Jun 29th, 11:40 AM - 12:00 PM

Session A7- Research

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Barriers and the Abundance and Diversity of Resident Stream Fishes

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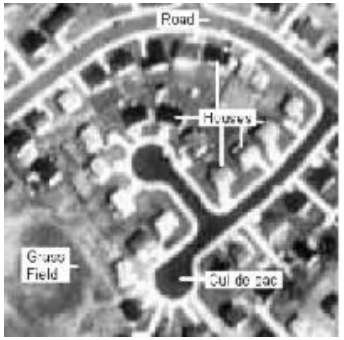


Forestry

Development

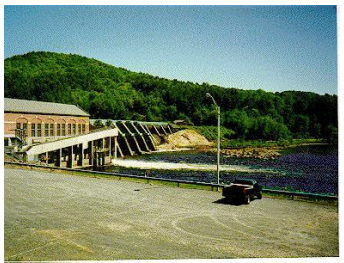
Atmospheric Deposition

Land Use And Forest Change

Ecosystem Change

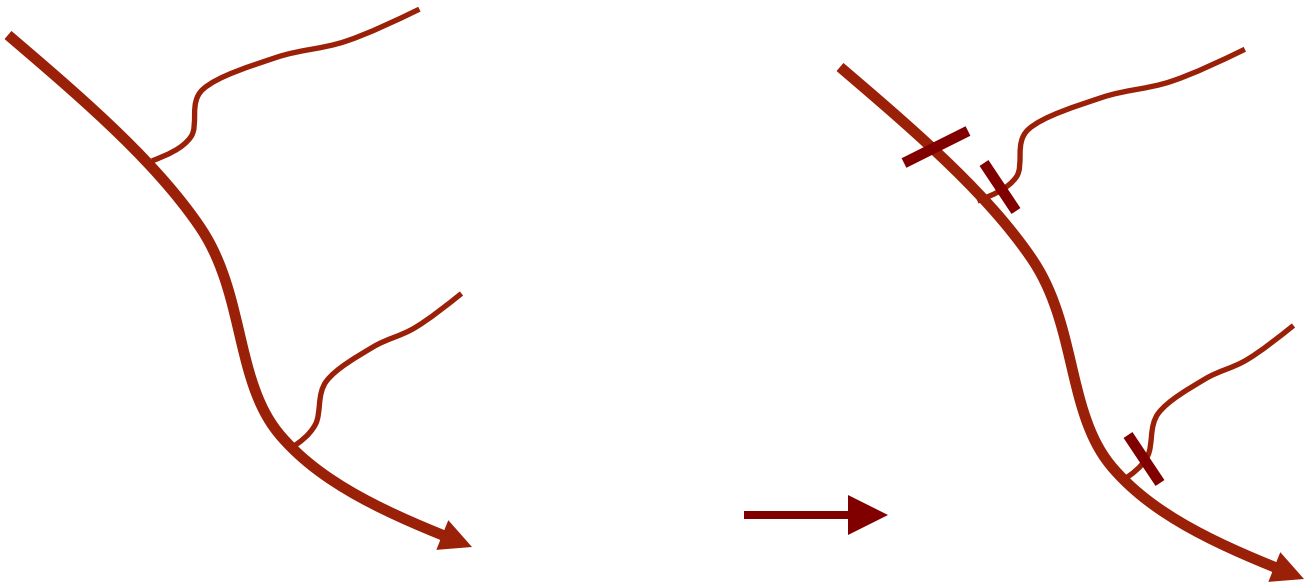
Fish Population And Community Change

Hydrologic Alteration And **Barriers to Movement**



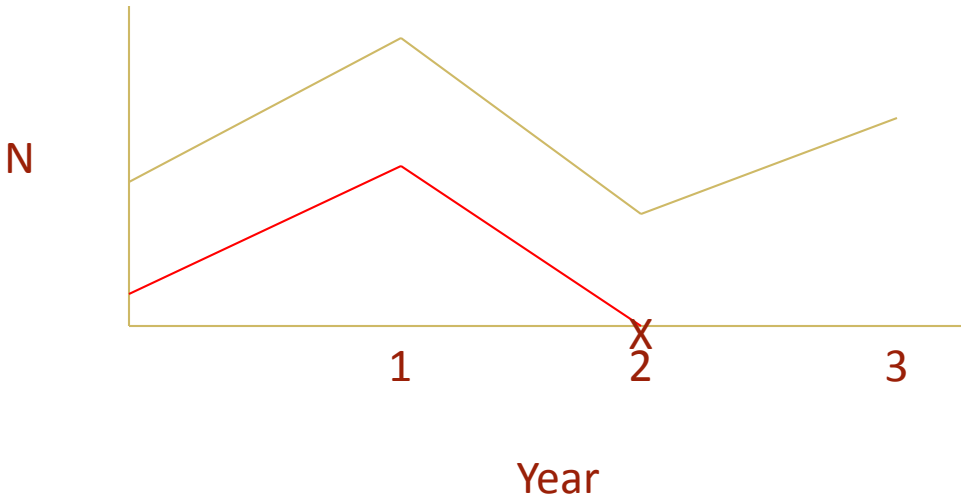
Fragmentation and Population Dynamics

- Turning a large connected population into a set of smaller, isolated populations
- What are the consequences?
- Demographic vulnerability



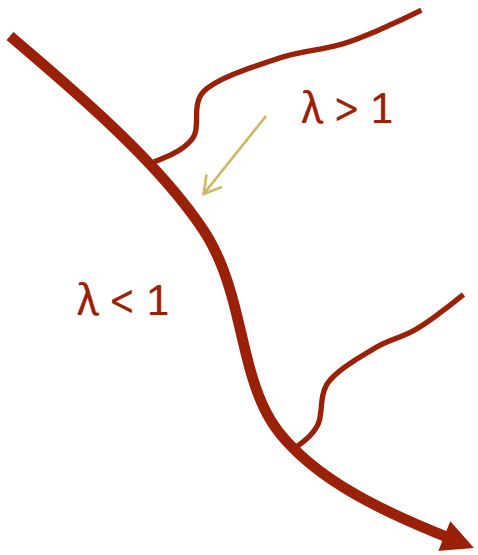
Spatial and temporal variation

- Populations fluctuate over time (demographic stochasticity)
- Populations cannot rebound from zero



Spatial variation and metapopulation dynamics

- Immigration can ‘rescue’ subpopulations with $\lambda < 1$
- Increases overall population stability



Basic Population Equation

$$N_t = N_{t-1} + B - D + I - E$$

N = Population size
B = Births
D = Deaths
I = Immigrants
E = Emigrants

Population Growth Rate (λ)
$\lambda < 1$ = declining population
$\lambda > 1$ = increasing population

Basic Population Equation

$$N_t = N_{t-1} + B - D + I - E$$

N = Population size
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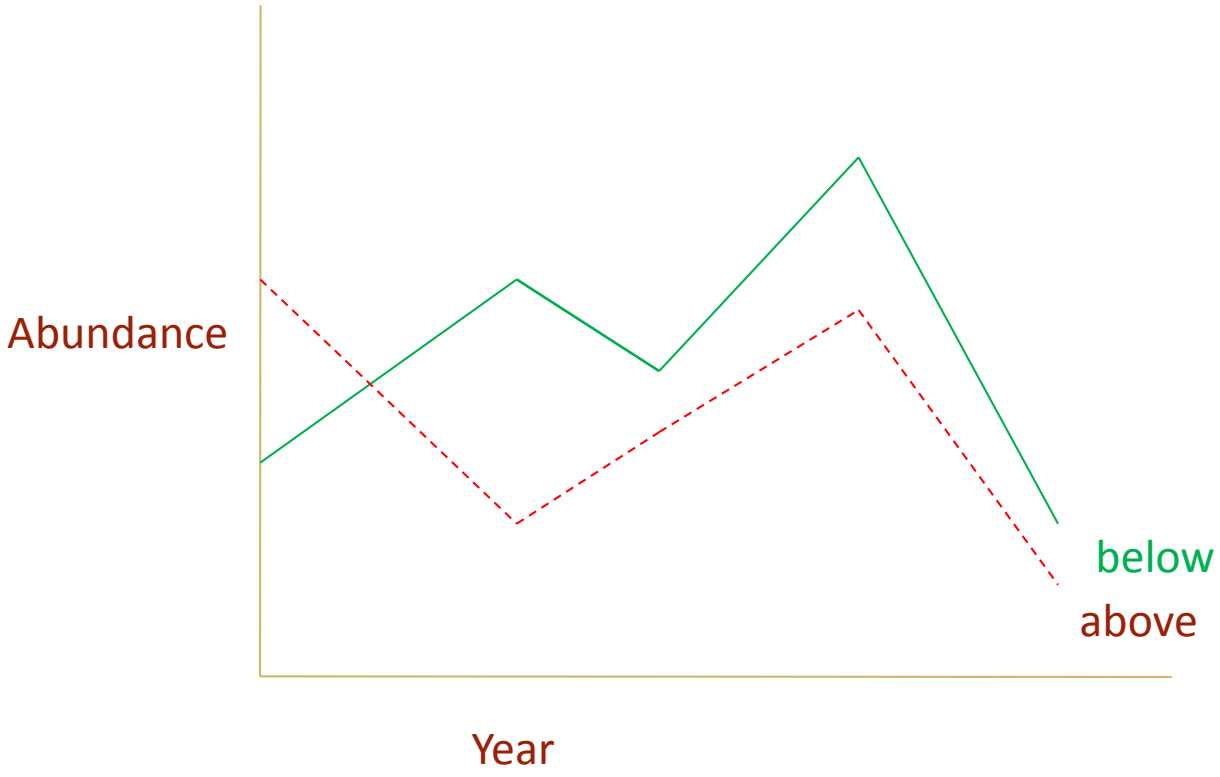
Population Growth Rate (λ)
λ < 1 = declining population
λ > 1 = increasing population

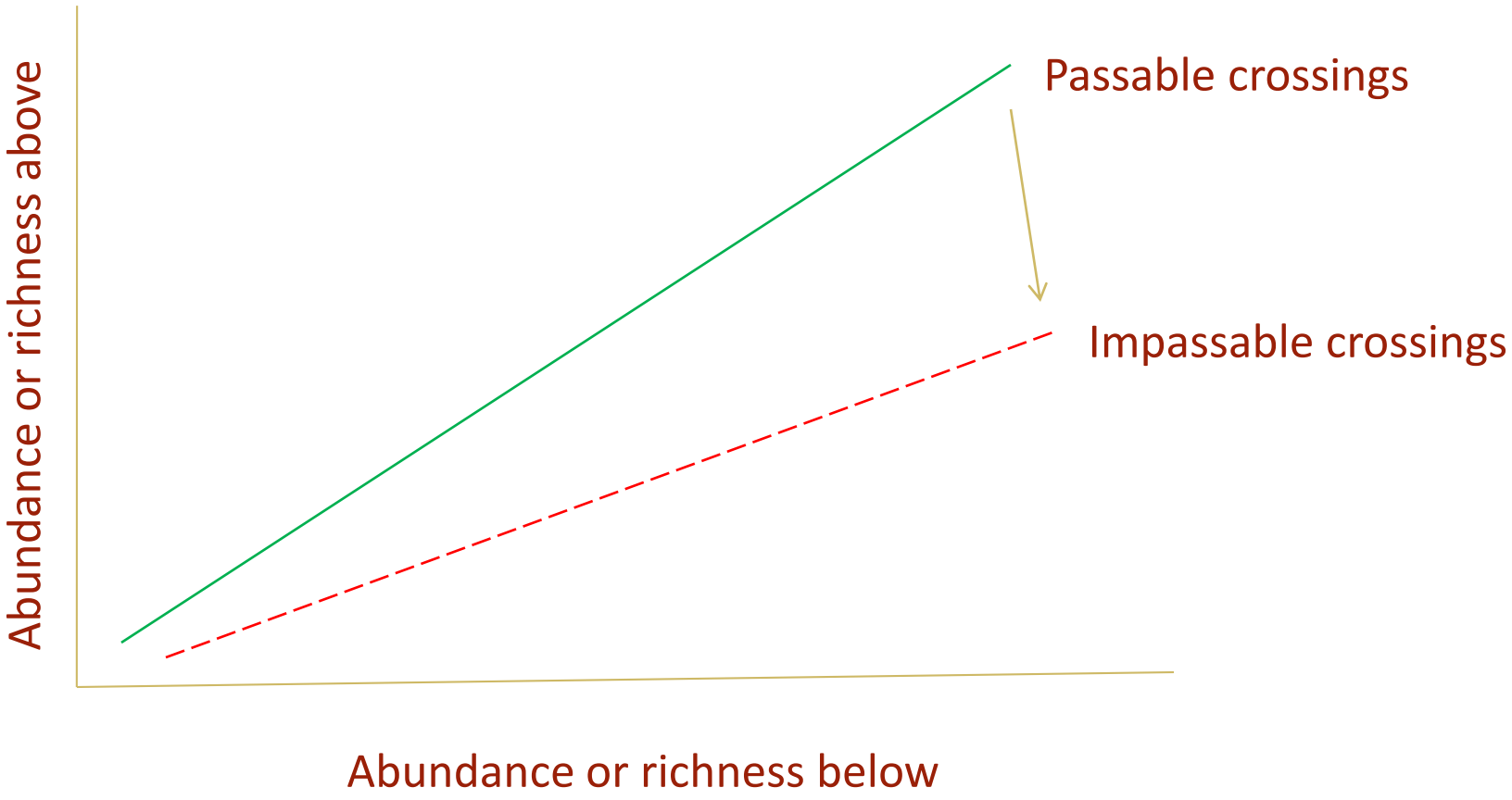
How important is immigration to population abundance?

- Stream-resident fishes move a lot more (and longer distances) than previously thought
- What happens when you reduce the Immigration term of the population equation?
- All else being equal, reducing I will decrease N
- Increased number of N values = 0 = reduced species richness

Using abundance and richness as indicators

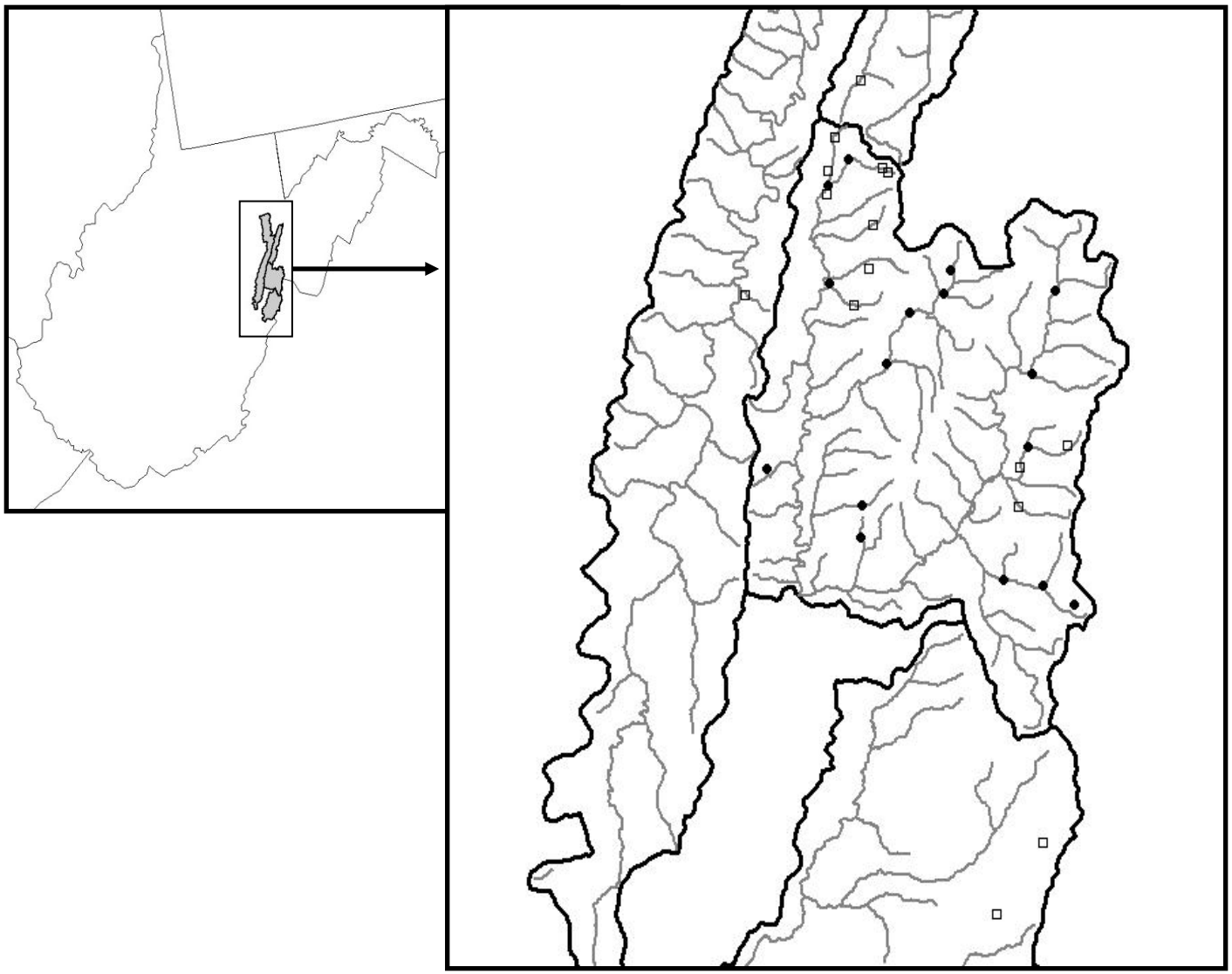
- Watershed scale (not individual crossings)
- Abundance and richness above and below predicted passable and predicted impassable road crossings



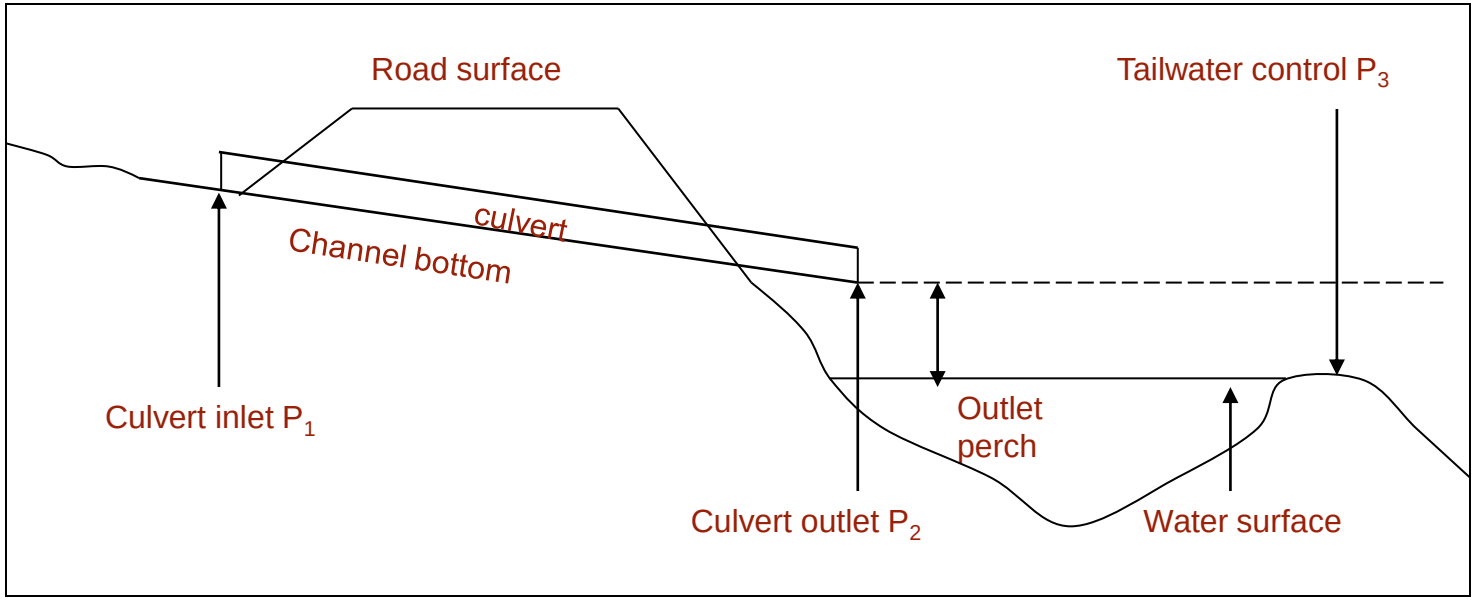

Abundance or richness above
Passable crossings
Impassable crossings
Abundance or richness below

Field Study

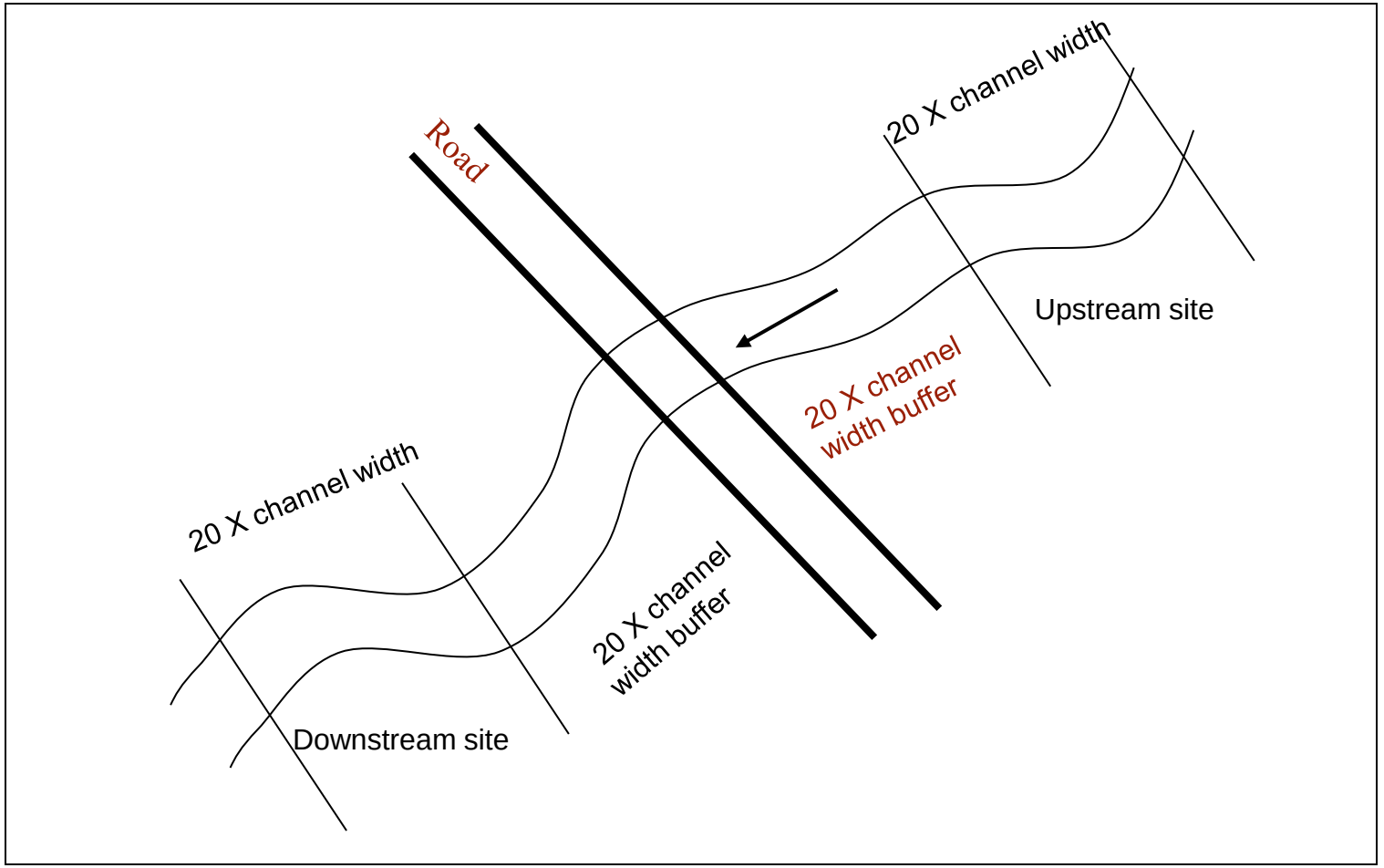
- Nislow et al. (2011) stream fishes above and below passable and impassable road crossings in a central Appalachian watershed
- Monongahela National Forest, West Virginia (MNF)
- 2^{nd}-3^{rd} order streams
- Diverse fish assemblage



Outlet perch > 12 cm and/or < 2.54 cm water in the culvert = **impassable**
Outlet at grade = **passable**



16 predicted passable sites
15 predicted impassable sites



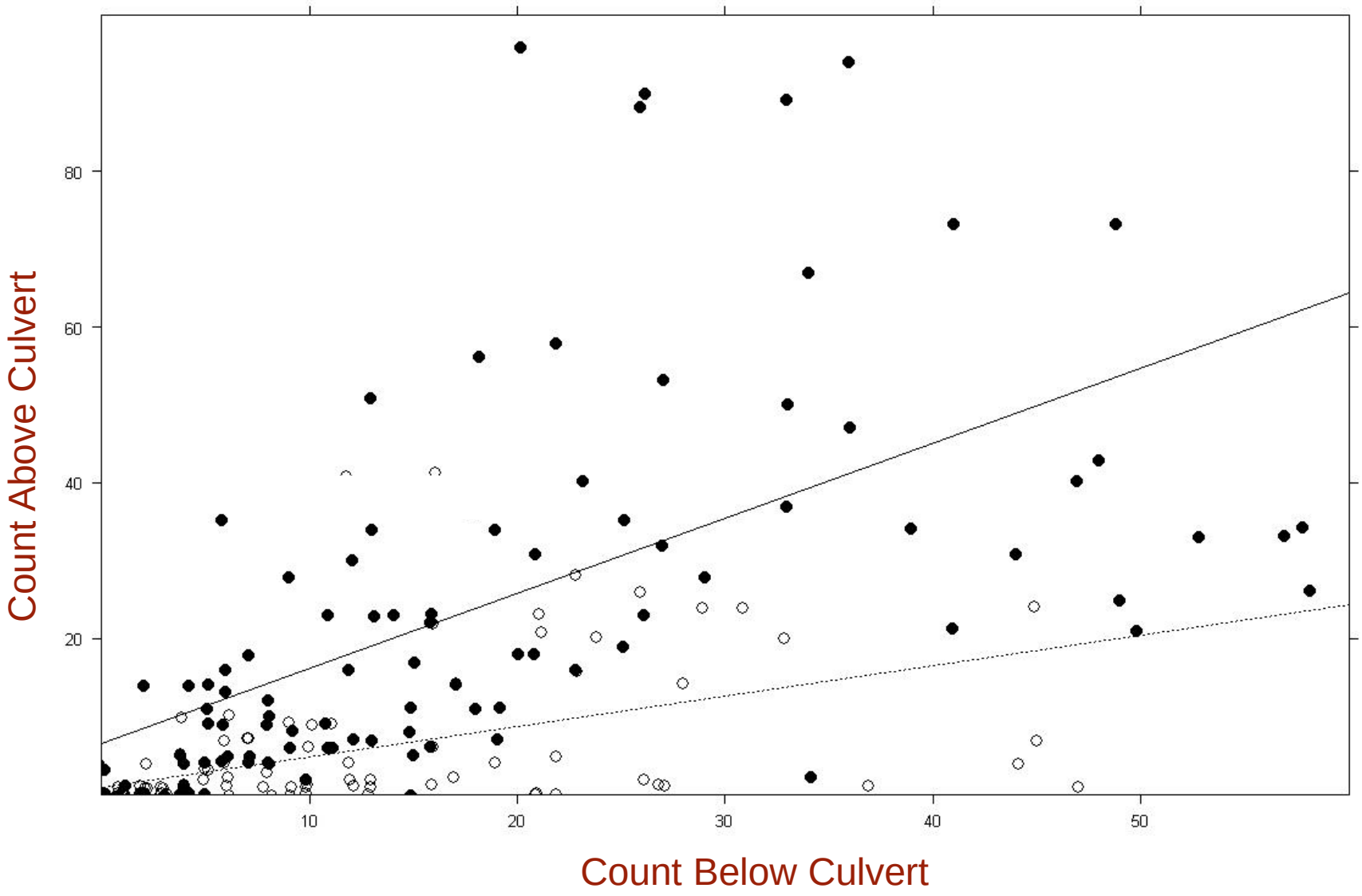
16 predicted passable sites
15 predicted impassable sites

Single- pass electrofishing
All sites sampled 2 years

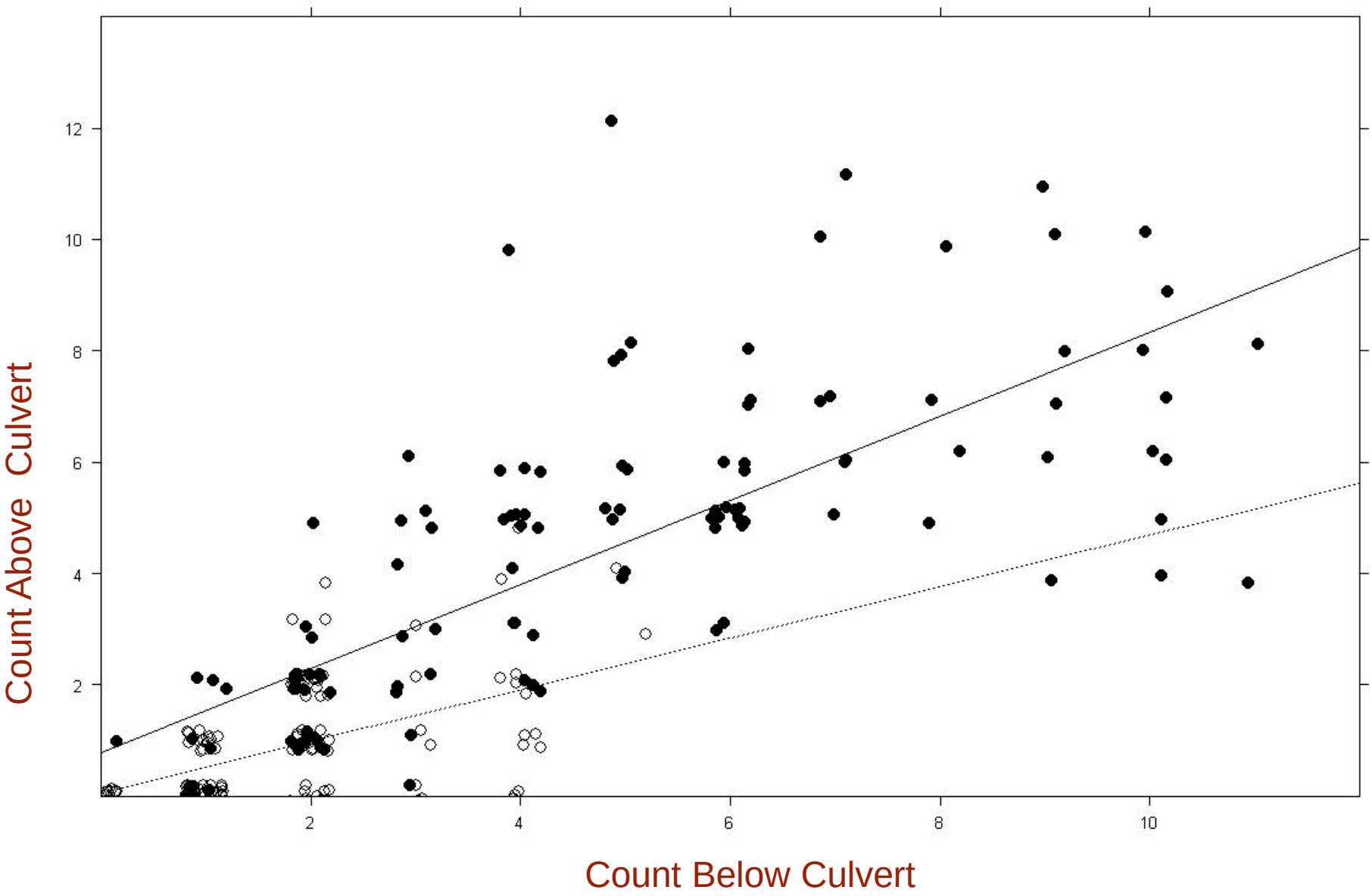
- 20 species; ~10K individuals over the course of the study
- Best predictor of abundance and richness – interactive effects of type (passable/impassable) and location (above/below) and species

	AIC	ΔAIC
type * location * species	**13914**	**0**
(type + location +species)^2	14103	189
type * species	14360	446
location * species	15398	1484
type + location + species	15467	1553
type * location	21592	7678

Abundance

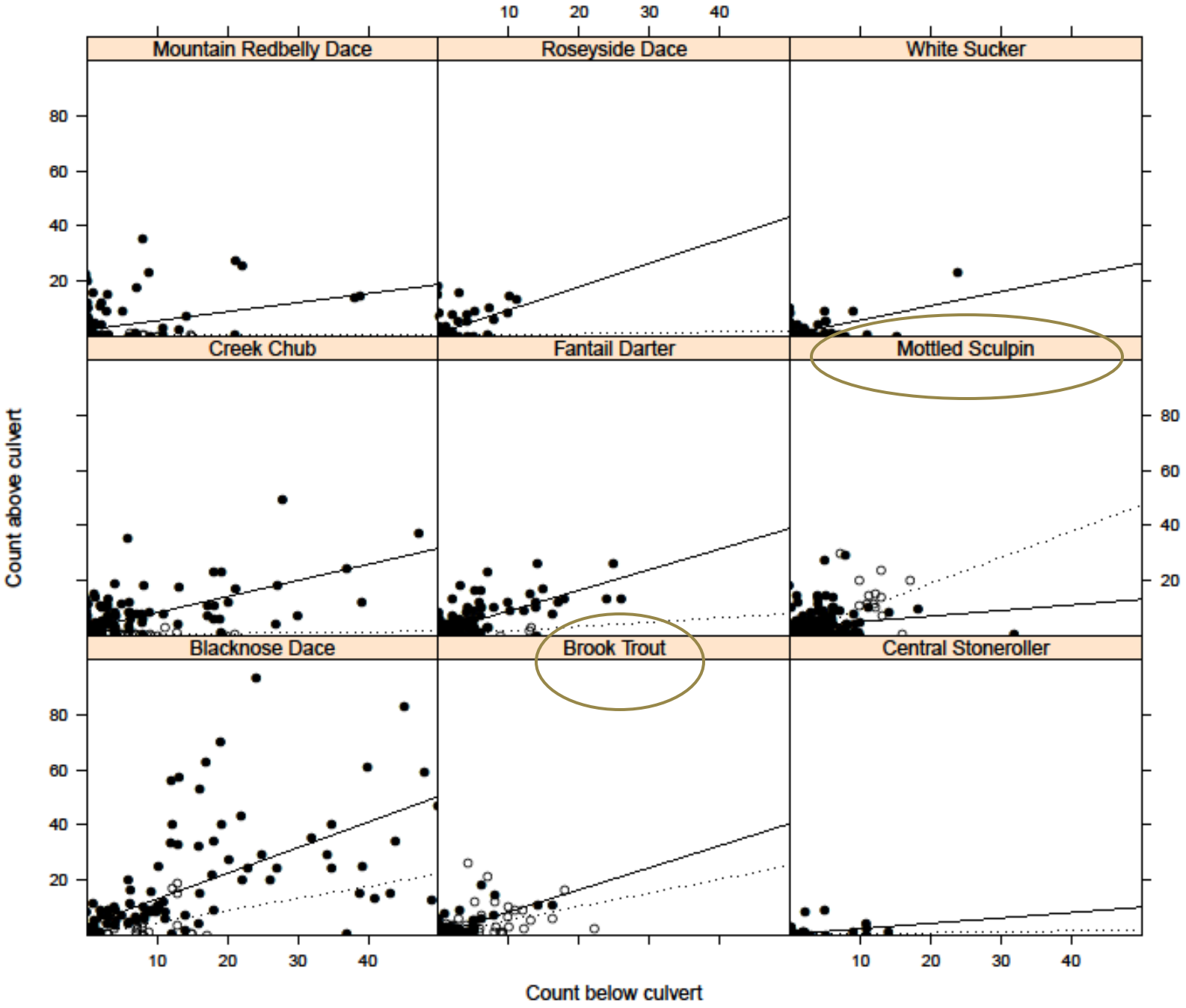

Count Above Culvert
Count Below Culvert
20
40
60
80
10
20
30
40
50

Richness



Summary – Abundance and Richness

- Predicted passable crossings – Equivalent abundance and richness above and below
- Predicted impassable crossings < half the number of species < half the total abundance above crossings


Mountain Redbelly Dace
Roseyside Dace
White Sucker
Creek Chub
Fantail Darter
Mottled Sculpin
Blacknose Dace
Brook Trout
Central Stoneroller
Count above culvert
Count below culvert
10
20
30
40
20
40
60
80

Summary – Species Differences

- Most of the frequently-encountered species showed the same pattern as observed for overall abundance
- Brook trout and mottled sculpin did not

Why?

Summary – Species Differences (cont.)

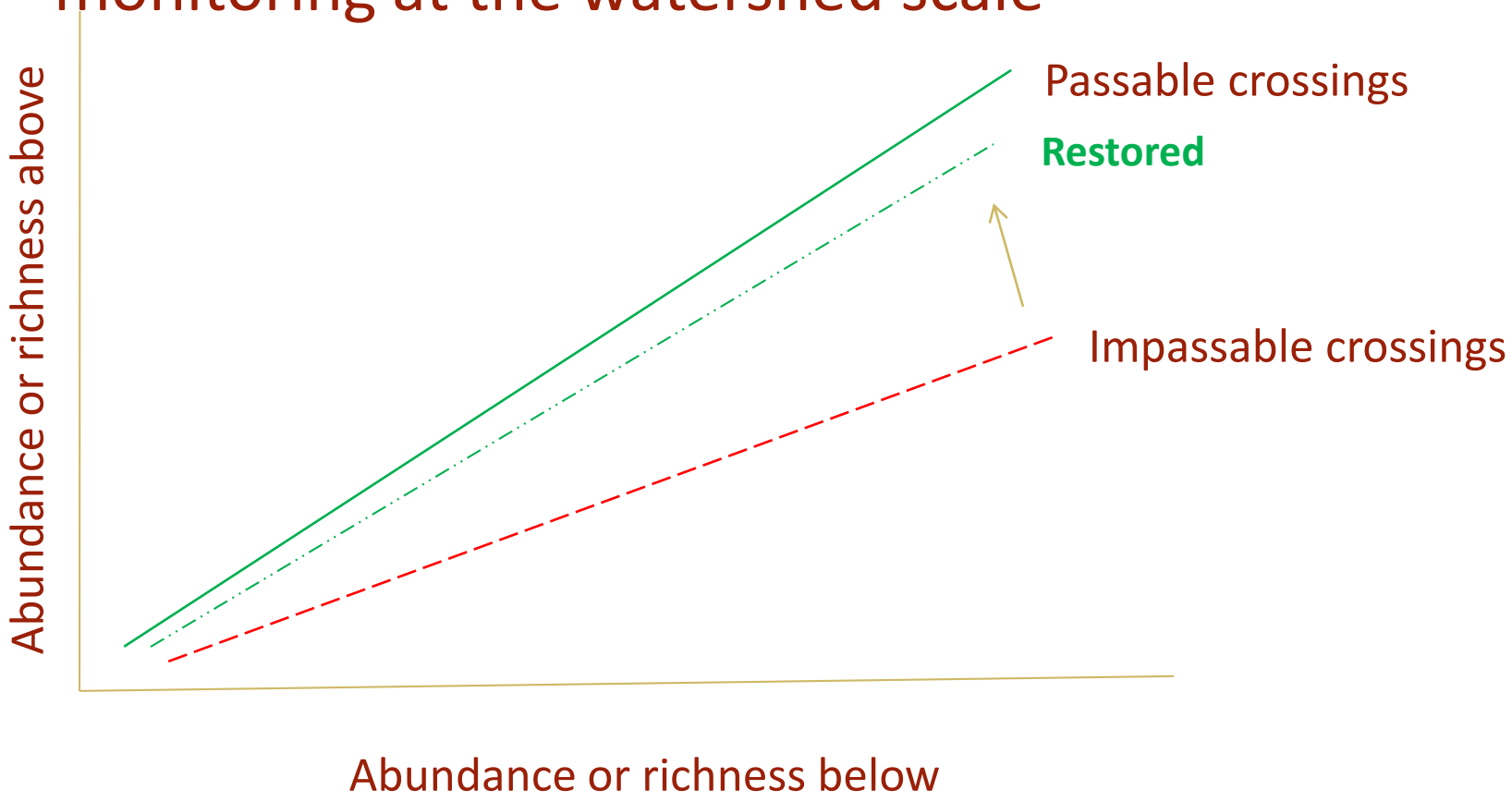
- Brook trout – passage criteria too stringent
- Many of the crossings unlikely to be complete barriers

Summary – Species Differences (cont.)

- Mottled sculpin – passage criteria probably not too stringent
- Limited movement
- Strong local density-dependent effects on survival and reproduction
- Reduce the importance of the Immigration term in the basic population equation

Conclusions and Implications

- Use of abundance and richness for effectiveness monitoring at the watershed scale



Conclusions and Implications

- Using patterns abundance and richness to reveal how stream fish populations ‘work’

Acknowledgements

- Monongahela National Forest
- Virginia Tech
- James Madison University
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- USFS-NRS
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