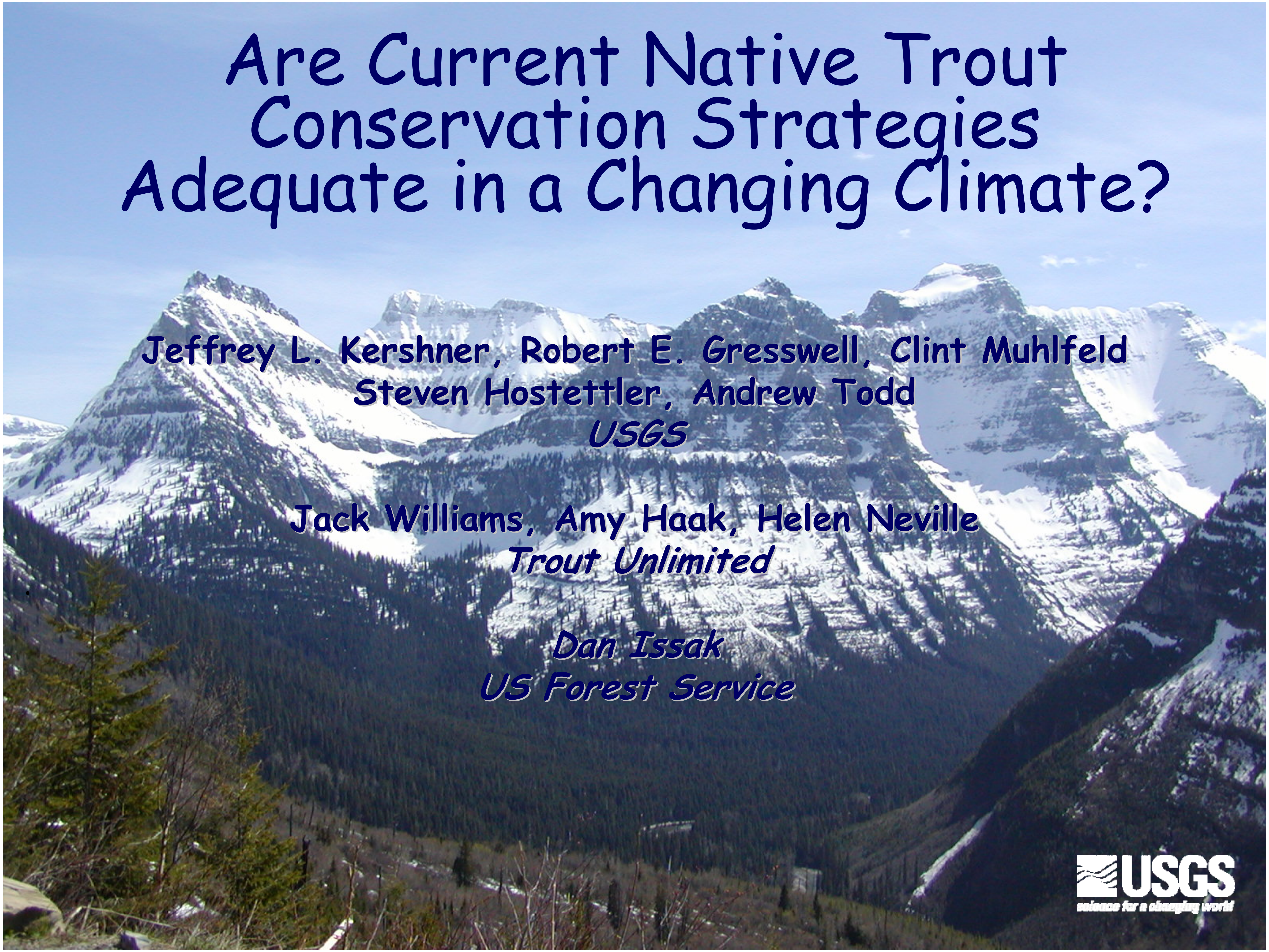


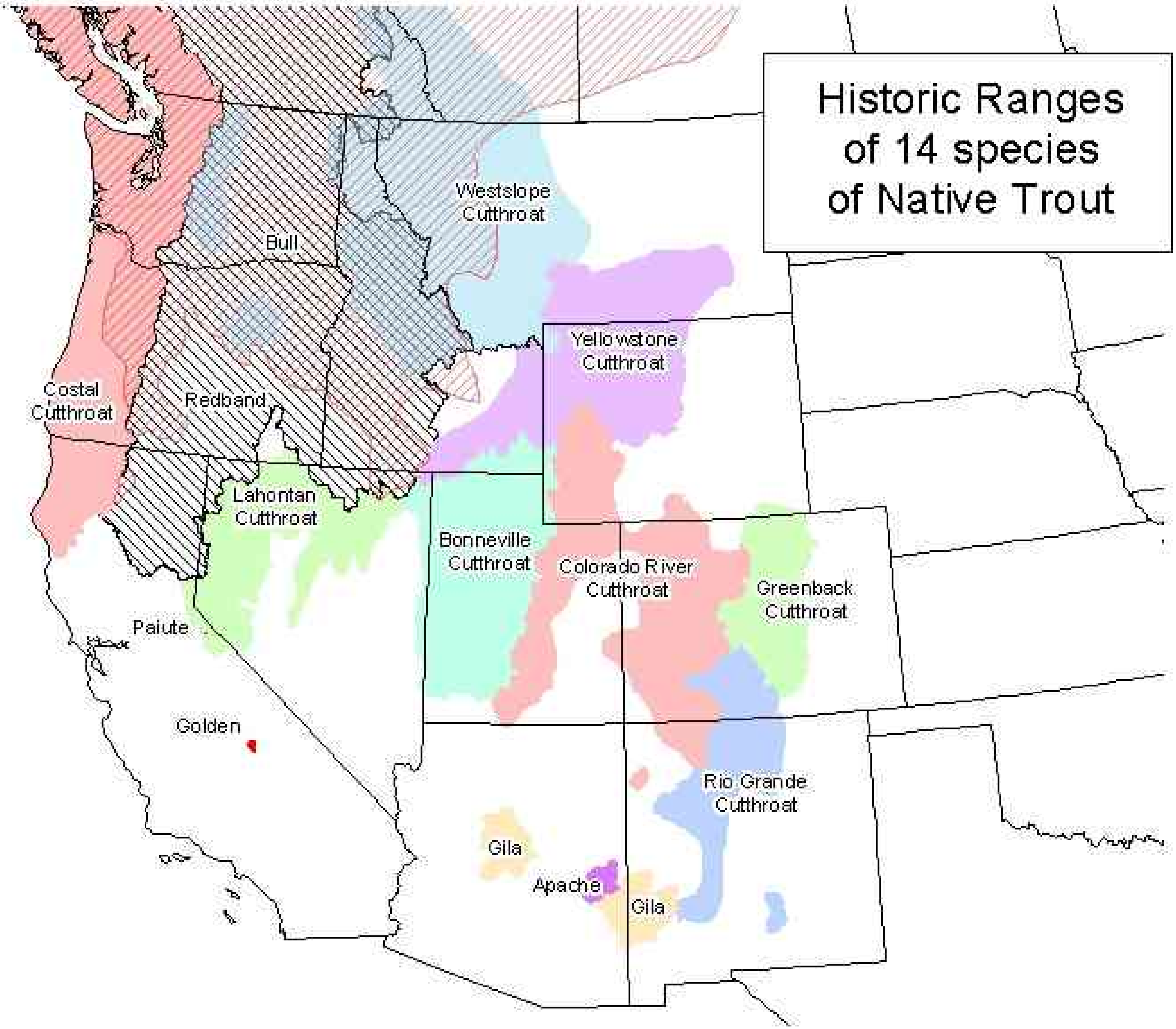
Are Current Native Trout Conservation Strategies Adequate in a Changing Climate?

Jeffrey L. Kershner, Robert E. Gresswell, Clint Muhlfeld
Steven Hostettler, Andrew Todd
USGS

Jack Williams, Amy Haak, Helen Neville
Trout Unlimited

Dan Issak
US Forest Service

USGS
science for a changing world



Historic Ranges of 14 species of Native Trout
Westslope Cutthroat
Bull
Yellowstone Cutthroat
Costal Cutthroat
Redband
Lahontan Cutthroat
Bonneville Cutthroat
Colorado River Cutthroat
Greenback Cutthroat
Paiute
Golden
Rio Grande Cutthroat
Gila
Apache
Gila

Interior Cutthroat

- native to large lake systems that are now remnant
- Large fluvial systems
- Multiple life history forms

Interior Cutthroat Trout: Causes for Decline

Flow Regime Changes

Habitat Loss/
fragmentation

Exotic Species/disease

USGS
science for a changing world

Our conservation portfolio..

- Conservation focus on headwater/tributary streams
- Non-native control
- Conservation by isolation
- Meta populations where possible
- Large majority of conservation actions on isolation

USGS
science for a changing world

In Contrast to ……

- Bull trout, Yellowstone and Westslope cutthroat still represented by large, intact habitat

- Conservation by sub-basin

What Have We Learned?

- More "populations" than previously thought
- Populations – Secure? Trajectory?
- Isolate/protect?

USGS
science for a changing world

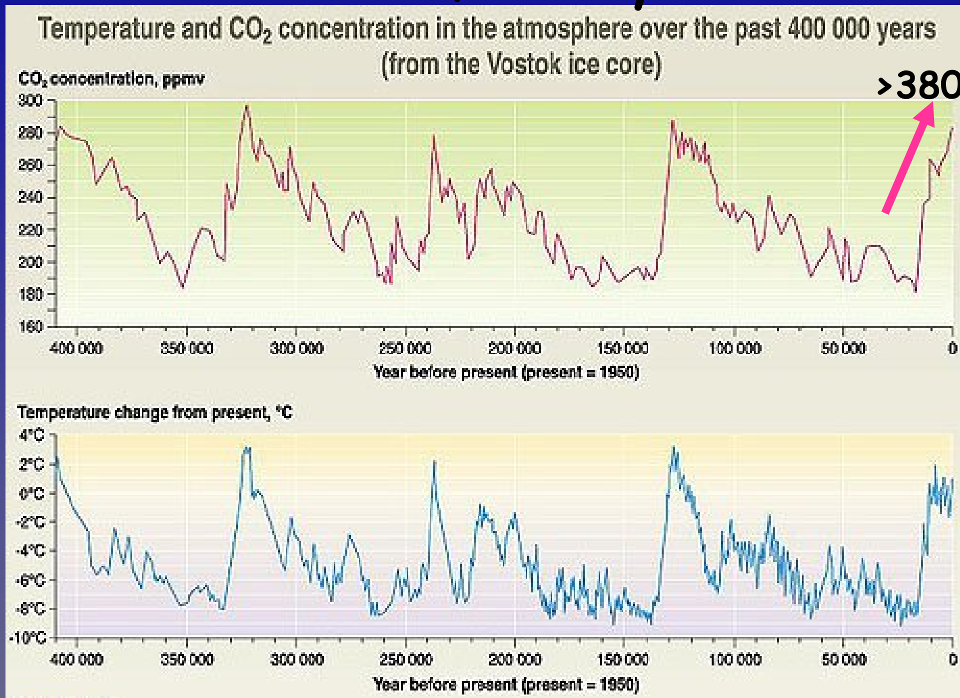
How do current projections for climate change affect the potential for persistence?

Key research questions:

- What is the geographic distribution of target species or populations in relationship to current temperature and flow regimes?
- How are the flow and temperature regimes likely to change in response to a warming climate?
- How will these large-scale changes in climate affect native salmonid distributions across the western United States?
- How well does the relationship between climate and salmonid distribution reflect actual measurements in a basin?

USGS science for a changing world

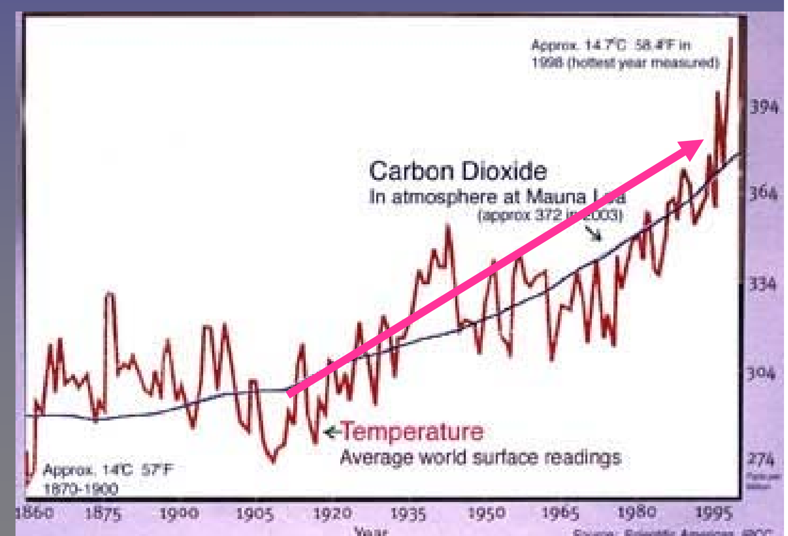
Last 400,000 yrs



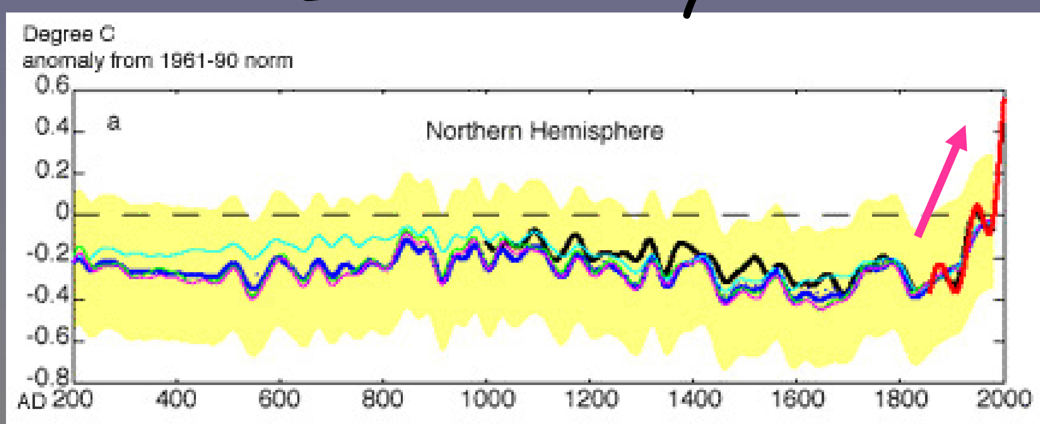
>380 ppm in 2005

Unprecedented Climate Change

Last 150 yrs



Last 2000 yrs



Temperatures AD 200-2000, from proxy temperature indicators and direct measurement (red), showing rise from from long-term cooling trend. Mann & Jones, Geophys. Research Letters, 2003.

(Whitlock 2007)

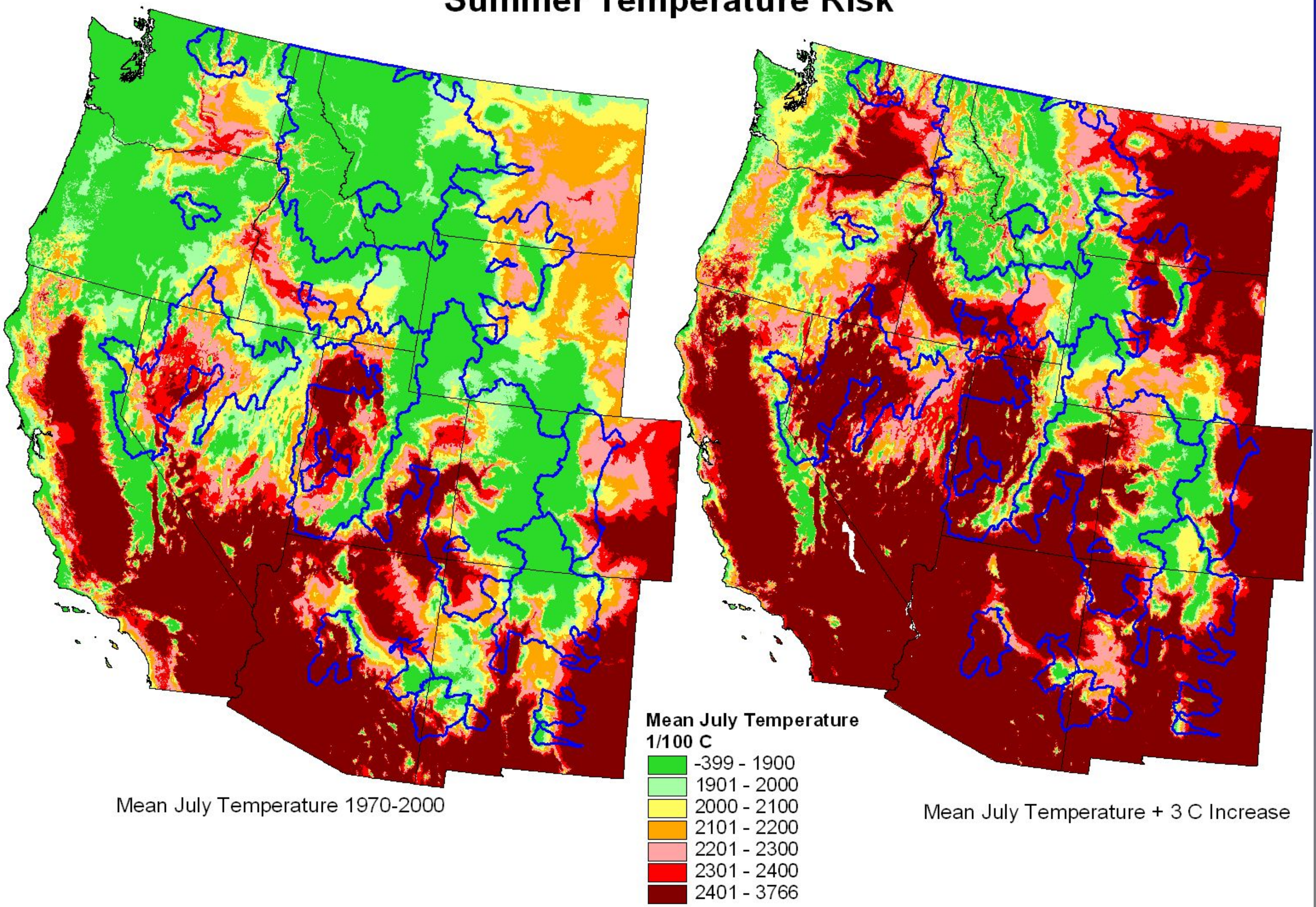
Risk Factors

- Increased summer water temperature resulting from an increase in air temperature.
- Larger and more frequent winter flood events resulting from an increase in rain on snow as warm mid-winter air masses become more common.
- More frequent wildfire where longer, hotter, and drier summers aggravate a situation that is already volatile due to past management practices.

Risk Factors

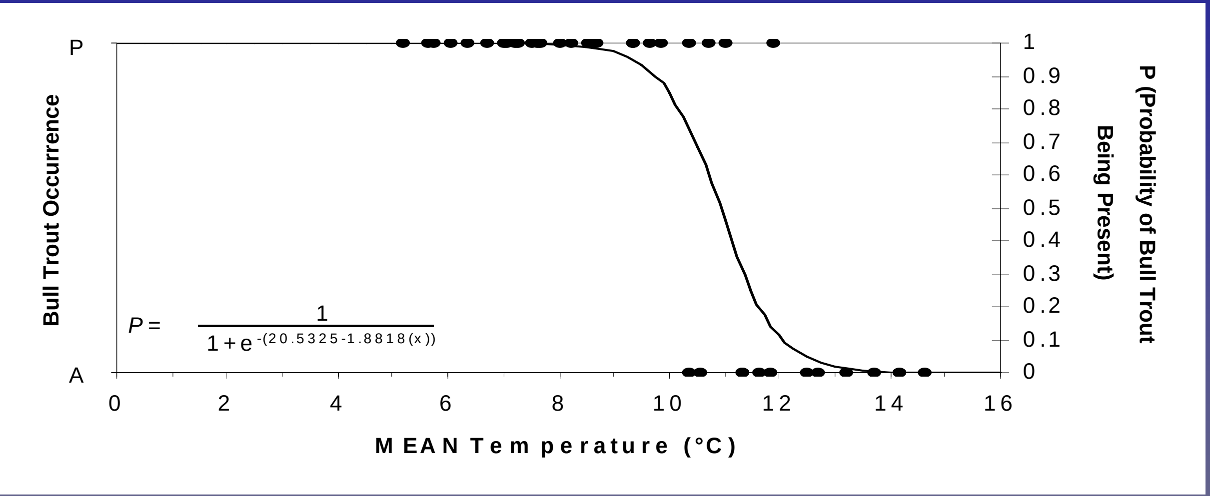
- Increased summer water temperature resulting from an increase in air temperature.
- Larger and more frequent winter flood events resulting from an increase in rain on snow as warm mid-winter air masses become more common.
- More frequent wildfire where longer, hotter, and drier summers aggravate a situation that is already volatile due to past management practices.

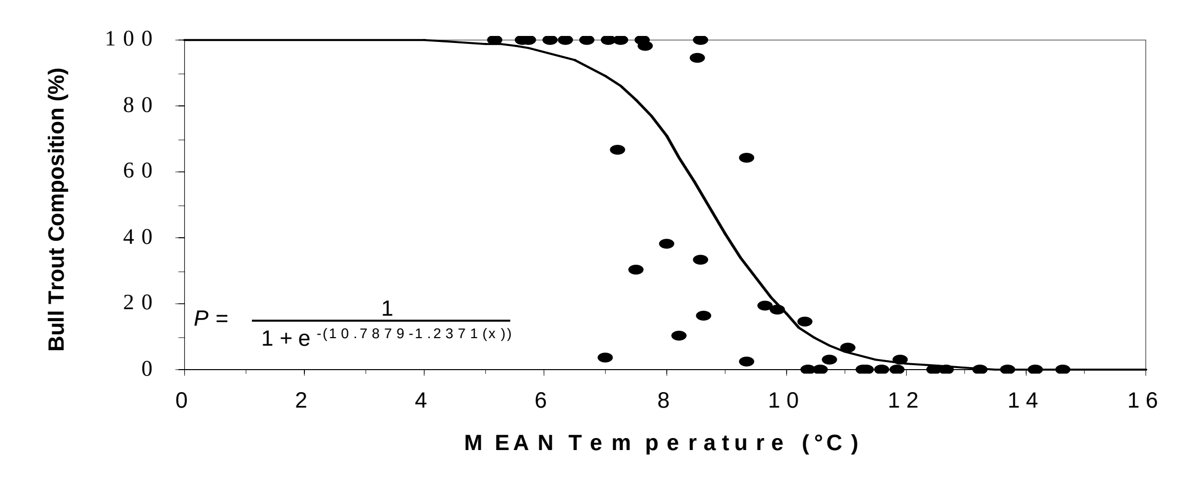
Summer Temperature Risk



Williams et al. 2007

The relationship between bull trout occurrence, composition, and density and the MEAN temperature metric.

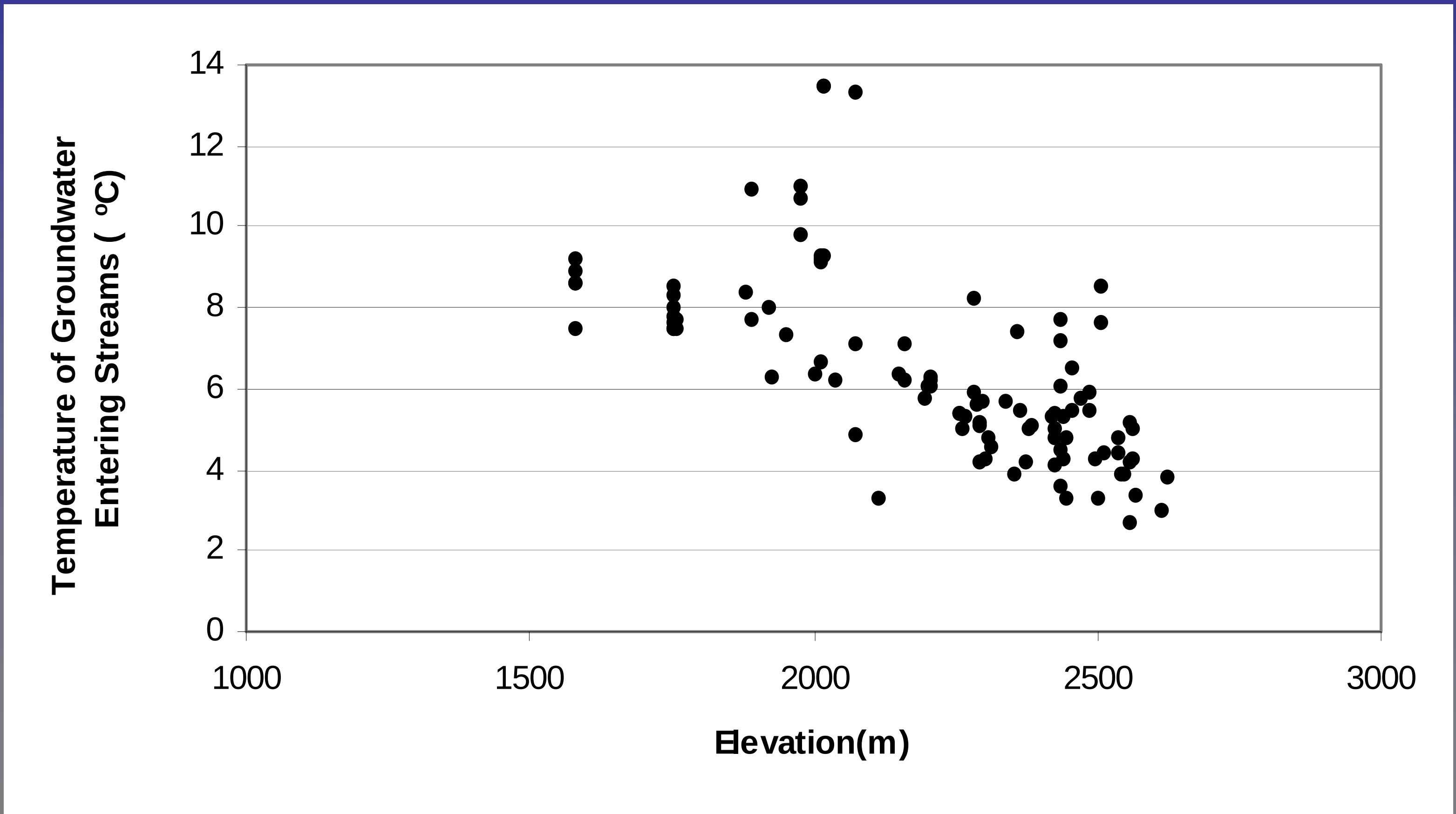




Gamett and Kershner (in prep)

USGS
science for a changing world

Relationship between the temperature of groundwater entering streams and elevation.



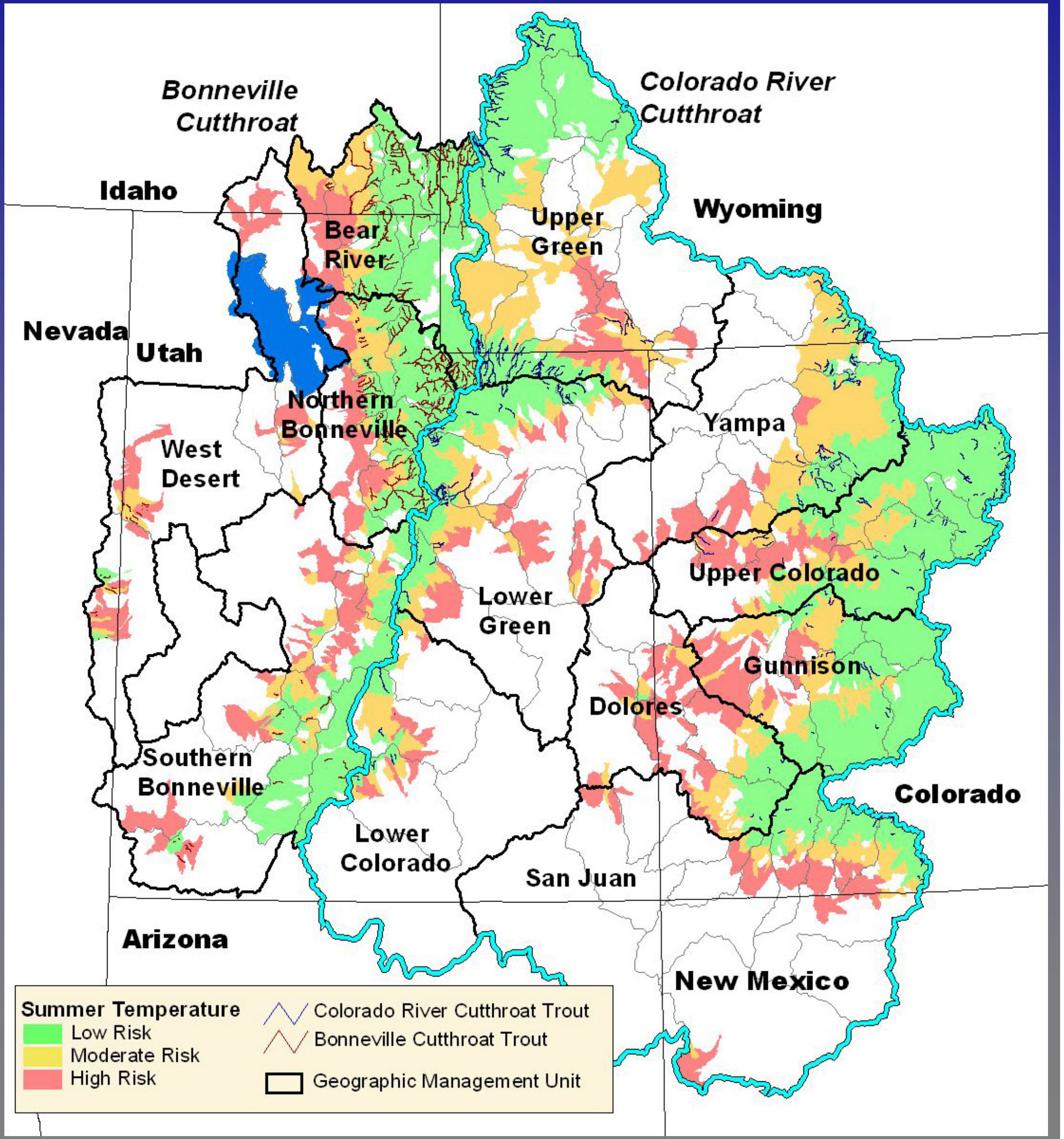
Gamett and Kershner (in prep)

USGS
science for a changing world

Increased Summer Temperature

Bonneville cutthroat: 8% of current habitat at high risk, 16% at moderate risk; 28% of historic habitat at high risk

Colorado River cutthroat: 5% of current habitat at high risk, 23% at moderate risk; 21% of historic habitat at high risk

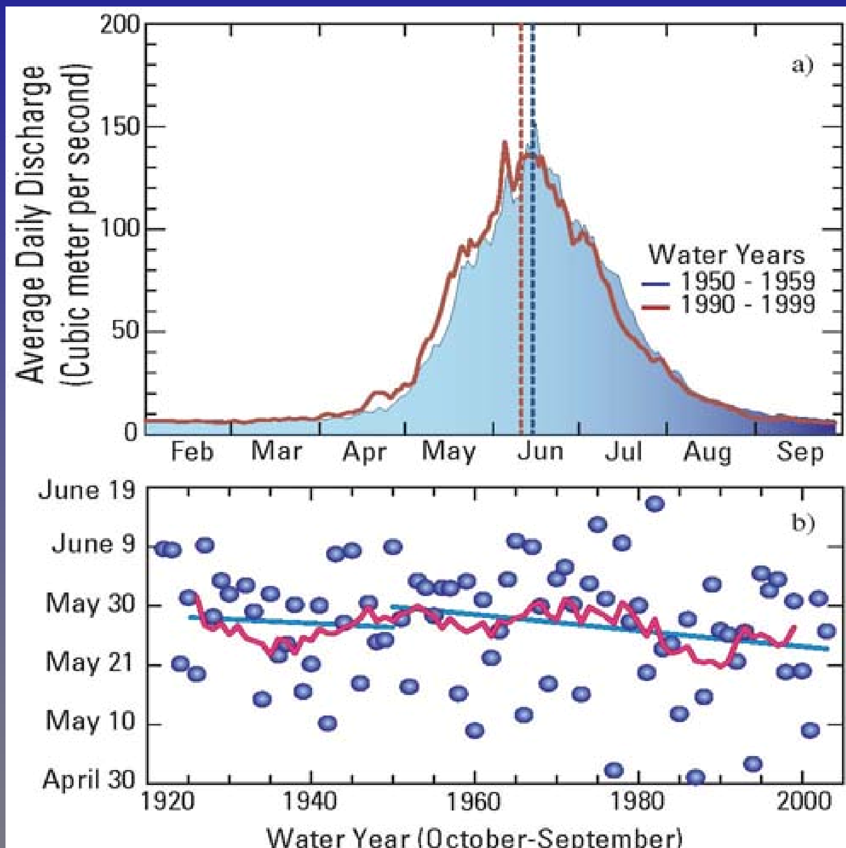


Williams et al. 2007

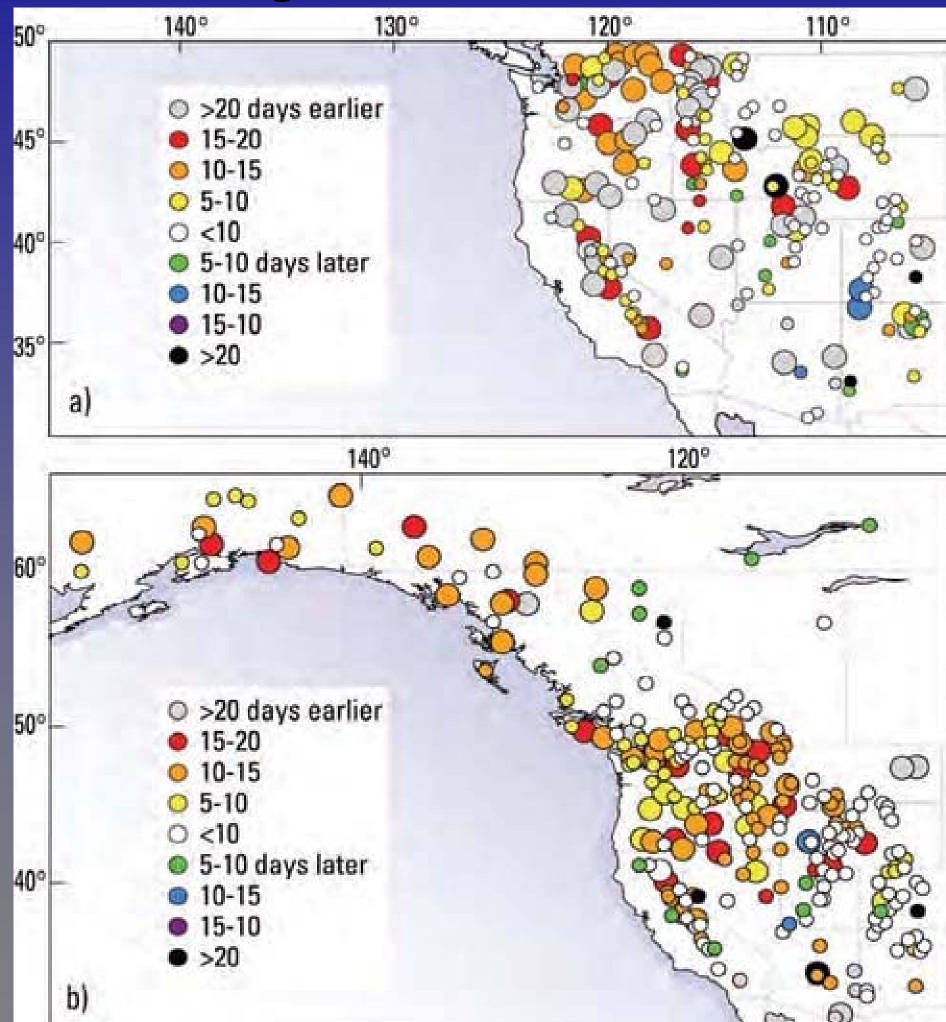
Risk Factors

- Increased summer water temperature resulting from an increase in air temperature.
- Larger and more frequent winter flood events resulting from an increase in rain on snow as warm mid-winter air masses become more common.
- More frequent wildfire where longer, hotter, and drier summers aggravate a situation that is already volatile due to past management practices.

Changes in stream flow in Clarks Fork Yellowstone



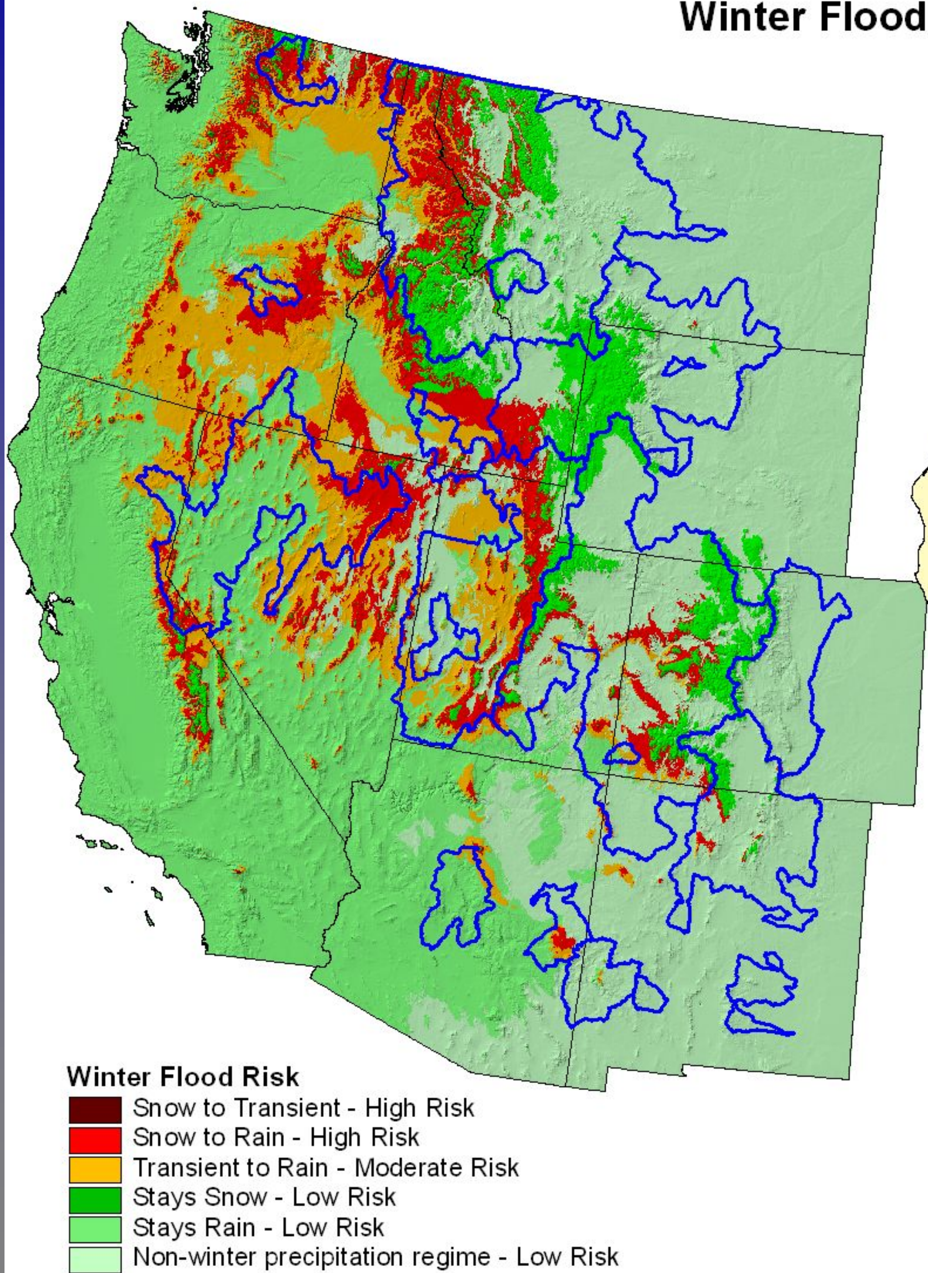
Timing of initial snowmelt surge (2005 vs 1950s)

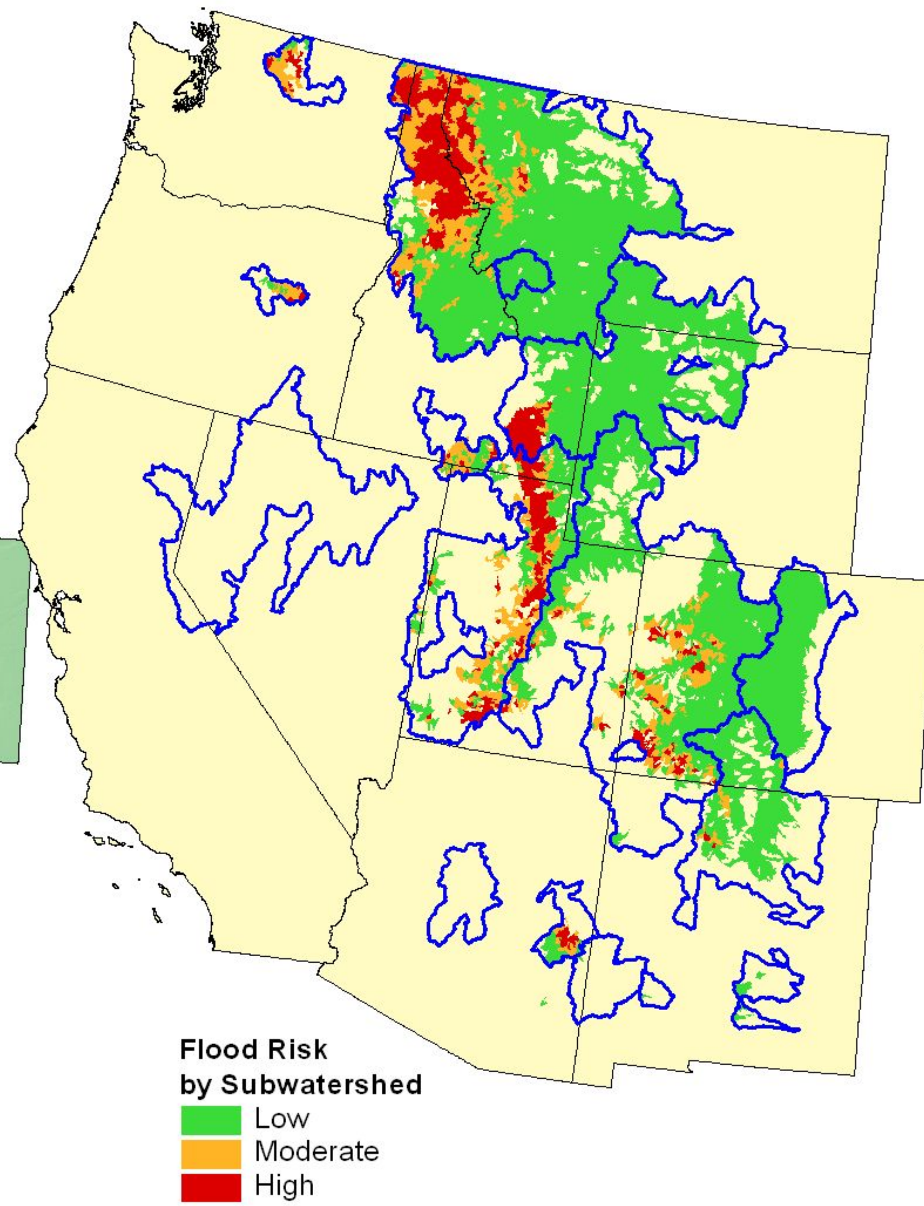


http://pubs.usgs.gov/fs/2005/3018/

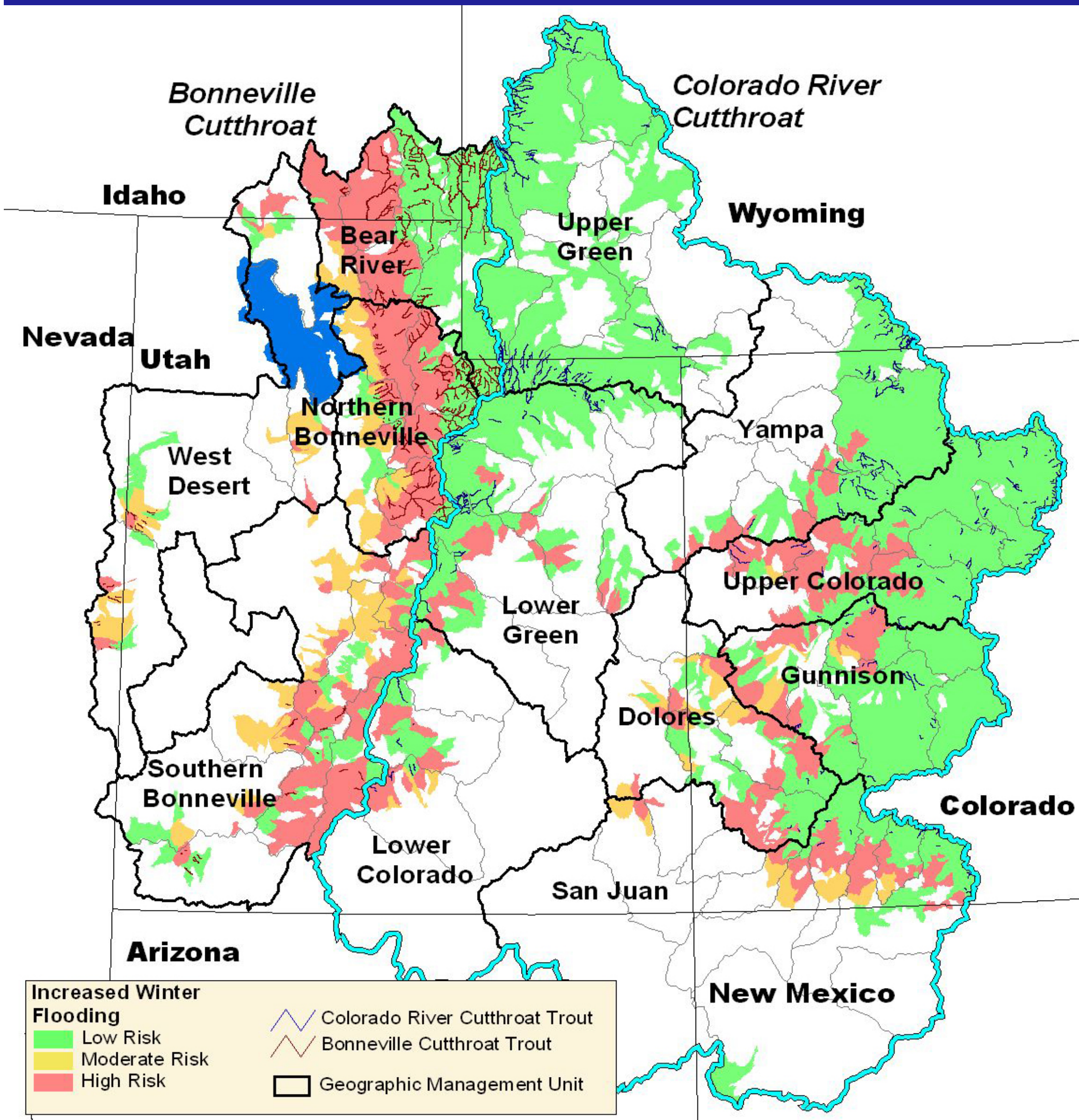
(Whitlock 2007)

Winter Flood Risk





Increased Winter Flooding



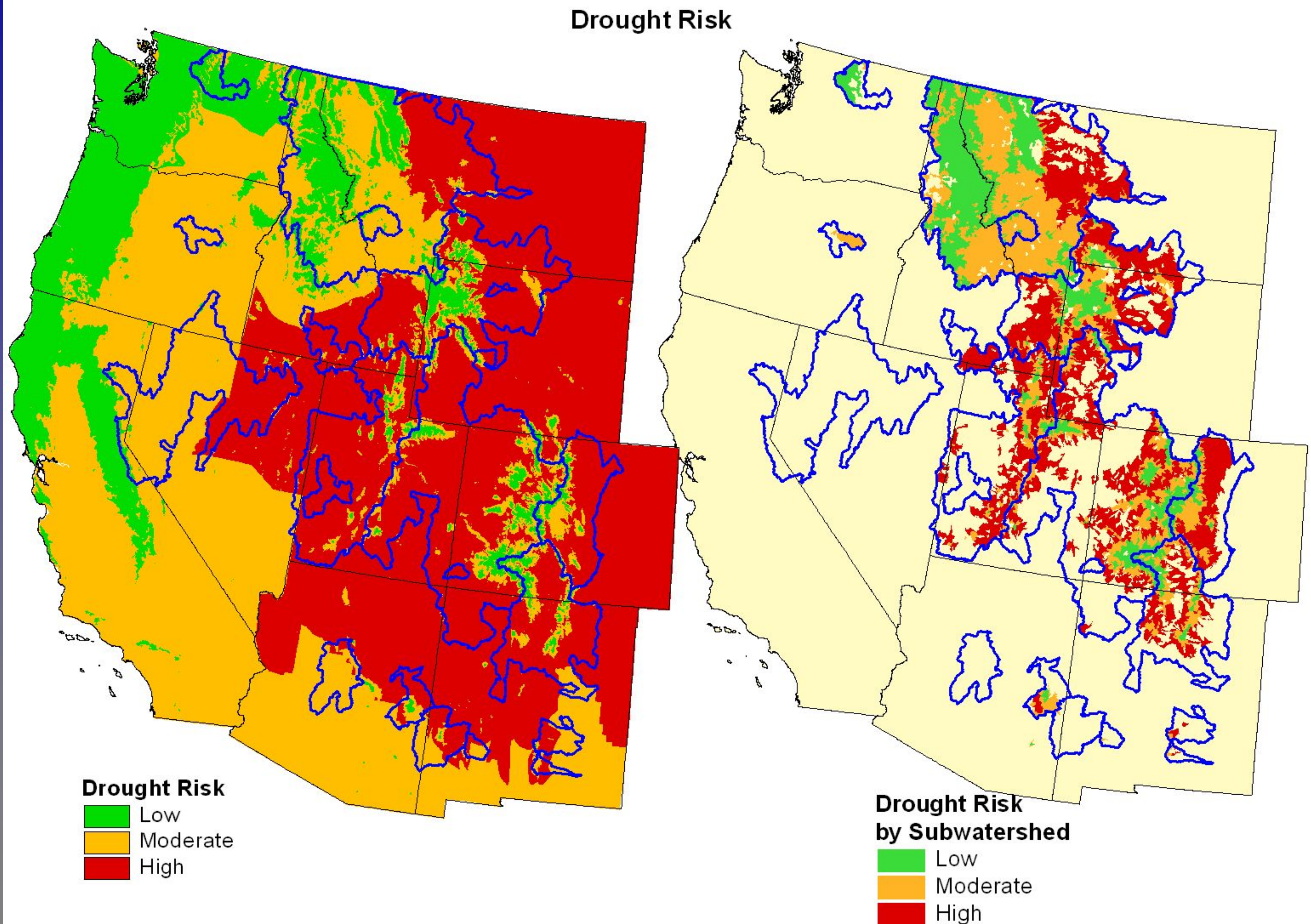
48% of current BCT habitat at high risk compared to 12% of current CRCT habitat

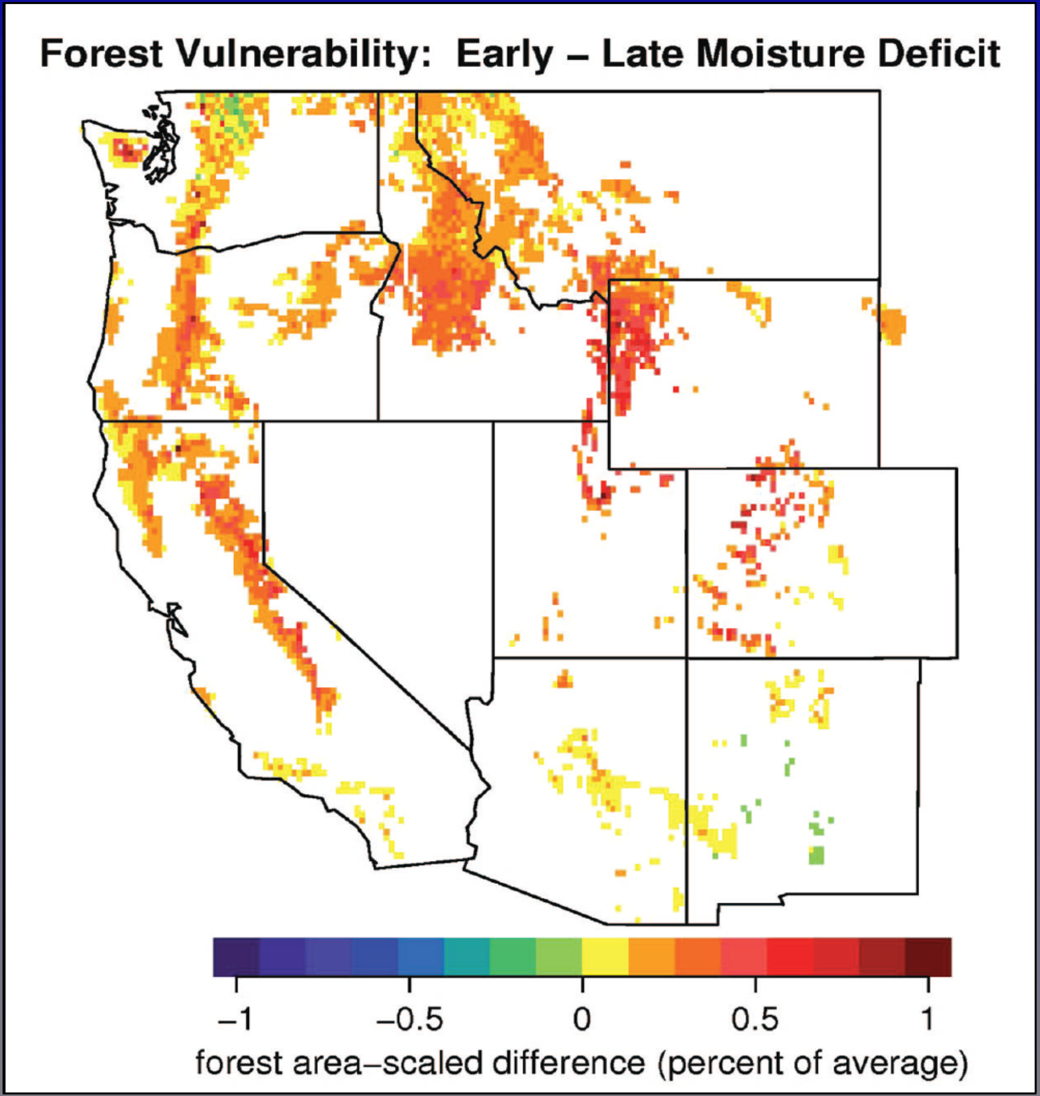
Changes in temperature have resulted in changes in flood risk as a function of basin's mid-winter temperature regime. (Hamlet and Lettenmaier, 2007)

Risk Factors

- Increased summer water temperature resulting from an increase in air temperature.
- Larger and more frequent winter flood events resulting from an increase in rain on snow as warm mid-winter air masses become more common.
- More frequent wildfire where longer, hotter, and drier summers aggravate a situation that is already volatile due to past management practices.

USGS
science for a changing world


Drought Risk
Drought Risk
Low
Moderate
High
Drought Risk
by Subwatershed
Low
Moderate
High

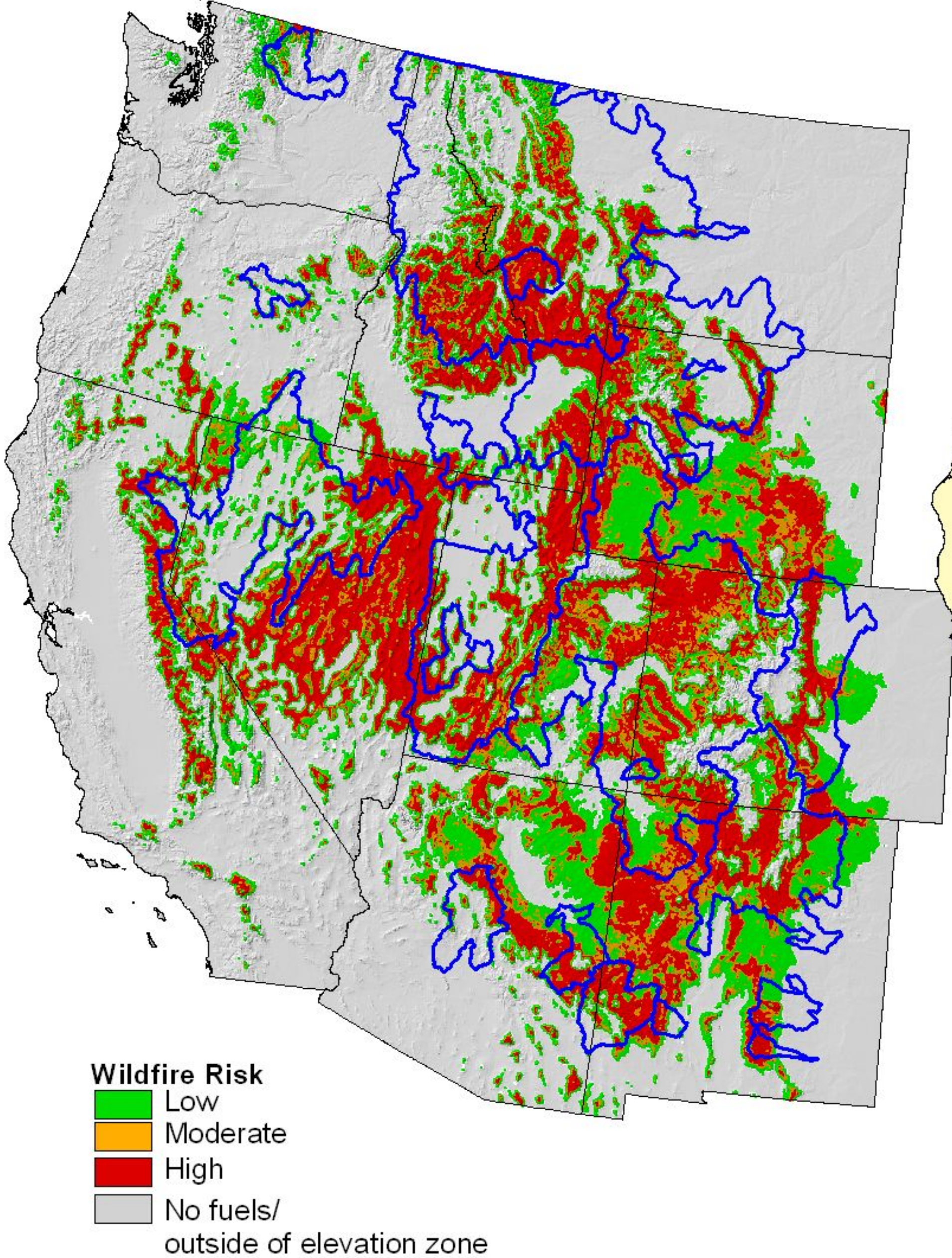


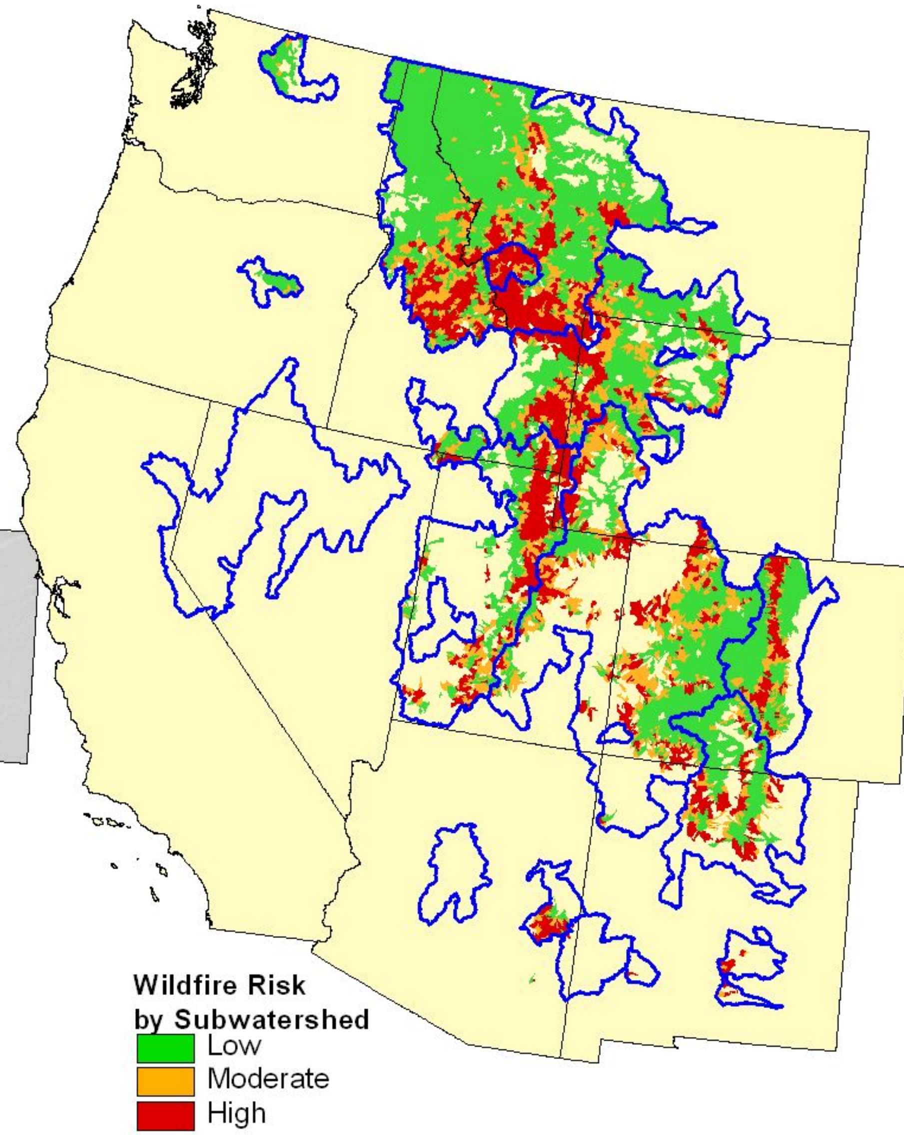
Vulnerability based on reduced snowpack, longer summers

(Westerling et al., Science 2006)

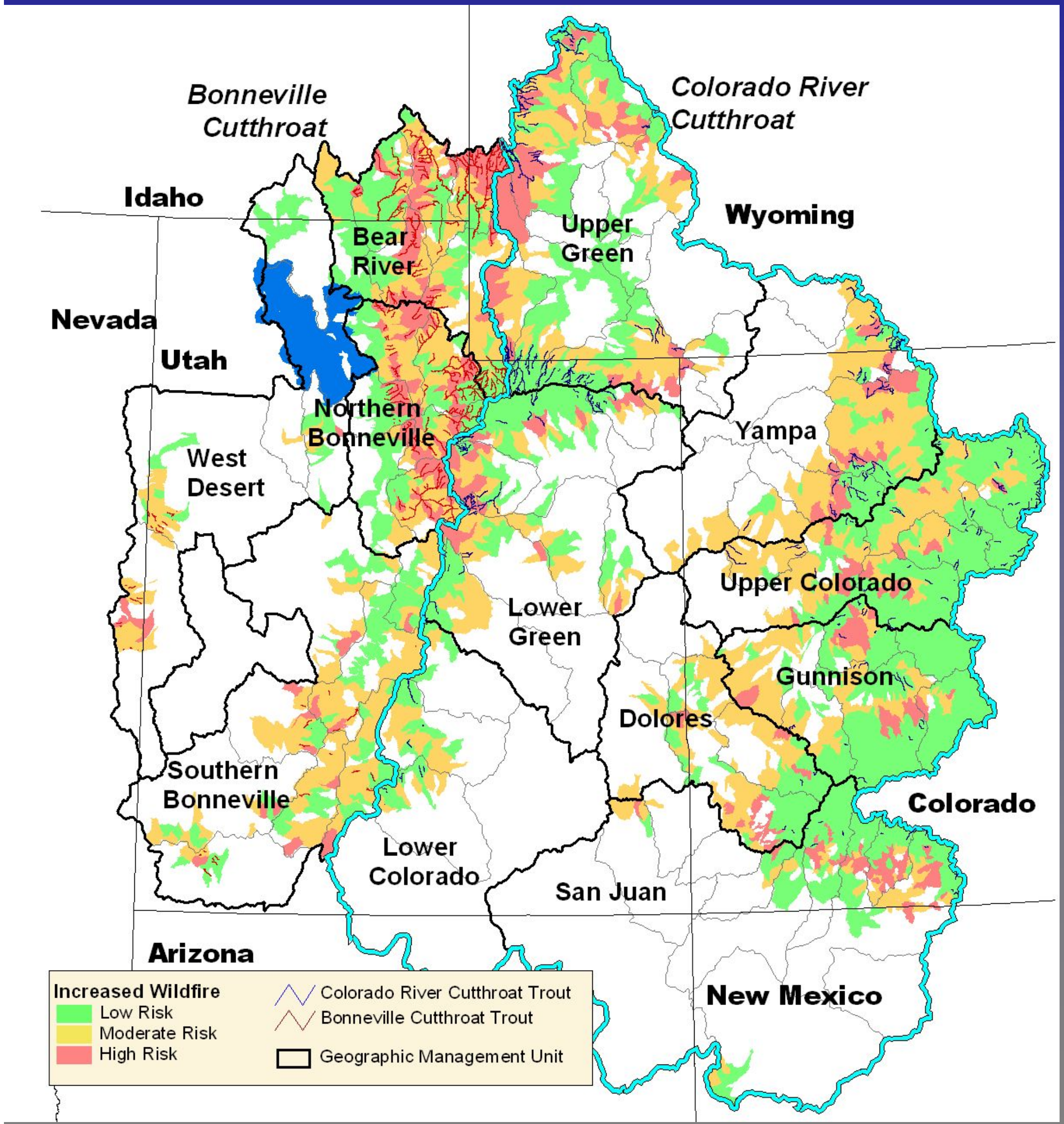
(Whitlock 2007)

Uncharacteristic Wildfire Risk





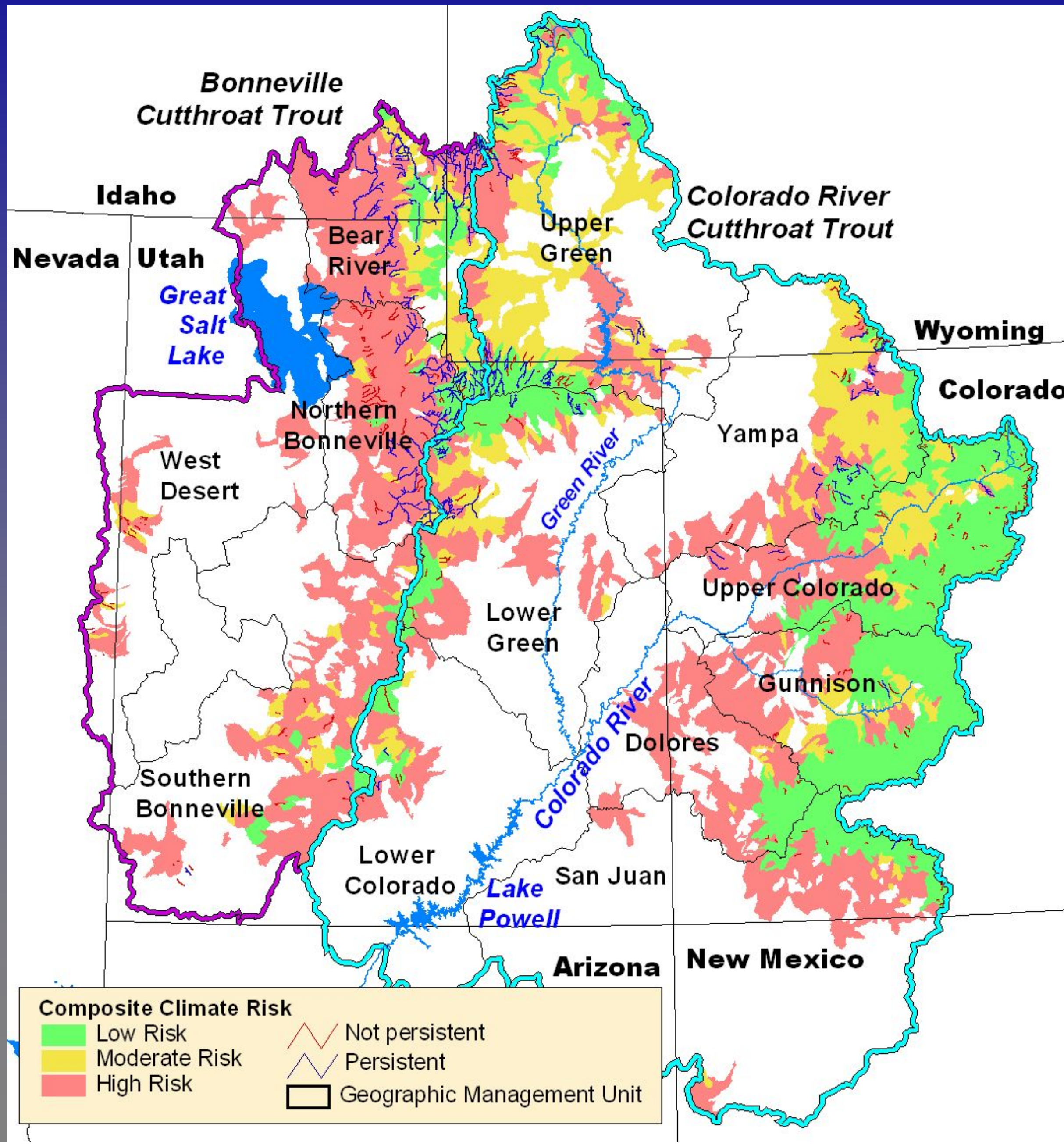
Increased Wildfire Risk



Westerling (2006) – 60% increase in frequency of large wildfires in Rockies since mid-1980's associated with increased temperatures and earlier snowmelts.

39% of current BCT habitat at high risk compared with 17% of CRCT habitat at high risk

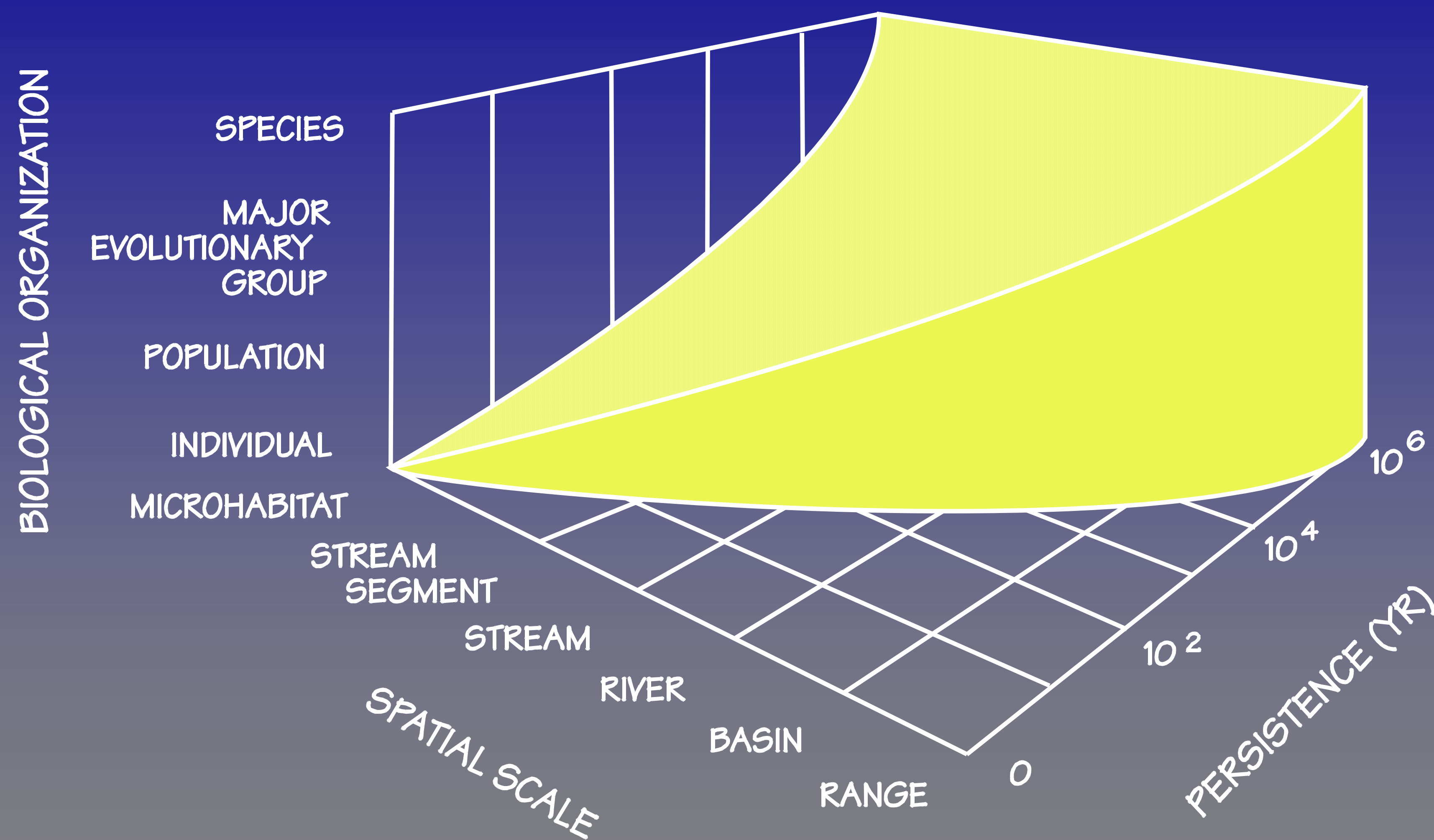
Composite Climate Risk



What is the future?

- Projected changes may exceed ability of species to respond at time scales necessary for adaptation to new conditions, i.e., *disequilibrium*.
- Disequilibrium will create opportunities for synergistic disturbances and invasive species….but may provide opportunities for restoration (rain on snow example) brook trout/cutthroat trout
- More/severe fires lie ahead.

(Whitlock 2007)



Adapted from Currens 1997

Do we need to re-think our Conservation portfolio?

- Conservation focus on headwater/tributary streams?
- Genetic diversity at the edges
- Non-native control?
- Conservation by isolation?
- Meta populations where possible?
- Supplemental stocking?