


# Evaluating Climate Change Vulnerability in the Pacific Northwest: Integrated Assessments of Potential Ecological Change in Three Case Study Landscapes

USGS science for a changing world

NATIONAL PARK SERVICE

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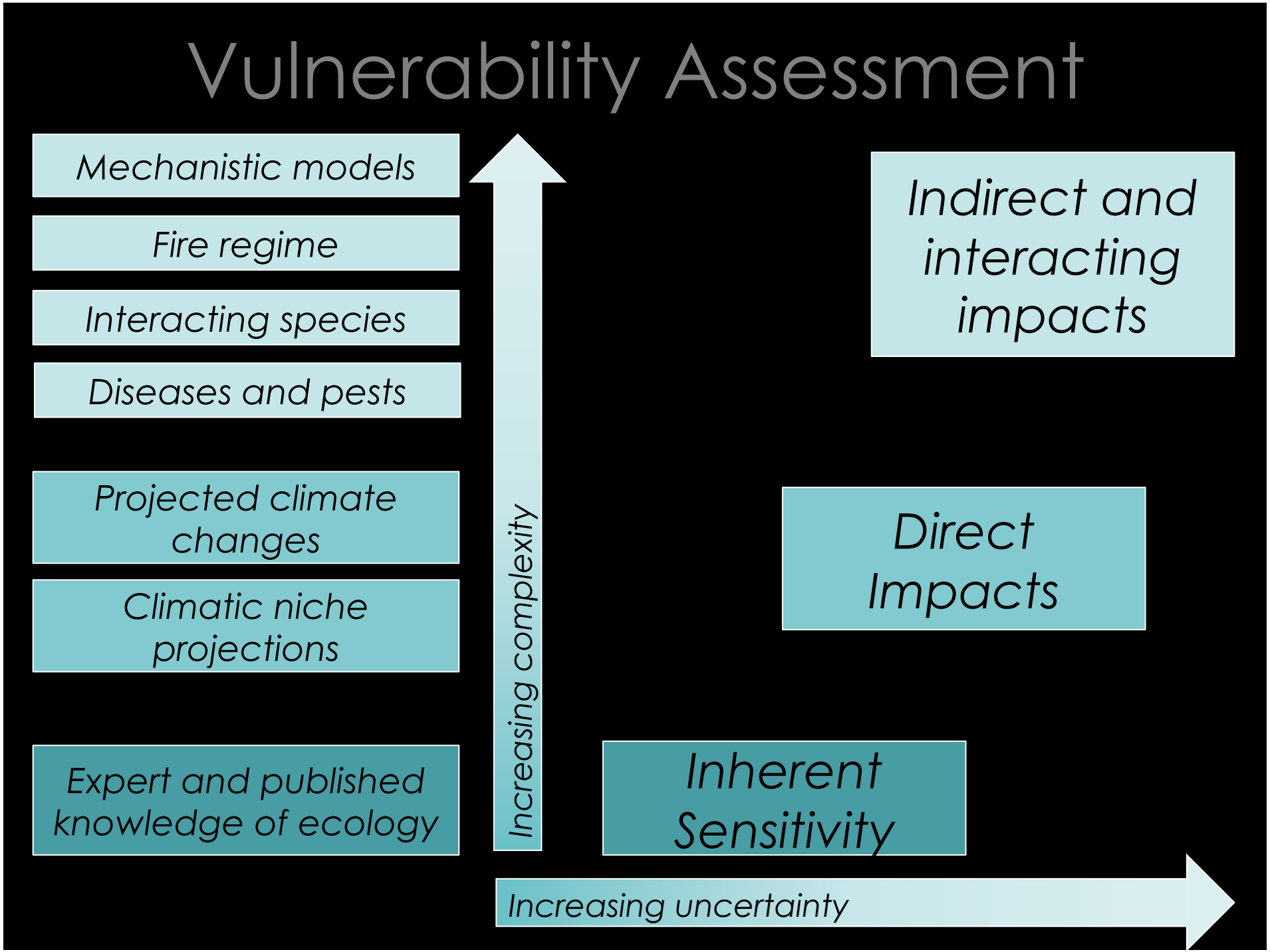
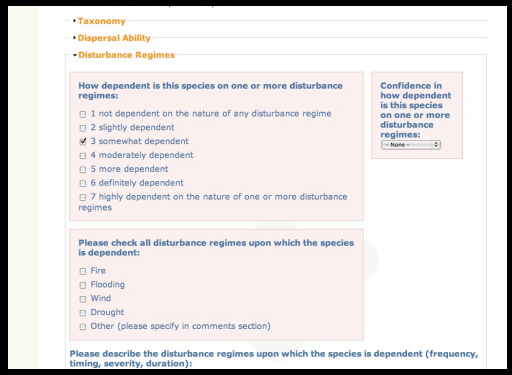
# Goal

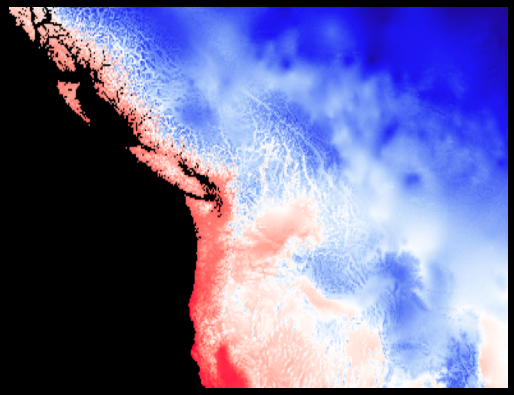
To apply multiple lines of evidence to assessing species vulnerability to climate change in focal landscapes.

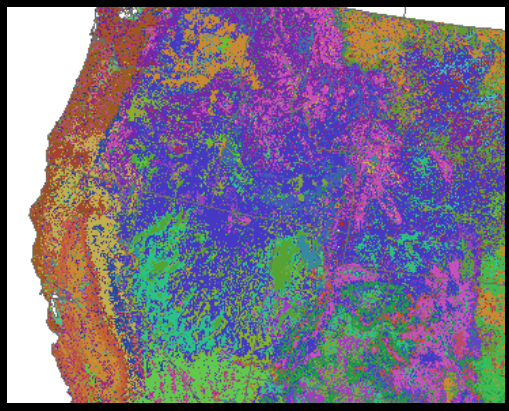

Vulnerability Assessment
Mechanistic models
Fire regime
Interacting species
Diseases and pests
Projected climate changes
Climatic niche projections
Expert and published knowledge of ecology
Increasing complexity
Indirect and interacting impacts
Direct Impacts
Inherent Sensitivity
Increasing uncertainty

# PNWCCVA Data

- Sensitivity database (Case 2013)
- Downscaled climate projections (Shafer and Bartlein 2011)
- Climatic niche models
  - –Tree species and vegetation systems (Case and Lawler 2013)
- Mechanistic vegetation change projections (Shafer, in review)
- A2 emission scenario, 2080s





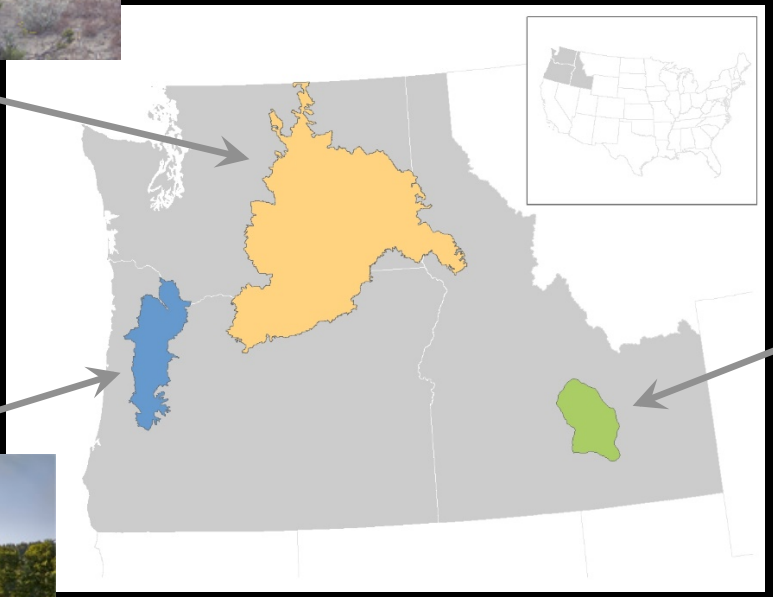
# Challenges

- Wide range of data types and information
- Potentially conflicting future conditions
- How to develop a coherent storyline?

# Three Case Studies

*Sagebrush steppe on the Columbia Plateau*

*Whitebark pine in the Pioneer Mountains, ID*



*Oregon white oak in the Willamette Valley, OR*

# Inherent Sensitivities

- *High elevation cold sites*
- *Depends on summer snowmelt*
- *Sensitive to fire regime change*
- *Under existing stress from insects and pathogens*

- *Spans wide north-south gradient*
- *Benefits from warm dry conditions*
- *Dispersal limited*
- *Sensitive to changes in fire regime*

- *Large geographic range with locally adapted genotypes*
- *Reduced snow and warm temperature may benefit*
- *Impacts from moisture changes differ depending on local soil conditions*

# Climatic Niche Models

- Based on climate conditions only
- Do not account for:
  - Dispersal
  - Competition
  - Evolutionary adaptation
  - $CO_2$ fertilization

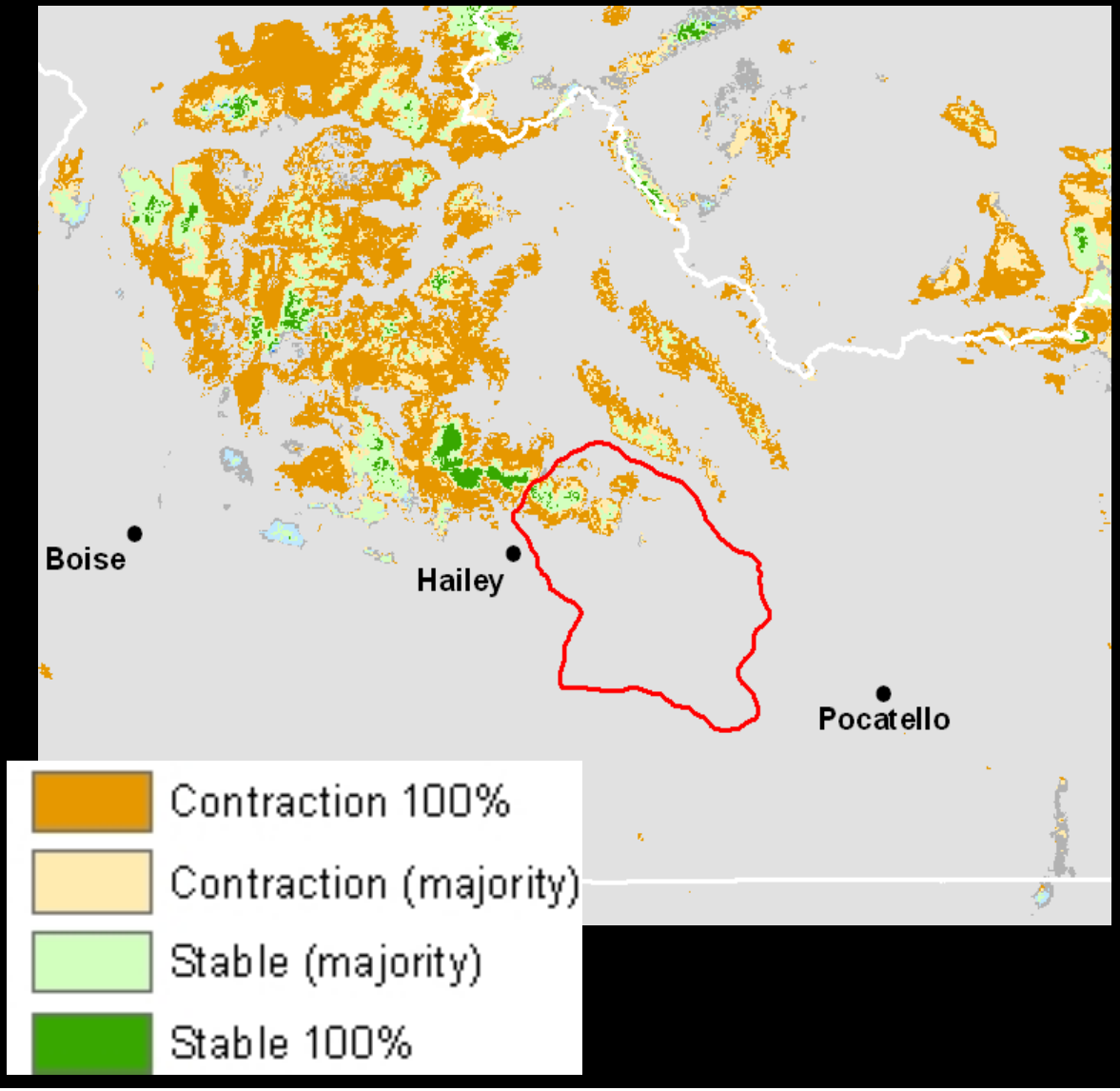
Where is the climate currently occupied by the species/system expected to be in the future?

# Climatic Niche Projections

*Whitebark Pine*

Consistent decline in climatic suitability

(Range Contraction)

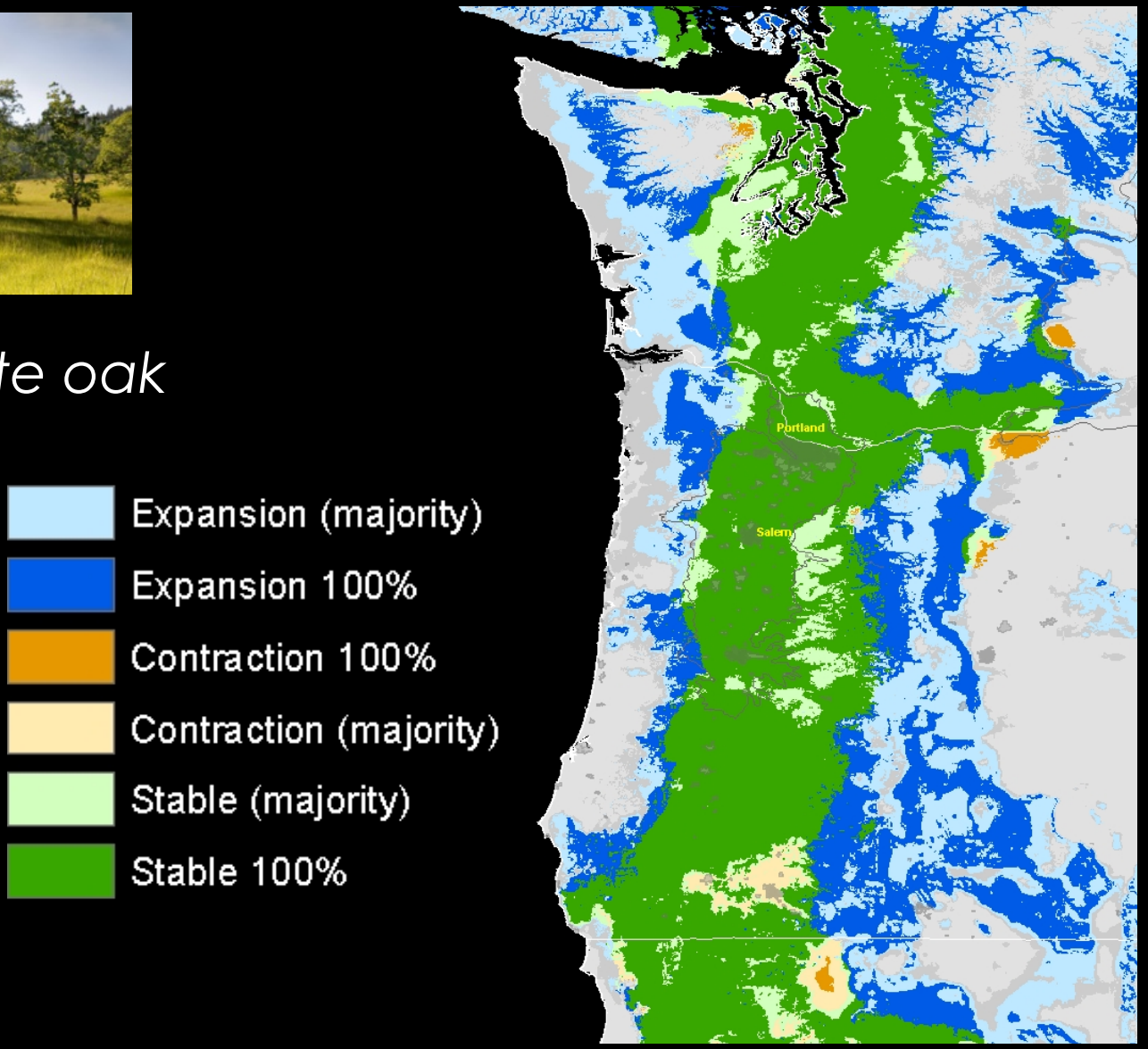


# Climatic Niche Projections

*Oregon white oak*

Consistent stable or improved climatic suitability

(Range Expansion)



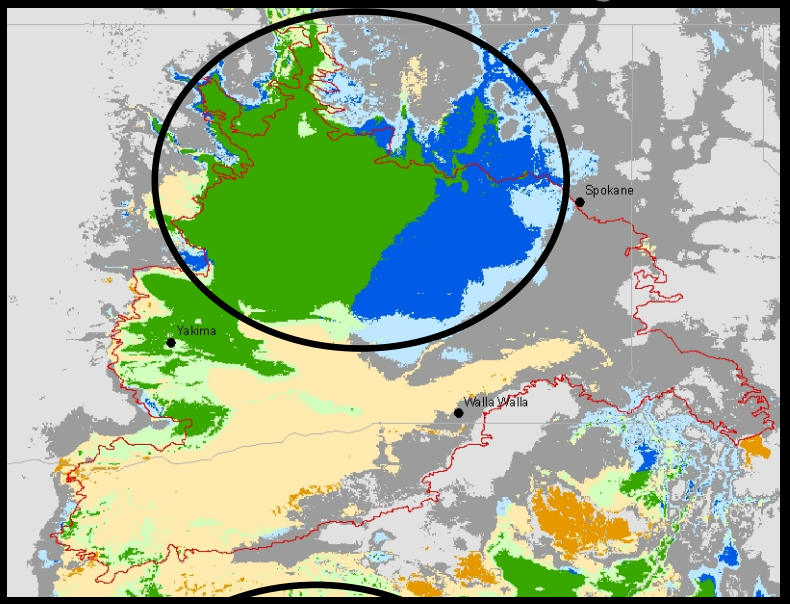
# Climatic Niche Projections

*Sagebrush Steppe*

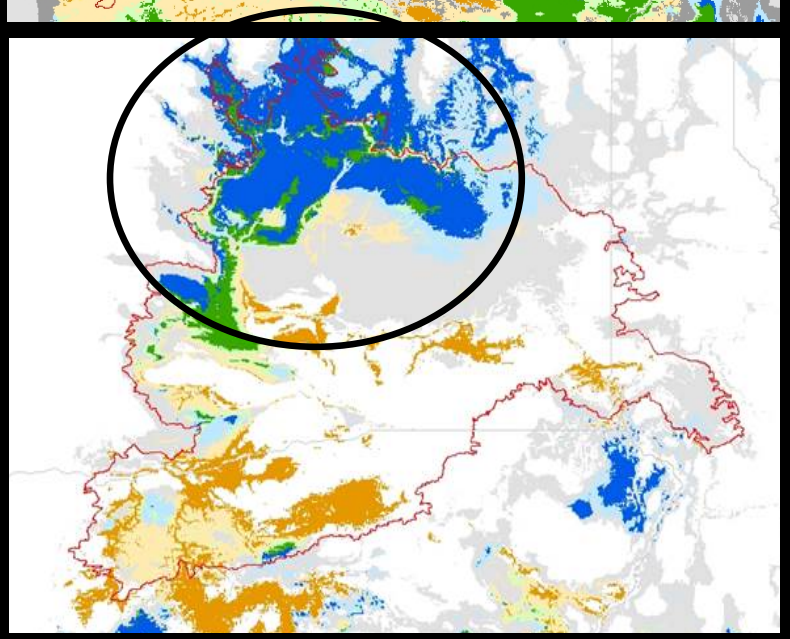
Less model agreement

Stability in the north

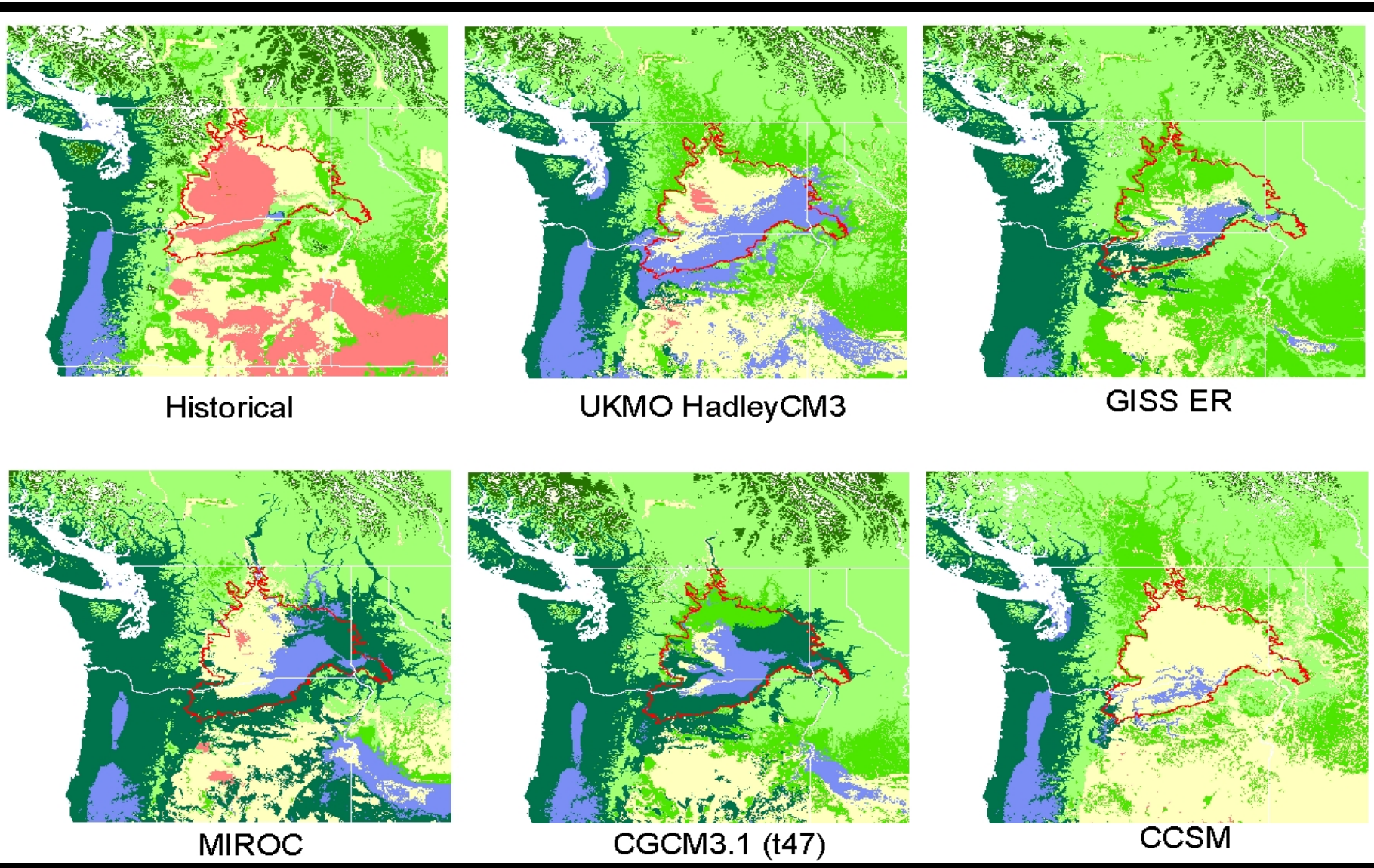
Contraction in the South




*Artemesia tridentata*



*Intermountain Basin Big Sagebrush Steppe*


Historical
UKMO HadleyCM3
GISS ER
MIROC
CGCM3.1 (t47)
CCSM
Shrub Steppe
Grassland
Various Forest Types
Lund Potsdam Jena Model
(Shafer 2012)

# How to reconcile?

Areas may be climatically suitable, but competition and other interactions can reduce or eliminate suitability

# Case Study Summaries

- *Highly sensitive*
- *Climatic suitability contracts*
- *Fire regime conditions change*
- *Potentially increased damage from insects and pathogens*

- *Moderate to low sensitivity*
- *Climatic suitability stable or improves*
- *Increased $CO_2$ may favor conifer forest*

- *Moderate to low sensitivity*
- *Shift in climatic suitability*
- *Impacts of climate and competition highly uncertain*

# Developing a Coherent Story

- Reviewing as many types of evidence as possible is critical
- Degree of convergence varies depending on the case
- Apparent disagreement may highlight uncertainty or just different processes
- Partnerships between land managers, field experts, and modelers are essential

# Acknowledgements

Special thanks to Tess O'Sullivan, David Patte, Tory Stevens, Mary Mahaffy, Sean Finn, and all workshop participants for their assistance in developing the workshops and subsequent reports.

We acknowledge the modeling groups, the Program for Climate Model Diagnosis and Intercomparison (PCMDI) and the WCRP's Working Group on Coupled Modelling (WGCM) for their roles in making available the WCRP CMIP3 multi-model dataset.

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Photos by Joe Rocchio

photo by Kirk Anderson

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