The Appalachian stream syndrome:

Diagnosing & managing impacts of multiple aquatic stressors

APRIL 13, 2017

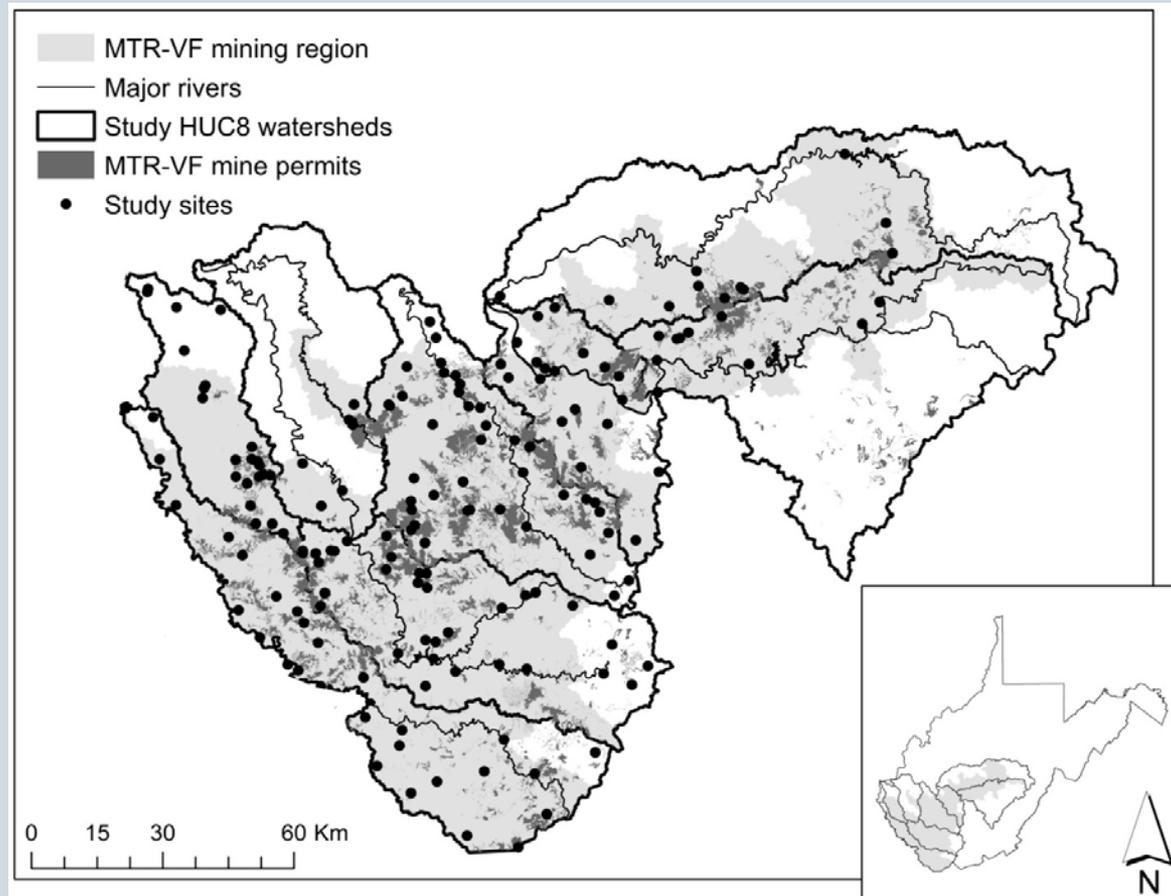ERIC R. MERRIAM
J. TODD PETTY

Background & Objectives

Background & Objectives

Research objectives:

1. Characterize detailed patterns in chemical degradation

2. Test whether degraded neighborhood conditions affect metacommunity structure (tolerance) and processes (dispersal)

Methods: study area

Methods: in-stream data

July–Aug 2010, 11, *or* 12

Water quality

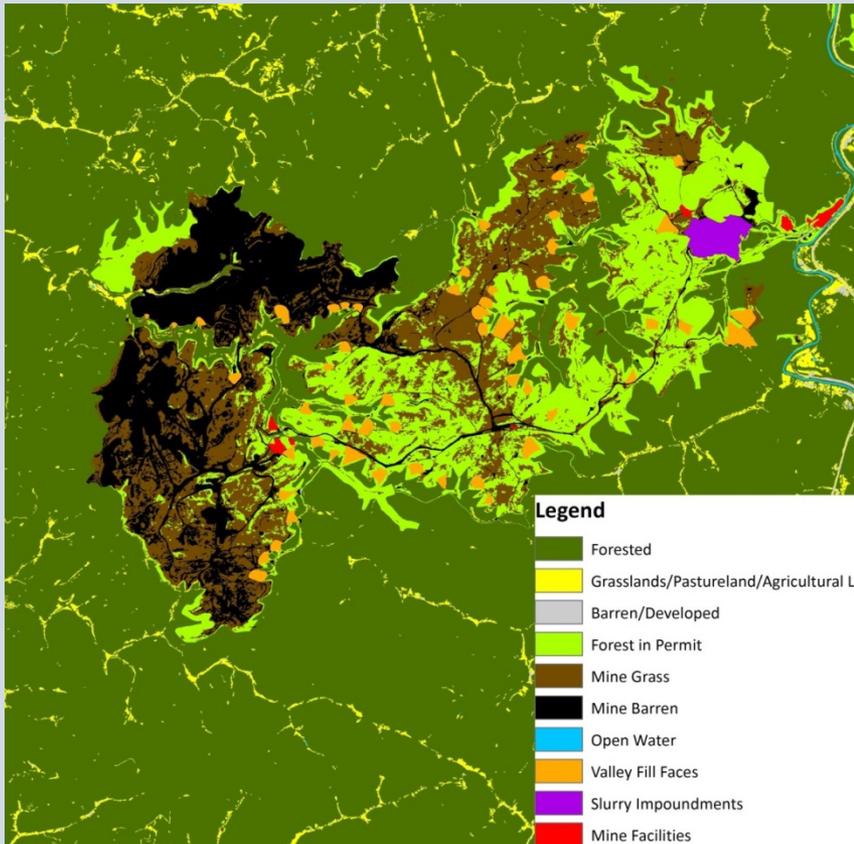- Low flow conditions

Physical habitat

- Quality (RVHA) and complexity

Macroinvertebrates

- Genus-level abundance data
- Tolerance and dispersal traits

Methods: Landscape data
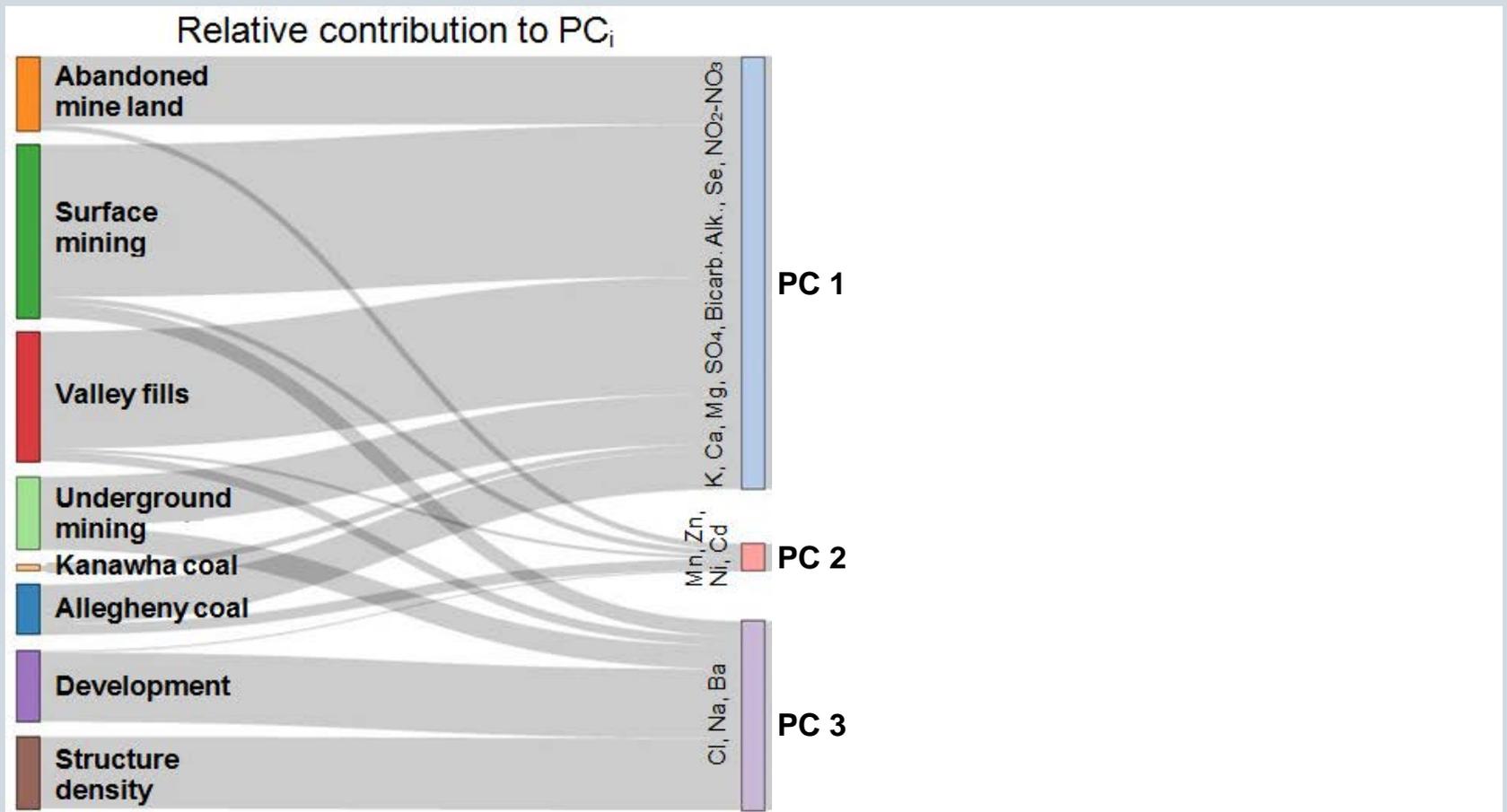

Land cover and use

- 2011 (July) NAIP imagery
- Feature extraction

Ancillary datasets

- Deep mine permits
- Structures
- Roads
- Coal geology

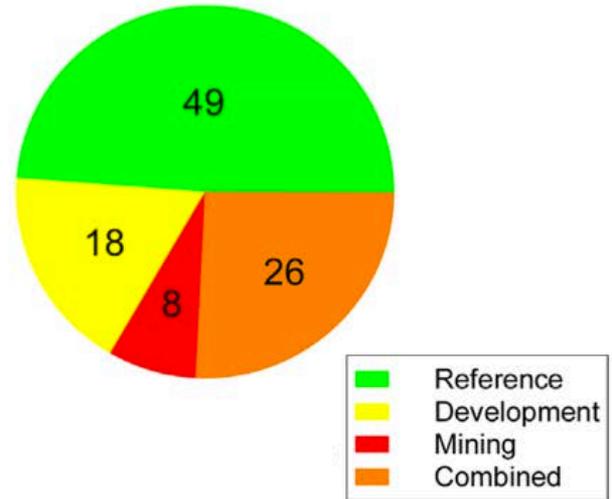*Temporal consistency between landscape and in-stream datasets*

Legend

- Forested
- Grasslands/Pastureland/Agricultural La
- Barren/Developed
- Forest in Permit
- Mine Grass
- Mine Barren
- Open Water
- Valley Fill Faces
- Slurry Impoundments
- Mine Facilities

Results: water quality

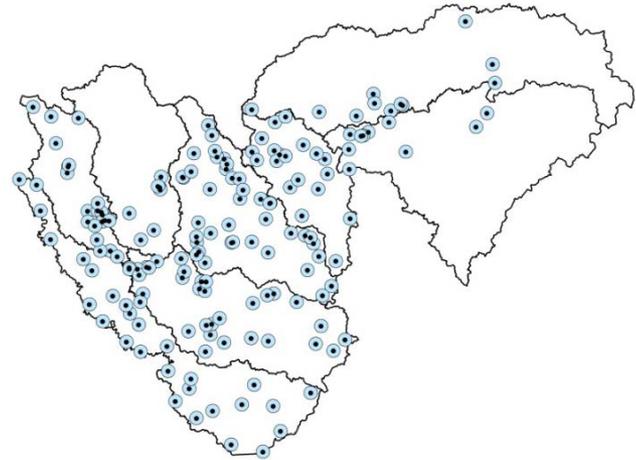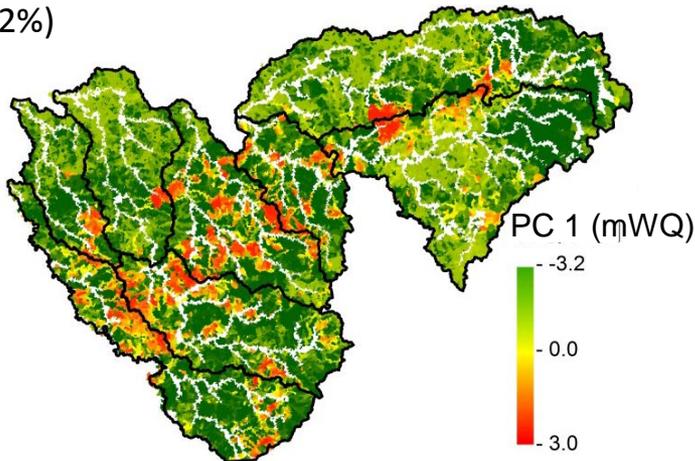Relative contribution to PC_i

Results: water quality

Results: Neighborhood effects

Dev. Explained (72%)
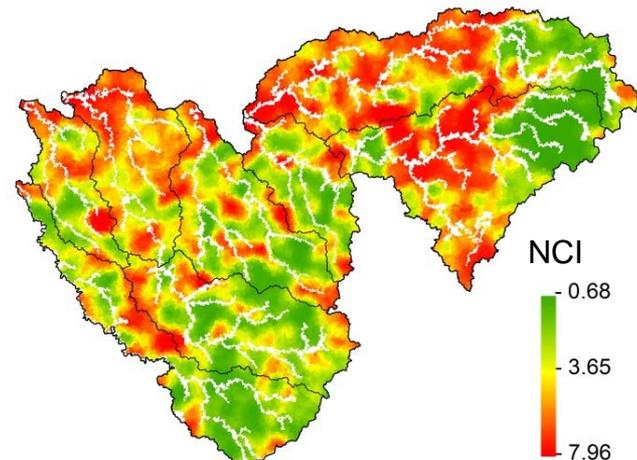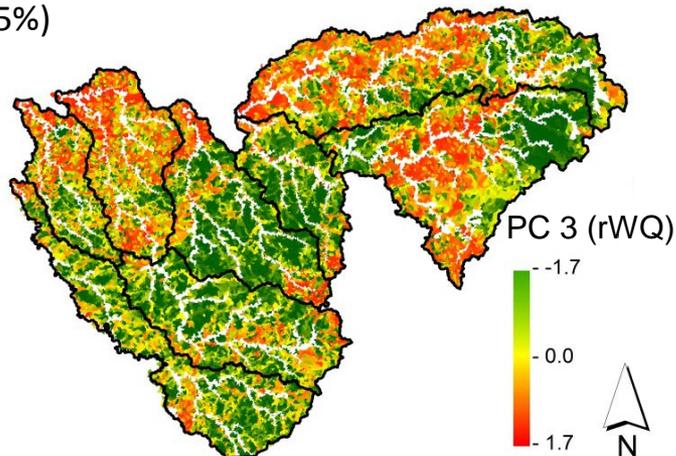CV Dev. (65%)

Surface mining
Forest

PC 1 (mWQ)
- -3.2
- 0.0
- 3.0

Dev. Explained (55%)
CV Dev. (45%)

Roads
Grass/Pasture
Structures

PC 3 (rWQ)
- -1.7
- 0.0
- 1.7

N

NCI
- 0.68
- 3.65
- 7.96
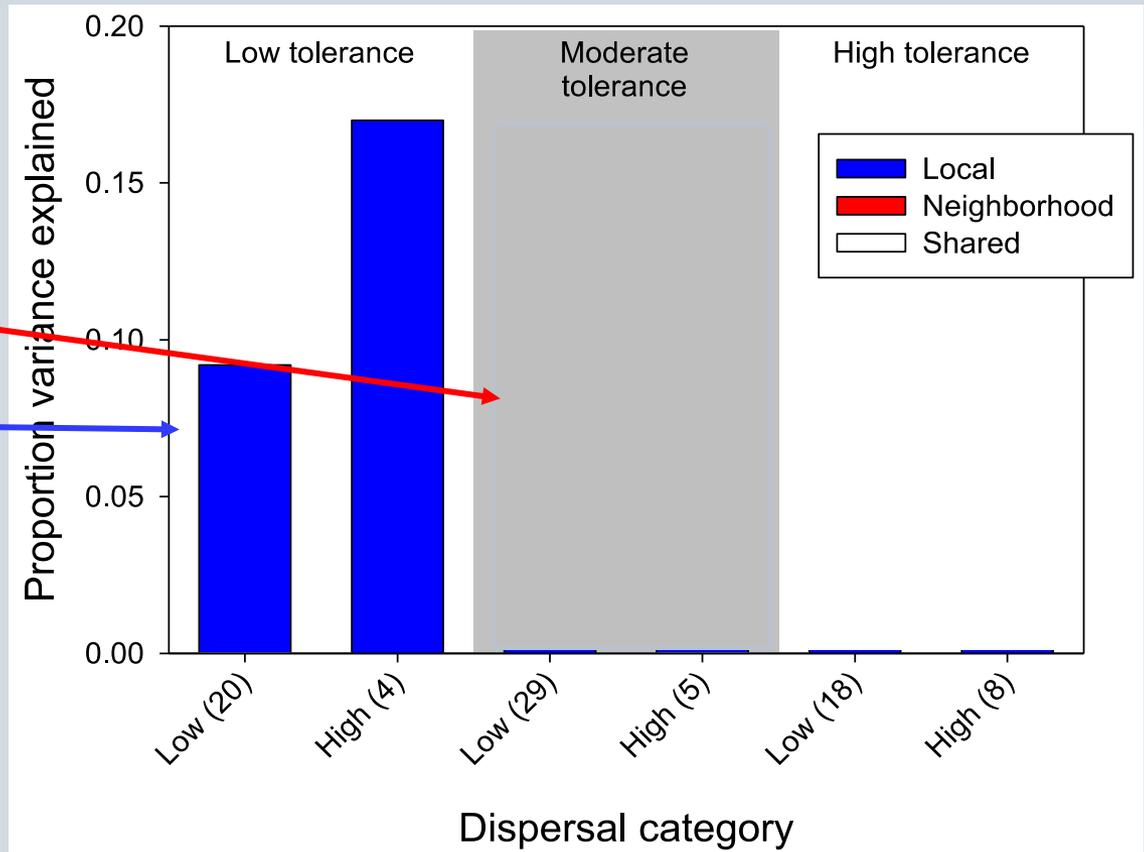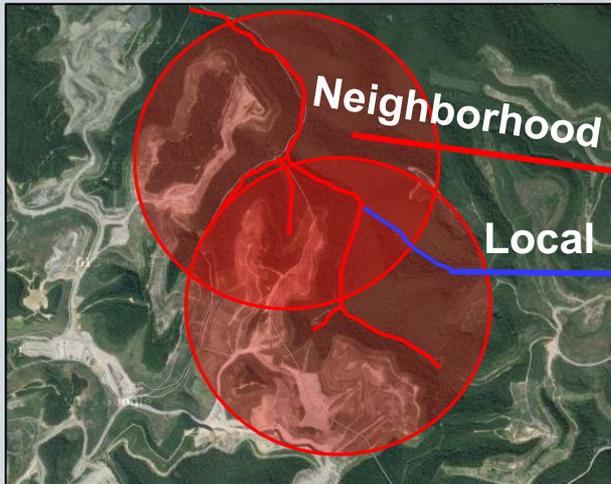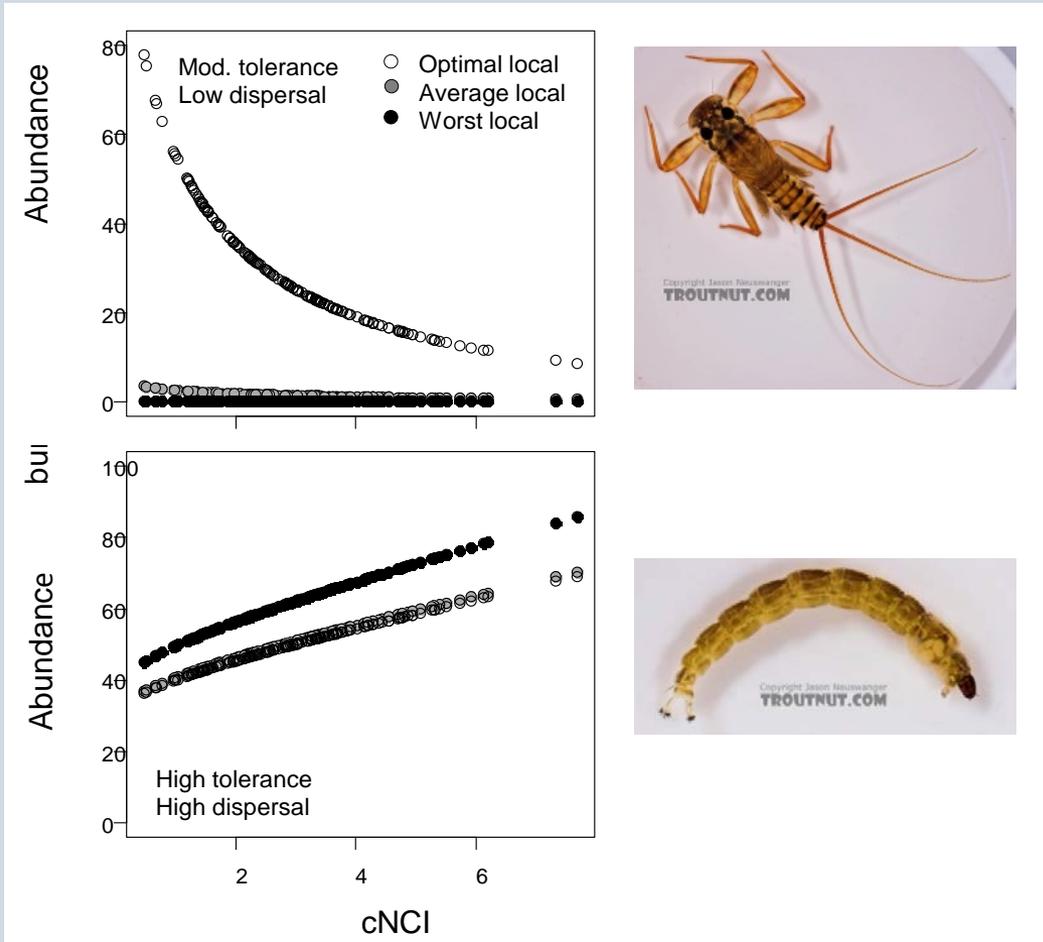
Results: neighborhood effects

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Conclusions

Pervasive land use degrades streams via 2 distinct pathways:

1. Degradation of local habitat
2. Degradation of neighborhood condition

Patchwork of distinct chemical signatures resulting from multiple natural and anthropogenic factors

Pervasive chemical degradation has regional biological implications

- Isolation effect on moderately sensitive, low dispersing taxa
- Increased mass effects associated with tolerant taxa

Management implications

Need for multi-stressor chemical remediation efforts

The capacity for restoration and preservation to maintain regional diversity is limited by neighborhood condition

Need strategic management actions that preserve metacommunity processes in the face of uncertain futures

- Preserve *network* of undisturbed headwater catchments

- Restoration should maximize neighborhood improvement

Acknowledgements

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