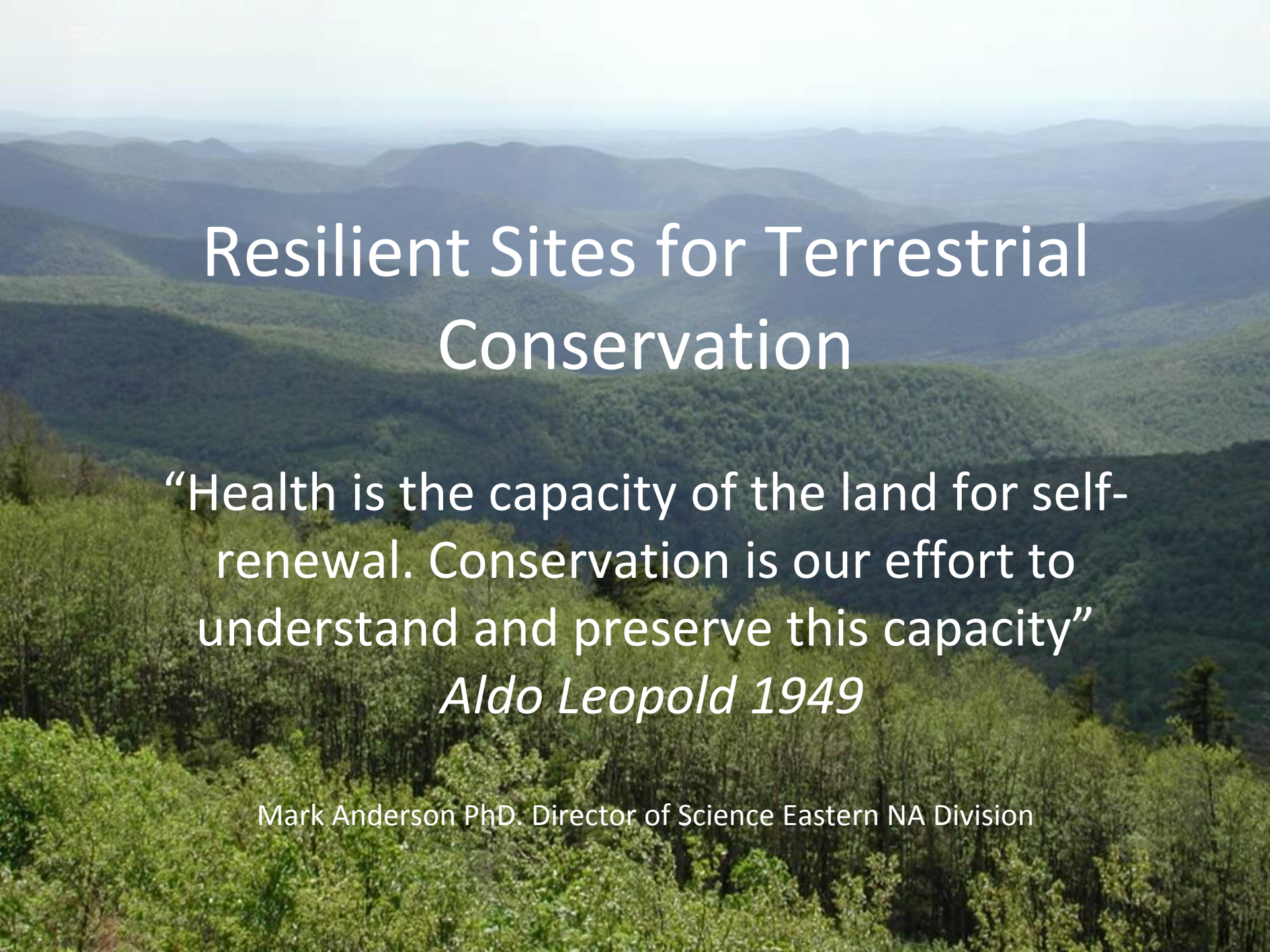


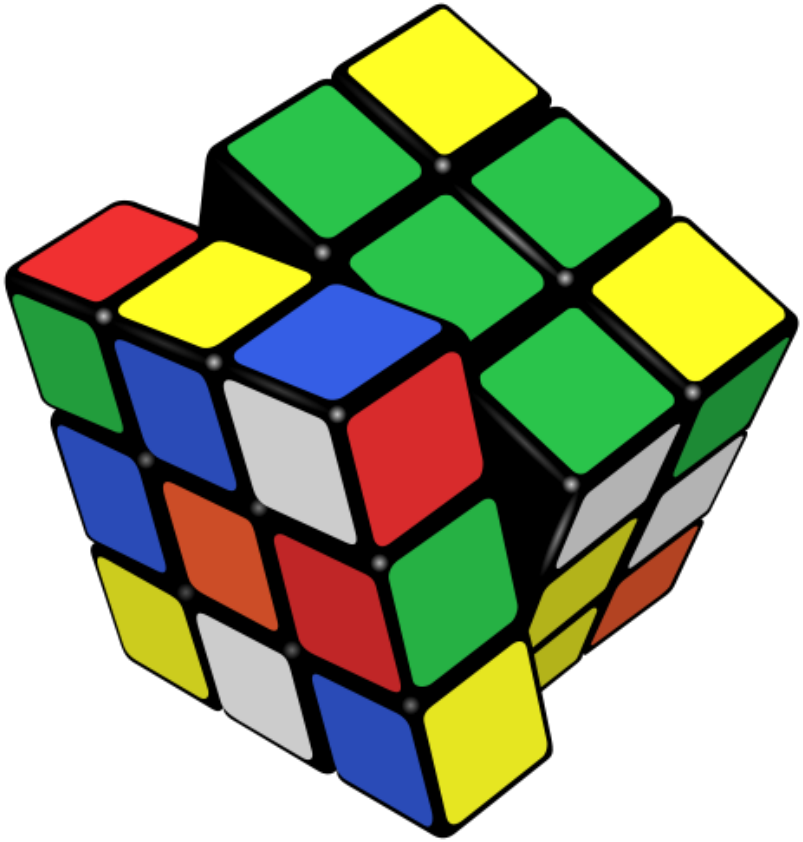
Resilient Sites for Terrestrial Conservation

"Health is the capacity of the land for self-renewal. Conservation is our effort to understand and preserve this capacity"
Aldo Leopold 1949

Mark Anderson PhD. Director of Science Eastern NA Division

What does Climate Change mean for Place Based Conservation?

You could go species-by- species



Rubik's cube

Very simple
compared to nature

8 corners, 12 edges
= 43 quintillion
permutations

Interactions

Diversity is tightly associated with the Physical Environment

Bicknell's thrush
High elevation
Granite & mafic

Shale barrens
Shale slopes

Serpentine Aster
Serpentine

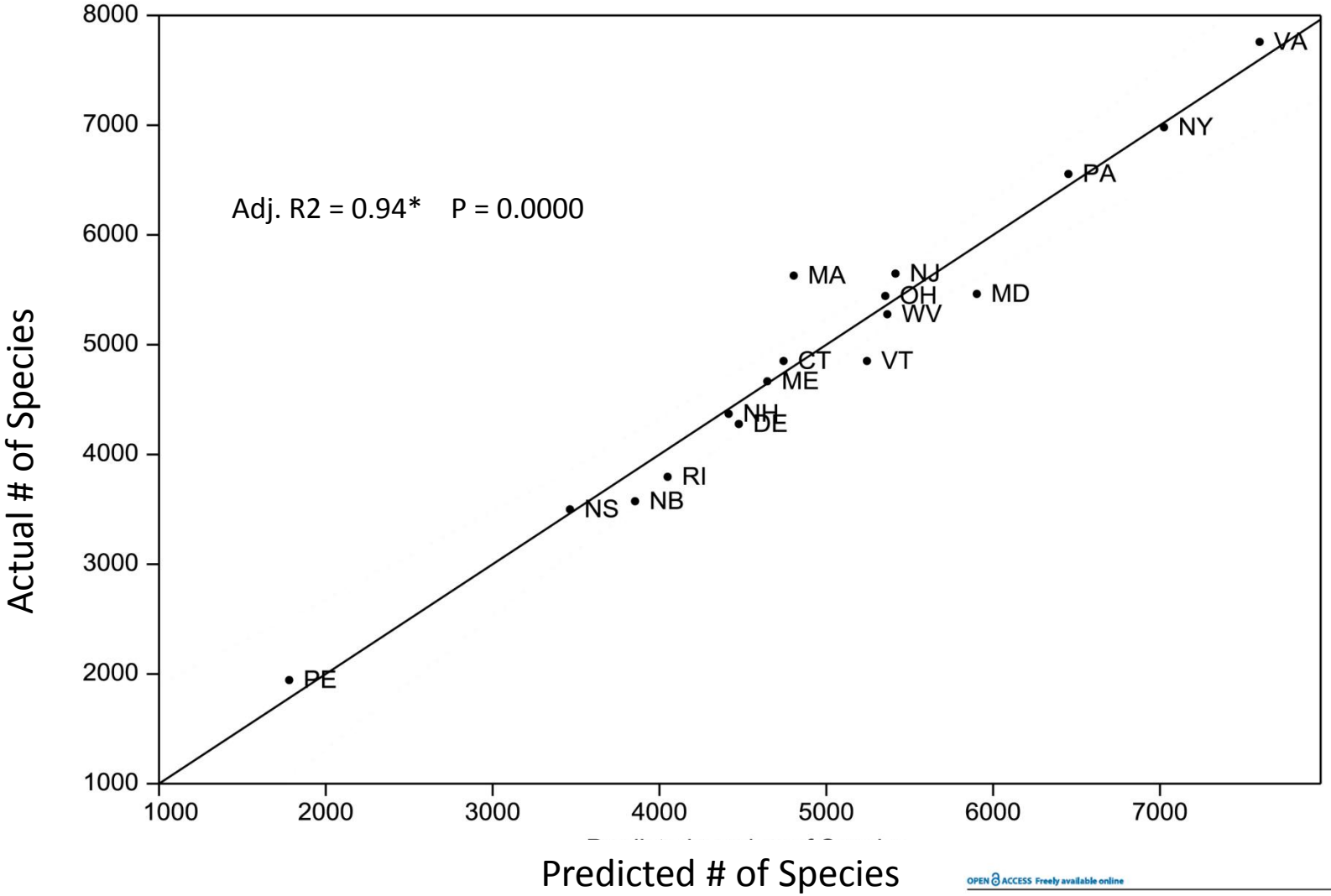
Piping Plover
Sandy beaches

Spartina grass
Fine silts and muds

Alasmidonta Mussels
Limestone rivers

Species Diversity

1) # of Geology classes, 2) Latitude, 3) Calcareous substrate, 4) Elevation range



OPEN ACCESS Freely available online

PLoS one

Conserving the Stage: Climate Change and the Geophysical Underpinnings of Species Diversity

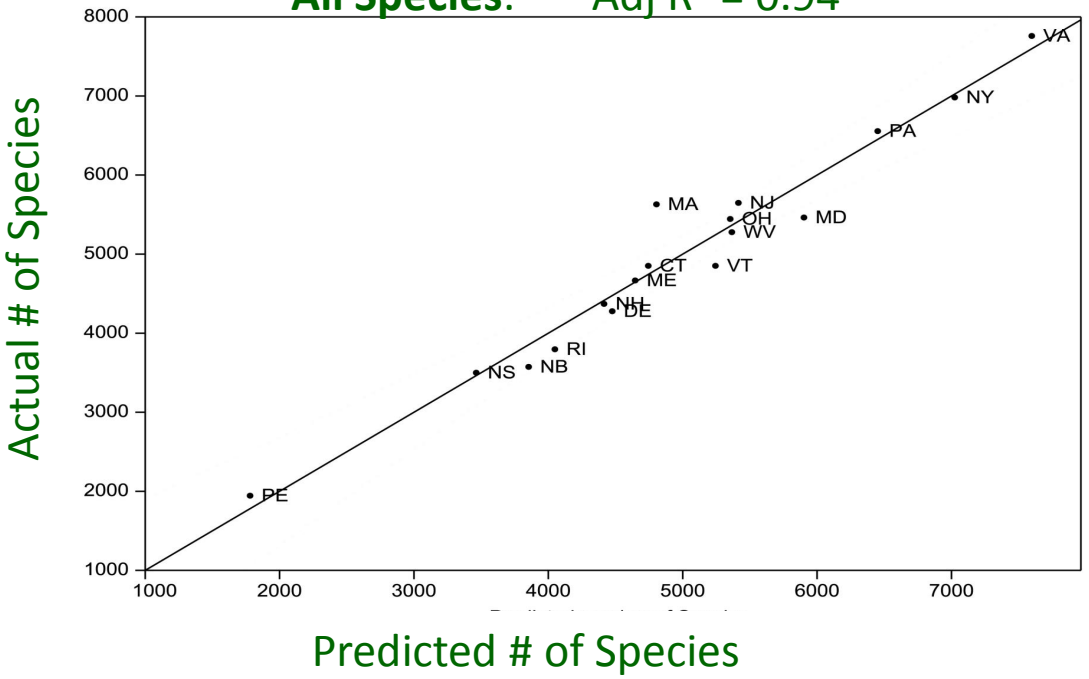
Mark G. Anderson*, Charles E. Ferree

The Nature Conservancy, Boston, Massachusetts, United States of America

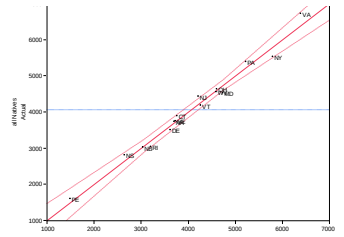
Coarse Filter: Diversity Predictions

based on # of Geology classes, Latitude, Calcareous substrate, Elevation Range

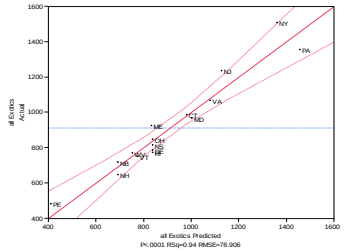
All Species: Adj R^2 = 0.94



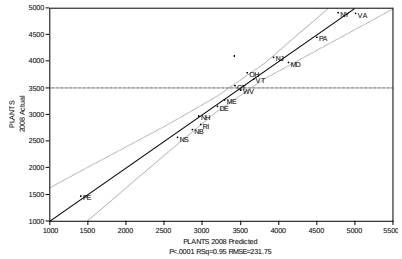
Native Species R^2 = 0.97



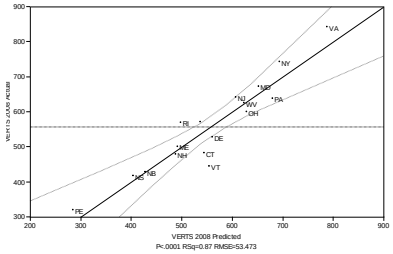
Introduced Species R^2 = 0.91



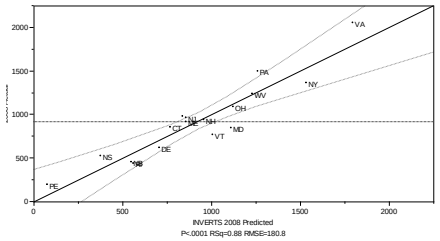
Plants R^2 = 0.95



Vertebrates R^2 = 0.87



Macro Invertebrate R^2 = 0.88



Conserving the Stage

Create arenas for evolution not museums of the past.

Sedimentary (sandstone)

Granite

Coastal Sand

Limestone

Fine Silt/Organic

Mafic (amphibolite)

Moderately Calcareous

Coarse Sand

Estimating the Resilience of a Site

Resilience: Definition

The capacity for renewal in a dynamic environment

- Gunderson 2000

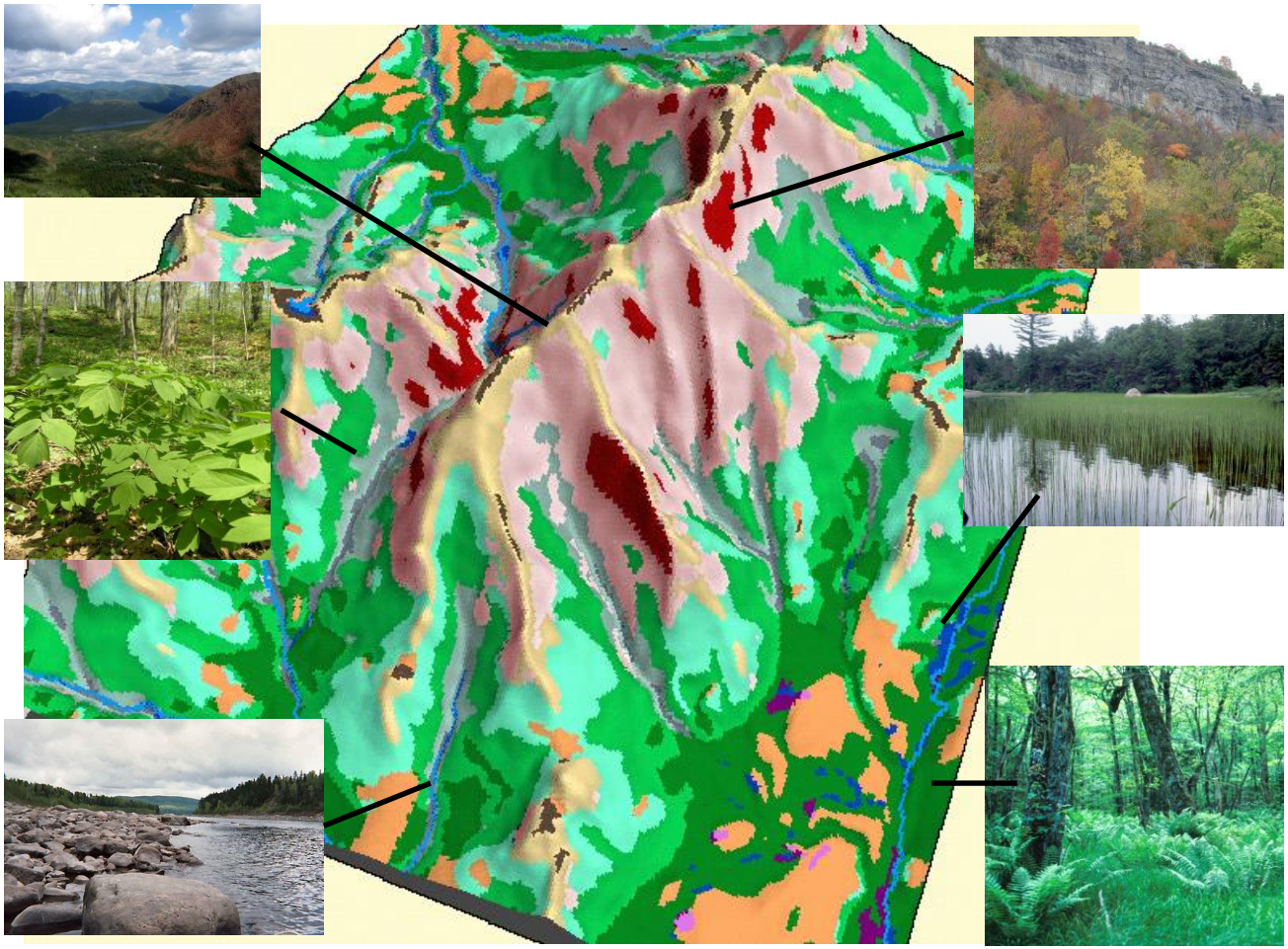
Highly Vulnerable
Limited capacity to adapt
Disrupted function, low diversity
Few options and alternatives
Weedy generalist species

Highly Resilient
Large capacity to adapt
Sustain function and diversity
Many options and alternatives
Diversity of native species

Resilient site: Has characteristics that maintain ecological functions and will likely sustain a diversity of species even as the composition and structure change with the climate

Landscape Diversity

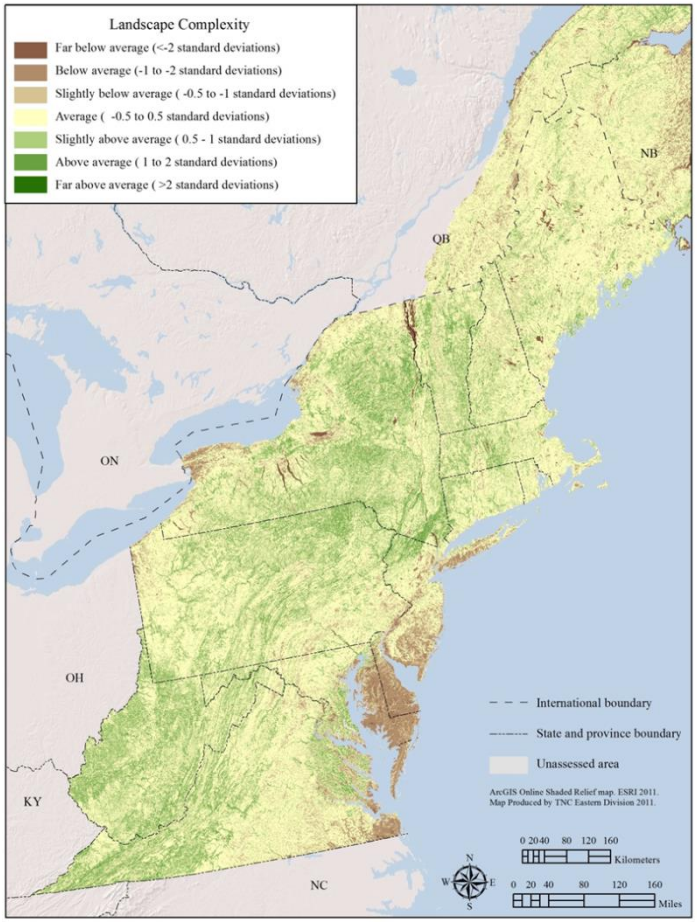
Landforms and topography split the regional climate into a number of micro-climates and these are what most species actually experience. In the literature this is called “microclimate buffering”



More Heterogeneity = more options for species to move and rearrange at a given site:

FOR EXAMPLE
Hot southern upper slopes
Cool northern toe slopes
Moist sheltered coves
Dry exposed ridges

Willis and Bhagwat, 2009. **Biodiversity and Climate Change**. Science , Loarie et.al. 2009. **The velocity of Climate Change** . Nature

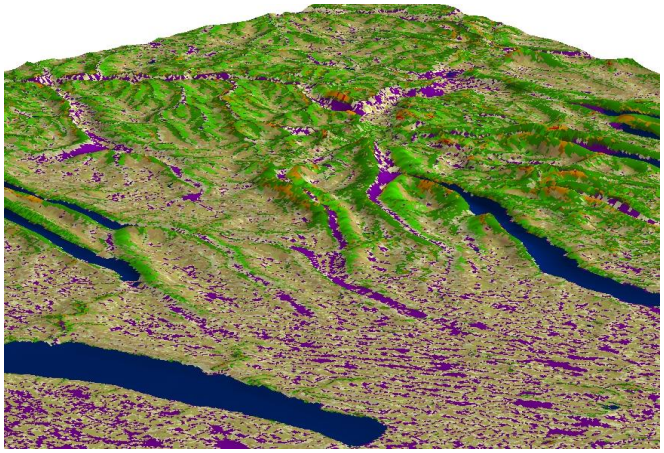


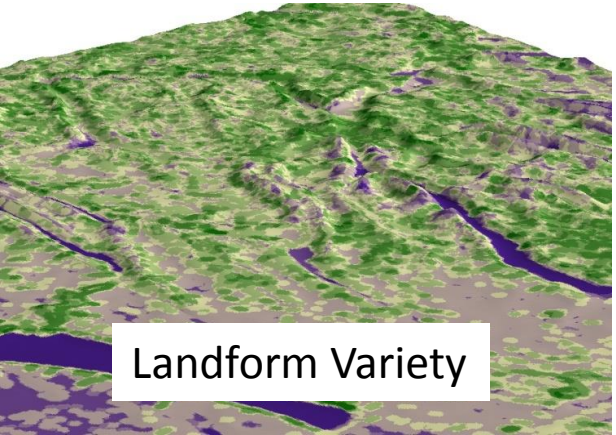
Landscape Diversity

Z-scores

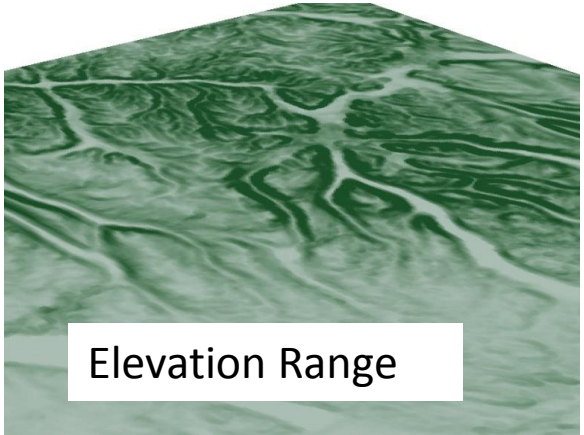
2LV+1ER + 1WD (flats only)

100 ac

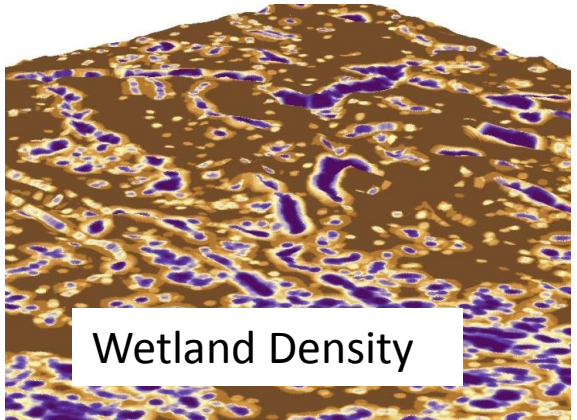




Landform Variety

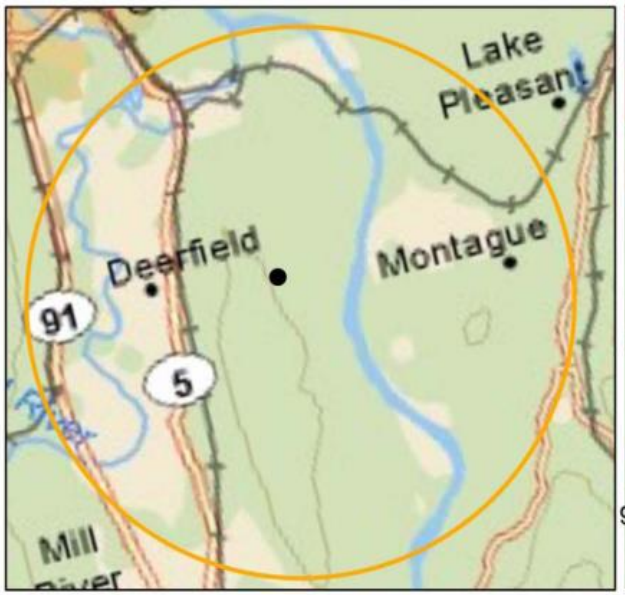


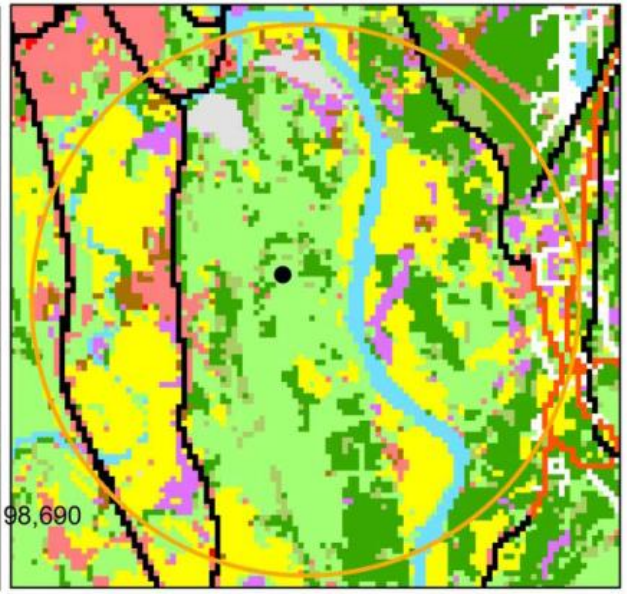
Elevation Range

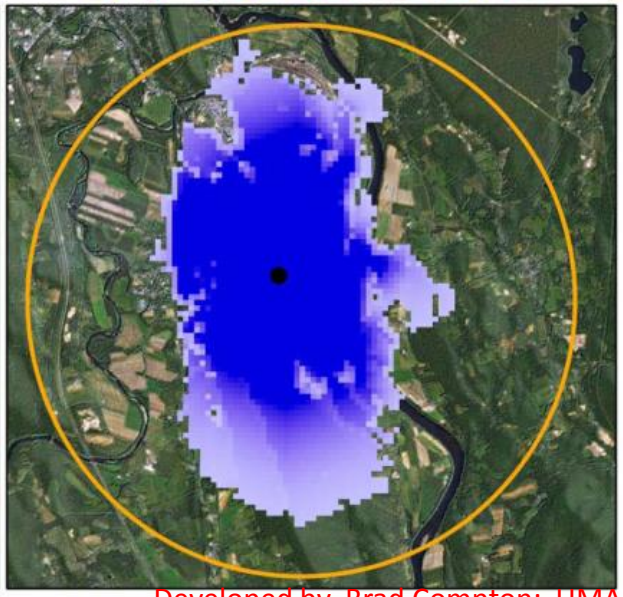


Wetland Density

Local Connectedness







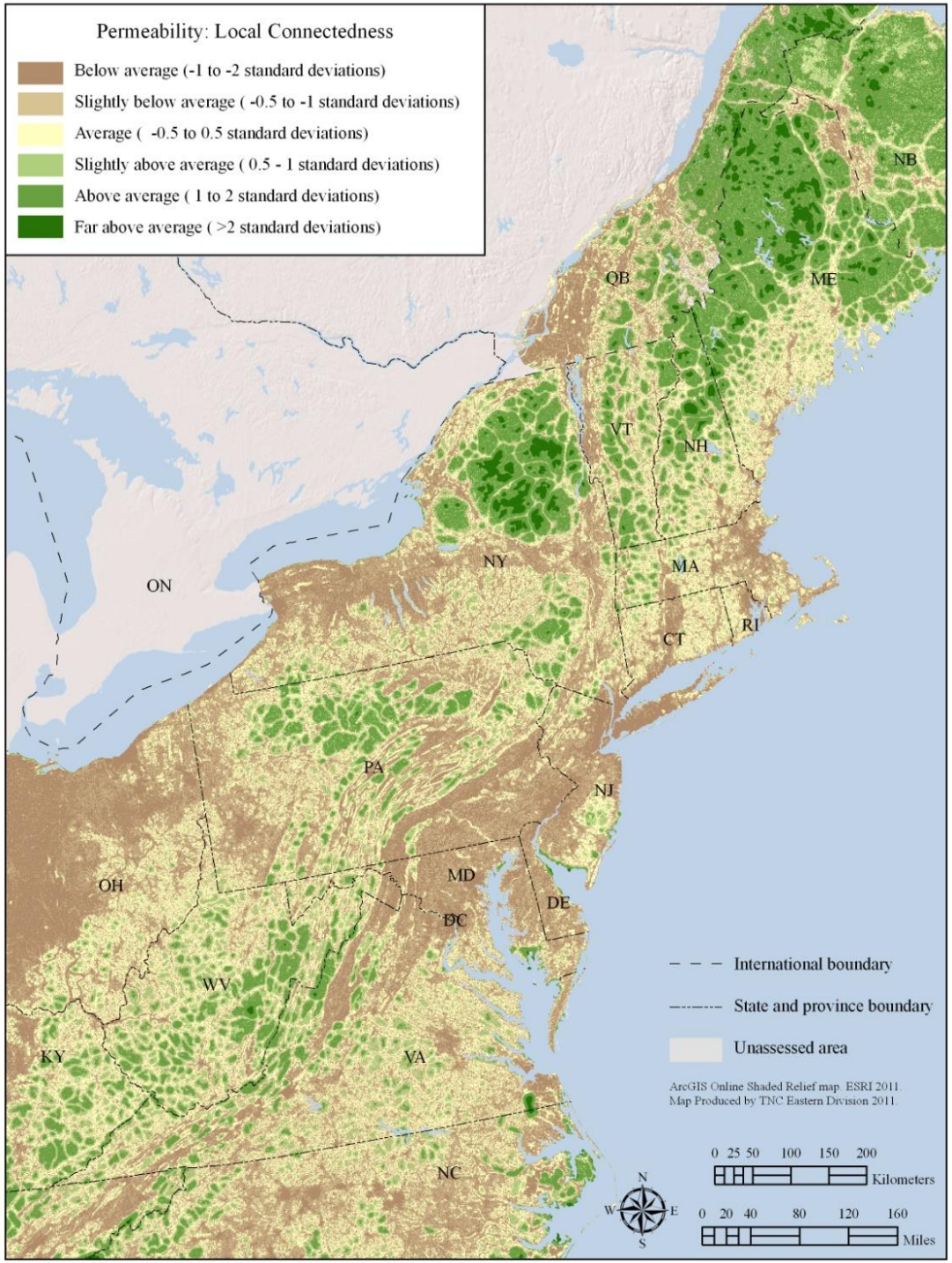
The degree to which the landscape allows for species movement and other natural processes

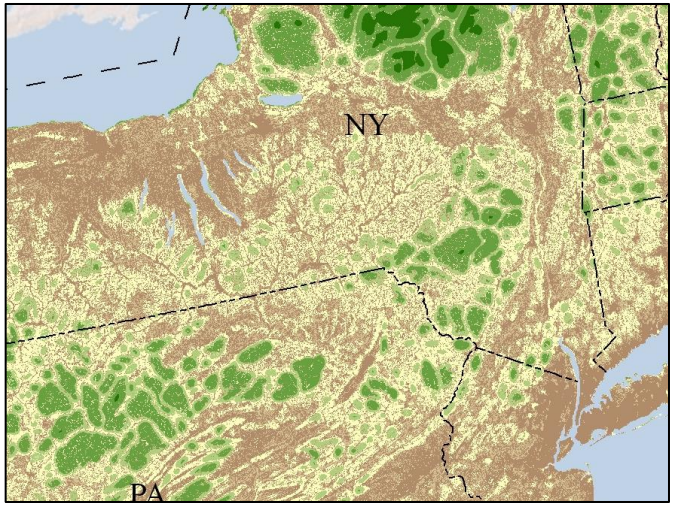
Highly Connected Landscapes provide many options and alternatives.

Fragmented Landscapes Provide few options for movement and processes

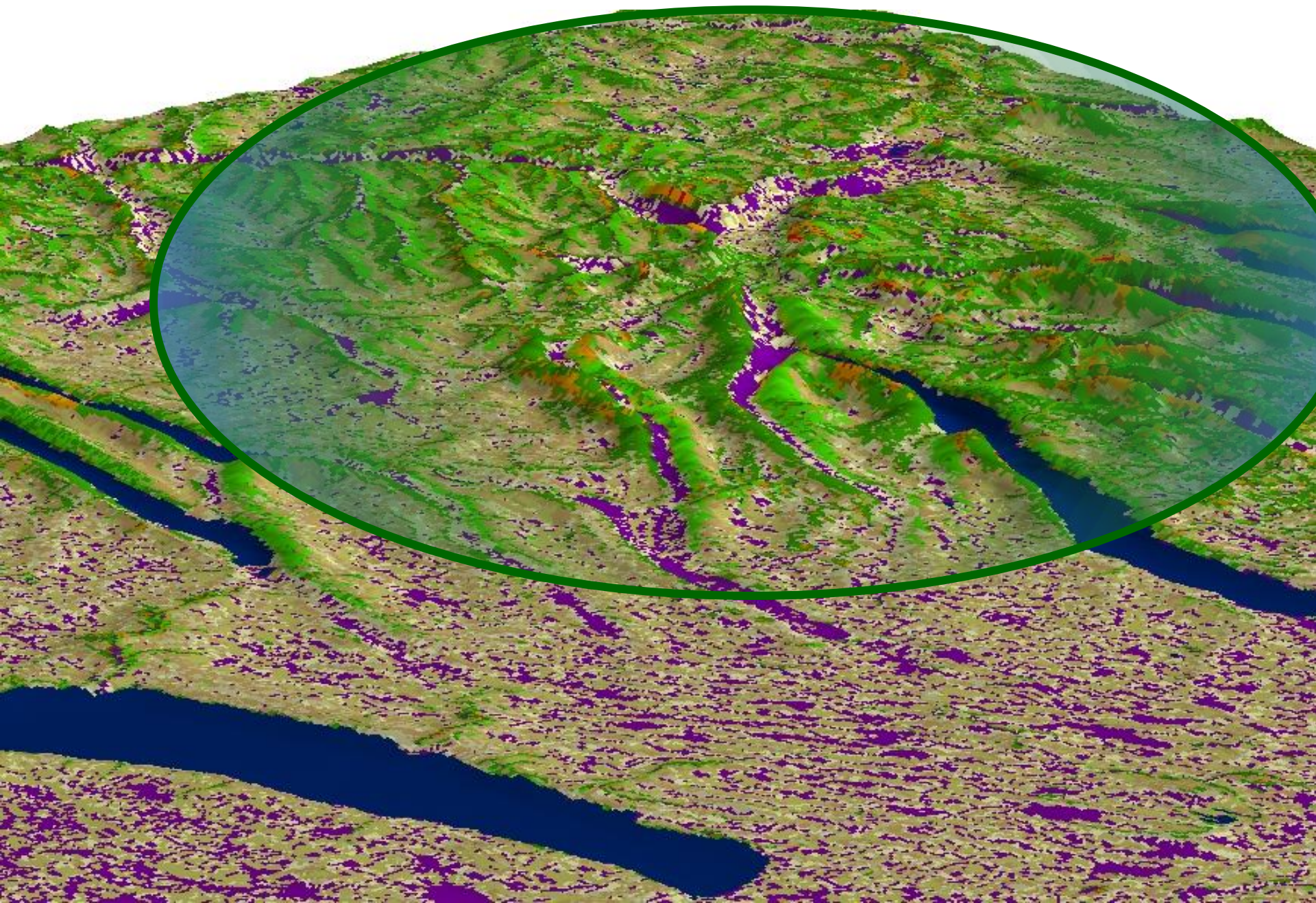
Developed by Brad Compton: UMASS CAPS/Landscape Ecology

Local Connectedness





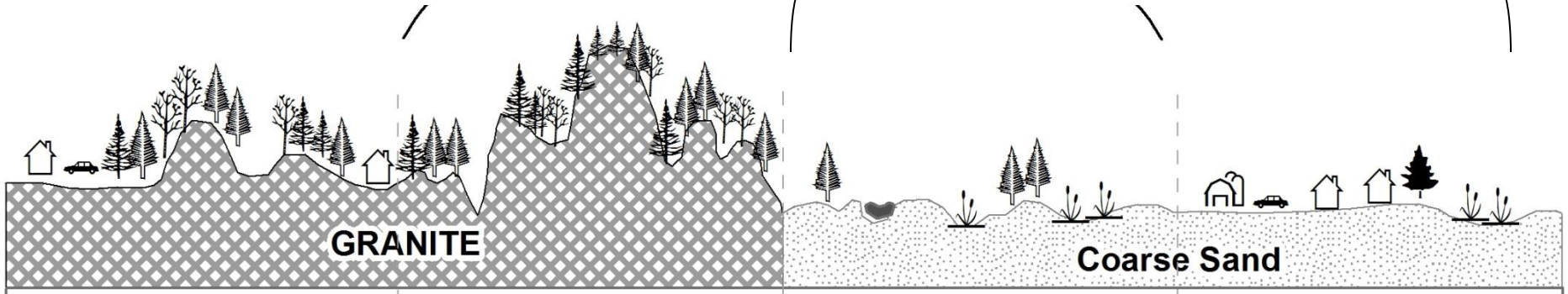
Complex and Connected = Many Options



Are some sites more resilient than others?

Granite to Granite

Sand to Sand



Landscape Complexity
Landform Variety = 5
*n sideslope
*s sideslope
*low hill
*wet flat
*dry flat
Elevation Range = 100 - 300 m

Local Connectivity
Low (26 out of 100)

Landscape Complexity
Landform Variety = 7
*summit
*cliff
*n sideslope
*s sideslope
*slope bottom flat
*wet flat
*dry flat
Elevation Range = 100 - 400 m

Local Connectivity
High (75 out of 100)

Landscape Complexity
Landform Variety = 4
*hummuck
*low hill
*wet flat
*dry flat
Elevation Range = 0 - 22 m
Wetland Denisty = medium/high

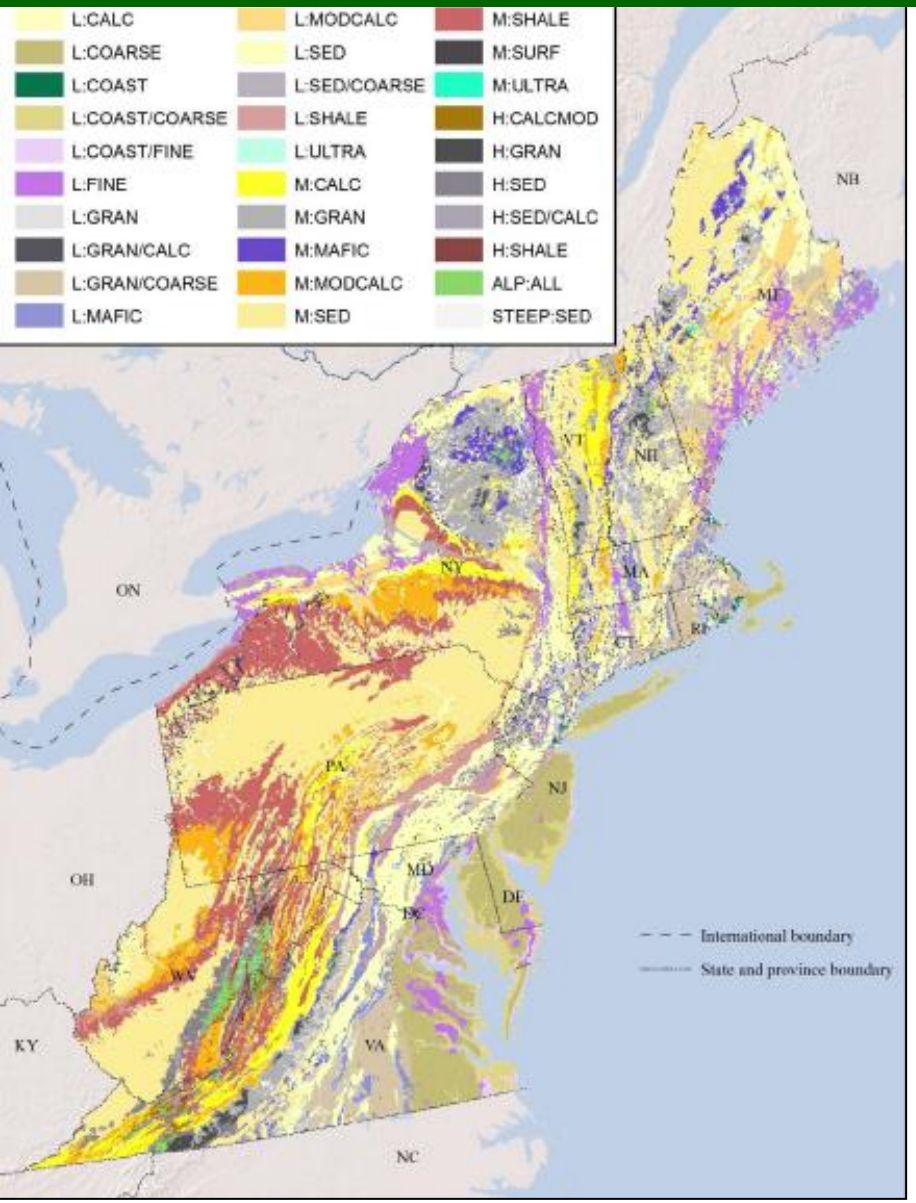
Local Connectivity
High (57 out of 100)

Landscape Complexity
Landform Variety = 2
*wet flat
*dry flat
Elevation Range = 0 - 10 m
Wetland Denisty = low

Local Connectivity
Low (8 out of 100)

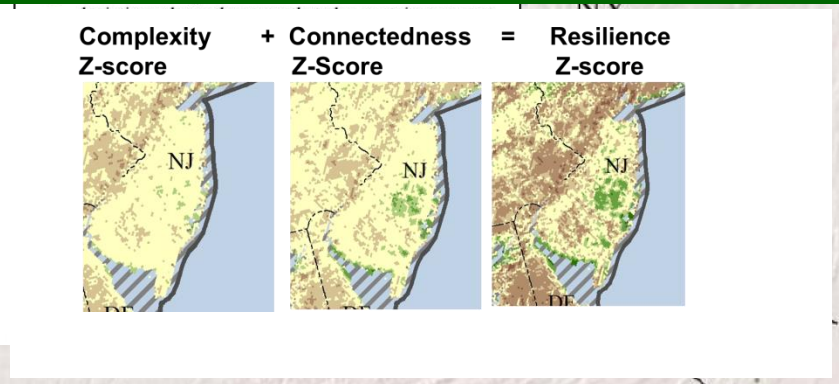
Resilience = many options

How does the Analysis Work? Conserving the Stage



The map show 29 different geophysical settings based on geology and elevation

Places are scored one setting at a time



Vulnerable = least landscape diversity and connectedness

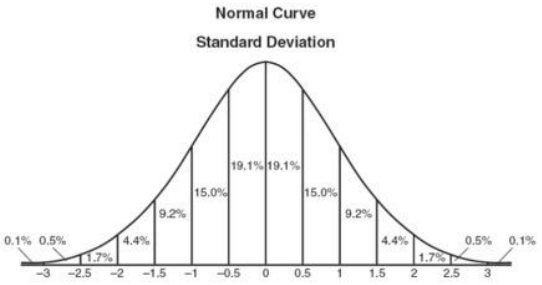
Resilient = most landscape diversity and connectedness

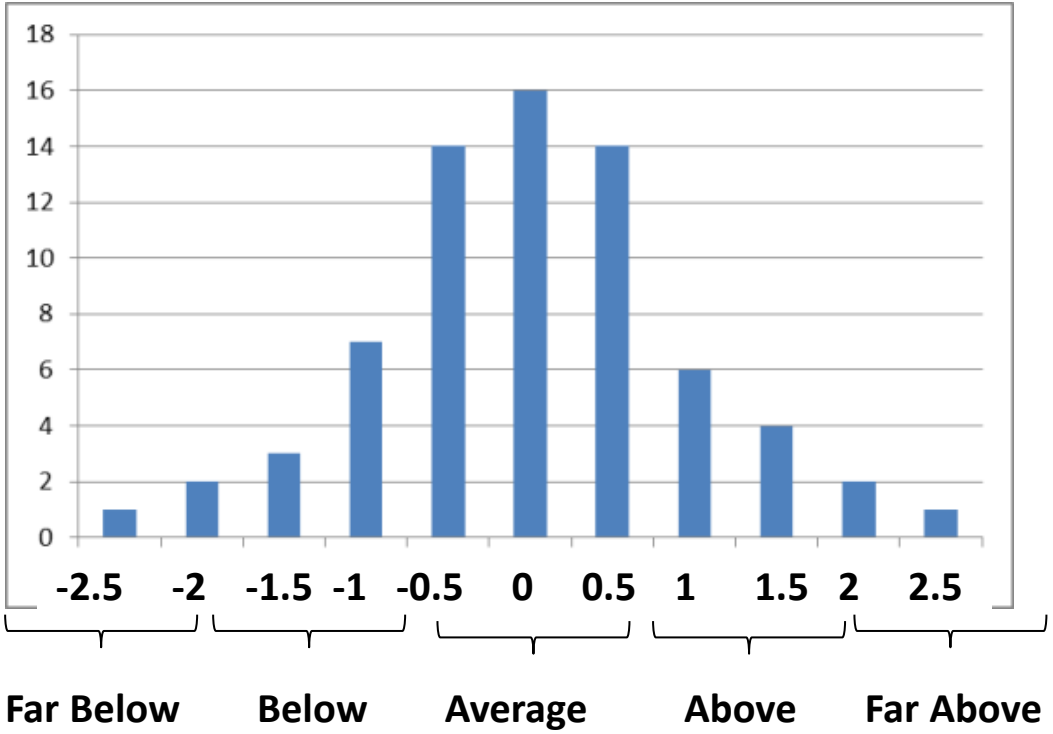
Note: this analysis does not address sea level rise or other coastline concerns

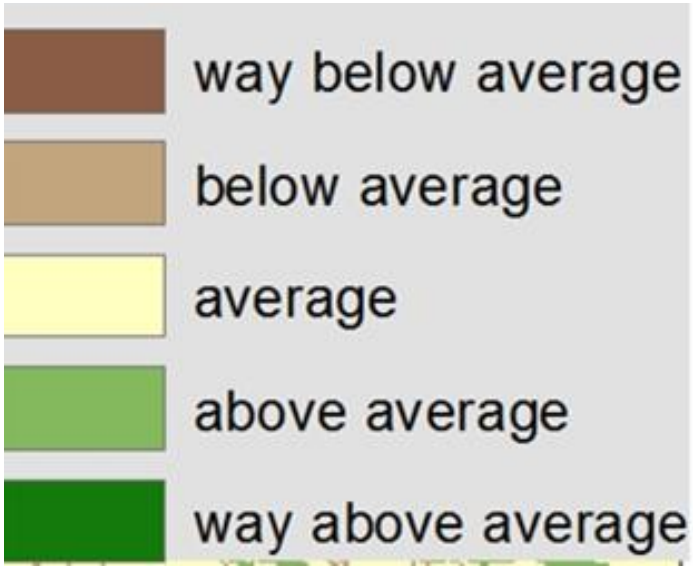
Coarse Sand at Very Low Elevations
Scores are applied to each setting

Green indicates above average (resilient)
Brown indicates below average (vulnerable)

HOW TO READ THE SCORES







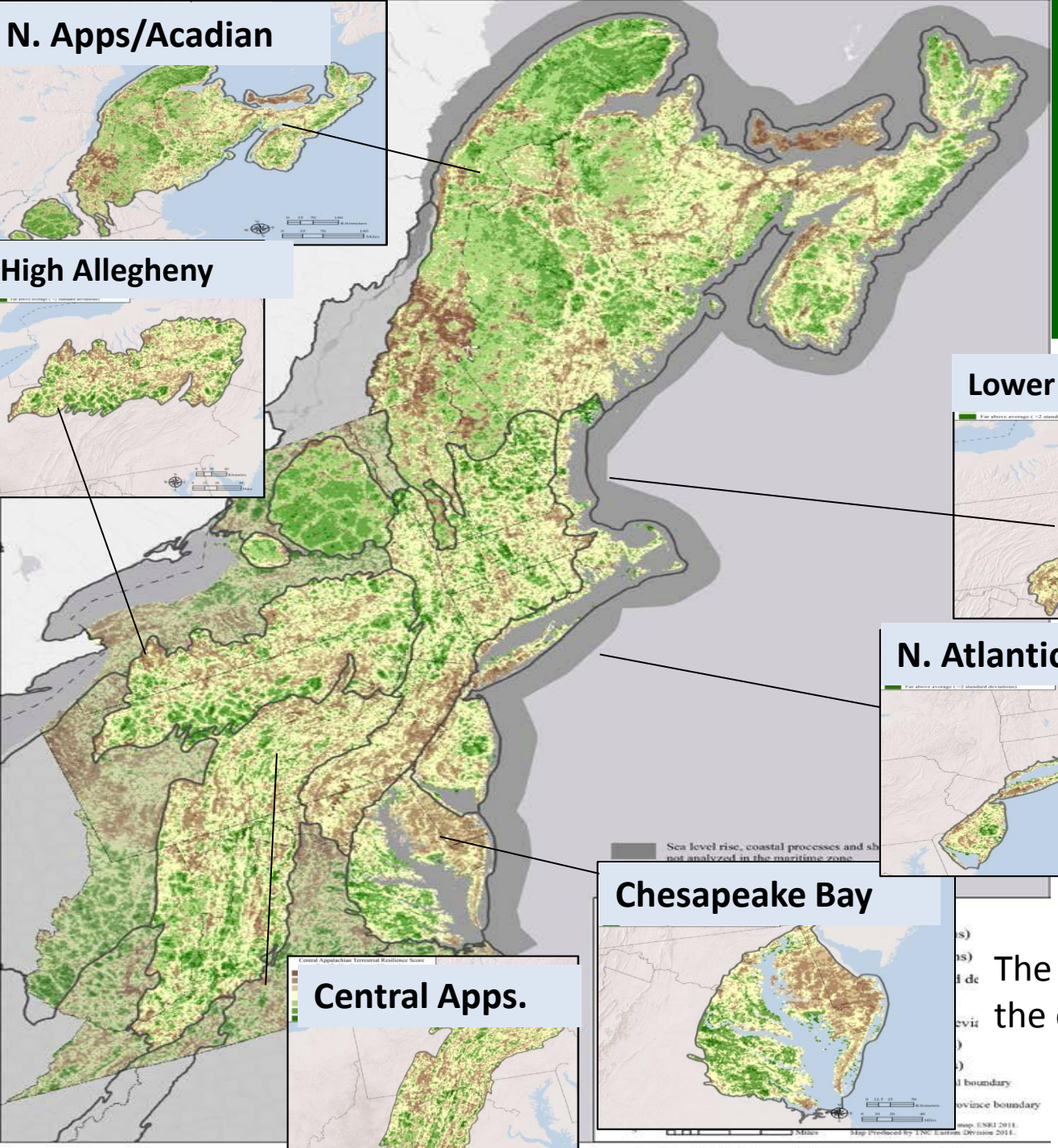
0 = Average , 1 = 1 SD above average

Say your score is 1.5. That means it is 1.5 Standard Deviations above the average score or “Above Average” greater than about 93% of the other cells of that setting

(In some versions we multiplied the score times 1000 (1.5 would read 1500)

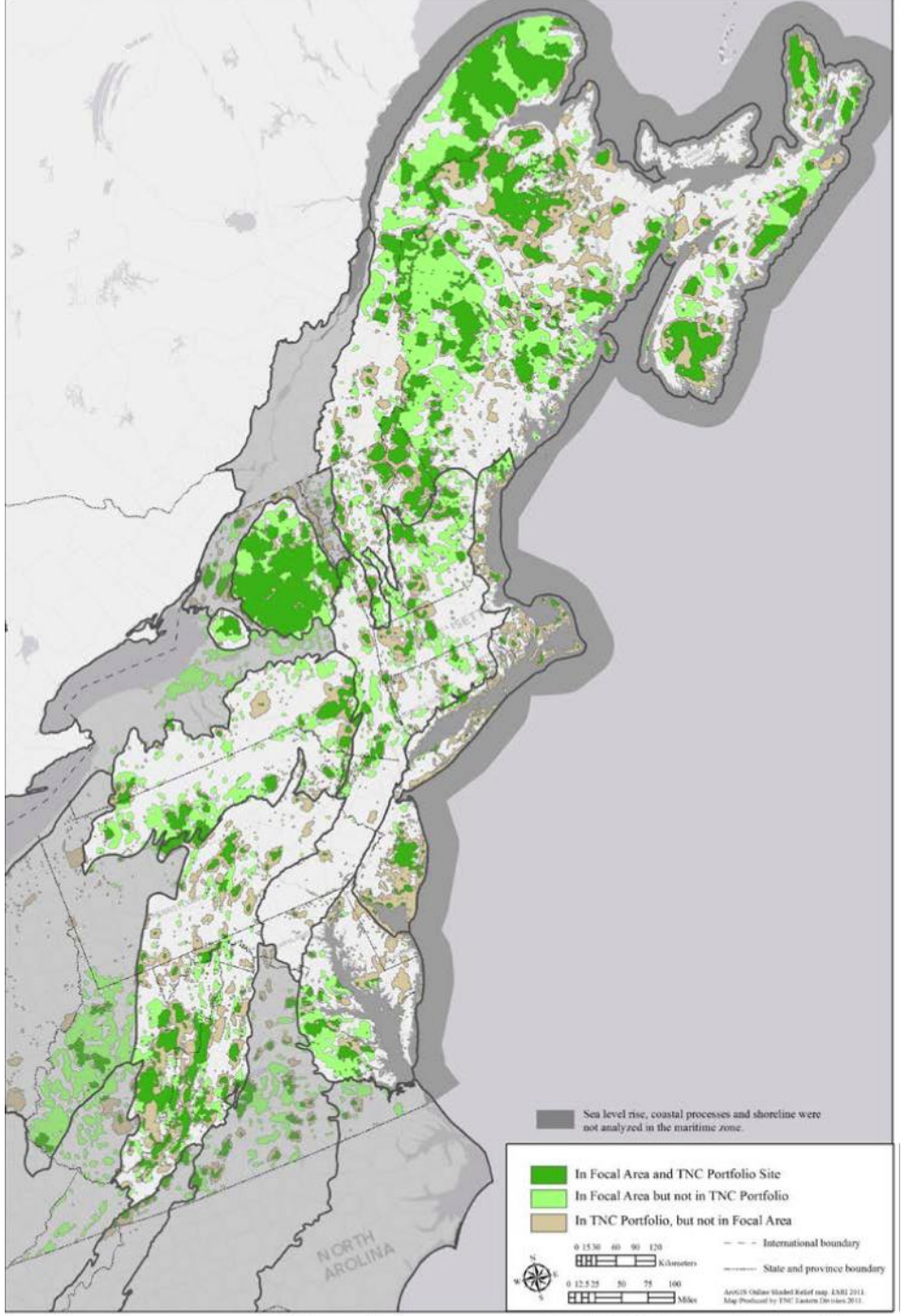
Final Results:

The highest scoring areas for each geophysical Setting by ecoregion



The final map is a composite of the ecoregional maps

TNC PORTFOLIOS
Species and Communities

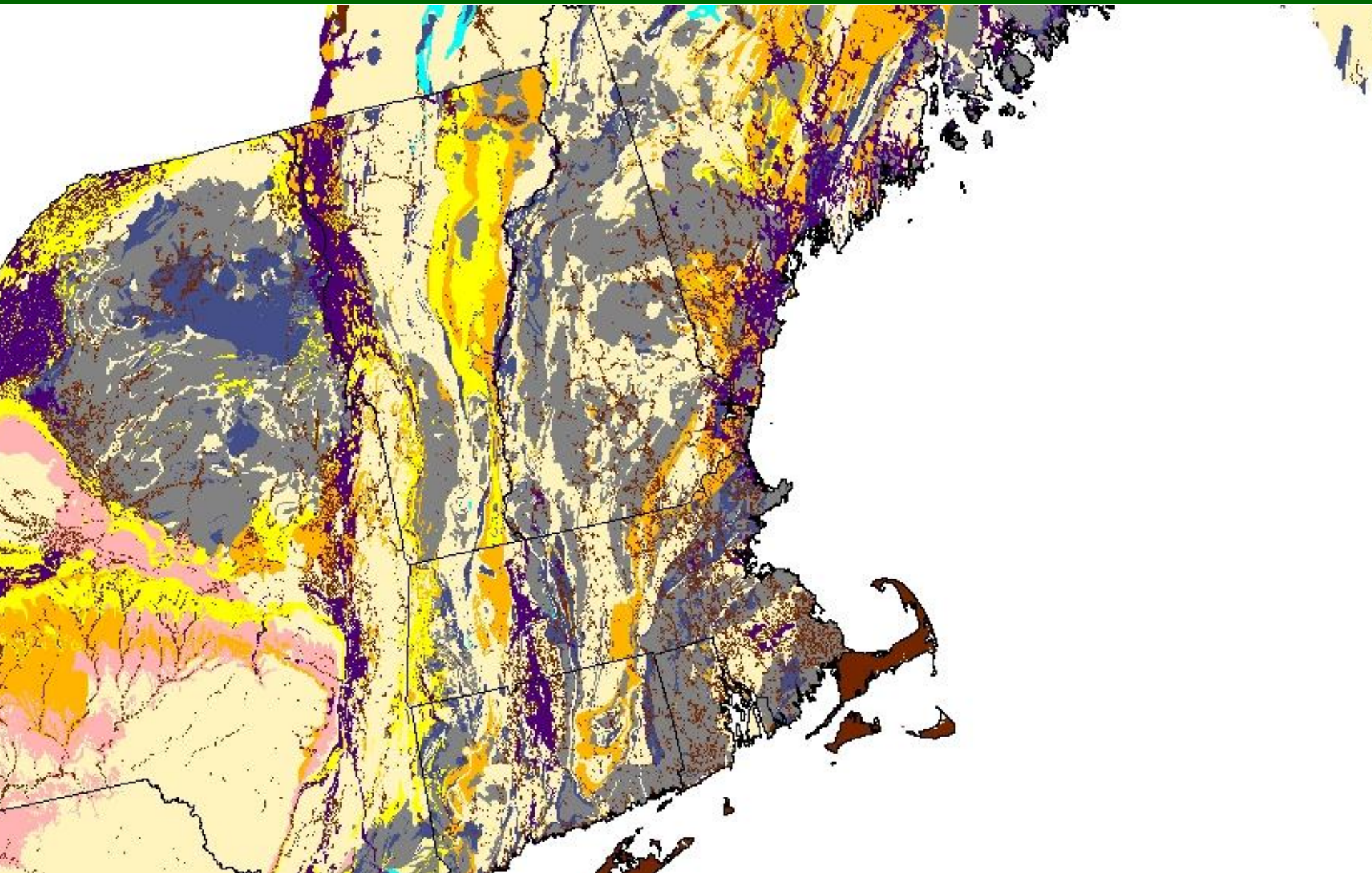


Focal Areas and TNC Portfolio Sites

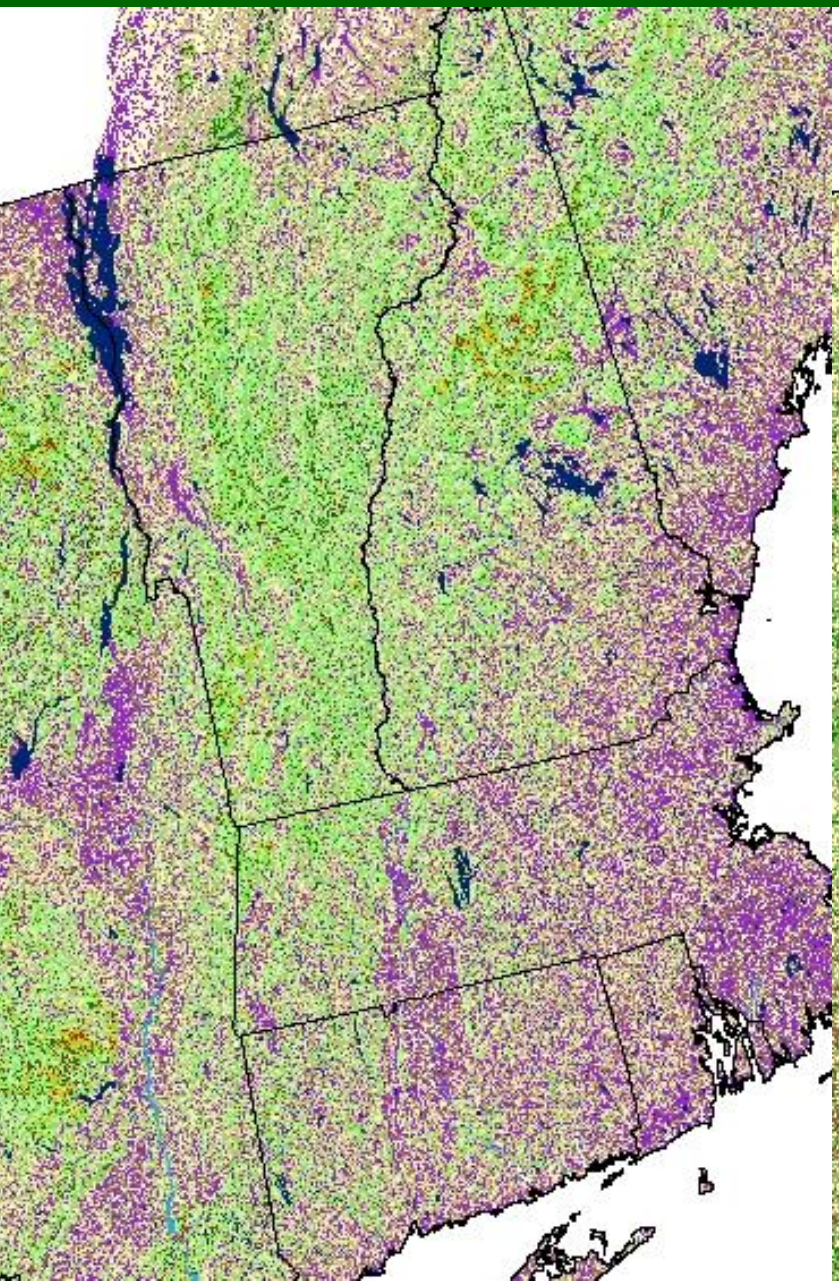
Cumulative Distribution of Taxa and Occurences across Resilience Score Catego

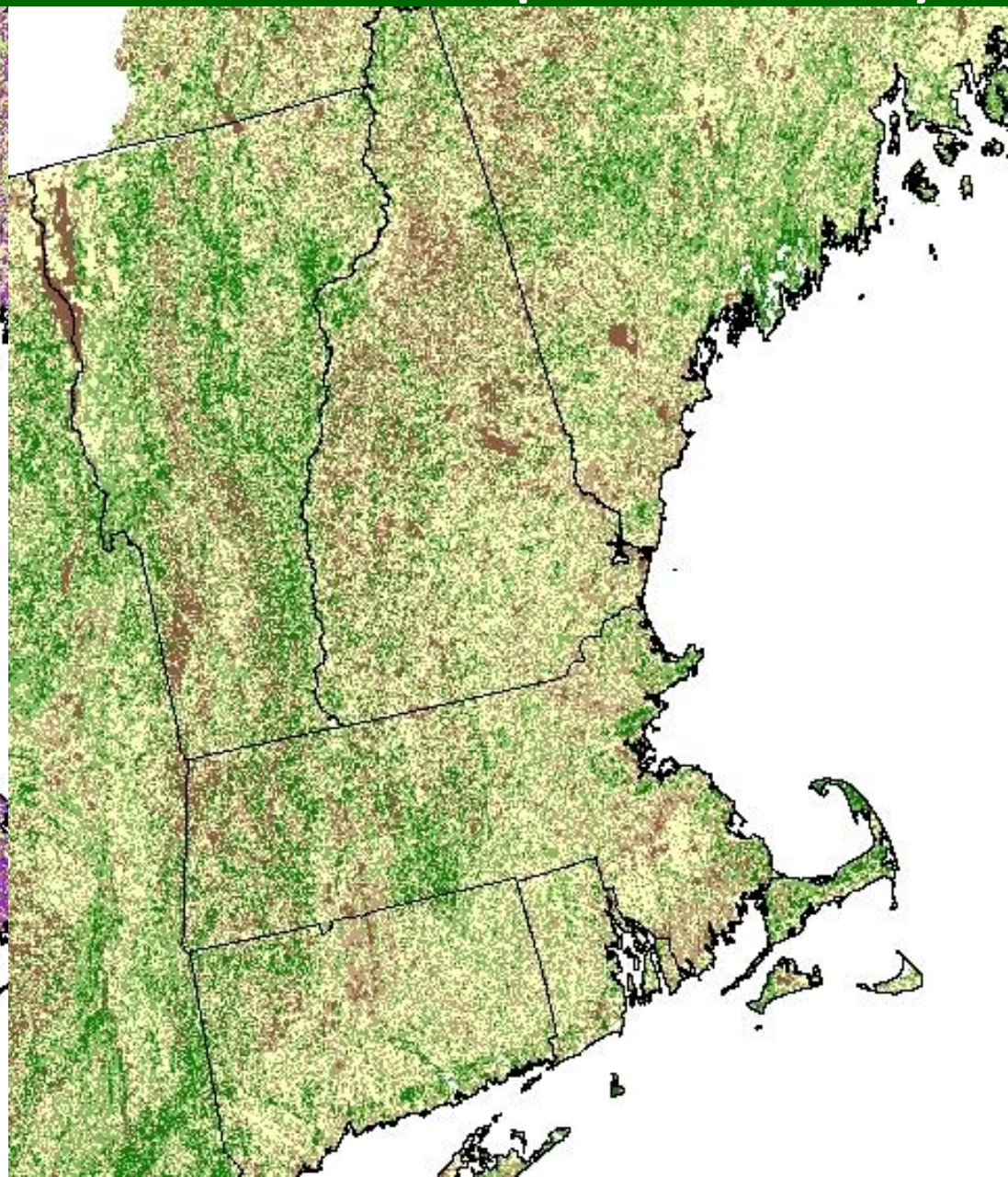
Groups	Total Number	Resilient >SD 0.5	Average SD -0.5 to 0.5
Species Taxa[a]			
Vertebrate Total	41	0.93	1.00
Amphibian	5	0.80	1.00
Bird	12	1.00	1.00
Mammal	16	0.94	1.00
Reptile	8	0.88	1.00
Invertebrate Total	166	0.69	0.91
Plant Total	207	0.77	0.91
All Taxa	414	0.75	0.92
Species Occurences[b]			
All Species	4592	0.49	0.78
Community Occurences[b]			
All Communties	2170	0.53	0.81
Actual vs. Expected Number			
Species Actual (*n* =4592)		1681	1348
Species Expected (*n* =4592)		1111	1754
Communities Actual (*n* =2170)		801	608
Communities Expected (*n* =2170)		525	829

CT River Watershed

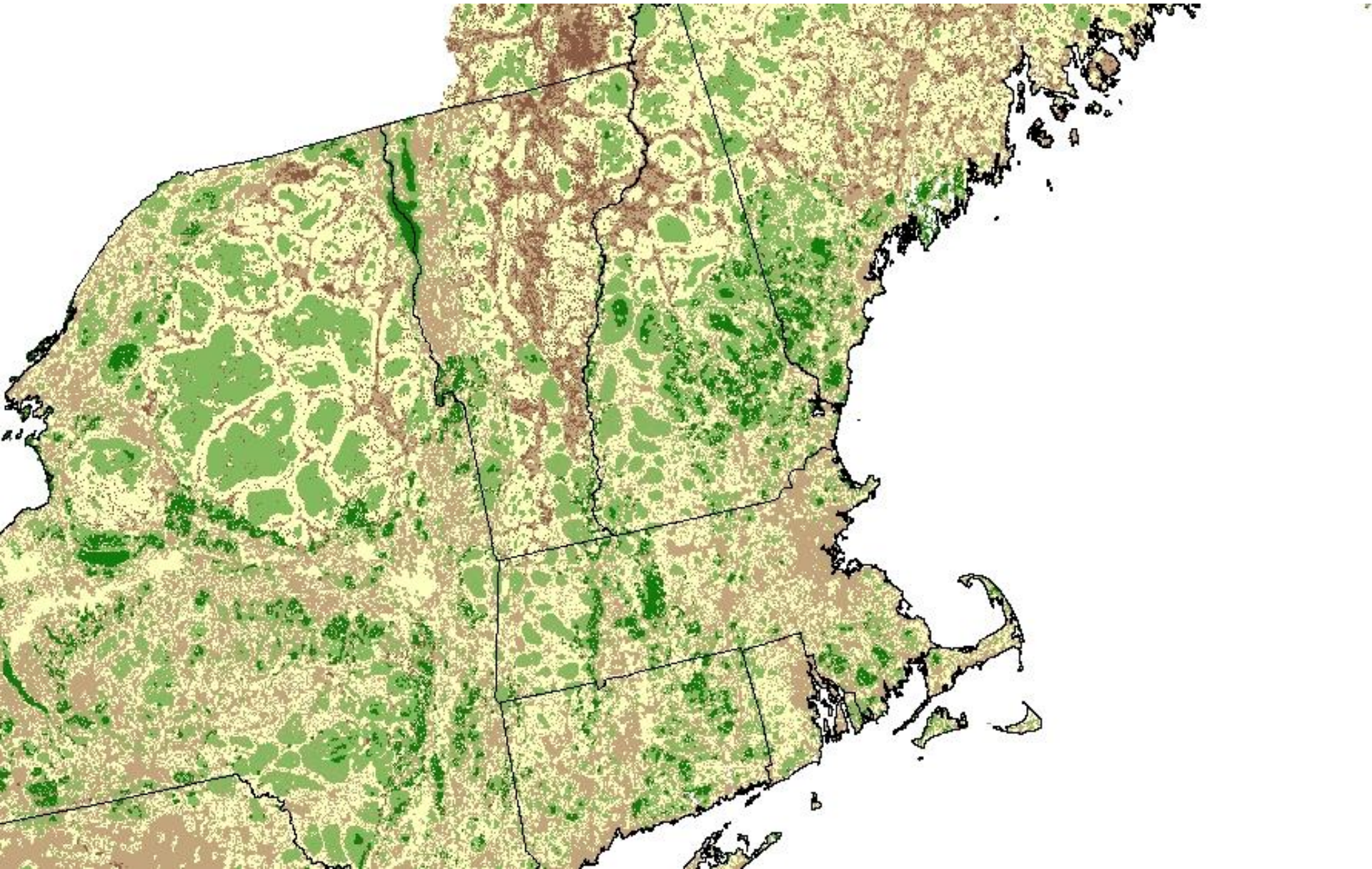


CT River: Landforms and Landscape Diversity

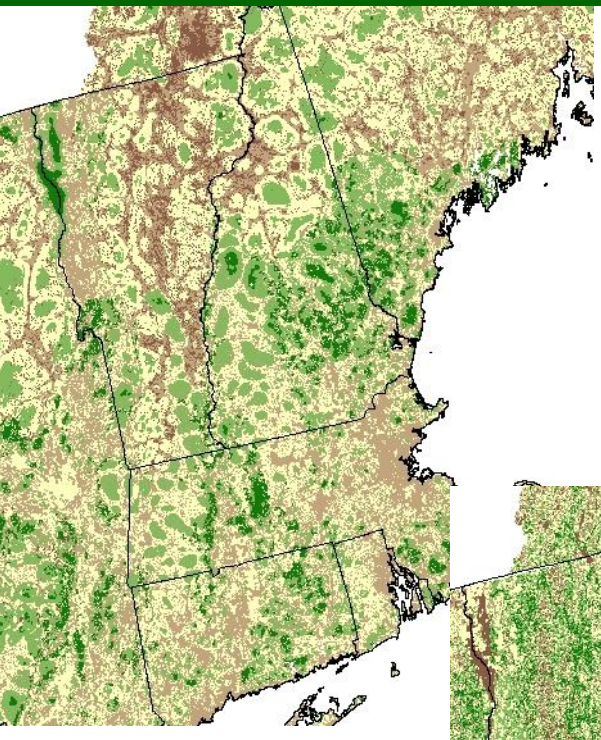




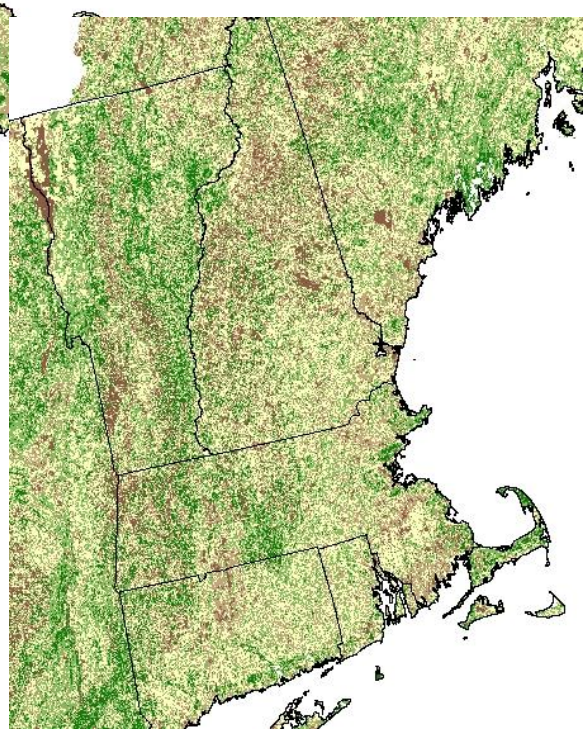
CT River Watershed



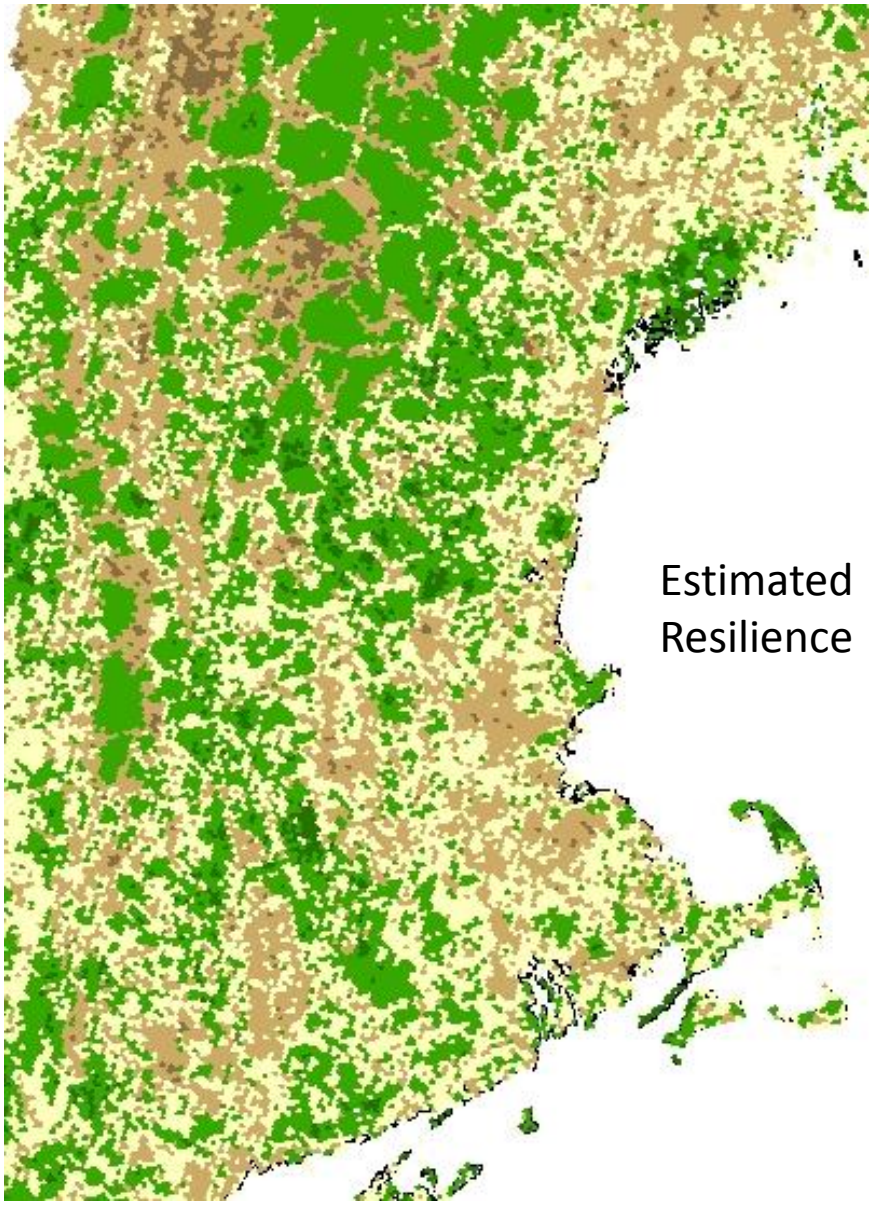
CT River Watershed



Connectedness

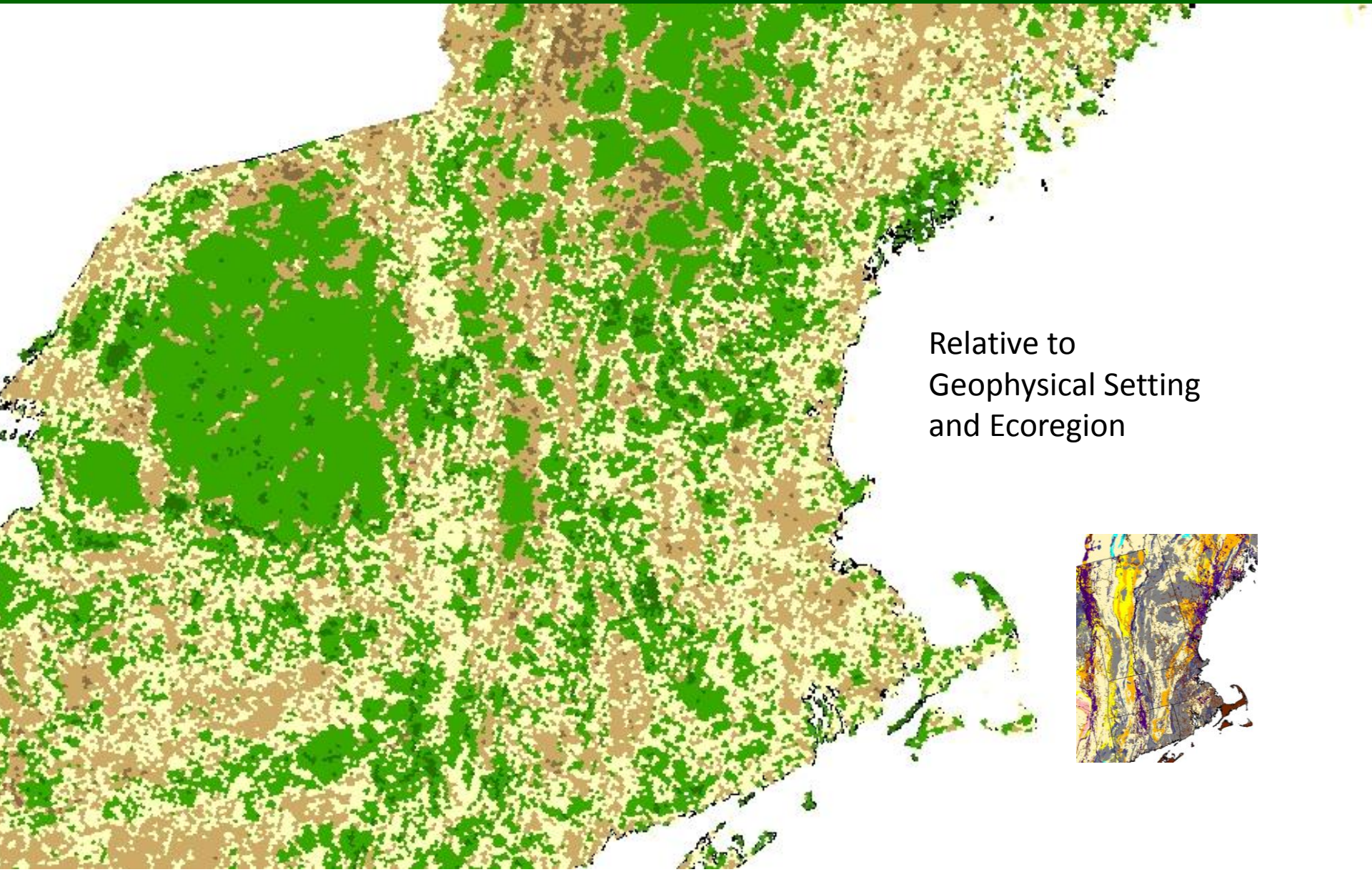


Landscape Diversity



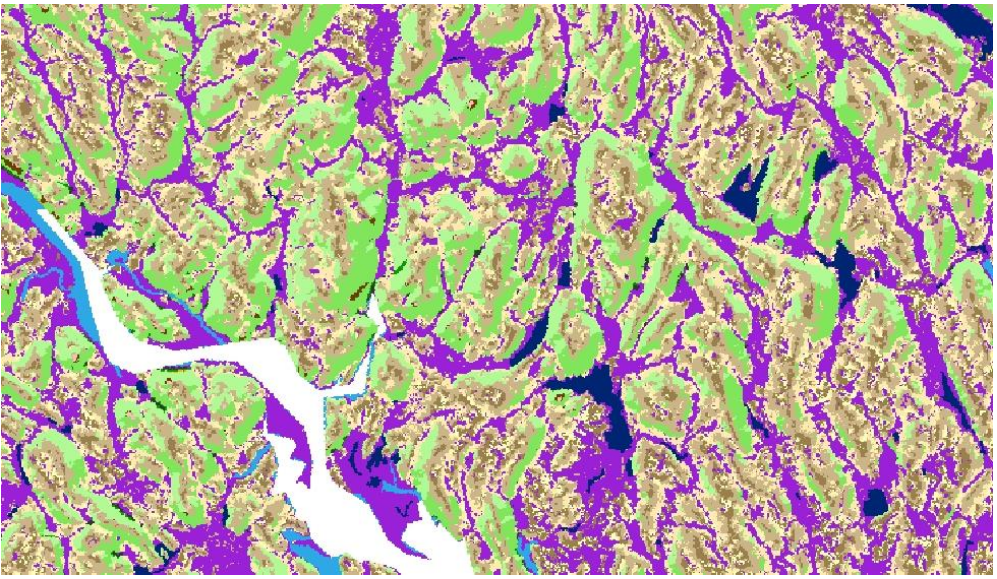
Estimated Resilience

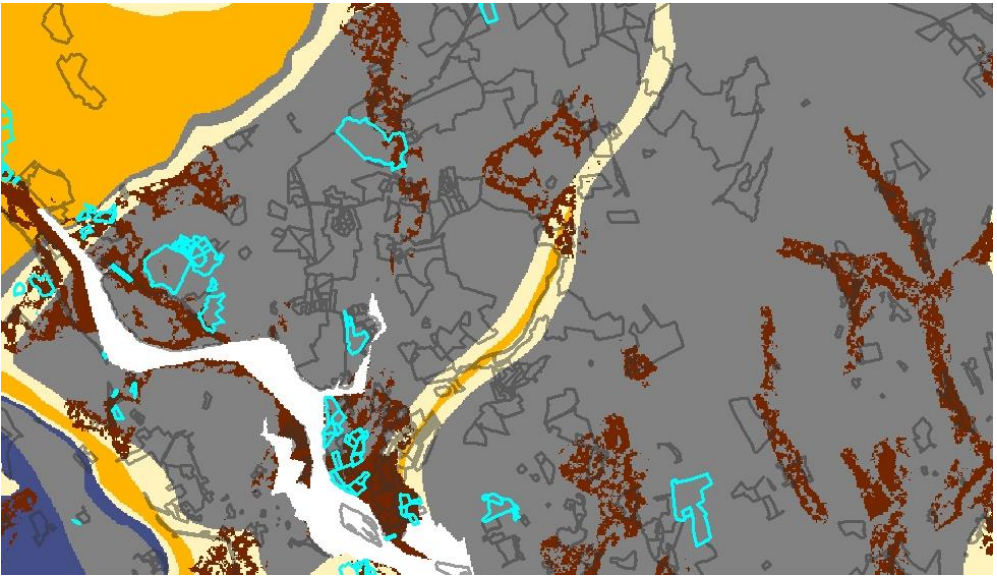
CT River Watershed

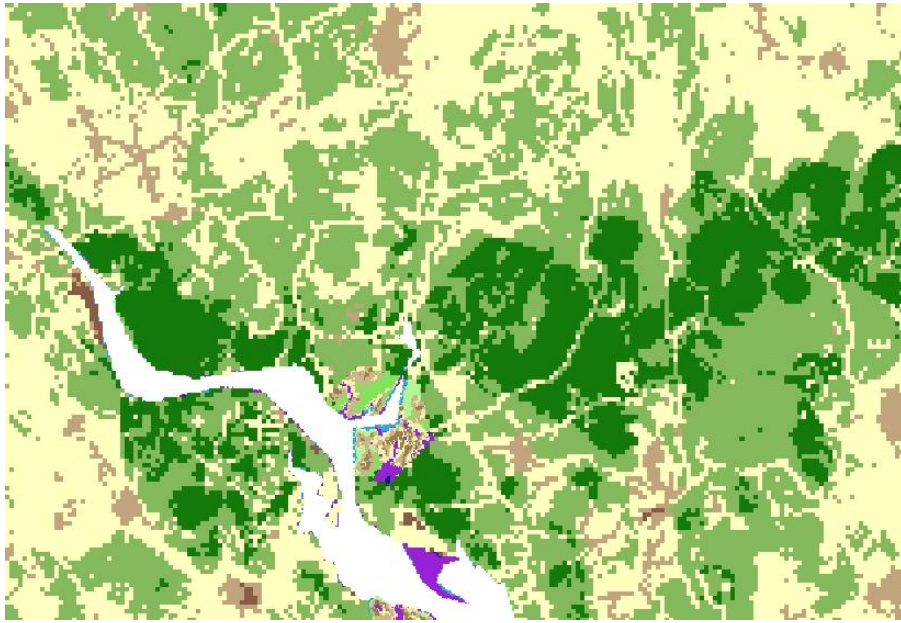


Relative to
Geophysical Setting
and Ecoregion

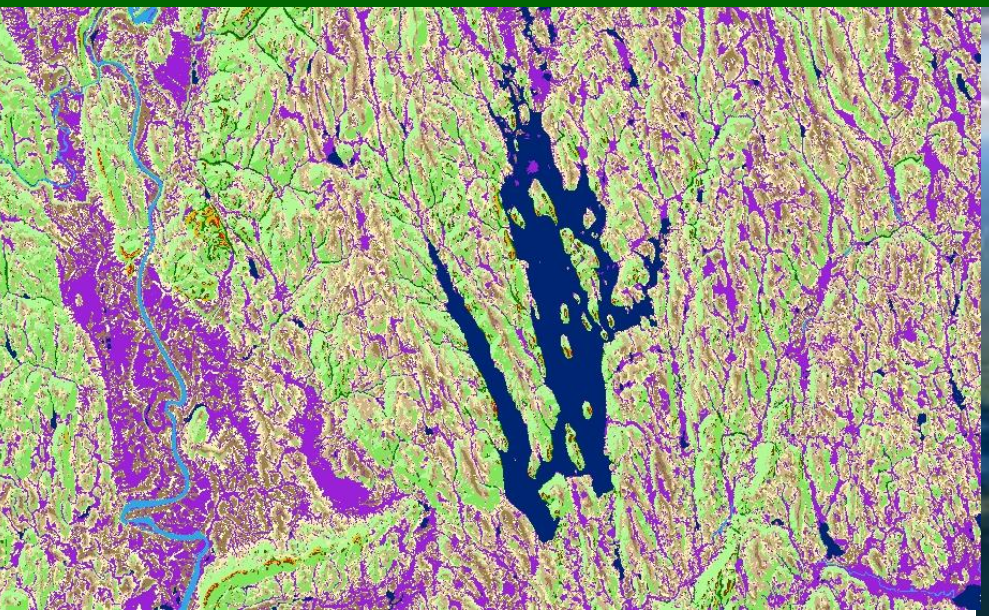
Nehantic, CT: Granite

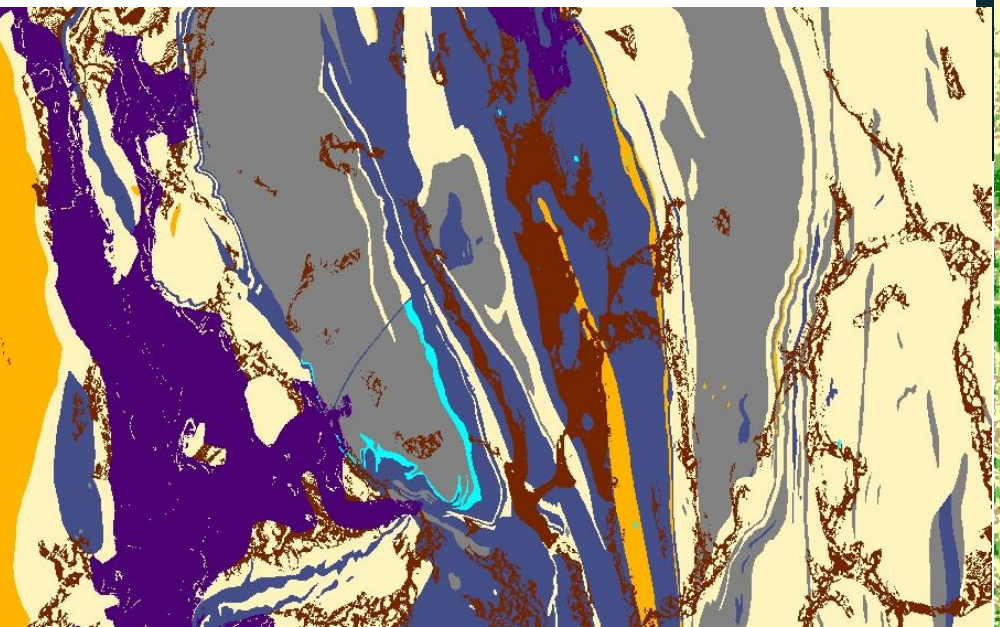


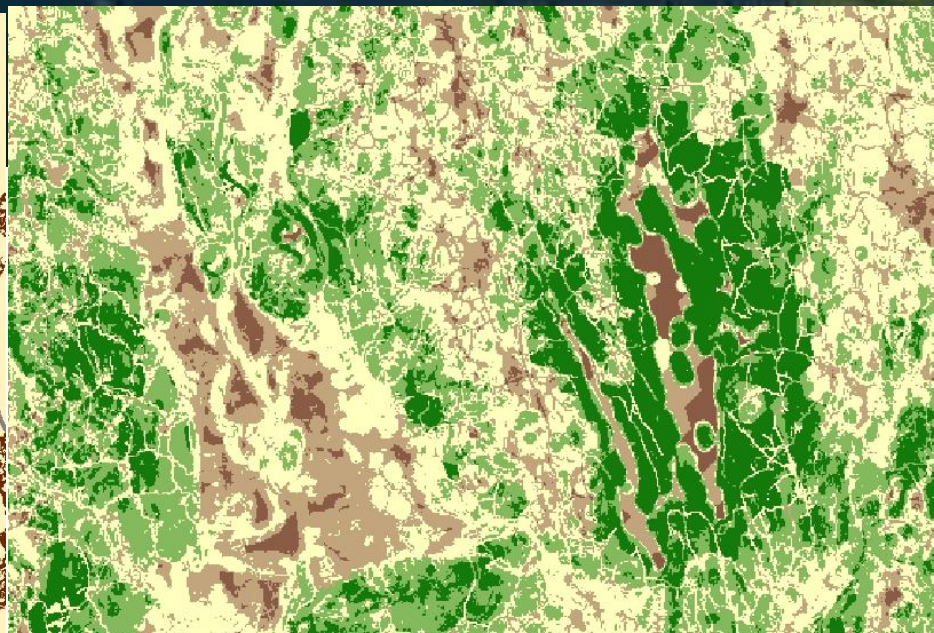




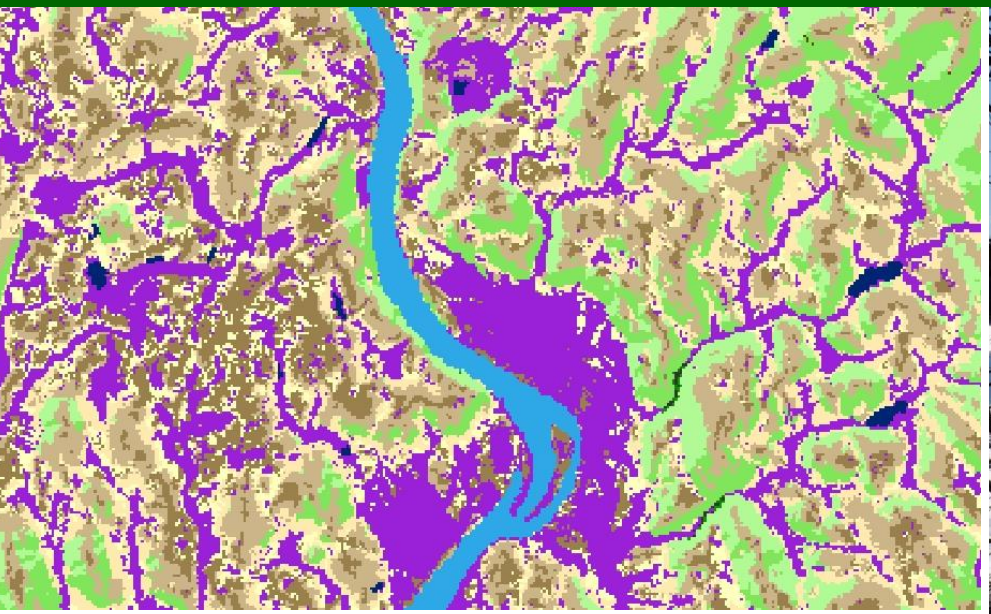
Quabbin, MA: Mafic/Mixed

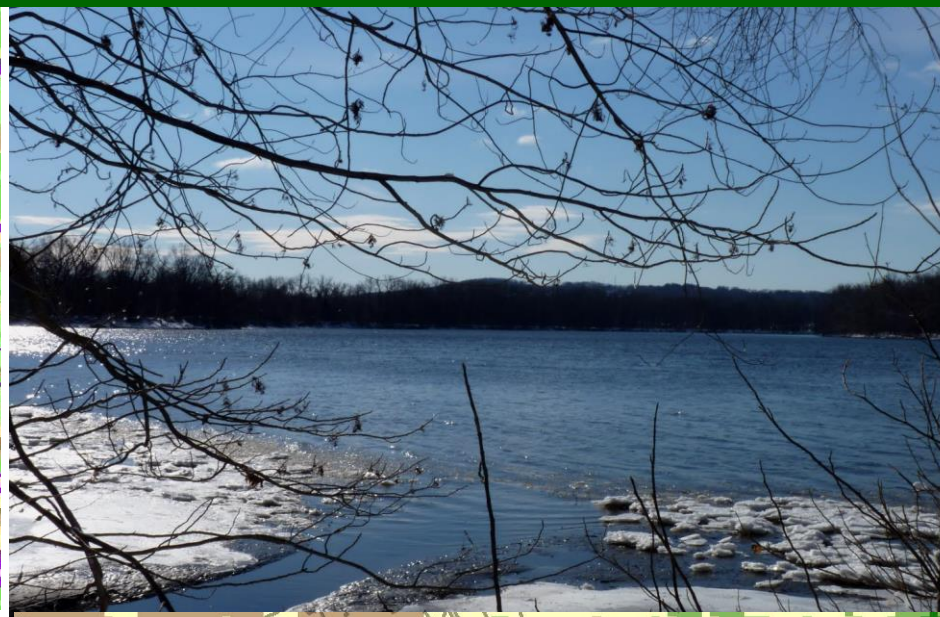


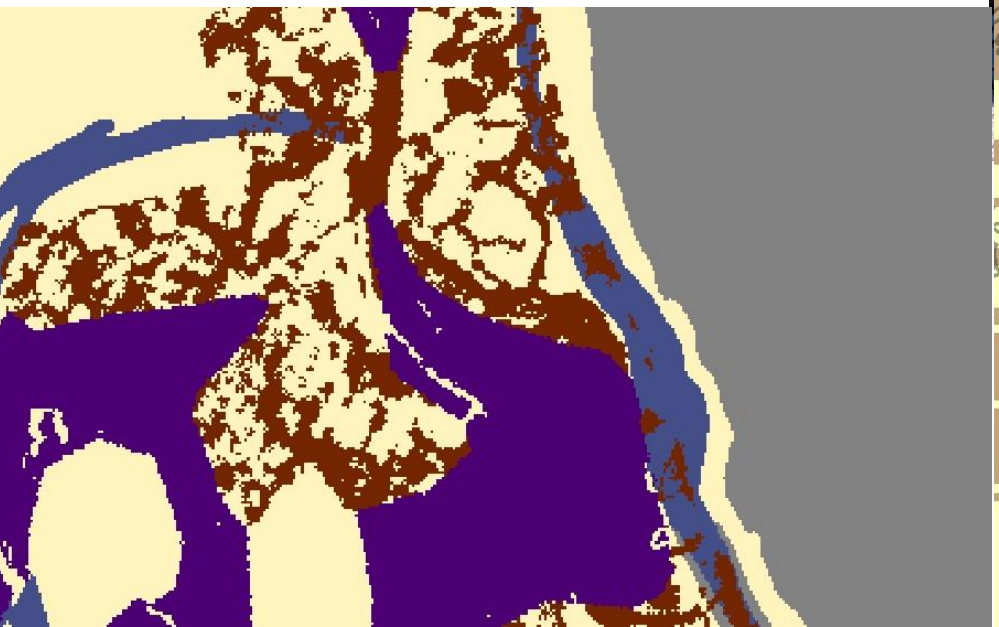


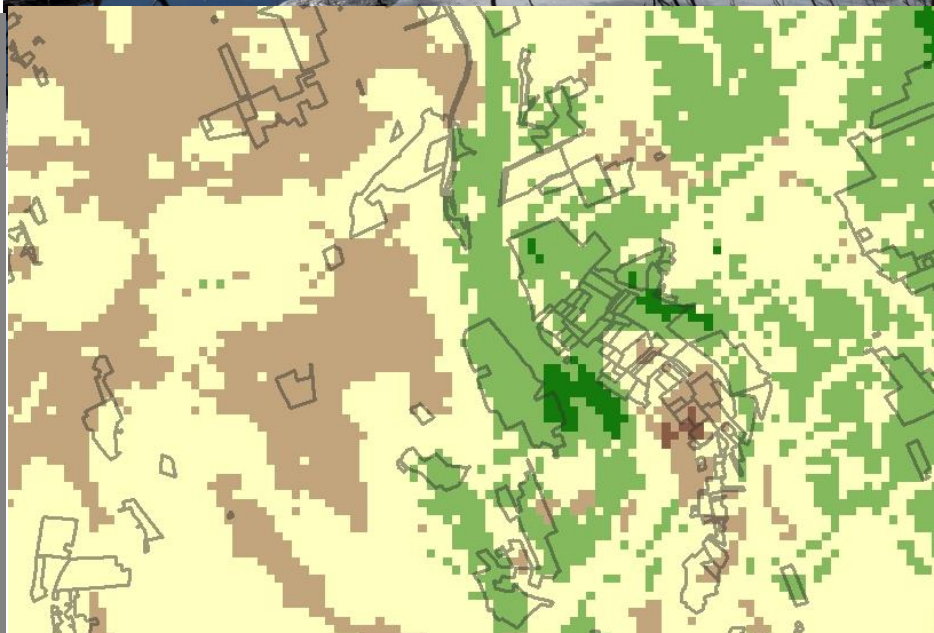


Wangunk Meadows, CT: Fine Silt

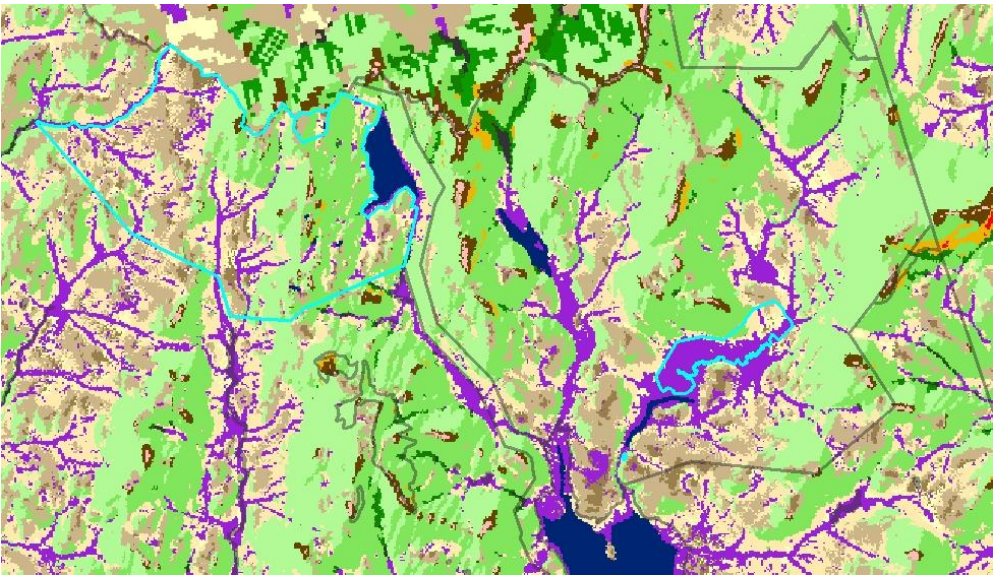


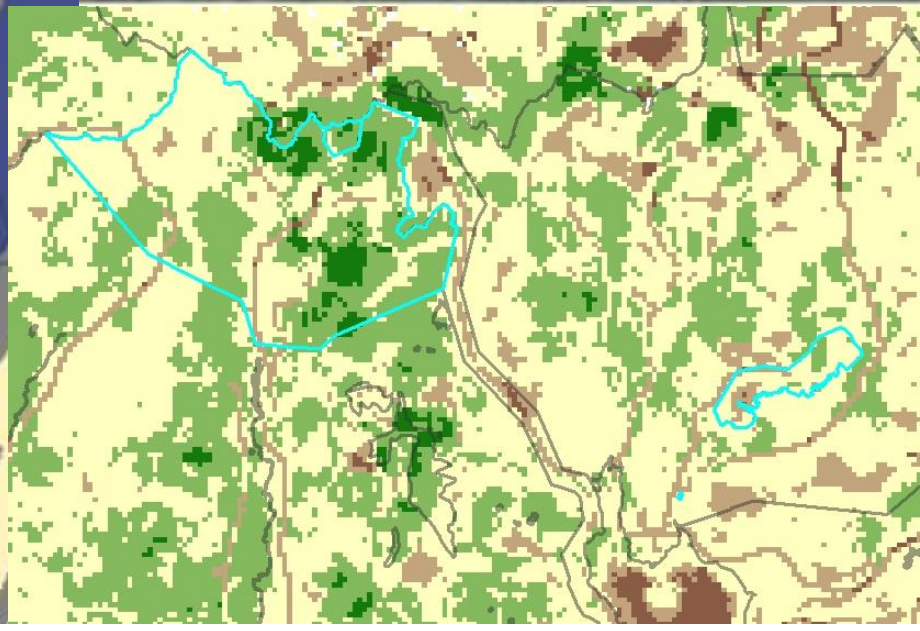




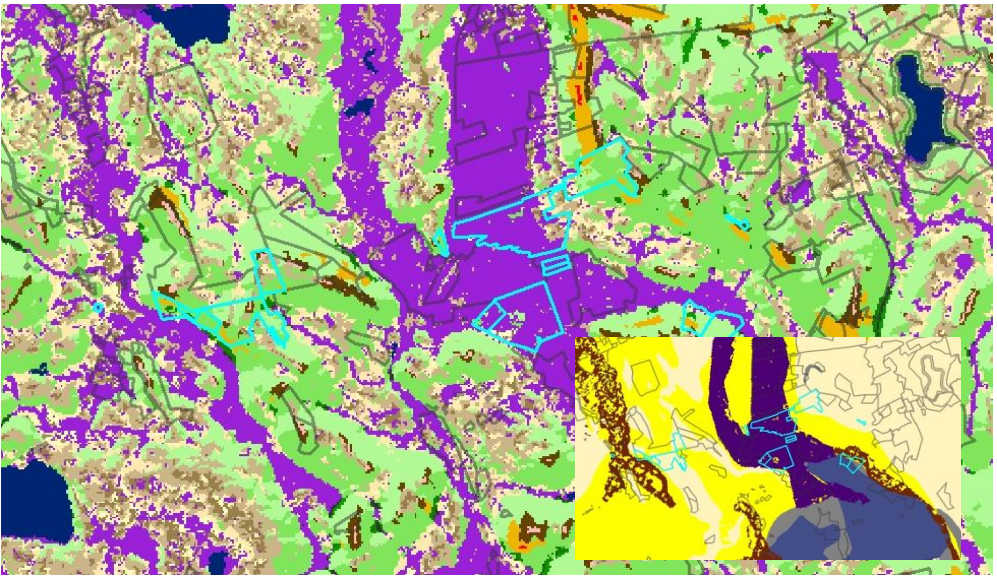


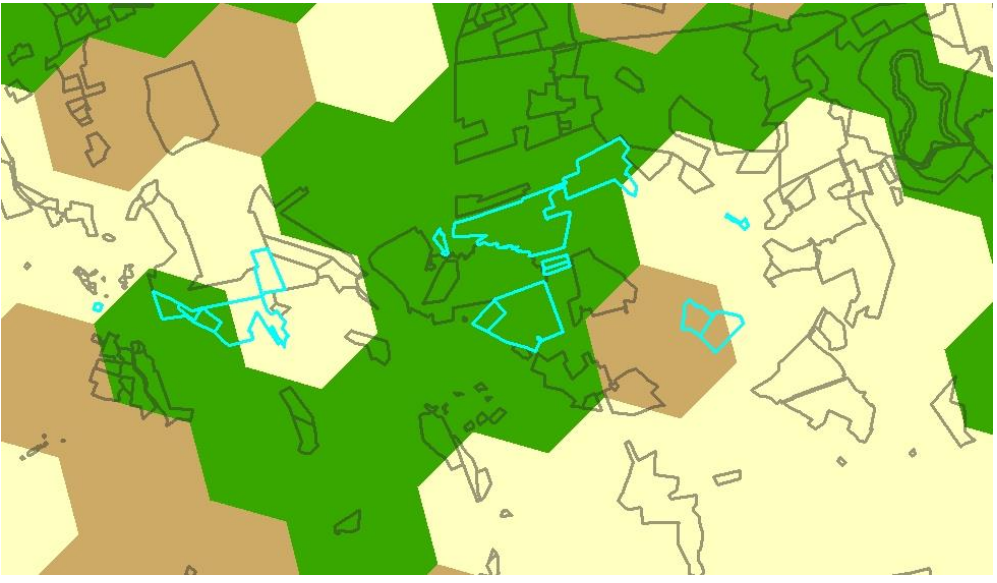
Connecticut Lakes: Sandstone NH

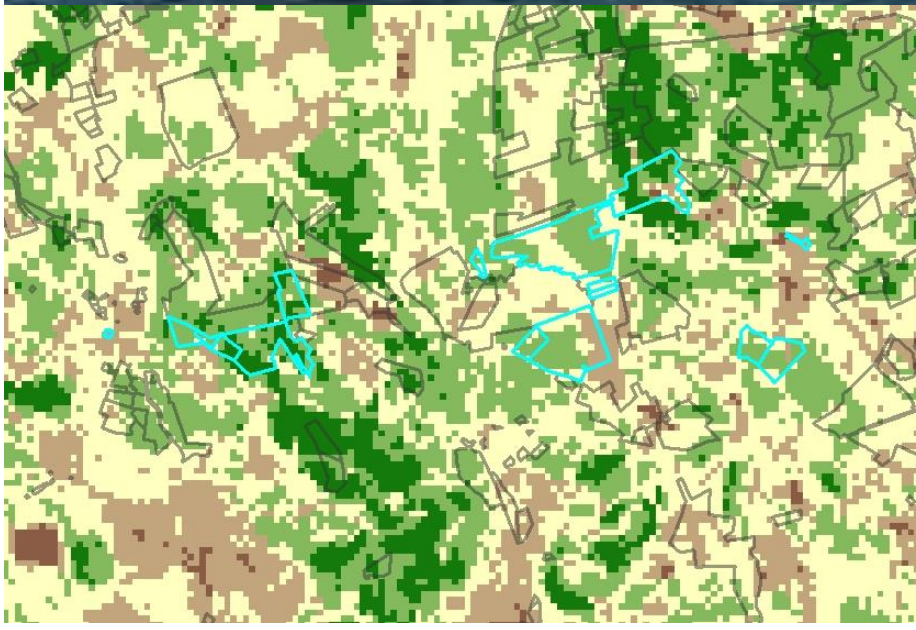




Canaan Mt – Robbins Swamp: Silt/Sed CT







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  - Caribbean
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    - Colorado
    - Eastern Division
      - Who We Are
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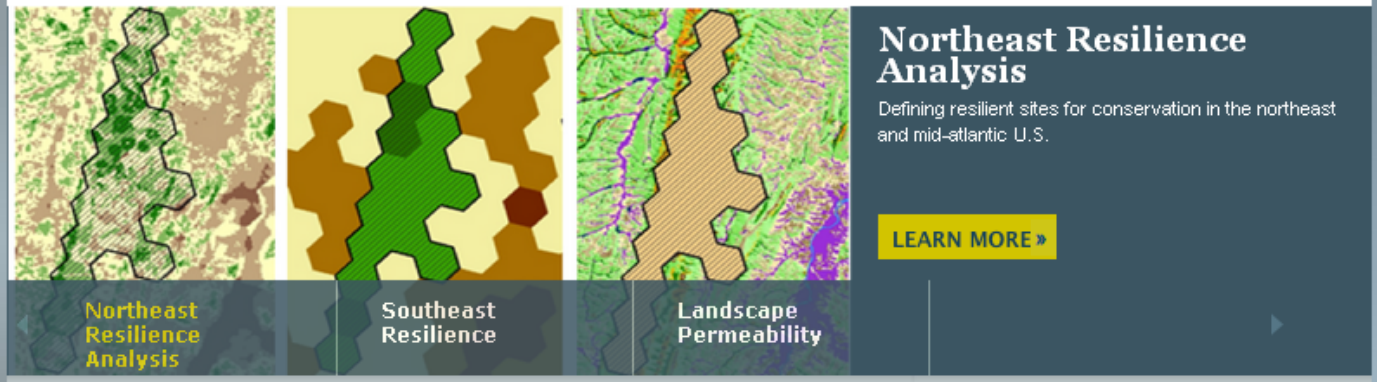
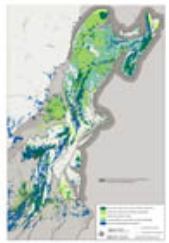
          - Habitat Map
          - Ecoregional Plans
          - Maps & Spatial Data
          - Secured Lands
          - Geospatial Analysis
          - Habitat Guides

Resilience

http://nature.ly/edconserve



Resilience concerns the ability of a living system to adjust to climate change, to moderate potential damages, to take advantage of opportunities, or to cope with consequences; in short, its capacity to adapt. The Nature Conservancy's resilience analysis develops an approach to conserve biological diversity while allowing species and communities to rearrange in response to a continually changing climate. This project identifies the most resilient examples of key geophysical settings, to provide managers and scientists with a nuanced picture of the places where conservation is most likely to succeed over centuries.



The resilience analysis had four parts. The project:
1) Mapped geophysical settings across the entire area,
2) Within each geophysical setting, located areas that have complex topography and are highly connected by natural cover,
3) Compared the identified sites with The Nature Conservancy's portfolio of important biodiversity sites,
4) Identified key linkages between sites.

The final products identify sites with high or low estimated climate resilience relative to their setting. The analyses are done for each geophysical setting within each ecoregion.

Key Resources

Northeast Resilience Datasets 90m
90m dataset, basic hexagons, coastal zones and focal areas for download (1gb download).

Additional Northeast Resilience Data
All resilience data used for the resilience analysis in the northeastern United States including intermediate products such as 30m landform variety (2.2gb download).

NE Resilience Report
Full report of the resilience project for the northeastern United States.

Permeability datasets
GIS data for the permeability study

Alexa

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Northeast Resilience Analysis
Defining resilient sites for conservation in the northeast and mid-atlantic U.S.

LEARN MORE »

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