



Whitebark Pine Restoration Area Mapping- Flathead NF

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Discussion Topics

- Project background
 - WBP management needs
 - *Restoration
 - Monitoring
 - How WBP composition in R1 differs from the GYE
 - How this project is different from past WBP mapping projects- project goals
 - Use the Flathead NF as a pilot study area
- Study goals
- Study methods and preliminary results
- Conclusions

Project background- WBP Management Needs

- Consistent methods are needed for WBP restoration planning
 - Currently WBP restoration efforts are planned based on expert knowledge of suitable locations for WBP restoration
 - Need a consistent method for identifying where WBP could grow
 - Need a consistent method for identifying areas where there would be limited competition for WBP establishment
- Perhaps remote sensing and terrain modeling could help!



View from Moose Peak across the Flathead looking areas that may be suitable for WBP restoration

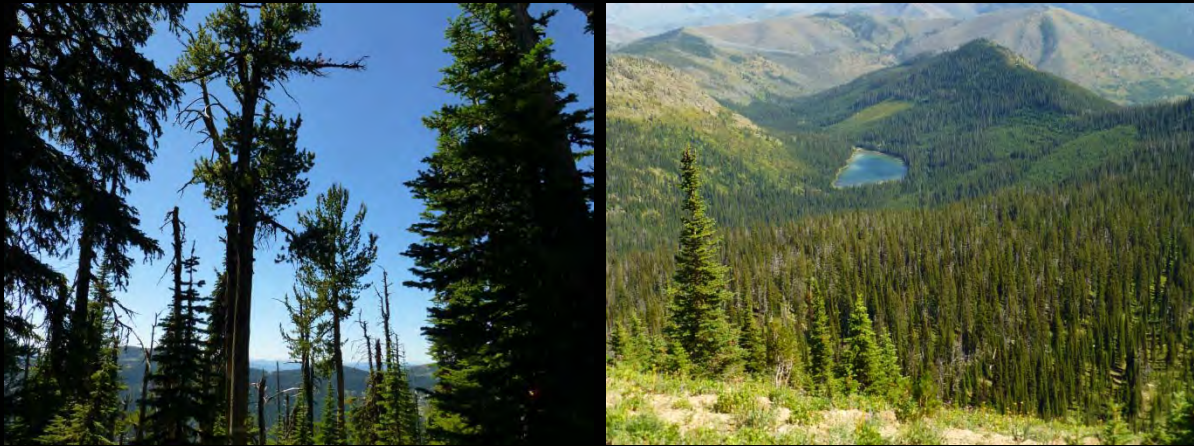
WBP composition in Region 1

- WBP in the GYE often is found in large stands



WBP mortality in the Gros Ventre Range, Bridger-Teton NFs, WY (Macfarlane et al 2010)

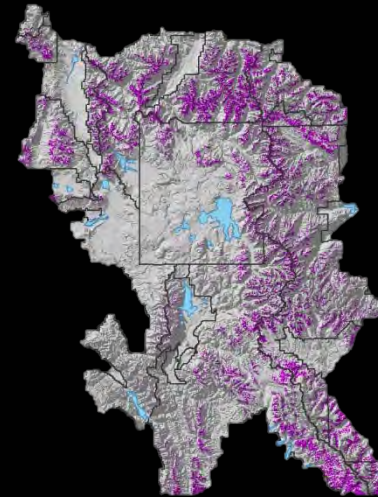
- Currently, WBP is largely mixed with other conifers throughout Region 1



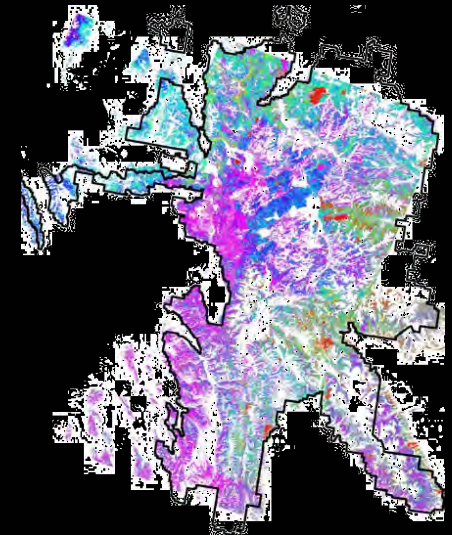
WBP mortality in the Flathead NF

How this project differs from past WBP mapping projects- project goals

- Past projects have largely concentrated on
 - Mapping WBP extent- Landenburger et al 2008
 - Mapping WBP mortality- Goetz et al 2009
- Since WBP mortality in R1 largely occurred prior to satellite remote sensing, alternative methods are needed
- This project's goals are to
 - Model WBP potential range
 - Within the WBP potential range, identify areas suitable for restoration



Landenburger et al 2008 map of WBP in the GYE

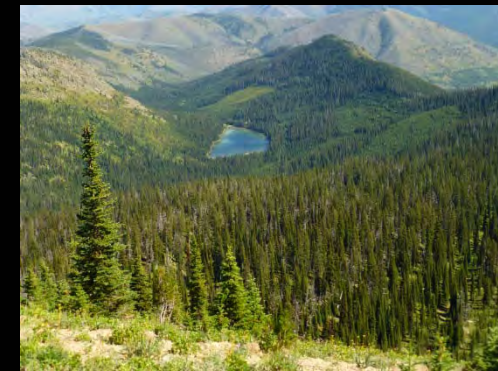


Goetz et al 2009 map of WBP mortality in the GYE



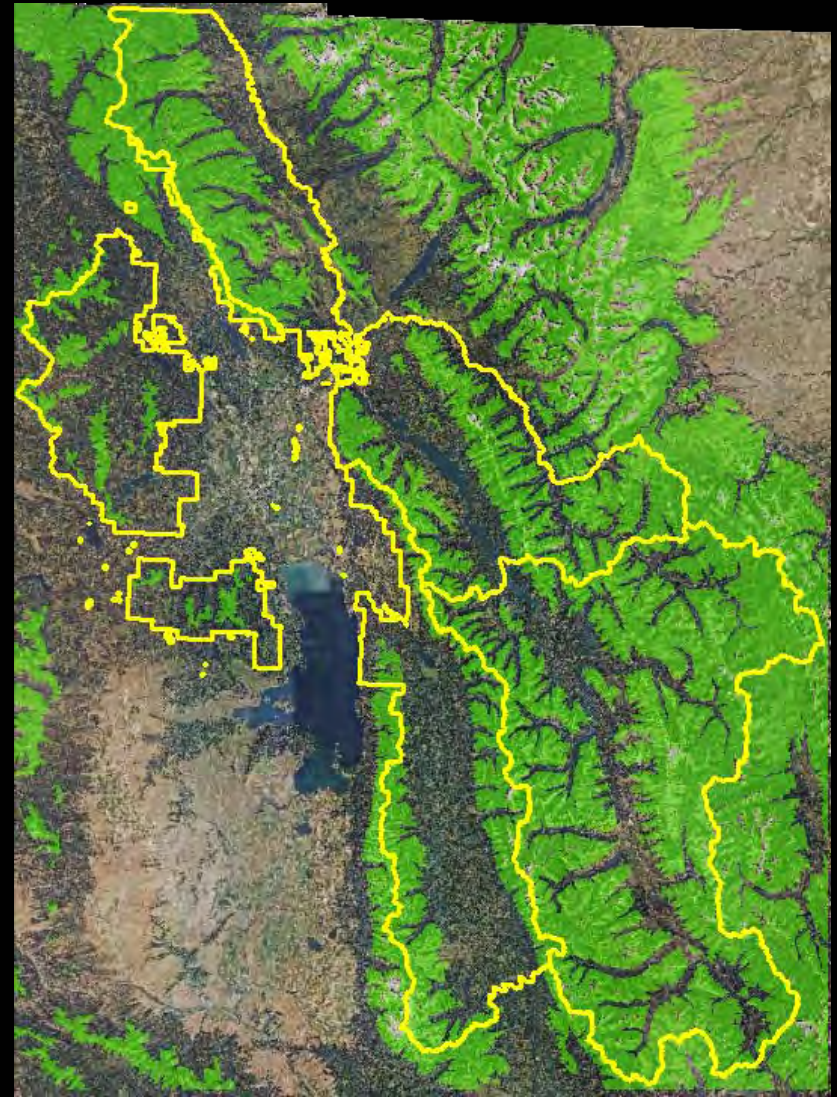
7/13/2009 11:08:31 AM (-6.0 hrs) Lat=43.49134 Lon=-109.80411 Alt=10981ft MSL WGS 1984
W.W. Macfarlane et al. 2009

Macfarlane et al 2010



WBP Range Methods Review

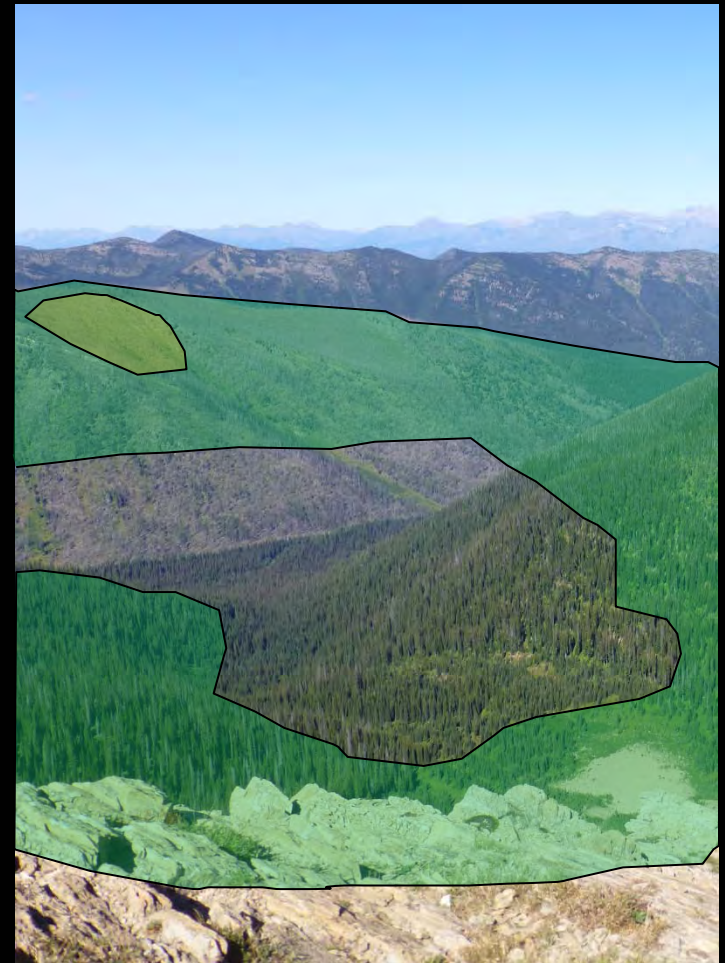
- Past range modeling efforts
 - Latitude in a regression model to model upper and lower elevation limits of WBP extent (Keane 2000)
- This project was interested in the idea of a “potential” range layer
- Potential range of WBP was loosely defined as- an area where WBP would be likely to establish with limited management



LEL = $2446.0856 - 0.001321(\text{NOC})$ $R^2 = 0.68$, $df = 35$, $SE = 150.21$
UEL = $2838.8867 - 0.001057(\text{NOC})$ $R^2 = 0.87$, $df = 26$, $SE = 67.60$

Project challenges

- Project challenges
 - How to model WBP potential range
 - No historical data of where WBP occurred prior to decline in the 20th century
 - Impossible to go back in time (beginning of the 20th century) to create a complete dataset
 - How to model restoration suitability
 - Need to be able to identify forest disturbances
 - Need to be able to ensure that vegetation establishment is limited since WBP does not compete well



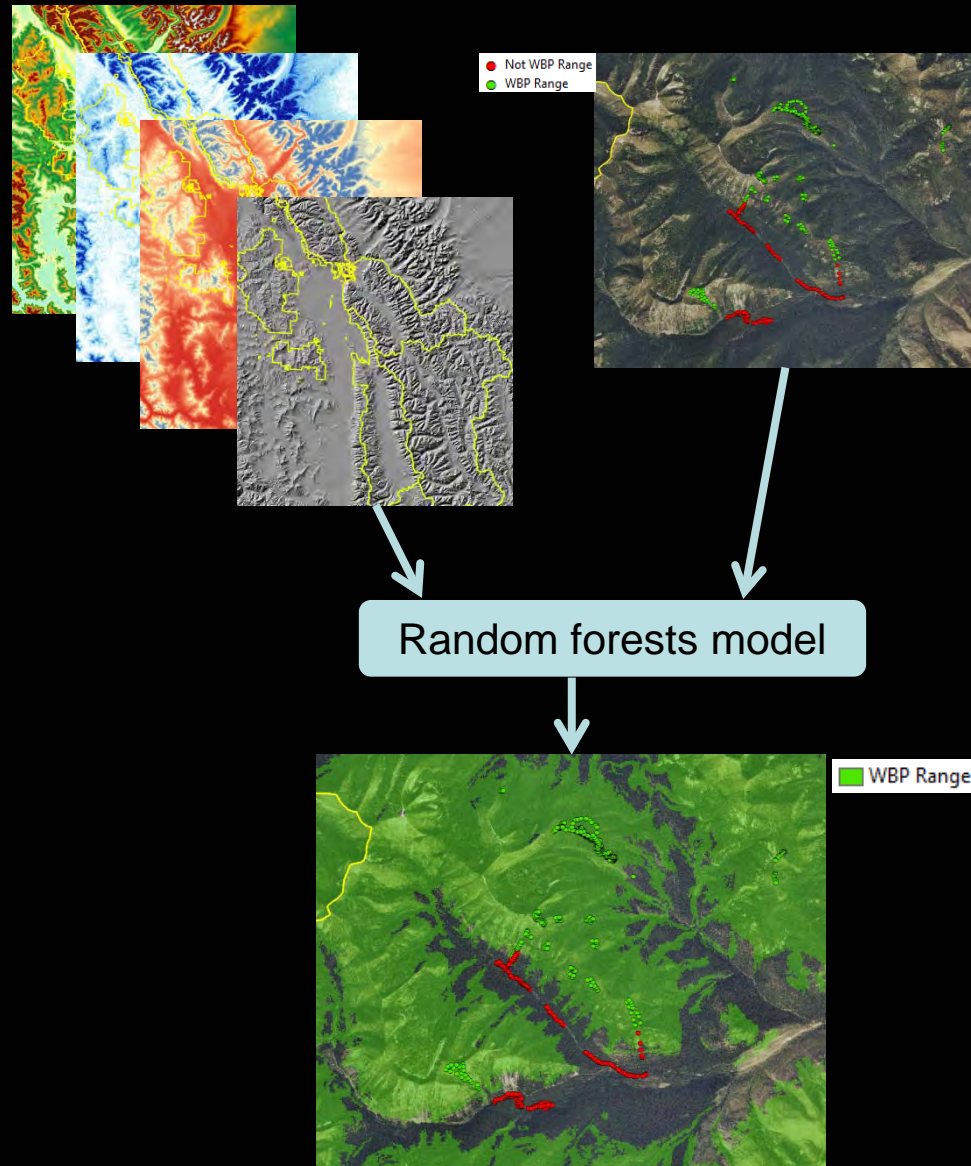
WBP potential range



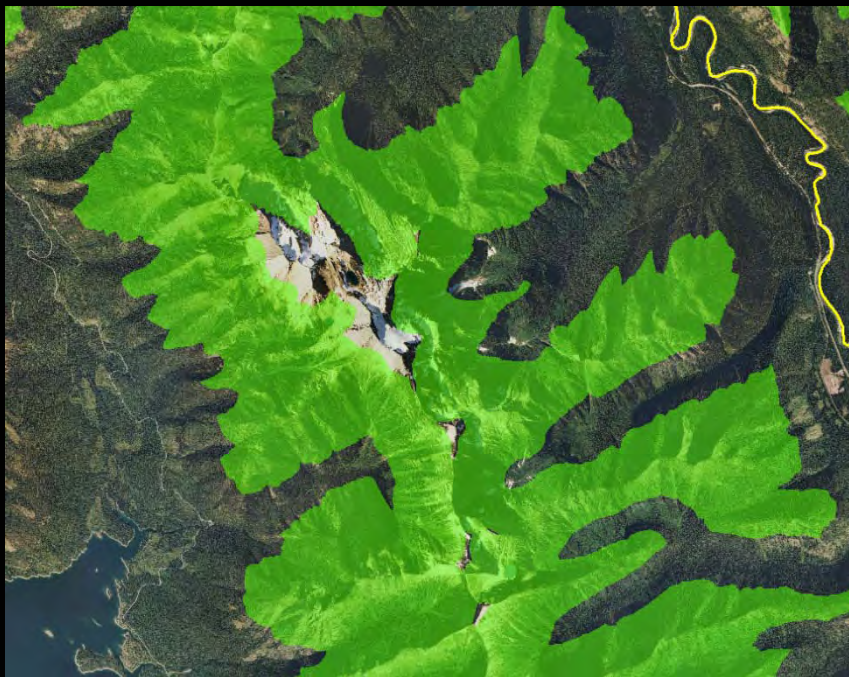
Suitable for WBP restoration

WBP Potential Range methods used

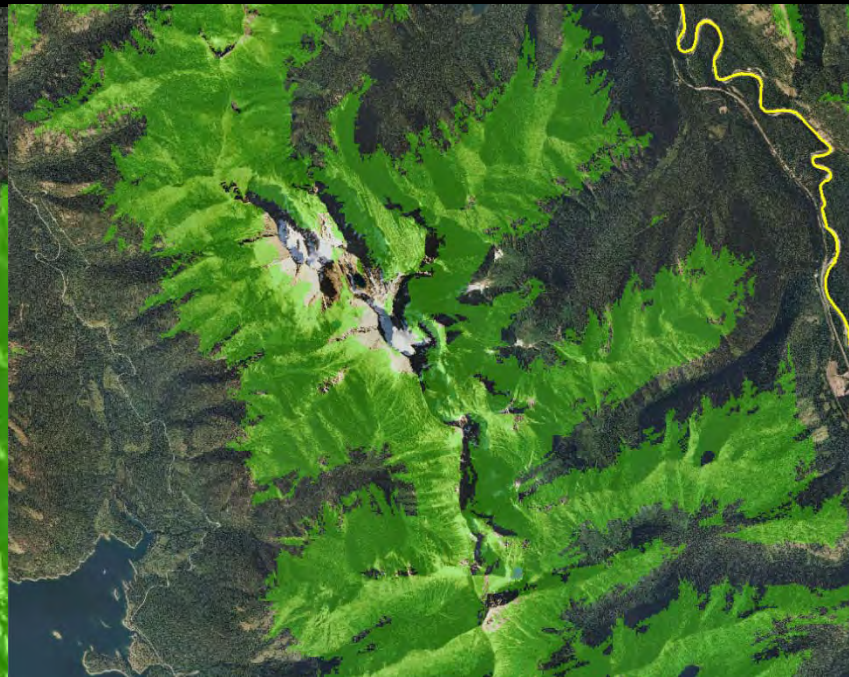
- Initially tried to develop a refined expert-based decision tree
- This failed due to an incomplete knowledge of where WBP “could” be
- Turned to a machine learning approach- random forests (Breiman 2001)
- Used climate and terrain data as predictor variables
- Created an expert-based calibration dataset indicating WBP potential range
- Created a random forest model to arrive at an output



Potential Whitebark Pine Range Results



Keane 2000 range layer

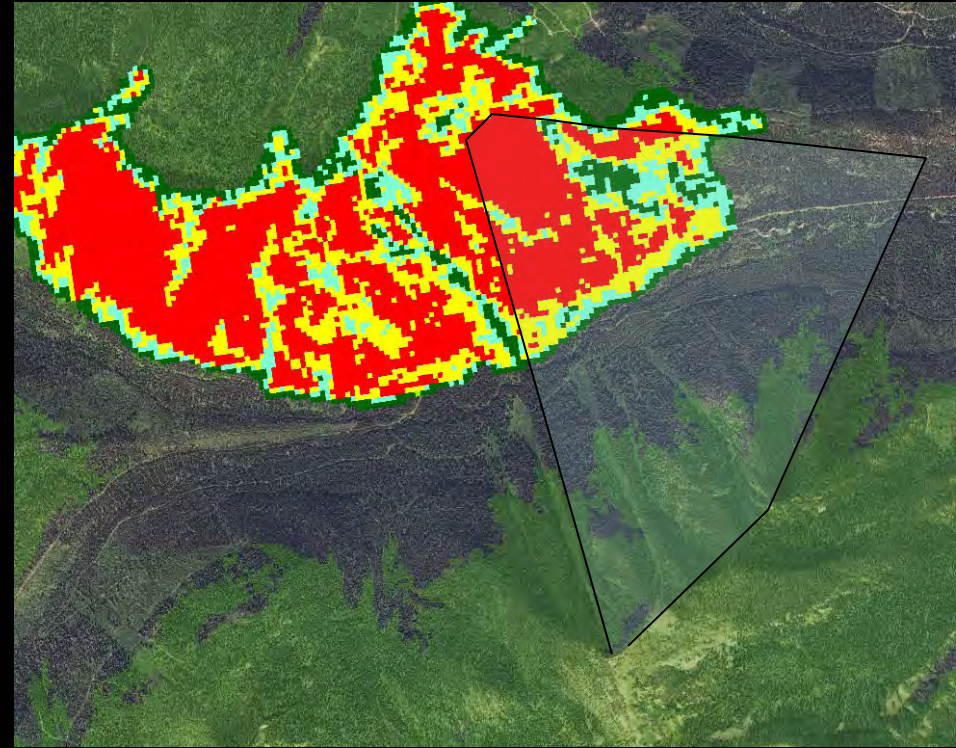
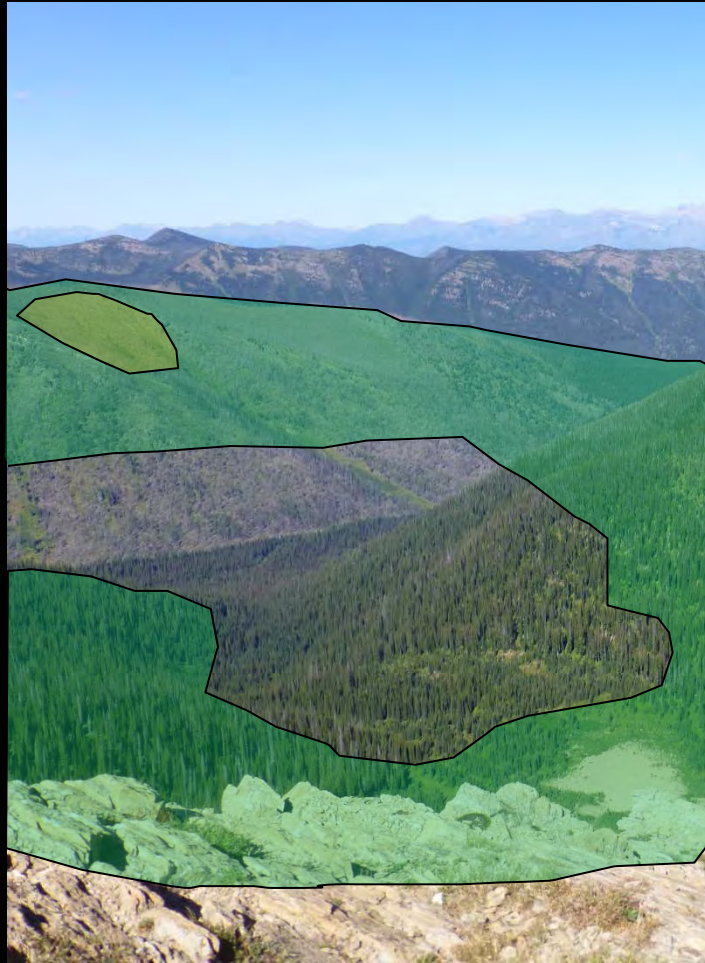


Modeled potential range layer



Modeled 2000 range layer

Restoration Suitability Mapping Methods Development



■ WBP Range

- Low Severity
- Moderate Severity
- High Severity



WBP potential range



Suitable for WBP restoration

Restoration suitability mapping methods- multi-data automated change detection

- Past efforts have used two-date change detection (Goetz et al 2008)
- Since the Landsat is now free, multi-date methods are practical
- Used the Vegetation Change Tracker (VCT) (Huang et al 2010) to identify disturbances
- VCT then tracks recovery trends
 - Allows for weighting of restoration suitability

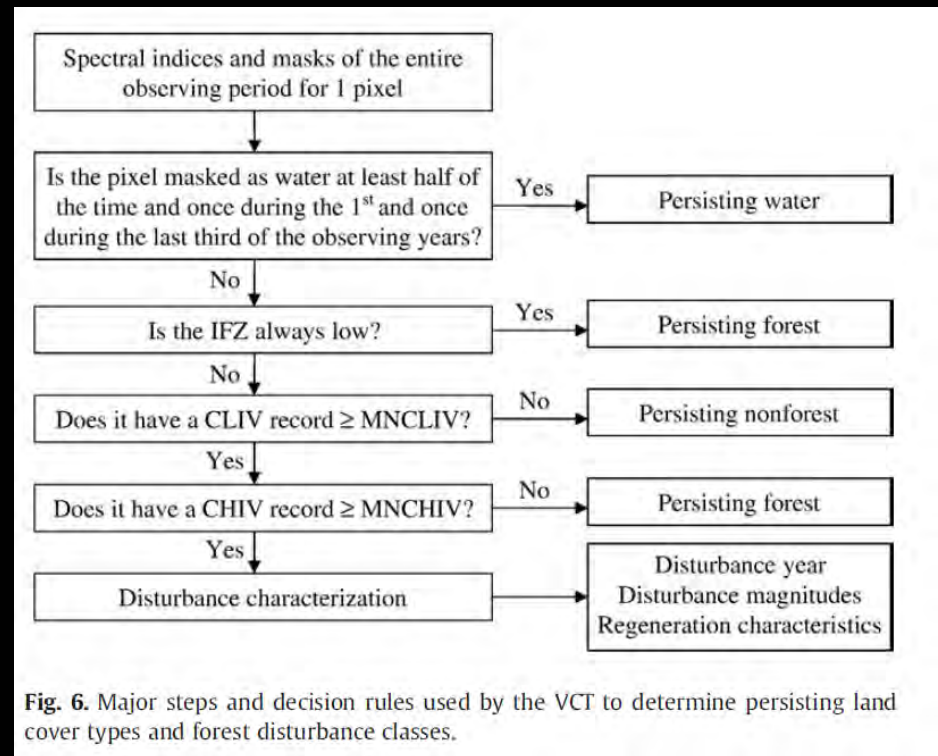
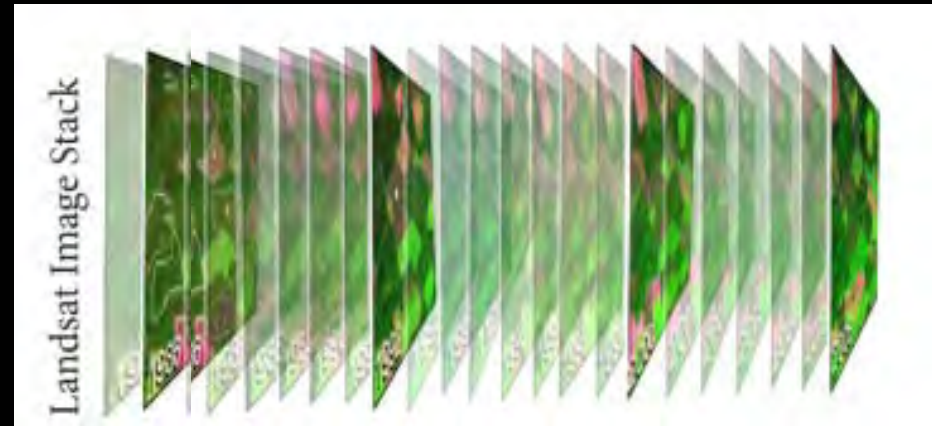
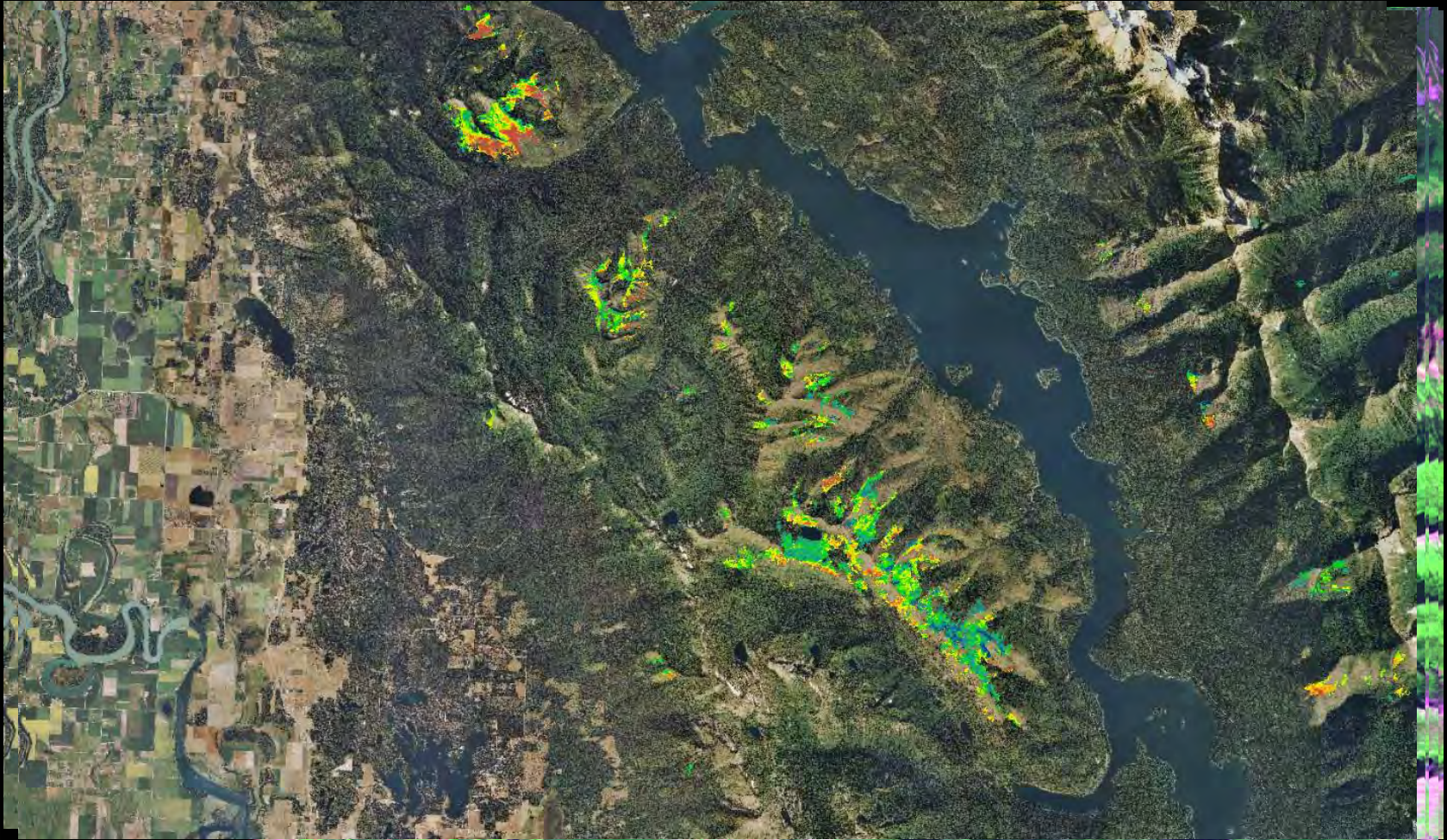


Fig. 6. Major steps and decision rules used by the VCT to determine persisting land cover types and forest disturbance classes.

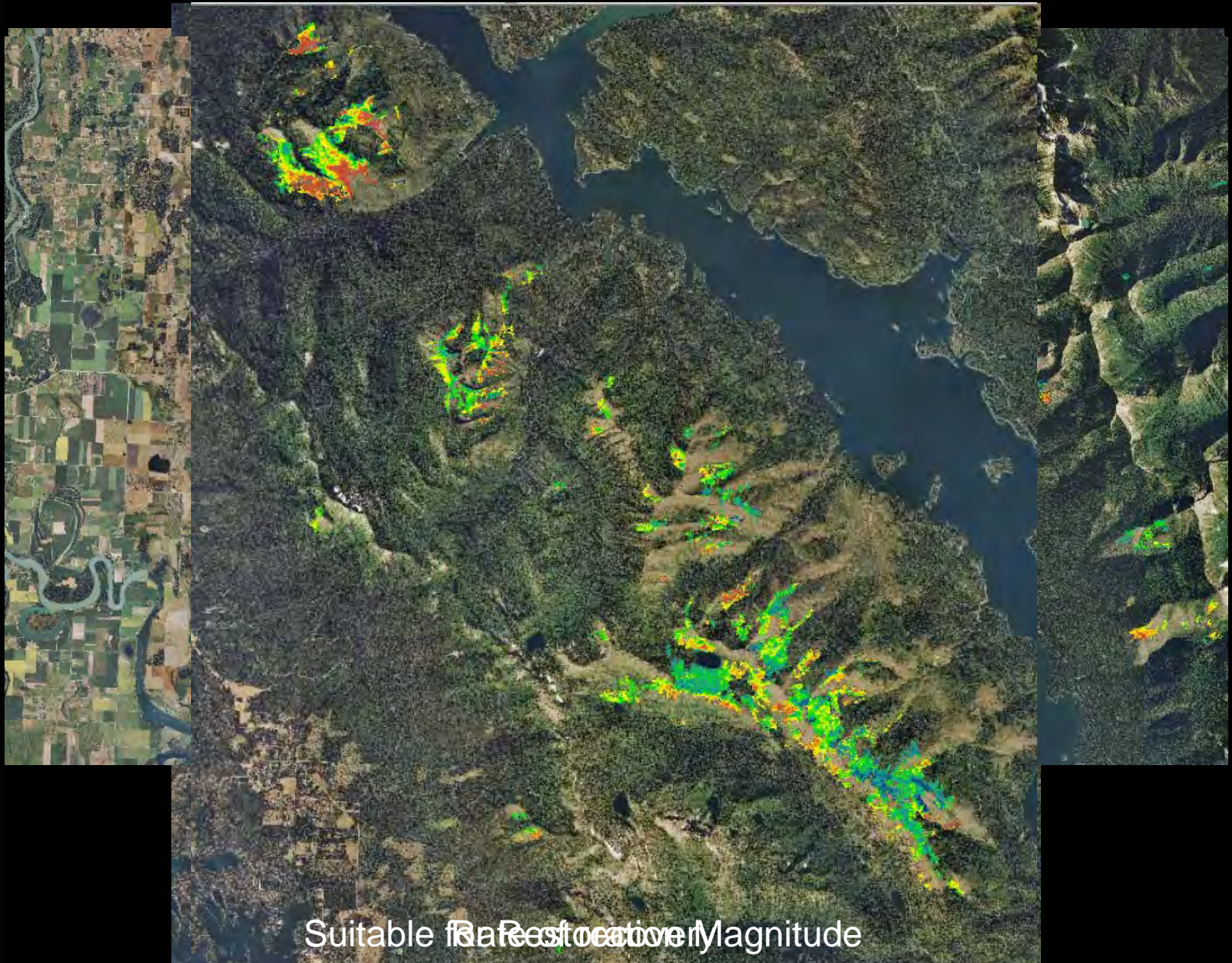
Restoration suitability map suite results



Suitability Results by Magnitude



A closer look at the restoration suitability products



Suitable for Restoration Magnitude



Conclusions

- Understanding how to consistently plan for WBP restoration across a Forest can be difficult
- Using a random forests model with expert-based calibration data, areas of potential WBP range can be effectively modelled
- Using multi-date change detection and recovery modeling, the Vegetation Change Tracker (VCT) effectively provides a suite of data useful for restoration suitability mapping

Sources

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Questions?



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