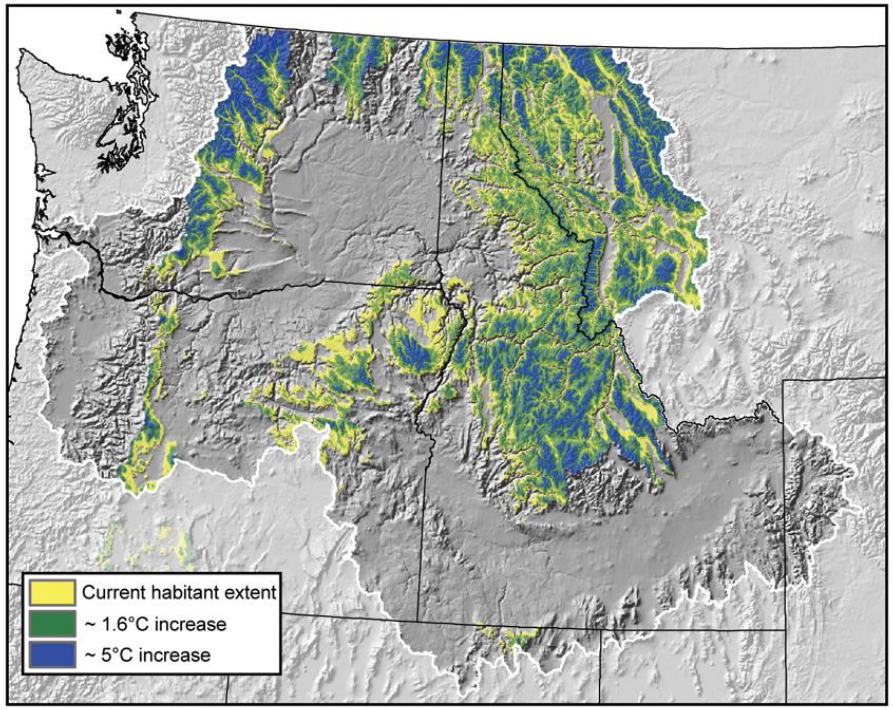
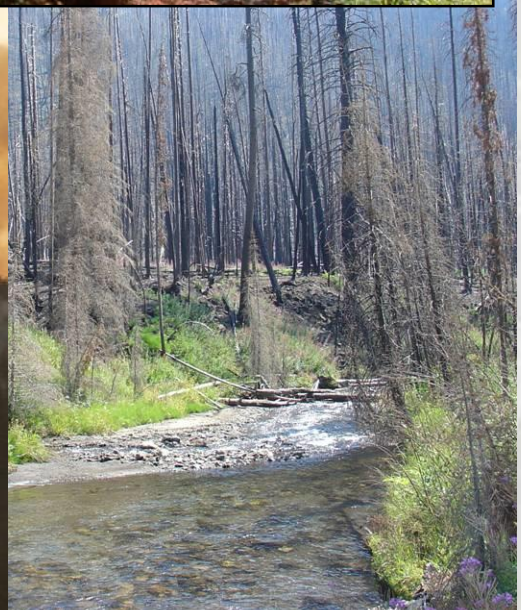
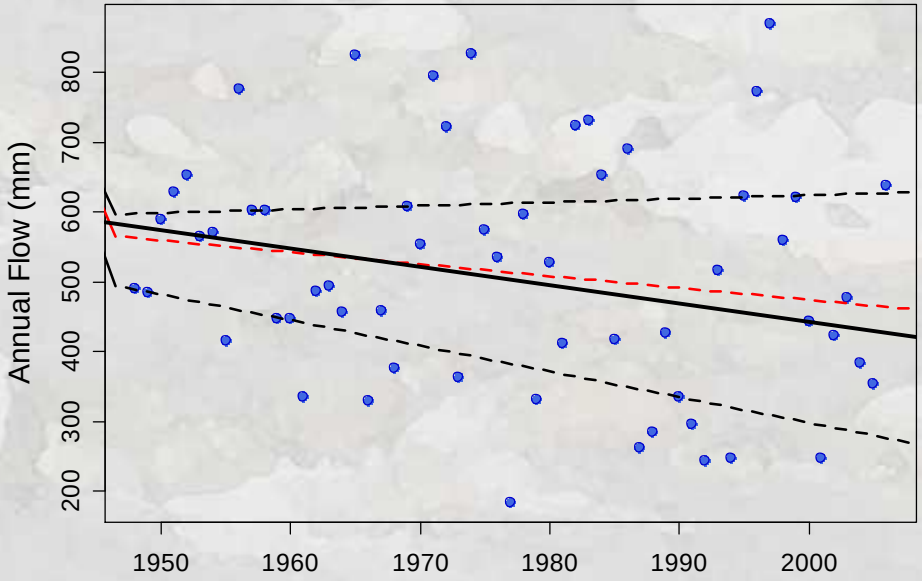
Forests, Fire, Water, Fish, and Climate Change,

Charles Luce, USFS Research

With contributions from: Penny Morgan, Kate Dwire, Dan Isaak, Zack Holden, Bruce Rieman, Matt Dare, Paul Hessburg, & Tom Black


Current habitant extent
~ 1.6°C increase
~ 5°C increase




Annual Flow (mm)
200
300
400
500
600
700
800
1950
1960
1970
1980
1990
2000


82

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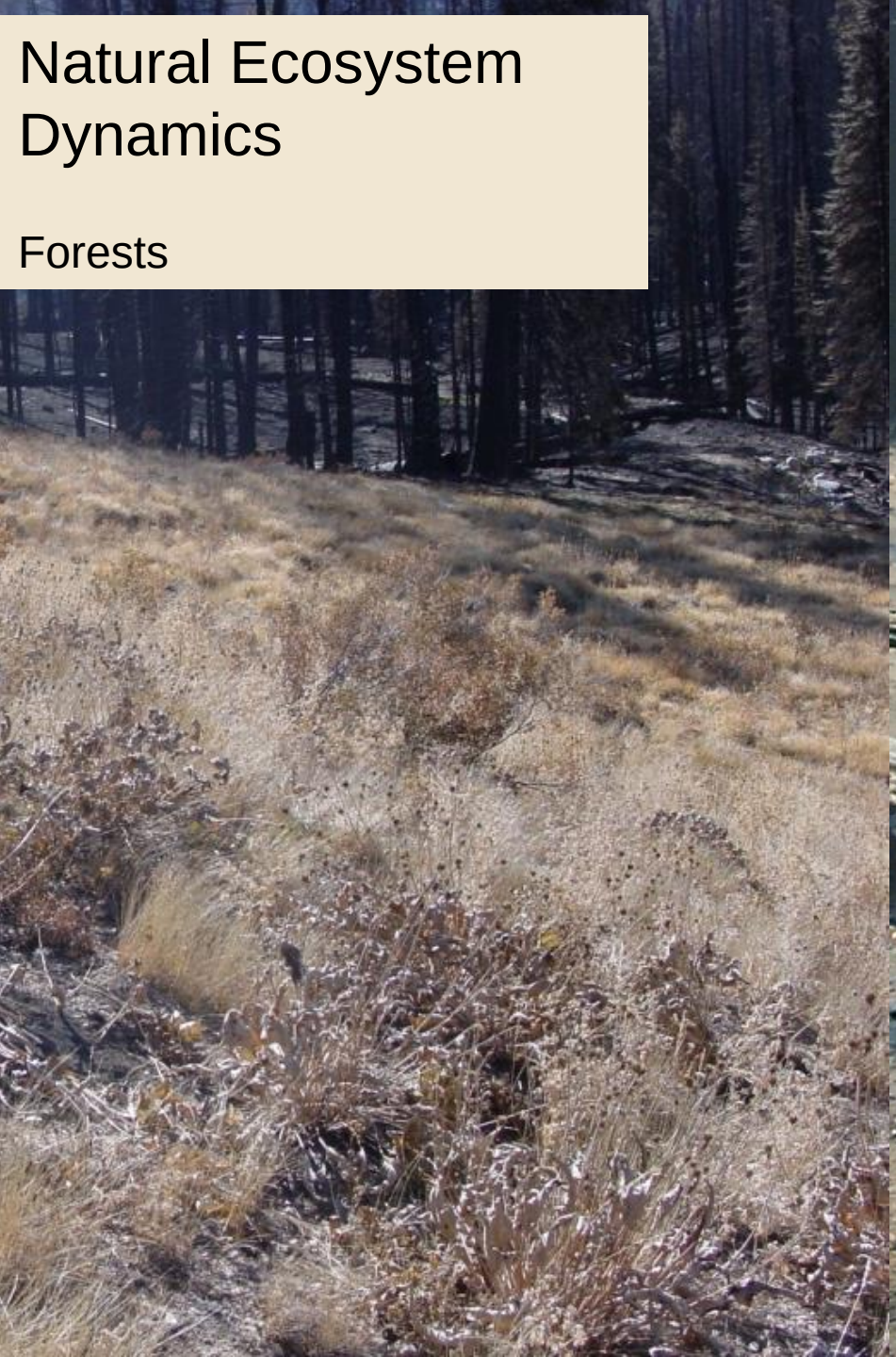
What are the key differences between natural and managed systems?

Natural Ecosystem Dynamics

Forests

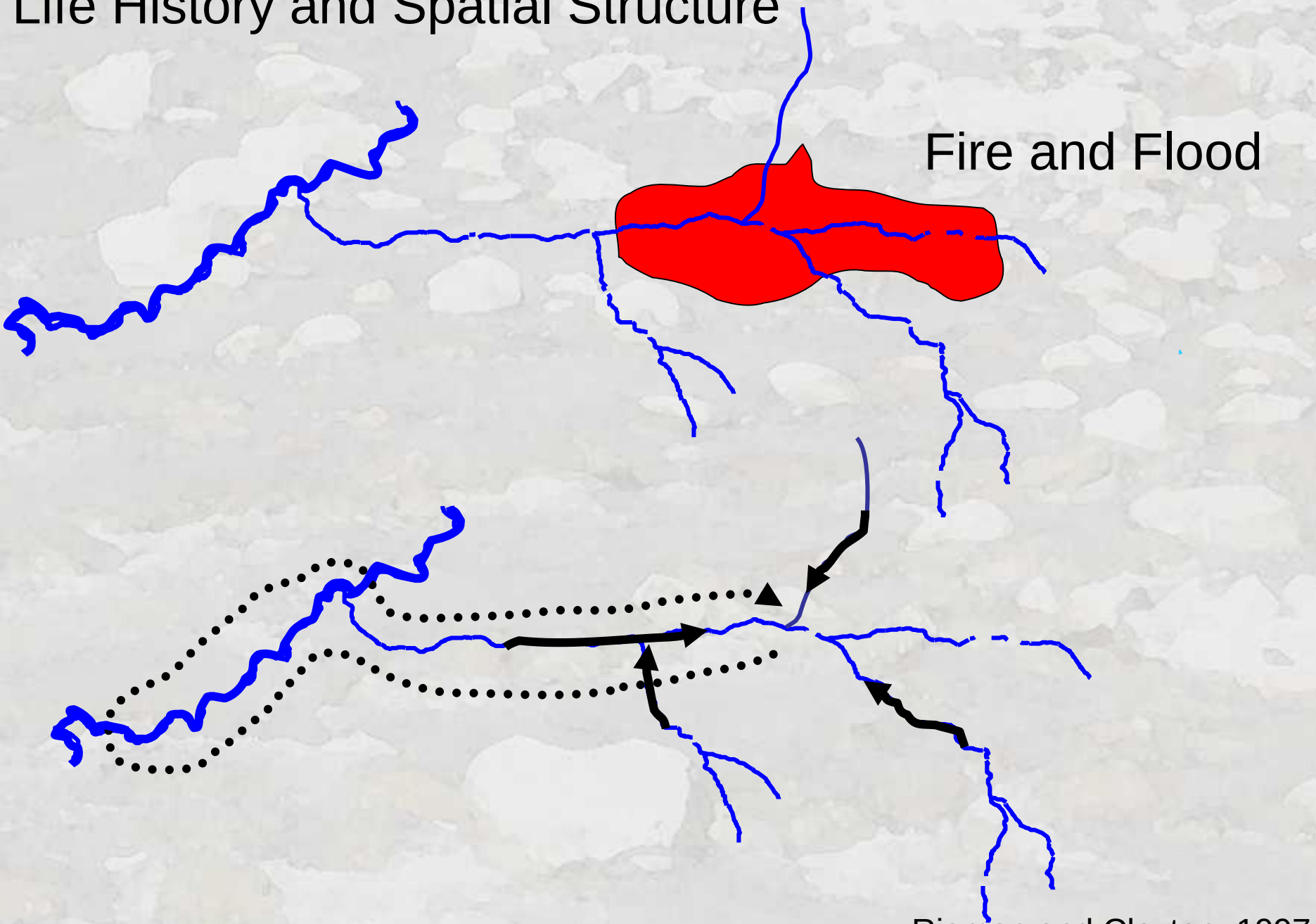


Natural Ecosystem Dynamics

Streams

Photo: R. Thurow

Life History and Spatial Structure



Rieman and Clayton, 1997

Impairment of Natural Dynamics from Management

Blocked migration

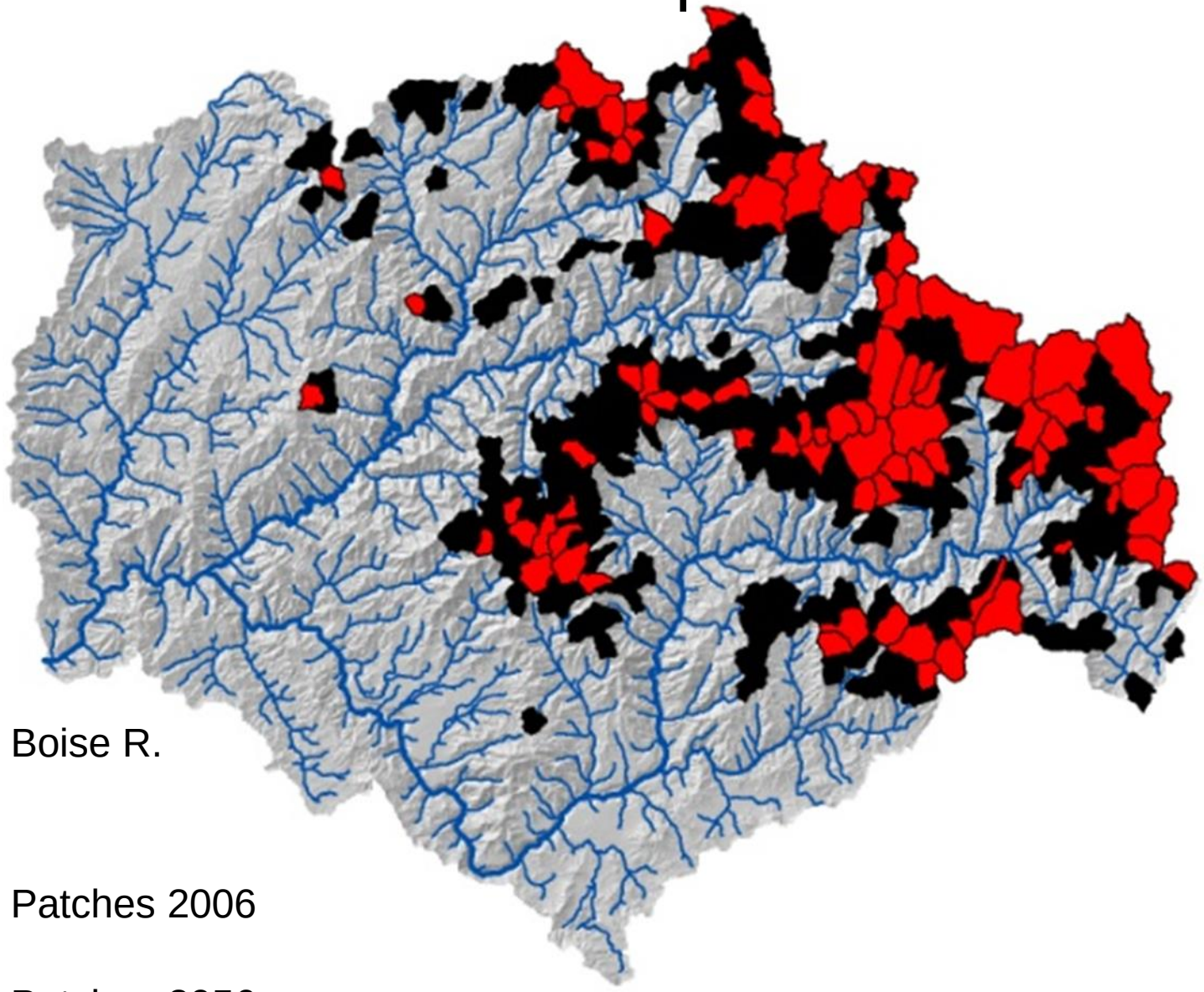
Reduced habitat quality and productivity

More continuous (contagious) fuels

Impairment of Natural Dynamics from Climate Change

Large scale insect damage

More isolated and smaller aquatic habitats

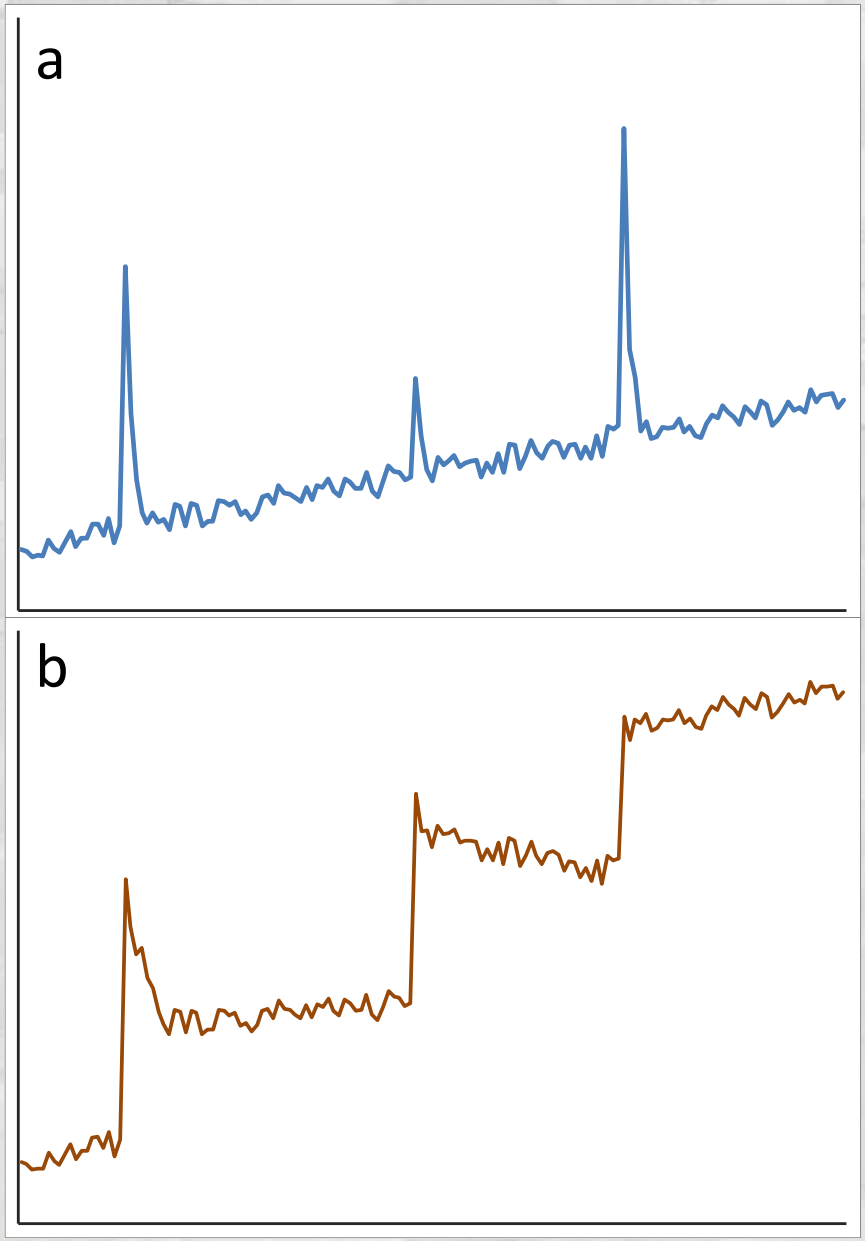


Habitat Losses Boise R.
2006-2056

Suitable Patches 2006

Suitable Patches 2056

Isaak et al., 2010



What is the future role of disturbance?

Relationship to climate extremes?

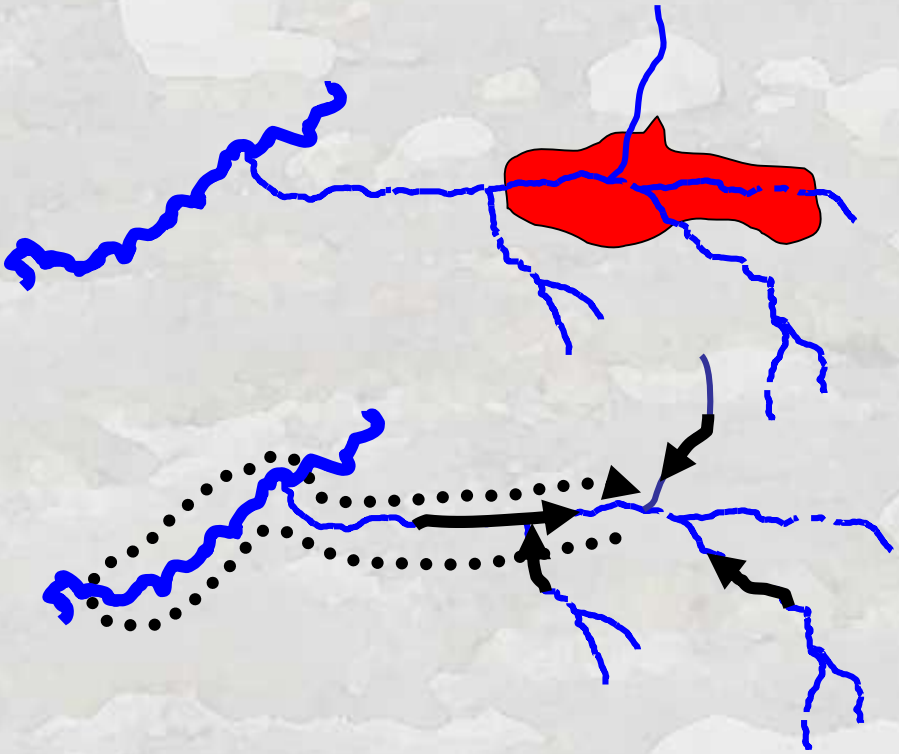
Planning Principles

- Respect the Dynamics
- Be proactive
- Seek Sustainable Solutions
- Consider the Forest-Riparian-Aquatic as one Ecosystem
- Think about spatial arrangements

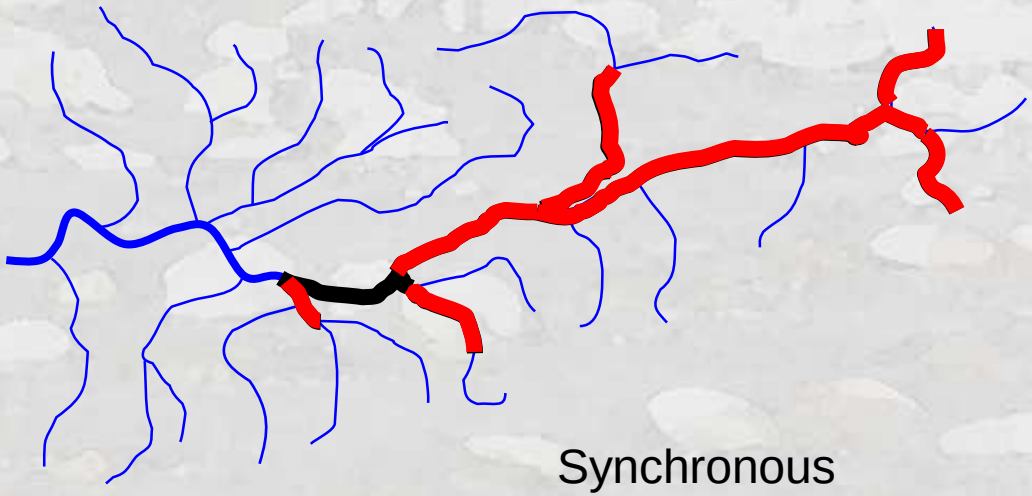
Planning Principles

- Respect the Dynamics
- Be proactive

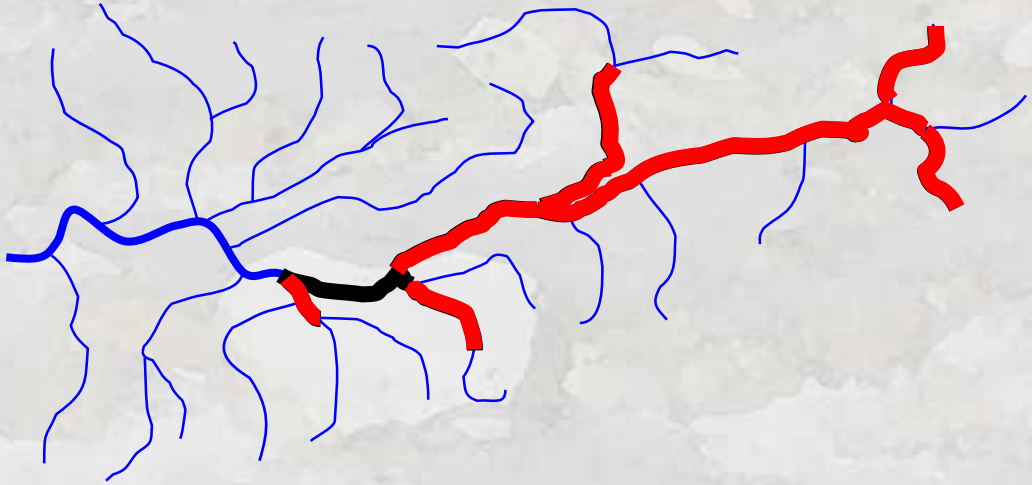
Target Connectivity
Pay Attention to Scale



Effect of Synchrony

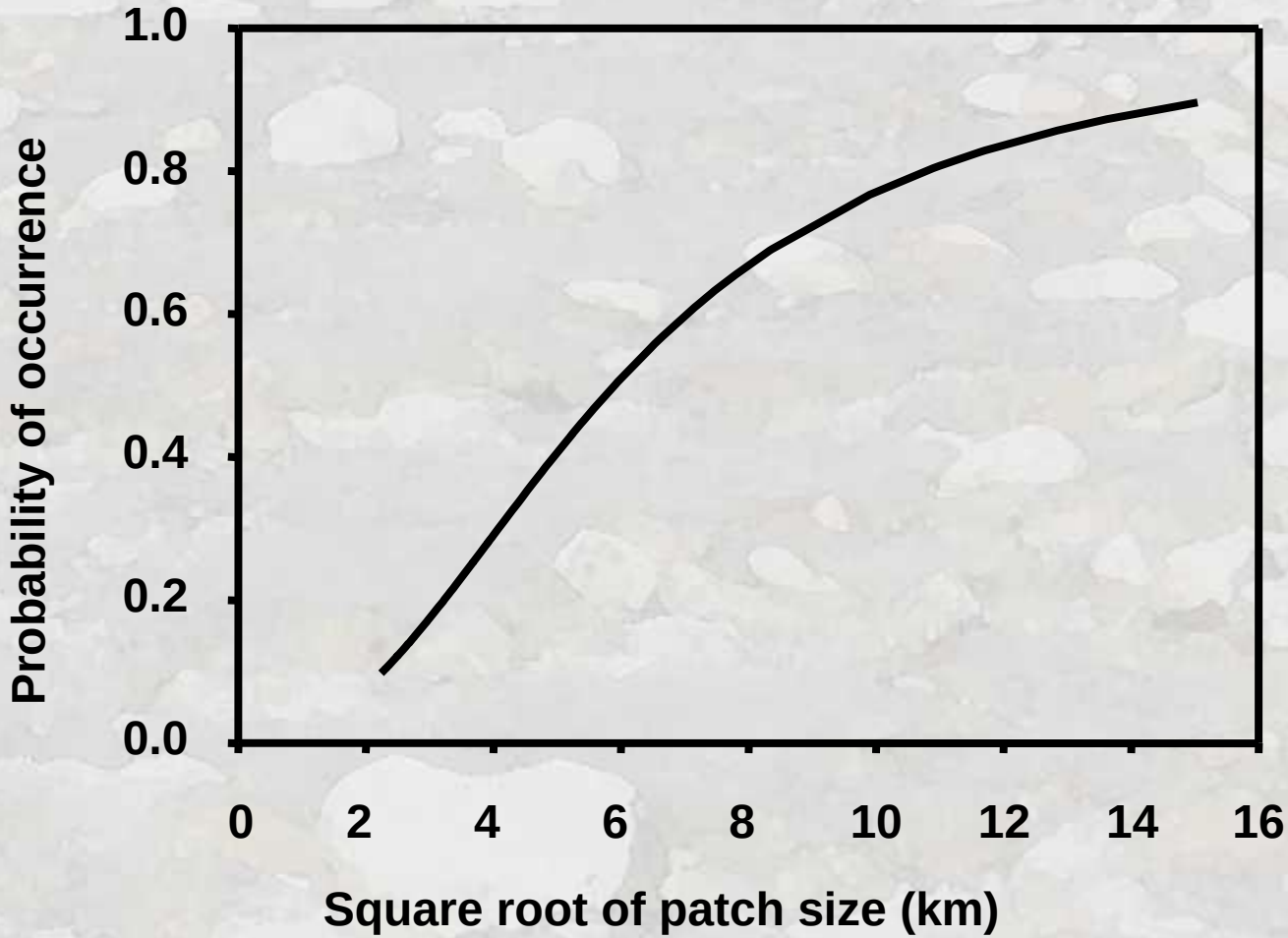


Synchronous



Asynchronous

How Big Is a Resilient Patch?



Dunham and Rieman, 1999

Planning Principles

- Respect the Dynamics
- Be proactive
- Seek Sustainable Solutions

Sustainability: Ability to persist or maintain with minimal investment of external resources or energy

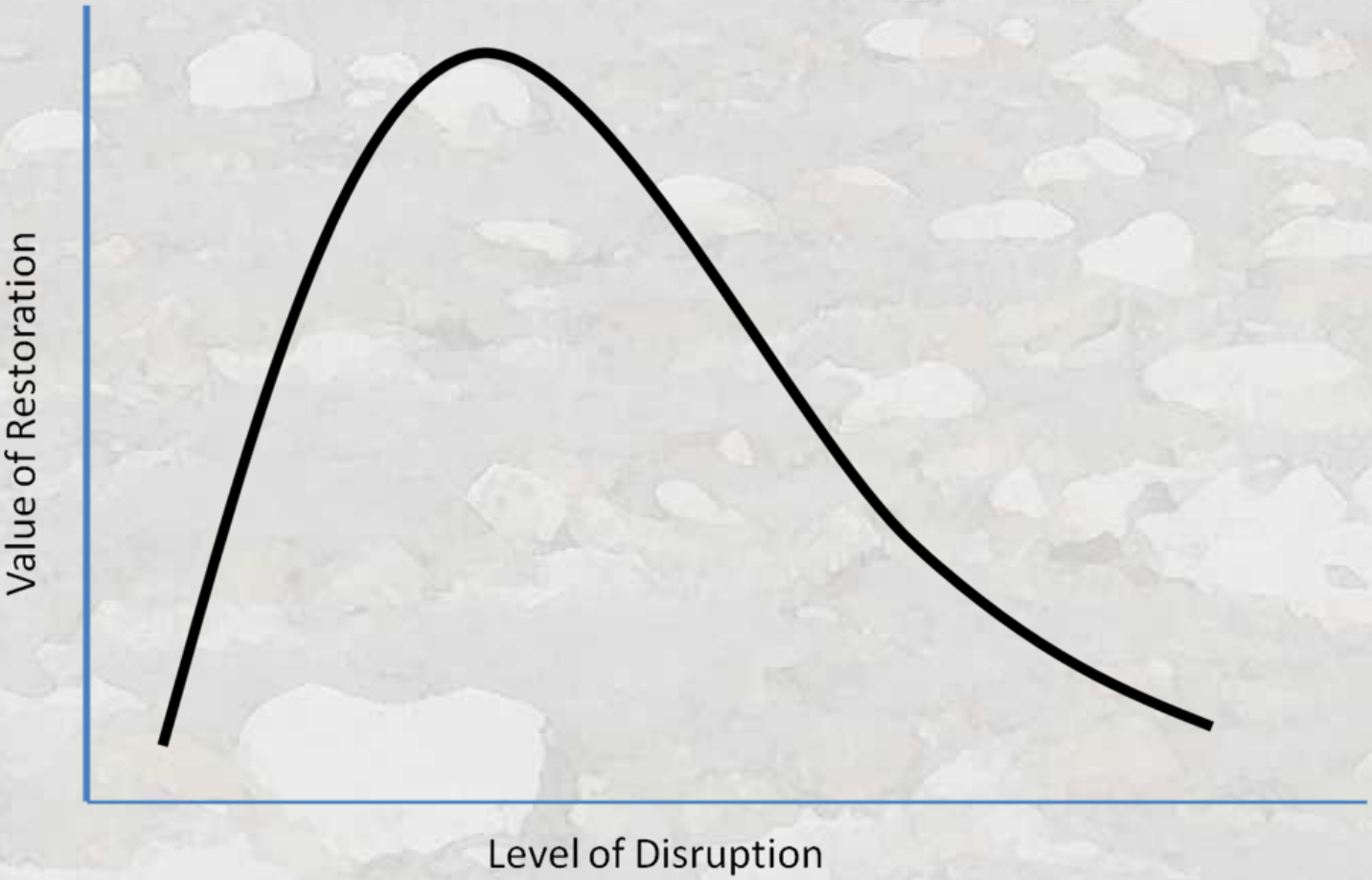
Management Options

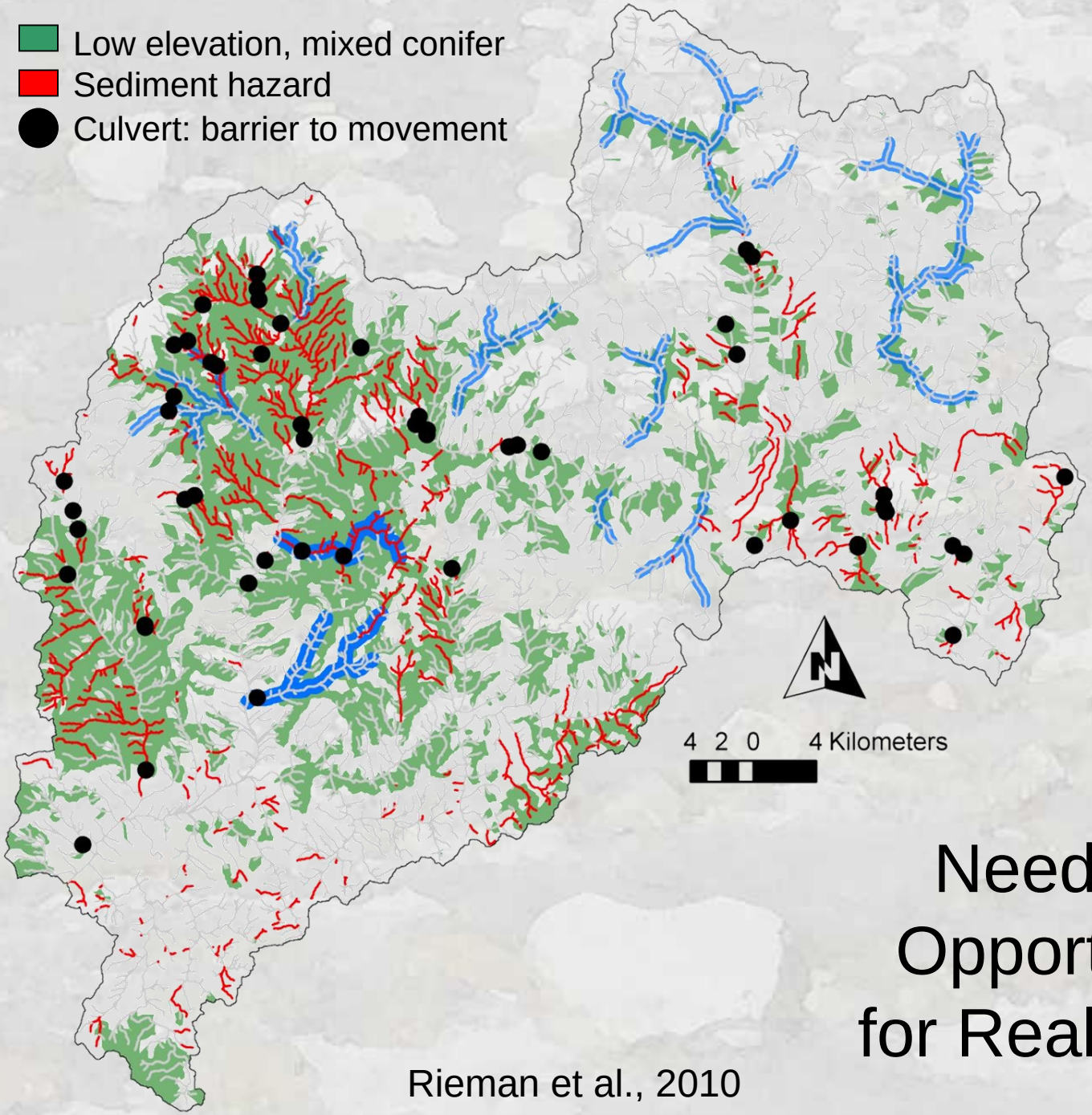
Objective	Societal Value	Example
Maintain	Ecological Function	Managing wildfires -not just fighting
Restore	Evolutionary Legacy	Road decommissioning
Control	Economic Benefits	Rotational harvests

Rieman et al., 2010

Restoration Purpose

Choose Priorities for Restoration Work

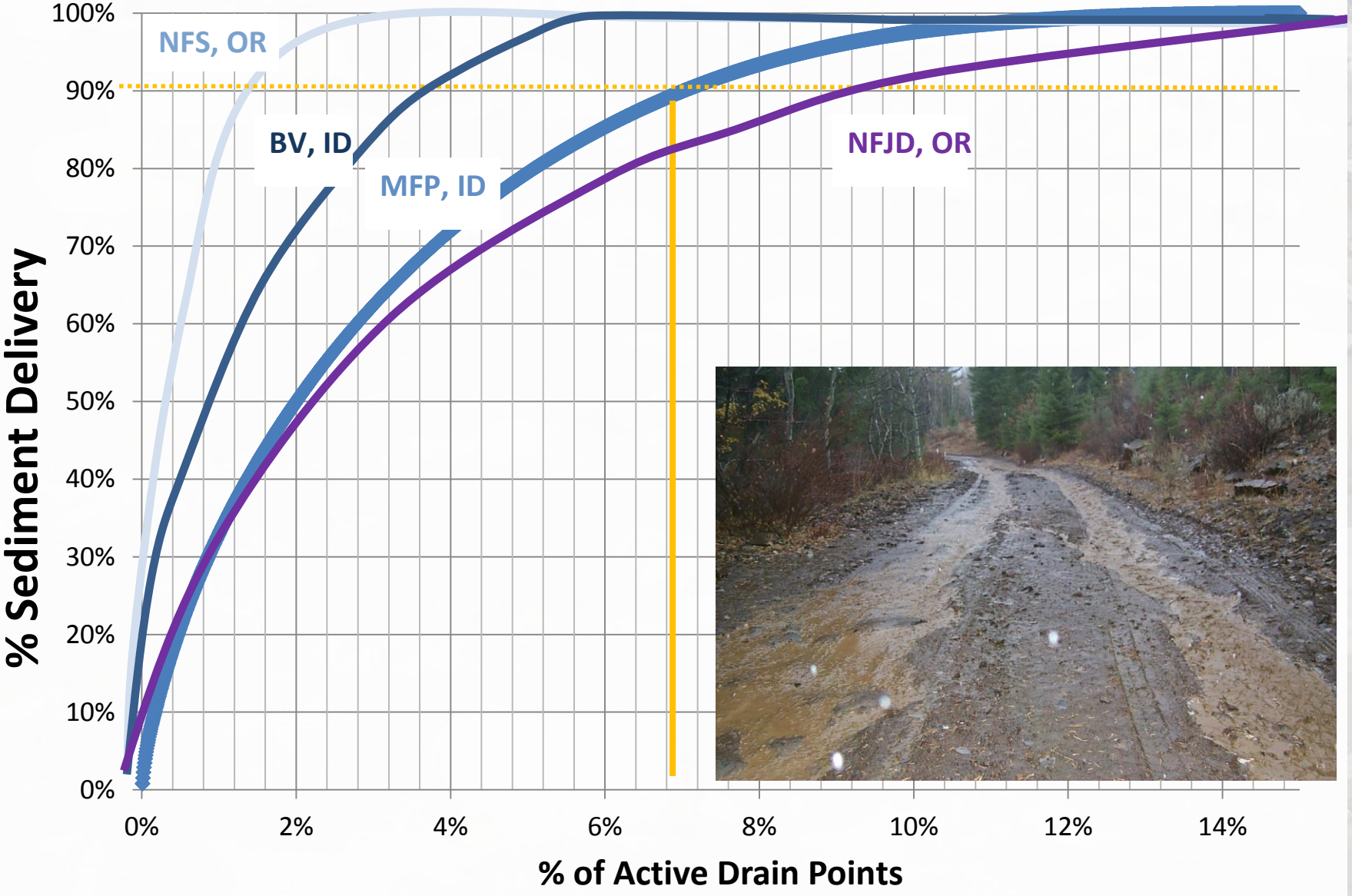




Needs and Opportunities for Realignment

Rieman et al., 2010

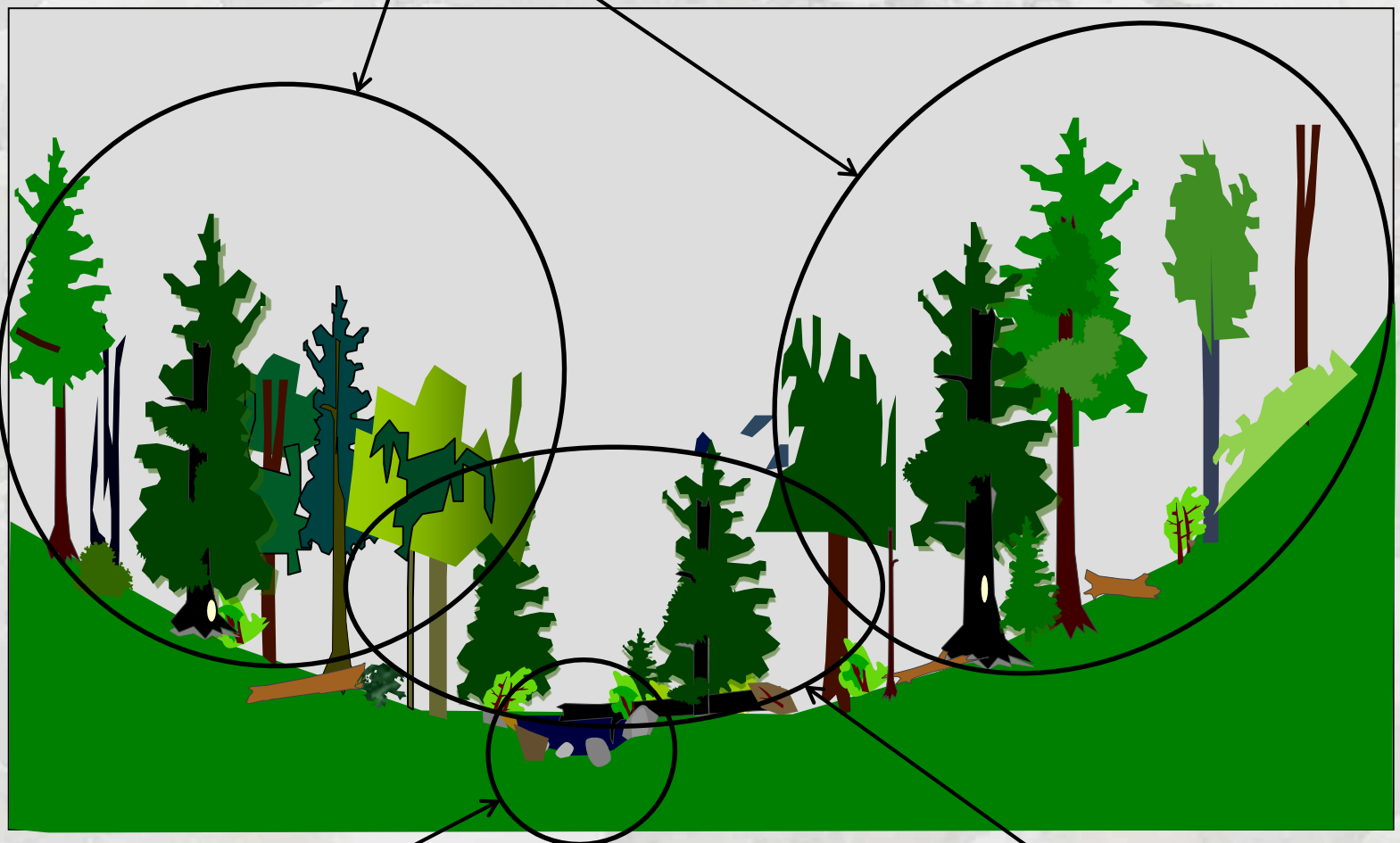
Most Sediment Input in Few Places



Planning Principles

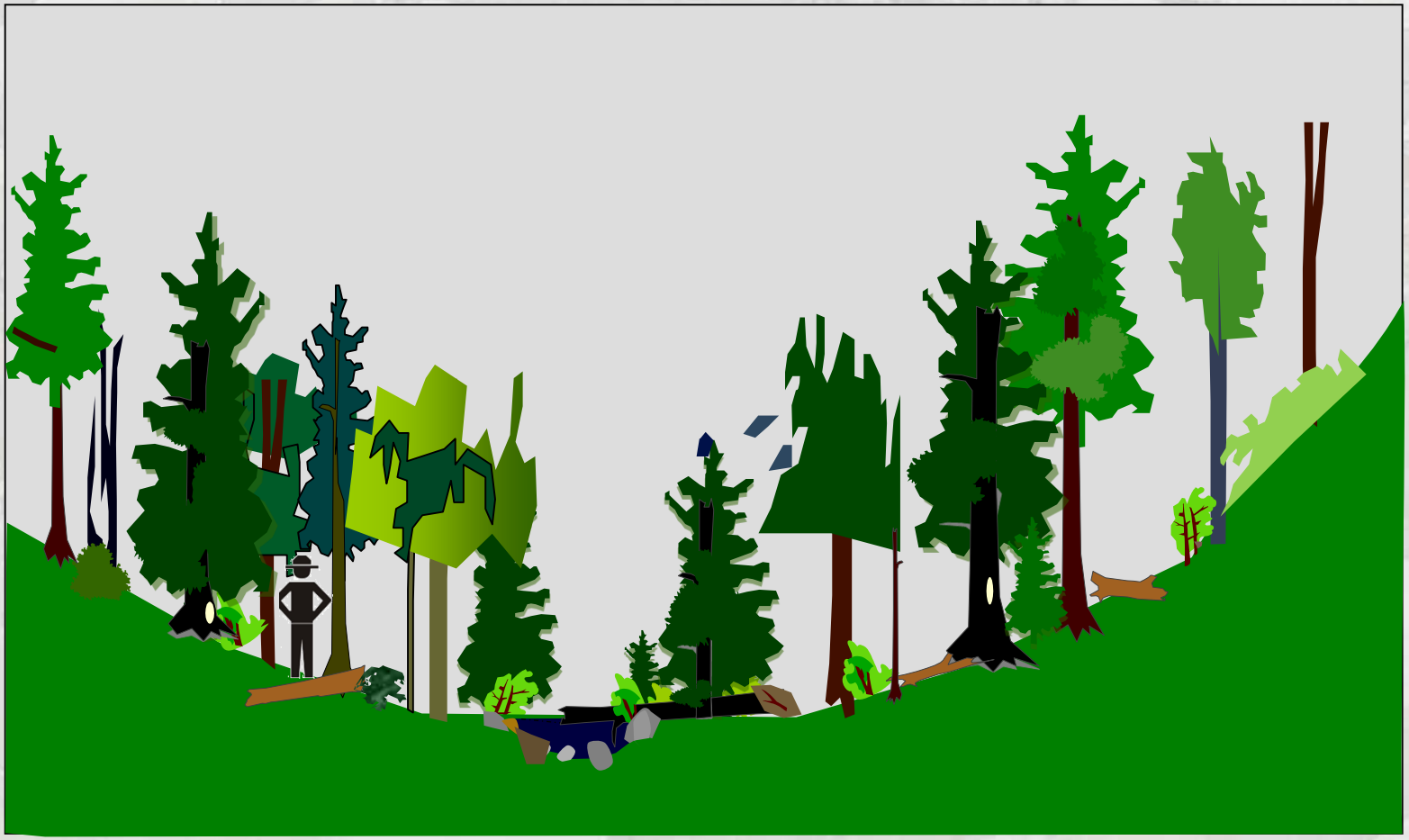
- Respect the Dynamics
- Be proactive
- Seek Sustainable Solutions
- Consider the Forest-Riparian-Aquatic as one Ecosystem

Forest Ecosystem (Forest Service)



Aquatic Ecosystem
(US Army Corps & NOAA Fisheries)

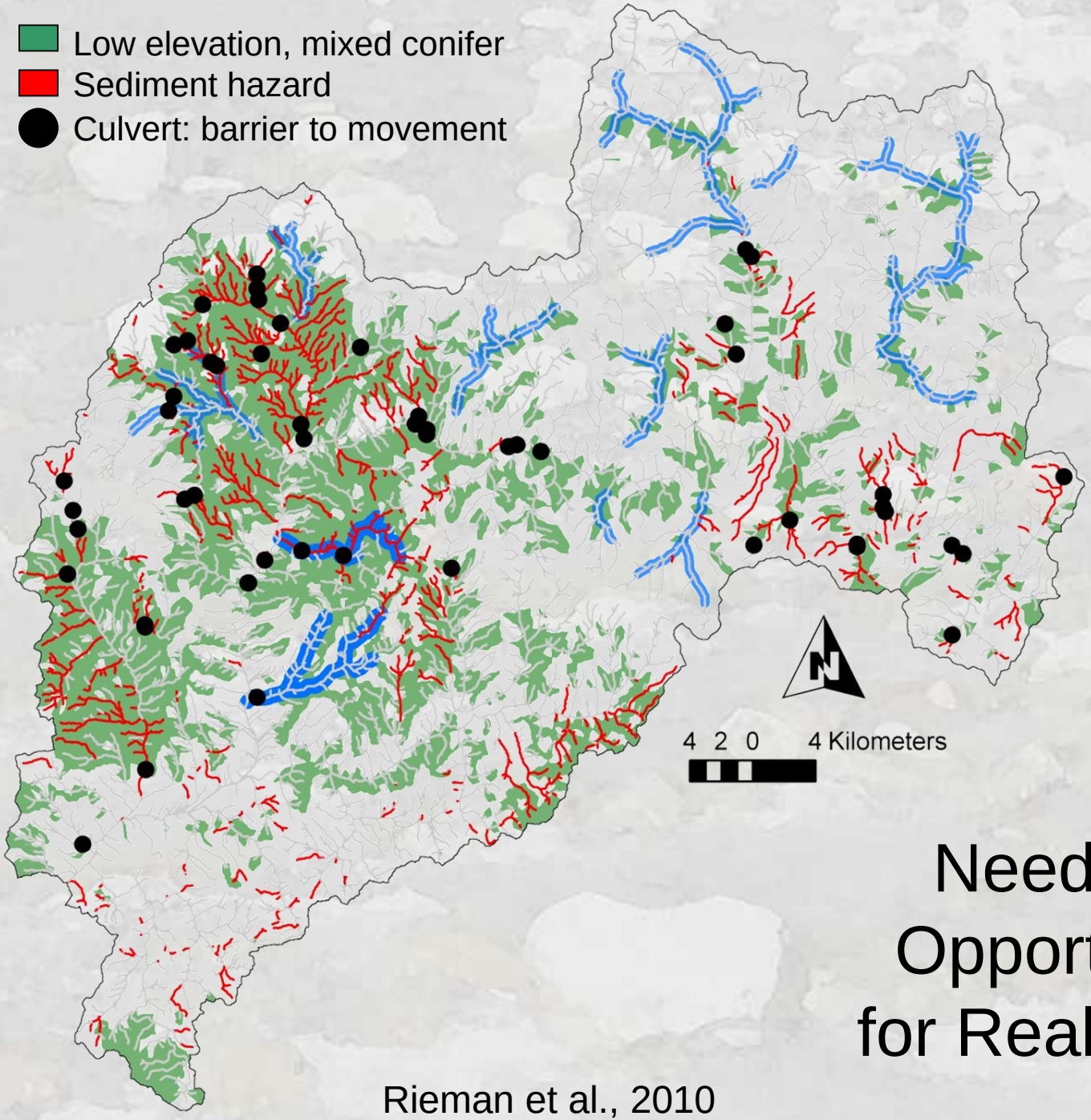
Riparian Ecosystem
(Fish and Wildlife Service)



Consider the interaction between
forest & stream objectives – control v. maintain

Planning Principles

- Respect the Dynamics
- Be proactive
- Seek Sustainable Solutions
- Consider the Forest-Riparian-Aquatic as one Ecosystem
- Think about spatial arrangements

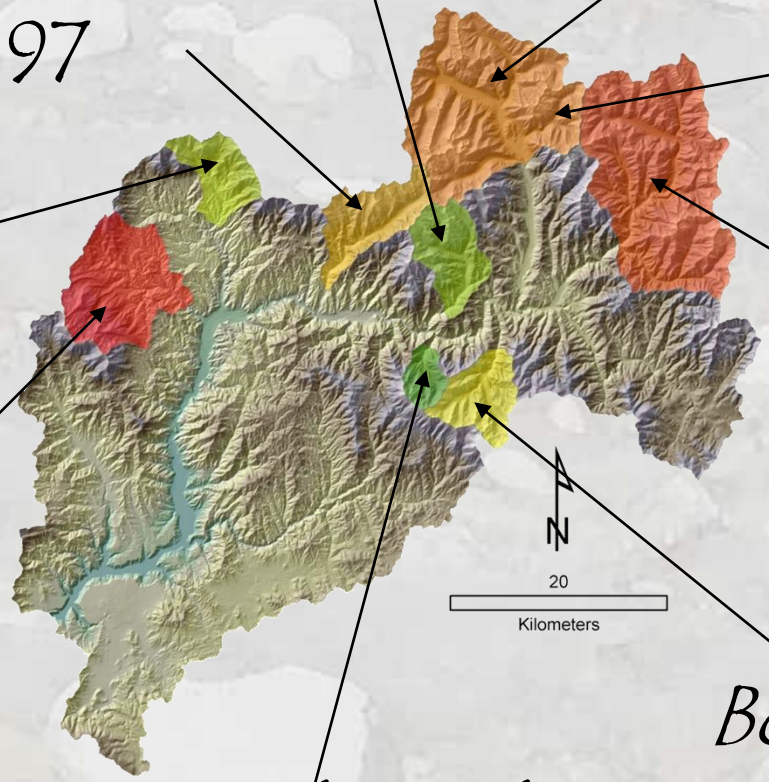


Needs and Opportunities for Realignment

Rieman et al., 2010

Full Distribution of Fire Sizes

Persistence Probability:



Skeleton
0.98

Ross Fork
0.99

Willow
0.97

Emma
0.15

Elk
0.67

Big Smoky
0.99

Trinity
0.97

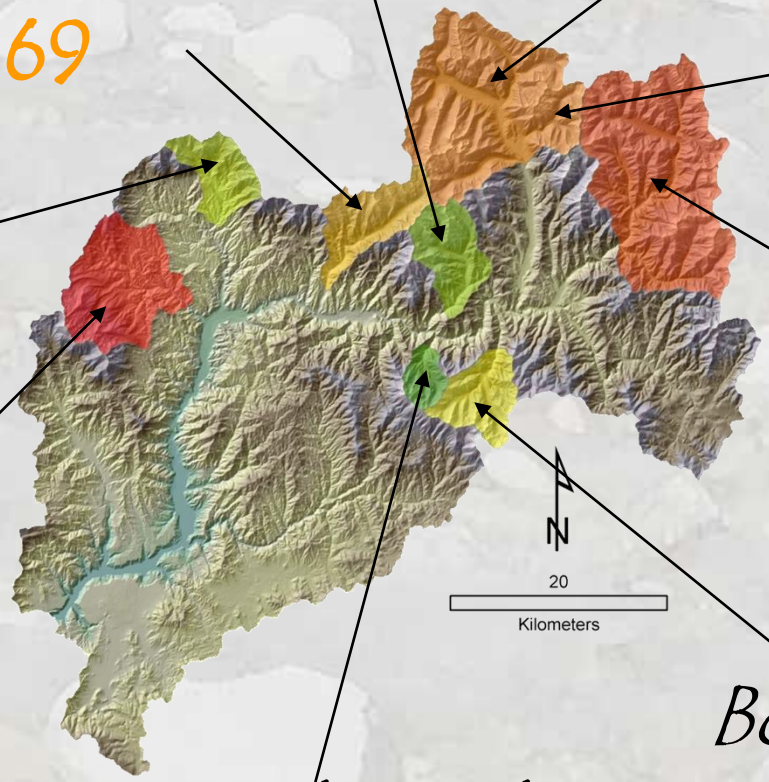
Deadwood
0.95

Boardman
0.97

Dare et al., 2011

What if each network burned at high severity?

Persistence Probability:



Skeleton
0.92

Ross Fork
0.86

Willow
0.69

Emma
0.13

Elk
0.14

Big Smoky
0.87

Trinity
0.58

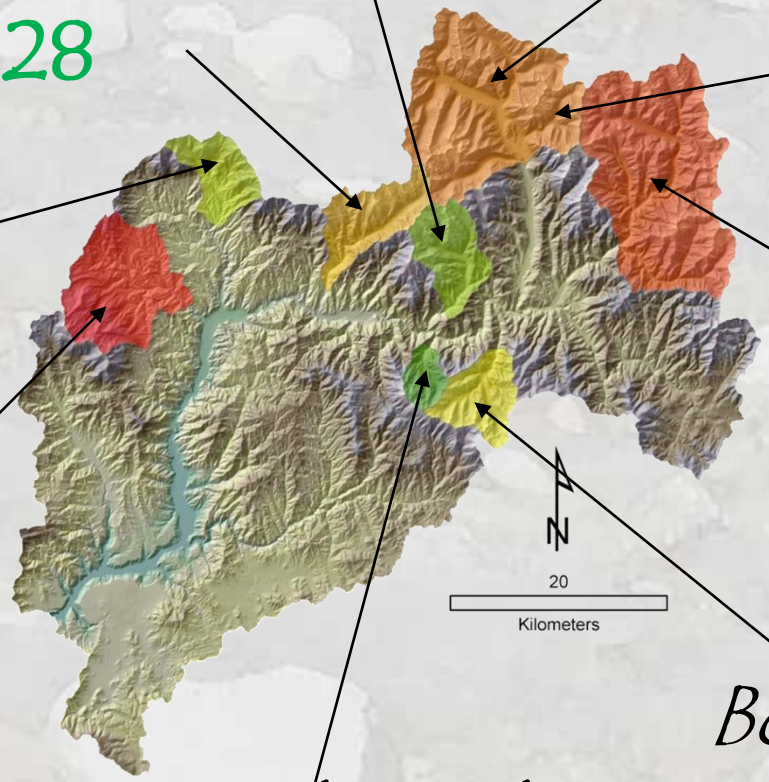
Boardman
0.58

Deadwood
0.95

Dare et al., 2011

Improvement with Fuel Treatments

Change in Persistence Probability



Skeleton
0.06

Ross Fork
0.13

Willow
0.28

Emma
0.02

Elk
0.53

Big Smoky
0.12

Trinity
0.39

Boardman
0.39

Deadwood
0.00

Dare et al., 2011

Closing Philosophy

- Planning for climate change tied to better planning for disturbance
  - Resilience
- Substantial information component
  - Strong and increasing uncertainty
  - Adaptation is learning!!
  - Invest in the managers' information base!

RMRS GTR 290

USDA

United States Department of Agriculture

Forest Service

Rocky Mountain Research Station

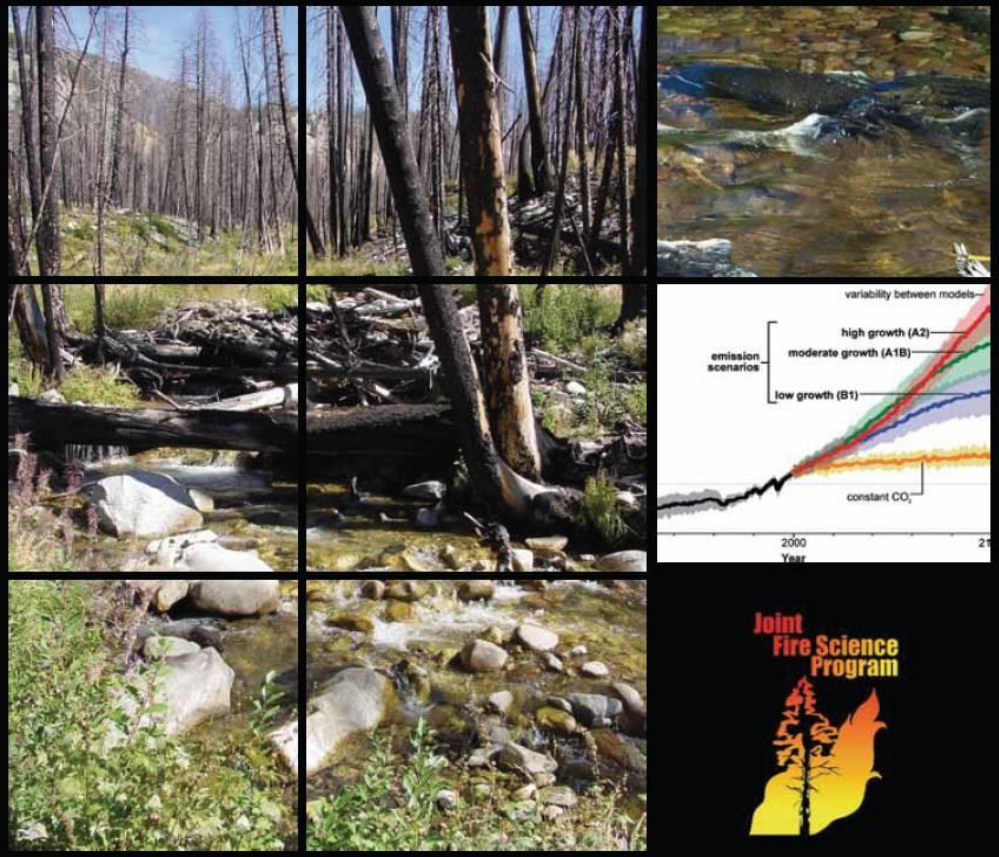
General Technical Report RMRS-GTR-290

September 2012

Climate Change, Forests, Fire, Water, and Fish:

Building resilient landscapes, streams, and managers

Charles Luce, Penny Morgan, Kathleen Dwire, Daniel Isaak, Zachary Holden, and Bruce Rieman



Joint Fire Science Program

http://www.fs.fed.us/rm/pubs/rmrs_gtr290.html