Mapping whitebark pine mortality and regeneration in southwest Montana forests

Linda Vance
Melissa Hart
Claudine Tobalske
Ute Langner

Spatial Analysis Lab,
Montana Natural Heritage Program/University of Montana

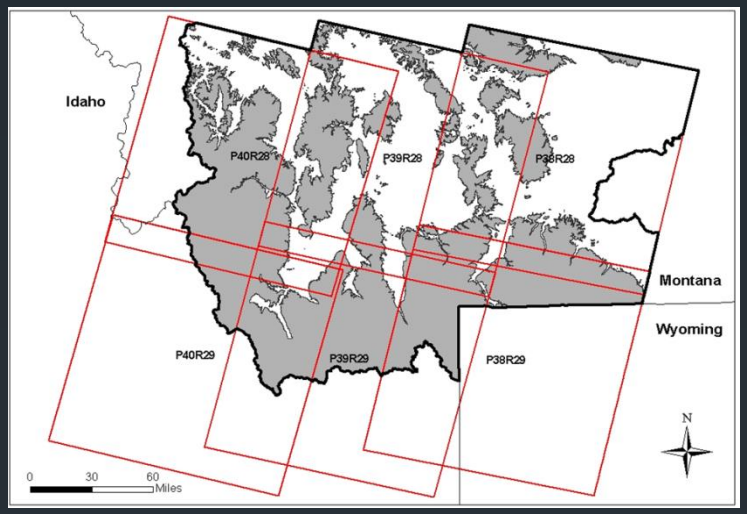
Project overview

- NASA-funded feasibility study in cooperation with R1 USFS to
  - Map whitebark pine mortality
  - Identify/map areas of whitebark regeneration
- Emphasis on southwest Montana forests, particularly the Beaverhead-Deerlodge NF
- Ideally, develop methods that allow for quick and easy updating of maps
- Overall goal to provide current mapping of whitebark for fire modeling and response and decision support tools

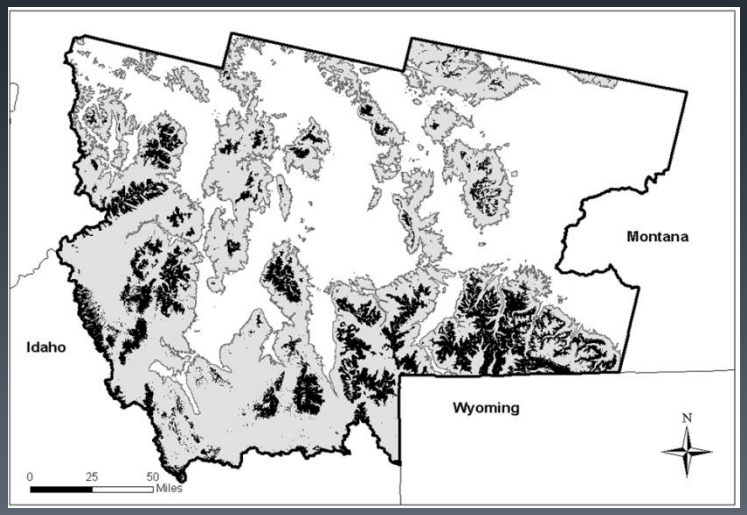
Conceptual approach

- Establish a baseline map of whitebark pine before extensive loss to blister rust and pine beetle.
- Use the baseline to track mortality at some later date (e.g., dead trees where whitebark was present in baseline map are dead whitebark)
- In areas of high mortality, look for regeneration

Baseline map from 1991 Landsat TM



- Predictive distribution first constrained by masking out areas below 1800m (5900 ft)

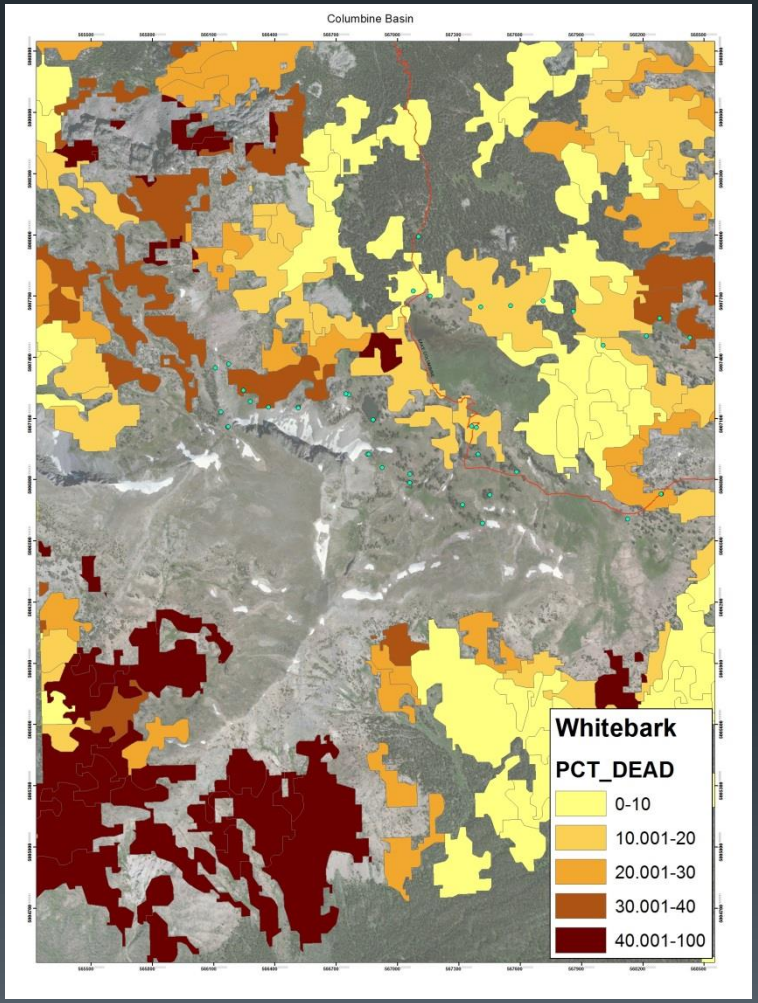


- 1991 Whitebark extent mapped with methods modified from Landenburger et al. (2008), using 22 predictive variables (6 reflectance, 6 PCA, 3 TCap, NDVI, elevation, slope, aspect, REAP, geology, and latitude

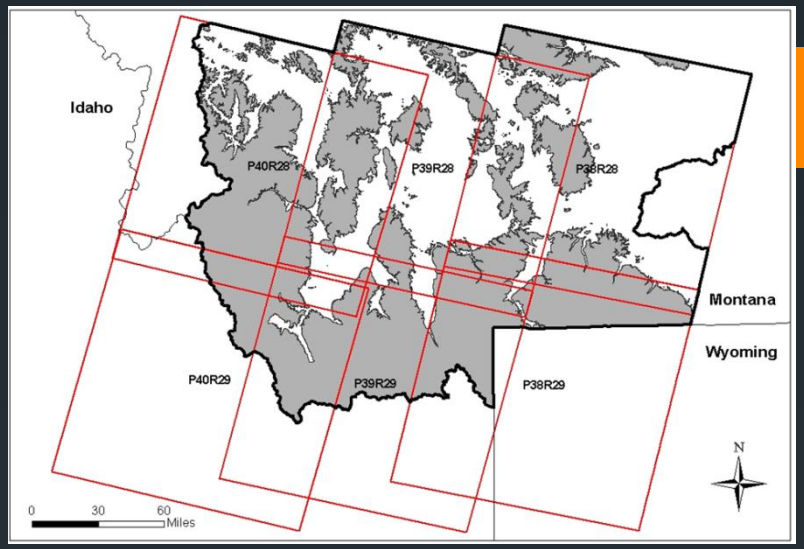
Mortality mapped from 2011 NAIP

- Using algorithm developed by project partner Steve Brown (R1 USFS), we processed raw NAIP images within WB distribution map to
  - Identify standing trees (live or dead);
  - Remove shadows
  - Separate green trees from red/dead trees

- V-MAP polygons were used to calculate dead-live percentages to guide field crews to target rich areas

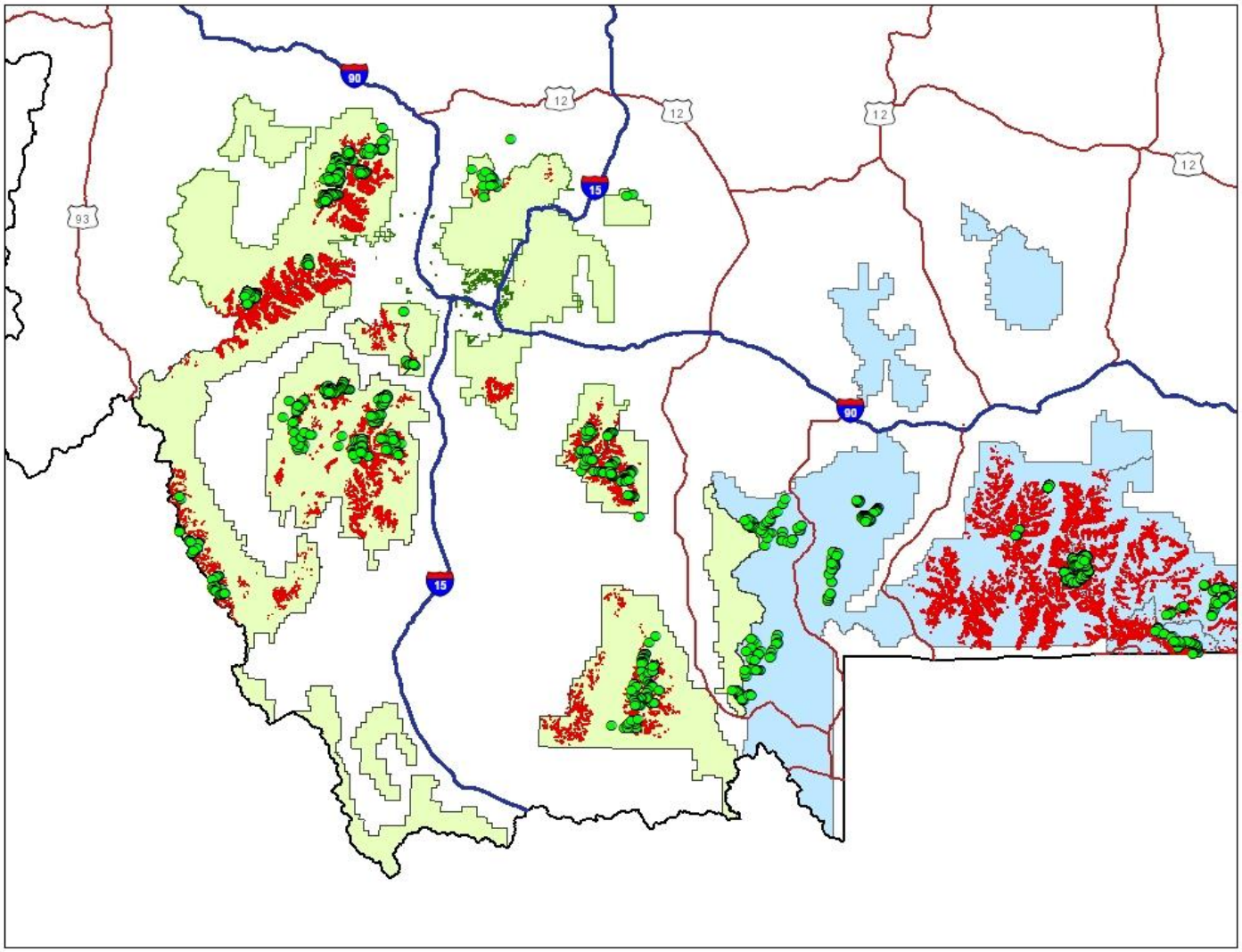


Initial accuracy of 1991 Model



	Presence (n)	Absence (n)	Whitebark producer's	Whitebark user's	Overall accuracy	Cohen's Kappa
P38R28	635	5730	77.64	90.46	96.95	0.8189
P38R29	1296	4006	93.60	98.62	95.84	0.9480
P39R28	1013	5051	82.33	91.95	95.84	0.8442
P39R39	913	3557	86.20	97.64	96.76	0.8957
P40R28	623	3684	70.95	85.49	94.06	0.7415
P40R29	709	1395	53.88	72.62	77.61	0.4651

Scope of fieldwork

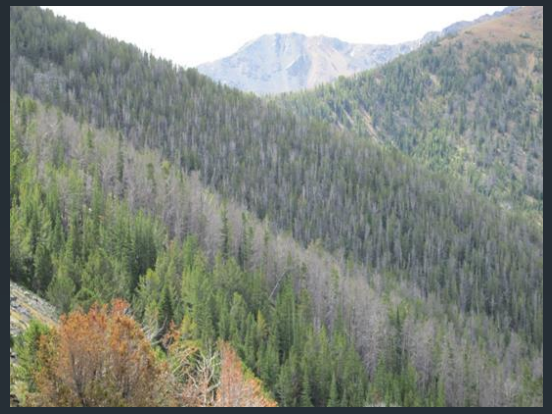


Initial observations on overall accuracy

- Producer accuracy for presence was spot-on almost everywhere.
- User accuracy fair (compromised by size of mapping units?)

Initial observations on live-dead model

- Results encouraging in forested areas, e.g., this area classified as 30-40% dead (2011 imagery).



- Treeline areas with scree and boulder fields present problems with both initial classification (tree/not tree) and live/dead

Next steps

- **With current funding**:
- Once 2013 field data is entered,
  - Complete accuracy assessment
  - Demonstrate how models and maps could be used for forest planning and fire modelling/response

- **With additional funding, if available:**
  - Use field data to revise 1991 predictive model and baseline map;
  - Reclass VMAP polygons, as necessary, or create new polygons from 2013 NAIP/Landsat
  - Run live/dead analysis using 2013 NAIP
  - Extend to all R1 forests

Additional applications

- Live-dead mapping approach can be applied to multiple years of NAIP to track decline;
- Live-dead mapping of entire forest allows us to identify “hotspots” of mortality, and tease out patterns (wind direction, aspect, proximity to lodgepole, etc);
- Live-dead progression can be extended forward for predictive purposes

Questions?