

Woody Habitat Structure Monitoring: Protocol Addendum

Developed by the Colorado Forest Restoration Institute

Overview

Sampling Objective: This protocol addendum was designed by the Colorado Forest Restoration Institute (CFRI) to collect comprehensive data on the abundance and quality of woody habitat structures within forest stands. Woody habitat structures (hereafter abbreviated as WHS) refer to logs, snags, and trees with decay and deformities that support wildlife activities such as denning, roosting, hunting, and foraging (Bull et al. 1997). WHS are critical to the lifecycles of wildlife, including primary and secondary cavity nesters, raptors, gamebirds, and a variety of mammals. The quality of WHS is determined by the presence of various characteristics, described within this addendum, that increase wildlife usability and can be aligned with different species' habitat requirements.

Guide to Use: This protocol addendum is suggested to be used both *before* and *after* forest treatments have been implemented, to generate increased understanding of how forest treatments impact the quality and quantity of WHS. This protocol was designed to be used in conjunction with other [CFRI standard protocols](#). Specifically, when following a CFRI standard protocol this addendum is to be implemented when measuring:

- Overstory Measurements for snags and living trees within a variable or fixed radius from plot center
- 1000 Hour Fuel Measurements for logs within a fixed radius from plot center

Overstory Measurements

1. Wildlife Snags

Definition: A *wildlife snag* is a dead standing tree that has certain characteristics (e.g., cavities, broken top, hollow bole) important to wildlife for activities including nesting, foraging, and scanning for prey (Bull et al., 1997; Ganey and Vojta, 2004; Bunnell, 2013). Species in the Rocky Mountain Region of Colorado that utilize snags include mountain bluebirds, Lewis's woodpeckers, pygmy nuthatches, and great horned owls. In this protocol, a *wildlife snag* meets the following criteria:

- ≥ 4.5 ft tall
- DBH ≥ 5.0 in
- Is rooted at ≥ 45 degree angle from the ground or is a “hang up” that is not rooted and supported by another tree, but otherwise standing at ≥ 45 degree angle from the ground

Steps:

- a. Record all standard measurements for snags encountered in-plot, as described in the “Tree Overstory” section of the standard protocol: species, status/decay class, DBH, total height, canopy base height, notes.
- b. If revisiting a previously measured plot, match each past snag record with standing in-plot snags. Make note of any “new” snags.
- c. Scan each snag for the following features:
 - a. Cavities: A cavity is defined as a round excavation >2.5 cm in diameter, that appears deep enough for use by nesting birds and micro mammals (Lehmkuhl et al., 2003). In this case, cavities include those excavated by birds, those that formed naturally as the result of wood decay processes, and root buttress cavities (Kraus & Krum, 2013). For each snag, use ocular estimation to identify cavities that meet the size threshold (see black line below for 2.5 cm benchmark), using binoculars if necessary. Count the number of cavities and record
_____ (2.5 cm)
 - b. Broken tops: Record if the snag has a broken-off or missing top (Ganey and Vojta, 2004)
 - c. Hollow: Record if the snag is hollow or has a substantial hollow section (greater than two vertical feet). Tip: a hollow snag may be indicated by an open, broken top, or by sounding a tree with a mallet

Safety note: Use extreme caution when approaching a snag, especially if there is wind. Take measurements quickly, use a hardhat, and then move away from the snag. If conditions are not safe to approach the snag (e.g., hang up, widow maker), estimate all measurements from a distance.

2. Living Trees with Decay and Deformities

Definition: There are various types of tree decay and deformities that make trees especially attractive to wildlife, such as Abert’s squirrel, black bears, dusky grouse, and Mexican spotted owls. These features include conks, broken or dead tops, forked trunks, lightning and fire scars, hollowed boles, dwarf mistletoe presence, brooming, and cavities. These features provide *a*) access to softened or rotten heartwood for excavation, nesting, and denning, *b*) create structural complexity of branches for

nesting, perching, or hiding, and *c*) provide or offer access to food sources such as mistletoe shoots (e.g., Bull et al, 1997; Mathiasen et al., 2004). Please see Appendix A for photographic examples of each type of decay or deformity. In this protocol, a *living tree with decay or deformities* meets the following basic criteria:

- ≥ 4.5 ft tall
- DBH ≥ 5.0 in
- Is rooted at ≥ 45 degree angle from the ground
- Has one or more feature indicative of decay or deformity

Steps:

- a. Record all standard measurements for living trees as described in the “Tree Overstory” section of the standard protocol: species, DBH, height, canopy base height, notes.
- b. If revisiting a previously measured plot, match each tree record with in-plot trees by referencing the previous data. Make note of any “new” trees.
- c. Thoroughly scan each tree for the *presence* of the following features. If a feature is present, check the appropriate box for the corresponding tree.
 - a. Conks- fungal fruiting bodies are evidence of heartwood decay, and are generally found on the main bole
 - b. Broken top- a tree whose uppermost branches and main stem have broken off
 - c. Dead top- the canopy of the tree is dead
 - d. Forked trunk- a bifurcation of the main bole above DBH; this also includes a forked top
 - e. Lightning scars- usually evidenced by a continuous groove or crack in the bark along the main trunk; oftentimes slightly spiraling
 - f. Fire scars- injuries caused by fire at the base of a tree usually resulting in exposed heartwood or a “catface”; there may or may not be charred bark
 - d. Hollow boles- a large cavity in the interior of the tree (*greater than two vertical feet*). Tip: a hollow tree may be indicated by an open, broken top, or by sounding a tree with a mallet
 - g. Dwarf mistletoe shoots- shoots are generally a rusty orange color and grow along branches; use binoculars if necessary to scan branches
 - h. Brooming- (i.e. witches brooms) hyper-branching that results in dense platforms and thickets of finer branches

- d. For each tree, *quantify* each of the following:
- a. Mistletoe Rating- Using the Hawksworth Mistletoe Rating System (see Appendix B), use binoculars to rate the Mistletoe Infestation for each tree (on a scale of 0-6) and record.
 - b. Cavities- For each tree, use ocular estimation to identify cavities that meet the size threshold and definition presented above (Lehmkuhl et al., 2003; Kraus & Krum, 2013), using binoculars if necessary. Count the number of cavities and record.

1000 Hour Fuels Measurements

1. Wildlife Logs

Definition: *Wildlife logs* are downed woody debris that serve as dens or shelter for mammals such as black bears, American martens, and mink, and provide cover from predators for smaller mammals (Bull et al., 1997). In this protocol, *wildlife logs* must meet the following criteria:

- ≥ 6.56 ft long (2 meters) (Davis et al., 2016)
- ≥ 3 " in diameter (Davis et al., 2016)
- If rooted, the log must be leaning at <45 degrees to the ground

Please note that *wildlife logs* are a subcategory of 1000 hour fuels which are described in the standard protocol. 1000 hour fuels differ from *wildlife logs* in that they have no minimum length.

Steps:

- a. Record all standard measurements for 1000 hour fuels as described in the "1000 Hour Fuels" section of the standard protocol: species, length, two end diameters, and decay status
- b. Wildlife log- If the fuel meets the larger size requirement (≥ 6.56 ft or 2 m long), record the fuel as a "wildlife log" and record the following:
 - a. Hollow- Consider a log hollow if the majority of the interior is hollowed out.
 - b. Cavities- For each tree, use ocular estimation to identify cavities that meet the size threshold and definition presented above (Lehmkuhl et al., 2003; Kraus & Krum, 2013). Count the number of cavities and record.

Citations:

Bull, E. L., Parks, C. G., & Torgersen, T. R. (1997). Trees and logs important to wildlife in the interior Columbia River basin. Forest Service general technical report (No. PB-97-199947/XAB; FSGTR-PNW-391). Forest Service, Portland, OR (United States). *Pacific Northwest Research Station*.

Bunnell, F. L. (2013). Sustaining cavity-using species: patterns of cavity use and implications to forest management. *International Scholarly Research Notices*, 2013.

Davis, C. R., Belote, R. T., Williamson, M. A., Larson, A. J., & Esch, B. E. (2016). A rapid forest assessment method for multiparty monitoring across landscapes. *Journal of Forestry*, 114(2), 125-133.

Ganey, J. L., & Vojta, S. C. (2004). Characteristics of snags containing excavated cavities in northern Arizona mixed-conifer and ponderosa pine forests. *Forest Ecology and Management*, 199(2-3), 323-332.

Hawksworth, F. G. (1961). Dwarf mistletoe of ponderosa pine in the Southwest (No. 1246). *US Department of Agriculture*.

Kraus D., & Krumm F. (2013). Integrative approaches for the conservation of forest biodiversity. *European Forest Institute*.

Lehmkuhl, J. F., Everett, R. L., Schellhaas, R., Ohlson, P., Keenum, D., Riesterer, H., & Spurbeck, D. (2003). Cavities in snags along a wildfire chronosequence in eastern Washington. *The Journal of wildlife management*, 219-228.

Mathiasen, R. L., Garnett, G. N., & Chambers, C. L. (2004). A comparison of wildlife use in broomed and unbroomed ponderosa pine trees in northern Arizona. *Western Journal of Applied Forestry*, 19(1), 42-46.

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For questions regarding the protocol and its use, please contact Savannah Lehnert:
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Appendix A: Photo guide to different types of woody decay. (Picture credits: Bull et al., 1997; Snyder, V)



A snag with a **broken top** can indicate a hollow bole



A snag with several **cavities** large enough for use by nesting birds



A **conk** or fungal fruiting body on an aspen



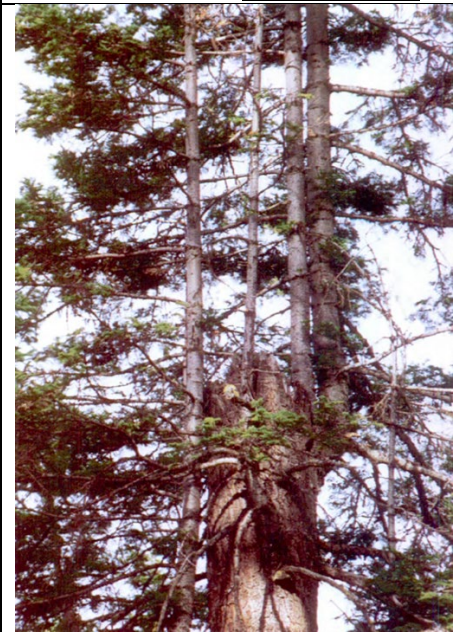
A **conk** or fungal fruiting body on a conifer



A slightly curving **lightning scar**



Fire scar on a ponderosa pine



A **broken top** on a tree that grew new leaders



A **hollow** "course woody debris"



Severe **mistletoe brooming**



Mistletoe brooming on a Ponderosa pine



Dwarf mistletoe shoots



Dwarf mistletoe shoots

Appendix B: The 6-class mistletoe rating system (Hawksworth, 1961)

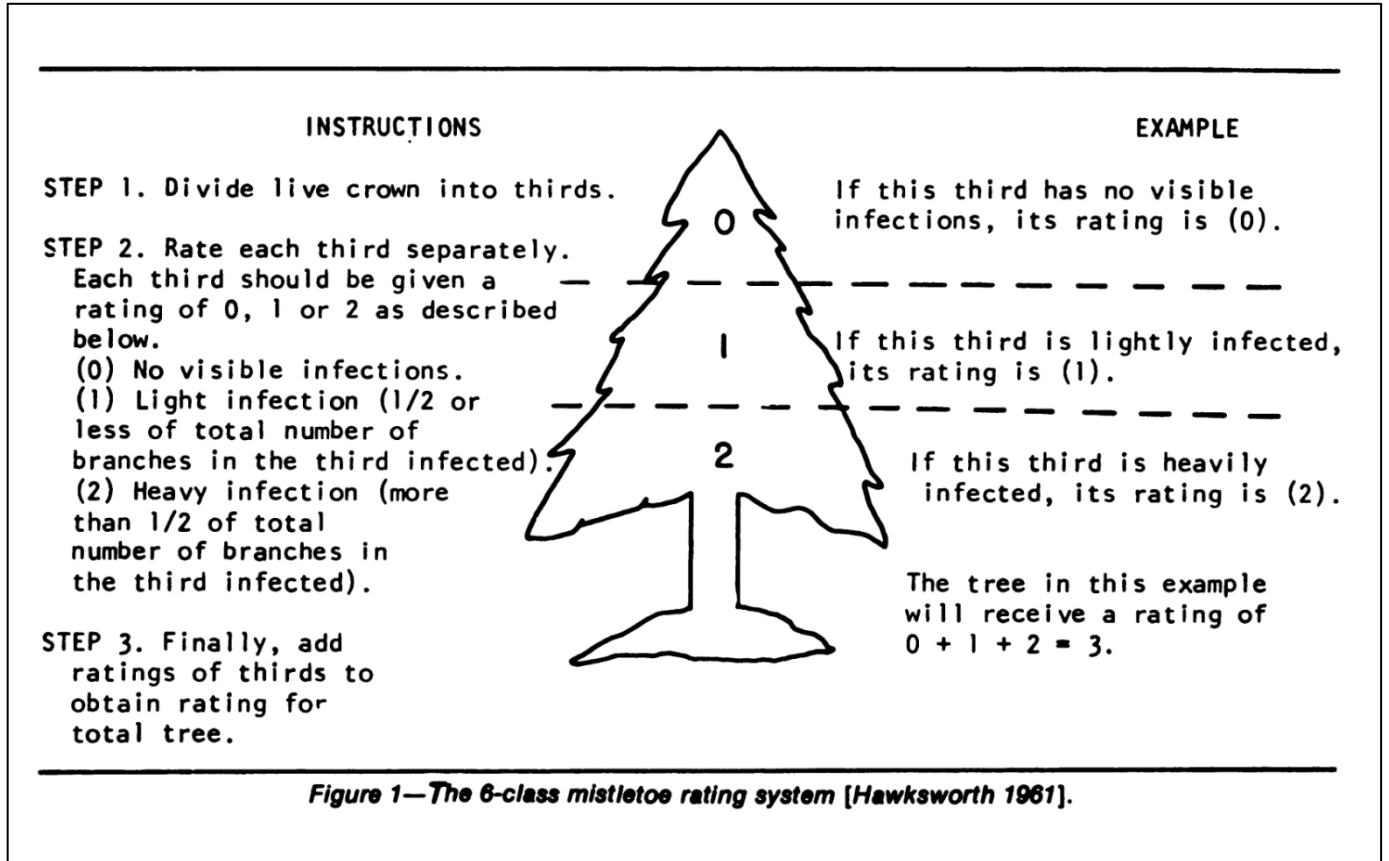


Figure 1—The 6-class mistletoe rating system [Hawksworth 1961].