all metrics.

1: Healthy. Tree appears to be in reasonably good health. No major branch mortality; crown is reasonably normal with the stand situation (dominant co-dominant, intermediate, suppressed); less than 10% branch and twig mortality, defoliation or discoloration present.

2: Slight decline. Branch mortality, twig dieback, or foliage discoloration present in 10-25% of the crown broken branches or crown area missing based on presence of old snags is < 26%.

3: Moderate decline. Branch mortality, twig dieback, or foliage discoloration present in 26-50% of the crown; broken branches or crown area missing based on presence of old snags is <50%.

4: Severe decline. Branch mortality, twig dieback, or foliage discoloration present in >50% of the crown; broken branches or crown area missing based on presence of old snags is >50%;

5: Tree is dead. Either standing or down (but >130 cm tall) Phloem under bark has brown streaks; few epicormic shoots may be present on the bole.

Mid-story Trees and Shrubs

Species

Within each 10m radius plot, all saplings (trees 2-10cm DBH) and shrubs >2cm DBH are recorded and tallied by species. For each individual shrub or sapling you do not need to record the exact DBH. For each midstory stem record herbivory (class) and vine class. Many individual shrubs and saplings have several stems. The primary stem has the largest DBH. Multiple stems or forks are tallied only if they qualify in diameter and angle, see below. Each additional stem of the same individual is listed as secondary, tertiary and so on.

In order to qualify as another stem it must be greater than one third the diameter of the main stem and must branch out from the main stem at an angle of 45 degrees or less (Figure 9B). Forks originate at the point on the bole where the piths intersect.

Forked sapling or shrub below DBH (Figure 10 B) are considered separate saplings and vine, herbivory data is collected per stem. The DBH is measured at 1.3 m. Multiple forks are possible if they all originate from approximately the same point on the main stem. In such cases, measure the DBH on all stems at 1.3 m.

Sapling or shrub forked at or above 1.3 m are counted as a single stem. If a fork occurs at or immediately above 1.3 m, measure diameter below the fork just beneath any swelling that would inflate DBH

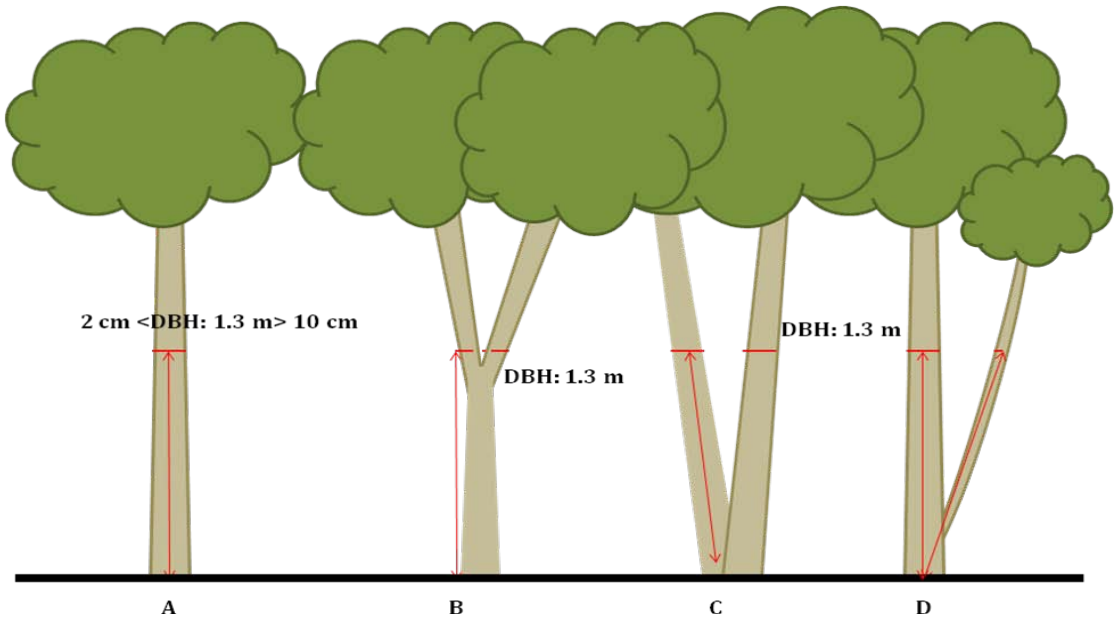


Figure 9

Vines

Vines are recorded, along with their stage of growth class (Class 1, Class 2 or Class 3), on individual stem. Only record vines that are alive.

Evidence of mammal herbivory (presence/absence) will be recorded for each stem and recorded as deer or rabbit browse.

Herbivory as leaf defoliation, will be quantified in the following classes: (0%, 1-5%, 6-20%, 21-50%, 51-75%, 76-100%). This is estimated off herbivory of live tissue (such as holes in a live leaf).

If there is an unknown species record the closest taxon you are able to identify. Collect the species and follow the protocol to press an unknown specimen.

Understory

Understory plant species include all herbaceous, woody seedlings <2cm DBH and vines. To sample the cover of understory plants four 1m x 1m subplots will be established within each 10m radius plot. The four plots will be established and measured along the cardinal direction tapes at 5 meters from PC in each direction (Figure 11. Facing away from plot center the lower left corner of 1m x 1m subplot will be at the 5m mark.

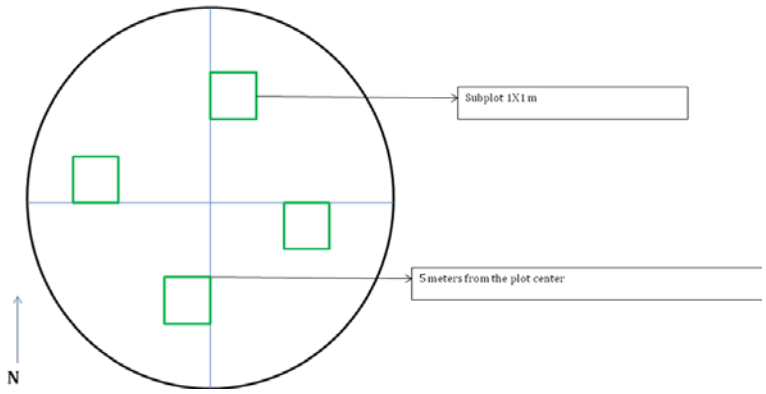


Figure 10: Understory subplots

For all measurements, two staff will independently determine a value from different vantage points. If staff disagree about an estimate, they should discuss the reasons for their ratings until an agreement is reached. Two cover estimates will be collected, Aeral Cover and Species Cover.

Aeral Cover

Aeral Cover, percent of total area of the subplot from 1m looking down of any substrates classified into the following categories:

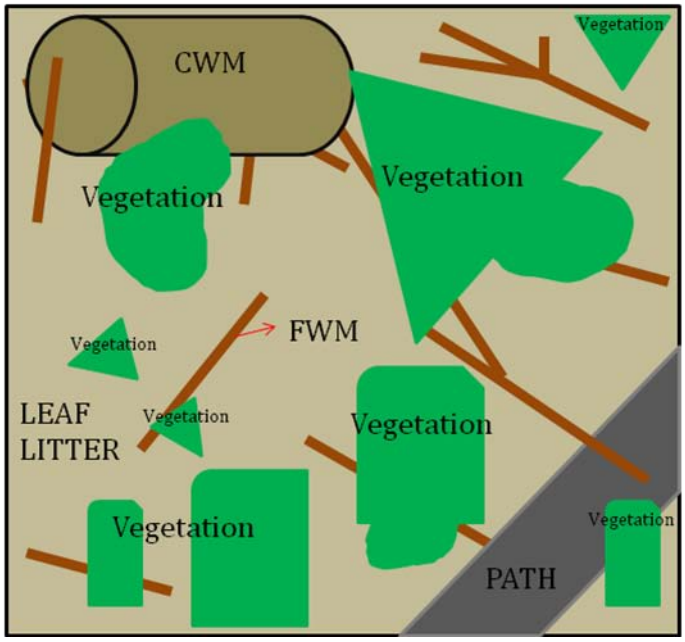
- Vegetation
- Coarse Woody Material
- Fine Woody material
- Leaf Litter
- Impermeable Surface (other constructed material, asphalt path etc)
- Bare Soil
- Trash/Dumping
- Live Wood
- Rock

Areal cover is expressed as a percentage of the subplot area occupied by each class from the perspective looking down from 1 m. Areal cover includes vegetation and non-vegetation cover. All cover is looked at two- dimensionally from an aerial view and overlap is ignored. The sum of the areal cover of all substrates will equal 100%. Record the percentage of cover for the visible(top) layer of vegetation within the entire subplot Vegetation included in the 1m x 1m subplot includes all live herbaceous, woody and shrub species less than 2cm DBH of below 1 m. Vines in the subplot less than DBH height are also recorded. For areal cover any substrate that is present but <1% is rounded up to 1%.

Any plants overhanging and not rooted in the subplot are not recorded. However, do record rhizomatous and trailing species (vines, *Rubus* spp.,*Toxicodendron*) in the plot even if not fully rooted.

Do not record an estimate for any substrate that occurs below the uppermost visible layer of vegetation (i.e. bare soil below vegetation).

Record "live wood" for a live overstory or midstory tree or shrub or root. If a sprout occurs at the base of a overstory/midstory tree, the sprout is treated like a woody seedling and given a % cover estimate (Figure 12: Areal cover).



Areal Cover:
Vegetation Cover + Non Vegetated Cover= 100%

Figure 11: Areal cover

Species Cover

Individual species cover is measured in the each 1m x 1m sub-plot.

The individual species cover is the cover for each plant species evaluated independently from the cover of other species. Cover estimates for each individual species are estimated out of 100 percent and recorded. Cover estimates for the all species in the exceed 100 percent (Figure 14) but an individual species cannot have a cover that exceeds 100 percent. If one or more individuals of the same species partially overlap, the total cover for that species is considered the percentage occupied by the species not by the single individual (Figure 15).

For species with < 0.5% cover record the species and list the percent as 0%. For species with a cover estimate between 0.5 and 1% record 1%.

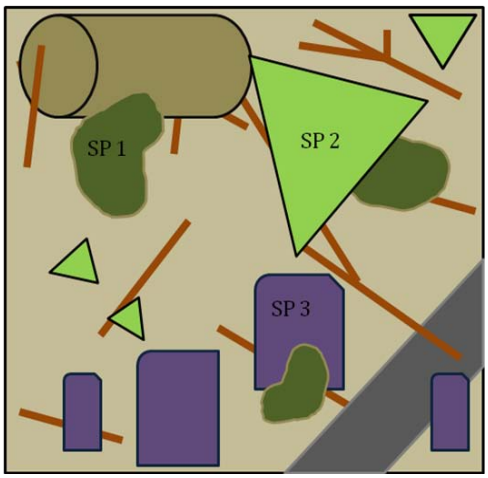


Figure 12: Species cover

All herbaceous plants (of any height) and woody plants less than 2 cm DBH (seedlings and sprouts) of any height will be given a species cover estimate (Figure 13: Species cover) based off of the outline of the plant canopy.

All vines (herbaceous and woody*)* that trail into the plot regardless of their root origin are also given a cover estimate. Aerial vines are also given a percent cover estimate if they are on top of other vegetation within the subplot. Aerial vines are not measured if they occur above 1m. If a vine is trailing on "live wood"(at the base of an overstory/midstory tree) below 1m, it is given a percent cover estimate.

Woody tree seedlings and sprouts (<2 cm DBH) will be given a cover estimate and individuals are tallied by species.

Any plants overhanging and not rooted in the subplot (e.g. tree branches, herbs, shrubs) will not be recorded (vines will be recorded).

When estimating cover in the field, always work in teams of two to find a consensus on the value. Using a grid system in the field will help estimate the cover. Cross-check total Areal "vegetation" percent cover estimates with the sum of percent vegetation cover accounting for overlap: no individual species should have a cover estimate greater than the total vegetation cover recorded in the areal cover.

If the species is unknown, record as "unknown" and describe to genus, family or other identifier take a photo and/or collect a sample. Check protocol "how to collect a sample" Record the sample identifier and follow the protocol for the "How to collect and press unknown species".

If the species is known but is not listed in the drop-down, record as ”unlisted” and record in “Taxon” section any useful information.

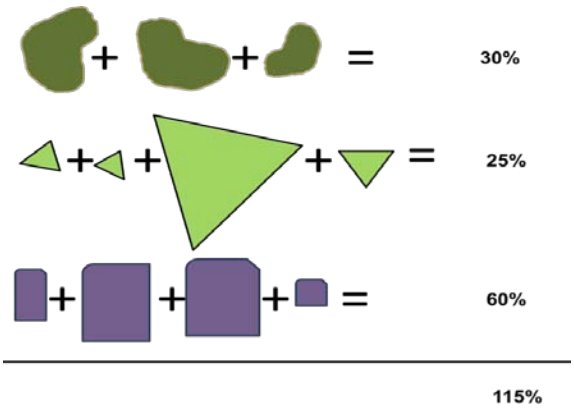


Figure 13. Species Cover can add up to more than 100% for all species within a subplot.

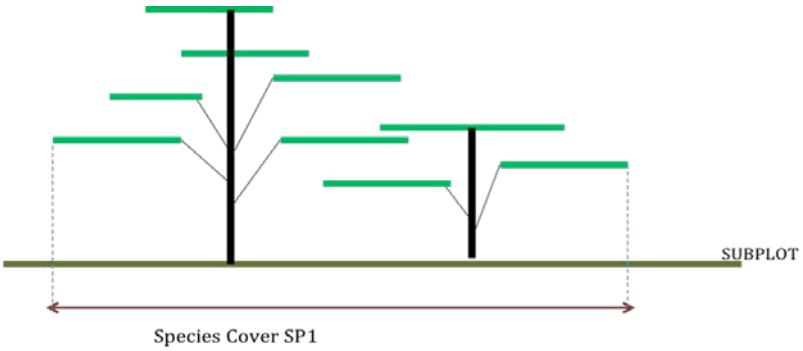


Figure 14. Don't count leaf overlap of the same species as separate cover.

Herbivory classes will also be tallied into the following classes: (0%, 1-5%, 6-20%, 21-50%, 51-75%, 76-100%) for the live foliage on the combined vegetation cover of each species. Also record if there is evident herbivory from deer, rabbits or both as a presence or absence.

Special cases: Moss, Lichens and fungi are not included as “vegetation” in the areal cover category but are recorded as separate categories. They are also given separate percent cover measurements.

Down woody material

Down woody material (DWM) is an important component of forest ecosystems. DWM is dead woody material on the ground in various stages of decay. As part of the upland/forest sampling we will collect Coarse Woody Material (CWM), Fine Woody Material (FWM,) leaf litter depth, and duff depth.

DWM helps describe the:

- Quality and structure of wildlife habitats.
- Structural diversity within a forest.
- Fuel loading and fire behavior.
- Carbon sequestration – the amount of carbon tied up in dead wood.
- Storage and cycling of nutrients and water – important for site productivity.

The following protocol is modified from the USDA Forest Service Forest Inventory and Analysis (FIA) method Phase 3 Field Guide – Down Woody Materials, Version 5.1, October, 2011. Down woody materials estimated by the FIA program are: coarse woody, fine woody, litter, herb/shrubs, slash, duff, and fuel-bed depth.

In this assessment , CWM includes downed or standing dead trees, shrub boles, large limbs, and other woody pieces that are severed from their original source of growth and on the ground >10 cm diameter and < 150cm in height. CWM also includes dead trees >10 cm DBH (either self-supported by roots, severed from roots, or uprooted). Other wooden debris, such as fence posts and cabin logs, are also included. For multi-stemmed woodland trees such as juniper, only tally stems that are dead and detached on the ground, or dead leaning or dead vertical.

FWM includes dead and downed branches, twigs, and small tree or shrub boles that are not attached to a living or standing dead source. FWM can be connected to a larger branch, as long as this branch is on the ground and not connected to a standing dead or live tree. Only the woody branches, twigs, and fragments that intersect the transect are counted. FWM can be connected to a down, dead tree bole or down, dead shrub. FWM can be twigs from shrubs and vines. FWM must be no higher than 30 cm above the ground to be counted.

CWM and FWM is sampled using the line intersect sampling method (also called planar intercept method). In this method, transects are established, and individual pieces of CWM or FWM are tallied if the central axis of the piece is intersected by the plane of the transect. In addition, each piece must meet specified dimensions and other criteria before being selected for tally. Leaf litter depth and duff depth will be recorded in the herbaceous subplot.

Locating and Establishing the Transect

A 20m transect is established to sample CWM and FWM. Transects are randomly established on each plot. It is extremely important to lay out the transect in a straight line to avoid biasing the selection of pieces. CWM is sampled along the entire length of the transect, FWM is sampled only on a portion of the transect because it is present in higher densities.

Establishing the Transect: Spin the compass and randomly stop. At a the resulting compass azimuth lay out a 20 m line transect (Figure 16) that stretches the length of the 10 m radius plot. From plot center facing the random compass azimuth, pull the 0 m point to the plot edge. The 10 m point on the tape will correspond to the plot center, and the 20 m point at the plot edge opposite the compass azimuth.

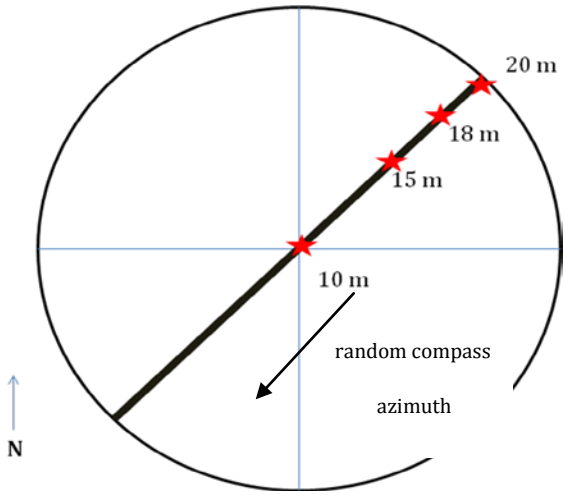


Figure 15. Random line transect for downed woody material.

Coarse Woody Material (CWM)

Any piece of CWM (as defined above) will be measured if it intersects the 20m transect. All pieces of CWM must intersect the point of intersection at or below a height of 1m. For each piece of CWM you will record, two diameter measurements, one at the large end and one at the small end, the length (height if it is standing) and decay class Follow the criteria listed below to determine if a piece qualifies and how to take the measurements.

When to Tally a piece of CWM

Coarse woody material (CWM) is sampled if its central longitudinal axis intersects the transect (Figure 14-3).

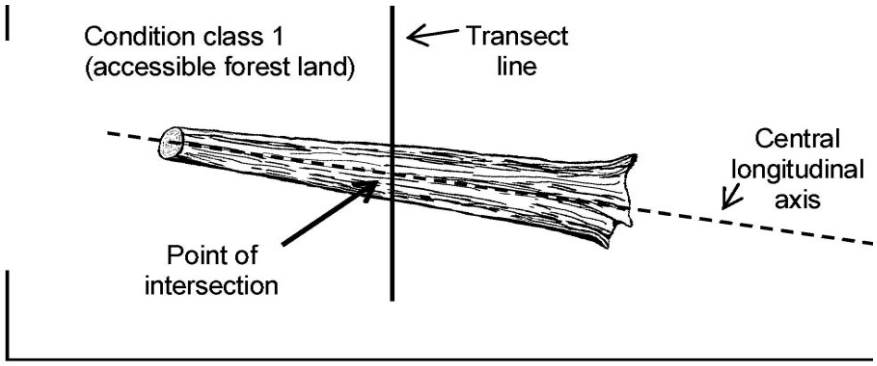


Figure 14-3 Tally rules for CWM

Tally pieces created by natural causes (examples: natural breakage or uprooting) or by human activities such as cutting only if not systematically machine-piled. Do not record pieces that are part of machine-piled slash piles or windrows, or that are part of a log "jumble" at the bottom of a steep-sided ravine in which individual pieces are impractical to tally separately. Instead, sample these piles according to instructions in section 1.5 'Sampling Residue Piles'. A slash pile or wind-throw consists of broken logs, limbs, and other vegetative debris.

Tally a piece only if the point of intersection occurs above the ground. If one end of a piece is buried in the litter, duff, or mineral soil, the piece ends at the point where it is no longer visible. Measure the diameter and length at this point.

If the central longitudinal axis of a piece is intersected more than once on a transect line or if it is intersected by two transect lines, tally the piece each time it is intersected (uncommon situation, see Figure 14-5).

If a piece is fractured across its diameter or length, and would pull apart at the fracture if pulled from either end or sides, treat it as two separate pieces. If judged that it would not pull apart, tally as one piece. Tally only the piece intersected by the transect line.

Do not tally a piece if it intersects the transect on the root side of the root collar. Do not tally roots.

When the transect crosses a forked down tree bole or large branch connected to a down tree, tally each qualifying piece separately. To be tallied, each individual piece must meet the minimum diameter and length requirements.

In the case of forked trees, consider the "main bole" to be the piece with the largest diameter at the fork. Variables for this fork such as TOTAL LENGTH and DECAY CLASS should pertain to the entire main bole. For smaller forks or branches connected to a main bole (even if the main bole is not a tally piece), variables pertain only to that portion of the piece up to the point where it attaches to the main bole (see Figure 14-6).

CWM does not include:

- Woody pieces < 10 cm in diameter at the point of intersection with the transect.
- Dead shrubs, self-supported by their roots.
- Trees showing any sign of life.
- Stumps that are rooted in the ground (i.e., not uprooted).
- Dead foliage, bark or other non-woody pieces that are not an integral part of a bole or limb. (Bark attached to a portion of a piece is an integral part).
- Roots or main bole below the root collar (The root collar is between the base of the aerial part of the plant and the top of the root system).

Record the Diameter and Length

The minimum length of any tally piece is 50 cm. Record the total length of the CWM piece from where you take the two diameter measurements. The goal is to get an accurate measurement to calculate the volume.

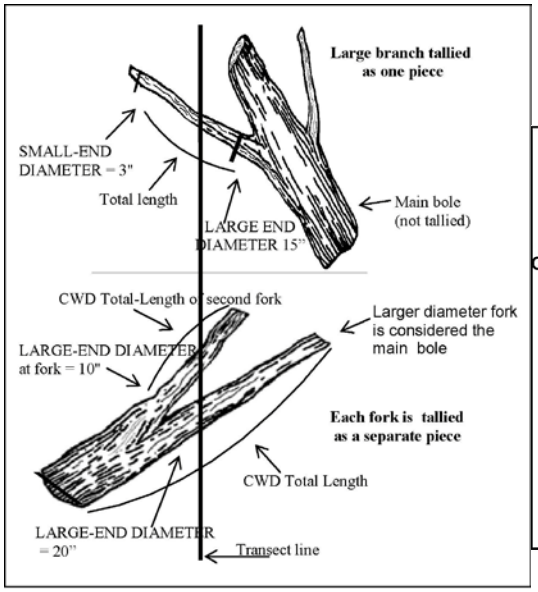


Figure 14-6. CWD tally rules for forked trees.

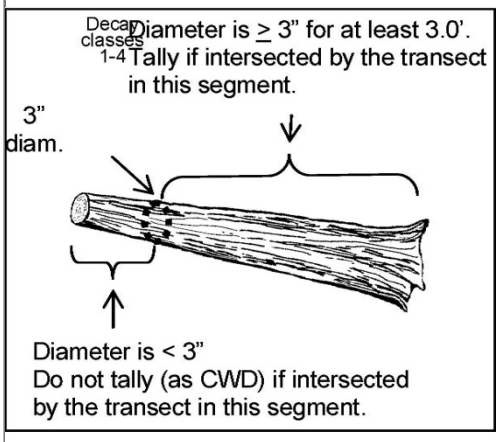


Figure 14-4. CWD tally rules for decay classes 1-4.

The diameter is most commonly measured by holding a tape above the log, at a position perpendicular to the length (Figure 14-7). If possible use a steel carpenters retracting tape to measure diameters.

Other methods include wrapping a tape around the bole if possible, holding a straight-edge ruler above the piece, or using calipers.

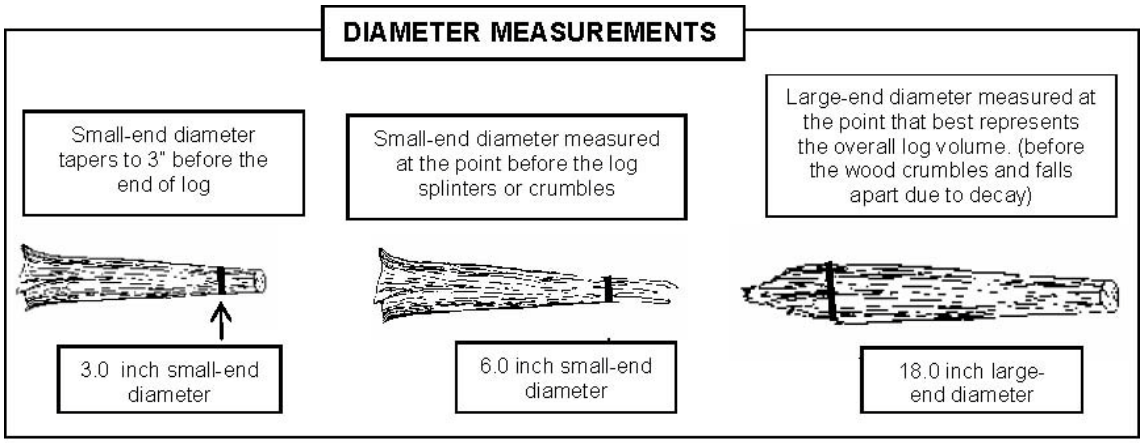


Figure 14-7. Diameter measurements

For pieces that are not round in cross-section because of missing chunks of wood or "settling" due to decay, measure the diameter in two directions and take an average. Estimate the longest and shortest axis of the cross-section ("A" and "B" in Figure 14-8), and enter the average in the diameter field. This technique applies to intersect, small-end, and large-end diameters.

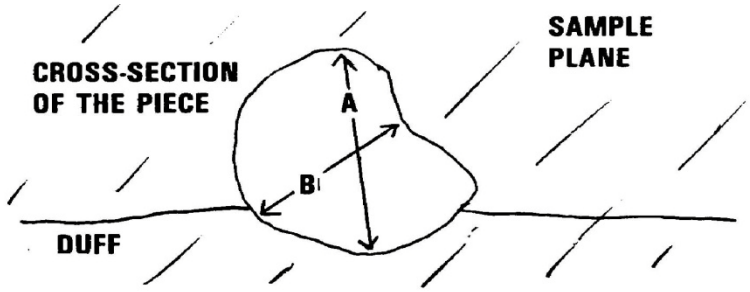


Figure 14-8. Estimating the diameter of pieces that are not round in cross-section.

If the transect intersects the log at the decayed or splintered end (Figure 14-9) (i.e., the portion where we do not consider it part of the log because it is falling apart), record the diameter at this location as the intersect diameter, but record the large end and small end diameter according to our established rules (i.e., at the points where they best represent the log volume). If the splintered end appears to be two separate pieces (i.e., a major split located just at the end) – in this situation treat it as one log and take a diameter around the end (take two measurements if it is odd shaped). Length would be measured between the large and small end diameters.

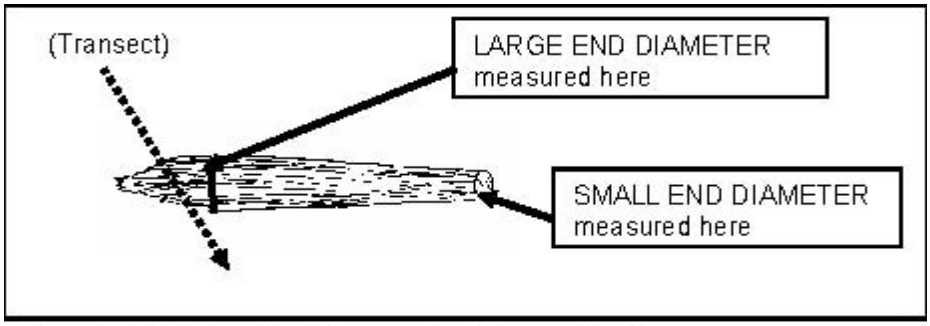


Figure 14-9. Example of decayed end intersecting the transect

DIAMETER AT THE SMALL END Record the diameter at the piece's small end. The diameter is recorded to first digit. (see Figure 14-7).

DIAMETER AT THE LARGE END Record the diameter at the piece's large end. The diameter is recorded to first digit. The large end will occur either at a broken or sawn end, at a fracture, or at the root collar. If the end is splintered or decomposing (sloughing off), measure the diameter at the point where it best represents the overall log volume.

CWM TOTAL LENGTH Record the total length of the piece. CWM TOTAL LENGTH is the length of the piece that lies between the piece's recorded DIAMETER AT THE SMALL END AND DIAMETER AT THE For Decay Class 5: DIAMETER AT THE SMALL END AND DIAMETER AT THE LARGE END are not recorded for a log, therefore the length is measured between the two physical ends of the log. For curved logs, measure along the curve. The minimum log length is 50 cm before it is a valid tally log

IS THE PIECE HOLLOW?

If it is record the piece is hollow (see Figure 14-10) and measure the diameter.

A piece is considered hollow if a cavity extends at least 50 cm along the central longitudinal axis of the piece, and the diameter of the entrance to the cavity is at least 1/4 of the diameter of the piece where the entrance occurs. The entrance occurs at the point where the circumference of the cavity is whole -- the point where wood is present completely around the circumference of the cavity. The length of the cavity begins at this point.

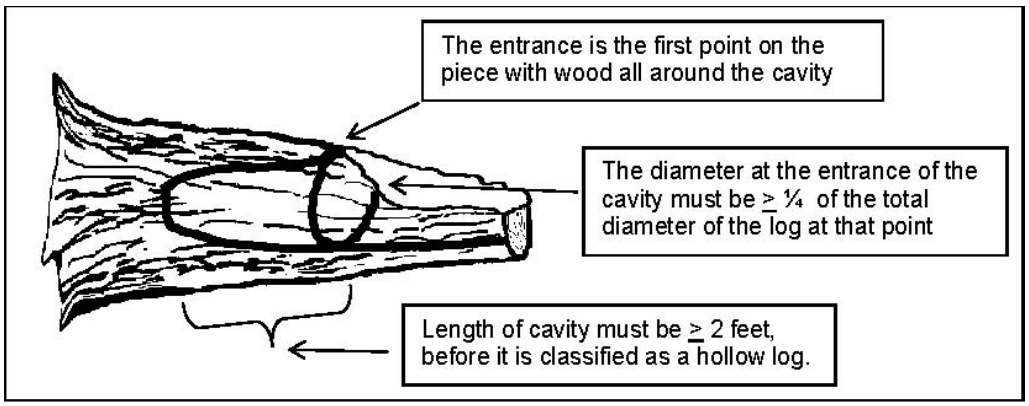


Figure 14-10. Determining if the piece is hollow.

Decay class of the piece.

Class 1: Sound, freshly fallen, intact logs with no rot, no conks present indicating a lack of decay, original color of wood, no invading roots, fine twigs attached with tight bark;

Class 2: Sound log sapwood partly soft but can't be pulled apart by hand, original color of wood, no invading roots, many fine twigs are gone and remaining fine twigs have peeling bark;

Class 3: Heartwood is still sound with piece supporting its own weight, sapwood can be pulled apart by hand or is missing, wood color is reddish-brown or original color, roots may be invading sapwood, only branch stubs are remaining which can't be pulled out of log;

Class 4: Heartwood is rotten with piece unable to support own weight, rotten portions of piece are soft and/or blocky in appearance, a metal pin can be pushed into heartwood, wood color is reddish or light brown, invading roots may be found throughout the log, branch stubs can be pulled out;

Class 5: There is no remaining structural integrity to the piece with a lack of shape as rot spreads out across ground, rotten texture is soft and can become dry powder when dry, wood color is red-brown to dark brown, invading roots are present throughout, branch stubs and pitch pockets have usually rotten down.

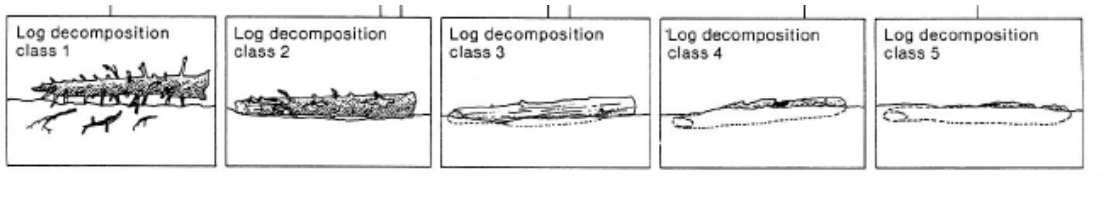
Note: CWM DECAY CLASS 5 pieces can be difficult to identify because they often blend into the duff and litter layers. They must still resemble a log, therefore, the first tally rule is that they must be > 15 cm in diameter, > 1.5 cm from the surface of the ground, and at least 50 cm long. Decomposed logs that are slightly elevated 'humps' on the ground are not tallied.

If a log is case hardened (hard, intact outer sapwood shell) but the heartwood is rotten, code this log as a CWM DECAY CLASS 2 with a HOLLOW PIECE and measure the Diameter of the hollow.

For piles of coarse woody material do not collect a decay class.

For decay class 5: tally a piece if it is > 15 cm in diameter at the point of intersection and > 15 cm high from the ground. The piece must be > 50 cm in length. The reason for treating decay class 5 pieces differently is because they are difficult to identify, especially when heavily decomposed. Only pieces that still have some shape and log form are tallied—humps of decomposed wood that are becoming part of the duff layer are not tallied.

For decay classes 1 to 4: Record a 1-digit code indicating the decay class of the piece. Code the decay class which predominates along the recorded CWM TOTAL LENGTH (1.3.4.4) of the piece. Use the guide below to determine CWM DECAY CLASS.



From Maser et al. 1979 showing examples of the log decomposition class ratings.

Species

Record the code indicating the species of the piece if it's possible to identify Species identification may be uncertain for some pieces.

A Pile of CWM

The line transect method is not practical when sampling CWM within piles and windrows. Piles and windrows created directly by human activity and log piles at the bottom of steep-sided ravines in which individual pieces are impossible to tally separately, are more efficiently sampled by measuring the size of the pile. However, loose CWM in piles created by wind throw, landslides, fires, and other natural causes should be tallied using line transects unless it is physically impossible to measure the pieces in the natural pile. If the pile contains pieces of CWM > 10 cm diameter that would be impossible to tally separately apply the following steps to determine: pile length, pile width and pile height (see Figure 14.11). Approximate the residue pile to a geometric shape (eg. parallelepiped cube) and record the following measurements: Pile length, Pile width, Pile height. For decay class estimate the prevalent one in the pile.

PILE LENGTH 1 Record the length of the sides of the pile.

PILE WIDTH 1 Record the width of the sides of the pile. Estimate to the nearest meter. PILE WIDTH 1 may often equal PILE WIDTH 2.

PILE HEIGHT: Record the code indicating the height of either end of the pile.

Fine Woody Material (FWM)

FWM is generally present in higher densities, therefore it will be sampled along the same transect as CWM but along a shorter interval. We will only tally Small (0.02 cm to 0.6 cm) and Medium FWM (0.61 to 2.5 cm) and in the first 5m (plot center to 15m) in the more northerly direction. We will tally Large FMW (2.51 to 9.9 cm) along the first 8 m in the more northerly direction. Only record FWM if it intersects the transect from the ground level to a height of 30cm.

FWM includes downed, dead branches, twigs, and small tree or shrub boles that are not attached to a living or standing dead source and are less than 10 cm diameter and larger than 0.2 cm. Only record FWM if it is visible at the point of intercept. Do not dig into leaf litter or soil to look for FWM that you cannot see.

FWM can be connected to a larger branch, as long as this branch is on the ground and not connected to a standing dead or live tree. Only the woody branches, twigs, and fragments that intersect the transect are counted. FWM can be connected to a down, dead tree bole or down, dead shrub. FWM can be twigs from shrubs and vines.

FWM must be no higher than 30 cm above the ground to be counted. FWM is divided into three size classes: Small from 0.2 to 0.6 cm, Medium: 0.7 to 2.5 and Large: cm 2.6 to 9.9 cm.

FWM does not include:

- Woody pieces > 10 cm in diameter at the point of intersection with the transect.
- Dead branches connected to a live tree or shrub; or to a standing dead tree or dead shrub.
- Dead foliage (i.e., pine or fir needles, or leaf petioles).
- Bark fragments or other non-woody pieces that are not an integral part of a branch, twig, or small bole.
- Small pieces of decomposed wood (i.e., chunks of cubical rot)
- Mulch placed as a landscaped path or for management as around a tree.

Table 2. Fine Woody Material classes and sampling location.

Category of FWM	Size Class	Diameter range	Transect length	Transect location

Small FWM	1	0.2 to 0.6 cm	5 meters	10 (plot center) to 15 meters
Medium FWM	2	0.7 to 2.5 cm	5 meters	10 (plot center) to 15 meters
Large FWM	3	2.6 to 9.9 cm	8 meters	10 (plot center) to 18 meters

The FWM transects start at the plot center and extend for 5 or 10 m distance.

Use the following criteria when sampling FWM.

1. Only sample FWM that intersects a plane from the ground to a height of 30cm.

2. FWM is sampled in three size classes, on the 8 m transect. Two of the FWM size classes (0.02 cm to 0.6 cm and 0.61 to 2.5 cm) are counted on a 5 m transect, from plot center (10m to 15m). Pieces in the large size class (2.51 to 9.1 cm) are counted on a 8 m transect, from 10 to18 m. These transects overlap. Note: individual diameters are not recorded for FWM. Record the number of pieces counted in this size class along the transect segment.

3. If the count exceeds 50 for small and medium the transect can be sub-sampled to estimate a total count for the transect segment. For example, an accurate count can be conducted on a 1.5 m section of the transect and then multiplied by 3 to provide an estimate for the 5 m transect, as long as the crew feels that the remaining transect has a similar density of FWM pieces.

4. Count a piece of FWM if it intersects the transect. Only count a piece if the twig, branch, wood fragment, or shrub/tree bole are woody. Do not count pine or fir needles or non-woody parts of a tree or shrub.

5. If there is no tally on a transect, enter NO FWM.

6. Tally a piece only if the point of intersection occurs above the ground. If a piece is buried in the litter, duff, mineral soil, do not tally the piece

7. If a transect intersects a large pile of material such as a wood rat's nest or a recently fallen tree (with many attached fine branches), crews should estimate a count based on #3.

8. If rocks, logs, or other obstructions are present along the transect include any FWM that is present on top of these obstructions in the respective FWM counts. If the obstructions are so large (huge boulder) that the top surface cannot be seen, assume the count is zero in this area, and continue counting if there is transect line beyond the boulder.

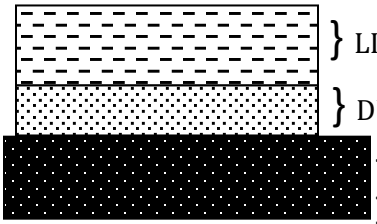
9. If a residue pile intersects the FWM transect at any point along the 5 to 8-meters section, do not measure FWM on this transect. It is too subjective determining exact boundaries of the pile, and how they relate to the exact point on the transect line. Measure a subsample of the pile along the intercept and apply the estimate to the length of the pile along the transect.

Leaf litter and Duff Depth Measures.

Litter is the layer of freshly fallen leaves, needles, twigs (< 0.025 cm in diameter), cones, detached bark chunks, dead moss, dead lichens, detached small chunks of rotted wood, dead herbaceous stems, and flower parts (detached and not upright). Litter is the loose plant material found on the top surface of the forest floor. Little decomposition has begun in this layer.

Duff is the layer just below litter (Figure 17). It consists of decomposing leaves and other organic material. You should see no recognizable plant parts; the duff layer is usually dark decomposed organic matter. When moss is present, the top of the duff layer is just below the green portion of the moss. The bottom of this layer is the point where mineral soil (A horizon) begins.

Staff should be absolutely sure they are measuring deep duff depths, instead of mineral soil layers or parts of the litter layer. Duff can easily weigh more than 6 times that of litter. If unsure of the bottom of the duff layer, crews should feel the texture of the suspect material in their hand. Rub the soil between your fingers. Does it crumble (duff) or feel more like modeling clay or sand (mineral).



} LITTER: intact leaves and organic matter

} DUFF: decomposed leaves and organic matter

} Mineral Soil: derived from parent material all organic matter is incorporated.

Figure 16.

Depth measurements for leaf litter and duff will be taken at the plot center (PC) and along the transect at 15 m, 18 m and 20 m(Figure 18). This measure is an indirect measurement of activity on the forest floor and can be used to indicate earthworm activity and micro and macro invertebrate habitat as well as nutrient cycling. To accurately measure the depth of the layer, gently insert your ruler and feel down to the mineral soil once you have clearly located the boundary between the litter, duff and mineral soil layers vertically measure the litter and duff to the nearest 0.01 cm. Refill holes after measuring. If no litter or duff is present, or if another substrate is present (i.e. rock, wood) record litter and duff as 0 cm.

Soil Sampling

Soil quality within New York City are known to vary greatly and have a long history of disturbance. Understanding the quality of the soils is an important part of the citywide Ecological Assessment. A soil sample will be collected at each plot and analyzed for the following tests.

Bulk Density

Soil Organic Matter

pH

Plant Available Nutrients

Heavy Metals

Soil Microbial Composition (PLFA on a subset)

Soil samples will be collected at a different time than the bulk of the Ecological Assessment data will be collected. Soil samples will be collected and kept cool in a cooler and transported to the lab within 24 hours of collection.

There will be a total of two bags from each plot.

Bag #1: A composite sample of at least 200 g of soil (not including gravel/rocks) for all soil tests except bulk density. This will be collected from the field.

Bag #2: A subset of the composite sample that contains a known volume of soil. This will be used for the bulk density measurement (the weight of soil divided by its volume).

Protocol:

In the field, collect 1 bag of soil from each plot. The bag should contain a composite sample of one soil core from the center of each subplot or 4 cores total per plot. Remember to only collect soils after leaf litter and duff depth have been collected.

After brushing off the leaf litter and duff layer, hold the soil corer perpendicular to the ground and press down until it is 10 cm deep. (This can be done by using labeling/masking tape to mark the corer at 10 cm.)

Remove the corer slowly and carefully from the ground to minimize any spilling of soil from the corer. Place the soil from the corer into the bag.

After all 4 cores have been collected, homogenize the soil inside the bag by shaking the bag. After the soil is homogenized, use a scoop of a known volume and place one scoop of soil into a second plastic bag. This second bag of soil will be for the bulk density measurement.

Enter information into the Toughbook. Record the Soil ID number of both bags:

Bag #1: ParkID_Plot_ID_B1

Bag #2: ParkID_Plot_ID_B2

Air dry all soil samples for at least 24 hours (to prevent mold) and store at room temperature.

Drop off soils at your reporting location.

Special instructions for collecting soils from microbial analyses:

When collecting soils for microbial analyses, remember to sterilize the corer with ethanol and wait for the ethanol to air dry (do not blow on the corer) before sampling from a new plot. The scoop should also be sterilized before it is used to scoop the subsample for bulk density. The corer doesn't need to be sterilized between subplots. Latex/nitrile gloves that have been sterilized with ethanol should also be worn when sampling soils

Additional Species

Record any additional species found in the 10 m radius plot. If the species is unknown, record as "unknown" and describe to genus, family or other identifier take a photo and/or collect a sample. Check protocol "how to collect a sample". Record the sample identifier and follow the protocol for the "How to collect and press unknown species".

If the species is known but is not listed in the drop-down, record as "unlisted" and record in "Taxon" section any useful information

Downed Trees

Downed Trees: Overstory trees >10cm that are blown over with the roots exposed, snapped below DBH will be counted as a tally of down trees within each overstory plot. Down trees can be alive or dead. Down trees are only counted if more than 50% of the tree bole would have been inside the plot if standing. Large branches or pieces of CWM with unknown origin are not considered.

Impacts

Recording the type of human and ecological impacts that could be causing changes in the health and condition of the natural areas is important to understanding and describing our urban forest. Recording the type of impacts and their extent will help us describe the relationship of ecological traits to human and ecological disturbances within an urban matrix. Think of this data as an organized area to put notes about the use, misuse and disturbances within a plot and the surrounding area.

At each plot you will record any observed impacts within the 10m radius plot and within a 20m buffer (total of 30m from plot center). Survey the plot and surrounding area, when you observe an impact select first the general impact (described below) and then record a more descriptive impact from the choice listed. Choose the category of impact closest to the list below. If there is a unique impact not described on the list, select "other". Multiple impacts can exist at a site and each should be listed separately, however the cover estimates should be discrete to each impact (i.e. 30% of site covered by dumping, 25% covered by fire).

The General impacts and their categories (Impact 2) are listed below.

IMPACT	Definition	Impact 2
CANOPY GAP	Hole in the canopy, negative space in continuous forest canopy. Where canopy is missing due to fallen or missing trees. Generally a side effects of tree falls and areas of local disturbance. Does not include wide open canopy in a non-connected canopy or non-forested area. Examples include: Direct Evidence: this is when a tree has fallen and it created a new gap in the canopy. Indirect Evidence: some branches indication that a gap was created by disturbance. No Evidence: A gap exists in the canopy but it is not clear if it is from a recent disturbance.	NA
DUMPING	Openly dumped waste, trash or human artifacts dumped in a debris piles or diffusely scattered, including but not limited to household trash, organic debris such as woodchips or wood piles, asphalt piles, bricks or concrete, automotives or toxic waste.	ASPHALT, Automotive, Concrete, Construction, Household, Human Feces, Illicit Trash, Other, Plant Debris, Toxic
EROSION	Movement of sediment, loss of organic matter layer on the forest floor due to physical or environmental processes. Often leading to erosion gullies, exposure of mineral soil, and piles of organic material on the	NA

	base of hillsides.	
FIRE	Evidence of burn or char marks across the landscape, including fire scars on trees, fire rings, charred logs, burned or charred vegetation.	RING, CHAR
HYDROLOGY	Open water or indication hydrological activity including salt marsh, shoreline, freshwater wetland, river or stream.	FLOODED, INLET, SHORELINE, STANDING WATER >5m2, STREAM, WETLAND
ILLEGAL USE (excluding dumping)	Evidence of human use that is against park regulations, illicit activity, gathering, camping,	
INFRASTRUCTURE	Buildings, singe, benches, fences, any type of intentional permanent structure within the park.	BUILDING, CONSTRUCTION FOUNDATION, HYDRANT PARK BENCH, PARK DRAINAGE, PARK FENCE, PARK LAMP, PARK SIGN, PARK STAIR, PARK WALL PARKING LOT, PARKING, TURNAROUND, TELEPHONE
RECREATION/ USE	Active recreation area within the natural area, this includes a golf coarse, biking, horse riding, car racing anything besides a path potentially used for running.	GOLF COURSE, Biking, Horse use, Landscaped
NATURAL RESOURCE MANAGEMENT	Evidence of natural resources management including, invasive removal, herbicide use, erosion control, maintenance and improvement of natural areas.	CRIBBING, CUT WOOD, , HERBICIDE, Other, Pruning, Restoration Site
NONE	No apparent impacts found within the plot and buffer zone.	NA
OTHER	A significant impact that does not fall into any other category.	NA

PATH	Walkway not accessible or used by cars including dirt path, desire line, concrete, asphalt, wood chip or any other type of path.	ASPHALT, CONCRETE, DESIRE LINE, DIRT, GRAVEL, MULCH OTHER, SAND, WOODCHIP
Road	Accessible and/or used by vehicles, asphalt, concrete or dirt road.	HIGHWAY, PARK ROAD
SOIL MODIFICATION	Movement or disturbance of soil (not due to erosion) such holes, berms, pit and mounds, trench, depression, compaction, evidence of earth worms.	BERM, COMPACTION,DEPRESSION, FILL, HOLE/PIT MOUND, TRENCH
TREE DAMAGE	Dendroglyphs, girdling, uprooted tree, fallen tree >10cm.	BLOW DOWN & TIP-UP, BROKEN TREE, DEAD TREES, GIRDLED, SNAG
WILDLIFE	Evidence of scat, bird house, bat box, signs of use, deer tracks.	SCAT, BIRD HOUSE/BAT BOX, DEER, MAMMAL

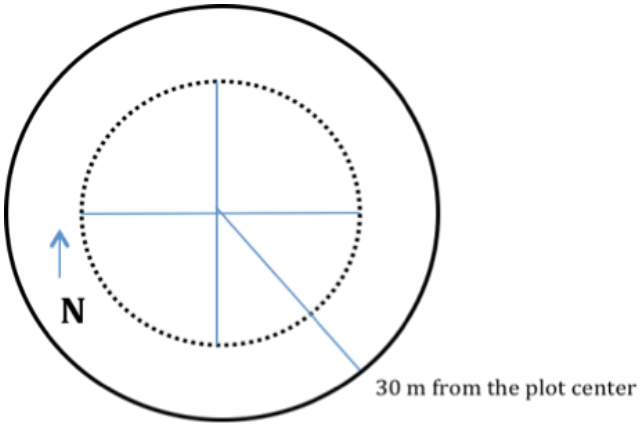


Figure 17

For any impacts within the 10m radius plot estimate the cover as a percentage from the categories (<1%, 1-10%, 11-25%, 25-50%, 50-75%, >75%). For reference, 3 1x1m subplots is equivalent to 1% of the entire plot area. For any impacts found between 10m-30m radius do not record the % cover and list it as outside the plot (Figure 19).

Glossary

Aerial cover: The uppermost surface of the vegetation and expressed as a percentage area occupied by each observed object

Areal Cover: surface area estimate looking down at substrates that cover the ground surface. Measured from 1m looking down at the ground surface.

Assessment : A quantitative or qualitative estimate or measurement of the status of a give environmental entity at a given time.

Blowdown: A tree that has been blown down by the wind. See Tip-Up.

Bole : The section of the trunk of a tree beneath the point where branching commences.

Broken Tree: A tree that has the main portion of the bole broken or snapped off, from wind, or other damage. The roots are not exposed.

Buttress roots (stilt roots or prop roots): Large roots on all sides of a shallowly rooted tree. Pretty rare in our forest but typically found in nutrient-poor rainforest soils and do not penetrate to deeper layers.

Canopy: One of several combinations of particular sets or layers of tree crowns and the volumes of space between or below them (e.g. Bongers 2001)

Canopy Gap: Hole in the canopy, negative space in continuous forest canopy. Gaps are formed by the death (or injury) of one or a few canopy trees (in some cases, by the fall of large branches), and gaps are defined as small openings formed in a forest canopy and generally occupying between 5m2 (Runkle, 1981) to 1000m2 in area in various forest types.

Coarse Woody Material (CWM): Dead and downed pieces or portion of pieces of wood greater than 10 cm diameter. Dead tree and shrub boles, large limbs, and other woody pieces that are severed from their original source of growth and on the ground. CWM also includes dead trees (either self-supported by roots, severed from roots, or uprooted) that are leaning > 45 degrees from vertical. Also included are non-machine processed round wood such as fence posts and cabin logs.

Defoliation: Loss of leaf foliage due to insect, disease, environment or other stressors

Dieback: Losing health and dying without an obvious culprit. This condition is also known as tree decline and tree damage

Discoloration: In this project, discoloration is an abnormal change in leaf tissue color (i.e. not from change in season)

Duff : The layer just below litter. It consists of decomposing leaves and other organic material. You should see no recognizable plant parts, the duff layer is usually dark decomposed organic matter. When moss is present, the top of the duff layer is just below the green portion of the moss. The bottom of this layer is the point where mineral soil (A horizon) begins

Dumping : Openly dumped waste, trash or human artifacts dumped in a debris piles or diffusely scattered, including but not limited to household trash, organic debris such as woodchips or wood piles, asphalt piles, bricks or concrete, automotives or toxic waste.

Erosion: Movement of sediment, loss of organic matter layer on the forest floor due to physical or environmental
processes. Often leading to erosion gullys, exposure of mineral soil, and piles of organic material on the base of hillsides.

Fine Woody Material (FWM): 0.02 cm and less than 10 cm in diameter Only includes the woody branches, twigs, and fragments that intersect the transect are counted. FWM can be connected to a down, dead tree bole or down, dead shrub. FWM can be twigs from shrubs and vines.

Fire: Evidence of burn or char marks across the landscape, including fire scars on trees, fire rings, charred logs, burned or
charred vegetation.

Hydrology: Open water or indication hydrological activity including salt marsh, shoreline, freshwater wetland, river or stream.

Illegal use: Activities against park regulations, illicit activity, gathering, camping.

Impermeable surface: A human made surface such as concrete or asphalt.

Infrastructure: Buildings, signage, benches, fences, any type of intentional permanent structure within the park.

Leaf litter: The layer of freshly fallen leaves, needles, twigs (< 0.6 cm in diameter), cones, detached bark chunks, dead moss, dead lichens, detached small chunks of rotted wood, dead herbaceous stems, and flower parts (detached and not upright). Litter is the loose plant material found on the top surface of the forest floor. Little decomposition has begun in this layer. Litter does not include bark that is still attached to a down log, or rotten chunks of wood that are still inside a decaying log or log end (i.e., if a decayed log end has a lot of rotten cubes or pieces laying on a log surface and exposed to air, they are considered part of the log and not litter – fire would burn differently if it hit a pile of rotten punky wood chips, cradled by the unrotted sapwood shell). If these rotten chunks have spilled out to the ground and are actually on the ground surface, then they would be included in the litter layer.

Limb: A large or main branch of a tree

Natural Resource Management: management of forest, water, soil, plants and animals, focused on improving and sustaining natural areas.

Overstory: the uppermost layer of foliage in a forest, forming the canopy.

Path: Walkway not accessible or used by cars including dirt path, desire line, concrete, asphalt, wood chip or any other type of path.

Pith: The center of the tree. Pith is composed of soft, spongy parenchyma cells, which store and transport nutrients throughout the plant. In eudicots, pith is located in the center of the stem.

Road: Accessible and/or used by vehicles, asphalt, concrete or dirt road.

Root collar: Transition point between the roots and the trunk.

Saplings: Small trees greater than 2 cm and less than 10 cm DBH.

Seedling: Young woody plants with a diameter at breast high less than 2 cm and any height.

Shrubs: Woody, perennial, often multi-stemmed, sub-canopy plants. Shrubs do not have the potential of reaching the canopy (i.e. *Viburnum*, *Lindera*, *Rubus*) in a mature forest. Shrubs >2cm DBH will be measured in the midstory, shrubs <2cm DBH will be measured in the herbaceous subplots.

Soil modification: Movement or disturbance of soil (not due to erosion) such holes, berms, pit and mounds, trench, depression, compaction, evidence of earth worms.

Species cover: cover for each plant species evaluated independently from the cover of other species

Sprout: stems that arise off of the base of the main stem, sometimes from a dead stump or tree.

Tip-up: A fallen tree with the root ball exposed.

Transect Intercept: A method of sampling elements the element is sampled if a chosen line segment, called a “transect”, intersects the element.

Tree Damage: Dendroglyphs, (tree carving; the original term refers to the New Zealand Maori’s practice of carving trees!), girdling (also called ring barking or ring-barking, is the complete removal of a strip of bark , consisting of cork cambium, phloem, cambium and sometimes going into the xylem, from around the entire circumference of either a branch or trunk of a woody plant), uprooted tree, fallen tree >10cm.

Trees: Single or multi-stemmed (can be multi-stemmed as a result of injury) woody plants greater that 10 cm DBH (1.3 m (4.5 feet) above the ground). Trees have the potential of reaching the canopy.

Understory Plants: All non-woody herbaceous plants, self-supporting plant species including herbs, ferns, graminoids (grasses, sedges), and forbs.

Understory: Plant life growing beneath the forest canopy without penetrating it to any extent

Vigor: In this project vigor is a combination of all the health metric to estimate a general condition of the examined tree.

Vines: Woody or herbaceous plants that trail along the ground or are supported on a living plant or structure.

Wildlife: Evidence of scat, bird house, bat box, signs of use, deer tracks.

How to Collect and Press a Specimen

When to collect a specimen:

If you find an unknown species in the plot, don't spend a lot of time trying to ID the species in the field. Instead collect a sample and bring it back to the office to be pressed and, if possible, record the genus or the family or any key characteristics (fuzzy bud, in wet forest).

Record it as UNKNOWN and just before you are about to leave the plot collect the specimen. We should never harvest a plant if doing so harms the overall population or environment we are trying to describe or protect, especially rare species in the NYC parks, so please look around and make sure is not a unique individual. While in the field, photograph the plant that you are going to collect (once they dry out they lose colors and other helpful features for identification) and link the number of the picture with the specimen ID. Then use flagging tape to label the specimen. The specimen ID will be park ID, the number of the plot followed by a progressive number. Record the number in your field datasheet, along with notes about where you found the specimen (e.g., lawn, wood, scrubland or Vineland), the day, and any other observations that might help with identification.

What to collect: The plant specimen should contain diagnostic characters relevant to the identification of the particular species, genus or family in question. If possible, collect a specimen that contains mature fruits, flowers, and the rooting system.

How to press a specimen: Bring the specimen back to the office either in a rigid container (to keep it from being crushed) or a plastic bag. A moist paper towel in the container will help prevent the plant from wilting.

To *press the specimen*, first clean off the plant by brushing off loose soil and drying excess moisture. Arrange the plant on a sheet of newspaper so that both sides of the leaves and all distinctive characteristics will be apparent once it is flattened. Next to the specimen, record the identification number, the location (park ID and plot ID), date of collection, and the name of the person who made the collection. Make sure the same information is in your field datasheet. Then, place another piece of newspaper on top of the plant.

Place the pieces of newspaper with your specimen inside between two pieces of blotting paper, and then between two pieces of corrugated cardboard. These allow air to circulate, preventing mold. Place the resulting package in the plant press and gently screw it down. As an alternative, you can hold it securely together with straps, or place some heavy objects (books, bricks) on top. You can dry several plants in the press at one time. Each one should be arranged with the same layers as described above. Depending on the water content of the plant and the surrounding air, it may take about 1-2 weeks before the specimens are completely dry.

Equipment Needs:

1 x 1 subplot	Datasheets (or Toughbook)	FWM ruler
30 meter distance tape	DBH stick	GPS unit
Chaining pin	Diameter Tape	Hand Magnifier lens
Chalk for marking trees	Digital Camera	Plant press
Clinometer	Flagging	Small ruler
Clipboards	Flagging tape	Soil
Compass	Flash Drive	

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