Can we achieve restoration goals for eastern dry forests with invasives and climate change?

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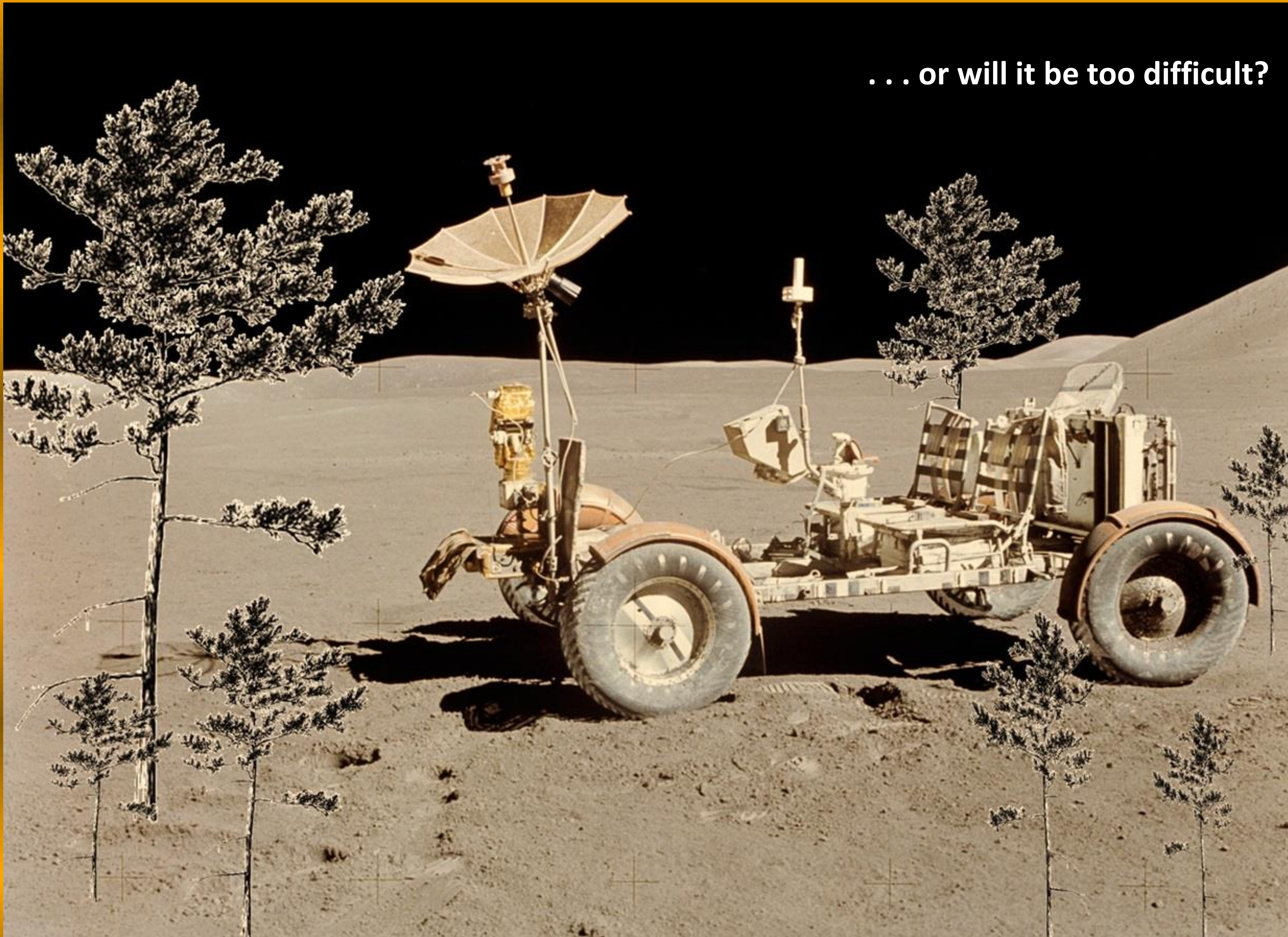
Pisgah National Forest, Grandfather Restoration Project
Collaborative Forest Landscape Restoration Program (CFLR)
July 15, 2014


. . . or will it be too difficult?

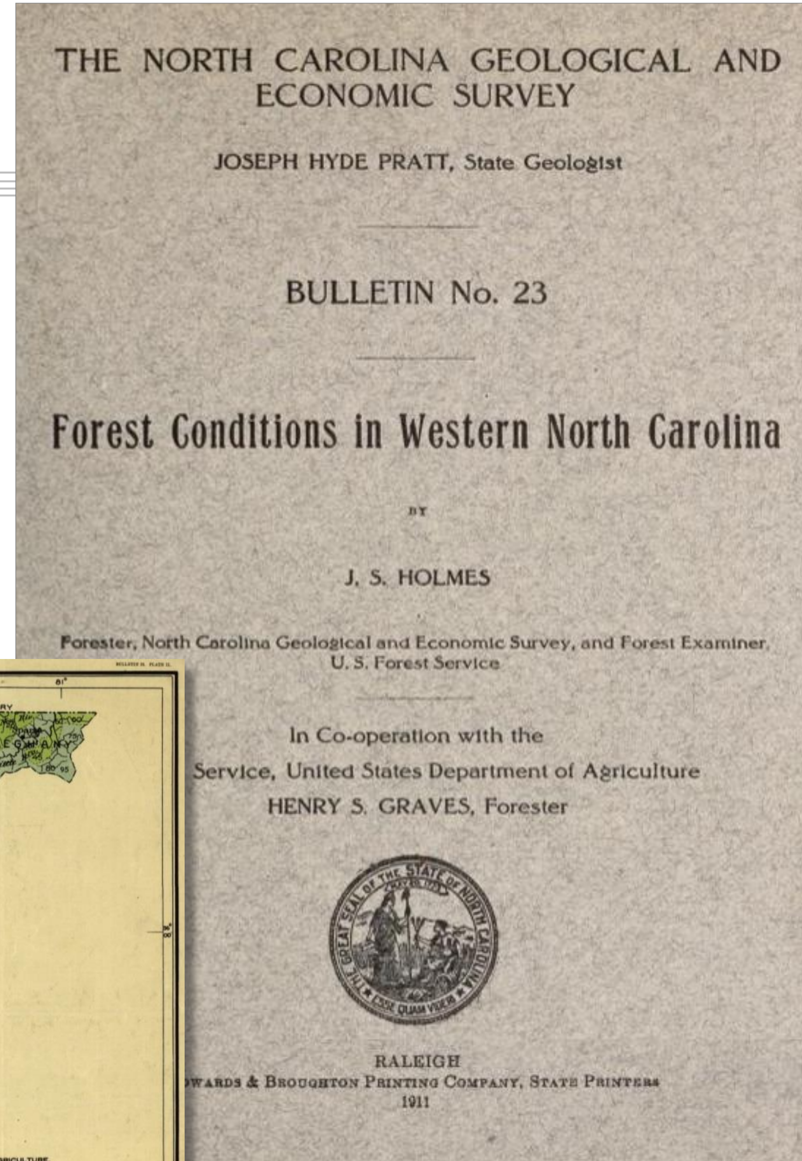
Outline

1. **Novelty**
    a. Management legacies: *changing the game*
    b. Climate trends and futures: *changing the rules*
    c. Invasive exotics: *changing the cards in our hand*
2. **Integrating multiple stressors**
    a. How do stressors work together?
    b. Individual vs. combined effects
3. **Broad-scale integrative solutions**
    a. A framework
    b. A local example with potential management options
    c. Summary

1. Novelty

Management legacies

Holmes, John Simcox, 1911. ***Forest Conditions in Western North Carolina.*** Bulletin No. 23. North Carolina Geological and Economic Survey. Raleigh. http://www.biodiversitylibrary.org/bibliography/84976#/summary


THE NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, State Geologist

BULLETIN No. 23

Forest Conditions in Western North Carolina

BY

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In Co-operation with the

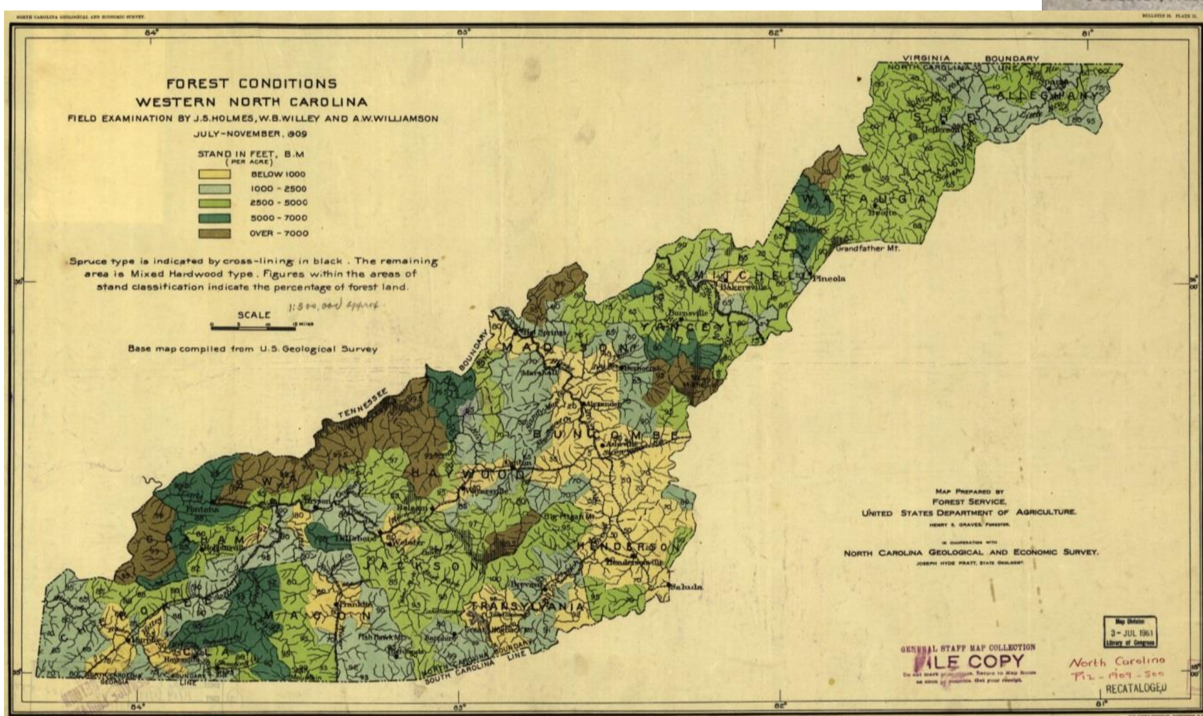
Service, United States Department of Agriculture

HENRY S. GRAVES, Forester

RALEIGH

wards & Broughton Printing Company, State Printers

1911



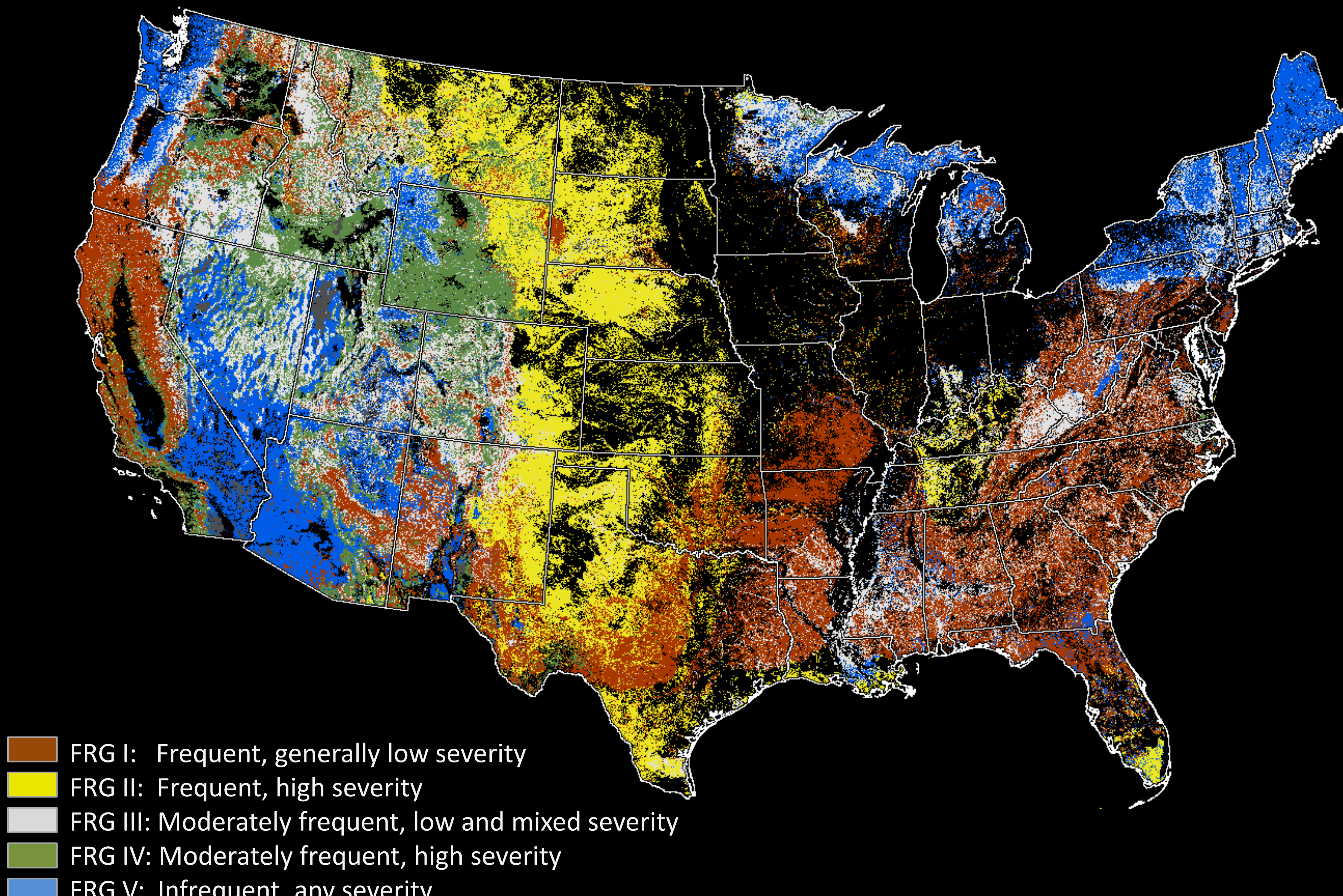
1. Novelty

Management legacies: A dry-forest disturbance in a mesic forest type (Holmes 1911)

MATURE SPRUCE FOREST BURNT OVER AND DESTROYED TWELVE YEARS AGO.

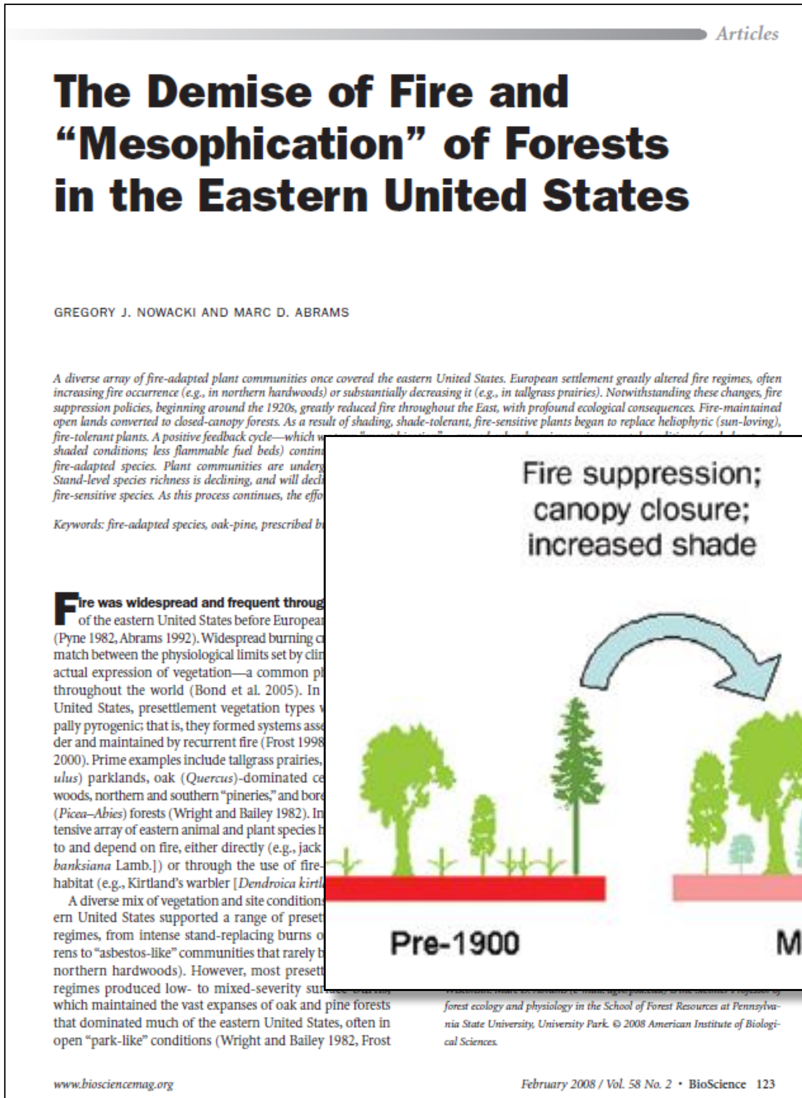
1. Novelty

Management legacies: Historical fire regime groups of existing natural vegetation (LANDFIRE)



1. Novelty

Management legacies: Historical versus present-day fire regimes



The Demise of Fire and "Mesophication" of Forests in the Eastern United States

GREGORY J. NOWACKI AND MARC D. ABRAMS

A diverse array of fire-adapted plant communities once covered the eastern United States. European settlement greatly altered fire regimes, often increasing fire occurrence (e.g., in northern hardwoods) or substantially decreasing it (e.g., in tallgrass prairies). Notwithstanding these changes, fire suppression policies, beginning around the 1920s, greatly reduced fire throughout the East, with profound ecological consequences. Fire-maintained open lands converted to closed-canopy forests. As a result of shading, shade-tolerant, fire-sensitive plants began to replace heliophytic (sun-loving), fire-tolerant plants. A positive feedback cycle—which w... shaded conditions; less flammable fuel beds) contin... fire-adapted species. Plant communities are under... Stand-level species richness is declining, and will decl... fire-sensitive species. As this process continues, the effo...

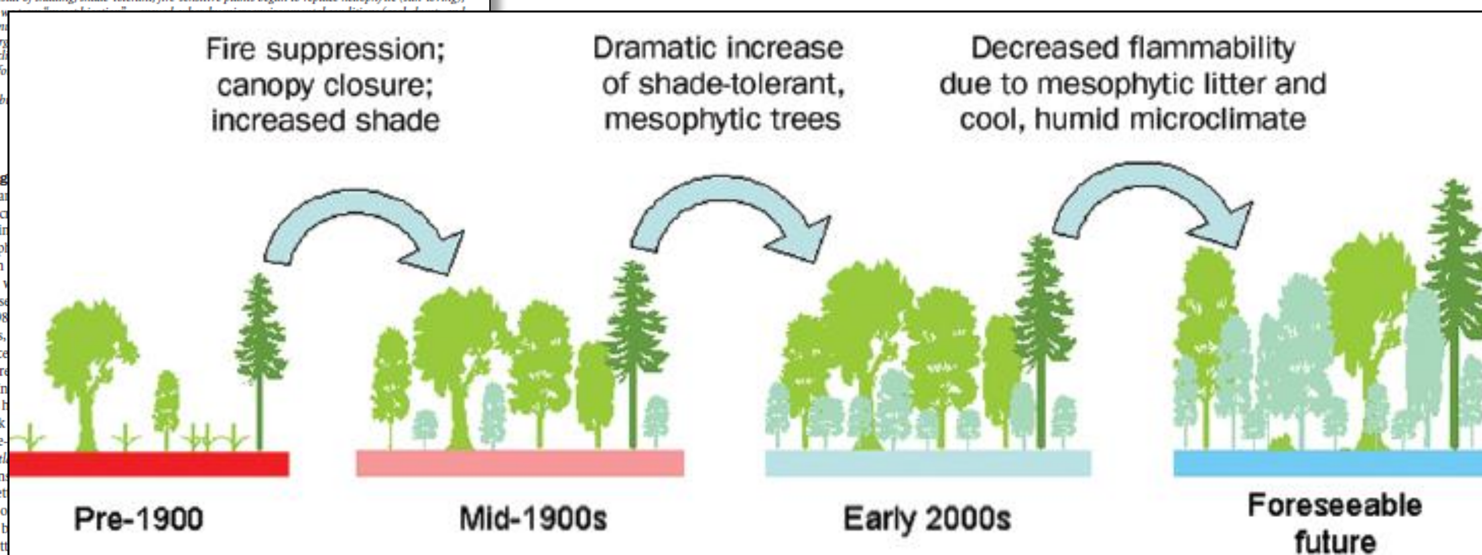
Keywords: fire-adapted species, oak-pine, prescribed b...

Fire was widespread and frequent throug... of the eastern United States before Europea... (Pyne 1982, Abrams 1992). Widespread burning c... match between the physiological limits set by cli... actual expression of vegetation—a common p... throughout the world (Bond et al. 2005). In ... United States, presettlement vegetation types ... pally pyrogenic; that is, they formed systems ass... der and maintained by recurrent fire (Frost 1998 ... 2000). Prime examples include tallgrass prairies, ... *ulus*) parklands, oak (*Quercus*)-dominated ce... woods, northern and southern "pineries," and bor... (*Picea–Abies*) forests (Wright and Bailey 1982). In... tensive array of eastern animal and plant species ... to and depend on fire, either directly (e.g., jack ... *banksiana* Lamb.]) or through the use of fire-... habitat (e.g., Kirtland's warbler [*Dendroica kirtl*...

A diverse mix of vegetation and site condition... ern United States supported a range of preset... regimes, from intense stand-replacing burns o... rens to "asbestos-like" communities that rarely b... northern hardwoods). However, most presett... regimes produced low- to mixed-severity su... which maintained the vast expanses of oak and pine forests that dominated much of the eastern United States, often in open "park-like" conditions (Wright and Bailey 1982, Frost

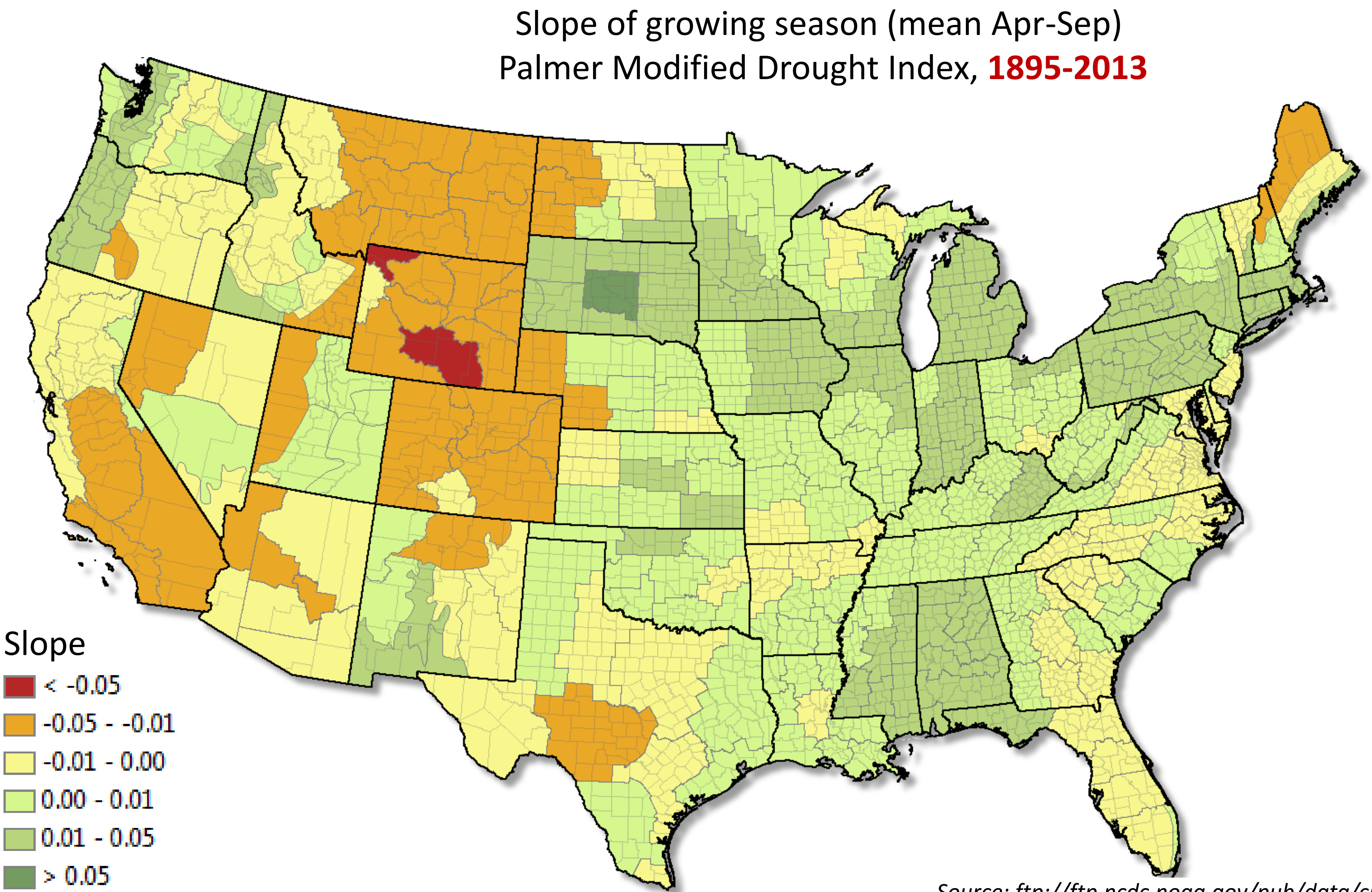
... forest ecology and physiology in the School of Forest Resources at Pennsylvania State University, University Park.

Without characteristic fire,
structural and compositional changes
contribute to forest mesophication:
<u>is this more fragile with climate change</u>?



1. Novelty

Climate trends and futures: Climate Division trends for the conterminous US

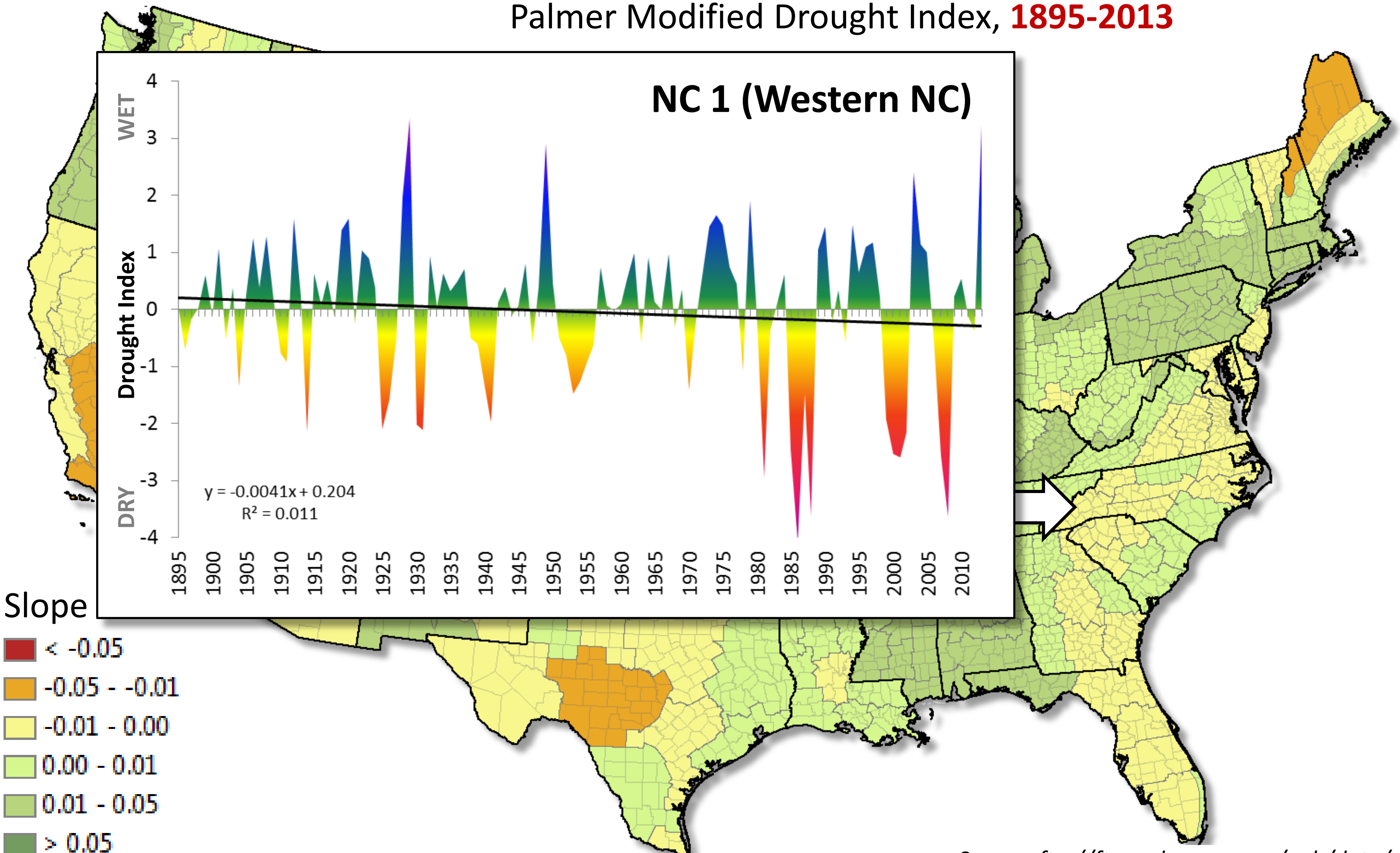


Source: ftp://ftp.ncdc.noaa.gov/pub/data/cirs/

1. Novelty

Climate trends and futures: NCDC Climate Division trends for the conterminous US

Slope of growing season (mean Apr-Sep)
Palmer Modified Drought Index, **1895-2013**



Source: ftp://ftp.ncdc.noaa.gov/pub/data/cirs/

1. Novelty

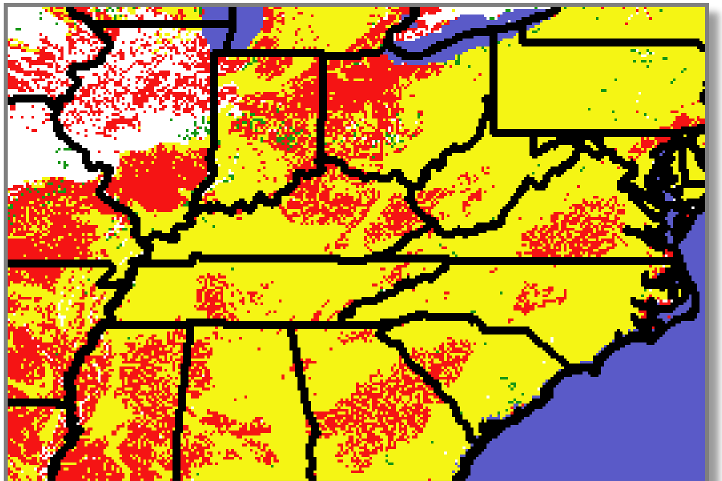
Predicting regional species stress from climate change: **The FORECASTS PROJECT**

<u>Source</u>: http://www.geobabble.org/~hnw/global/treeranges5/climate_change

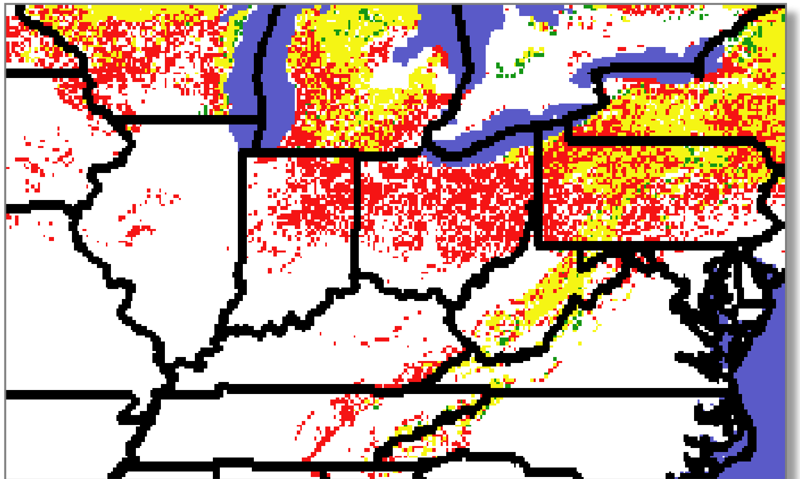
GAIN
PERSIST
LOSE

Range Shift for Hadley B1 Scenario, 2050

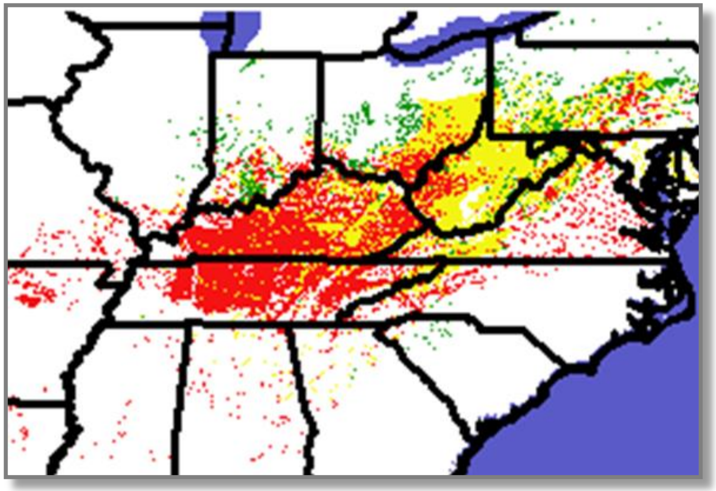
Red Maple



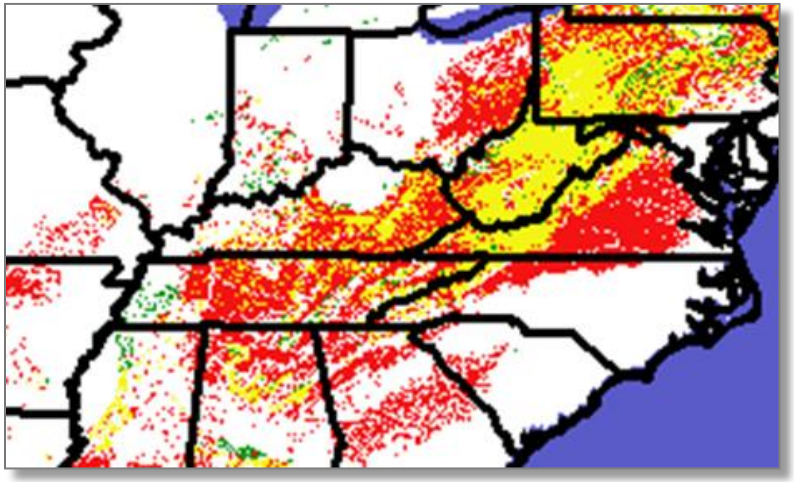
Yellow Birch



Yellow Buckeye



Cucumber Magnolia



1. Novelty

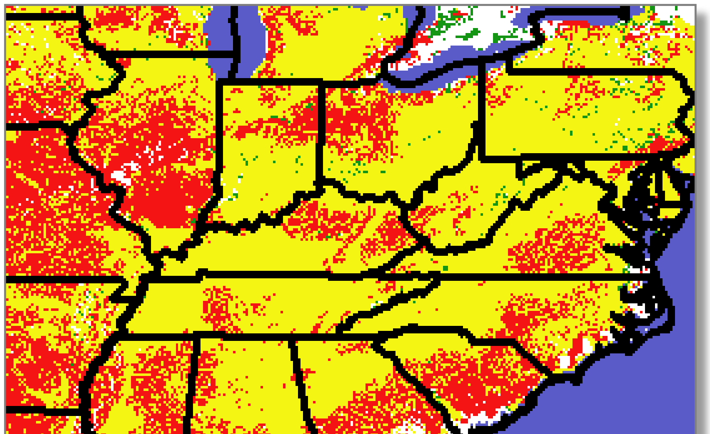
Predicting regional species stress from climate change: **The FORECASTS PROJECT**

GAIN
PERSIST
LOSE

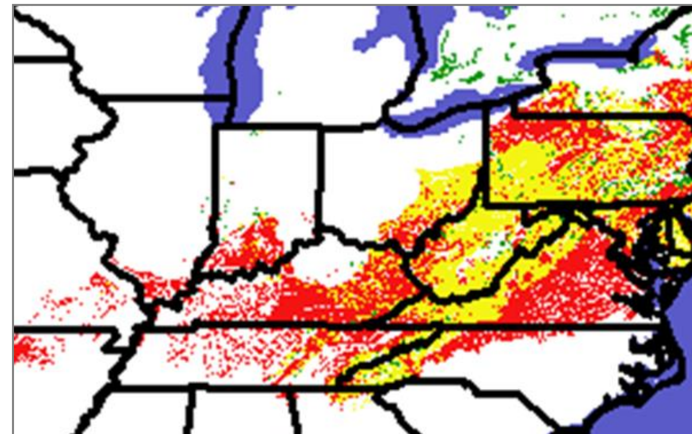
Source: http://www.geobabble.org/~hnw/global/treeranges5/climate_change

Range Shift for Hadley B1 Scenario, 2050

White Oak



Pitch Pine



Northern Red Oak

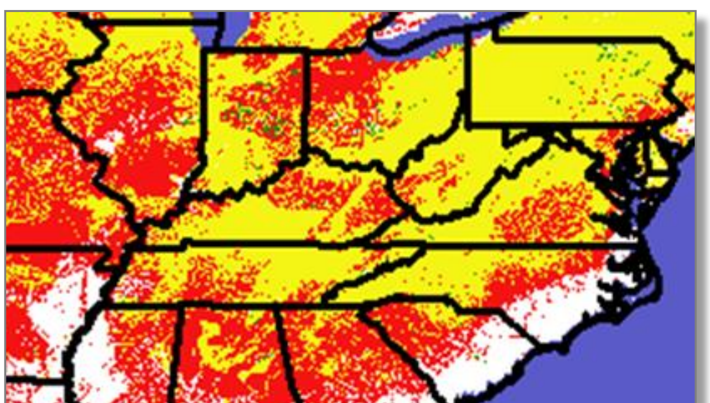
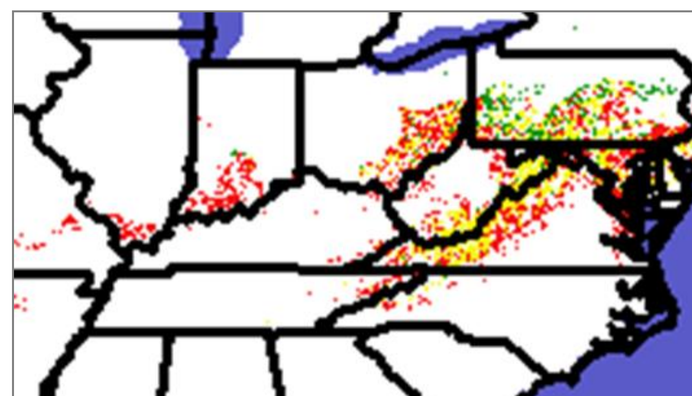
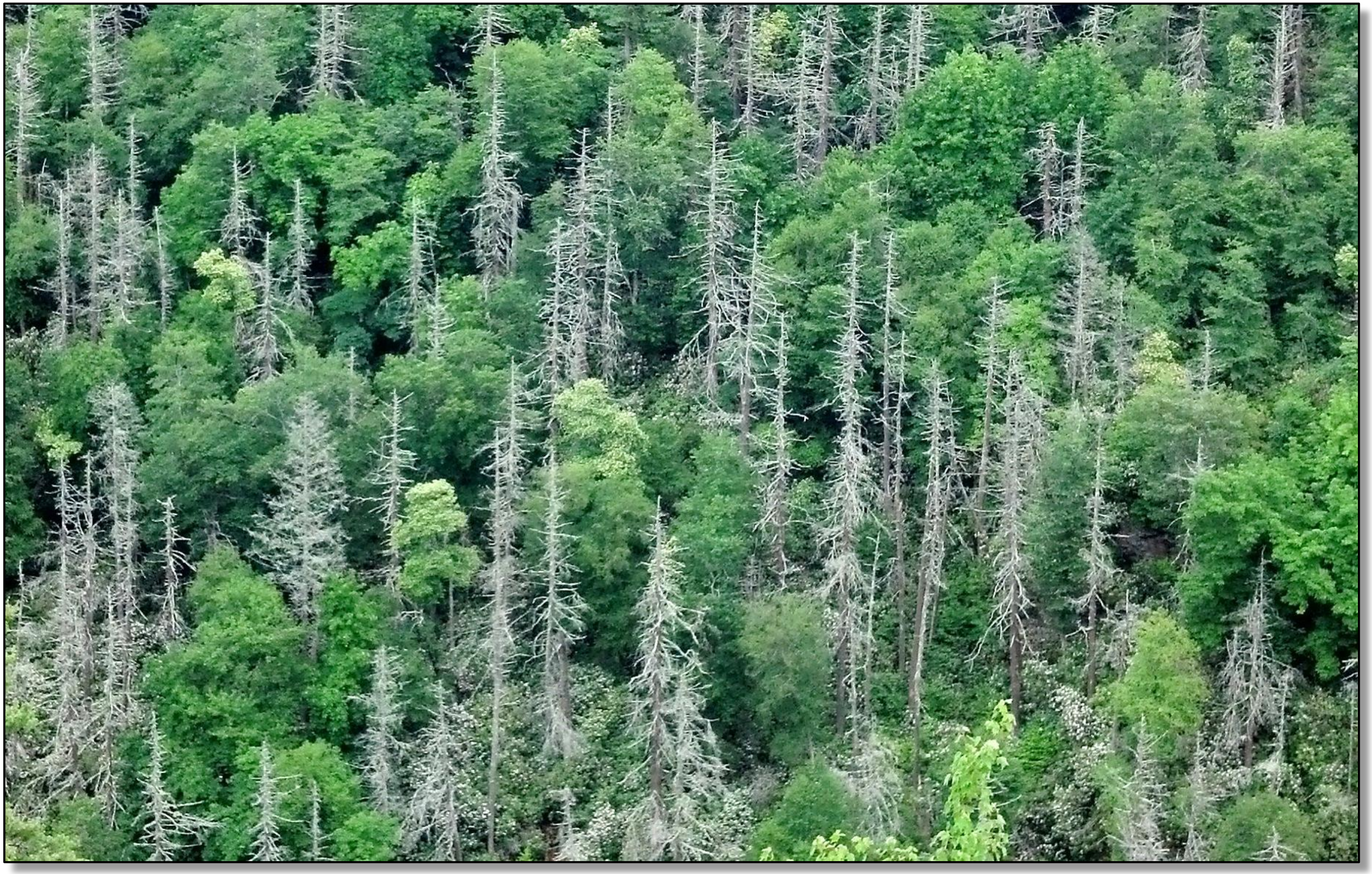


Table Mouontain Pine



1. Novelty

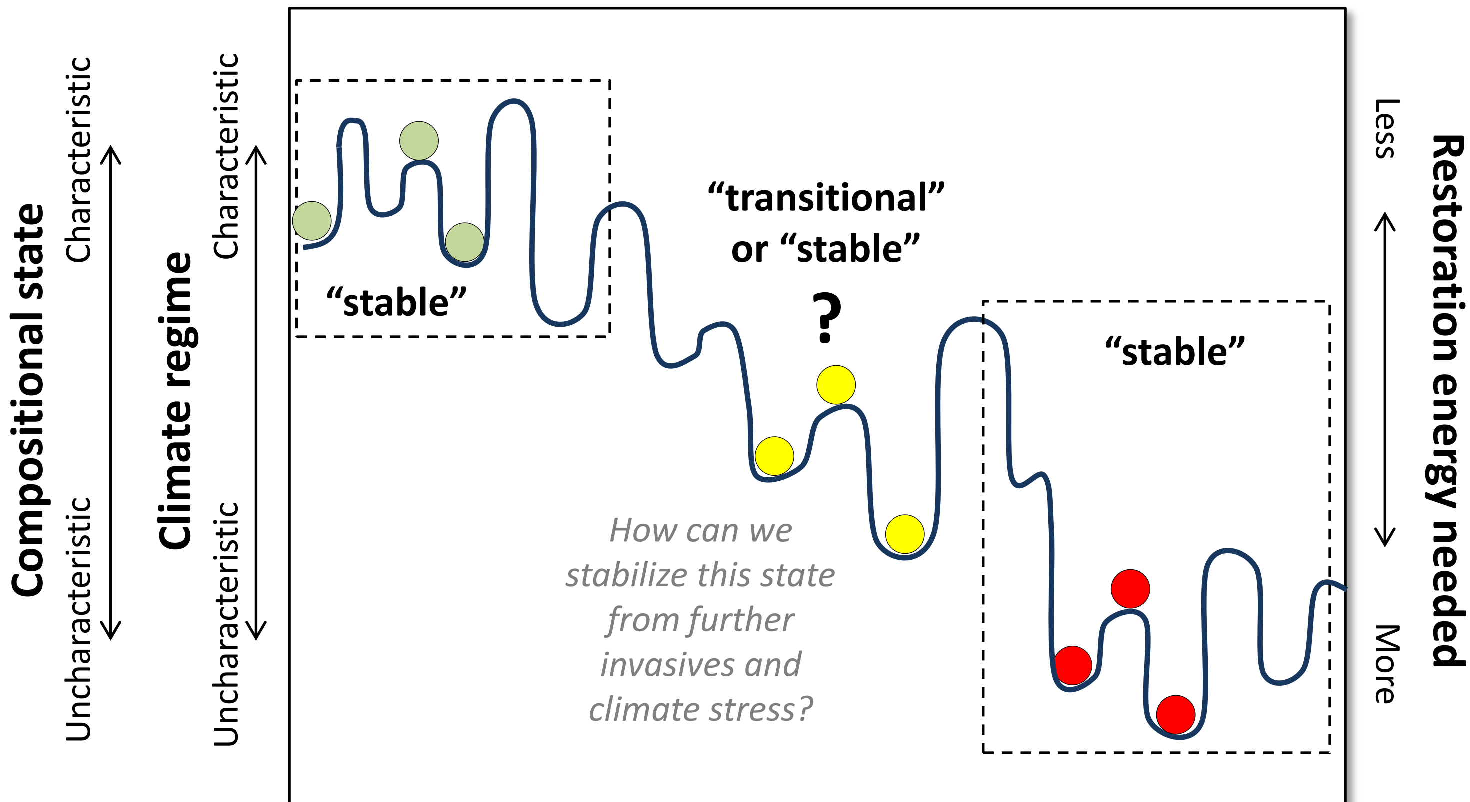
Invasive exotics: not all exotics are bad, but some are really bad!



Linville Gorge, July 2014: Photo by SP Norman USFS

1. Novelty

Hypothetical linkages with invasives and climate change

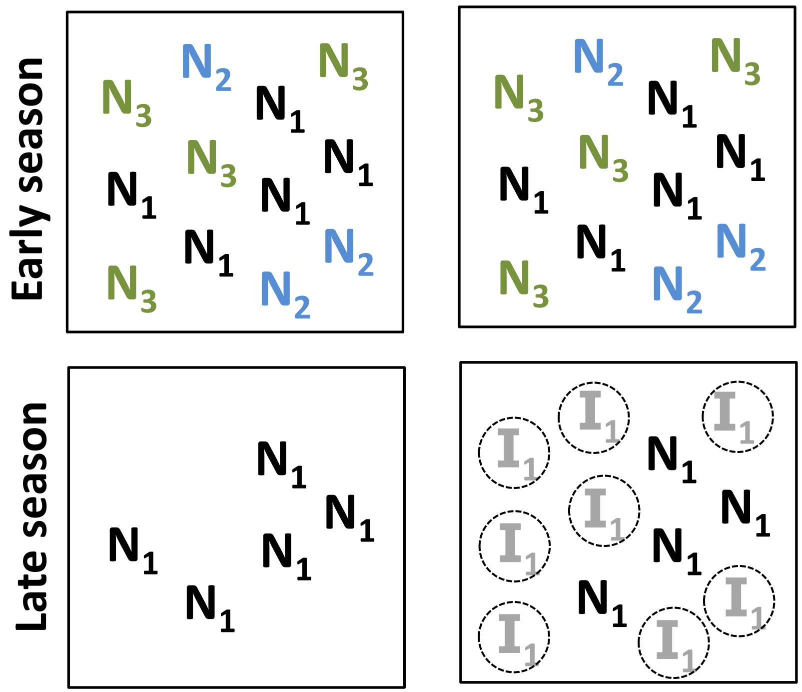


1. Novelty

Invasive exotics and resiliency

N Native
I Invasive

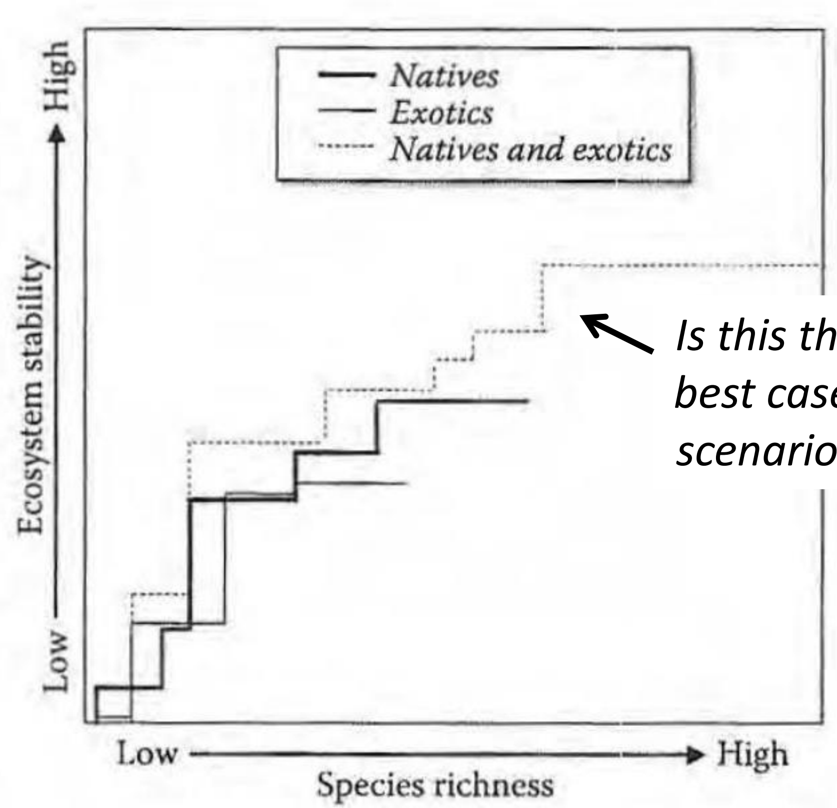
Initial conditions | Empty niche filling (tolerance)



Native communities often harbor "empty niches".

Some exotics don't displace existing species, but may reduce invasibility.

Hypothetical impact of natives and "empty-niche-filling exotics" on stability



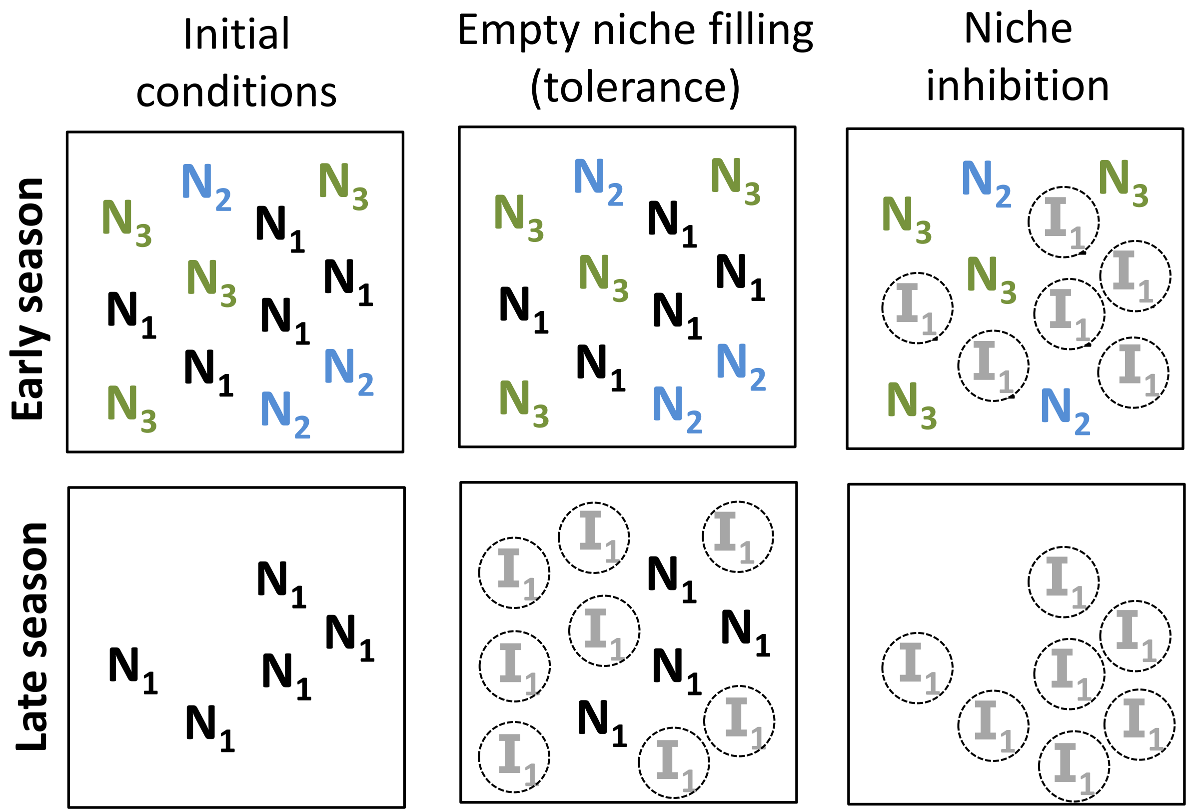
Is this the best case scenario?

Guo and Norman 2013

1. Novelty

Invasive exotics and resiliency

N Native
I Invasive



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Invasives can displace natives through direct competition.

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Invasive exotics and resiliency

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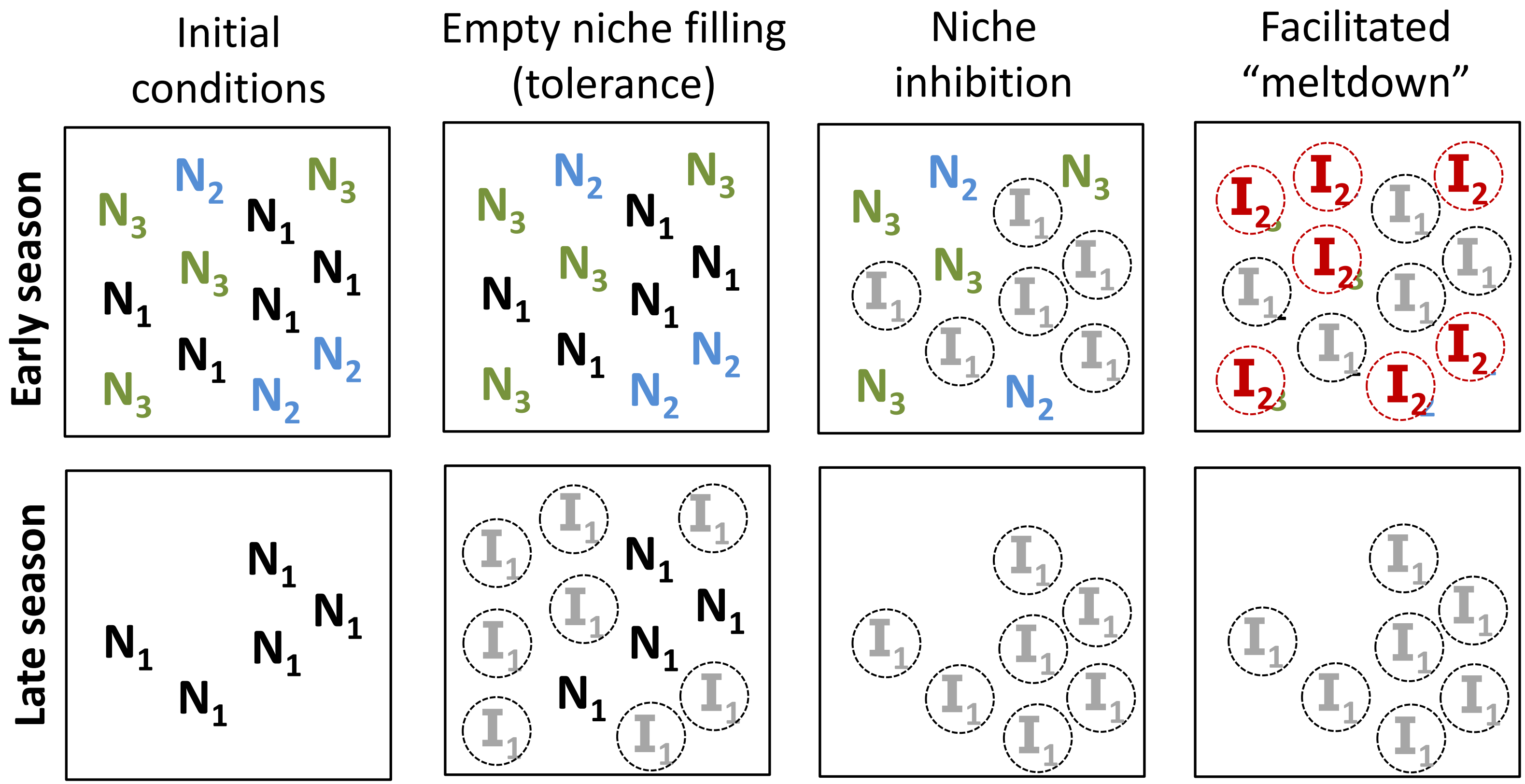


Native communities often harbor “empty niches”.

Some exotics don’t displace existing species, but may reduce invasibility.

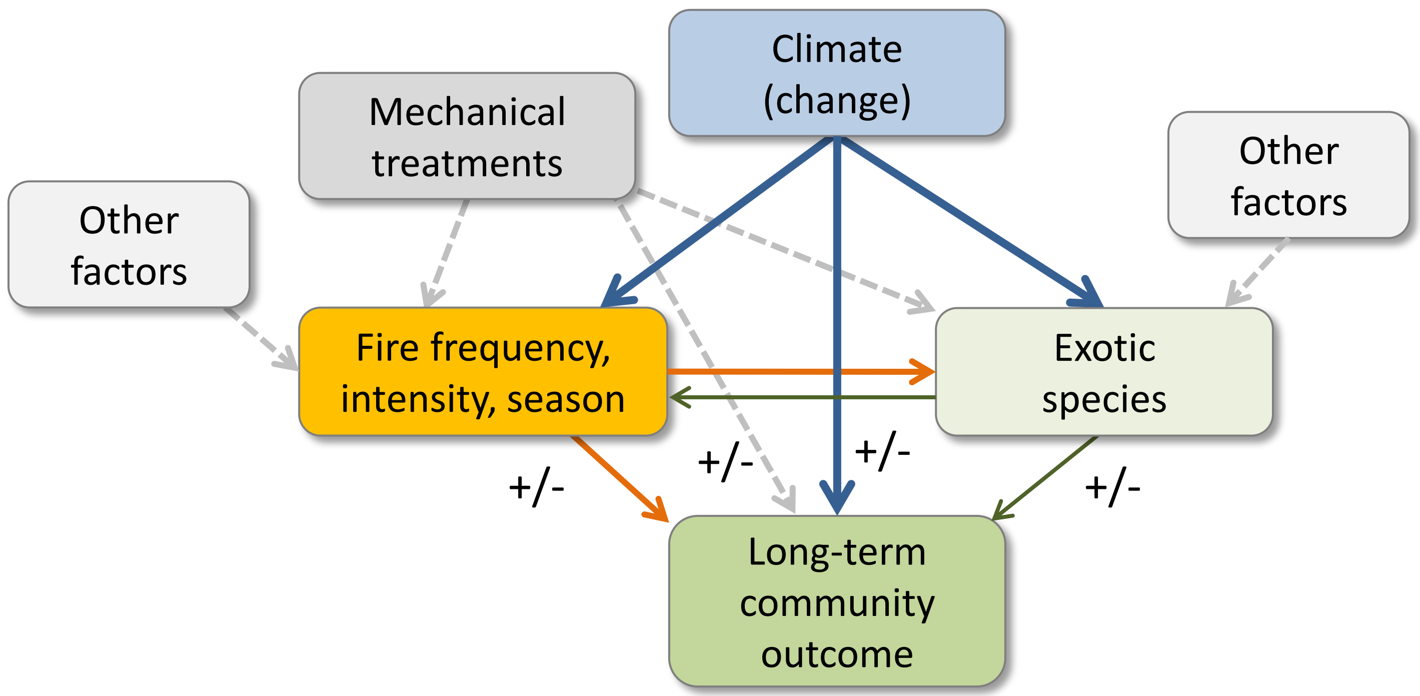
Invasives can displace natives through direct competition.

Some invasives can cause a cascading loss of natives by altering disturbance regimes or keystone functional roles.

2. Integrating multiple stressors

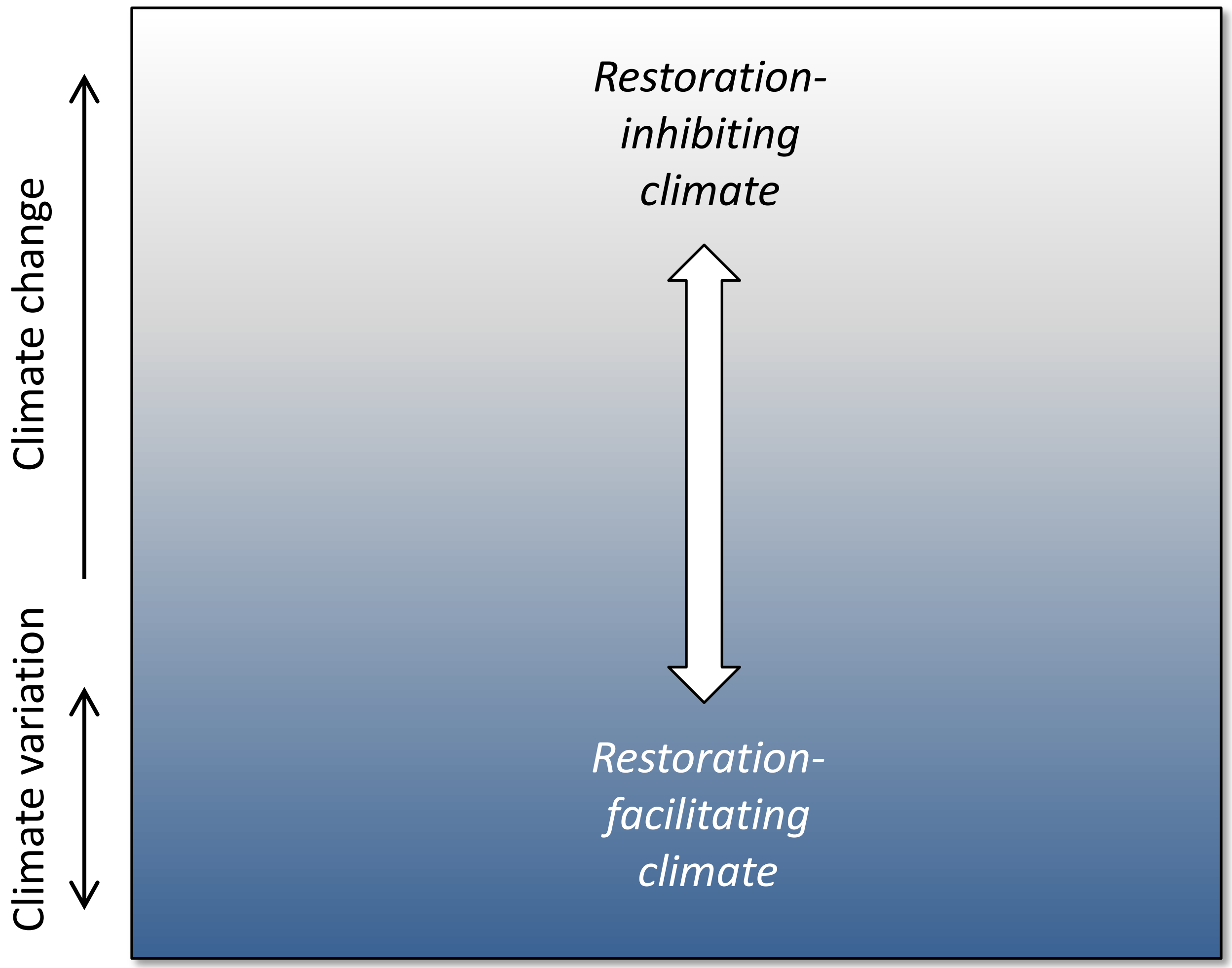
How do stressors work together?

A conceptual model showing direct and indirect influences of invasives and climate change on community outcome



2. Integrating multiple stressors

Individual vs. combined effects



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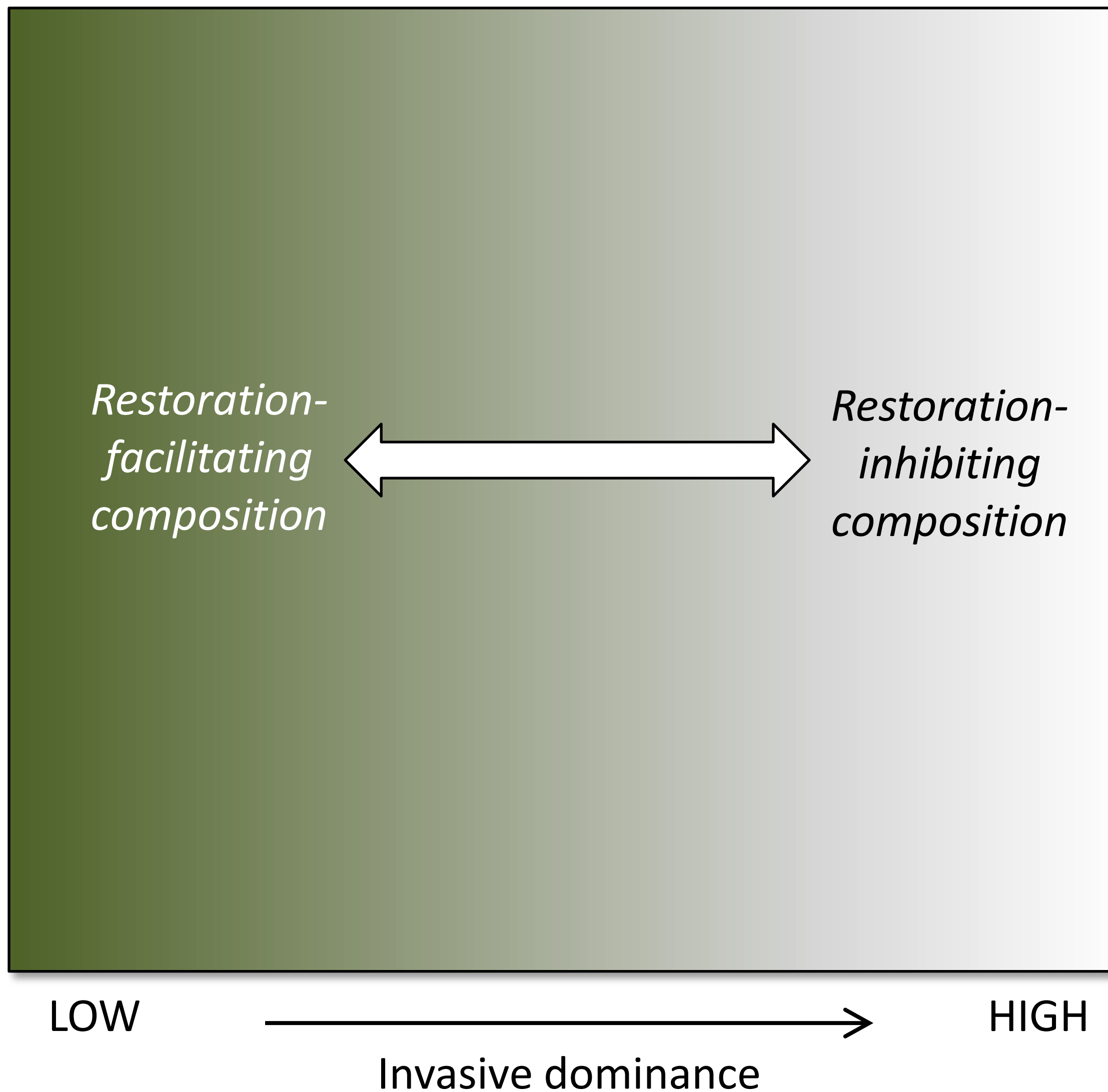
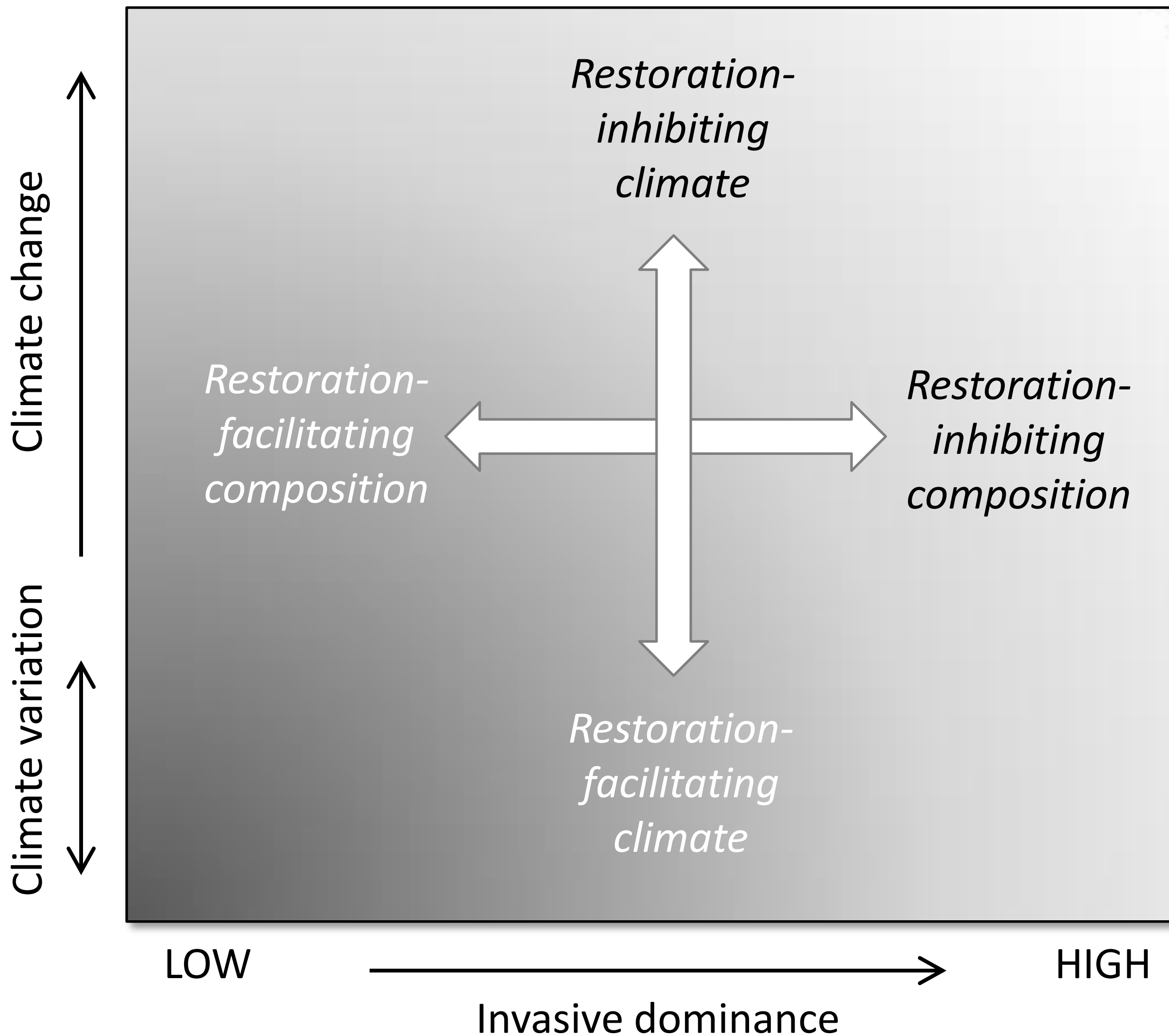


2. Integrating multiple stressors

Individual vs. combined effects



2. Integrating multiple stressors

Interactive effects can have varying degrees and types of independence and synergy

INDEPENDENT

Climate change \ Invasive dominance	1	2	3
3	3	3	3
2	2	2	3
1	1	2	3

ADDITIVE

Climate change \ Invasive dominance	1	2	3
3	4	5	6
2	3	4	5
1	2	3	4

MULTIPLICATIVE

Climate change \ Invasive dominance	1	2	3
3	3	6	9
2	2	4	6
1	1	2	3

DOMINATED

Climate change \ Invasive dominance	1	2	3
3	3	3	3
2	2	2	2
1	1	1	1

CANCELLING

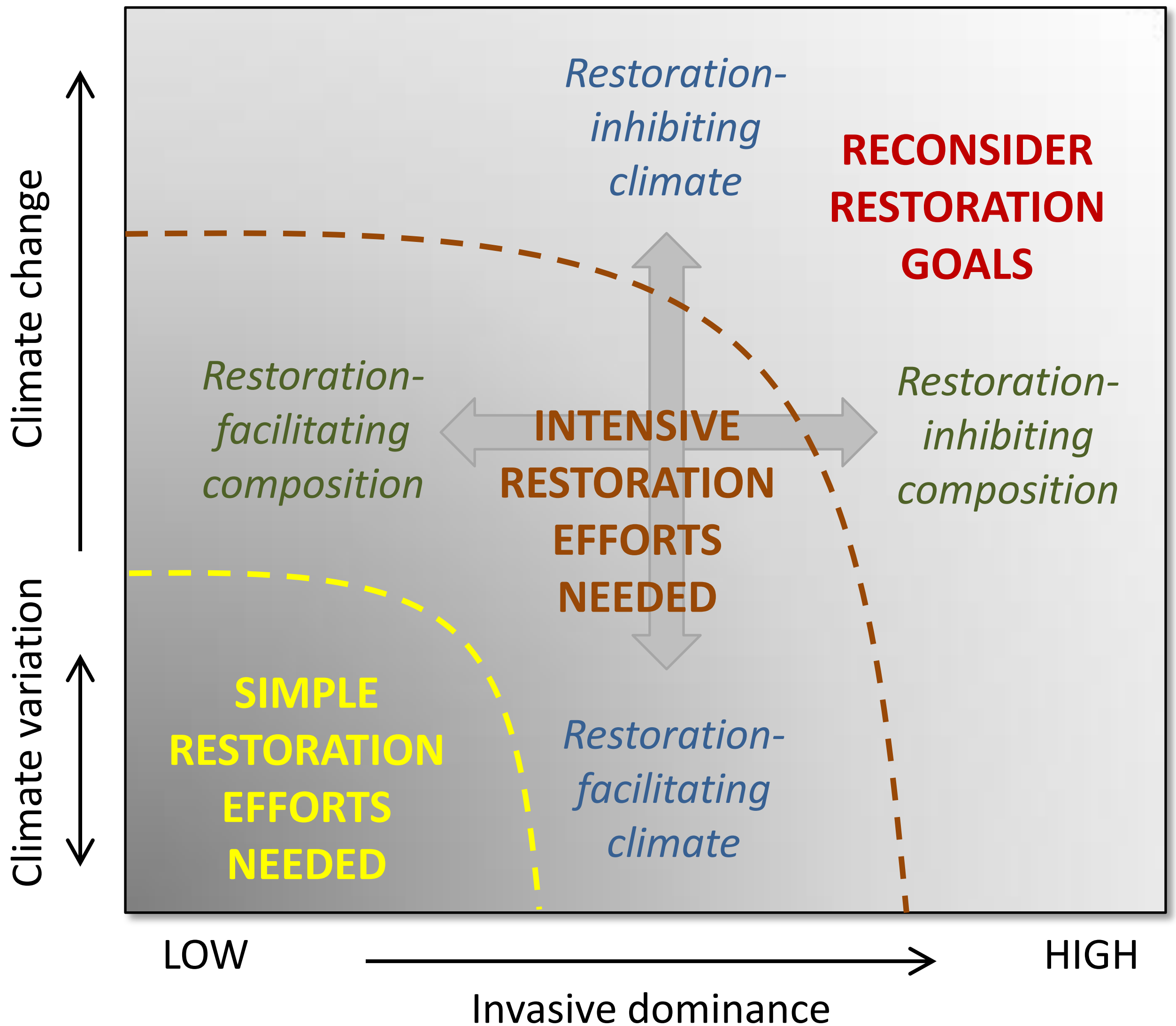
Climate change \ Invasive dominance	1	2	3
3	3	3	3
2	3	4	3
1	2	3	3

THRESHOLDED

Climate change \ Invasive dominance	1	2	3
3	3	6	9
2	2	2	6
1	1	2	3

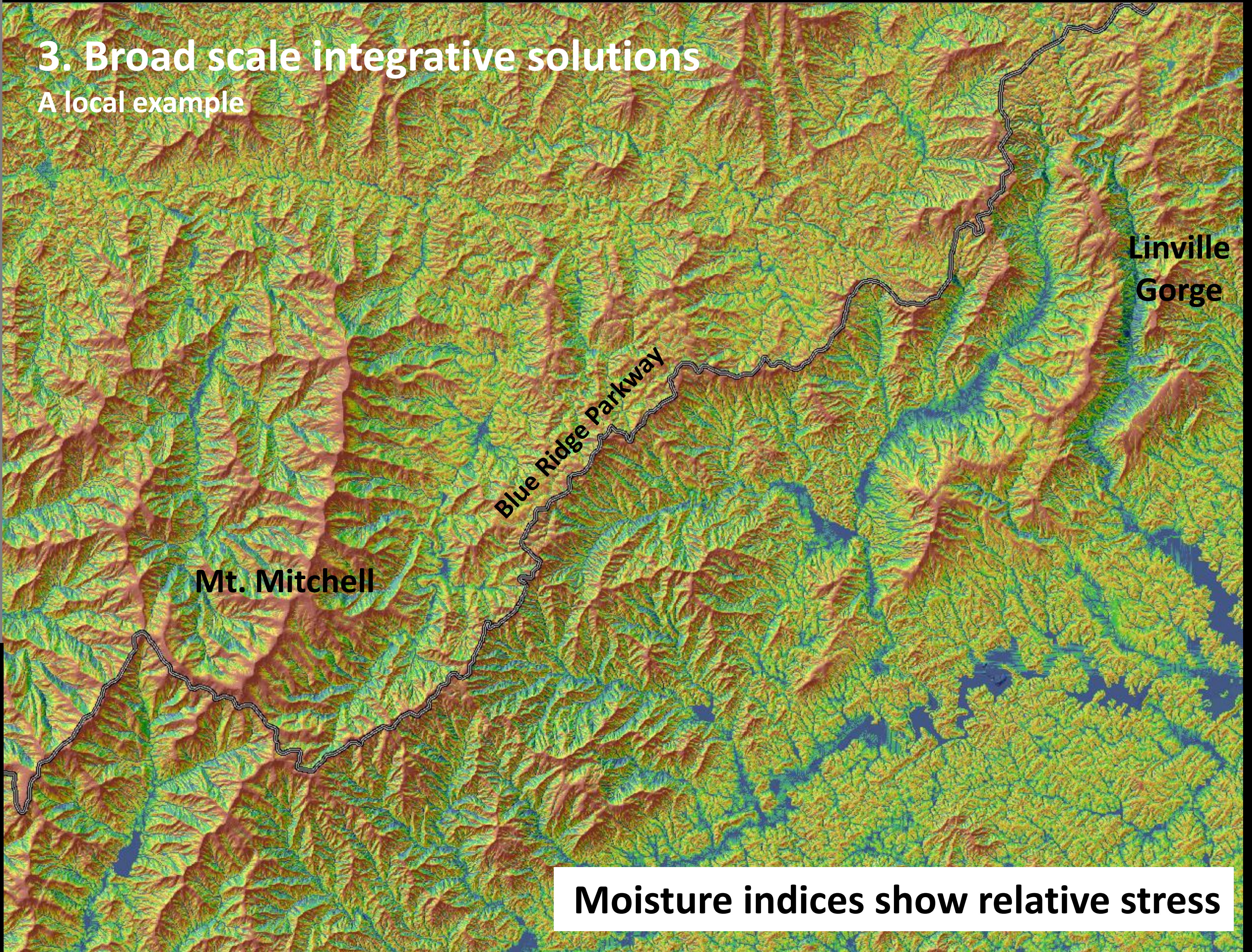
3. Broad scale integrative solutions

A framework for dealing with multiple stressors



3. Broad scale integrative solutions

A local example



3. Broad scale integrative solutions

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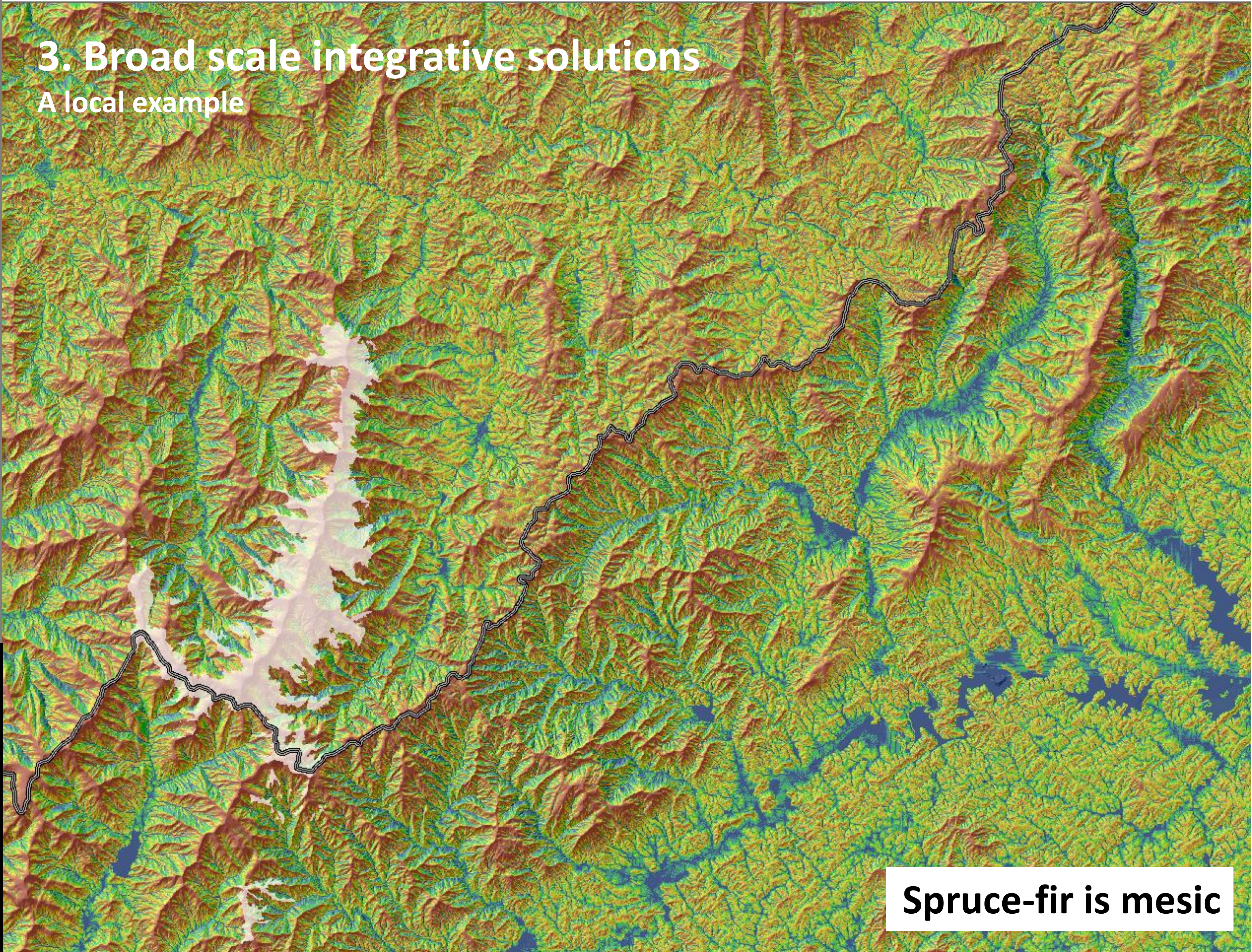

3. Broad scale integrative solutions

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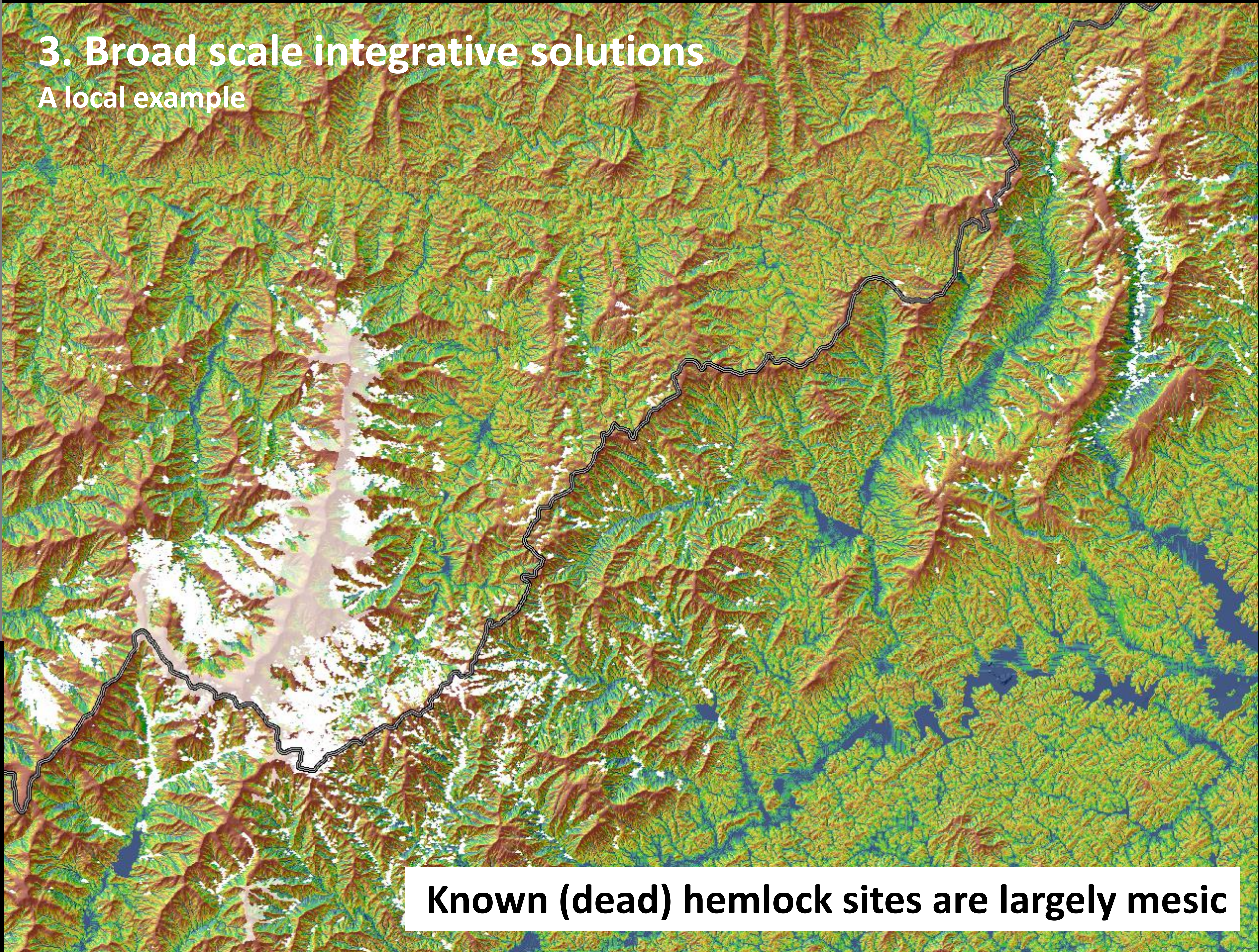
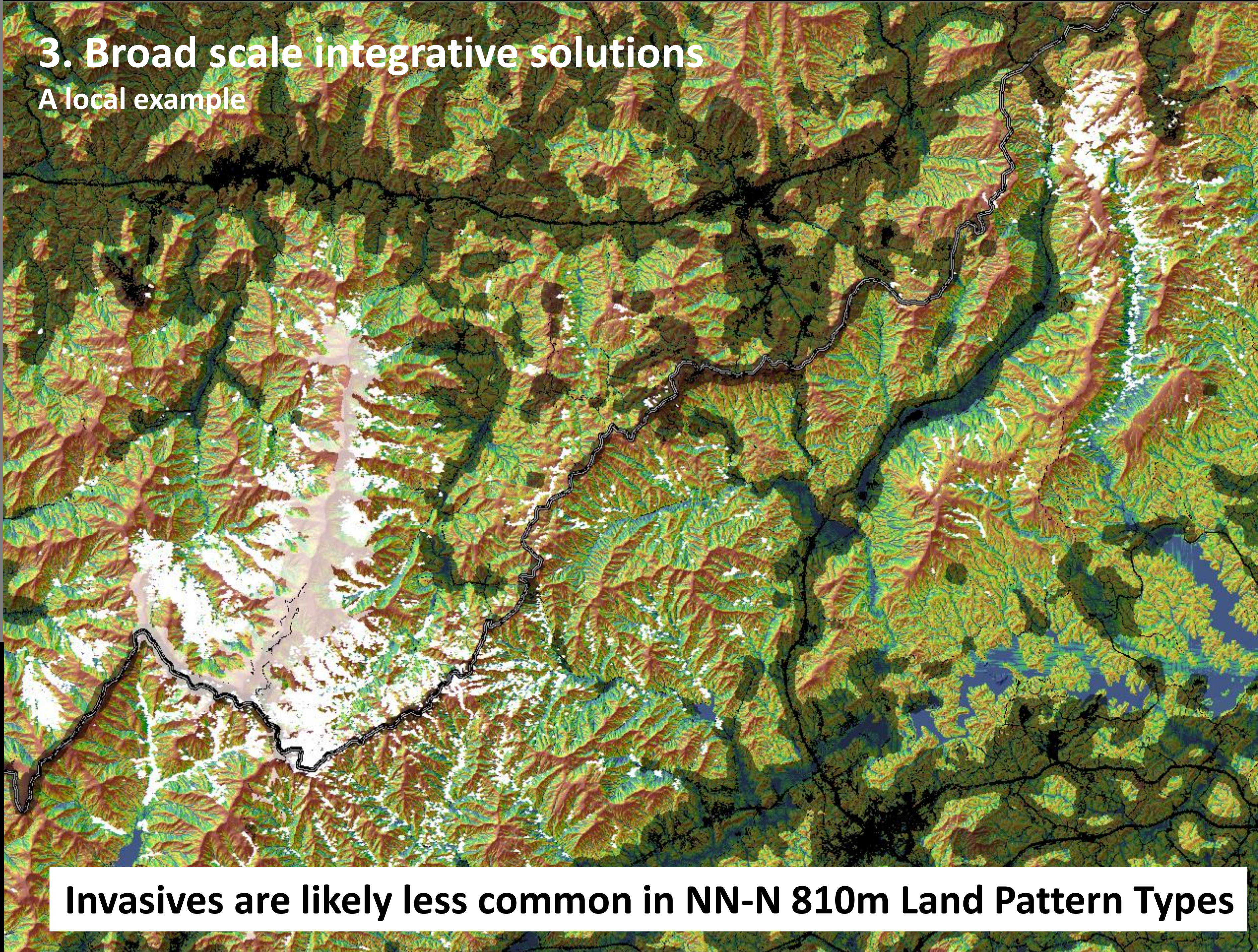


Known (dead) hemlock sites are largely mesic

3. Broad scale integrative solutions

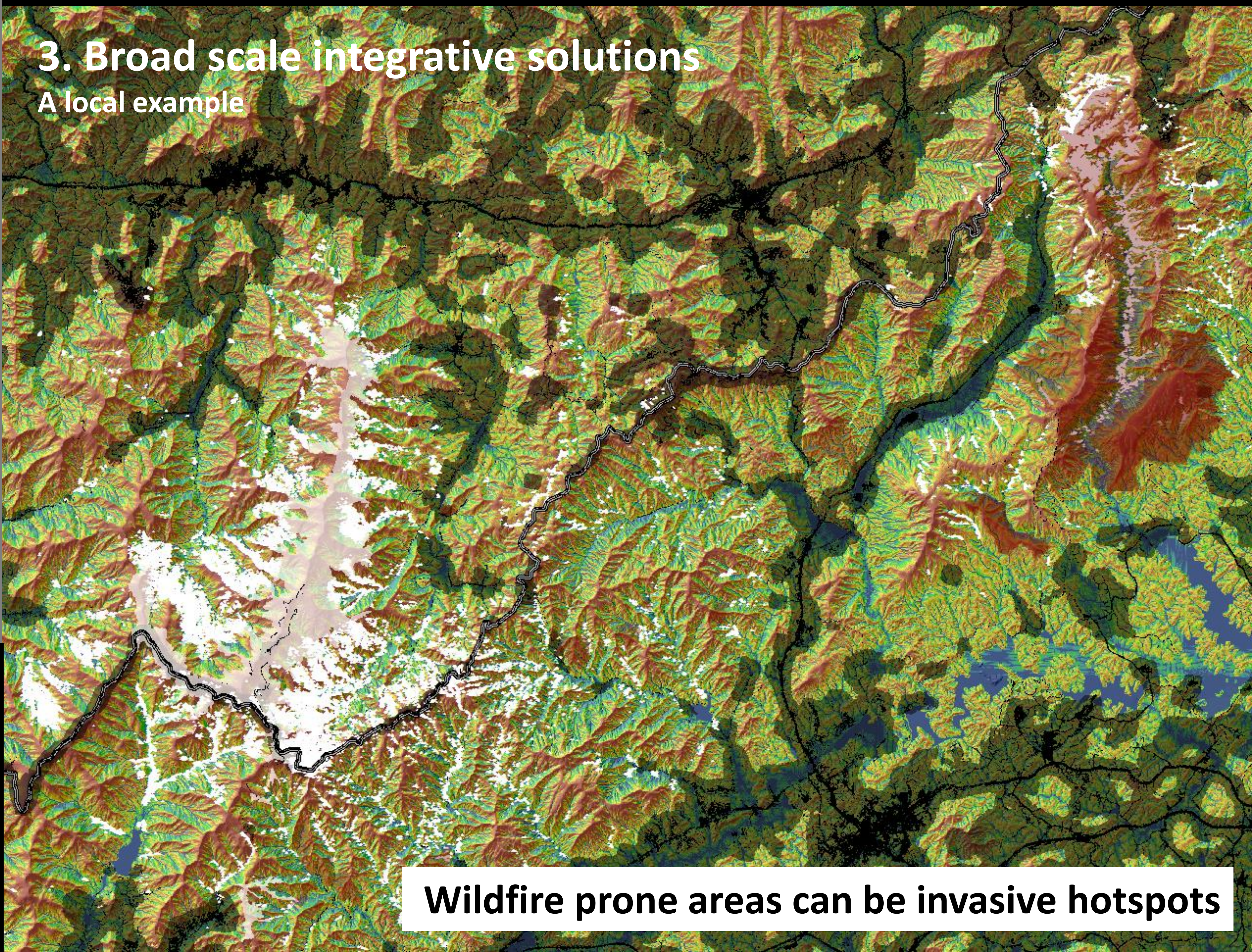
A local example



Invasives are likely less common in NN-N 810m Land Pattern Types

3. Broad scale integrative solutions

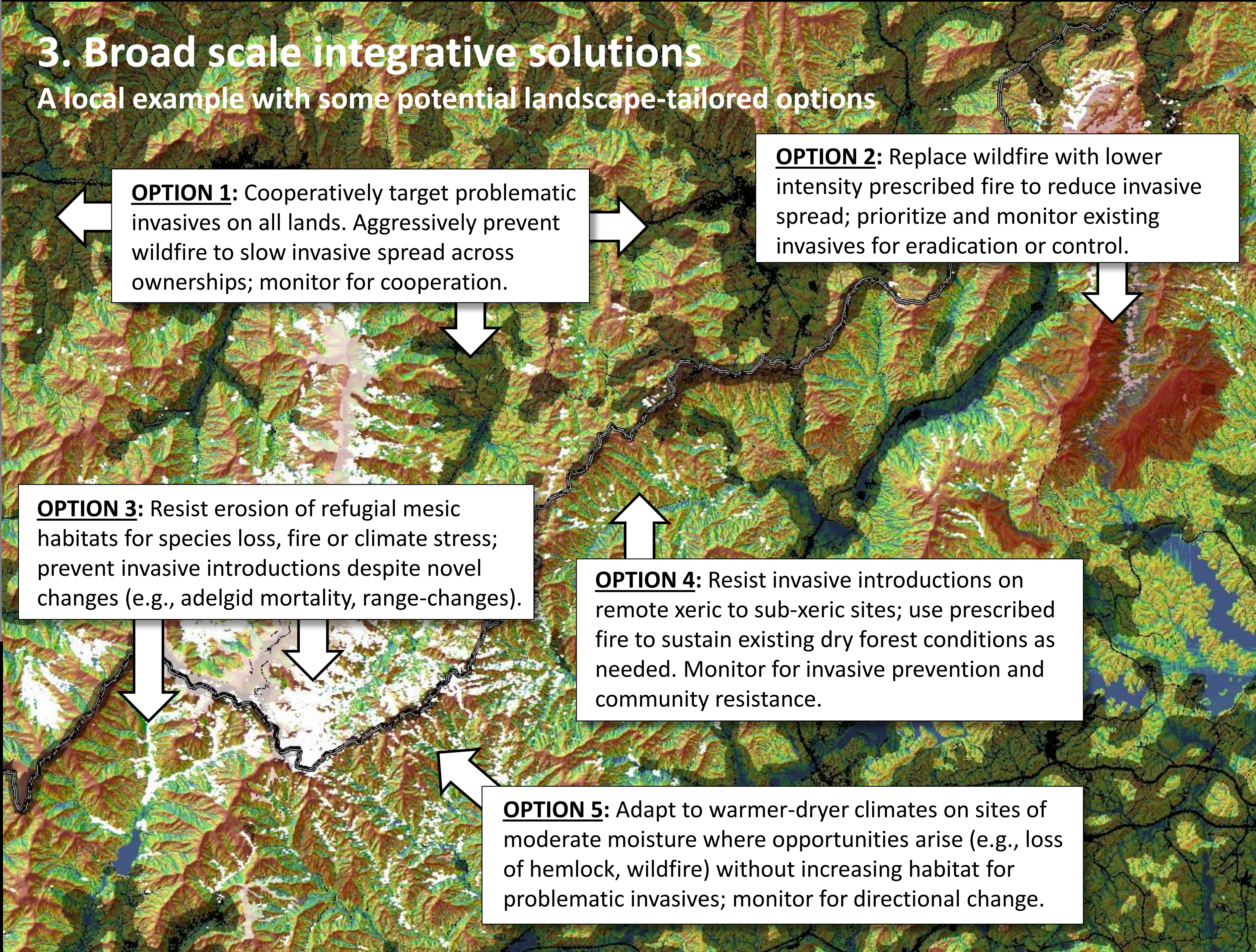
A local example



Wildfire prone areas can be invasive hotspots

3. Broad scale integrative solutions

A local example with some potential landscape-tailored options



<u>OPTION 1</u>: Cooperatively target problematic invasives on all lands. Aggressively prevent wildfire to slow invasive spread across ownerships; monitor for cooperation.

<u>OPTION 2</u>: Replace wildfire with lower intensity prescribed fire to reduce invasive spread; prioritize and monitor existing invasives for eradication or control.

<u>OPTION 3</u>: Resist erosion of refugial mesic habitats for species loss, fire or climate stress; prevent invasive introductions despite novel changes (e.g., adelgid mortality, range-changes).

<u>OPTION 4</u>: Resist invasive introductions on remote xeric to sub-xeric sites; use prescribed fire to sustain existing dry forest conditions as needed. Monitor for invasive prevention and community resistance.

<u>OPTION 5</u>: Adapt to warmer-dryer climates on sites of moderate moisture where opportunities arise (e.g., loss of hemlock, wildfire) without increasing habitat for problematic invasives; monitor for directional change.

3. Broad scale integrative solutions

Summary thoughts

1. Restoration of dry forest structure and composition may increase resilience with climate change, but it may also escalate problems with invasive species.

2. When hazards are integrated, the strongest management options may change across the landscape, particularly with very long-term planning horizons.

3. We may not need to achieve or monitor the same type of things to be successful.