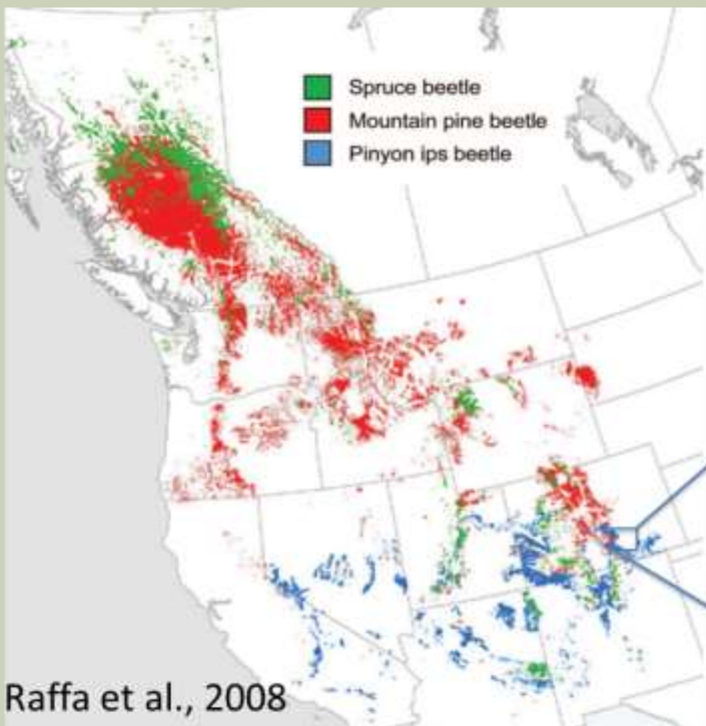
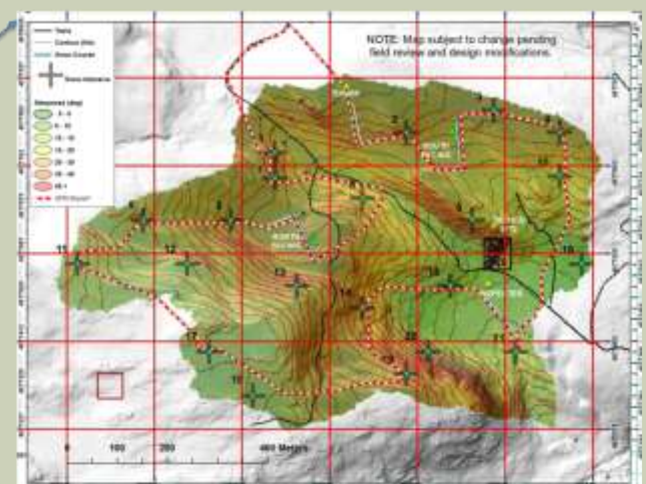
ASSESSING SPATIAL AND TEMPORAL SNOWPACK EVOLUTION AND MELT WITH TIME-LAPSE PHOTOGRAPHY

Caitlin Bush

PURPOSE

Quantify spatial and temporal changes of snowpack melt rate relative to changes in canopy structure and aspect in a central Rocky Mountain watershed.





OBJECTIVES

- Calculate snow depths using time-lapse photography via trail cameras without perturbing snowpack.
- Test how snowpack patterns are related to slope, aspect and canopy cover.

PROJECT SUMMARY

- Three research sites chosen in No Name watershed
- Cameras capture fluctuations in snow depths
- Time-lapse photography and analysis
- Complimentary ongoing research

DESIGN/METHODS

- Cameras placed at three sites in the No Name watershed
- Cameras powered by local battery
- Data downloaded to local SD card
- Snow stake measurements

DESIGN/METHODS

- Data collection at each site
- Photographic data assessment
- Special precautions

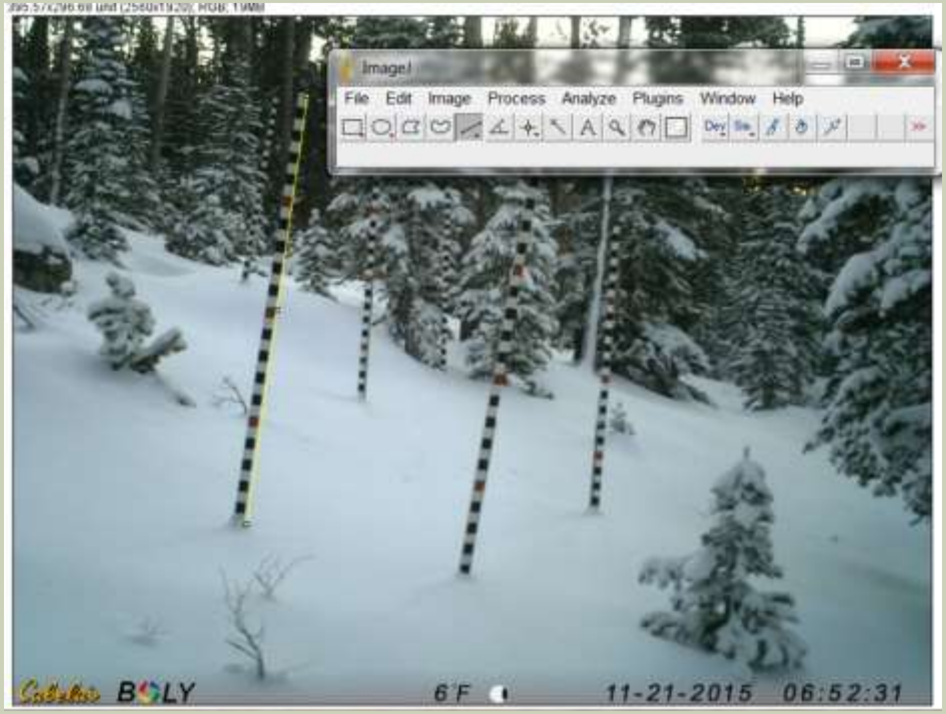
CONTINUOUS DATA COLLECTION

- Monitor fluctuations of snowfall, snow melt, and redistribution on site
- Cameras at three locations, record data in 2- hour increments
- Elucidate surface water and groundwater connections

PHOTOGRAPHIC ANALYSIS

- Image-J (W.Rasband) allows for efficient photographic snow survey analysis

- Pixel analysis



WHY IS THIS IMPORTANT?

- Snow is primary contributor to hydrological systems
- Snow quantification arduous due to topography
- Modeling to understand snow yields to environment and role in water budget

WHY IS THIS IMPORTANT?

- Photographic analysis less expensive, less time consuming
- Previous research has not assessed the use of game cameras
- Image-J improves on previous programs

WHY THIS IS IMPORTANT

- Snow stake accuracy
- Assessing new methods for potential use in future endeavors
- Effects of mountain pine beetle on No Name watershed

RESULTS

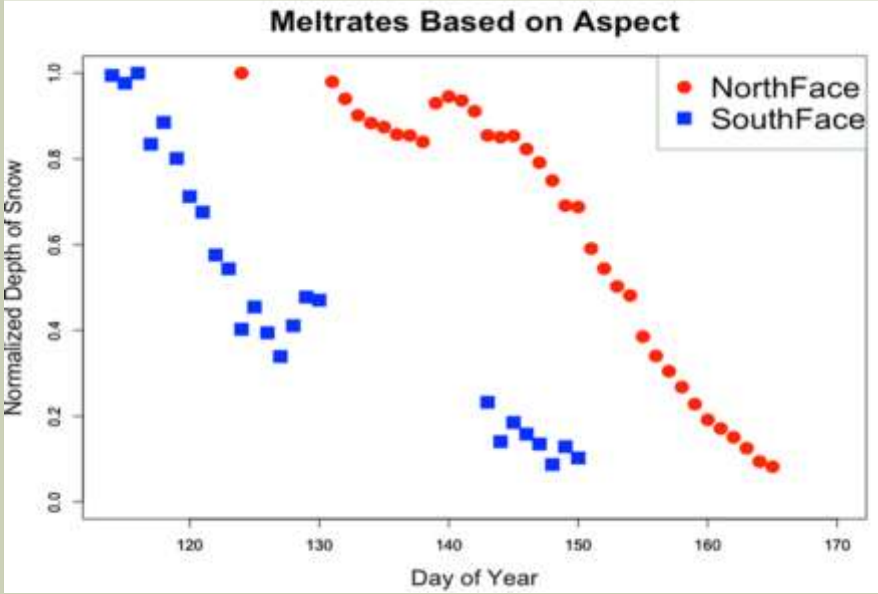


Fig 1.Snow melted 16 days earlier in SF than NF with approximately same rate.

RESULTS

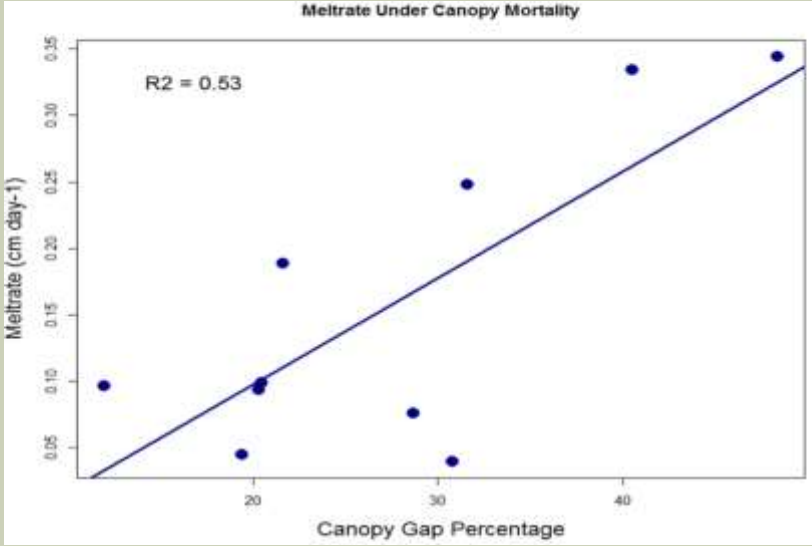


Figure 2: Melt-rates were predominately influenced by canopy gap fraction, regardless of slope aspect.

Evolution of snow was related to neither aspect nor canopy gap fraction. (Right)

WHAT DOES THIS ALL MEAN?

- Canopy gap fraction was the most important factor that affected snow melt-rates regardless of aspect and agrees with work on flat terrain showing earlier melt after bark beetle mortality (Biederman et al 2013).

- Snow began melting in the Trench, South face, and then the North facing sites consecutively. Snow melting rates were similar across all sites after melting started.

- Snow depth measurement was highly correlated ($R^2 = .99$) with the sonic-snow-depth sensor (not shown here).

- Results from this work indicate that the method may provide a cost-effective, low-maintenance method to monitor snow depth in any location.

CONCLUSION

- This work suggests that as forest canopy gap increases from mortality, the snowmelt rates will increase and this can be effectively incorporated along with aspect into snow melt models.

- This could result in downstream flooding in areas where the canopy has undergone massive dieback, such as the Rocky Mountains after the bark beetle epidemic

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