Annual Temperate Forest Tree Mortality Protocol

# **Sites:** Smithsonian Ecological Research Center (SERC), Smithsonian Conservation Biology Institute (SCBI), Harvard Forest (HARV), Wind River Forest (WFDP), Ordway-Swisher Biological Station (OSBS)

**Methods:**

*General*

Locate the southwest corner of the 20 x 20 m quadrat. Within the quadrat, locate all trees you are working on and make sure you check all trees before moving to the next quadrat. Coordinates (x, y) are given in reference to a 20 x 20 m square.

*Tree classification*

Find the trees’ tag on the datasheet or electronic data form. Mark tree is as either **“A”** (alive), **“AU”** (alive unhealthy), **“DS”** (dead standing), **“DG”** (dead ground), **“DN”** (dead not found).

**Notes**:

Sometimes a tree recorded dead in a previous year is “back to life”. If a dead tree is alive in the current census (meaning you are 100 % sure it is alive), mark the tree as A and make a note in comments.

If the status is **“A”**

1. Mark status
2. Record crown position.
3. Record **percentage of crown** still intact (%).
4. Record **percentage of crown** living

If the status is “**AU**”

**AU** is used for trees that are alive but noticeably unhealthy (e.g., fallen and uprooted but not yet dead, wounded, insect damage).

1. Record FADs in **order of importance\*** (at least 1 factor)- See FAD codes below.
2. Record crown position.
3. Record **percentage of crown** still intact (%).
4. Record **percentage of crown** living
5. Record lean angle (if leaning > 15°)
6. Record Liana load.
7. Record wound, canker, or rot categories (if applicable)
8. **Take pictures:** Take a picture of alive unhealthy tree if picture appropriately captures FAD. For example, take picture of wounds to main bole, but not of leaf damage high in canopy. **Take a picture of the tag first** then make 2-3 pics of main FADS. Make nice close-ups if any insect or insect galleries are found.

**\* In FastFieldForms, click FAD in order of importance**

If the status is **“DS”** & previously “**A”**:

1. Record FADs in order of importance (at least 1 factor)- See FAD codes below.
2. Record crown position.
3. Record **Percentage of crown** still intact (%).
4. Record **percentage of crown** living (%)
5. Record lean angle (if leaning > 15°)
6. Record Liana load.
7. Record wound, canker, or rot categories (if applicable)
8. **Take pictures:** Take a picture of dead tree if picture appropriately captures FAD. **Take a picture of the tag first** then make 2-3 pics of main FADS. Make nice close-ups if any insect or insect galleries are found.

If the status is **“DG”** & previously “**A”**:

1. Record FADs in order of importance (at least 1 factor)- See FAD codes below.
2. Record **Percentage of crown** still intact (%).
3. Record **percentage of crown** living (%)
4. Record Liana load.
5. Record wound, canker, or rot categories (if applicable)
6. **Take pictures:** Take a picture of dead tree if picture appropriately captures FAD. Take a picture of the tag first then make 2-3 pics of main FADS. Make nice close-ups if any insect or insect galleries are found.

--Note: for stems that were “A” and now “DG” (typically uncommon) it is unnecessary to record canopy position

If the status is **“DS”** & previously “**DS”**:

1. Mark status
2. Record crown position\*.
3. Record **percentage of crown** still intact (%)\*
4. Record **percentage of crown** living (%)\*
5. Record lean angle (if leaning > 15°)\*
6. Record Liana load\*.

\*record this information for remote sensing/crown delineation purposes

If the status is **“DG”** & previously “**DS**”

Record status and continue.

--Additional Fields--

***Lean angle (%)***

If tree is still rooted and is leaning, estimate the angle of lean in degrees from vertical. This angle is measured in degrees from the base through the POM (see figure below).

***Liana load (levels: 0 – 4)***

0 = lianas absent

1 = up to 25% of the tree crown covered by lianas

2 = 26–50% liana cover

3 = 51–75% liana cover

4 = 76–100% liana cover.

***Wounded main axis (levels: 1 = small, 2 = large, 3 = massive)—figure below***

1 = small damage, smaller in area than a square of DBH × DBH in shape.

2 = large damage, greater in area than a square of DBH × DBH in shape.

3 = massive damage, affecting >50% of the basal area (i.e., a very deep and extensive wound; Figure 8c) or >50% of the living length (Figure 8d). These are cases of main stem breakage in which the breakage is not complete and the broken part is still connected and alive, and trunks that have been longitudinally split in two.

***Canker, swelling, deformity (levels: 1 = small, 2 = large, 3 = massive)***

1 = small deformity area, smaller in area than a square of DBH × DBH in shape.

2 = big deformity, greater in area than a square of DBH × DBH in shape.

3 = massive deformity or canker, greater than >50% of the basal area or >50% of the main axis length.

***Rotting trunk (levels: 1 = small, 2 = large, 3 = massive)***

1 = small rotting area, smaller in area than a square of DBH × DBH in shape.

2 = big rotting area, greater in area than a square of DBH × DBH in shape.

3 = massive rotting, affecting >50% of the basal area or >50% of the main axis length.

*Comments and other status indicators*

For tree conditions or agents of mortality not specifically defined below, record diagnosis in the notes or comments section of the form.

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| **FAD Categories:**  **U**= Unable to determine cause of death  *Mechanical damage*  **B**= Broken stem (note cause, indicate level on tree)  **CR**= Crushed by other tree or tree parts  **UP**= Uprooted tree (root bole exposed)  **S**= Slope failure (evident landslide even if small)  **L**= Lightning (tree splitting, straight scars from above)  **Fi**= Fire (stem charred, fire scars on bark) | *Biological agents*  **AN**= Animal damage (specify animal if possible)  **BB**=Bark beetles present, beetle galleries.  **I=**  Insect infection (e.g. EAB, other)  **DF**= Complete defoliation ((record crown condition using Smith/Flower method below 1 – 5 scale).  **F**= Fungi visible (give names if known)  **K**= Canker or swelling present  **LF**= Leaf damage (look for leaf spots, blotch, etc.)(new 2019)  **W =** Wound  **R**= Rotting stem.  **R1**= Root damage  **R2**= Armillaria root disease |

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***Crown illumination (taken from Arellano et al., 2020)***

5 = Canopy completely exposed to overhead and lateral light

4 = Full overhead light; > 90% exposed to vertical light

3 = some overhead light

2 = Lateral light; < 10% exposed to vertical light

1 = No direct light; only receives light filtered through other trees

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**Lean angle (Taken from Arellano et al., 2020)**

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**Crown assessment (taken from Arellano et al., 2020).**

**Top left is 100% crown intact and 100% crown living, top right—100% intact and 90% living, middle left—90% intact and 70% living, middle right—90% intact and 50% living, bottom left—70% intact and 30% living, bottom right—40% intact and 0% living**

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**Schematic of wound size (taken from Arellano et al., 2020)**