Resilient Stream Networks

in the Northeast and Mid Atlantic

The Nature Conservancy Eastern Division Science

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Terrestrial Resilience:

Natural Strongholds for Climate Change

Green: More Resilient

Brown: More Vulnerable

Yellow: Average

Sea level rise, coastal processes and shoreline were not analyzed in the maritime zone.

Ecoregional Boundaries
Far below average (<-2 standard deviations)
Below average (-1 to -2 standard deviations)
Slightly below average (-0.5 to -1 standard deviations)
Average (-0.5 to 0.5 standard deviations)
Slightly above average (0.5 - 1 standard deviations)
Above average (1 to 2 standard deviations)
Far above average (>2 standard deviations)

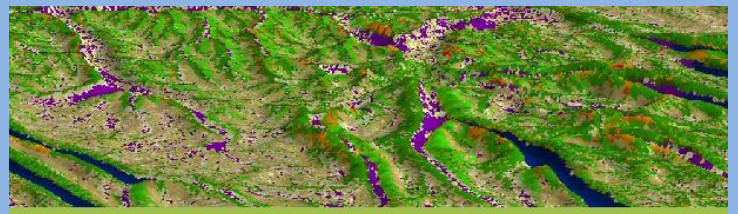
0 15 30 60 90 120 Kilometers
0 12.5 25 50 75 100 Miles

International boundary
State and province boundary

ArcGIS Online Shaded Relief map. ESRI 2011.
Map Produced by TNC Eastern Division 2011.

Regional Terrestrial Resilience Score
Stratified by Setting and Ecoregion with Regional Override

This work is the counterpart to the Eastern Terrestrial Resilience Project. It is based on the importance of conserving the geophysical stage



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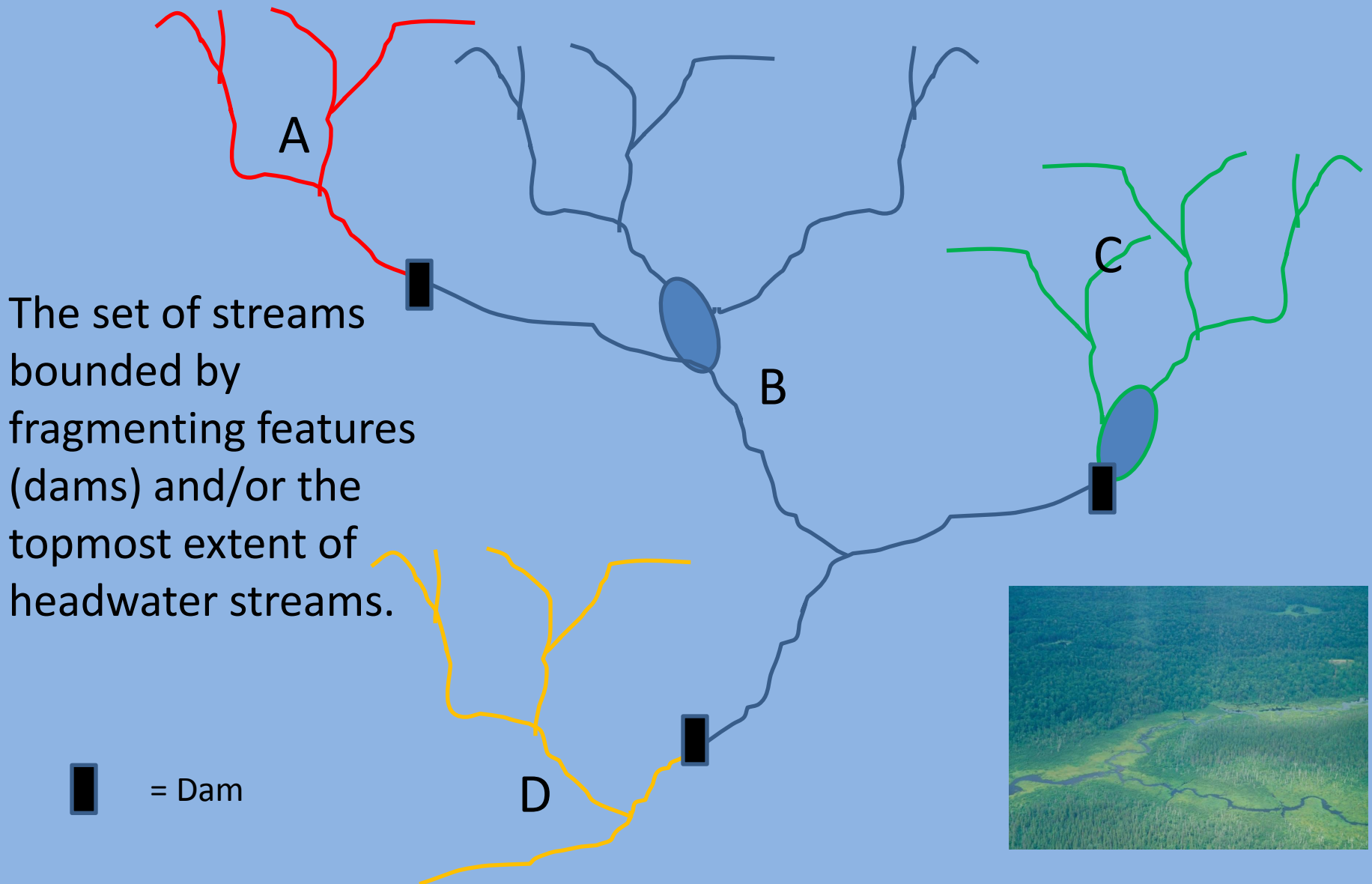
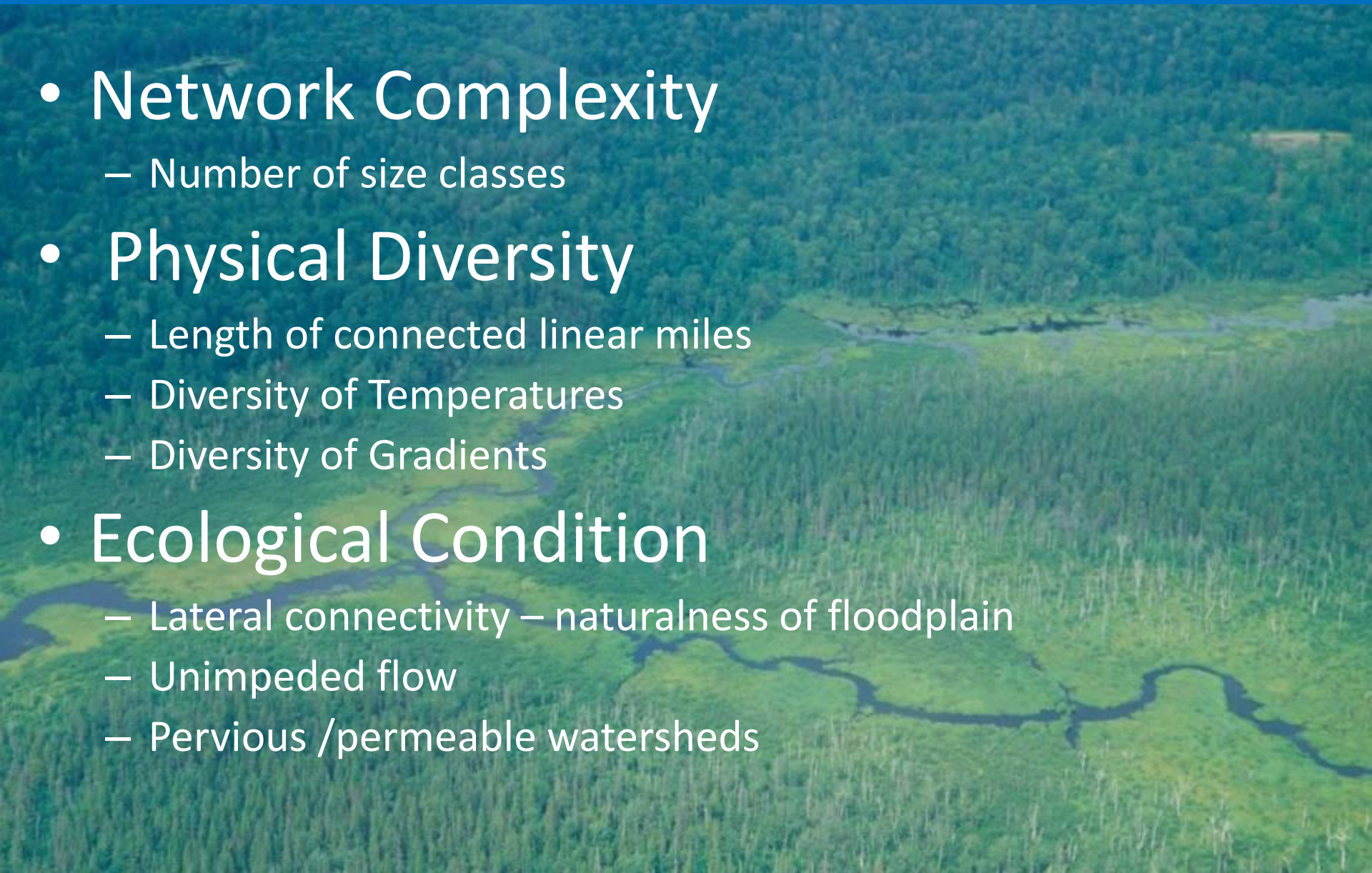
Resilient Sites for Terrestrial Conservation
in the Northeast and Mid-Atlantic Region

The Nature Conservancy · Eastern Conservation Science
Mark G. Anderson, Melissa Clark, and Arlene Olivero Sheldon

Functionally Connected Networks



What Makes a Stream Resilient?



- Network Complexity
  - Number of size classes
- Physical Diversity
  - Length of connected linear miles
  - Diversity of Temperatures
  - Diversity of Gradients
- Ecological Condition
  - Lateral connectivity – naturalness of floodplain
  - Unimpeded flow
  - Pervious /permeable watersheds

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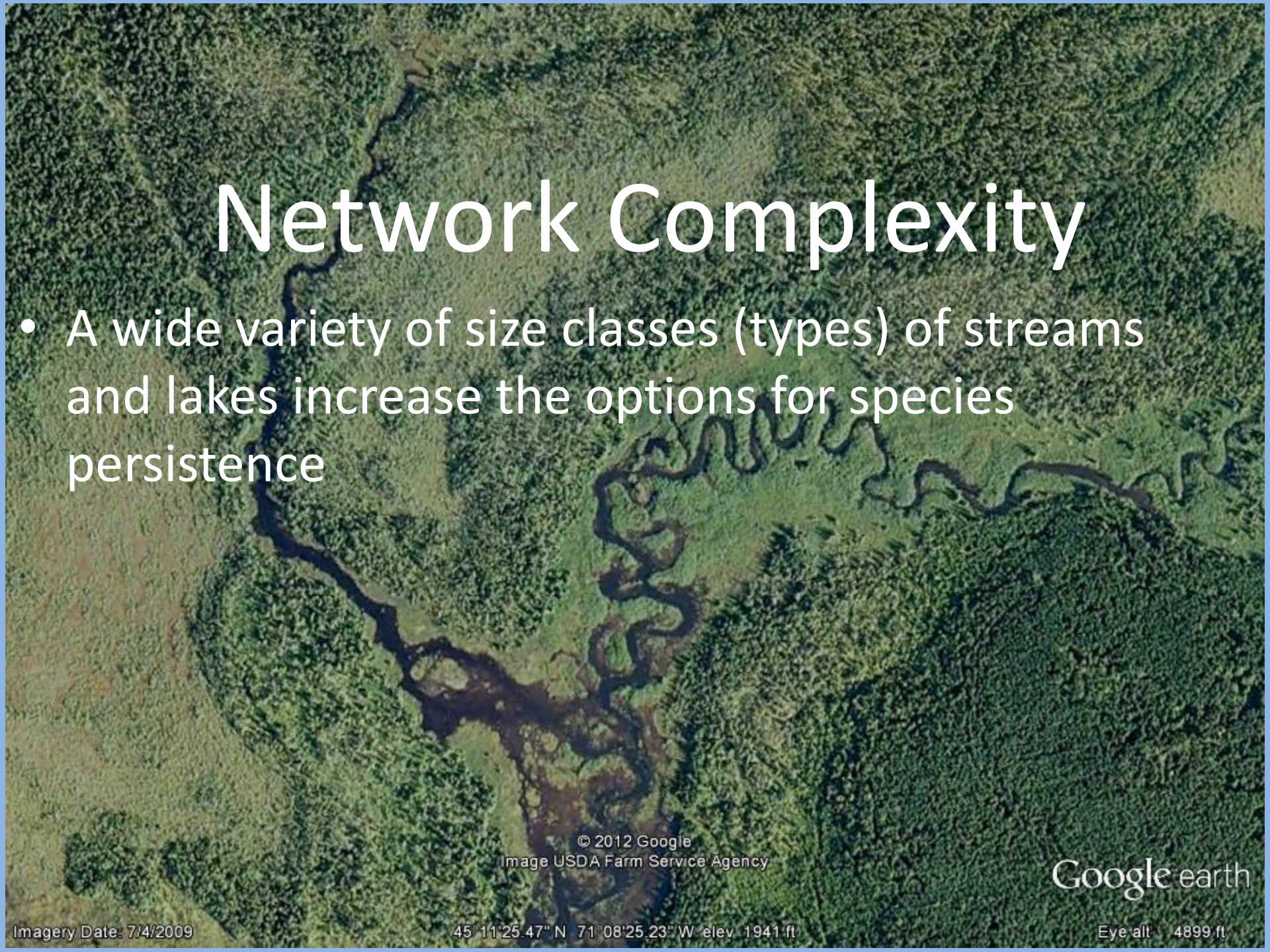
  - Permeable (pervious) watersheds

Counterpart of Landscape complexity

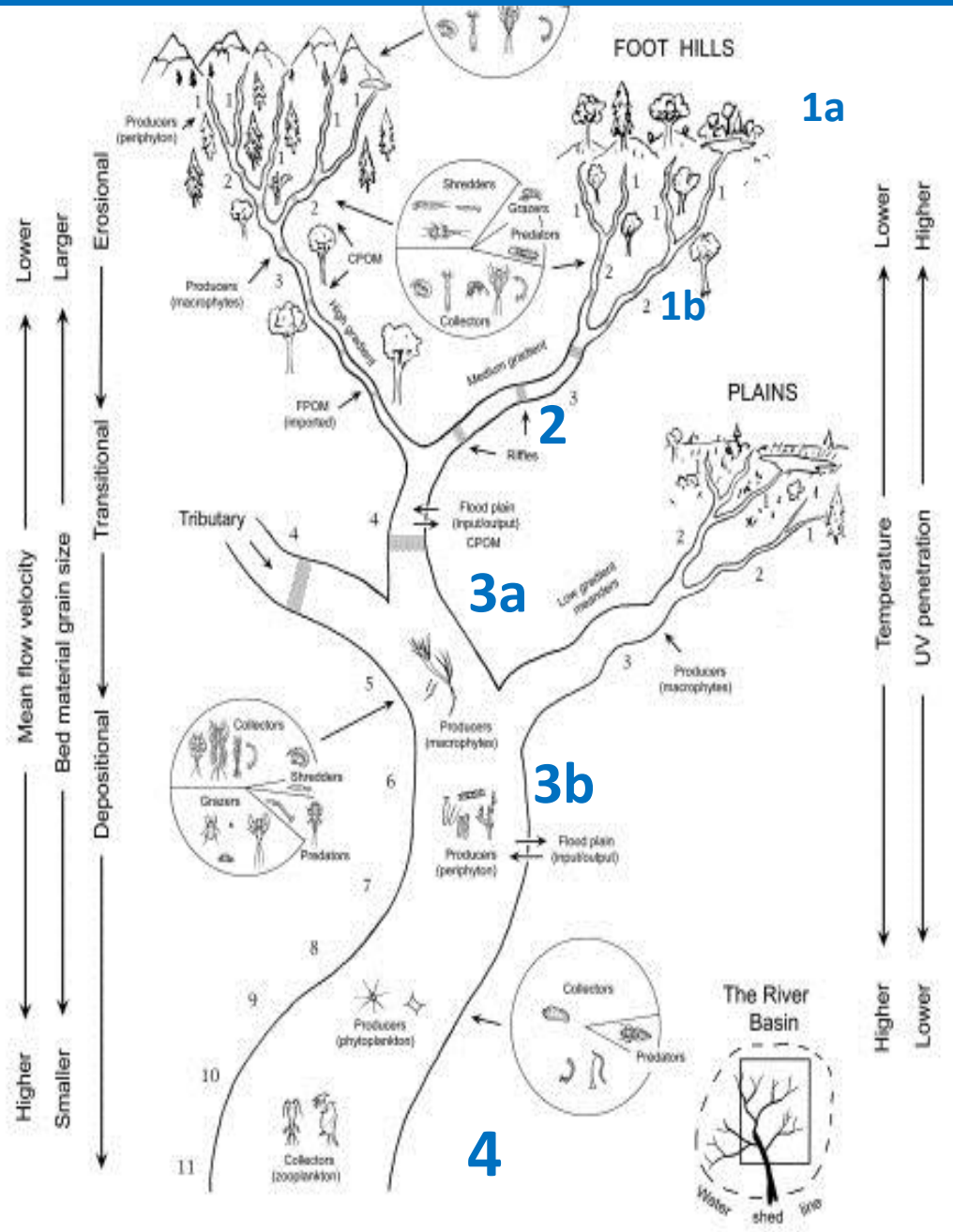
Counterpart of Local Connectedness

Network Complexity

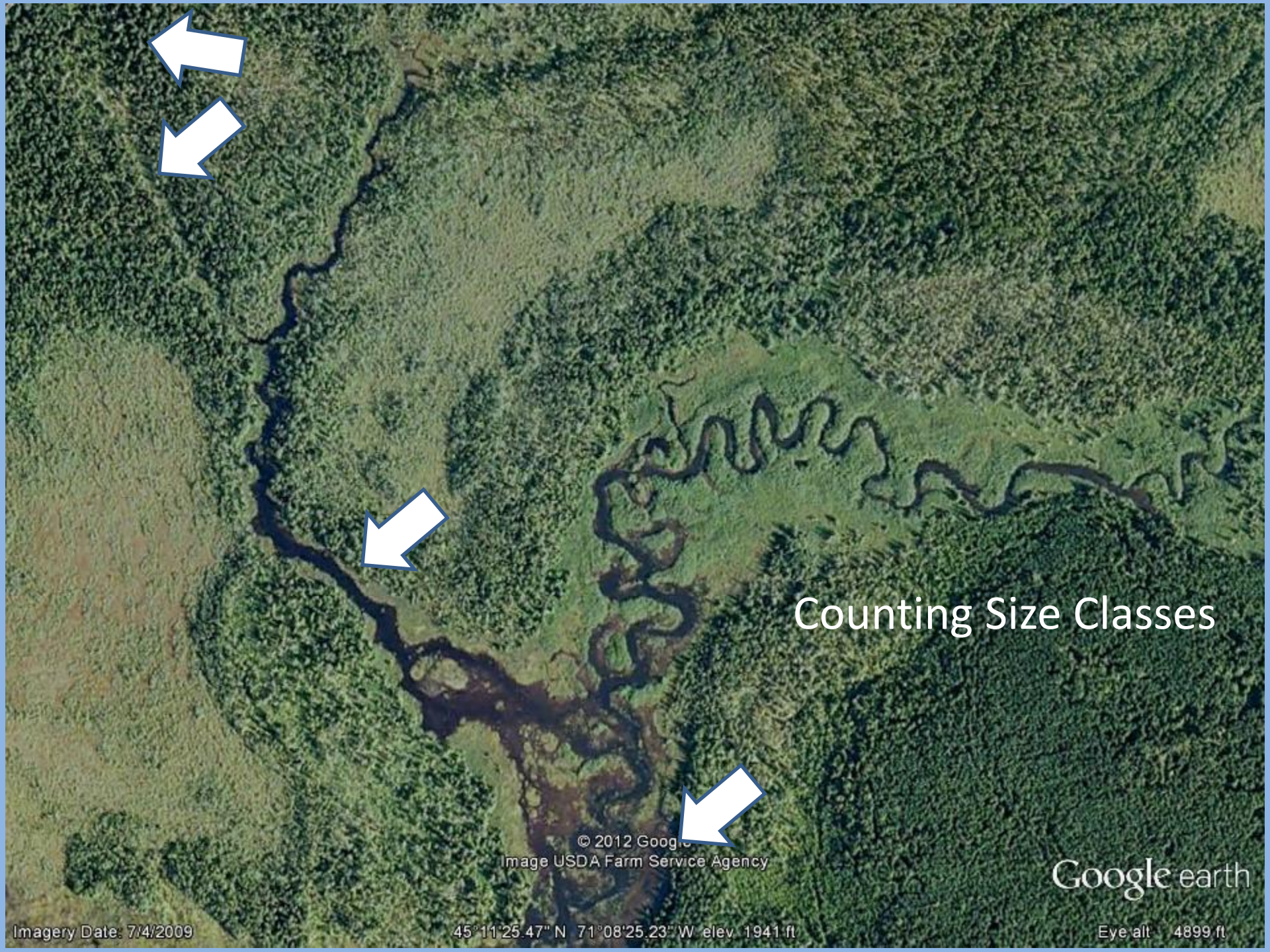
- A wide variety of size classes (types) of streams and lakes increase the options for species persistence

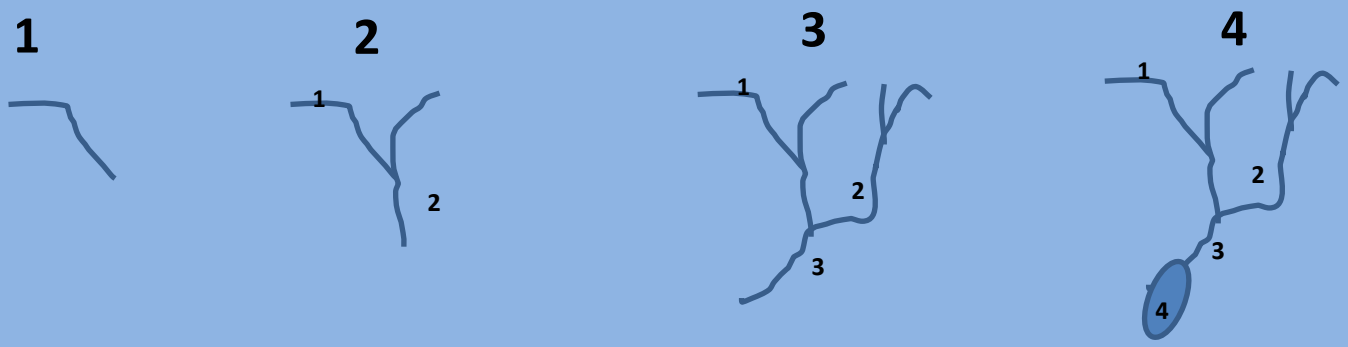


Number of Size Classes



1a	Headwaters: 1-4 sq. mi.
1b	Creeks: 4-39 sq. mi.
2	Small River: 39-200 sq. mi.
3a	Med. Tributary: 200-1000 sq. m
3b	Med. Mainstem: 1000-3900 sq
4	Large River: 3900 - 9600 sq. mi.
5	Great River: 9600+ sq. mi.
6	Small Lakes: <200 acres
7	Large Lakes: >200 acres


Counting Size Classes
© 2012 Google
Image USDA Farm Service Agency
Google earth
Imagery Date: 7/4/2009
45°11'25.47" N 71°08'25.23" W elev 1941 ft
Eye alt 4899 ft



Few options Vulnerable

Network Diversity Threshold

We counted the # of size classes of streams, rivers, and lakes within each network. Networks with a complexity level of 5 or higher were selected as a complex set to further evaluate.

Diversity

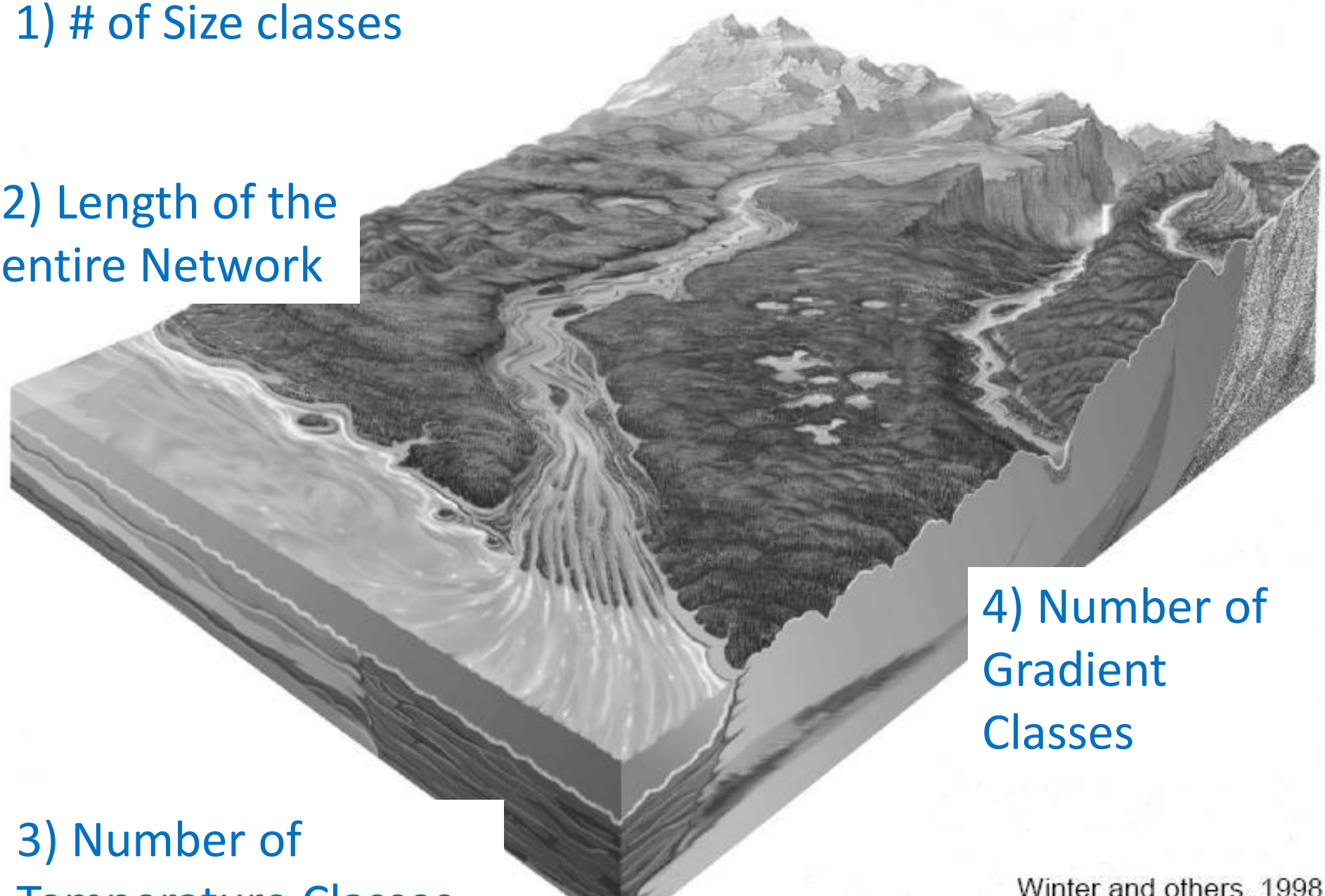
- Long networks provide room for the daily and seasonal movements of the inhabitants

- A variety of temperatures and gradients - warm quiet waters to fast cold waters – provide ample microhabitats

Diversity

1) # of Size classes

2) Length of the entire Network



4) Number of Gradient Classes

3) Number of

Winter and others, 1998

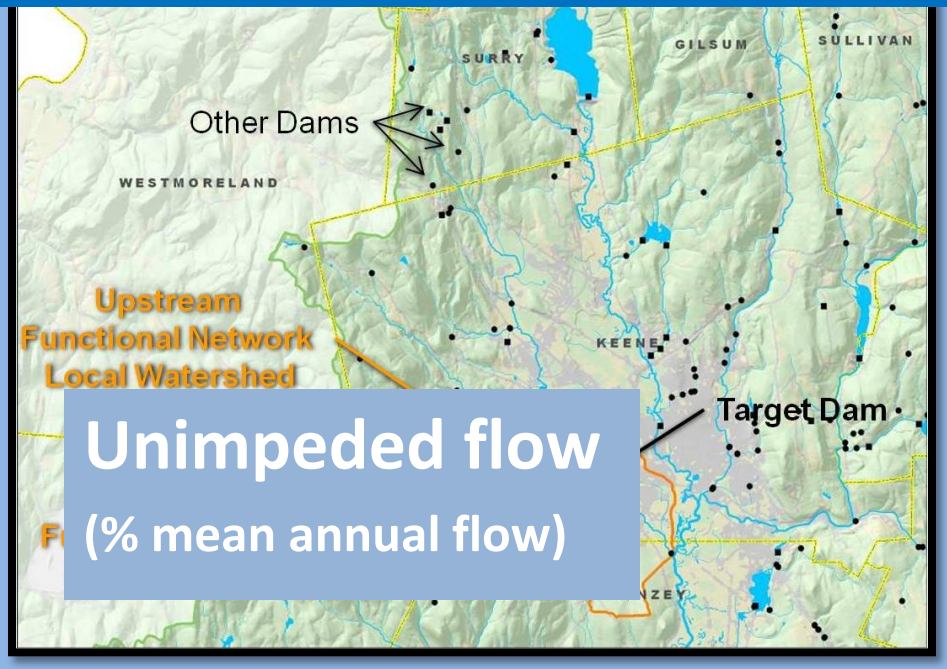
Condition

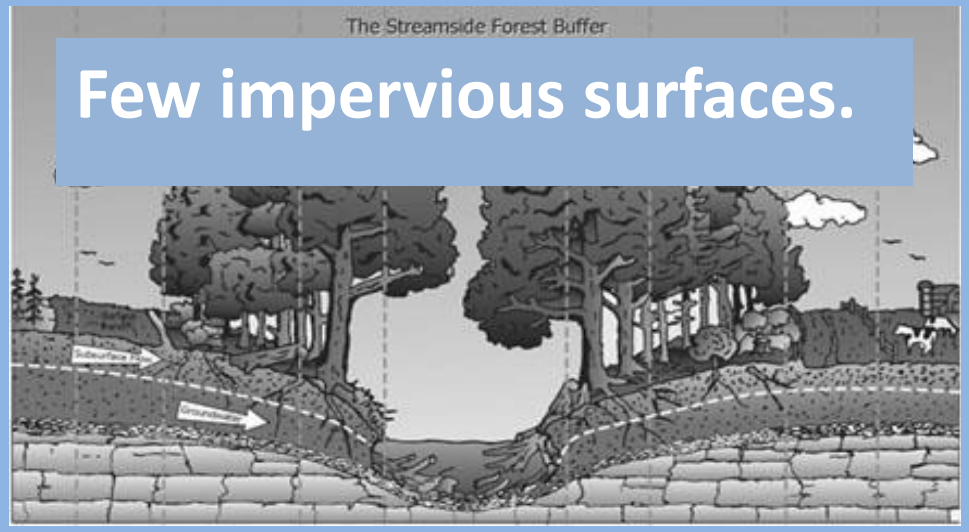
- Intact floodplains with mostly natural cover ensure that stream organisms have access to their nutrients, food and space resources.

- Permeable watershed in mostly forested cover and unimpeded upstream rivers with few dams ensure a natural flow regime.

Condition

Naturalness of the floodplain





Integration

Complexity Threshold:
# of stream, river, and lake size classes >= 5

Diversity Score: = sum of normalized scores for:
- Length
- Gradient
- Temperature

Condition Score: = sum of normalized scores for:
- Floodplain naturalness (ARA size 2)
- Dam storage
- Imperviousness surfaces

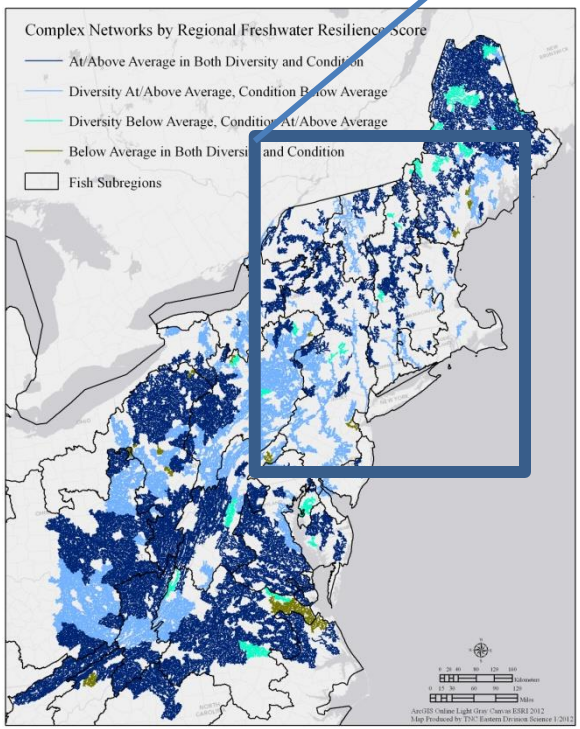
Results

- 346 networks meet the complexity threshold of >= 5. The next set of maps show only these networks

- Maps highlight classes based on standard deviations relative to the mean score for all networks containing size 2 rivers (1468)

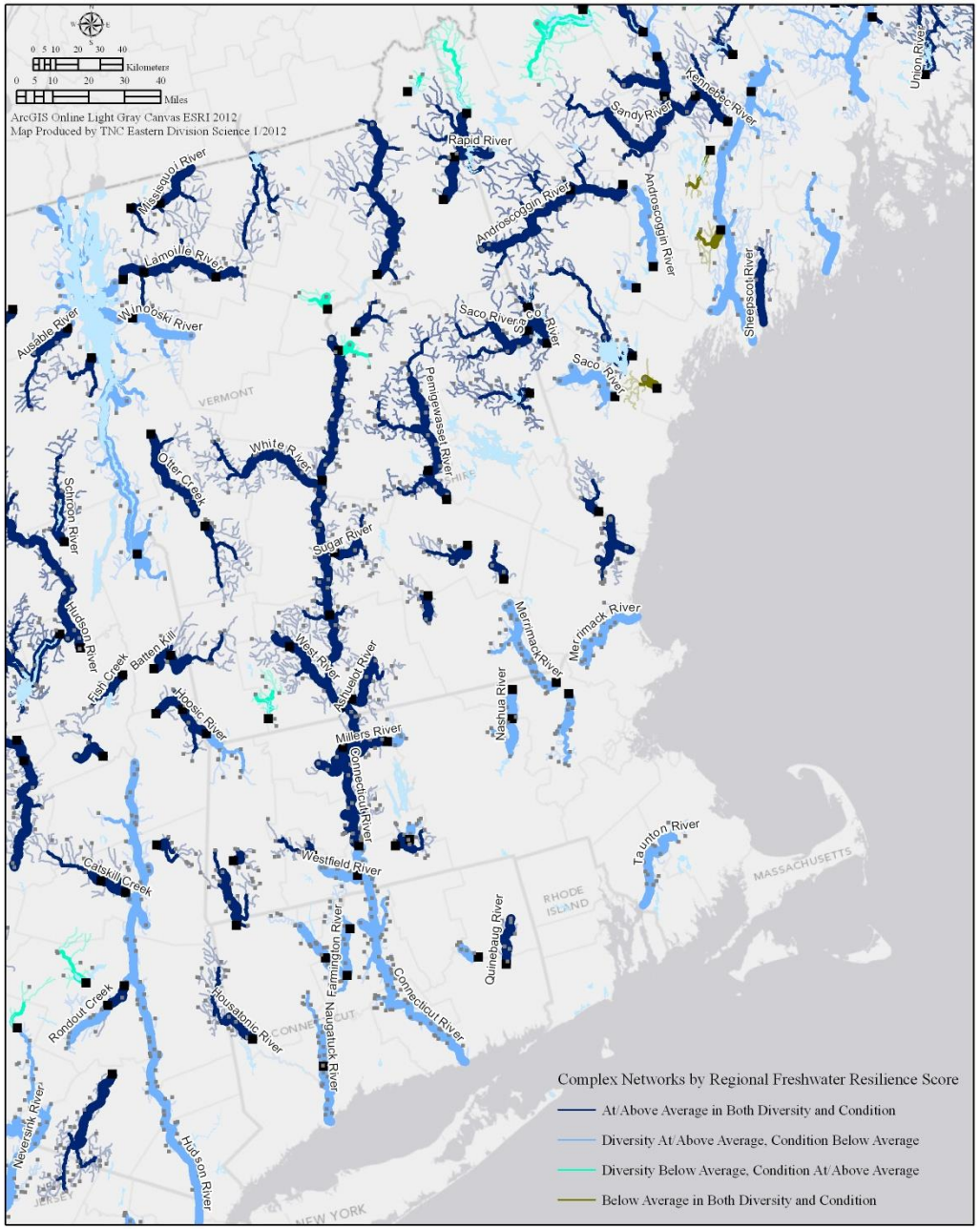
Complex Networks (346)

In the next set of slides the stream networks will look like blobs of color.



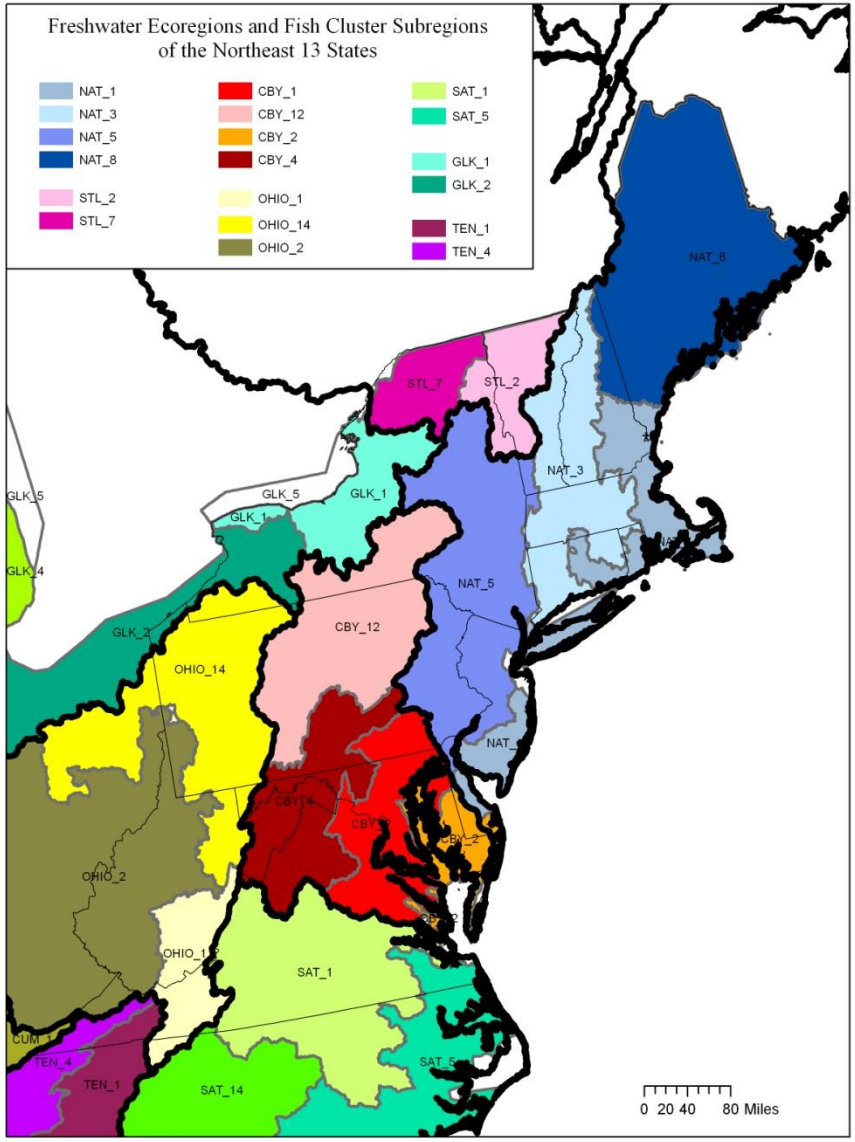
Regional Freshwater Resilience Score
Stratified by Fish Subregion with Regional Override

Colors match this legend for the thicker size 2+ rivers; headwaters are shown thinner and with a 50% transparency which lightens their colors

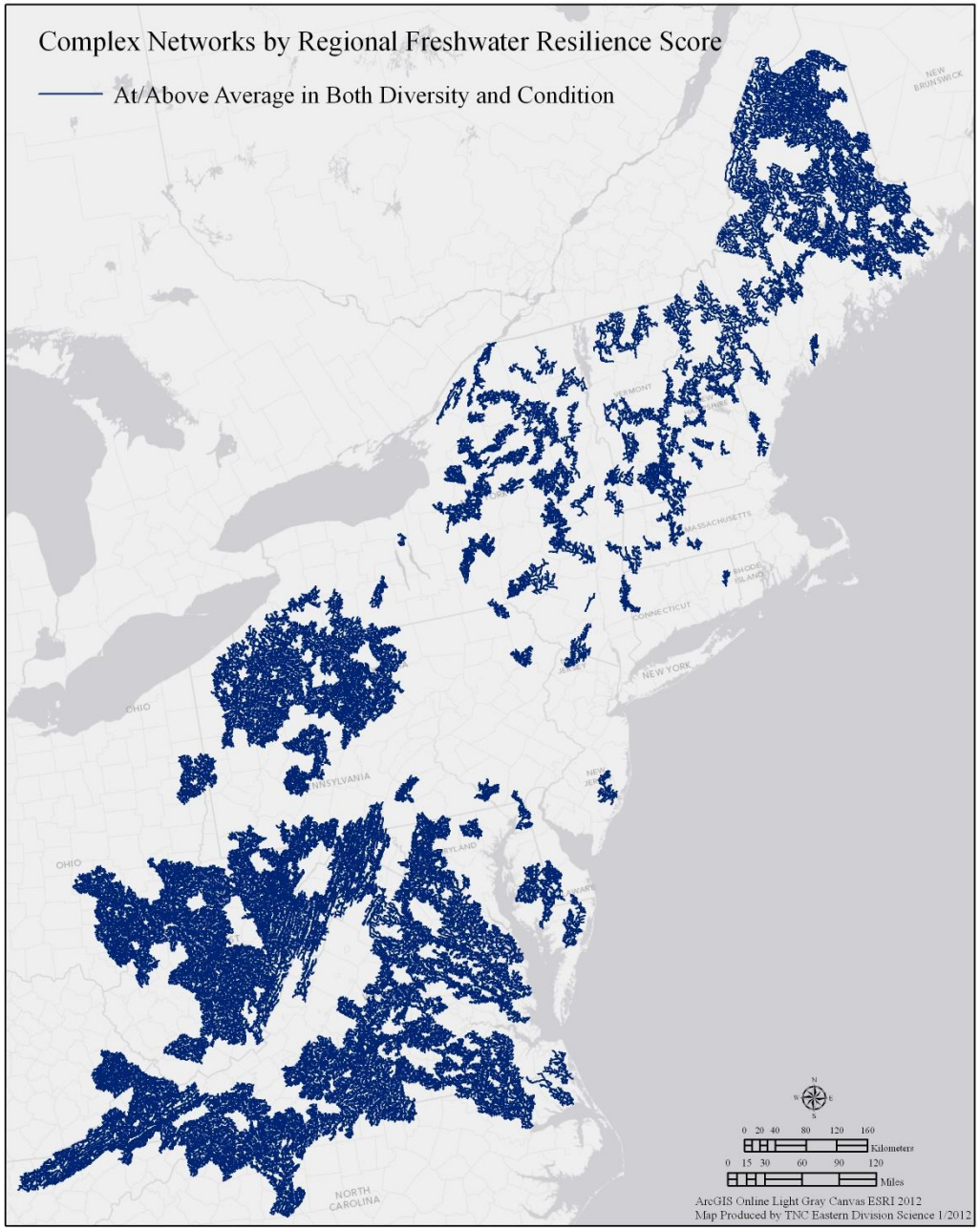


Regional Freshwater Resilience Score
Stratified by Fish Subregion with Regional Override

Comparisons are made within: Fish Subregions



Portions of Freshwater Ecoregions that have a similar fish fauna.



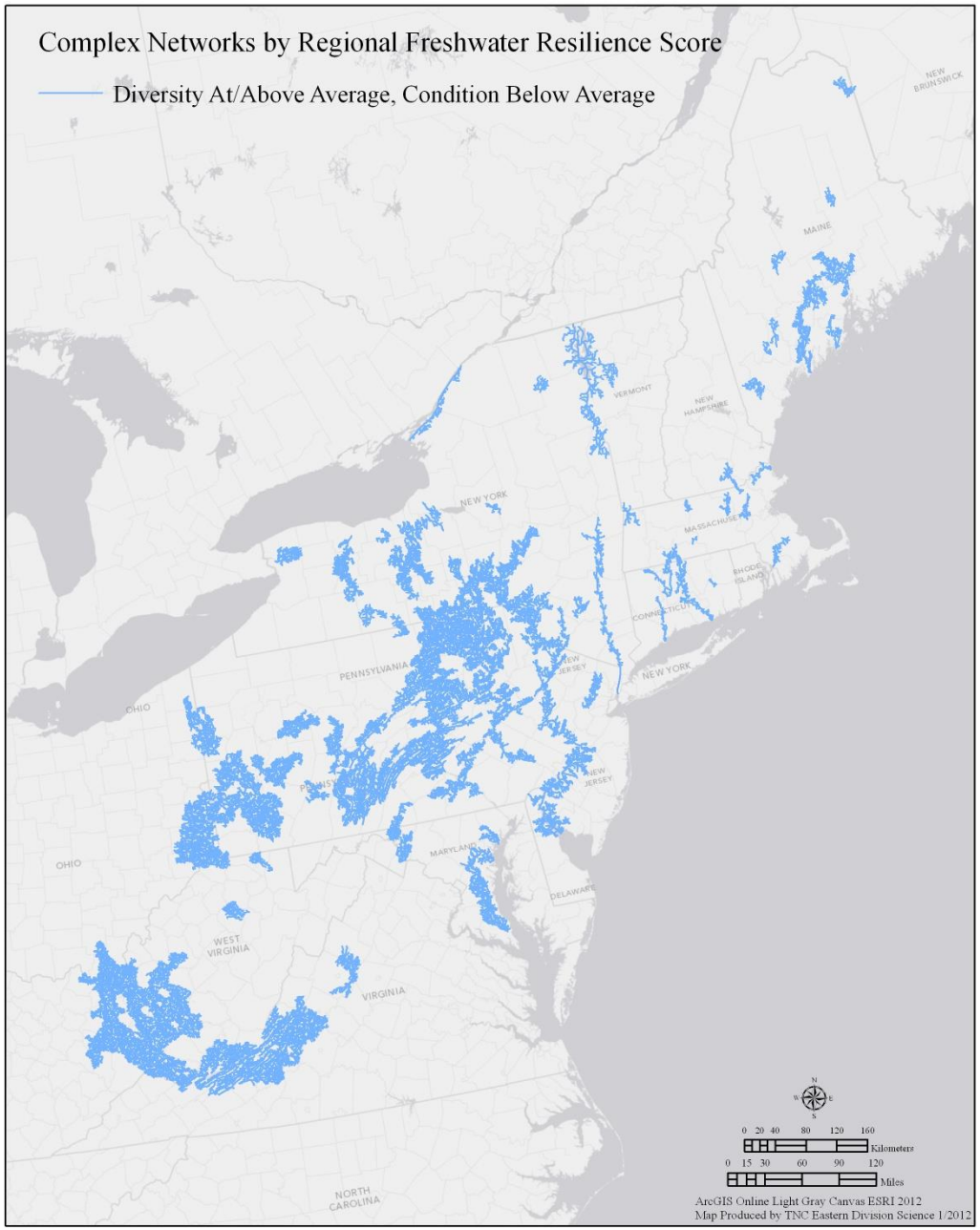
Regional Freshwater Resilience Score

Stratified by Fish Subregion with Regional Override

Above Average for Diversity AND Condition

(within Fish Region)

Highlight Networks that score at/above the mean in both Diversity and Condition in Fish region or Regional (0.5, 211)



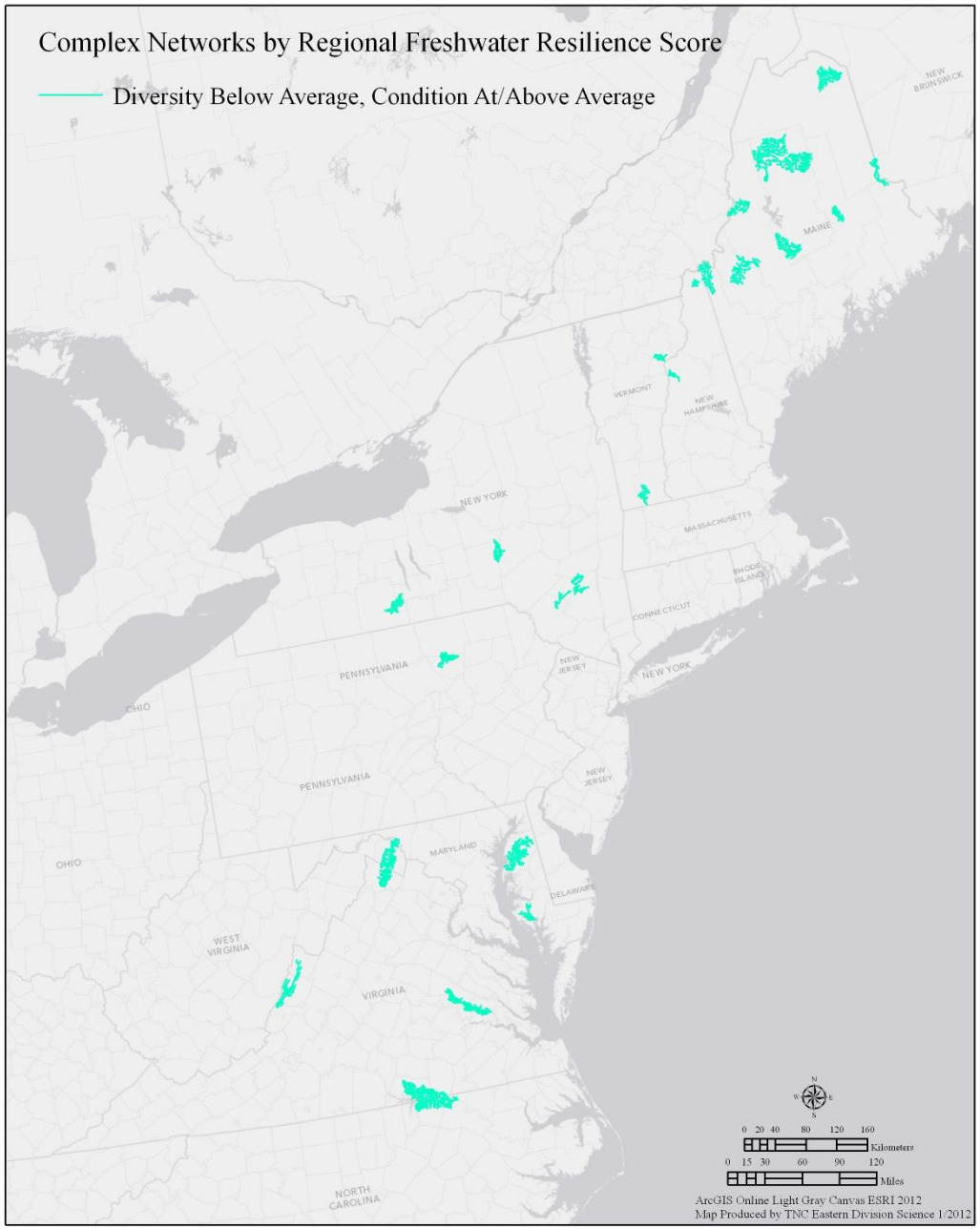
Regional Freshwater Resilience Score

Stratified by Fish Subregion with Regional Override

Above Average for **Diversity** but not Condition

(with Fish Region)

Highlight Networks that score at/above the mean in both Diversity and Condition (95)



Regional Freshwater Resilience Score

Stratified by Fish Subregion with Regional Override

Above Average for **Condition** but not Diversity

(with Fish Region)

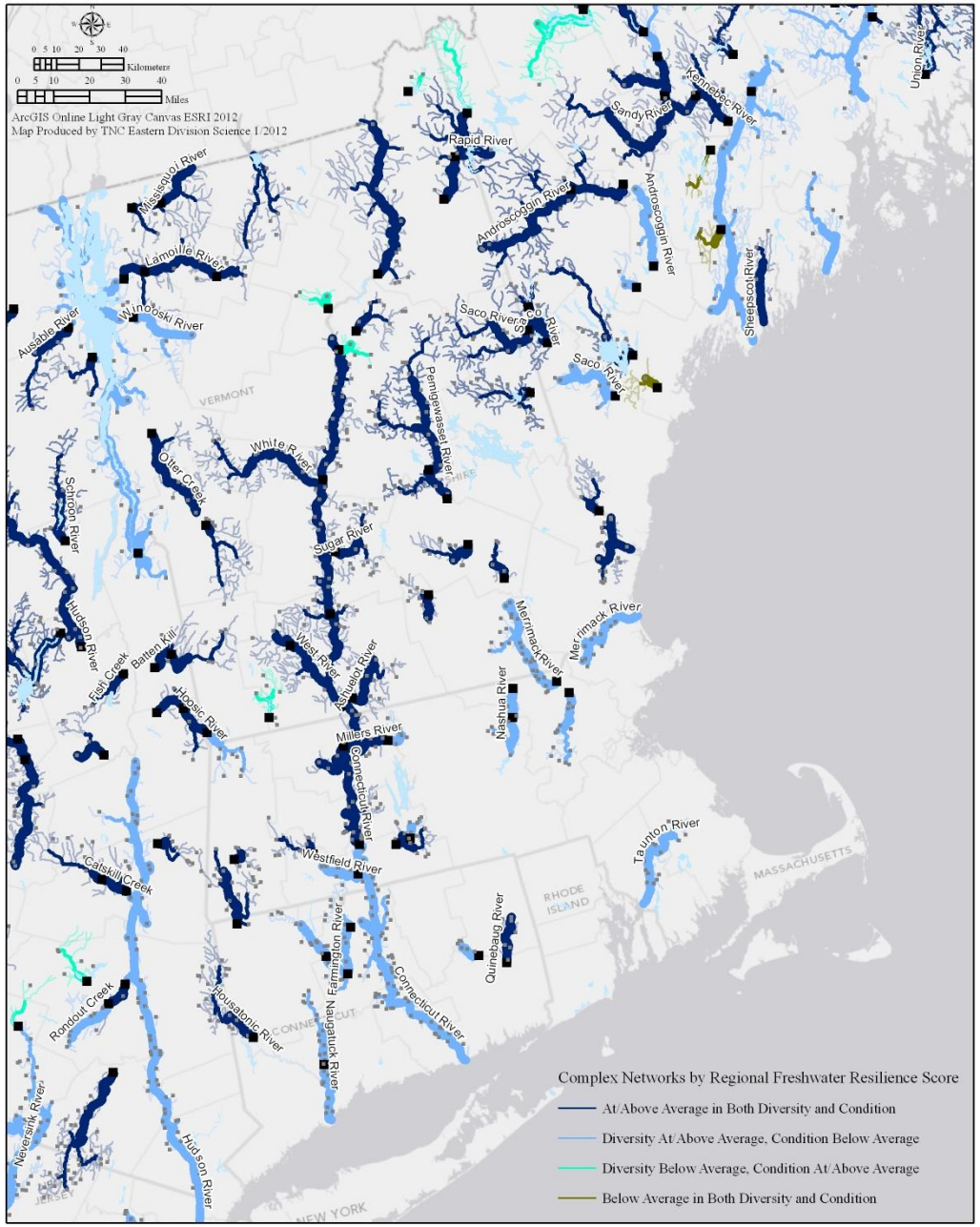
Highlight Networks that score at/above the mean in both Diversity and Condition (26)

Freshwater Portfolio Tier 1 Rivers by their Regional Freshwater Resilience Score

- At/Above Average in Both Diversity and Condition
- Diversity At/Above Average, Condition Below Average
- Diversity Below Average, Condition At/Above Average
- Below Average in Both Diversity and Condition

Examples (AA in Both)

Catskill Creek
Battenkill River
Rish Creek
Otter Creek
White River
Upper Hudson River
Ausable River
Lamoille River
Mississquoi River
Rapid River
Upper Androscoggin River
Ashuelot River
Millers River
Qunegaug River
Upper Housatonic River



Regional Freshwater Resilience Score

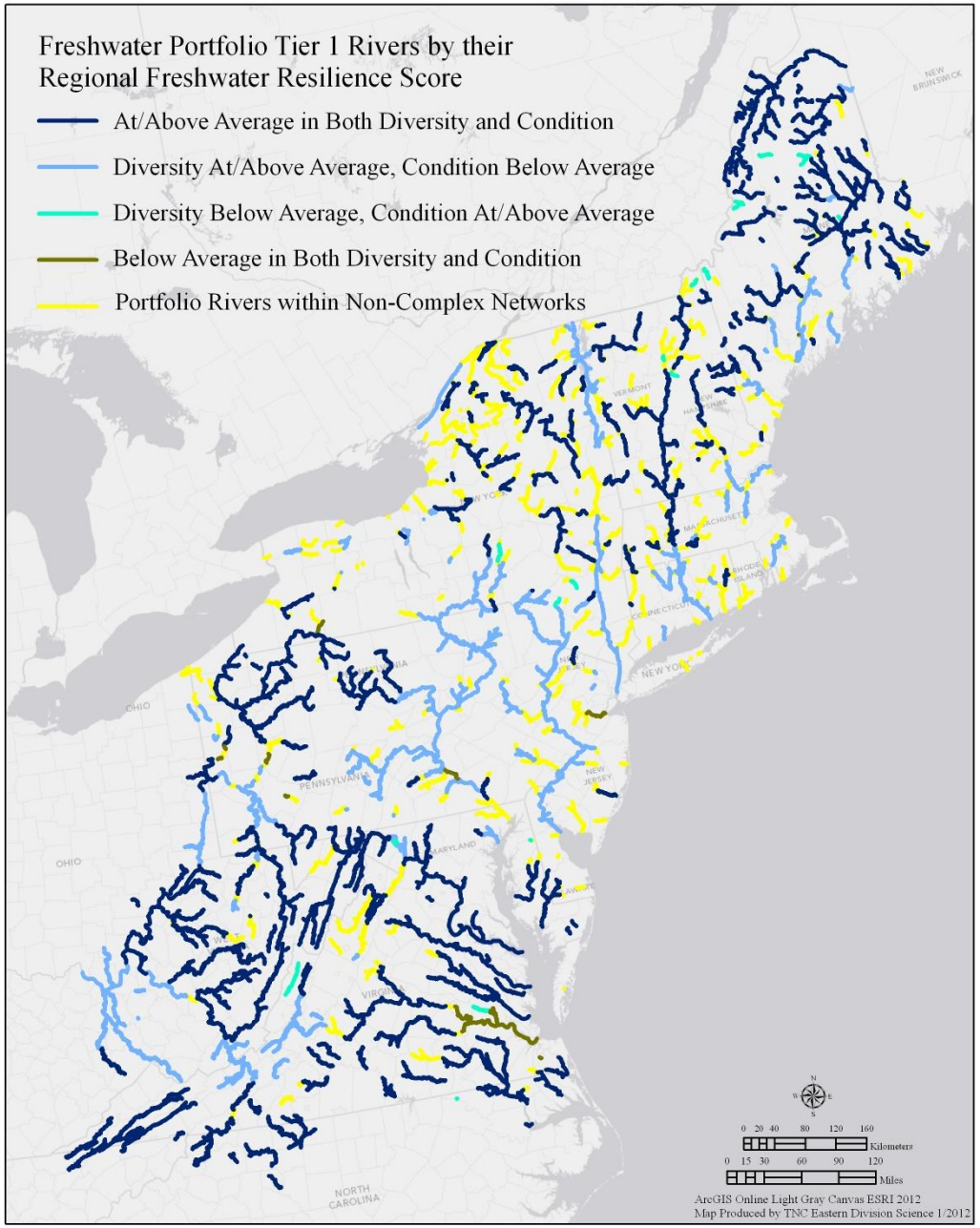
Stratified by Fish Subregion with Regional Override

Portfolio Rivers

Ranked by their Freshwater Resilience Score

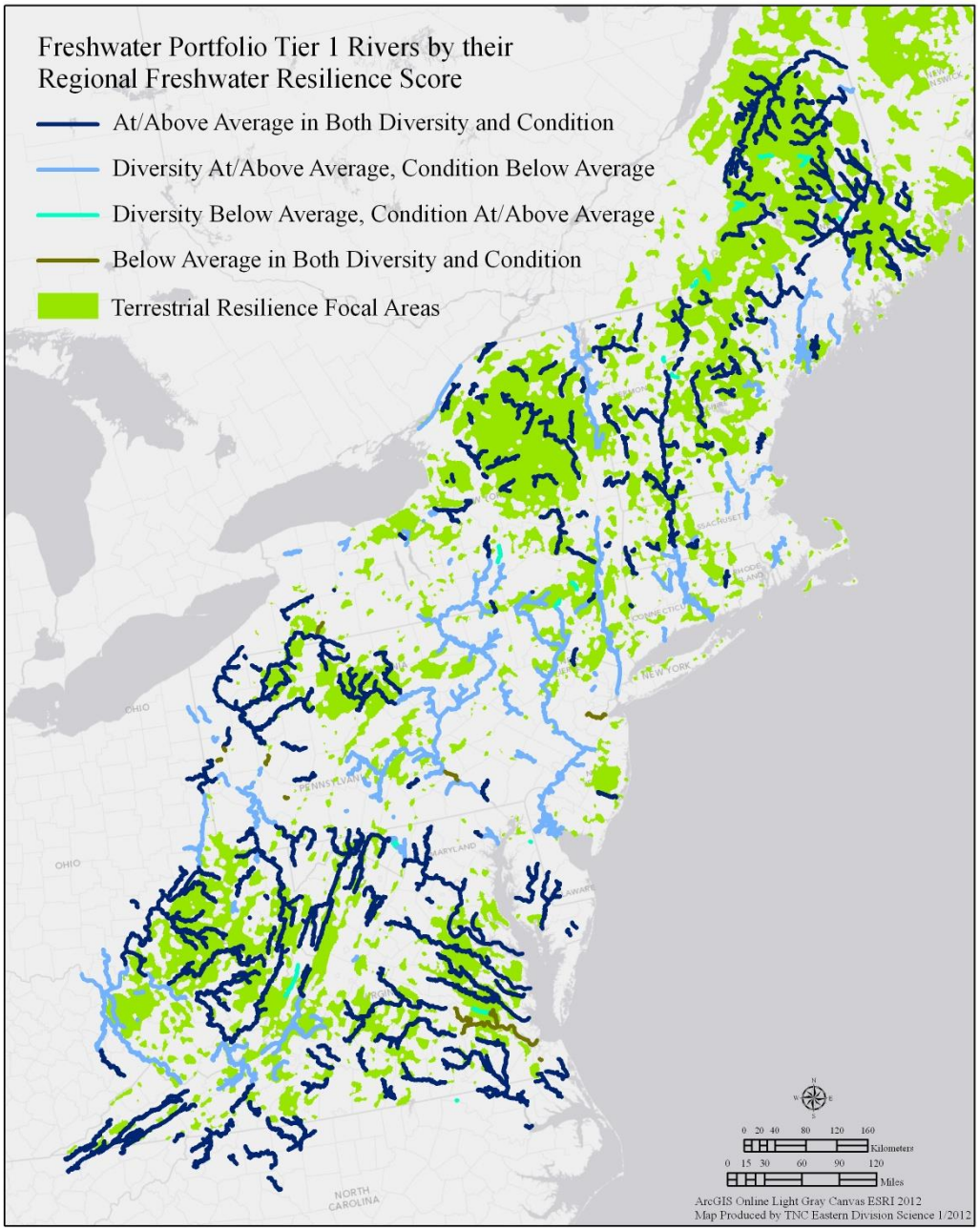
The Nature Conservancy's Freshwater Portfolio is comprised of representative stream networks that score high for both condition and natural aquatic diversity

The map shows which networks also score high for climate change resilience – and which one s do not.



Portfolio Rivers by Regional Freshwater Resilience Score

THANK YOU



Portfolio Rivers by Regional Freshwater Resilience Score
with Terrestrial Resilience Focal Areas

Africa
Asia Pacific
Latin America
North America
Canada
Caribbean
United States
Alaska
Arizona
California
Colorado
Eastern Division
Who We Are
Where We Work
Science and Data
Maps & Spatial Data
Terrestrial Projects
Terrestrial Resilience
Northeast
Southeast
Permeability
Habitat Map
Ecoregional Plans
Maps & Spatial Data
Secured Lands
Geospatial Analysis
Habitat Guides

Resilience

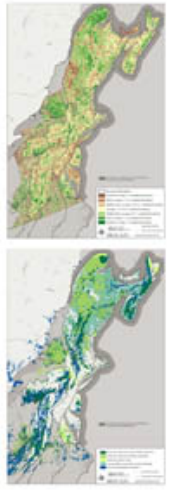
http://nature.ly/edconserve

Northeast Resilience Analysis

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

LEARN MORE »

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