

# Aerial Survey Standards

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Forest Health Monitoring  
Program

State and Private Forestry  
Forest Health Protection



# I. AERIAL SURVEY DATA

These are the minimum data that must be collected, if present, while conducting aerial survey.

## 1. FLOWN/NOT FLOWN Areas

**Definition:** FLOWN areas are those areas surveyed by air. NOT FLOWN areas are those areas not surveyed by air.

**Coding:** FLOWN and NOT FLOWN areas will be delineated as one or more polygons on a map, of any scale, which can be georeferenced.

**Metadata Associated with FLOWN/NOT FLOWN Areas:** Metadata should include date of survey or range of dates, surveyors, and mission purpose (e.g., general overview, special survey). See also the metadata requirements in the Aerial Survey Geographic Information System (GIS) Handbook.

## 2. DAMAGE TYPE

**Definition:** All mapped damage agents must fit into one or more of the following damage types.

- Defoliation
- Mortality
- Discoloration
- Dieback
- Top Kill
- Branch Breakage
- Main Stem Broken or Uprooted
- Branch Flagging
- Other

**Coding:** ONLY MORTALITY AND DEFOLIATION damage types MUST be recorded and reported if present during survey. Recording and reporting other damage types is optional. Polygons may be coded with up to three damage types and their associated causal agents. Nationally, there will be agreement on the damage type associated with each causal agent, when applicable. Two or more damage types can be assigned to agents that cause different types of damage in different parts of the country.

**Special Surveys:** Only the damage type of interest needs to be recorded and reported during a special survey.

### *DEFOLIATION*

**Definition:** Damage that results in physical or functional removal of foliage, partially or wholly by some agent. A list of agents causing defoliation will be developed regionally from the Field Sampled Vegetation (FSVeg) VEG\_DISTURBANCE\_AGENTS code list, to be included as part of the definition. This list can also be found in the Aerial Survey GIS Handbook, Appendix E.

**Mapping Threshold:** Map all defoliation observed from the air that can be mapped. The minimum mappable size of defoliation polygons varies with causal agent (some cause much more visible defoliation than others), host, amount of other high priority damage in the same area, observers, flight altitude and terrain, and air quality.

**Damage Assessment:** Indicate high or low severity of defoliation for both hardwoods and conifers:

- **Low:** <50% of susceptible foliage in polygon is defoliated
- **High:** >50% of susceptible foliage in polygon is defoliated

Additional damage classes can be recorded by individual regions or states if desired, as long as they are consolidated into the above two classes for national reporting.

**Damage Pattern:** Determine if the pattern of defoliation is continuous or discontinuous within each polygon. When the pattern changes from continuous to discontinuous will be determined qualitatively by the sketchmapper according to regional rules.

## ***MORTALITY***

**Definition:** Standing dead trees that have died since the last survey.

**Mapping Threshold:** Thresholds for host species or host/agent groupings will be developed regionally. Desirable mapping thresholds for different hosts and/or causal agents will vary due to ecological, economical, or technical reasons (e.g. in Oregon, individual dead sugar pine and Port-Orford-Cedar are mapped due to their extremely high ecological, political, and economic value; other species are mapped only when there are 5 or more dead in a polygon).

**Damage Assessment:** Estimate the number of dead trees per acre. Other ways of estimating mortality can be done while sketchmapping (such as recording percent mortality within polygons or counting the number of dead trees in a polygon) and later converted to dead trees per acre.

**The following damage types are not required to be mapped for national reporting. However, if mapped and reported nationally, these standards should be followed.**

## ***DISCOLORATION***

**Definition:** Foliage is a color other than green, such as yellow, red, purple, black, or brown. If it is known that the discoloration will result in defoliation or mortality within 1 or 2 years, then it can be coded as defoliation or mortality rather than discoloration, e.g. bark beetle-killed trees fading from green to yellow to red before dying. A list of agents causing discoloration will be developed regionally from the FS Veg code list, to be included as part of the definition.

**Mapping Threshold:** Map all visible discoloration. The minimum mappable size of discoloration polygons will vary with causal agent (some cause much more visible discoloration than others), survey objectives, amount of other high priority damage in the same area, observers, flight altitude and terrain, and air quality.

**Damage assessment:** Severity ratings are not required, but if they are recorded and reported nationally, use the following categories:

- **Low:** <50% of foliage in polygon is discolored
- **High:** >50% of foliage in polygon is discolored

Additional severity classes can be recorded by individual regions or states if desired; however, for national reporting, they must be grouped into the above two categories.

**Damage Pattern:** Damage pattern will be assumed to be continuous and coded as such during post-flight data processing, unless recorded as non-continuous during survey.

### ***DIEBACK***

**Definition:** Distal portions (tips) of branches in upper part of crown killed since last survey, with dead or dying (yellow, red, or brown) foliage. Non-distal portions of these branches have visible green, live foliage. A list of agents causing dieback will be developed regionally from the FSVeg code list, to be included as part of the definition.

**Mapping Threshold:** Map all visible dieback. The minimum mappable size of polygons with dieback will vary with causal agent (some cause much more visible dieback than others), survey objectives, amount of other high priority damage in the same area, observers, flight altitude and terrain, and air quality.

**Damage Assessment:** Severity ratings are not required, but if they are recorded and reported nationally, use the following categories:

- **Low:** <50% of trees in polygon with dieback
- **High:** >50% of trees in polygon with dieback

Additional severity classes can be recorded by individual regions or states if desired; however, for national reporting, they must be grouped into the above two categories.

### ***TOPKILL***

**Definition:** Top portion of the tree, including the terminal and all branches in that area, killed since the last survey with dead or dying foliage visible (yellow, red, or brown). Stem is not broken. This type of damage is usually associated with conifers; it can, however, be seen in hardwoods that have a distinctive main stem and terminal. A list of agents causing top kill will be developed regionally from the FSVeg code list, to be included as part of the definition.

**Mapping Threshold:** Map all visible top kill that occurred since last survey. The minimum mappable size of polygons with top kill will vary with causal agent (some cause much more visible top kill than others), survey objectives, amount of other high priority damage in the same area, observers, flight altitude and terrain, and air quality.

**Damage Assessment:** Severity ratings are not required, but if they are recorded and reported nationally, record trees per acre with topkill.

### ***BRANCH BREAKAGE***

**Definition:** Broken branches in any portion of the crown since the last survey or that has occurred recently. Broken branches identified by either a missing or a dangling distal portion; exposed wood at break is bright white or light colored (exposed wood on breaks older than one

year has usually darkened). Non-distal portions of these branches have visible green, live foliage.

**Mapping Threshold:** Map all branch breakage that is visible since last survey. The minimum mappable size of polygons containing trees with broken branches will vary with survey objectives, amount of other high priority damage in the same area, observers, flight altitude and terrain, and air quality.

**Damage Assessment:** Severity ratings are not required, but if they are recorded and reported nationally, use the following categories:

- **Low:** <50% of trees in polygon with broken branches
- **High:** >50% of trees in polygon with broken branches

Additional severity classes can be recorded by individual regions or states if desired; however, for national reporting, they must be grouped into the above two categories.

### ***MAIN STEM BROKEN OR UPROOTED***

**Definition:** Main stem broken at any point or uprooted since last survey or that has occurred recently. Tree is no longer vertical above break or uprooting. Trees that have been recently uprooted or broken have green or fading foliage and exposed wood at break is bright white or light colored (exposed wood in breaks older than one year has usually darkened).

**Mapping Threshold:** Map all main stem breakage or uprooting that is visible since last survey. The minimum mappable size of polygons with stem breakage or uprooting may vary with survey objectives, amount of other high priority damage in the same area, observers, flight altitude and terrain, and air quality.

**Damage Assessment:** Severity ratings are not required, but if they are recorded and reported nationally, use the following categories:

- **Low:** <50% of trees in polygon broken or uprooted
- **High:** >50% of trees in polygon broken or uprooted

Additional severity classes can be recorded by individual regions or states if desired; however, for national reporting, they must be grouped into the above two categories.

### ***BRANCH FLAGGING***

**Definition:** Some, but not all, branches on tree with red or yellow (dying) foliage since last survey. Remaining branches green.

**Mapping Threshold:** Map all branch flagging that is visible since last survey. The minimum mappable size of polygons containing trees with flagging will vary with survey objectives, amount of other high priority damage in the same area, observers, flight altitude and terrain, and air quality.

**Damage Assessment:** Severity ratings are not required, but if they are recorded and reported nationally, use the following categories:

- **Low:** <50% of trees in polygon with branch flagging
- **High:** >50% of trees in polygon with branch flagging

Additional severity classes can be recorded by individual regions or states if desired; however, for national reporting, they must be grouped into the above two categories.

## ***OTHER***

**Definition:** A type of damage other than described in the categories above.

**Mapping Threshold:** Map all "other" damage that is visible since last survey. The minimum mappable size of polygons containing trees with "other" damage will vary with survey objectives, amount of other high priority damage in the same area, observers, flight altitude and terrain, and air quality.

**Damage Assessment:** Severity ratings are not required, but if they are recorded and reported nationally, use the following categories:

- **Low:** <50% of trees in polygon with "other" damage
- **High:** >50% of trees in polygon with "other" damage

Additional severity classes can be recorded by individual regions or states if desired; however, for national reporting, they must be grouped into the above two categories.

## **4. CAUSAL AGENT**

**Definition:** Any biotic or abiotic agent that causes damage to a tree, or other plant of concern.

**Coding:** Label each polygon with causal agent during sketchmapping if possible; later amendments can be made as better information is obtained (e.g. from ground checks). The FS Veg code list will serve as the national causal agent code list. Polygons may be labeled with up to three causal agent codes.

## **5. HOST**

**Definition:** Tree or other plant species (e.g. longleaf pine), species group (e.g. true fir), forest type (e.g. pinyon-juniper), or tree type (e.g. hardwood) showing damage. Use the most specific host designation possible.

**Coding:** The FHM Manual Appendices A and C, Eastern and Western, will serve as codes for host. These codes can also be found in the Aerial Survey GIS Handbook, Appendices F & G. Polygons may be labeled with up to three host codes.

# **II. QA/QC ACTIVITIES**

Each FHM Region will develop a QA/QC program that includes, at a minimum, the following components.

## **1. SKETCHMAPPER TRAINING & CERTIFICATION**

**Pre-Apprenticeship Qualifications:** Sketchmappers should have normal color vision, be able to control nausea in plane while sketchmapping, and endure limited space and movement for prolonged periods of time. Additional qualifications include:

- A sincere desire and interest to fly aerial survey
- Ability to track and orientate (i.e., very good map-reading skills)

- Some knowledge of local trees and damage (before flying, a sketchmapper must spend some time on the ground to learn local conditions including damage agents and symptoms)
- Comfortable flying in small aircraft (i.e., not afraid of flying)
- Ability to legibly (i.e., understandable by others) record polygons or points and their attributes on a map

**Apprenticeship:** Should include:

- Aviation safety and management training
- Tracking proficiency (being able to track position of aircraft on map)
- Sketchmapping proficiency (polygon placement and attributing is generally similar to expert observers)

**Certification:** Sketchmapping skills should be approved by the state or regional aerial survey program manager.

## 2. ANNUAL TRAINING & EVALUATION

**Pre-survey season training:** Review aerial survey safety procedures; familiarize observers with damage signatures, mapping thresholds, severity ratings, etc.; review polygon attributing codes; coordinate with cooperators.

**Post-survey evaluation:** Review and summarize past survey season; discuss needed changes; finalize maps prior to GIS processing.

**Accuracy assessment:** Implemented following development of a standard methodology.

## III. GIS REQUIREMENTS

Minimum GIS requirements for aerial survey data have been published in a national handbook (Aerial Survey Geographic Information System (GIS) Handbook). This handbook is available at this web site.

## IV. REPORTING REQUIREMENTS

The following information is to be reported by December 31st of each year to the Forest Health Protection office in Ft. Collins, CO:

1. FLOWN and NOT FLOWN polygons for your region or state, with associated metadata (date of survey, surveyors, and mission purpose)
2. Defoliation polygons, with associated defoliation severity (Low or High) and pattern of defoliation (Continuous or Discontinuous)
3. Mortality polygons, with associated dead trees per acre
4. Causal agent and host associated with each of the above defoliation and mortality polygons

