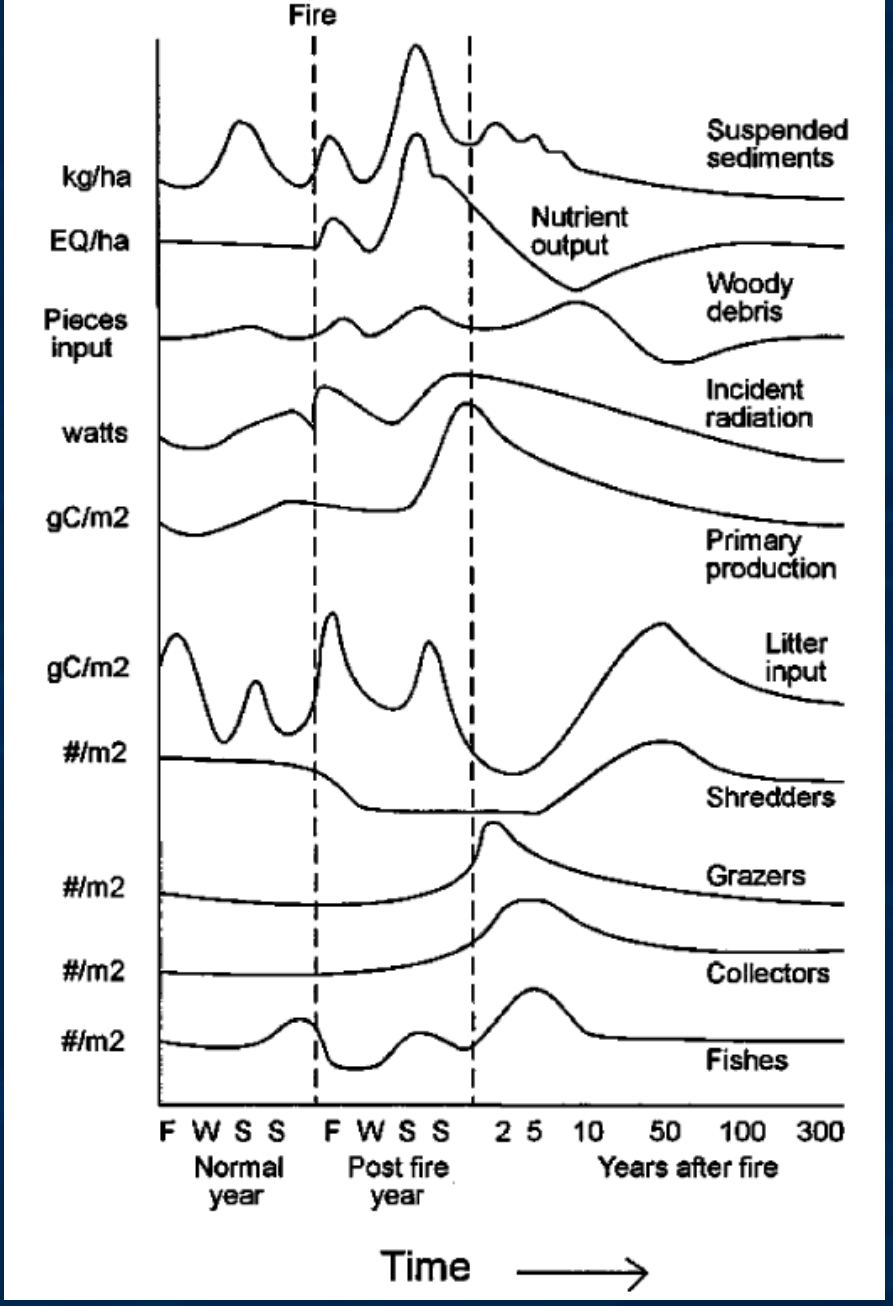
In-stream restoration and fish passage in the context of fire

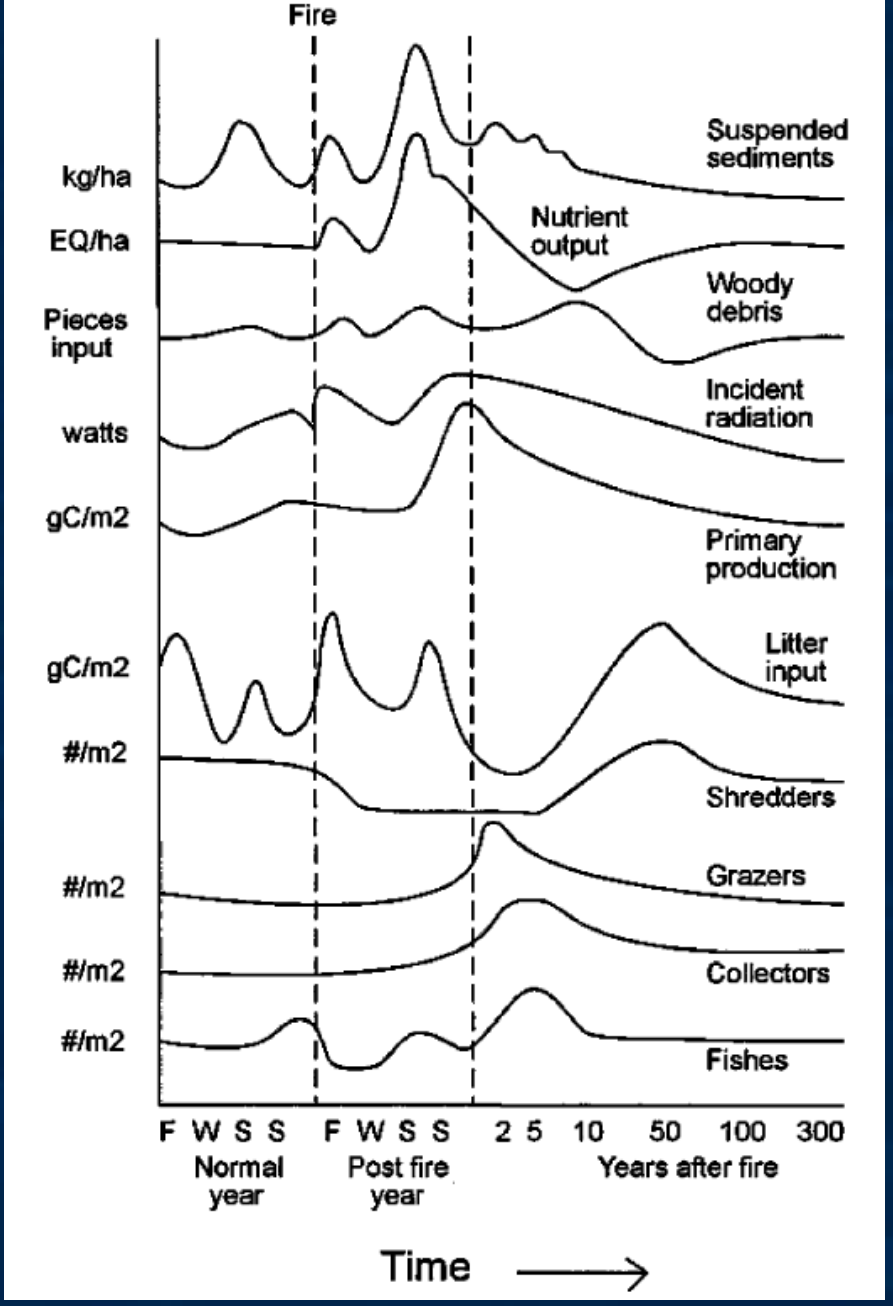
Helen Neville



Gresswell 1999

Systems rebound over time…

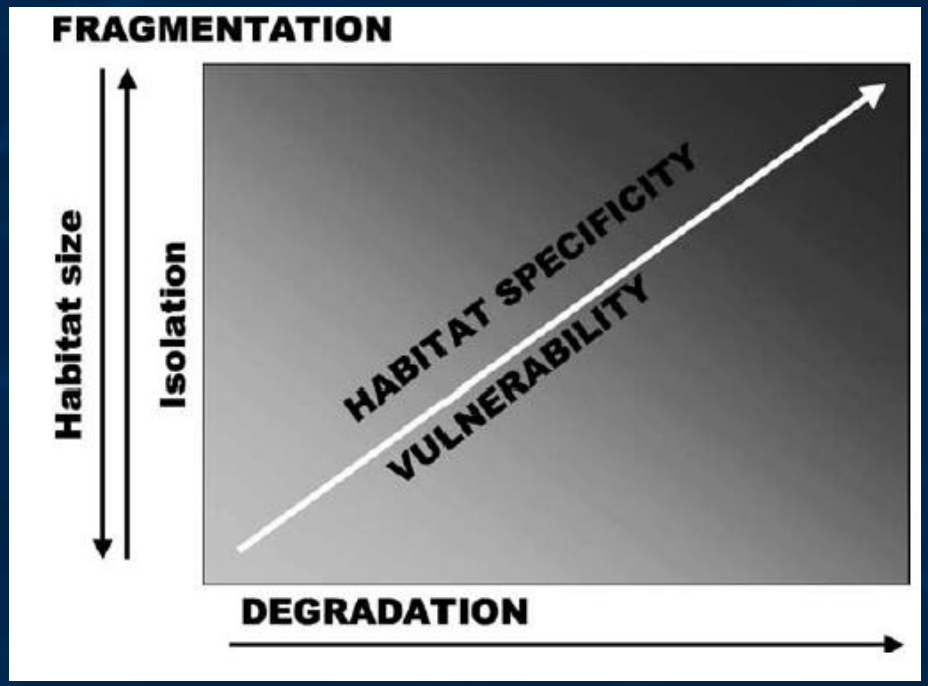
TROUT UNLIMITED



Gresswell 1999

Systems rebound over time…

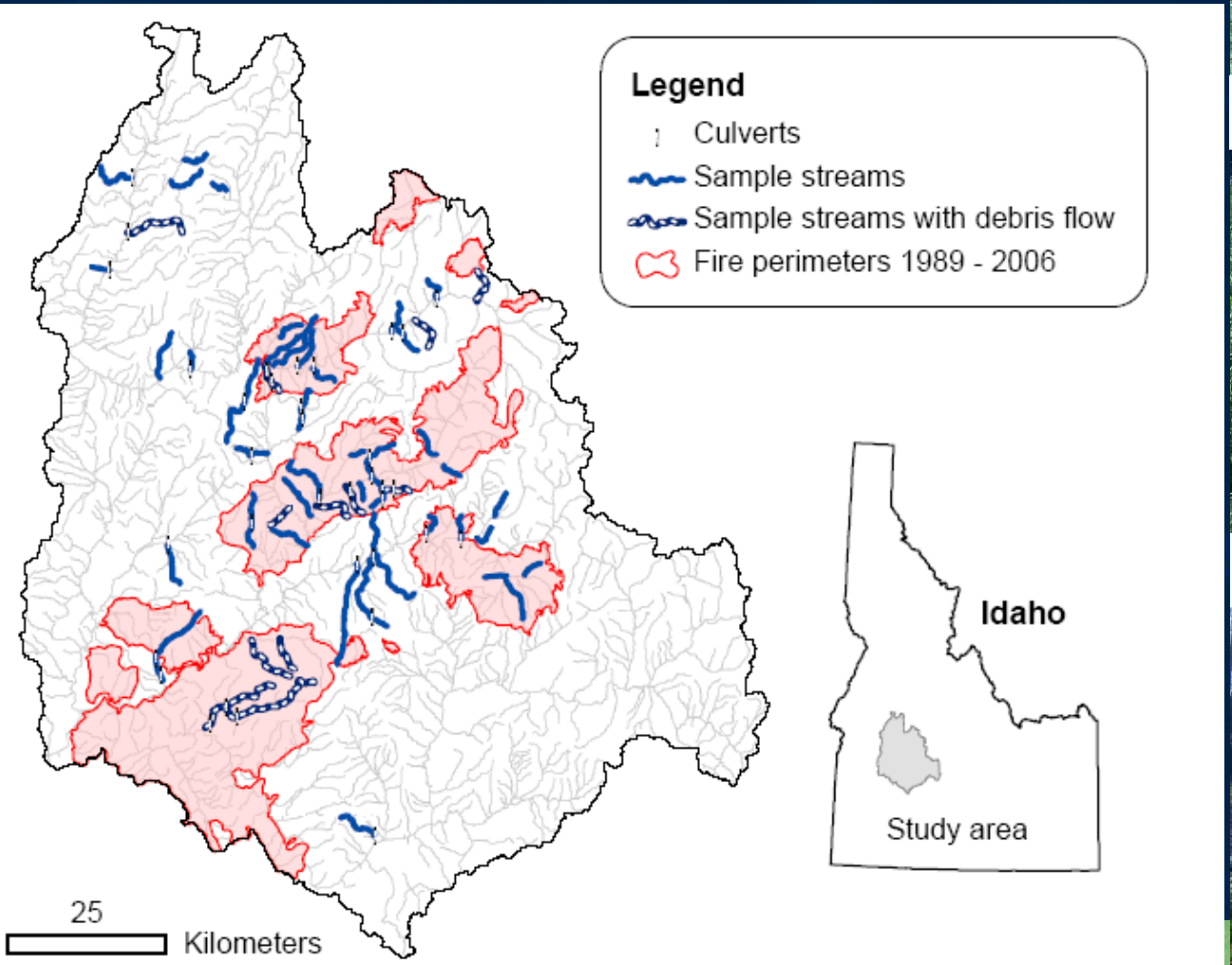
But vulnerability depends on context



Dunham et al. 2003, Forest Ecology and Management

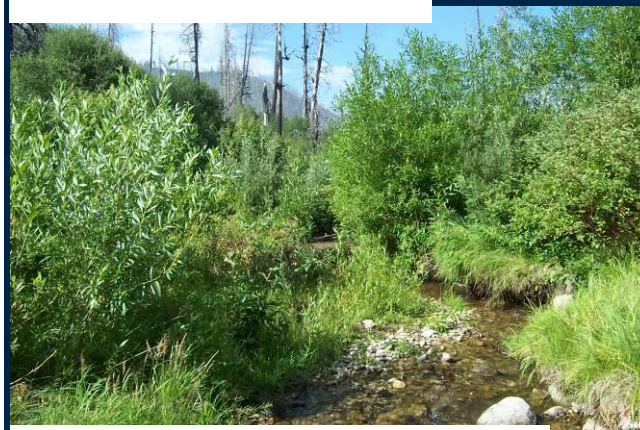
Genetic impacts
Boise and Payette Rivers, ID

55 streams



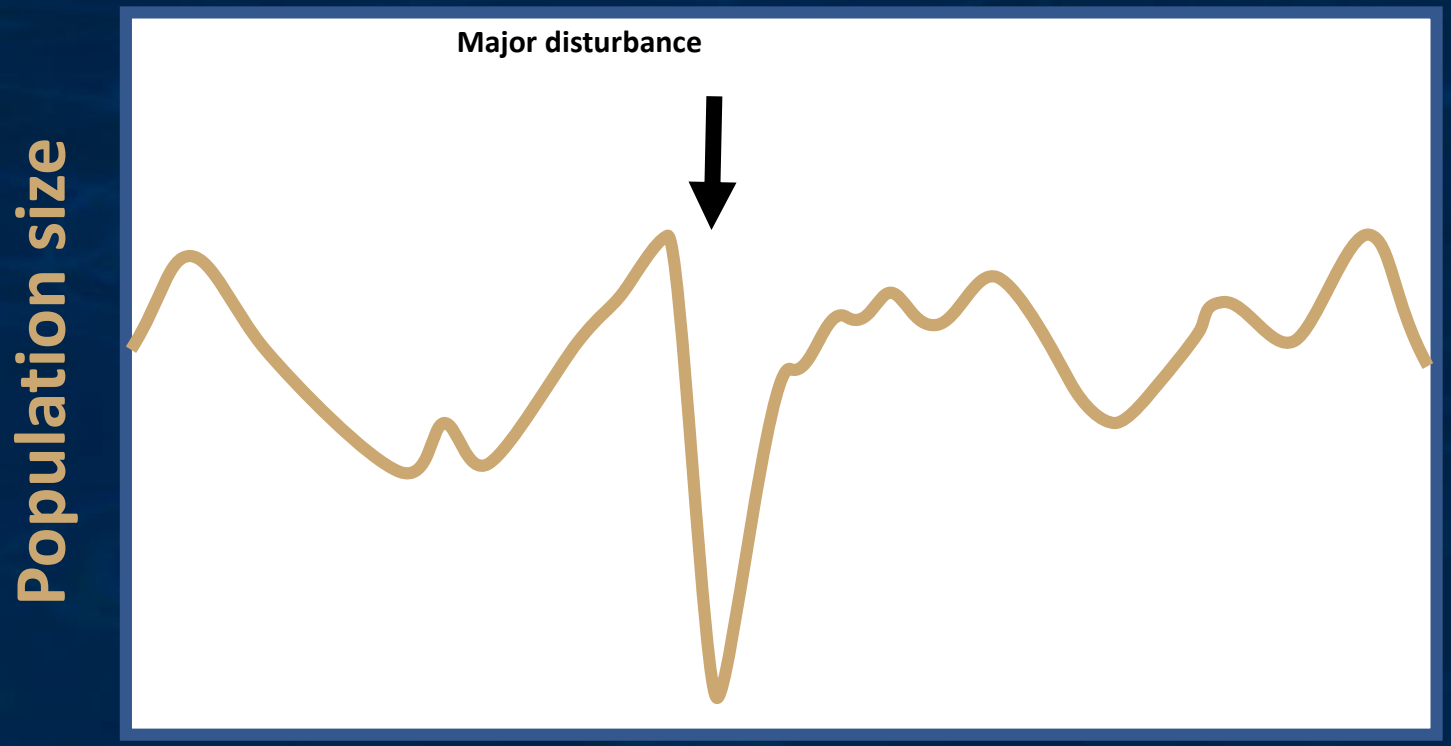
Undisturbed

Burned



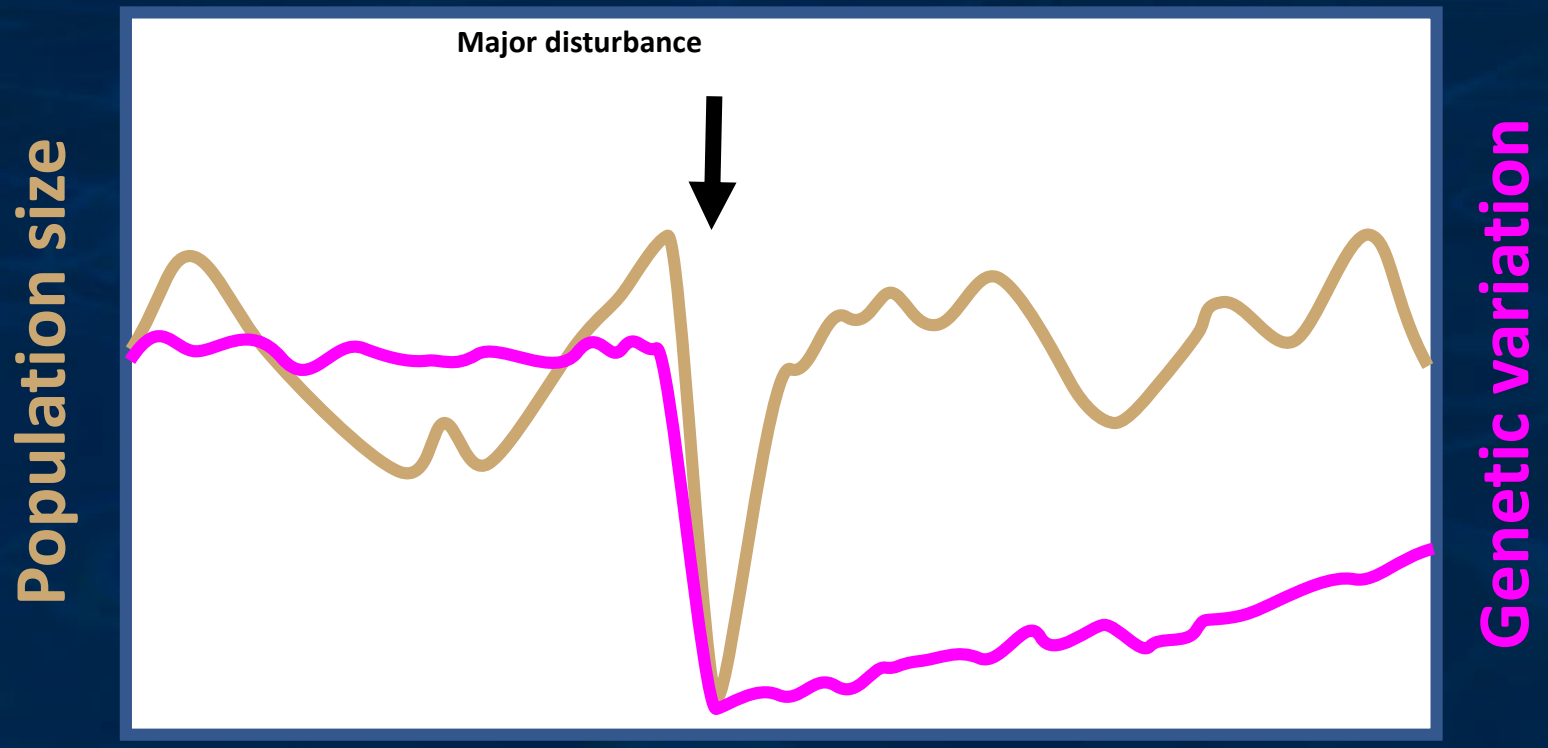
Burned & reorganized

Disturbance and resilience

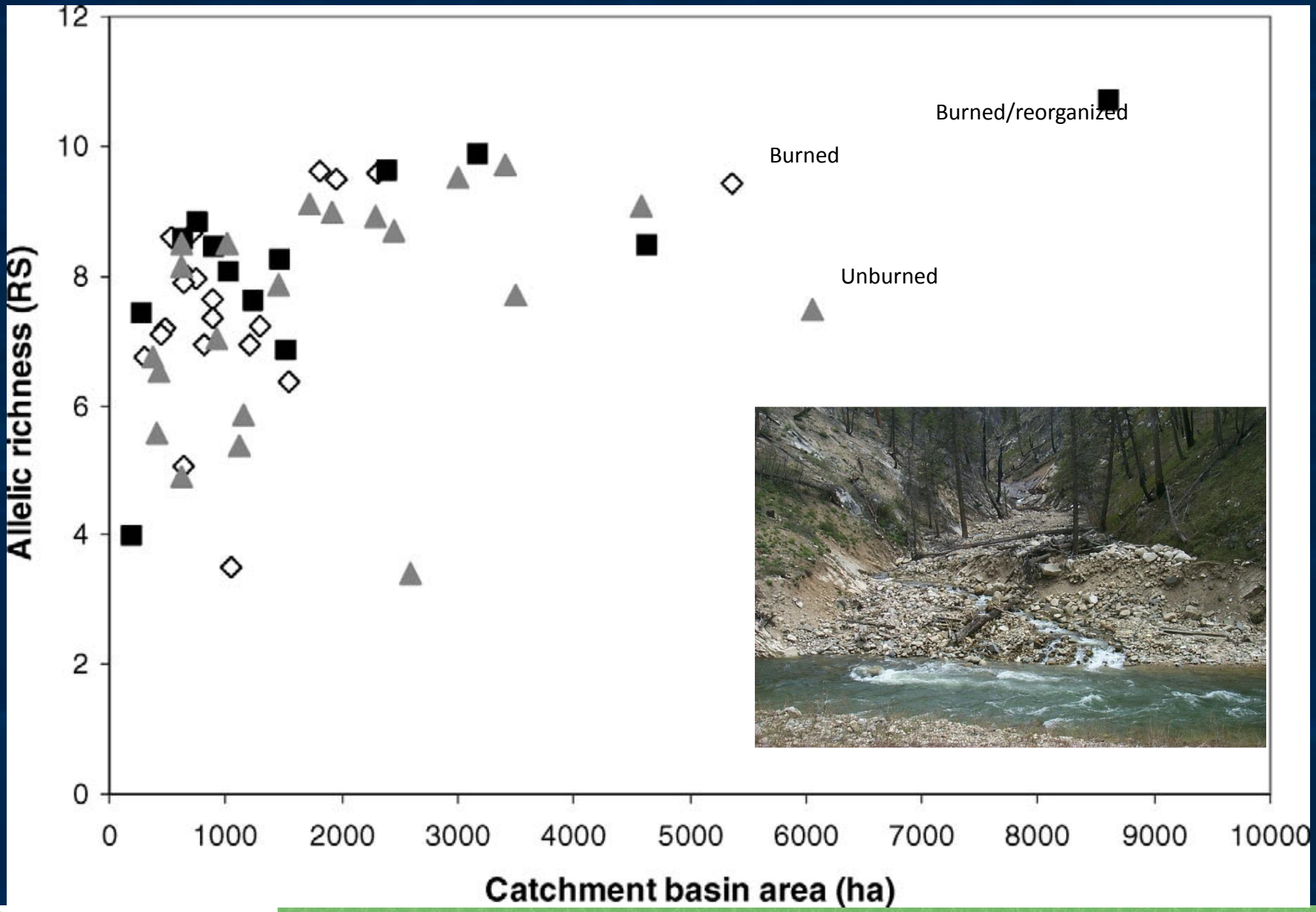


Dunham et al. (1999)

Disturbance and resilience

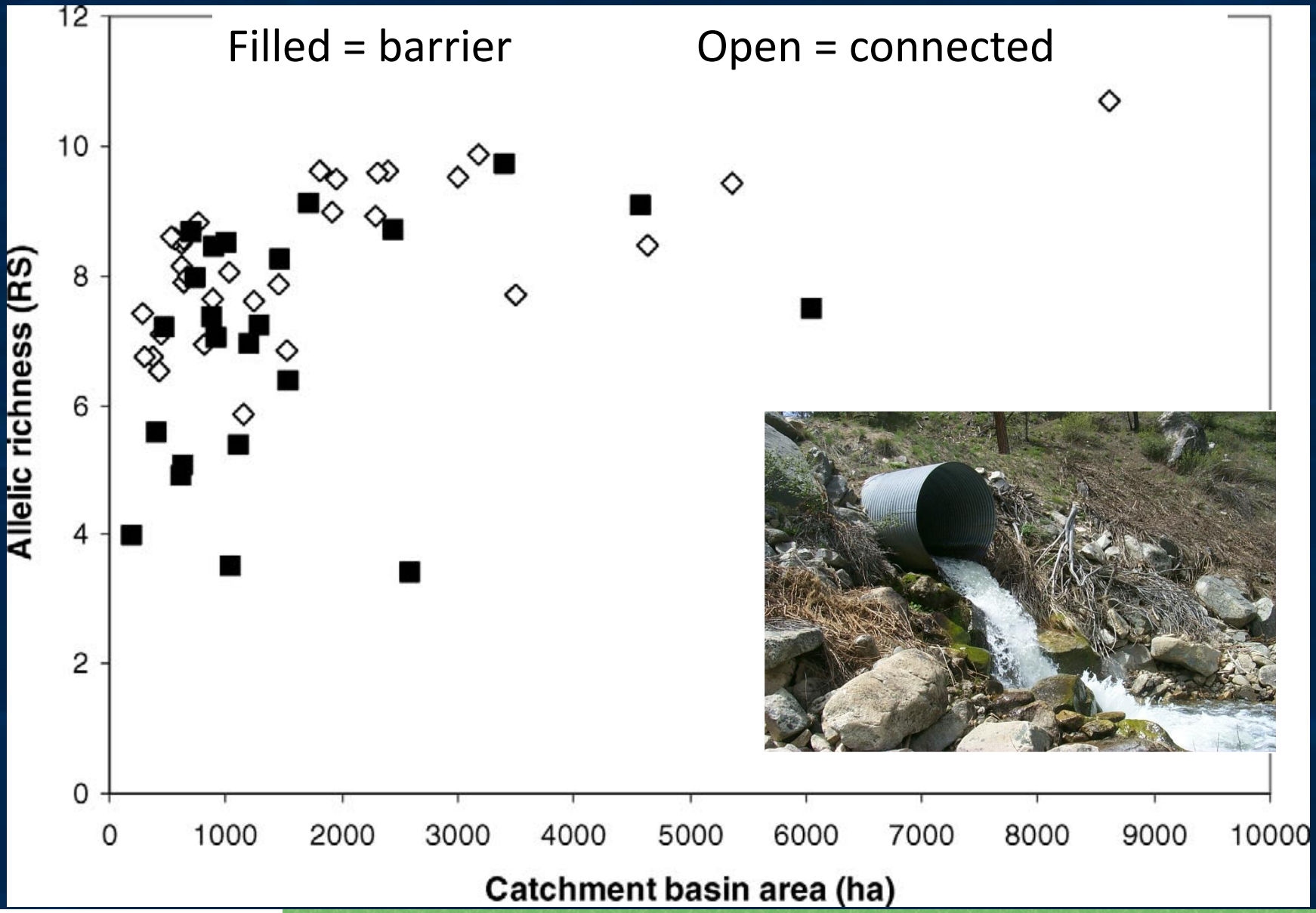


No difference in burned areas

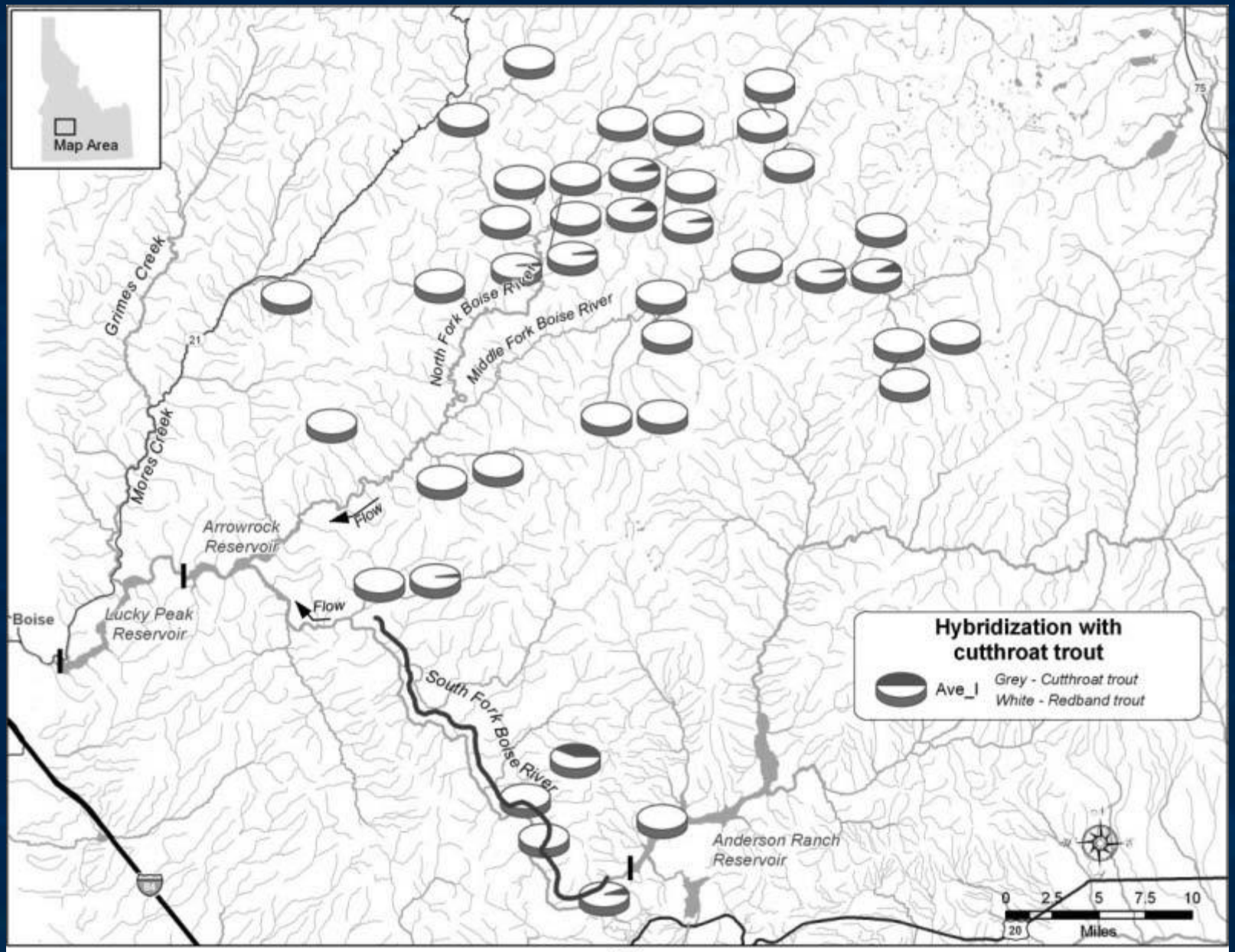


Neville et al. 2009

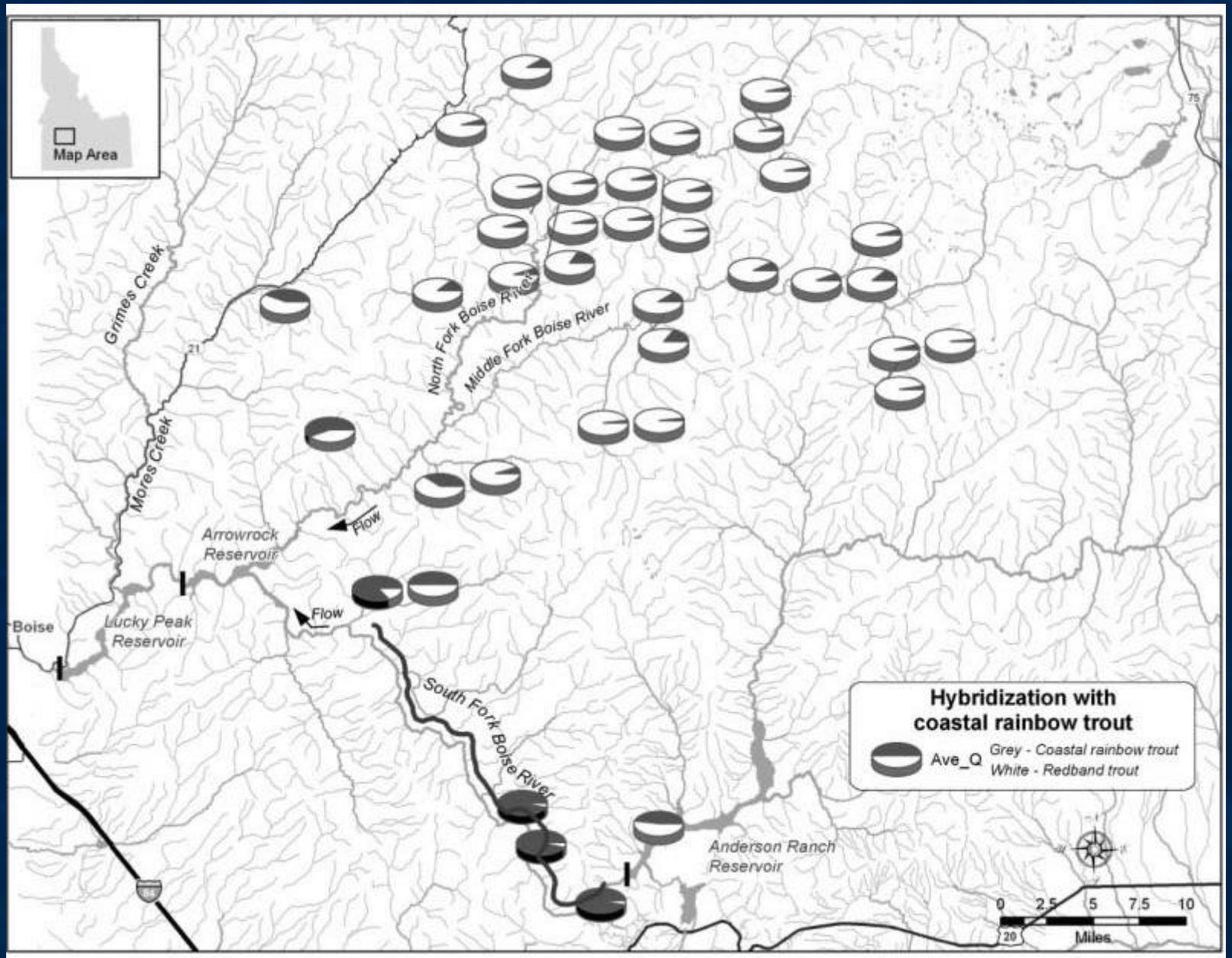
Only influence was isolation by culverts



Neville et al. 2009


Map Area
Grimes Creek
Mores Creek
North Fork Boise River
Middle Fork Boise River
Arrowrock Reservoir
Flow
Flow
Boise
Lucky Peak Reservoir
South Fork Boise River
Anderson Ranch Reservoir
Hybridization with cutthroat trout
Ave_I
Grey - Cutthroat trout
White - Redband trout
0 2.5 5 7.5 10
Miles

(a)


Map Area
Grimes Creek
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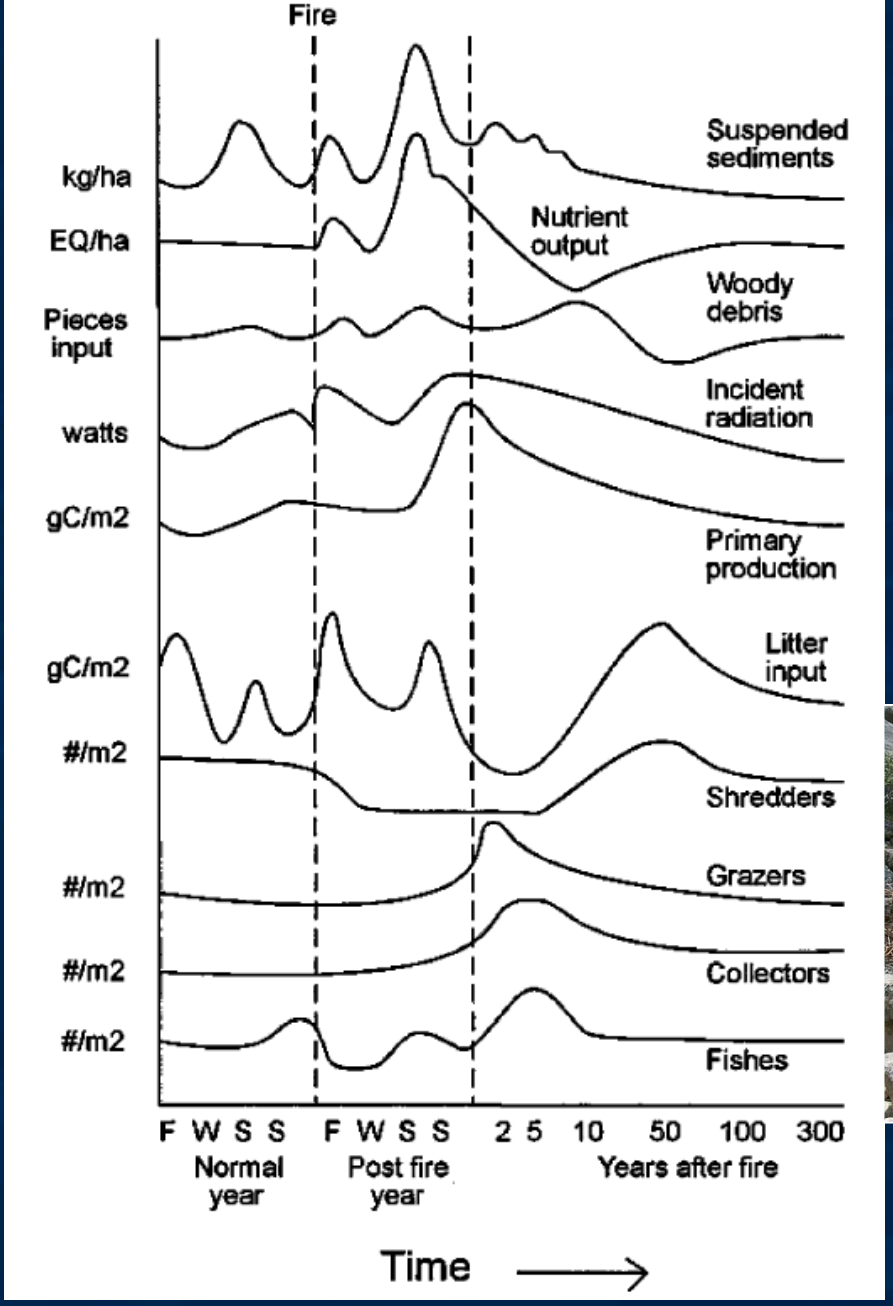
North Fork Boise River
Middle Fork Boise River
Arrowrock Reservoir
Flow
Flow
Boise
Lucky Peak Reservoir
South Fork Boise River
Anderson Ranch Reservoir
Hybridization with coastal rainbow trout
Ave_Q
Grey - Coastal rainbow trout
White - Redband trout
0 2.5 5 7.5 10
Miles

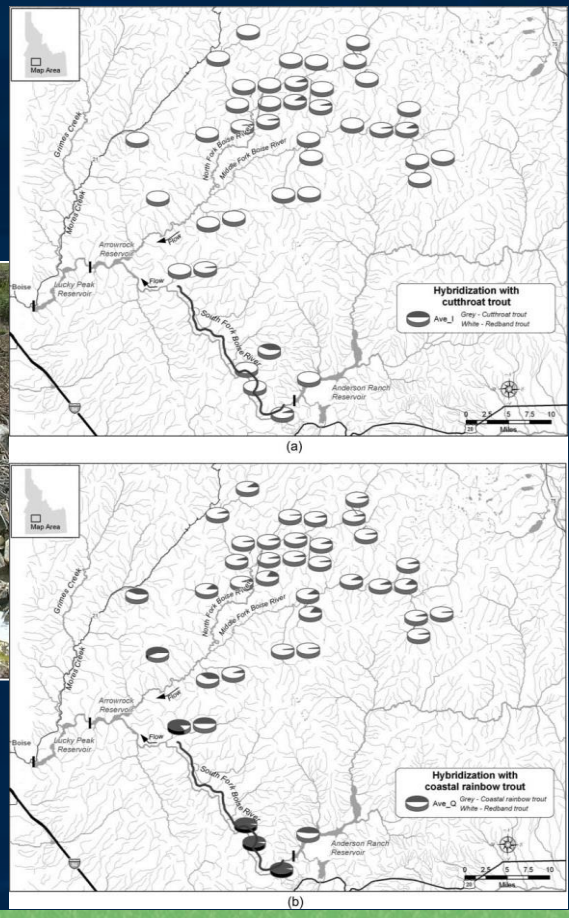
(b)



Gresswell 1999

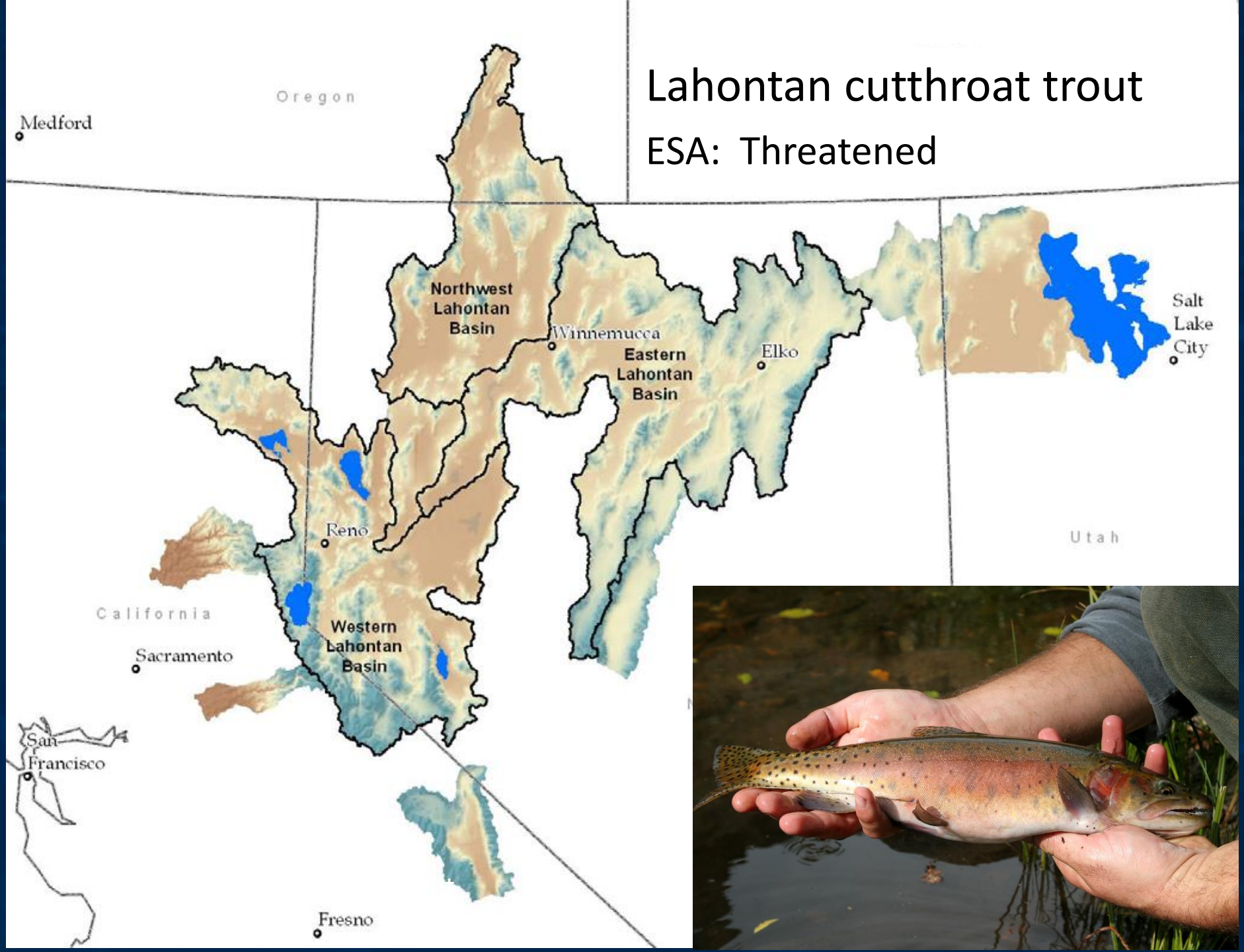
Systems rebound over time

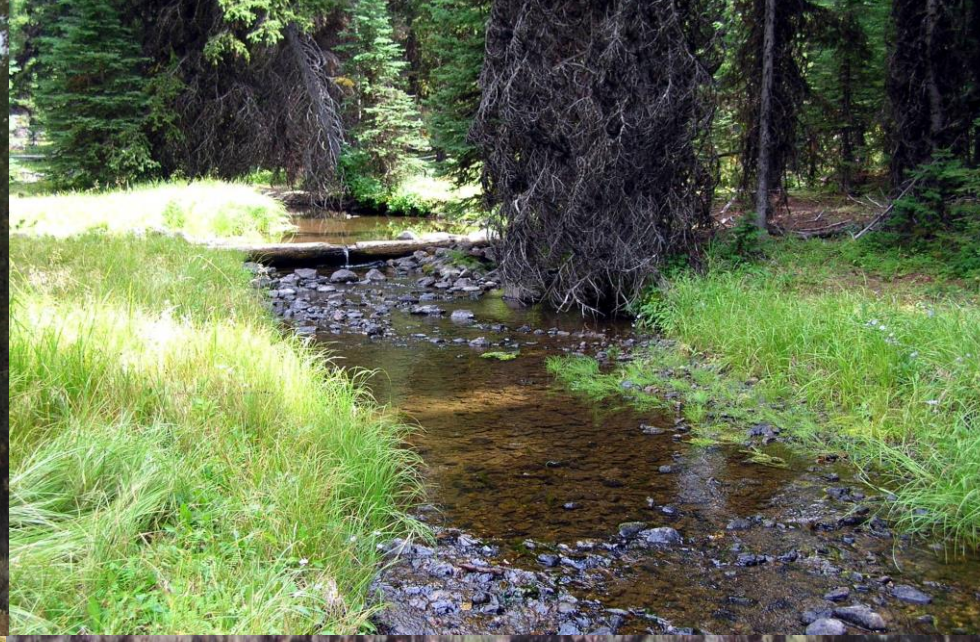
But vulnerability depends on context



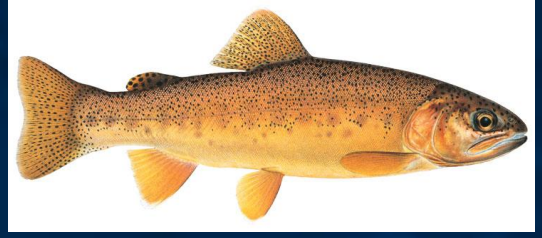
Lahontan cutthroat trout

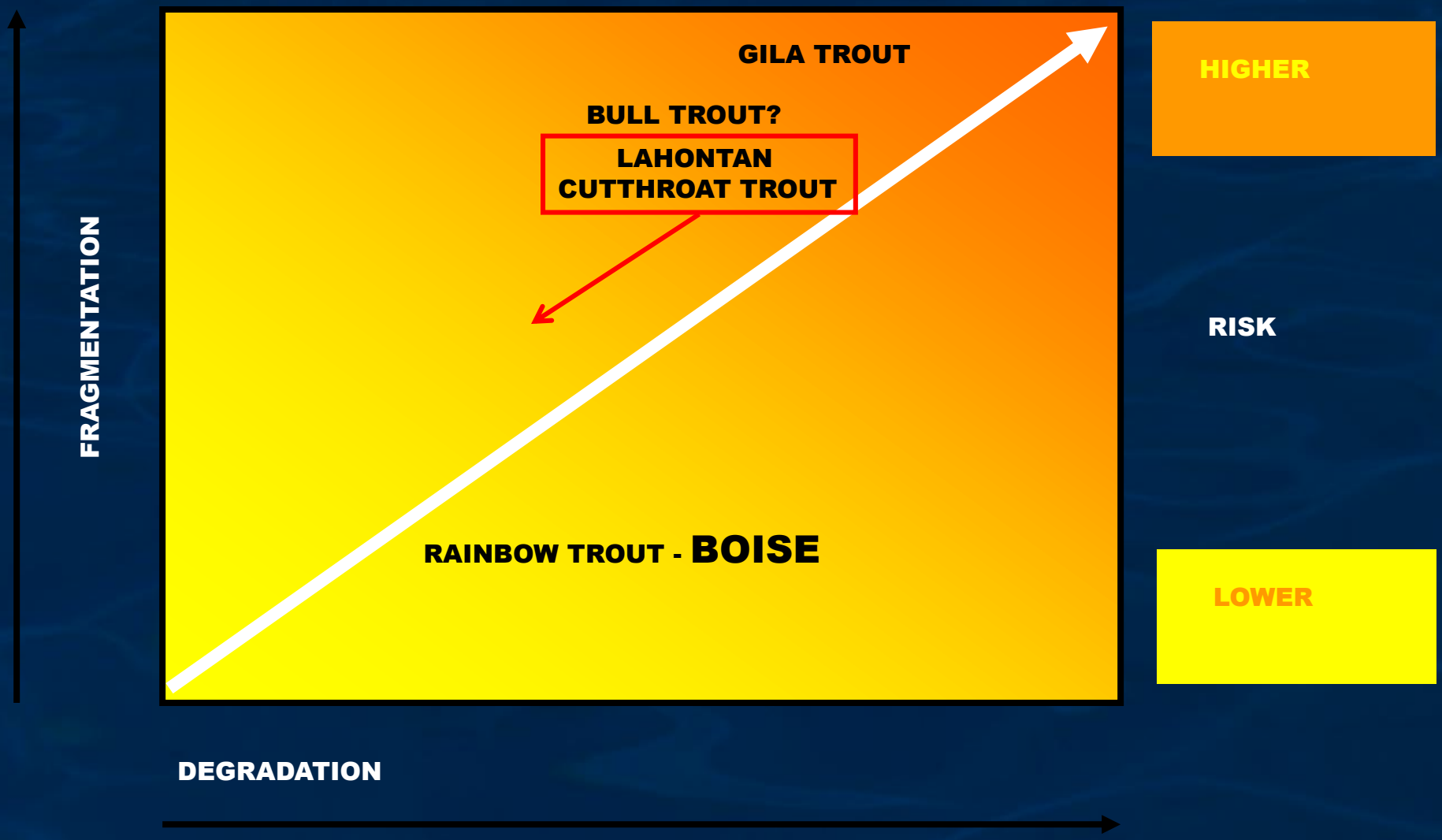
ESA: Threatened





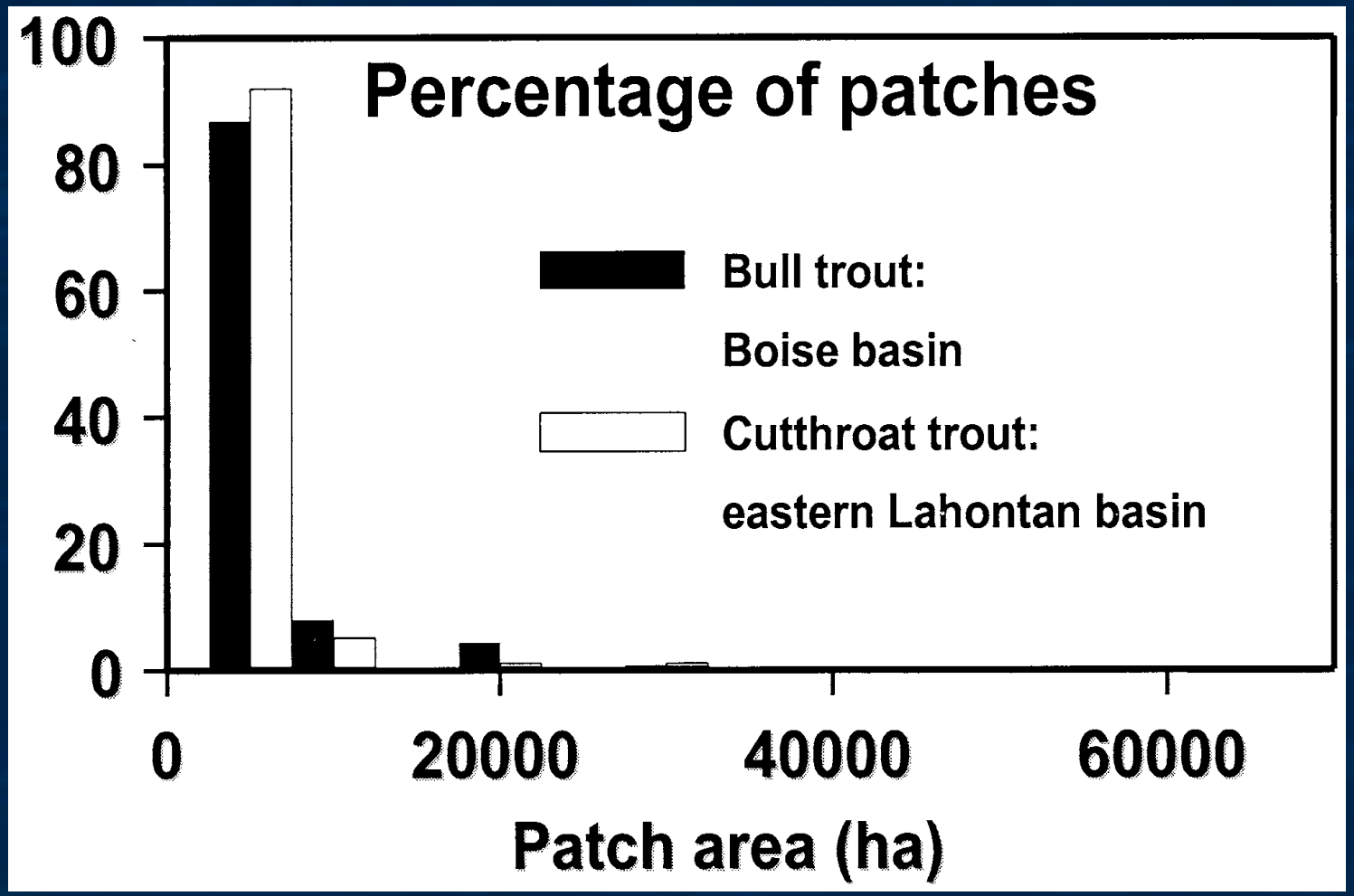
Is *wildfire* a threat?





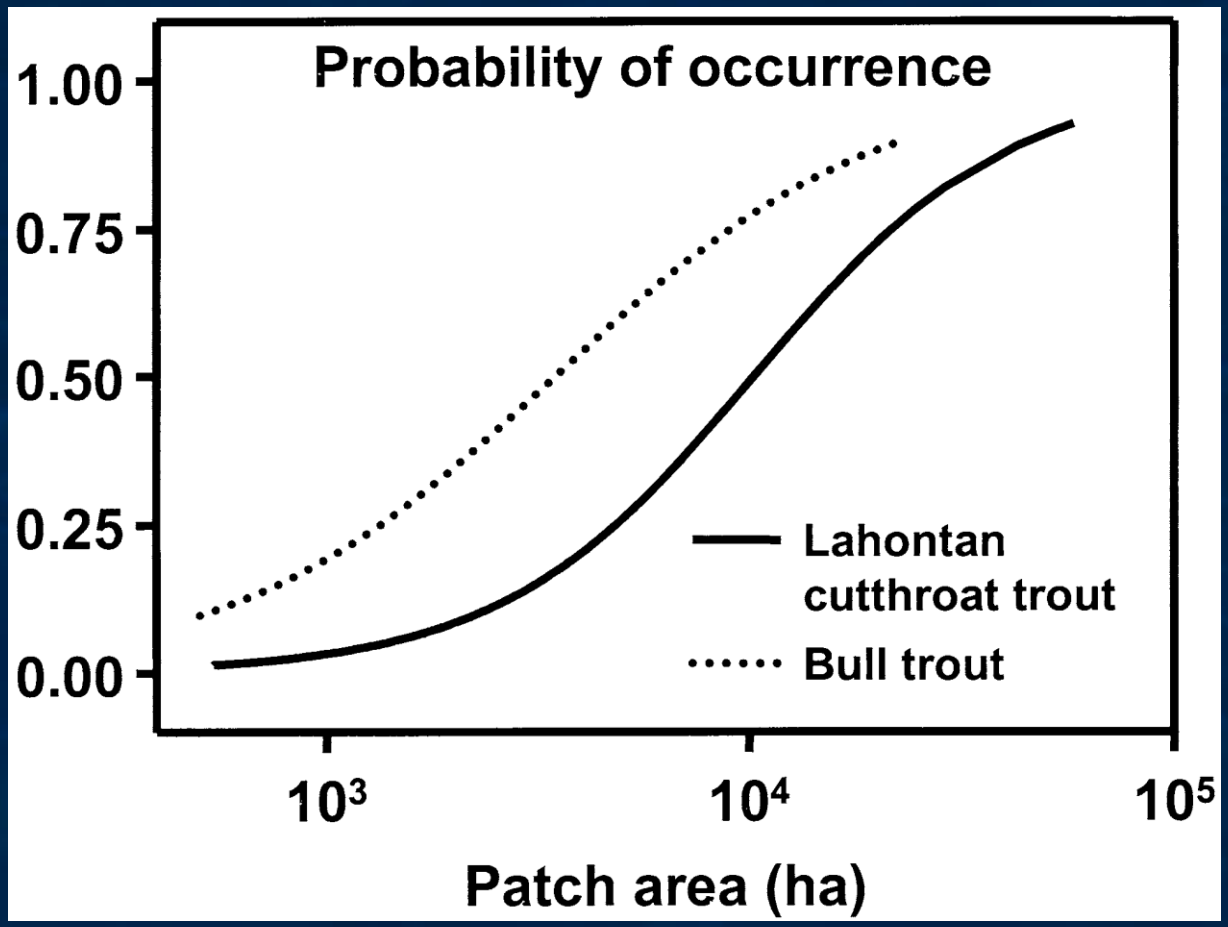
Dunham et al. (2003)

Most populations isolated in small patches



Dunham et al. 2002: Patch-based models of species occurrence: lessons from salmonid fishes in streams

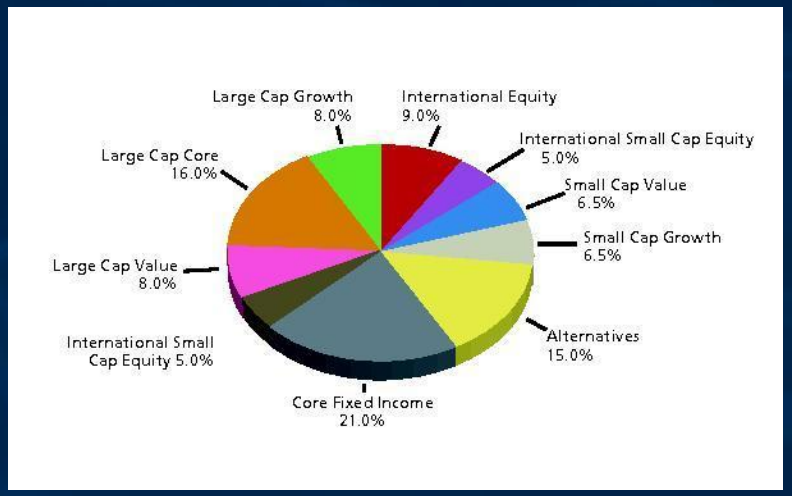
With lower probability of occurrence



Portfolio Theory provides a framework for making conservation goals

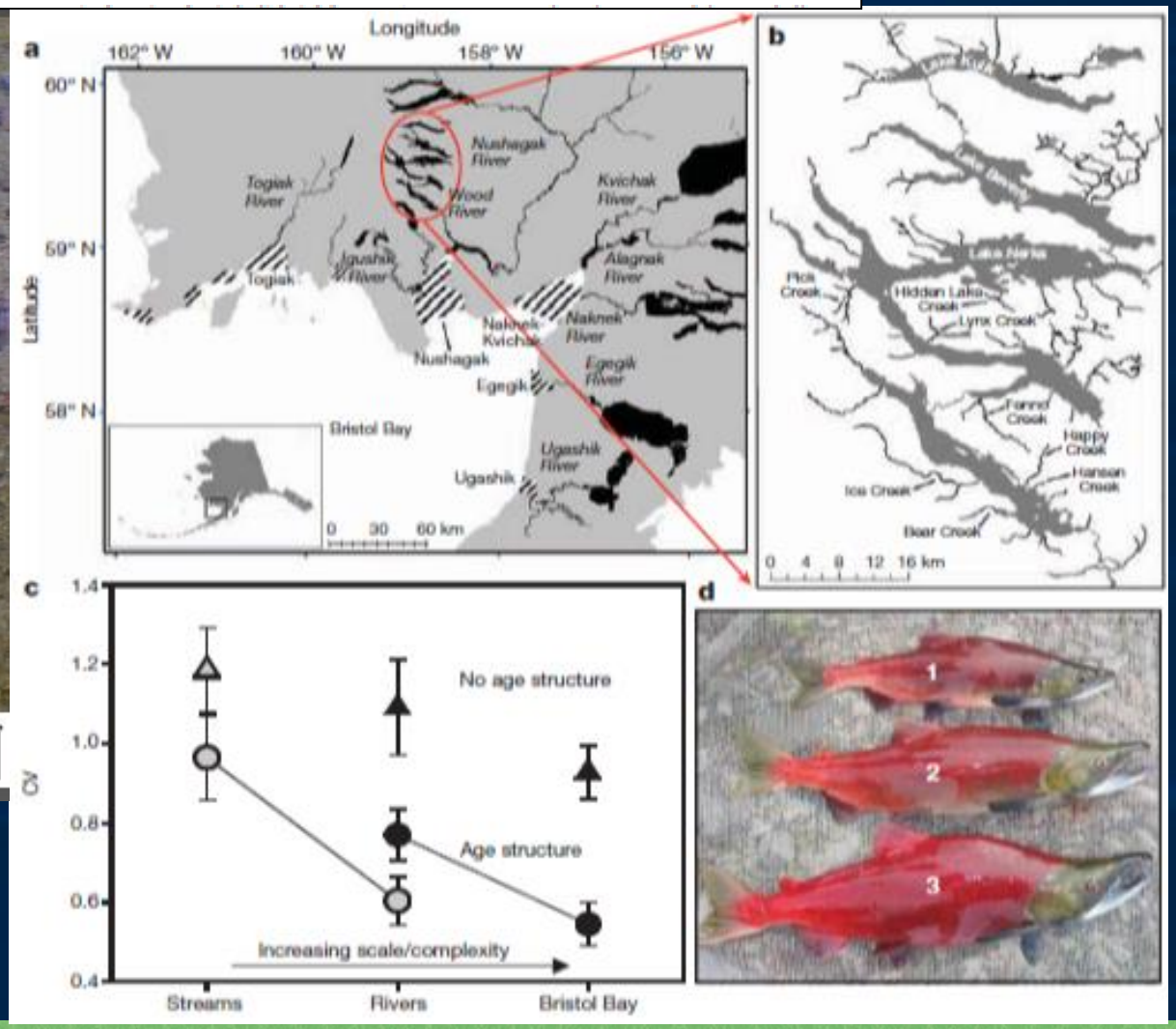
Portfolio Theory

Diversity provides stability and will
increase resistance and resilience of species and ecosystems
to
to environmental change



Population diversity and the portfolio effect in an exploited species

Daniel E. Schindler[1], Ray Hilborn[1], Brandon Chasco[1], Christopher P. Boatright[1], Thomas P. Quinn[1], Lauren A. Rogers[1] & Michael S. Webster[1]



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http://www.tandfonline.com/loi/ujfm20

Spreading the Risk: Native Trout Management in a Warmer and Less-Certain Future

Amy L. Haak [a] & Jack E. Williams [b]

[a] Trout Unlimited, 910 Main Street, Suite 342, Boise, Idaho, 83702, USA

[b] Trout Unlimited, 329 Crater Lake Avenue, Medford, Oregon, 97504, USA

Available online: 01 May 2012

American Fisheries Society Mercer Award for best paper in 2012

What should portfolios for trout look like?

Balanced | **Unbalanced**

Retains historical genetic, life history, and geographic diversity

- Presence of large inter-connected populations
- Populations occupy a variety of habitats (streams, rivers, lakes)
- All life history forms present historically are represented
- Multiple genetically pure populations exist in all historically occupied sub-basins

Has lost historical diversity

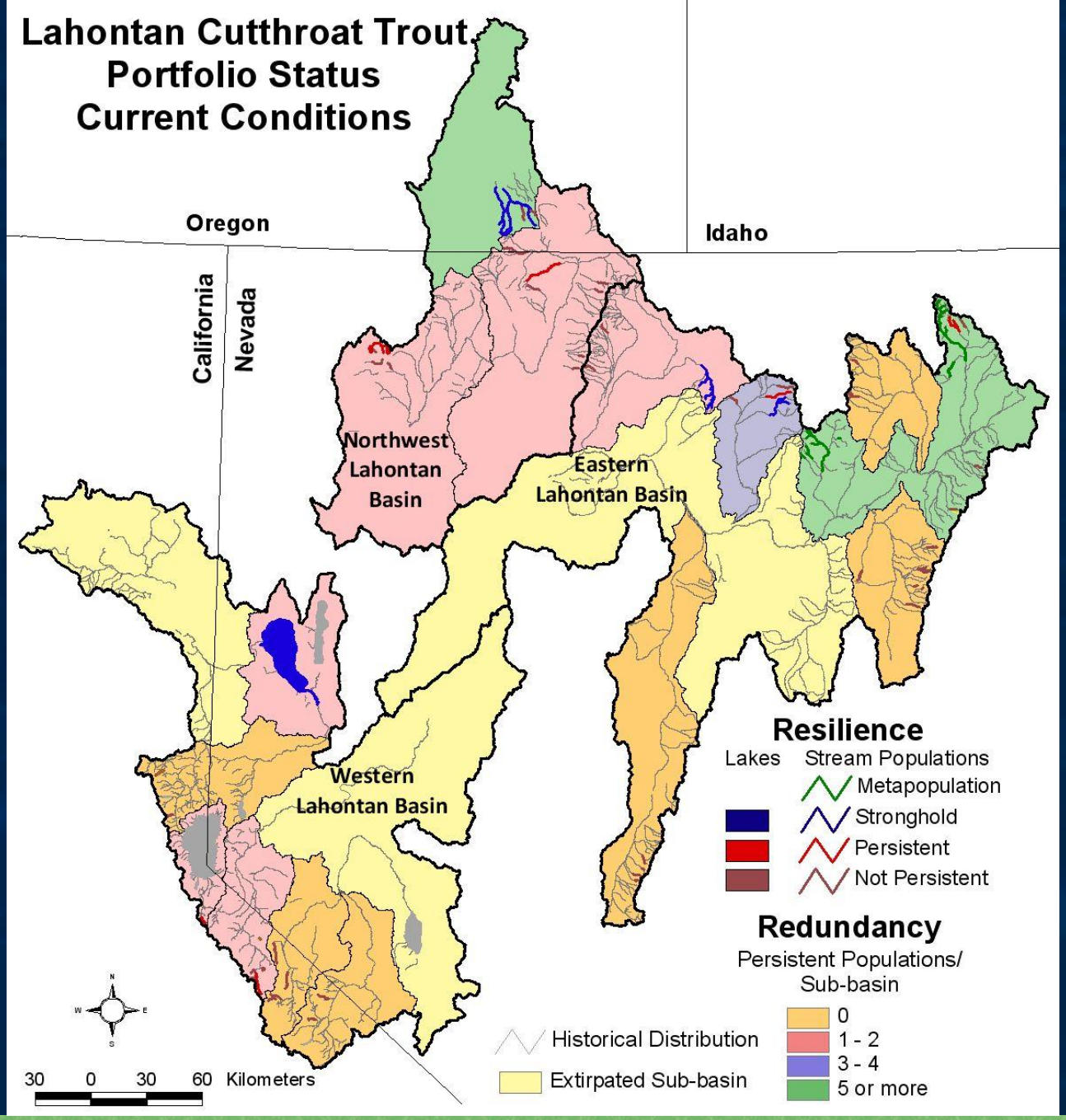
- Small populations
- Minimal connectivity
- Small stream habitats
- No migratory populations
- Reduced geographic distribution

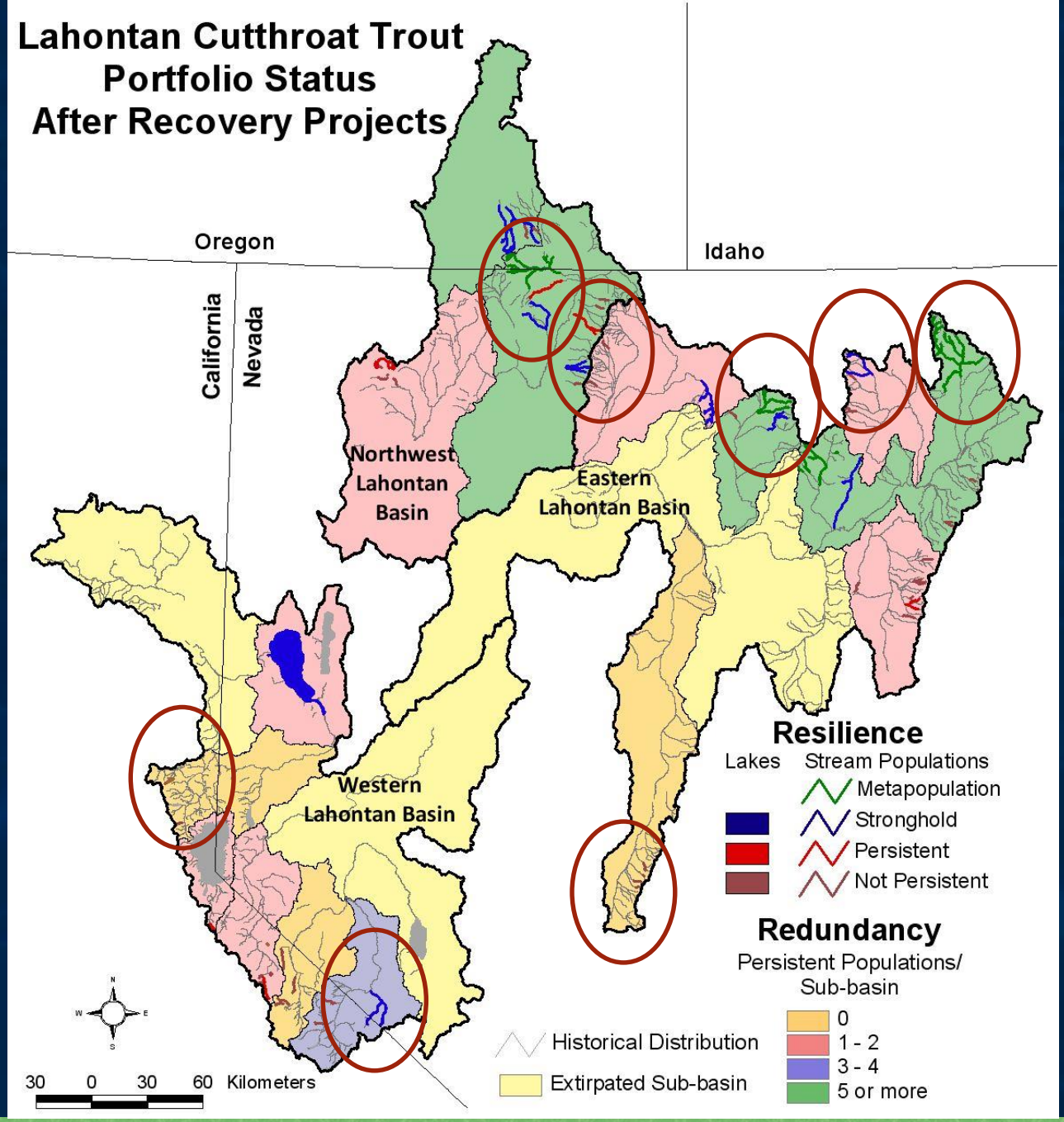
Not possible to restore all historical conditions, but successful management strategies should move species towards a more balanced portfolio.

Once the largest cutthroat trout

"Salmon-trout: 41 lbs world record

We are working to restore large, migratory, resilient systems


Lahontan Cutthroat Trout
Portfolio Status
Current Conditions
Oregon
Idaho
California
Nevada
Northwest Lahontan Basin
Eastern Lahontan Basin
Western Lahontan Basin
Resilience
Lakes
Stream Populations
Metapopulation
Stronghold
Persistent
Not Persistent
Redundancy
Persistent Populations/ Sub-basin
0
1 - 2
3 - 4
5 or more
Historical Distribution
Extirpated Sub-basin
30 0 30 60 Kilometers

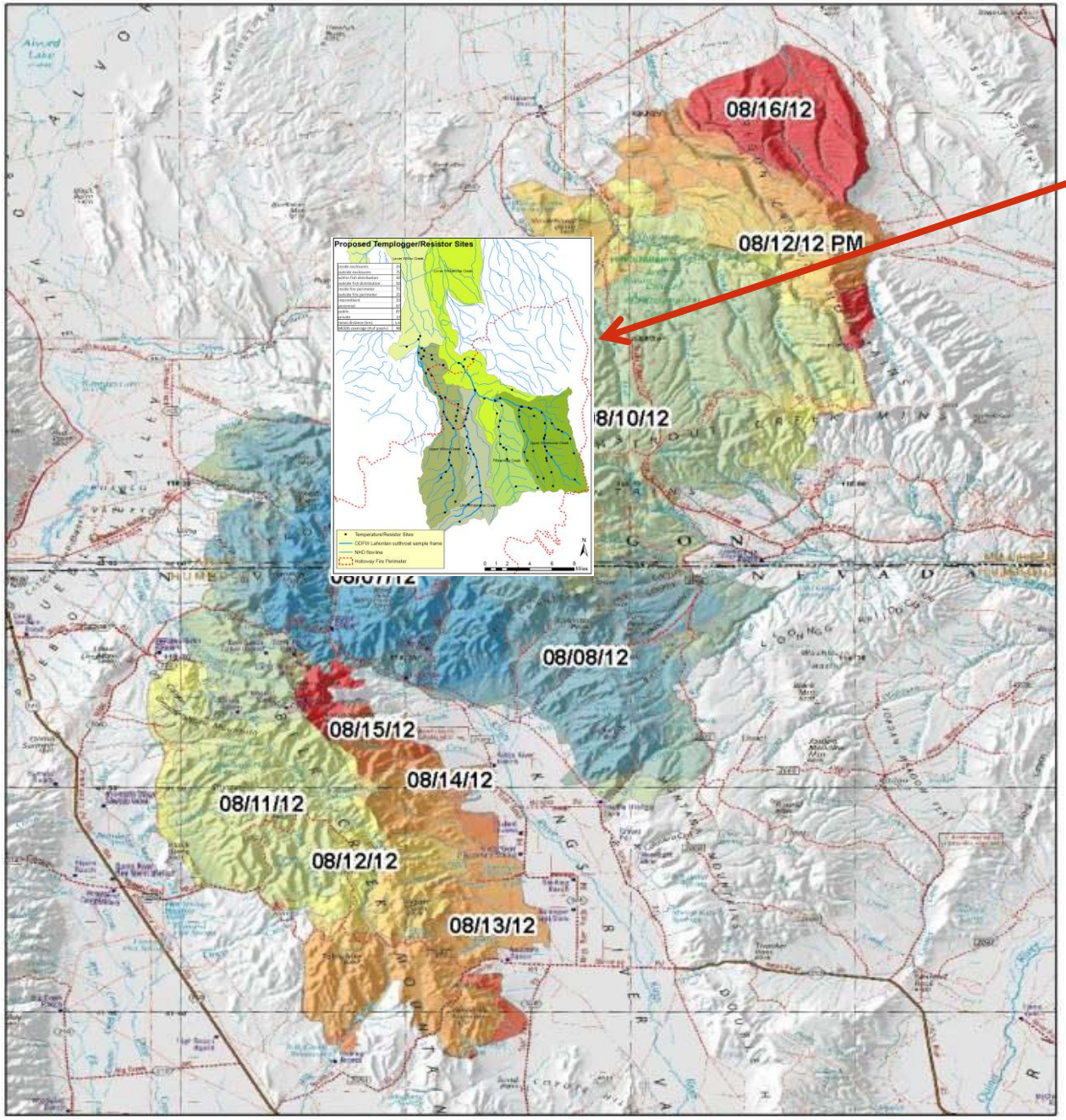

Lahontan Cutthroat Trout
Portfolio Status
After Recovery Projects
Oregon
Idaho
California
Nevada
Northwest
Lahontan
Basin
Eastern
Lahontan Basin
Western
Lahontan Basin
Resilience
Lakes
Stream Populations
Metapopulation
Stronghold
Persistent
Not Persistent
Redundancy
Persistent Populations/
Sub-basin
0
1 - 2
3 - 4
5 or more
Historical Distribution
Extirpated Sub-basin
30 0 30 60 Kilometers

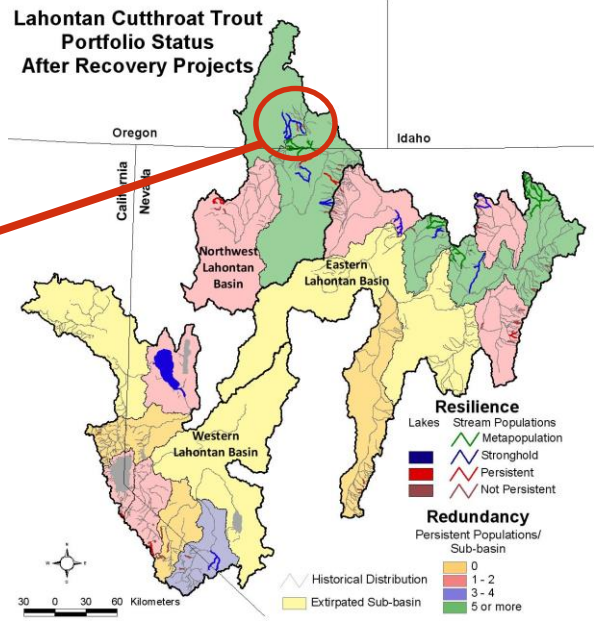
Strategies for restoring resiliency range-wide

- **Reduce stressors that exacerbate effects of disturbances, like fire and climate change:**
  - Restore habitat, improve flows
    - Grazing, diversions
  - Remove non-natives (and protect habitats)
- **Build resiliency and redundancy:**
  - Reconnect habitat – strongholds/metapopulations
  - Reintroduce populations

Fire

- Over 2 million acres burned across the Great Basin in 2012 alone: big disturbance
- 460,000+ acre Holloway fire in Oregon ripped through one the few – and largest – interconnected stream systems remaining for Lahontan cutthroat trout





Encompassed almost entirety of one of our largest interconnected LCT populations

10/27/2012 10:56

10/09/2012 10:00

10/16/2012 13:17

Beaver ponds provided refuge

10/10/2012 10:10

Wildfire Management Alternatives

WWH

Alternative	Assessment
Pre-fire management •Population resilience •Fuels management	Proactive – general improvement in ecosystem integrity
Manage during the fire	Reactive – does not address ecosystem, only fire
Post fire management	Reactive – may be too late to deal with post fire disturbance
Fire monitoring and research	Great in theory, and hopefully getting better in practice

Dunham et al. (2003)

Changing the context elsewhere:

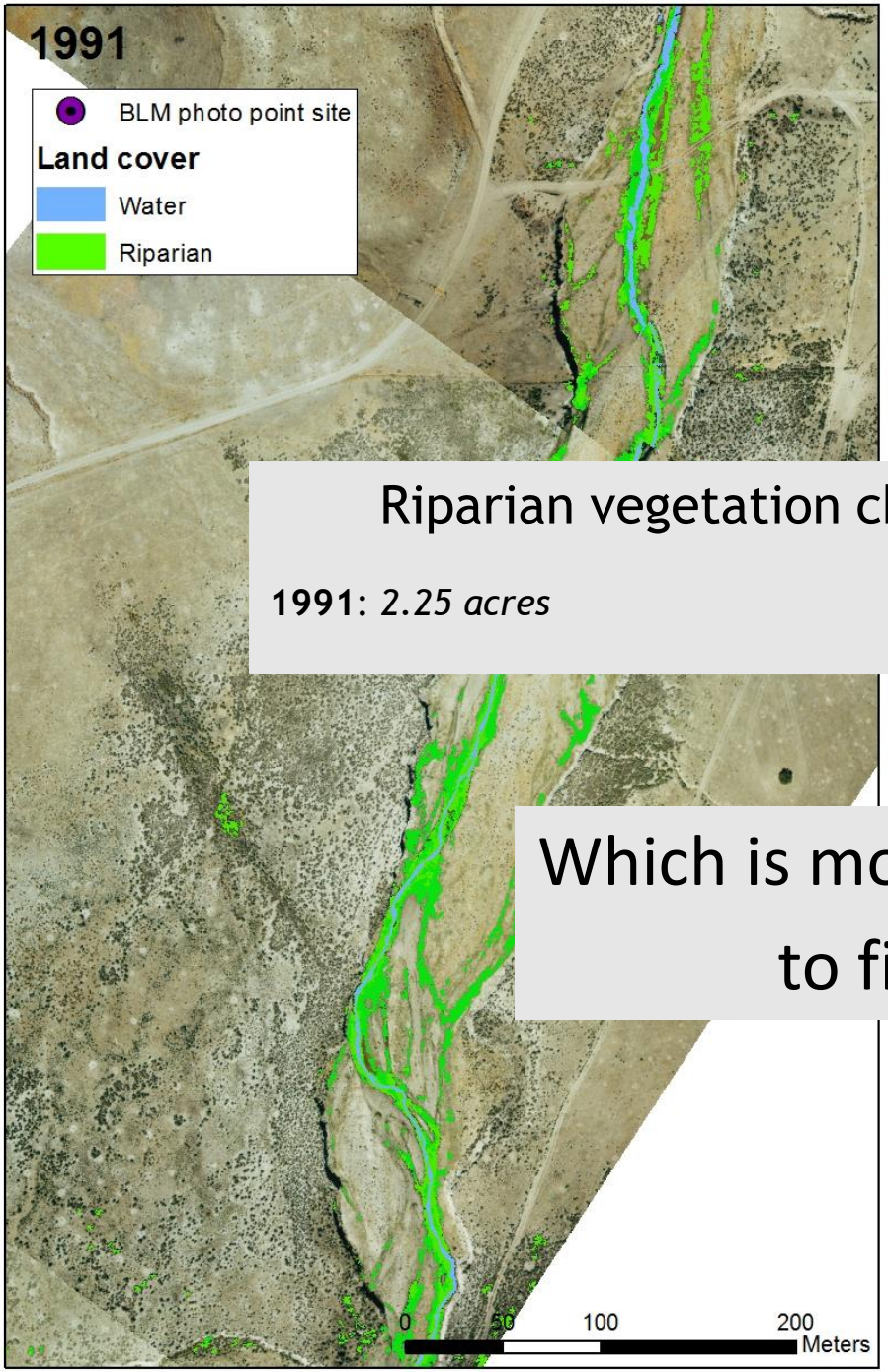
Susie Creek, NV

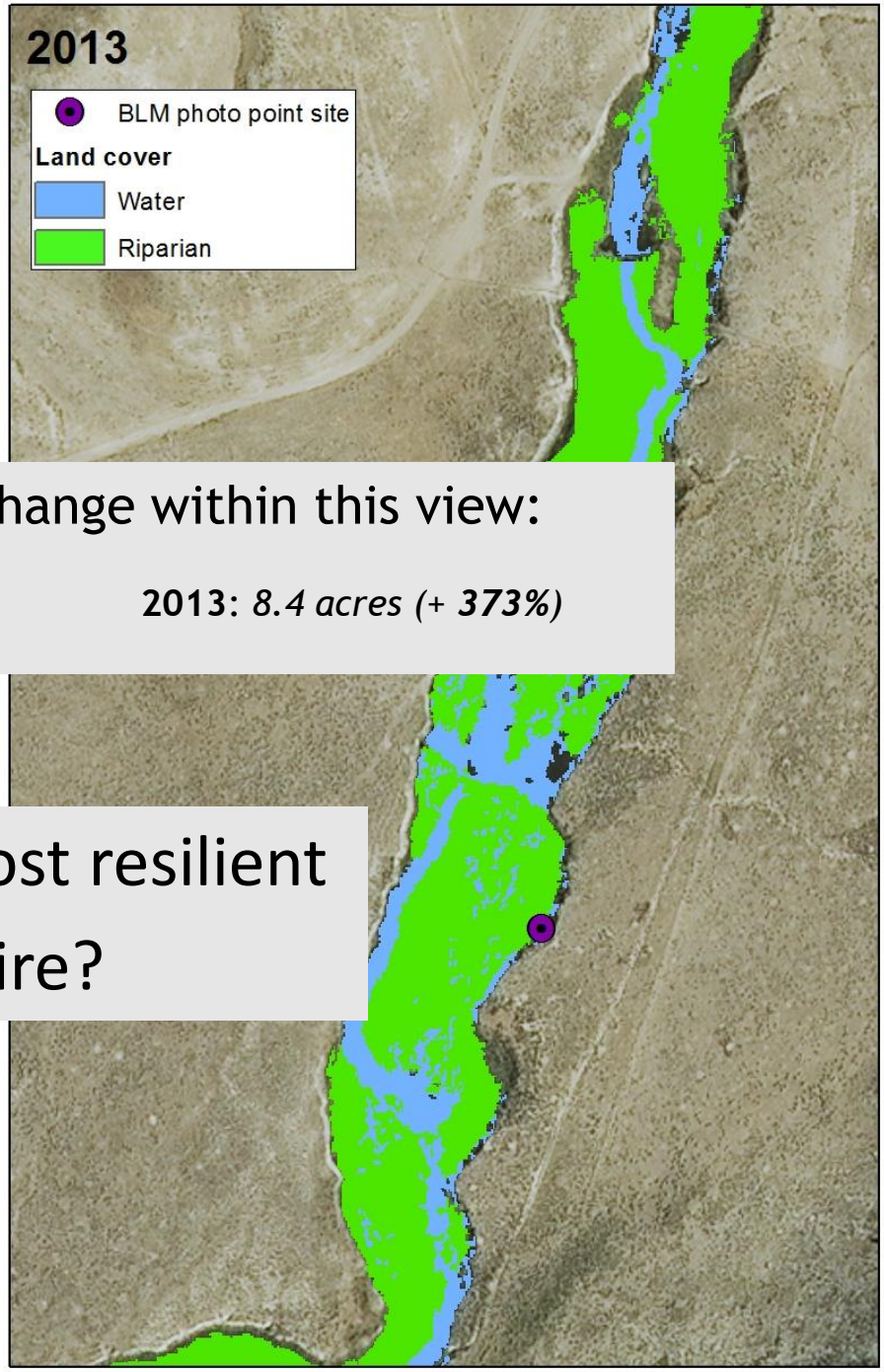
Changes from prescriptive grazing Practices: Elko BLM and private partners

Grazing changed from annual hot season use to spring (April-May) and fall (October-November) use by cow-calf pairs

1991
VIEW
0
50
100
200
Meters

2014
VIEW





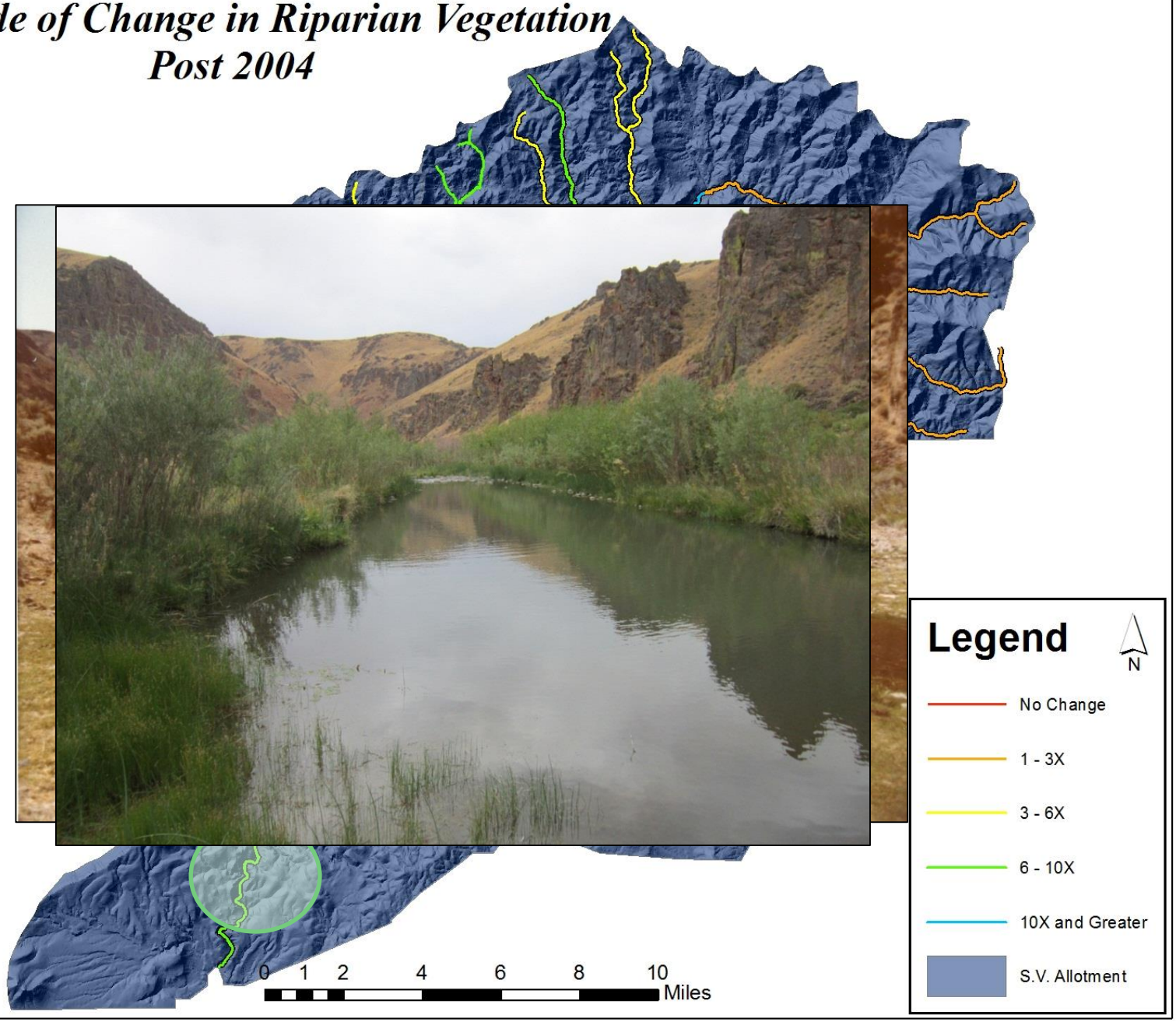
Riparian vegetation change within this view:

1991: *2.25 acres*

2013: *8.4 acres (+ **373%**)*

Which is most resilient to fire?

Magnitude of Change in Riparian Vegetation Post 2004

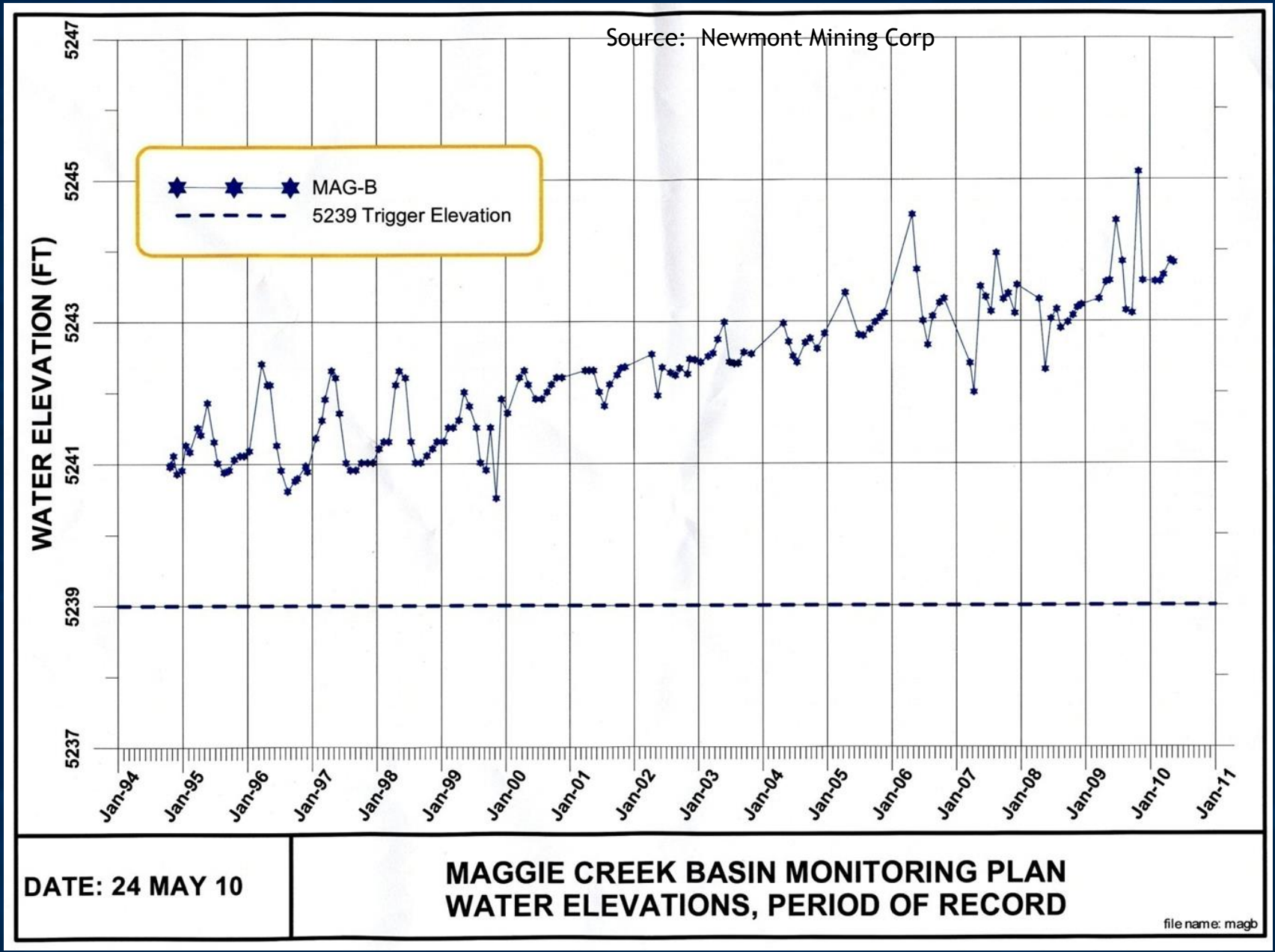


LCT monitoring, Maggie creek

- Maggie Creek Watershed Restoration Project: Habitat restoration since 1993 showing significant improvements

Elko BLM

The number of beaver dams increased from 107 in 2006 to 271 in 2010



2 foot increase in groundwater

Remote Sensing Projects – Elko District, BLM

Quantifying Change in Riparian Vegetation in Response to Prescriptive Livestock Grazing Over Time and at a Watershed Scale

Project	Livestock Management Change	Imagery	Riparian Vegetation (acres)[1]				Approx. Acres Increase Since Management Change
			1972-78	1991-98	2006	2010-13	
Marys River[2] (ORC 2011)	Early 90's	Landsat	6805	6564	8429*	8682	**2118**
Squaw Valley Allotment[2] (ORC 2015)	2003	NAIP, BLM Imagery	452	325		819	**494**
Maggie Creek Watershed Restoration Area[2] (ORC 2009)	Early 90's	94 CIR and 2006 NAIP CIR		716	1532		**816**
Maggie Basin (White Horse Associates 2011)	Early to mid 90's	NAIP			520[3]	706[3]	**186**
Susie Basin (Trout Unlimited 2015)	Early 90's to 2007	NAIP, BLM imagery		164		234	**70**

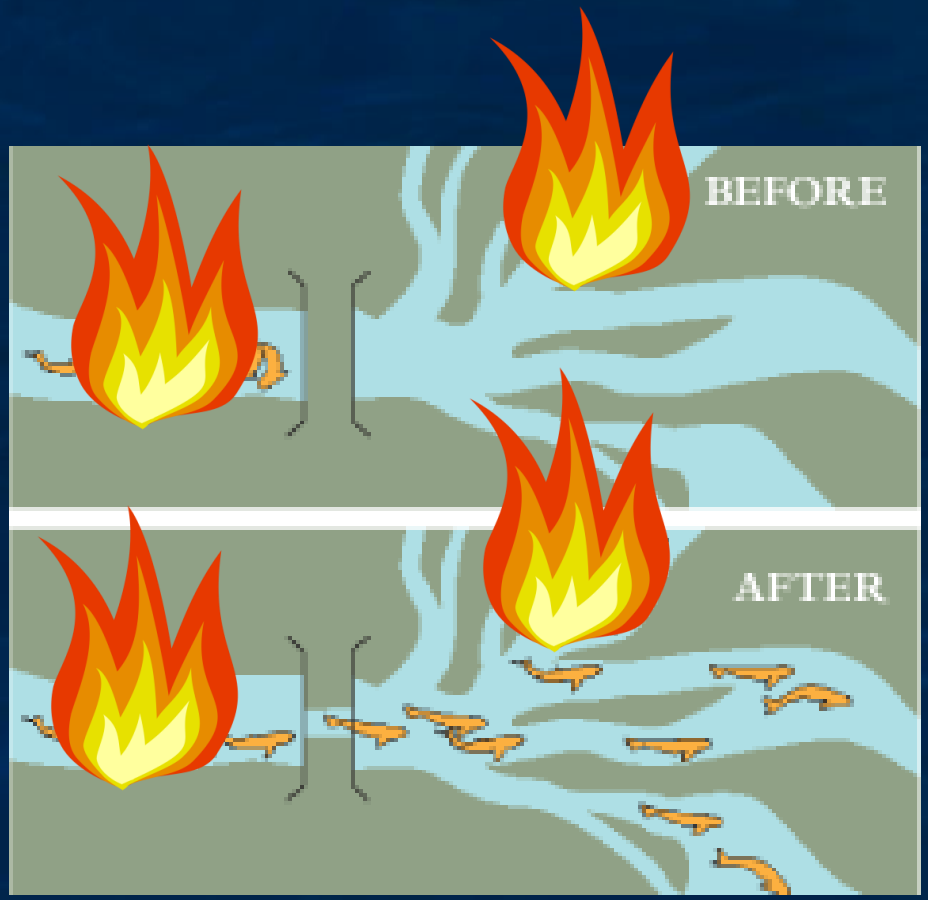
[1]Includes herbaceous and woody riparian vegetation.
[2]Includes riparian vegetation within defined "potential riparian area".
[3]Includes water/marsh vegetation.

TROUT UNLIMITED

Courtesy of Carol Evans

Better riparian habitat and more water = resiliency in the face of fire

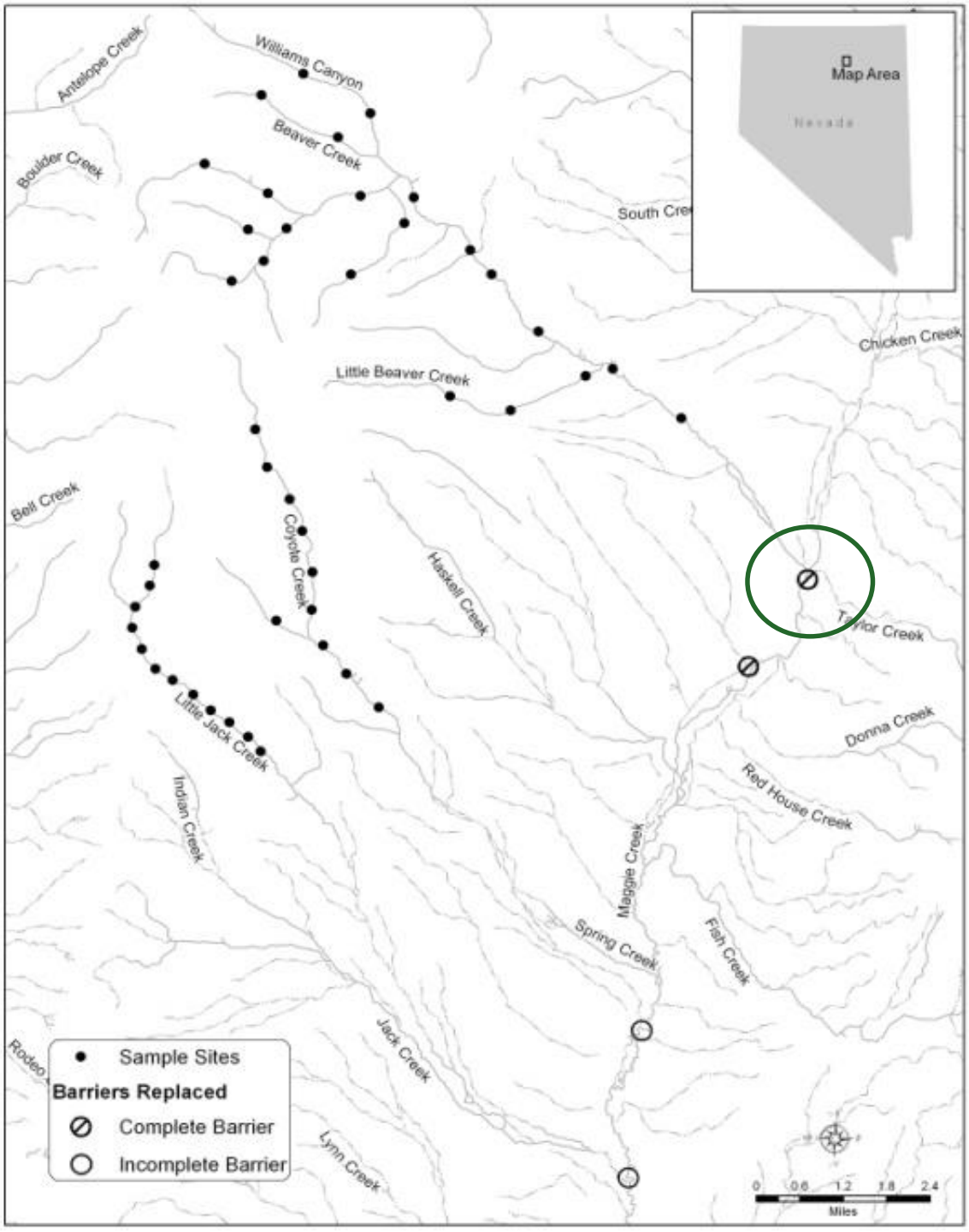
But fish have to be able to access the refugia…



Maggie Creek: culverts remediated in 2005

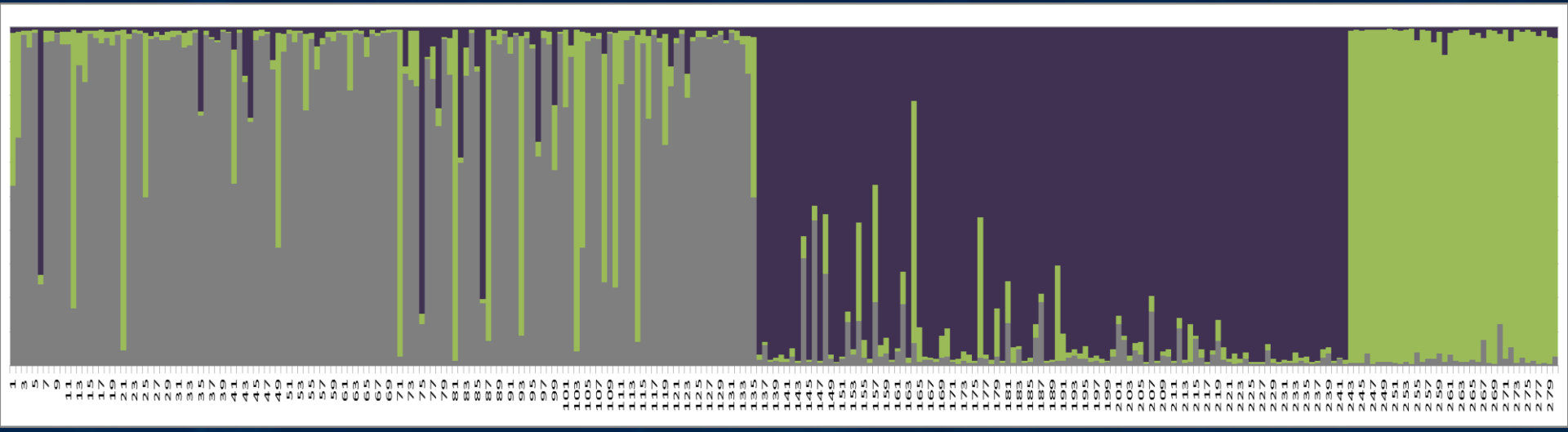
→

- TU has sampled fish from 44 sites since 2001 ('before-after')
- Demographic, genetic, and fish movement data

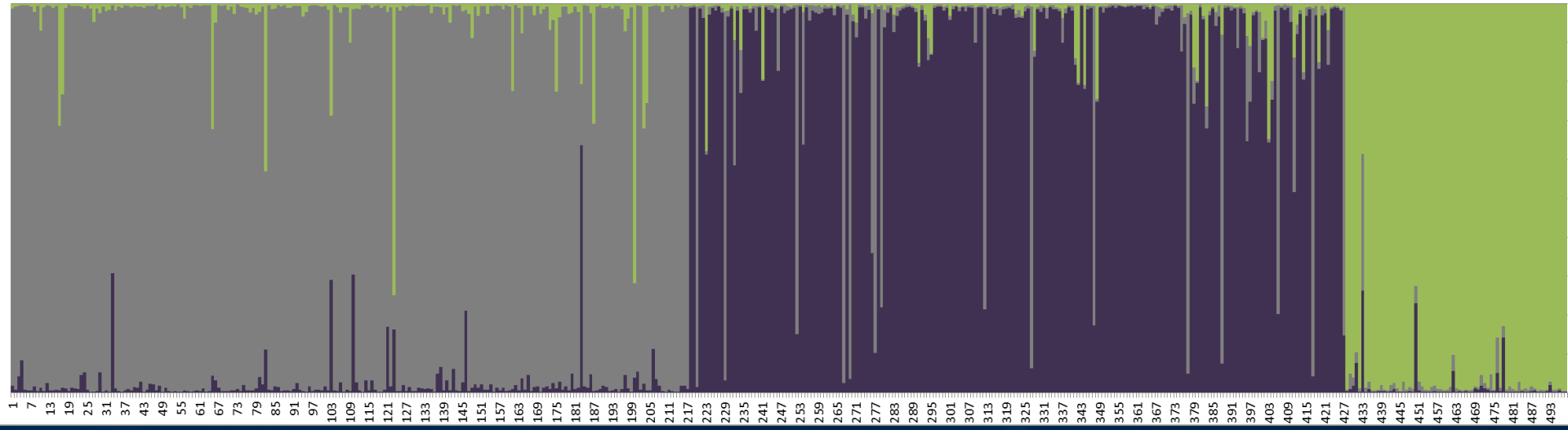


Genetic results confirm movement

2009

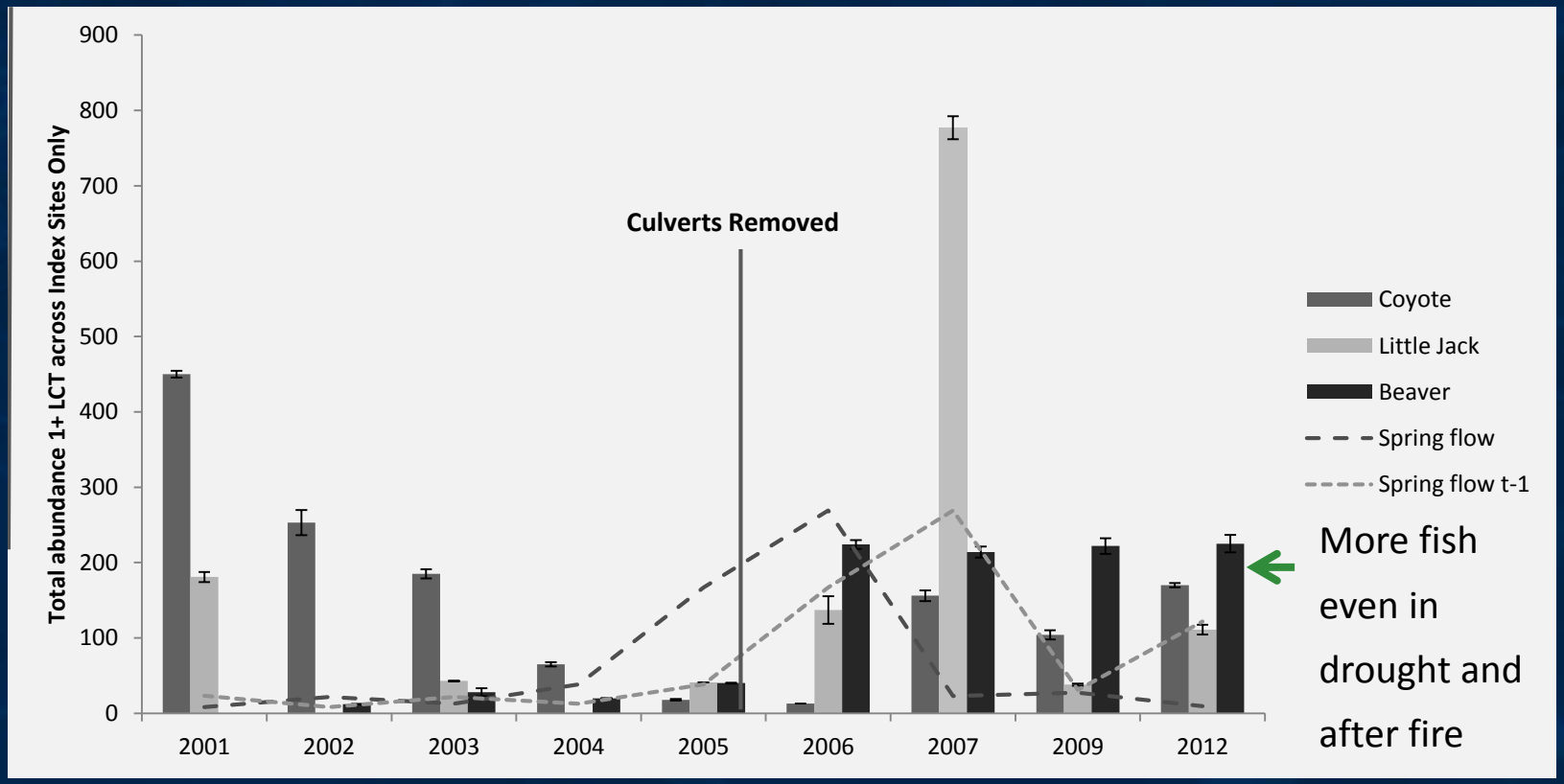


2012



Beaver Coyote LJ

Maggie Creek

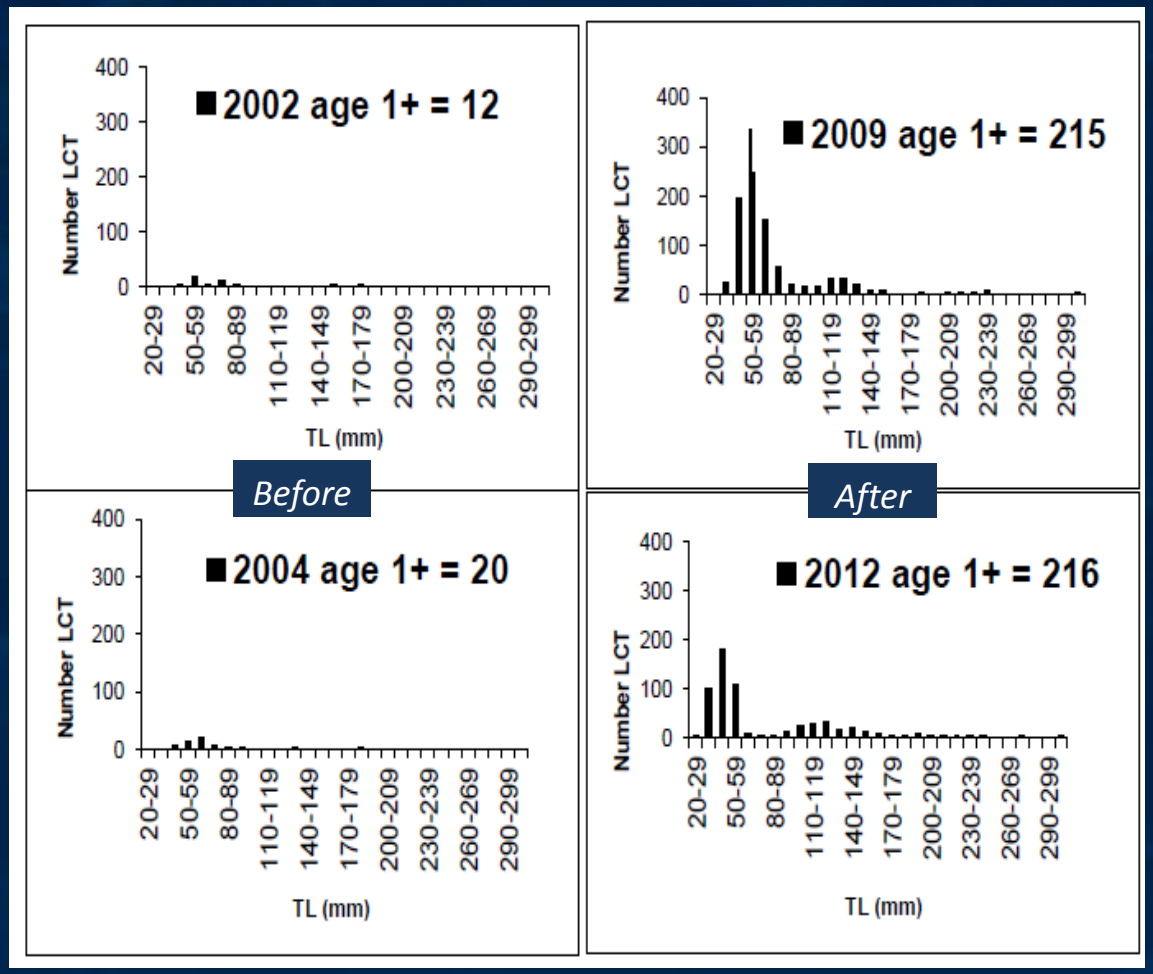


Fire

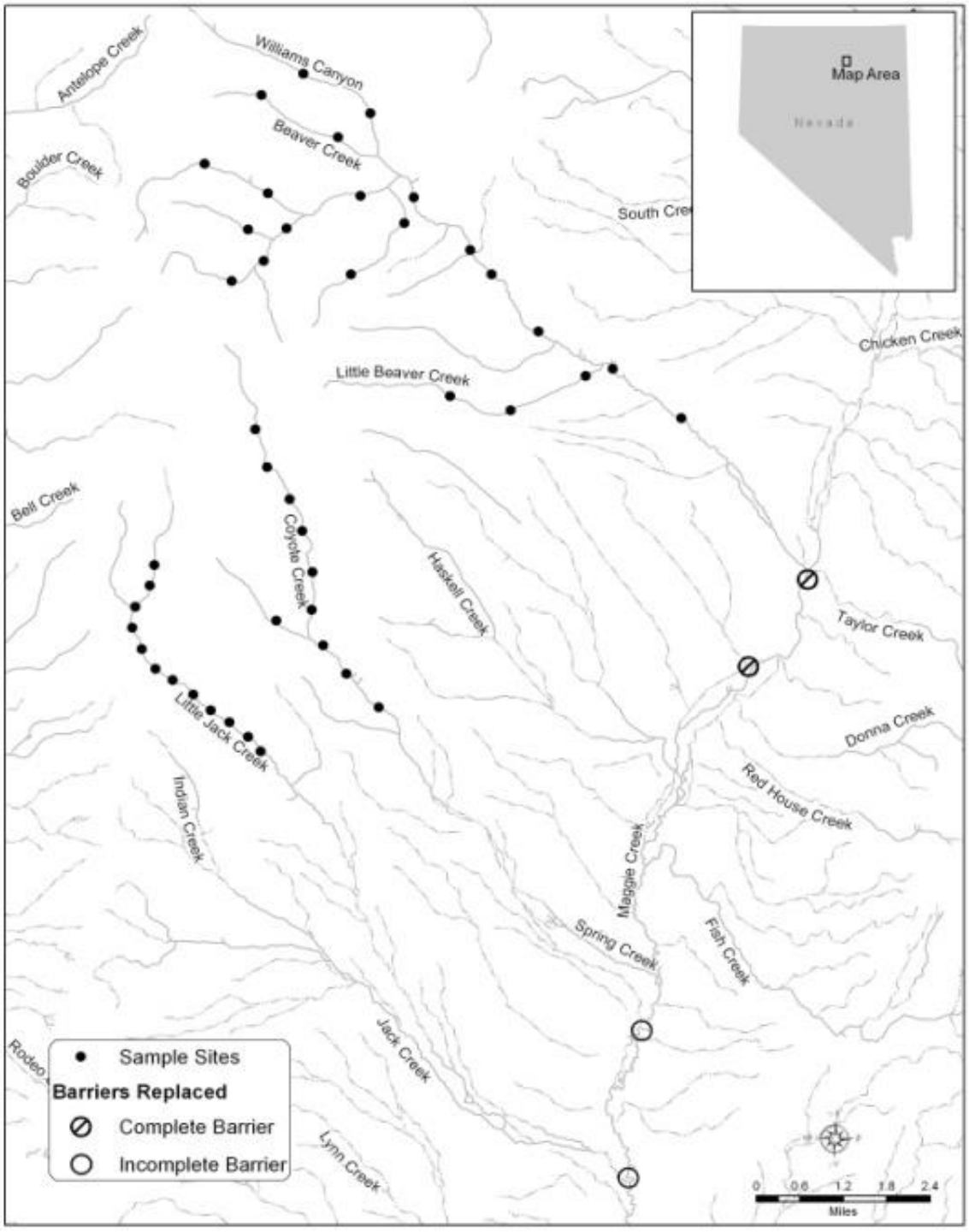
Fire

We are seeing more fish and more large fish, even during drought and fires

Beaver creek



Protected entire population from nonnative invasion (way down off map)



The human dimension of increasing resiliency:

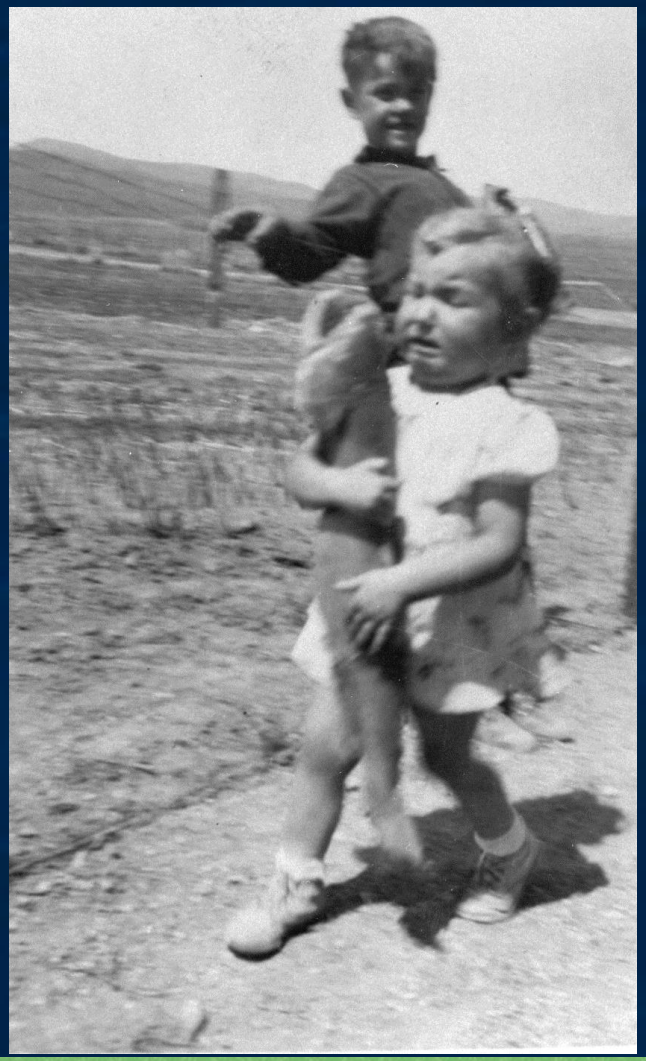
- **Most progress to date on public lands: 'low hanging fruit'**
- **~50% of historic LCT range on private land**
  - Represents huge future opportunity
- **LCT are ESA listed – who wants them on their land?**
- **Safe Harbor agreements as key strategy**
- **Through NFWF program, TU funds 100% of an NDOW SHA biologist to implement agreements**

Safe Harbor Agreements

- 76 streams with private land, SHA needs
- Facilitating major restoration and reintroduction projects
- Helping to build good will in a contentious landscape and better prepare ranchers for the future:

"Thanks to this restoration work, and those beavers that 20 years ago we would have killed, we had water this year where I'm sure we wouldn't have otherwise" -
Jon Griggs, Maggie Creek Ranch

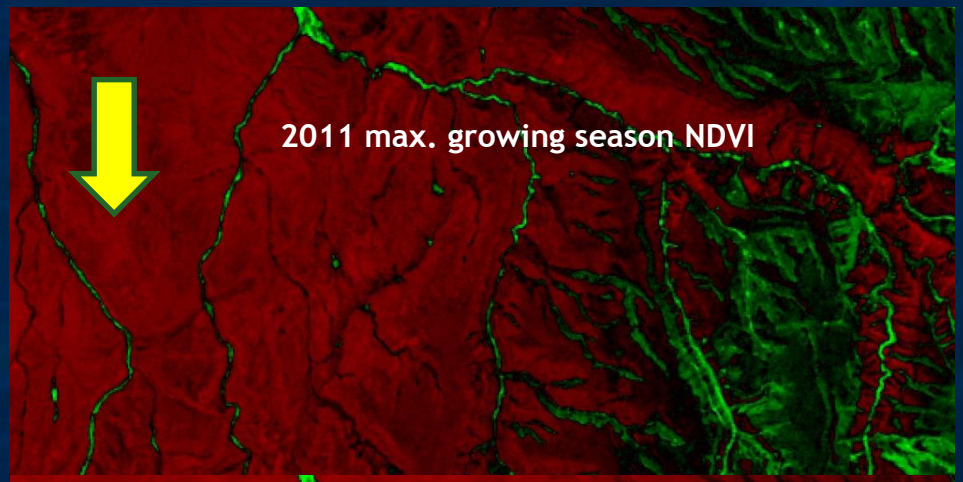
Questions?

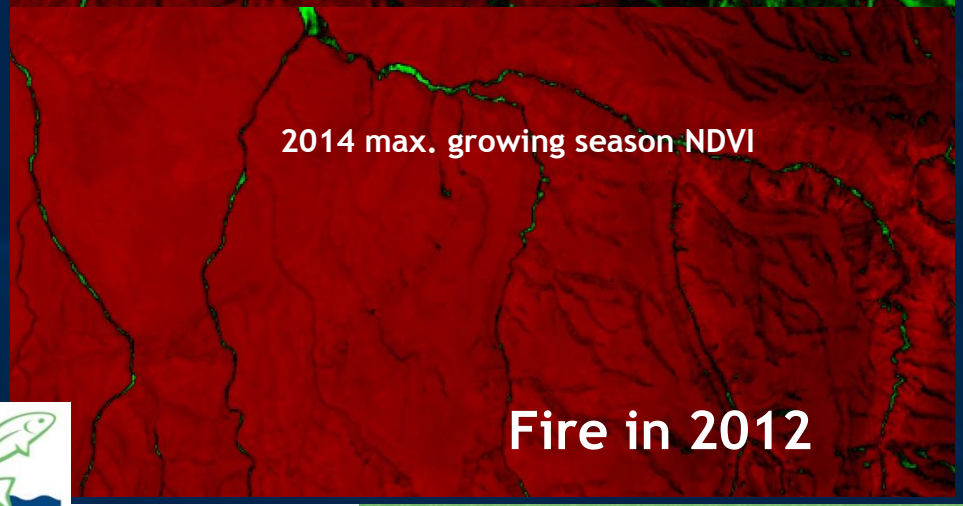


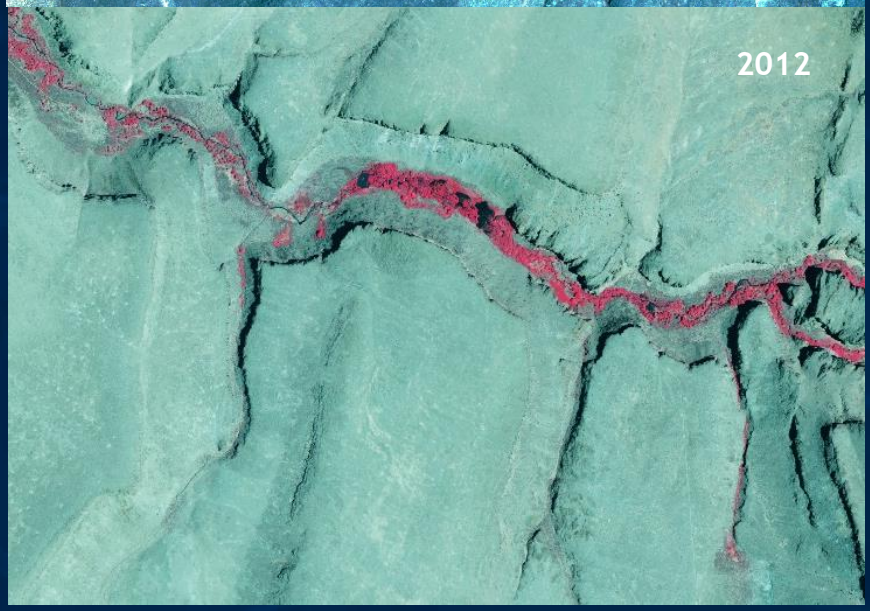
Aerial and satellite imagery analysis with BLM for Willow-Whitehorse Creeks, OR

Aerial photos: 1983, 1995, 2005, 2009, 2014 (post-fire)

Satellite imagery: 1985-2015

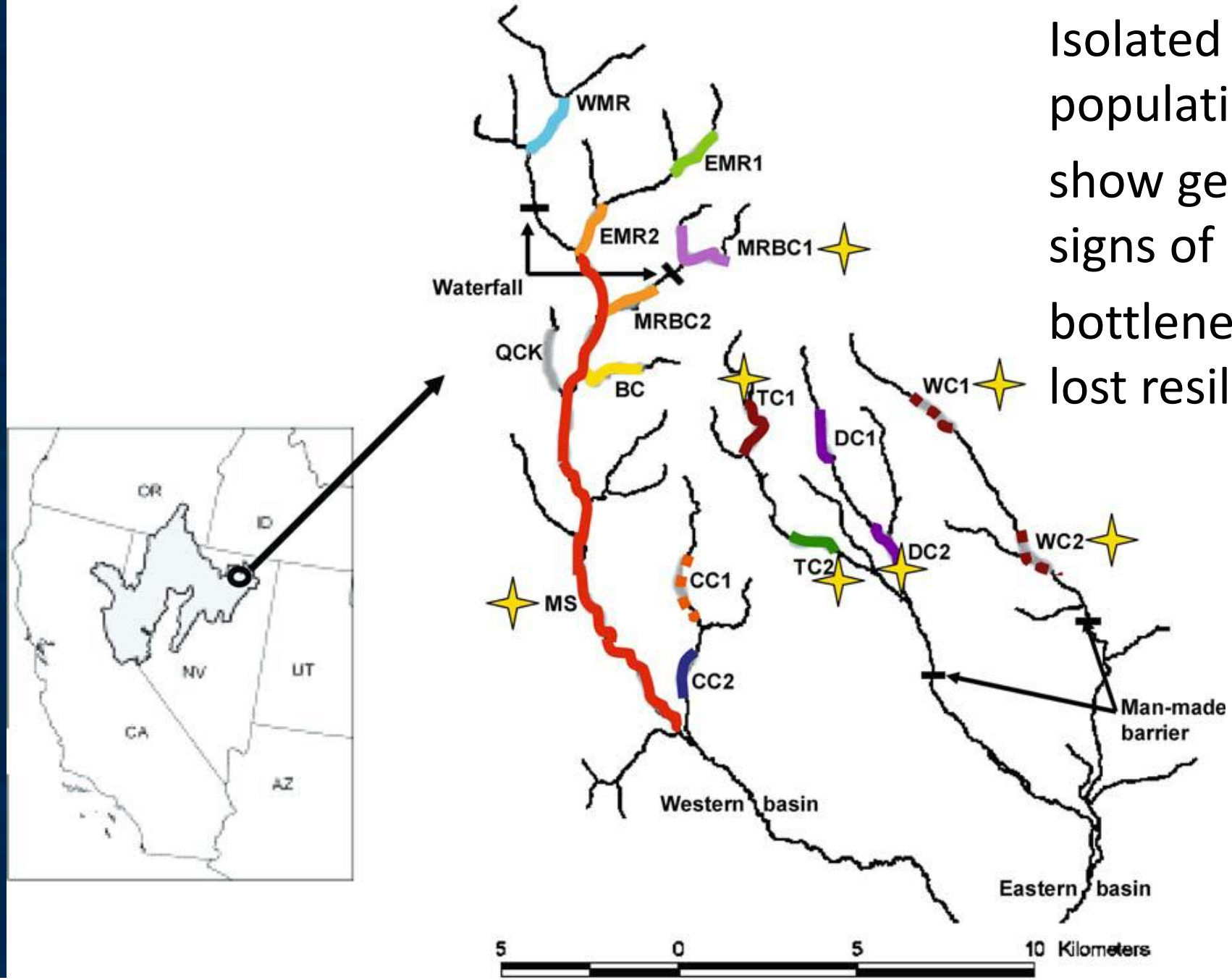






TROUT UNLIMITED

Isolated populations show genetic signs of bottlenecks = lost resiliency



Neville, Dunham and Peacock 2006, Landscape Ecology, 21: 901-916