



How Well Do Aerial Detection Survey Maps Capture Mortality on the Ground?



The Project To conduct a region-wide "ground truth" of the Pacific Northwest Region (R6) ADS lodgepole pine (LPP) mountain pine beetle mortality (MPBM) maps.

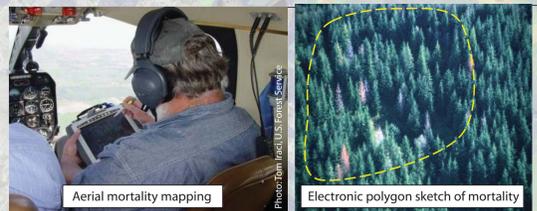
Rationale A good correlation between MPBM mapped by the ADS and ground data could permit us to substitute ADS for measured MPBM field data. ADS maps would then be useful for validation and refinement of models that predict the spatial distribution of MPBM.

Questions

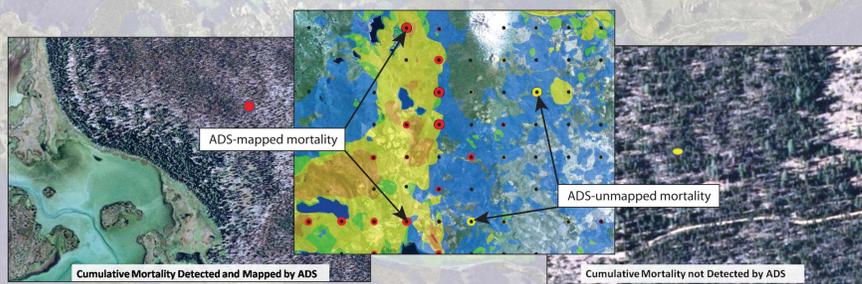
1: What dataset can we use to ground-truth the ADS map?



2: How spatially accurate are ADS MPBM maps?



3: If overall agreement is mixed, are portions of the ADS MPVM survey maps more spatially accurate?

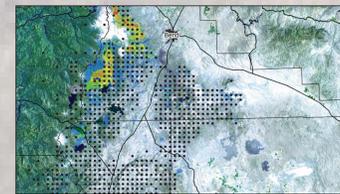


4: How well do ADS MPBM intensity levels match ground conditions?

Methods

Continuous Vegetation Survey (CVS) plot data were used as the ground truth dataset.

The cumulative MPBM over the re-measurement interval of each CVS plot was matched and then compared with cumulative ADS MPB estimates over the same time period.



CVS plots cover all Forest Service lands in Oregon and Washington.

Spatial accuracy was represented as the proportion of the time the ADS mapped MPBM where it occurred on the ground and did not map it where it did not occur.

MPBM in LPP on CVS Plot?	CVS Plot within ADS Polygon?	
	Yes	No
Yes	Match!	False negative
No	False positive	Match!

The better agreement there was (with respect to presence/absence of MPBM) between the ADS and co-located CVS plots, the more accurate we considered the ADS to be.

Plot attributes were then assessed for their capability to screen out situations where the ADS was unlikely to detect mortality.



Photo: Tom Iraci, U.S. Forest Service

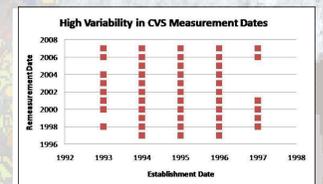
Analysis of agreement between ADS mortality intensities and ground conditions. Where MPBM (TPA) was mapped, ADS mortality and mortality on co-located plots were compared.

Results

Overview of CVS plots used to ground truth the Aerial Detection Survey

Plot size = 1 ha and has a measurable component of Lodgepole pine (LPP) over 5 inches dbh

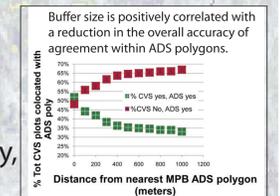
# Plots	3028
Number of measurement year combinations	49
# Plots where mountain pine beetle mortality (MPBM) occurs on dominant and codominant LPP	694
Average MPBM (trees/acre)	28.2
Median MPBM (trees/acre)	104.3



Establishment and re-measurement intervals for CVS plots

ADS significantly under-estimates the spatial extent of MPBM and as a result has relatively low overall accuracy. Only 18% of plots with mortality were mapped by ADS.

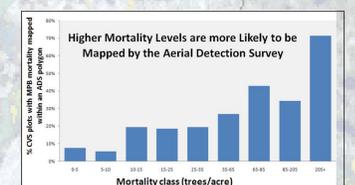
MPB Mortality On CVS plot	CVS Plot within ADS Polygon (Based on the mortality of dominant and codominant LPP)			
	Yes		No	
Yes	# plots	Average (median) MPB Mortality TPA	# plots	Average (median) MPB Mortality TPA
Yes	126	3557 (28.2 (104))	568	6273 (11.0 (63))



Buffer size is positively correlated with a reduction in the overall accuracy of agreement within ADS polygons.

Low spatial accuracy seems attributable to the failure to detect ongoing mortality, not spatial misalignment

High MPBM densities within the CVS plot re-measurement interval increase the likelihood of detection.



MPBM outbreaks prior to CVS plot establishment seemed to mask subsequent MPBM and thus decrease the probability of inclusion within an ADS MPBM polygon.



Old ADS mapped and CVS plot mortality.

Where both ADS and CVS data sources show mortality, ADS underestimates dominant and co-dominant tree mortality levels, on average, by a factor of 2.

Conclusions and Observations

The overall accuracy of the ADS is low because detectability is low. Specific observations related to this conclusion include:

- CVS data are the best ground-based data available but are less than ideal because of the variability in establishment dates (1993-1997) and re-measurement intervals (1-14 years).
- ADS cumulative MPBM data is not accurate enough to justify its use as a primary data source to validate and refine spatial MPB mortality models.
- Low spatial accuracy appears attributable to the failure to detect ongoing mortality, not spatial misalignment.
- We believe a subset of ADS with good correspondence may be feasible may not leave an appropriate sample size to validate spatial risk models.
- We hypothesize that the temporal relationship between CVS plot data re-measurement intervals and MPB outbreaks may explain a significant part of the remaining mapping error.
- Future work will focus on addressing this hypothesis and will include follow-up fieldwork.