

Part 2: Are CVS plots a suitable tool to directly field check the spatial ADS cumulative mortality estimates?

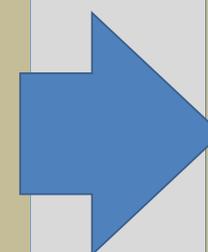
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Introduction

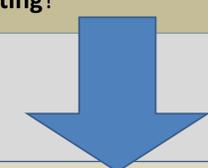
Aerial Detection Survey (ADS) cumulative mortality estimates could be useful tools to validate and calibrate landscape level bark beetle (mountain pine beetle, MPB, *Dendroctonus ponderosae*) spatial risk models provided that mortality is detected and mapped with a fair degree of spatial accuracy.

However, there appears to be poor correspondence between ADS and ground based measurements of mortality (as represented by the R6 Current Vegetation Survey (CVS) forest inventory plots). Extensive analysis of data could not clearly explain the lack of correspondence nor identify a subset of ADS data suitable as a validation tool. Although plots with high mortality were more likely to be included in an ADS polygon than those with lower mortality, there was not a clear accuracy threshold above which the ADS data appeared sufficient for risk rating system validation.



Questions Addressed in 2010 Field Season

1. Were ground based mortality measurements of tree mortality likely accurate?
2. If so, are there other explanations (besides lack of detection) for the lack of correspondence that could be identified in the field?
3. Are CVS plots an appropriate evaluation tool for ADS?
4. Does the current field work change our assessment of ADS as a validation tool for MPB hazard rating?



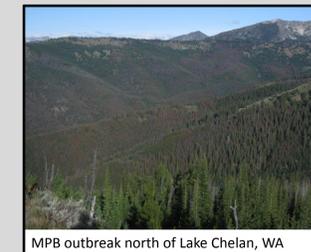
Methods

• We obtained cumulative mortality (from ADS) due to MPB across all years available (1980-2009). These summary maps (to left) were created by the cumulative mortality software developed by Julie Johnson (R6-FHP) and a similar summary algorithm written in the IDL language.

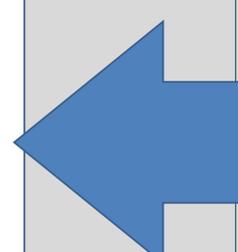
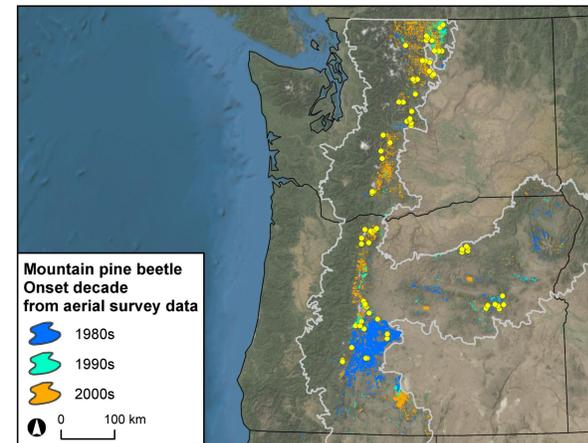
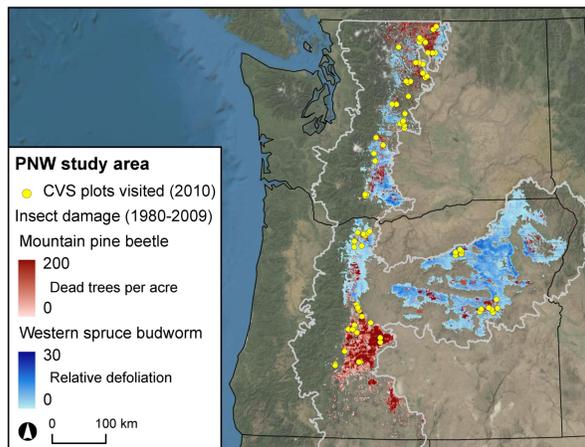
• 72 CVS plots were visited in the field in 2010:

1. A range of cumulative MPB mortality mapped by ADS from 1980-2009, stratified by time since MPB onset.
2. Three major ecoregions: East Cascades, North Cascades, Blue Mountains. (Maps show the outline of these ecoregions combined).
3. Eight national forests: Fremont-Winema, Deschutes-Ochoco, Malheur, Umatilla, Mt. Hood, Gifford Pinchot, Mt. Baker-Snoqualmie, Okanogan-Wenatchee.
4. Areas of pure MPB and areas with mixed MPB and western spruce budworm (*Chionistoneura occidentalis*) to assess confounding effects (example to right).

• Verification of CVS mortality measurements. At the central stake position, all trees were located and compared to the previous CVS observation via tag number to make sure trees were correctly labeled as live or dead.



Study area and sample plots



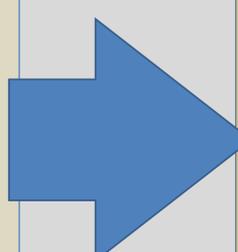
Results and Observations

CVS plot observations of dead trees really are dead >99.9% of the time. Of all the CVS tree tags we checked (thousands), only one tree that had been identified as dead was actually still alive.

So why the poor correspondence between ADS and CVS? Differences between ADS and CVS may have multiple sources of uncertainty, including four important factors:

1. **Scale mismatch between points and polygons.** Any given point is not representative of the average condition across a polygon, and CVS plot density is too low to have more than one plot for a given polygon.
2. **Scale mismatch between ground-based and plane-based observations.** A small number of dead trees at a given plot rapidly scales up to tens or hundreds of trees per acre (Table 1). Aerial surveyors rarely, if ever, estimate 100 TPA dead.
3. **Aerial surveyors cannot see all dead trees.** Surveyors count only current and previous year mortality of dominant and may miss slow, delayed mortality within stands hit hard earlier.
4. **Temporal windows of CVS plot re-measurement and insect outbreaks do not necessarily match.** The CVS plot intervals are highly variable and limited to first measurements occurring in 1993 at the earliest. Many MPB areas were hit hardest in the 1980s, especially in the Central Cascades, so the trees were already dead before the first CVS measurement.

Plot radius (m)	Multiplier to get from area sampled to one acre	Example number of trees	Example TPA	Example number of trees	Example TPA
5	52	5	258	10	516
10	13	5	64	10	129
20	3	5	16	10	32



Recommendations and Suggested Future Work

1. Cumulative mortality from ADS by itself is not a suitable tool for MPB risk assessment. We were unable to clearly explain enough of the discrepancy between the CVS plots and the ADS to identify subsets of the ADS that could be appropriately used to test MPB hazard rating systems.
2. CVS inventory plots are less than ideal for validation of ADS cumulative or other landscape-level mortality maps. This may change once the FIA plot system re-measurement become available.
3. Possible alternative technique(s) to validating MPB risk. Validate against imputed landscape mortality map developed using current FIA plots adjusted by yearly remote sensing information (e.g., LandTrendr algorithm).

