Monitoring grizzly bear habitat disturbance and phenology across spatial and temporal scales using remote sensing technologies in western Alberta, Canada.

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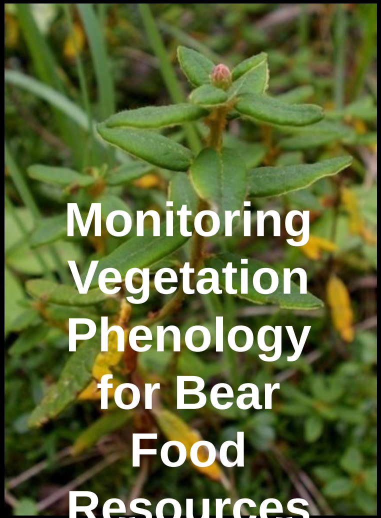
Objectives

- Development of techniques and products to monitor landscape change and disturbance over large areas
- Four main themes to our approach:



1. Monitoring Vegetation Phenology for Bear Food Resources

Aim: Develop a more comprehensive understanding of the temporal onset (phenology) of key bear foods and how it changes over the landscape

Approach: Use time lapse camera units to monitor phenology across a transect and relate to changes in satellite responses.

Seven Pentax digital 6 mega-pixel cameras installed with intervalometer and solar panel in weather sealed case

Daily images captured between 12 - 1:00 pm

Network of cameras along an elevation transect with mixed deciduous and coniferous pairs.

Phenological camera images - 14 April to 26 October 2009

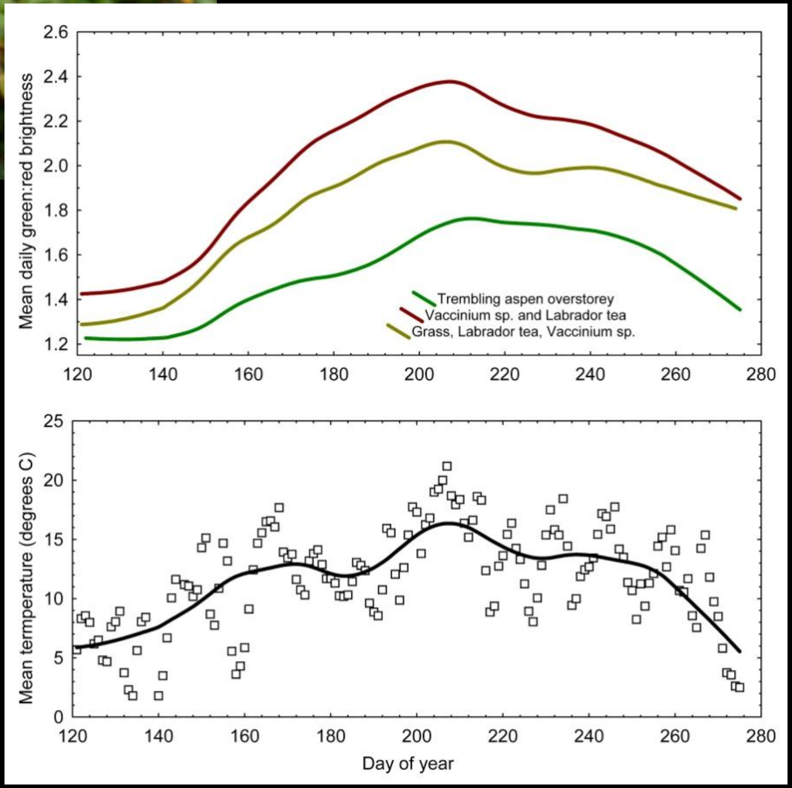
Bryan Spur mixed site

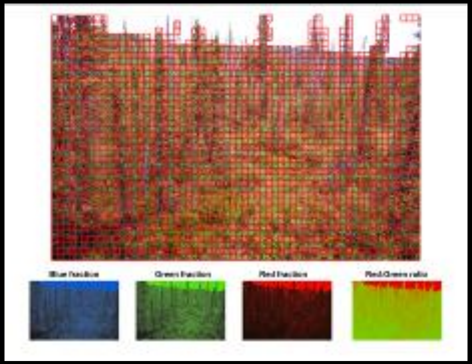
Prospect Creek conifer site

1. Monitoring Vegetation Phenology for Bear Food Resources

Accomplishments:

1 full year of data collected (2009 growing season)
Processing complete for over 6,800 images





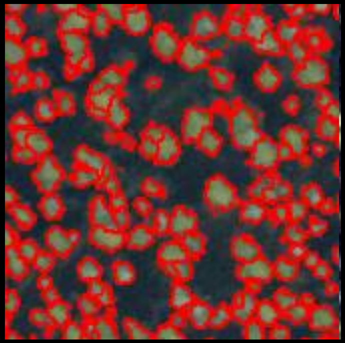
Phenological cycle mapped for the seven sites
Linking phenology to bear food development

Next Steps: Cameras being placed near key bear sites in 2010.
Matching phenological response with field observations of phenophases and satellite imagery acquired at the seven sites.

2. Mapping the Mountain Pine Beetle (MPB)

Aim: Monitor and map MPB red-attack across key areas of the Grizzly bear range

Approach: Use a combination of high spatial resolution aerial imagery and satellite data datasets to detect and map red attack.



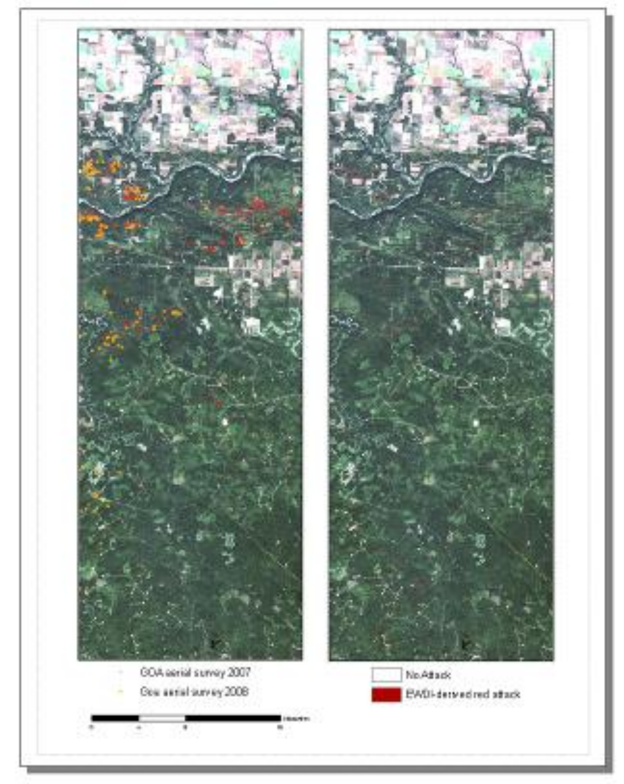
Step 1. Use high spatial resolution imagery to detect individual or groups of tree crowns. Automatically detect using an adaptive sampling design

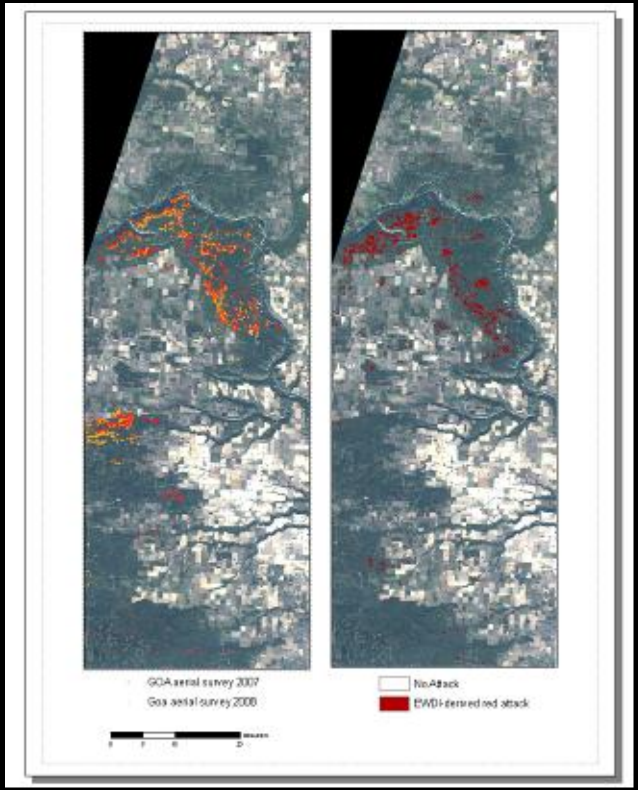
Step 2. Training 30m Annual Landsat imagery to detect annual change in red attack over larger regions

Accomplishments:

Annual mapping done over 400 x 400km from 2007
Methods published and used by BC MOF
Annual Mapping Accuracies > 70%

Use of high spatial resolution aerial data critical for accuracy and monitoring





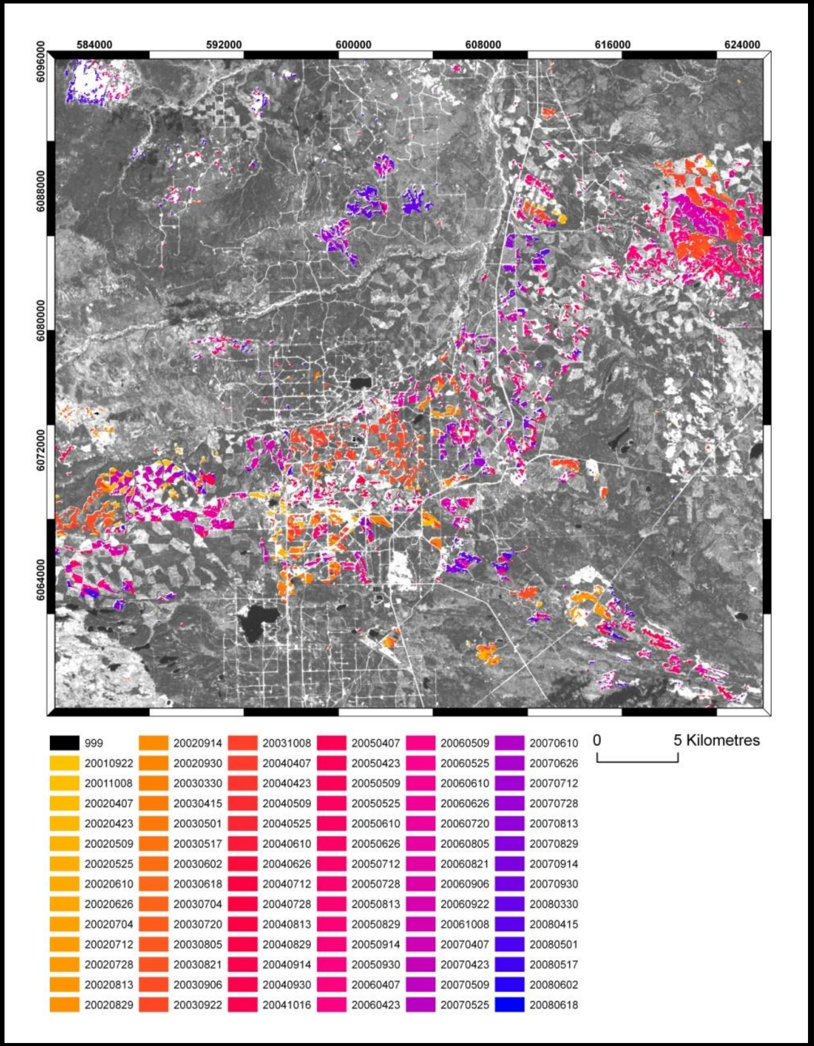
Next Steps: Continued mapping and spread monitoring into 2011

Increasing automation of image processing and red attack identification

3. Large Area, 1ha Mapping of Bi-Weekly Landscape Disturbance

Aim: Map and attribute the fast-paced disturbance (harvesting, fire, exploration) over the landscape at bi-weekly (16 day) intervals.

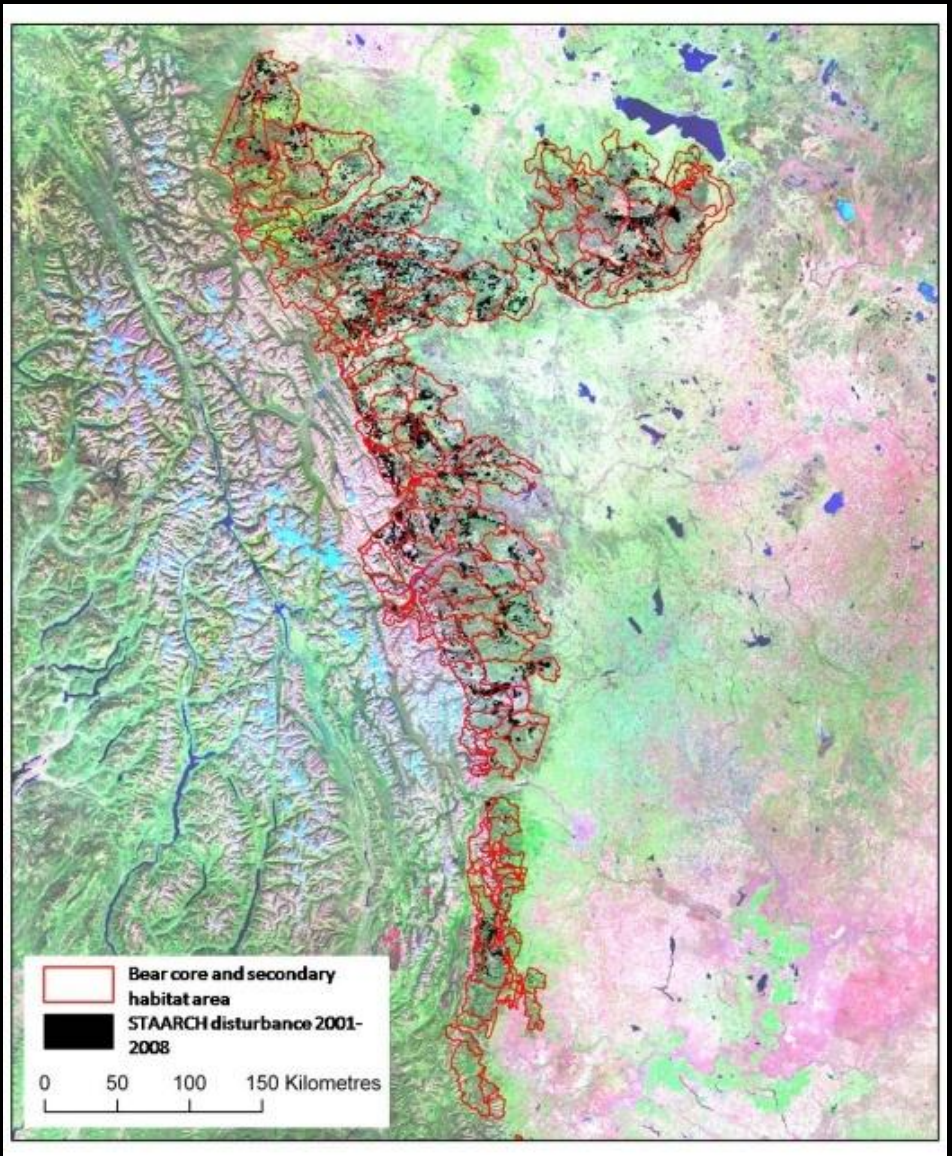
Approach: Use temporally dense (1km MODIS imagery- daily) fused with fine spatial resolution (30m LandSat - annual).



Our published algorithm STAARCH Spatial and temporal adaptive algorithm for mapping reflectance change uses Landsat to make a change mask between 2000 and 2008. MODIS data then assigns bi-weekly dates to the disturbance.

Accomplishments:

500 x 1500km complete covering Grizzly bear focus areas and majority of the Western Foothills from 2000-2008



Accomplishments:

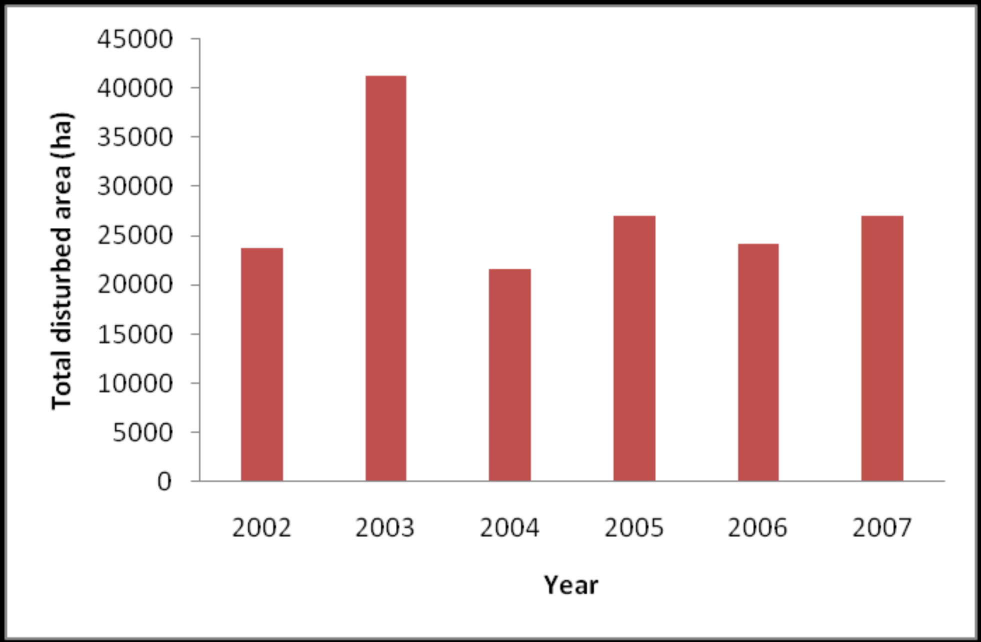
Temporal distribution of disturbance within Grizzly bear focus areas, by year and by month (within the growing season – April to Sept).

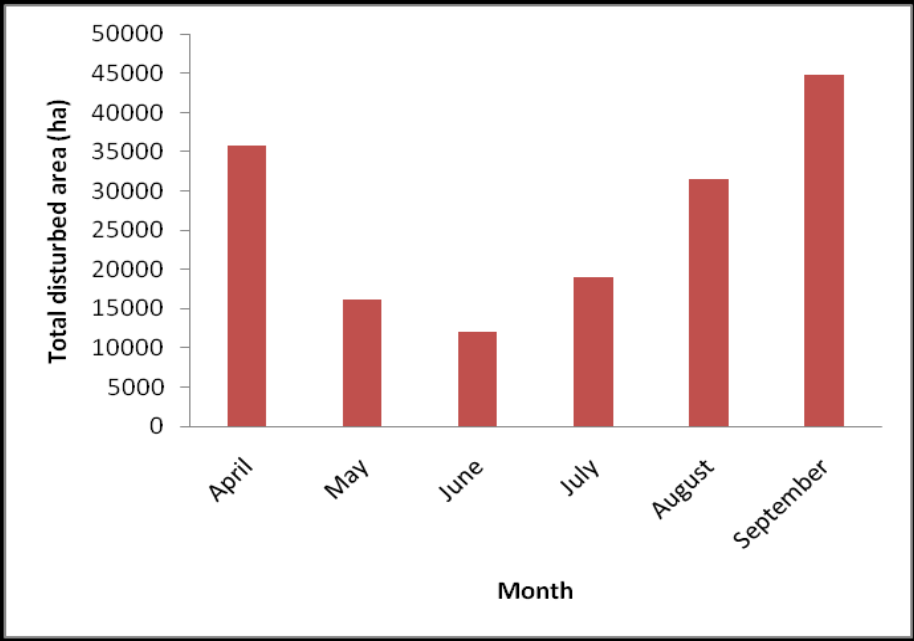
Next Steps: Automatically attribute the disturbance based on spatial / spectral characteristics.

Integration of patterns of disturbance into bear movement and home range models.

Characterisation of western foothills disturbance patterns.

Use as input to stand age maps for long-term yield prediction.

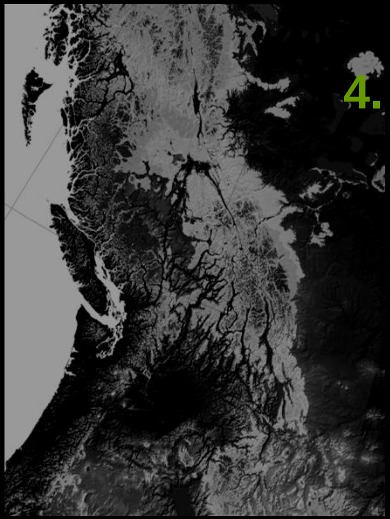




FOREST EDGES
Accomplishments:

Consistent and quantitative algorithm to detect forest edges integrated with land cover products to generate class transitions which are critical for habitat using 4 processing steps

- Classified satellite image;
- Wetness (based on image spectral values);
- Edges defined with brightness relates strength;
- Different types of edges defined.

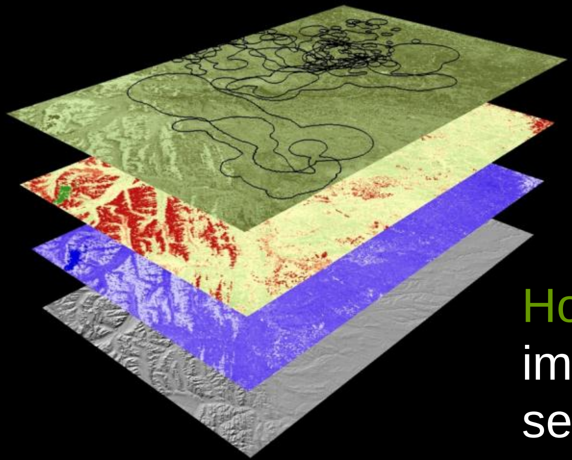


4. Short and Long-Term Forest Resources under Changing Climate

Aim: Develop a comprehensive picture of what the forest will look like in 2020, with respect to MPB, current land use and changing climate.

Approach: (A) Investigate relationships between home range size and factors such as topography, land cover, mountain pine beetle impacts, habitat productivity, and disturbance

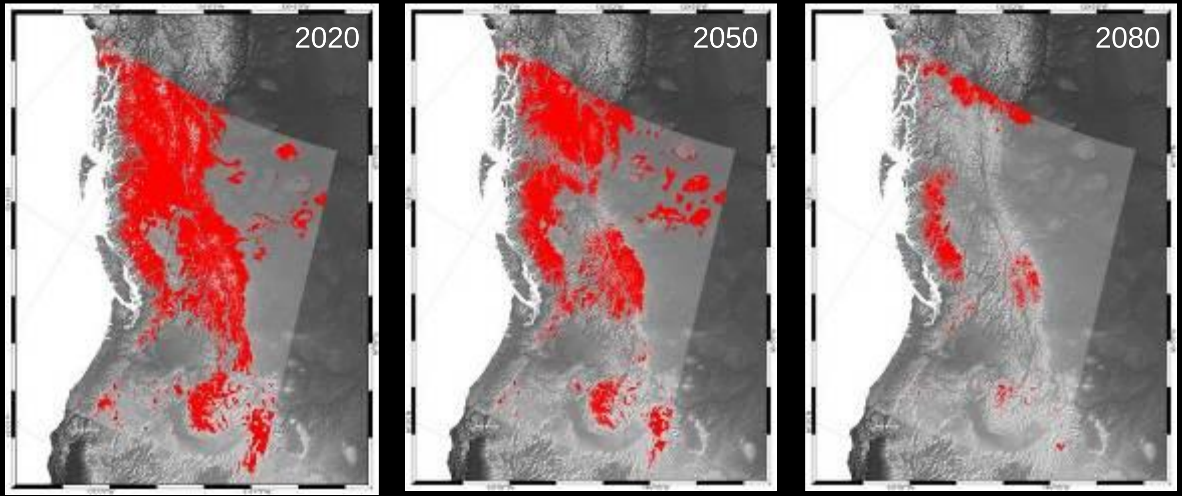
(B) Combine current and future climate layers, with forest growth models and changes in species abundance, using the current land base and disturbance regimes to make predictions of future forest species dominance and yield.



Home Range Analysis: Currently refining analysis using improved information related to bear sex, age and seasonal habitat usage.

Accomplishments:

Using process-based models of forest growth, with climate forecasts, we have predicted where lodgepole pine (*Pinus contorta*) species is currently and where it will be best suited to grow over the next 80 years.



Climate Change Scenario:
Canadian Climate Centre (CGCM2) SRES A2 (no reduction in CO_2 emissions)

Next Steps: Combine predictions with stand age maps produced from historical 1970 Landsat imagery, and STAARCH output.

Link predictions with growth and yield calculations to calculate future yields.

Conclusion

- The integration of remote sensing data from field-based, air and satellite platforms provides the most comprehensive data with which to map landscape condition and change.
- Linking data with models and algorithms provides an overall approach and products which are accessible, useable and relevant to policy makers.