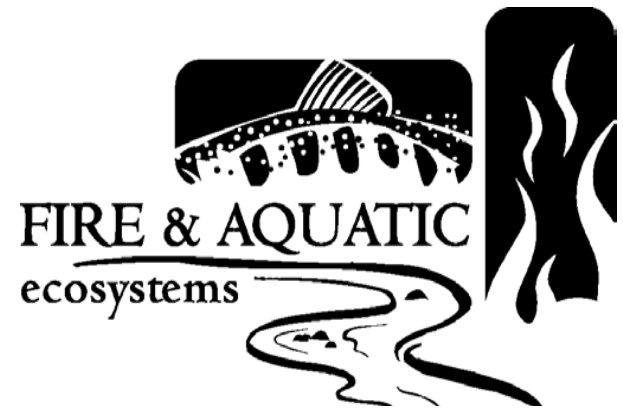


Perspectives on persistence of native fish and nonnative fish invasions in fire-prone landscapes

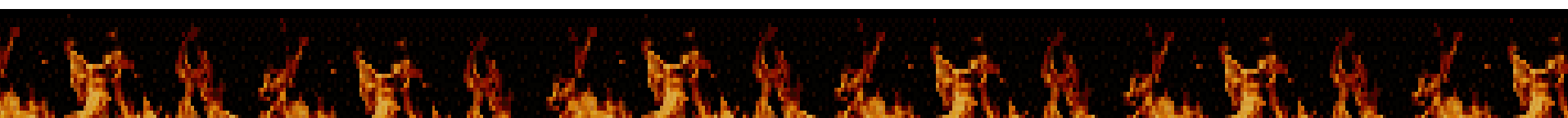
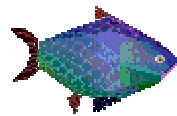


Jason Dunham, RMRS - Boise

Mike Young, RMRS - Missoula

Bob Gresswell, USGS - Corvallis

Bruce Rieman, RMRS - Boise



Fire and Fish: Management Issues

How can fire affect fish?

What scales are relevant?

**When and where does fire or
fire management pose a threat?**

**Do fires facilitate invasions of
nonnative fishes?**

**What management alternatives
are most likely to benefit fish?**

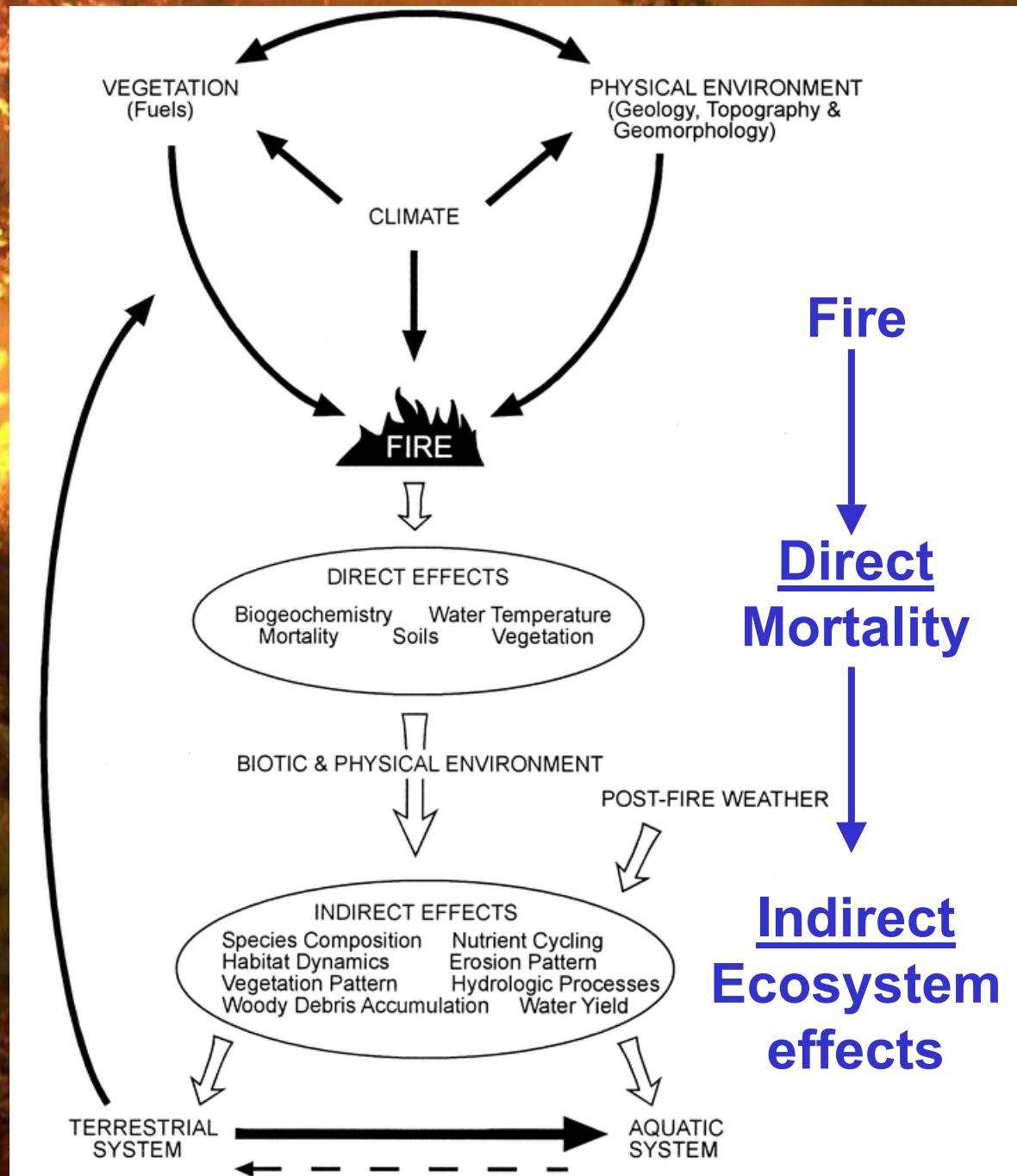
Photo: Clear Creek Fire 2000, Salmon-Challis NF



How can fire affect fish?

Direct and indirect pathways

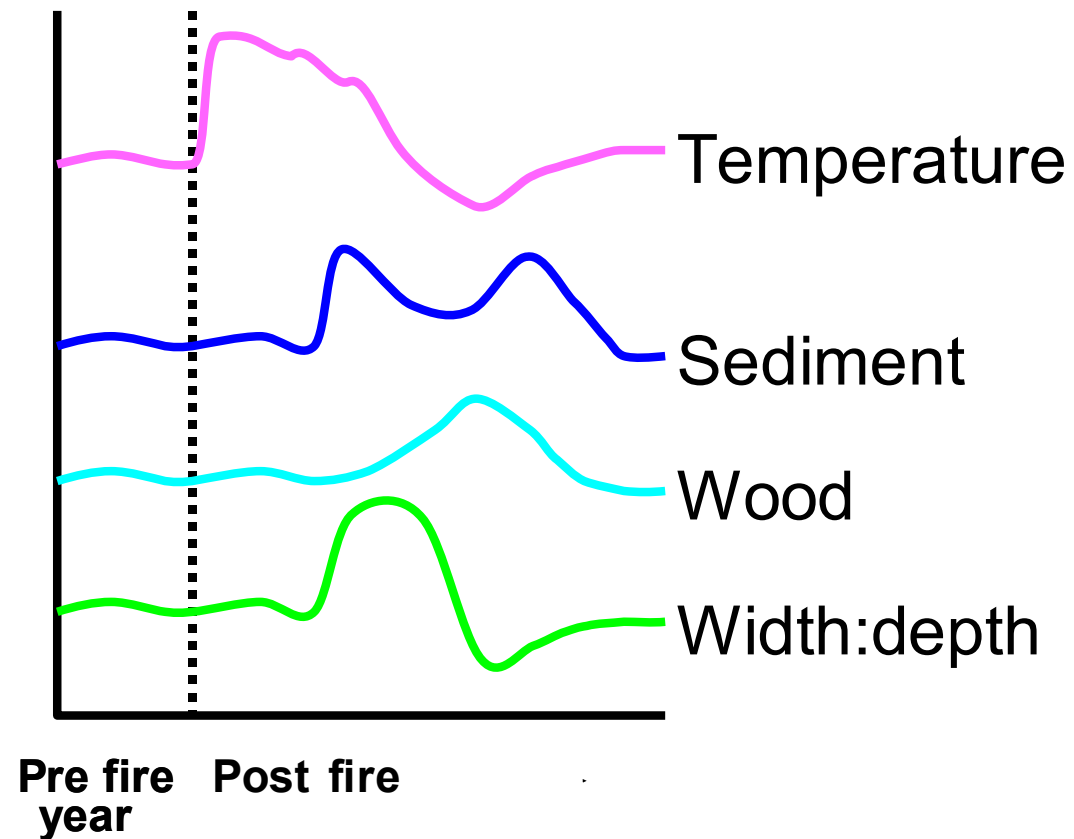
(Gresswell 1999)



How can fire affect fish?

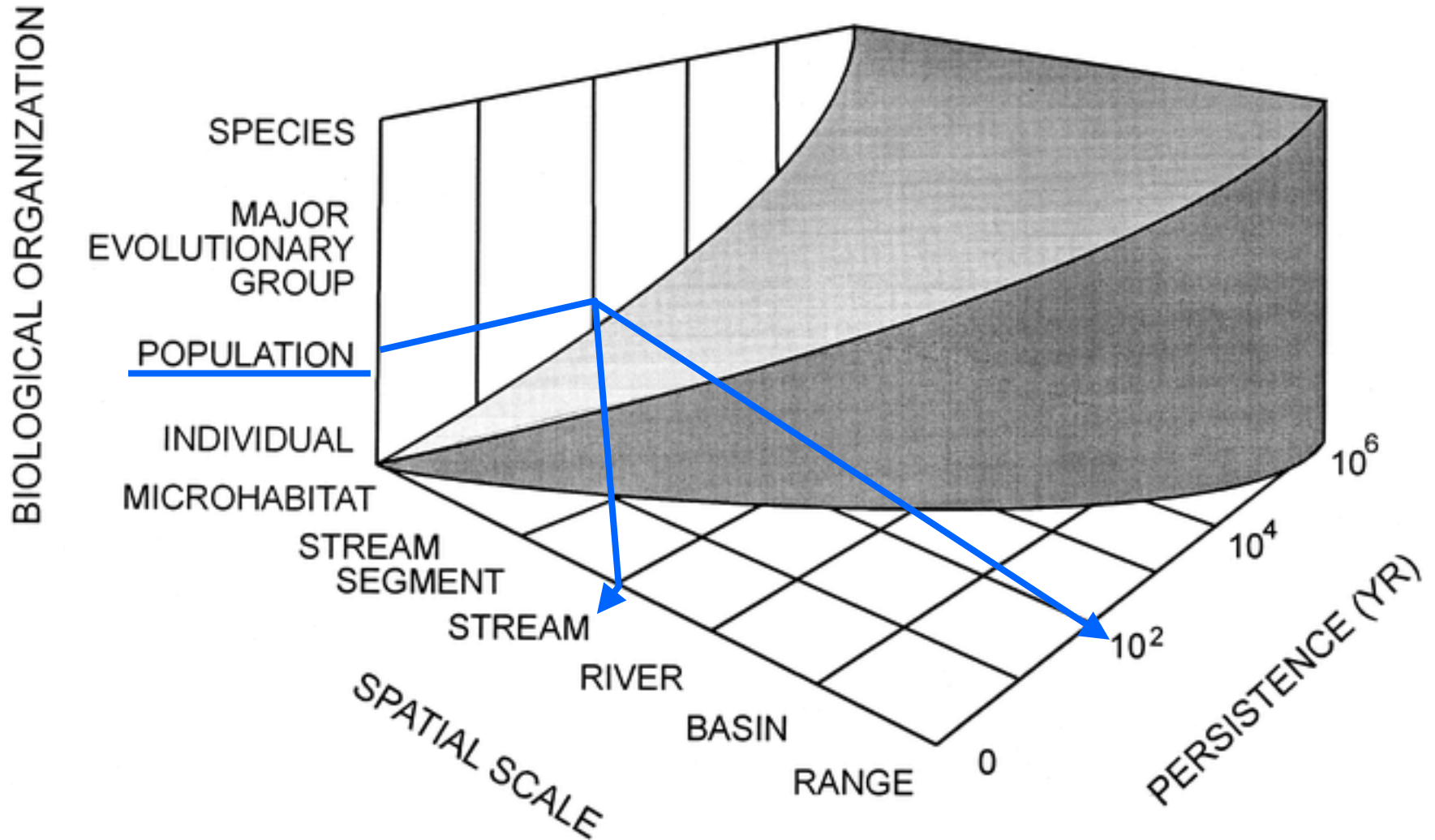
Short and long-term effects

(Minshall et al. 1976; 2001; Gresswell 1999)



What scales are relevant?

Populations are the basic units of conservation



(Currens et al.; Gresswell 1999)



What scales are relevant?

Aquatic ecosystems and fish habitat

“Traditional views” → “Emerging views”

Small-scale

Habitat conditions

Static view

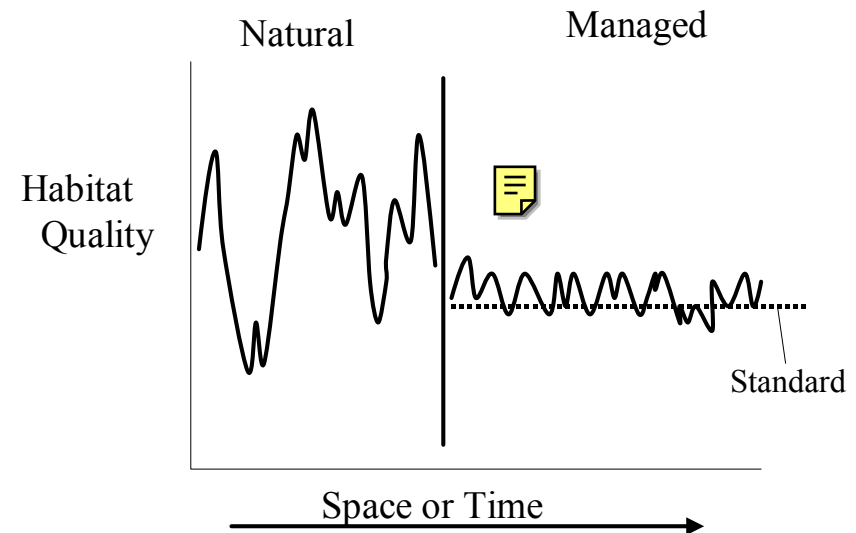
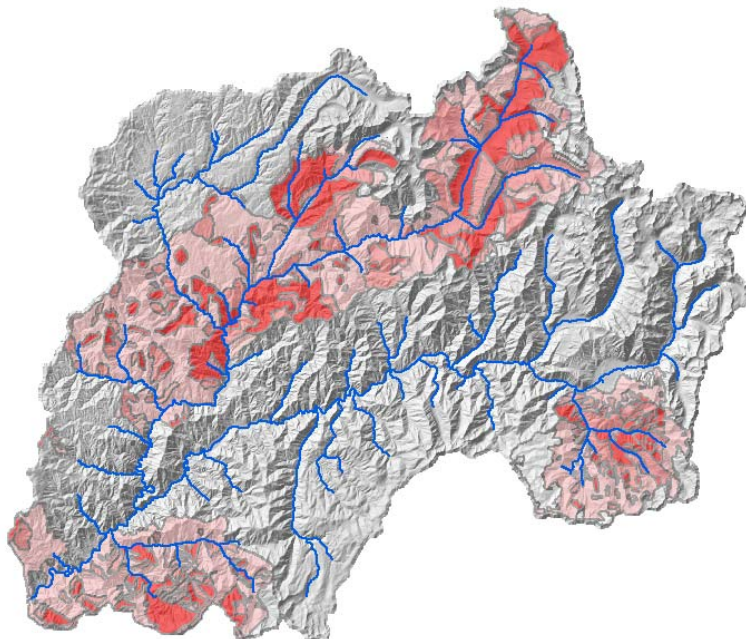
Threshold standards

Multi- and larger scales

Habitat forming processes

Dynamic view

Distribution of conditions



When and where does fire pose a threat to fish population *persistence*?

Hypothesis: Vulnerability to fire is conditioned on three interrelated factors:

- 1. Disturbance**
- 2. Habitat fragmentation**
- 3. Life history diversity**



Disturbance – Indirect effects of fire

Postfire debris flows and flooding in small streams are most widely recognized as the biggest threat to fish



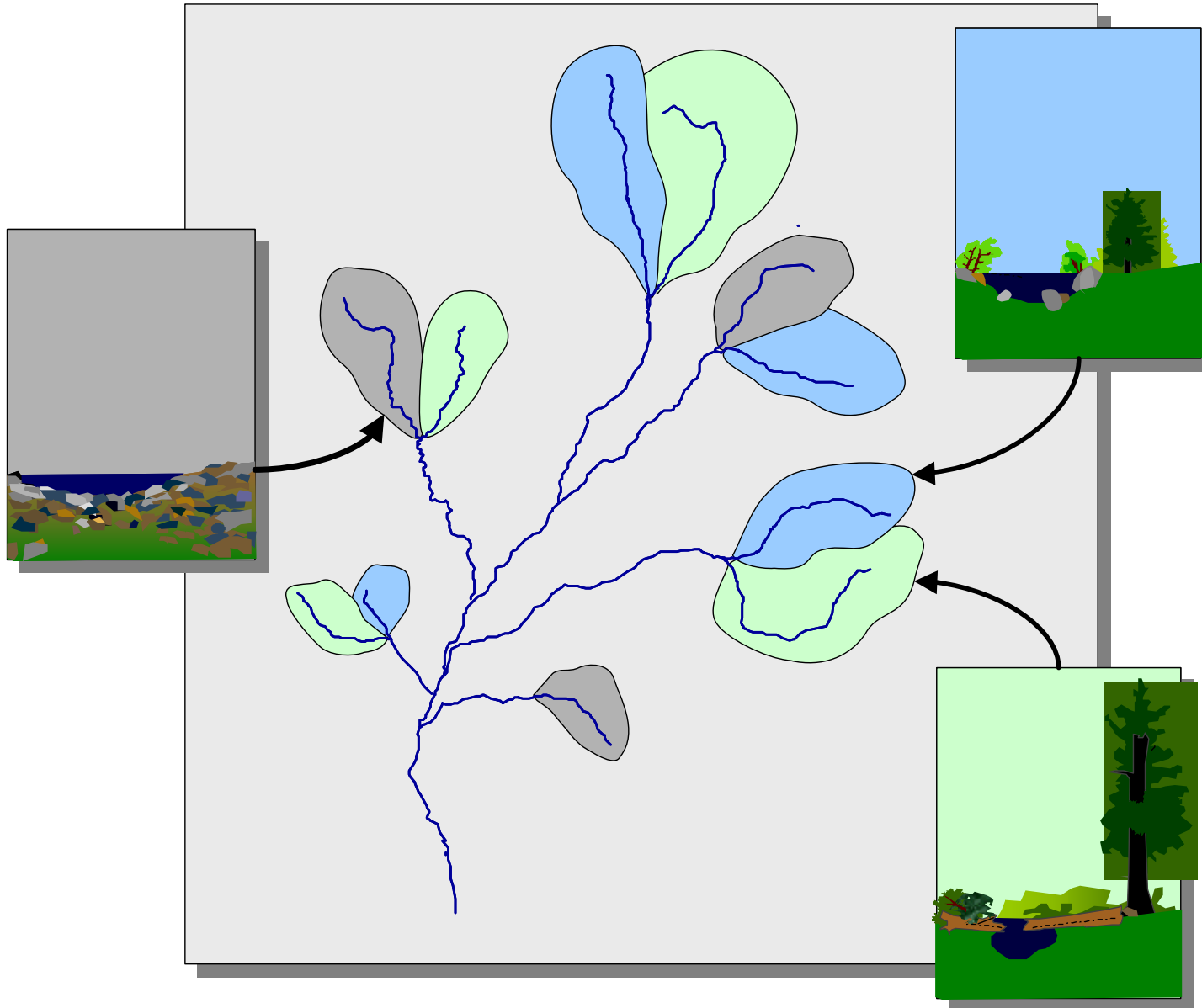
Postfire channel disturbance is dampened in larger systems (e.g., Burton 2000)

Post-fire debris floods in tributaries of the NF Boise River deposited large volumes of fine sand in the river in 1995.

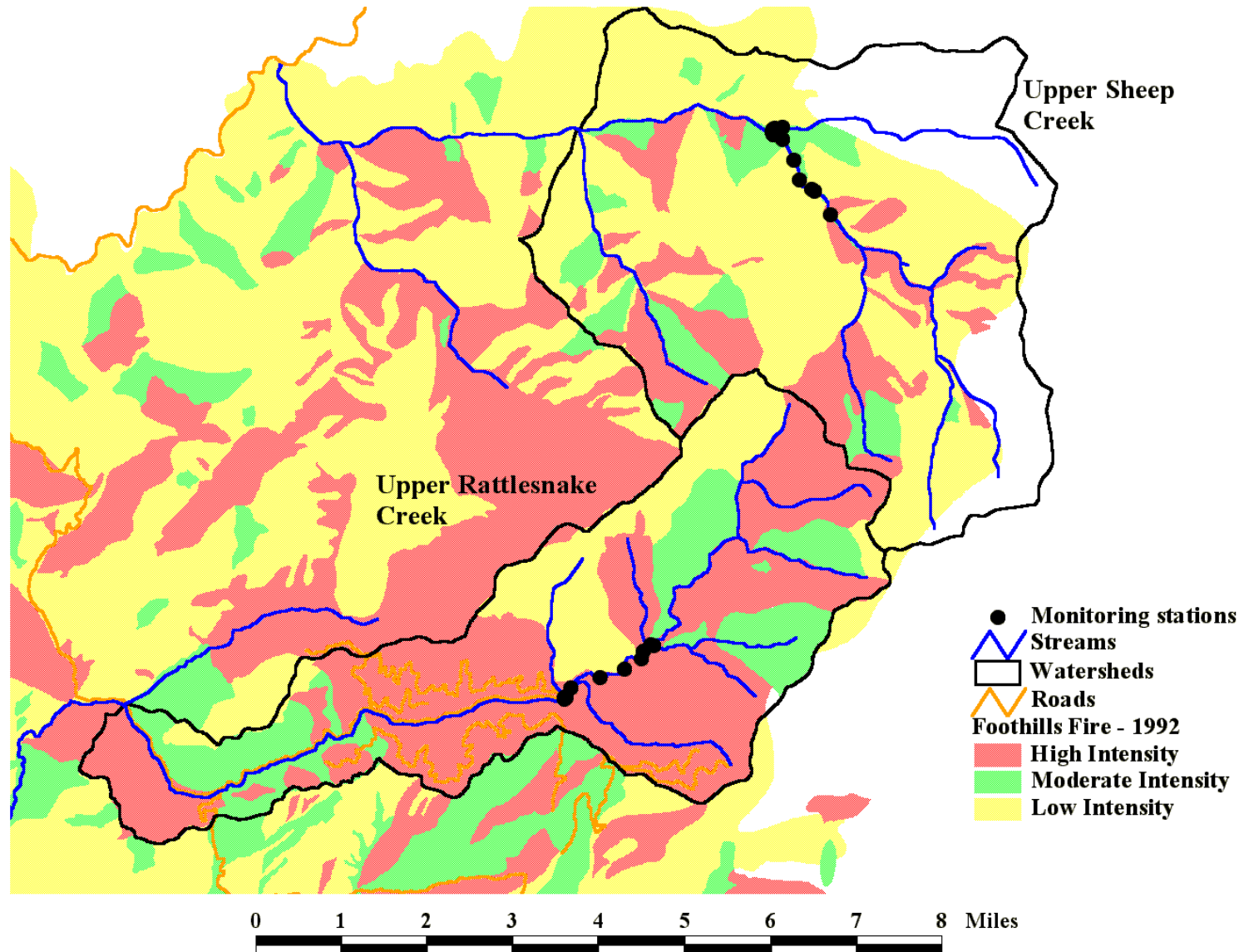
By the year 2000, most of this sand had been moved out of the stream and on to river bars.



Physical events less likely to occur together (in synchrony) over larger areas (Benda, Miller, Reeves et al.)



Heterogeneity within fire perimeter (Lertzman et al. 1998)



Boise Foothills Fire – 1992 (map from Burton 2000)



Postfire disturbance - key points

- **Disturbances are more severe in small, headwater streams**
- **Disturbances are more likely to affect whole populations in small headwater streams**
- **Fires and related disturbances can be very heterogeneous over larger areas or timeframes**

Contrasting effects of human disturbance

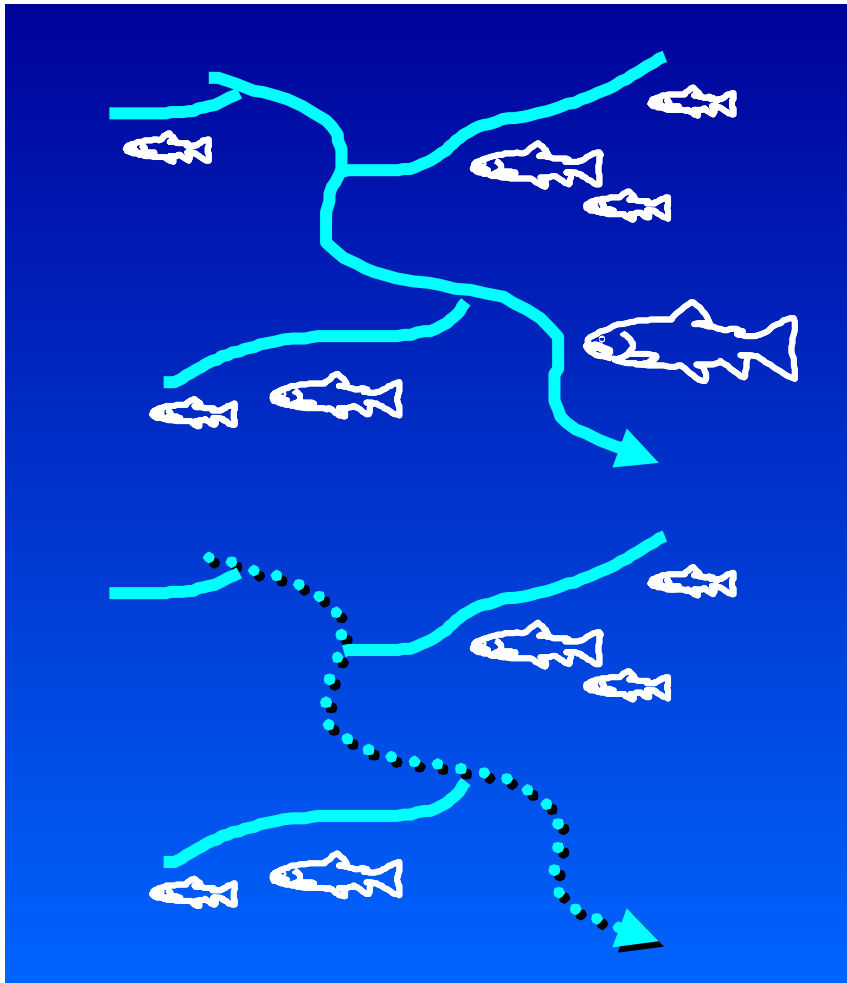
- **Human disturbance more likely in higher order streams (downstream areas) and lower gradient streams**
- **Human disturbances may interact with fire-related disturbance to affect fish more severely**

E.g., Habitat loss and fragmentation



General observation: Habitat loss and degradation leads to fragmentation and loss of life history diversity

-Are such populations less resilient to fire effects?



Interconnected habitat

- + Habitat size**
- + Dispersal**
- + Complexity**
- + Life history diversity**

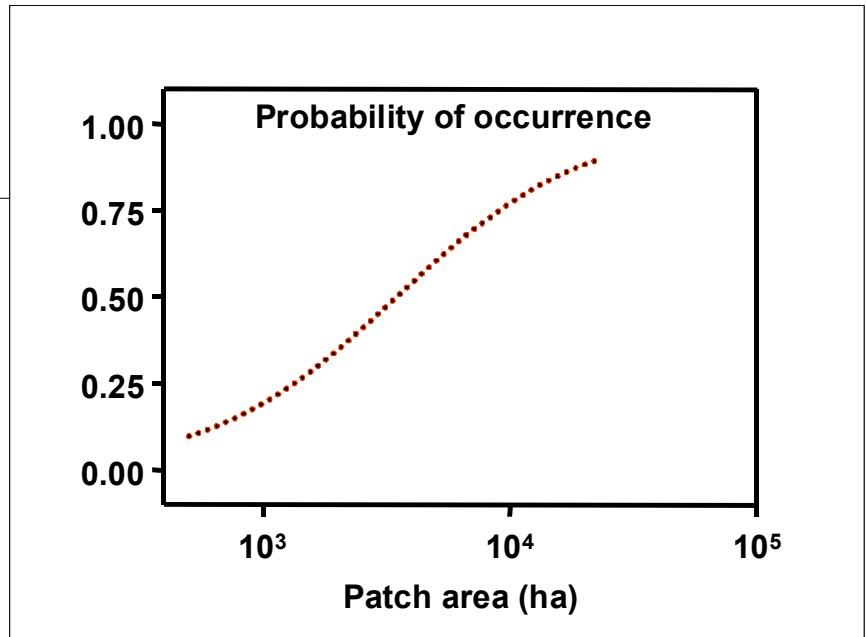
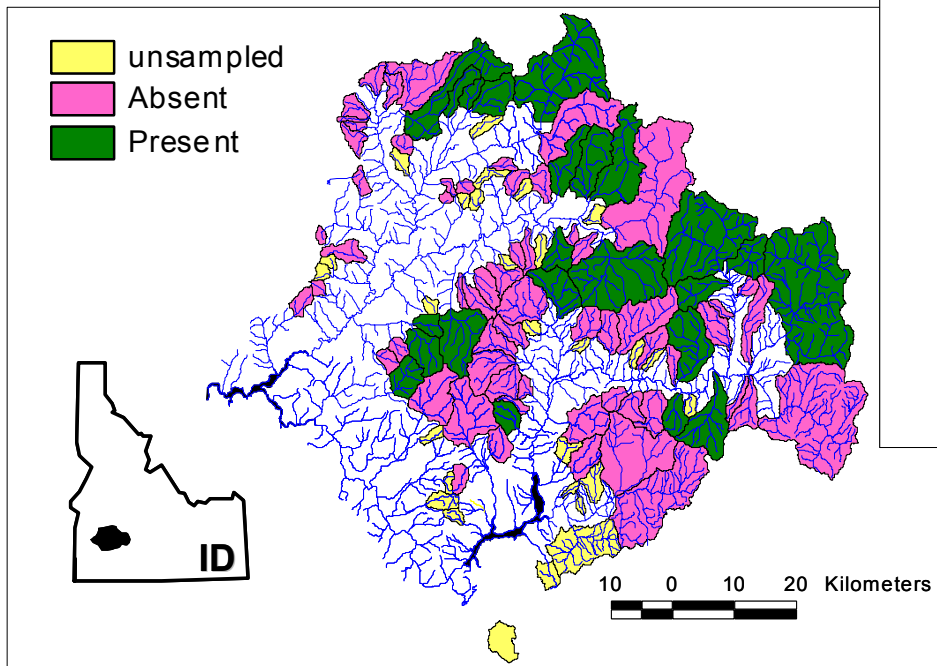
Fragmented habitat

- Habitat size**
- Dispersal**
- Complexity**
- Life history diversity**

Evidence from patterns observed within species: occurrence of local populations in relation to

- * **Fragmentation (habitat size, isolation)**
- * **Human disturbance (road density)**

BOISE BASIN BULL TROUT



Dunham and Rieman 1999

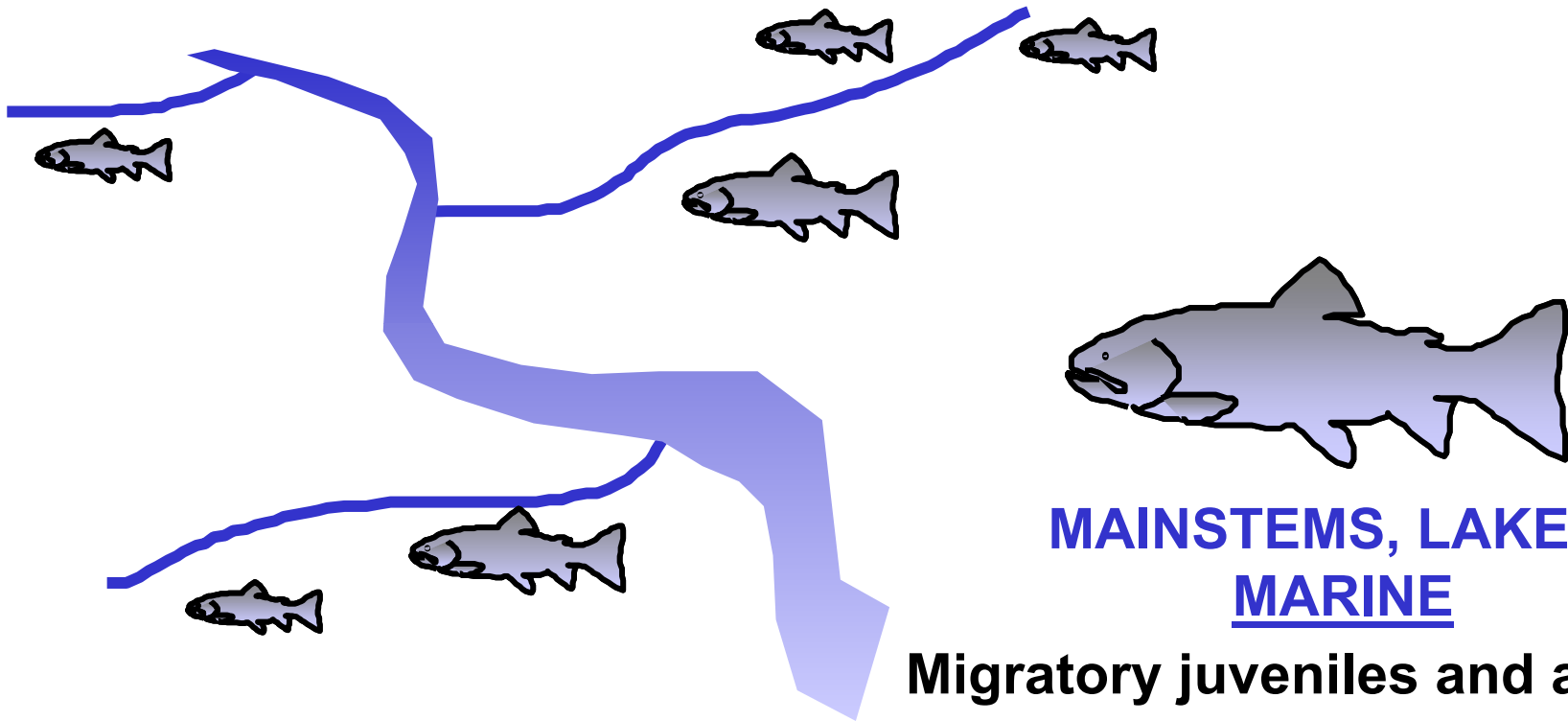


Life history diversity

HEADWATERS

Resident adults

Spawning and early rearing by migratory fish

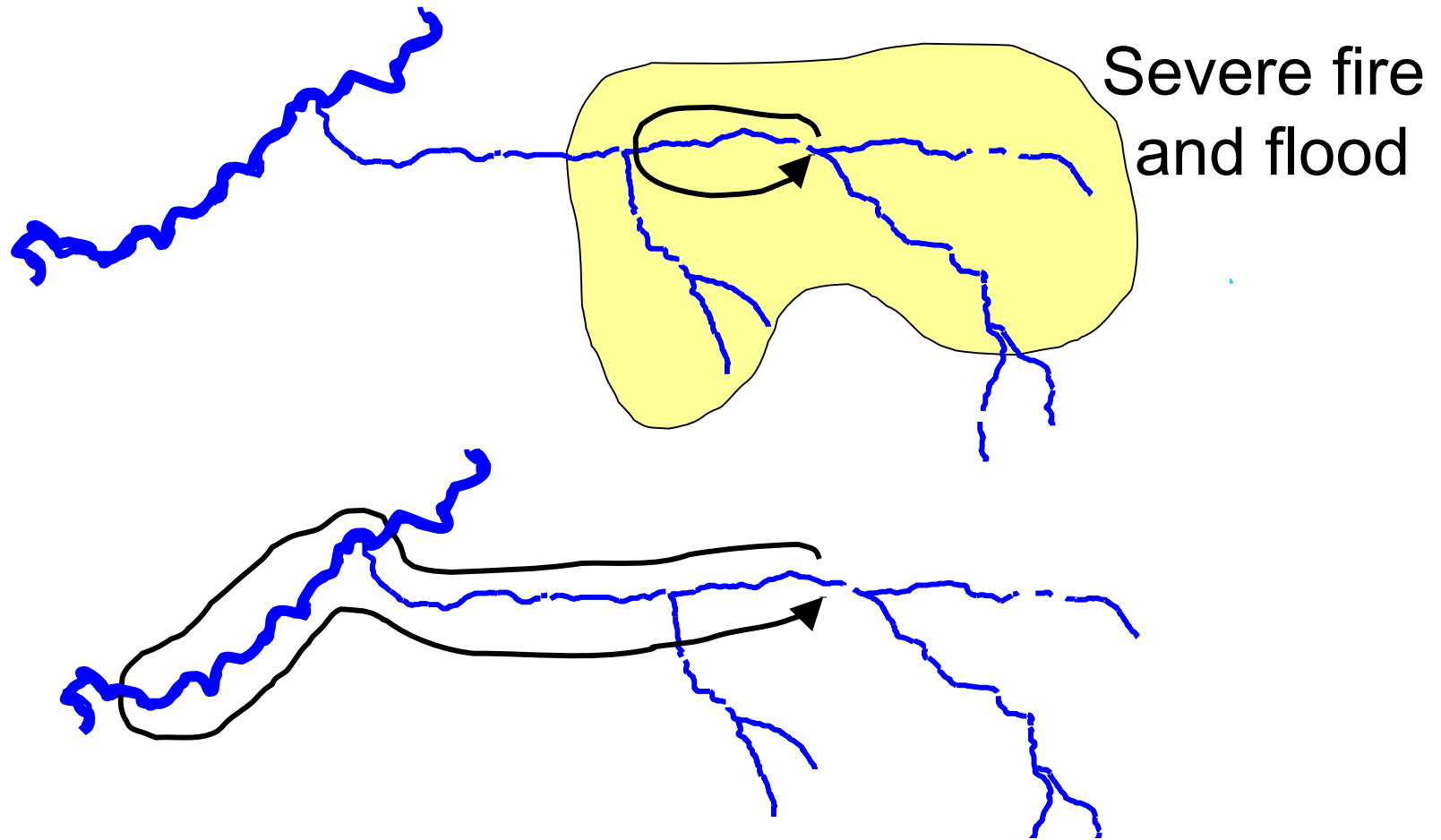


MAINSTEMS, LAKES,
MARINE

Migratory juveniles and adults



Life history diversity: bull trout and “external” refugia

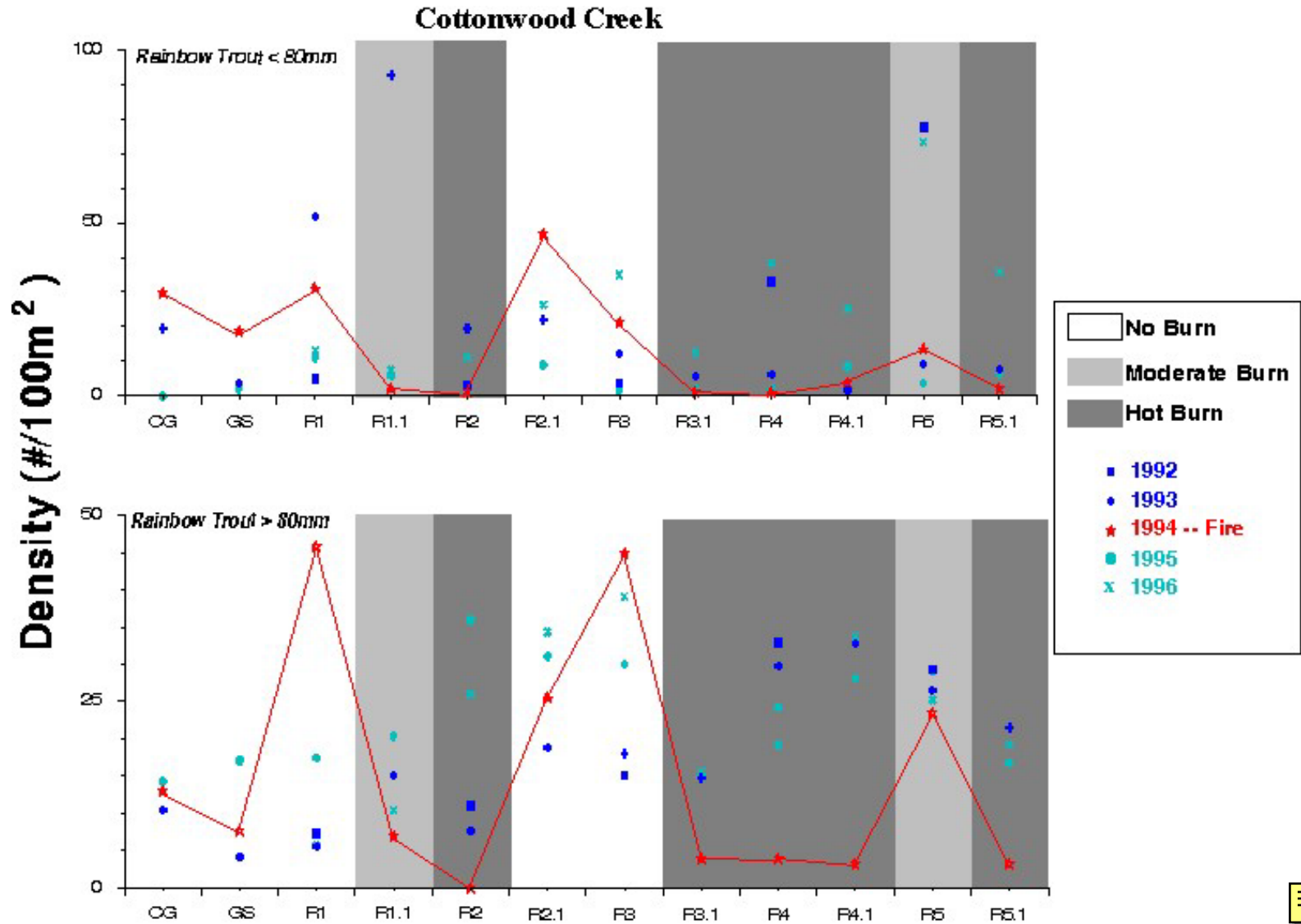


Rattlesnake Creek, Boise basin (Rieman et al. 1997)



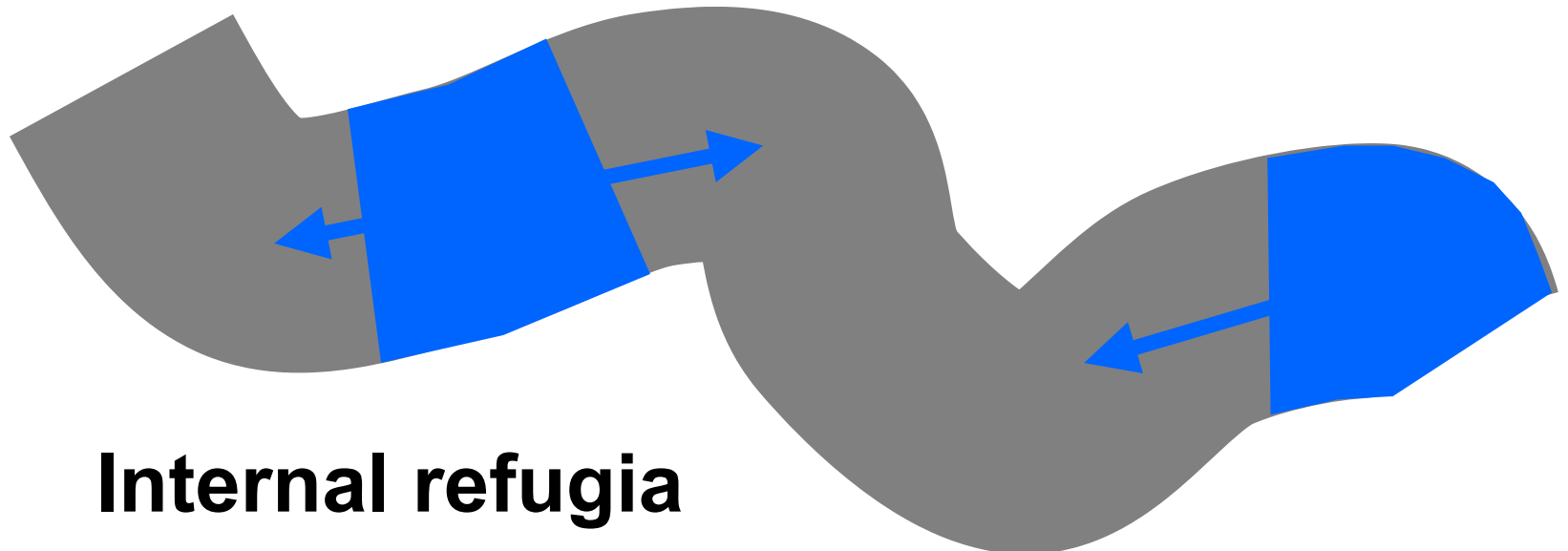
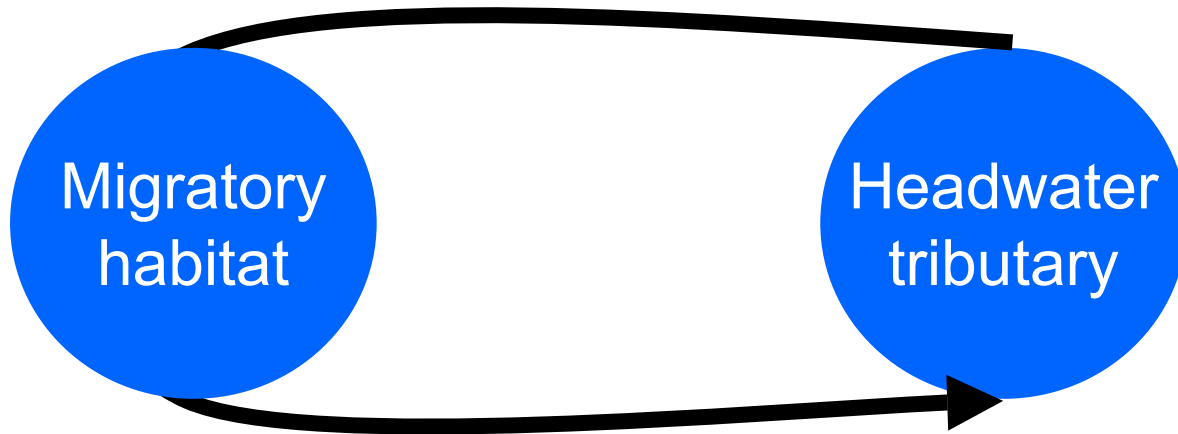
Fish responses to fire: recolonization from internal refugia

Rainbow trout in Cottonwood Creek



Post-fire recovery: two mechanisms (Rieman et al. 1997)

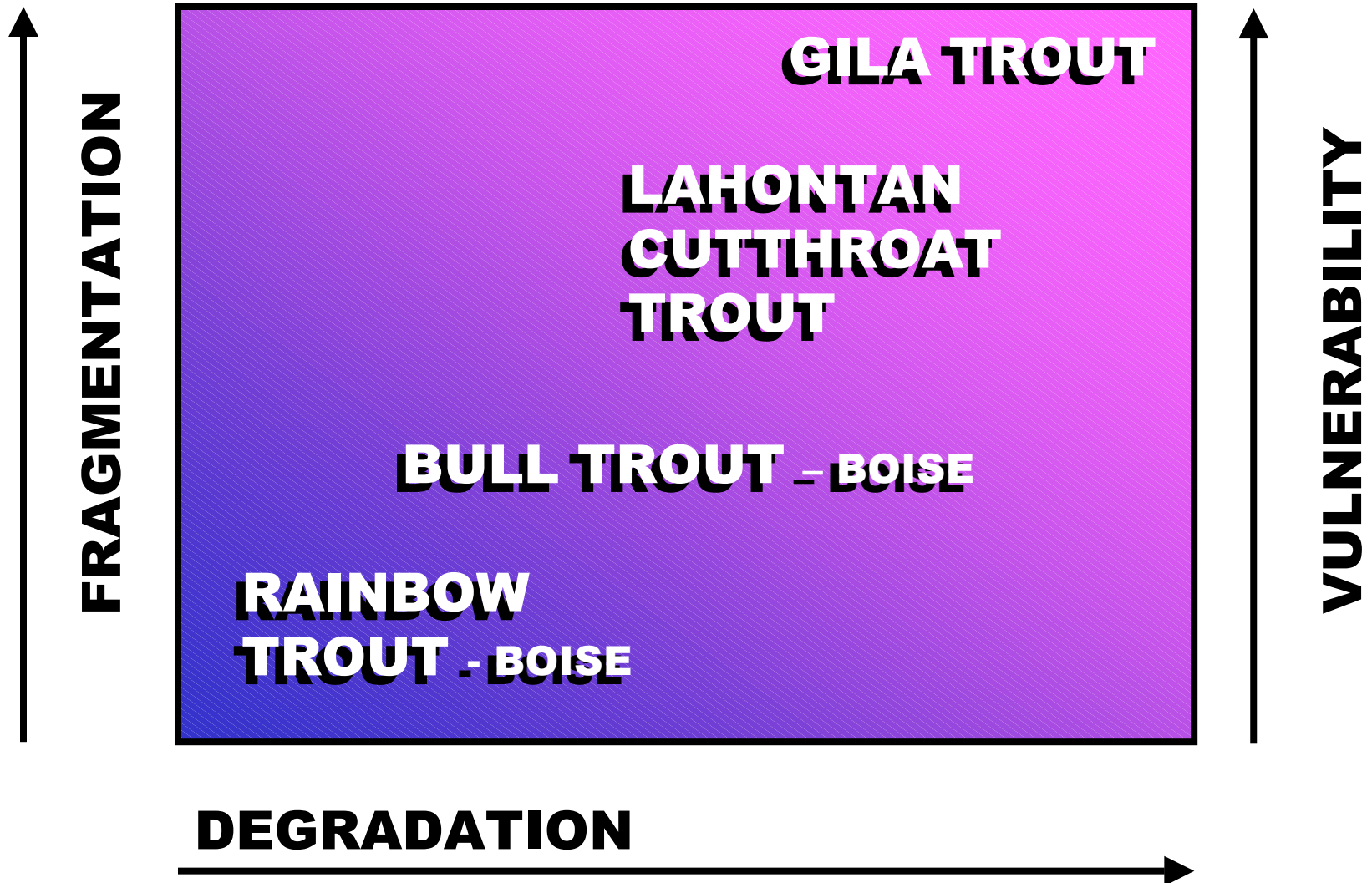
Life history/habitat diversity



Internal refugia



**SPECIES SENSITIVITY TO FIRE EFFECTS
- PATTERNS AMONG SPECIES
(may also apply *within* species)**



Do fires facilitate invasions of nonnative fishes?

Nonnative trout – genetic and ecological impacts

Brook trout



Rainbow trout



Brown trout

Cutthroat trout

Do fires facilitate invasions of nonnative fishes?

1. Causes of post-introduction invasions
2. Effects of invasions on native species

Native fish only (resistant or not colonized)	Native and nonnative fishes (sympatry)
No fishes present (barriers, unsuitable)	Nonnative fishes only (displacement or replacement)



Do fires facilitate invasions of nonnative fishes?

Lessons from salmonid fishes

- 1. No evidence to suggest fire itself has differential impacts on nonnative trout**
- 2. In general, our understanding of nonnative invasions and potential impacts is extremely limited**
- 3. Will nonnatives negate all of the progress we make with managing the “4-H” factors, e.g., Hydro, Harvest, Habitat, Hatcheries?**
- 4. Are there alternatives to present management alternatives for nonnatives?**
- 5. Can we predict where and when nonnatives are a problem?**



What management alternatives are most likely to benefit fish?

Fire example

**General alternatives
(Dale et al. Bioscience 2001)**

Pre-fire management

**Managing the
system before the
disturbance**

Manage during the fire

**Managing the
disturbance**

Post fire management

Managing recovery

Fire monitoring and research

**Monitoring for
adaptive
management**



What management alternatives are most likely to benefit fish?

Alternative	Assessment
Pre-fire 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



NFP and R1/R4 STUDIES

Does fire matter – when and where?

Can we classify watersheds or landscapes in regard to their vulnerability to fire effects on fish?

Examine fire effects (e.g., distribution, presence, coexistence) across a wide gradient of landscapes in relation to fire histories and fire-related disturbance

Products

- Tools for risk assessments: strategic prioritization of fire management activities**
- Tools for monitoring fire effects**

