The role of riparian climate corridors in promoting ecological resilience

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Acknowledgements

- Mark Anderson and his team
- 75 scientists, 8 years of work
The world is changing

Global Temperatures

- Annual Average
- Five Year Average

Temperature Anomaly (°C)

Newscientist.com
Plants and animals must adapt or relocate
Key question

- How do we ensure that the places we conserve today will support a diversity of plants and animals in the future?
Conserving fundamental processes
Steps in the process

1. **Climate-Resilient Sites**: Identify natural climate strongholds
2. **Connected landscapes**: Map the critical connecting features needed for dispersal among climate resilient sites
Resilient Sites

How can we identify sites where biodiversity is likely to be able to persist in the face of climate change?
Local redistribution
What creates natural resilience?

- Many microclimates leading to landscape diversity
  - Topography
  - Elevation range
  - Wetlands
  - Soils
Landscape diversity is only useful if organisms can access better conditions

- Local connectedness
- Less fragmented areas are more connected
Landscape Diversity

**Microclimate Estimates**
Every 30 m cell gets a score based on
- Landform variety
- Elevation range
- Wetland Density
- Soil Variety
Local Connectedness

Connectedness Estimates
For every 30 m cell based on roads, development, agricultures in a 3 K radius
Resilience Index

Areas for each Geophysical Setting with the highest landscape diversity and the highest local connectedness.
Resilient and Connected Landscapes

How do we ensure that biodiversity can redistribute in a changing world?
• Conserving resilient sites can help biodiversity persist in the face of “short-term” change

• However, in the long term most organisms will need to redistribute beyond local microclimates to survive climate change

• This involves **dispersing** to newly suitable habitat
What factors influence the likelihood of dispersal?

- Source
- Distance
- Permeability
- Unoccupied habitat
- Resilient sites
How we identified connecting landscapes

- Used Circuitscape
- Imagines “current” passing through landscape
- Suitable habitat allows current to flow more easily
- Habitat alteration creates “anthropogenic resistance”, reducing flow
- Not focused on specific terrestrial species, but general premise that intact natural habitat facilitates dispersal
Wall to Wall Circuitscape: Anthropogenic Resistance

- Diffuse Flow
- Concentrated Flow
- Blocked Flow
Beyond habitat suitability: dispersal in an era of climate change

• 754 species
• 5 taxa

• Median of 11.0m uphill/decade
• ~65% of species shifted upslope*

• ~25% of species shifted downslope*

Weighted connectivity

Upslope, northward and anthropogenic model. Circuitscape analysis applied to a resistance grid derived from landforms and anthropogenic resistance, with northward flows given twice the weight of east-west flows. Areas of high current flow are predicted to be important for upslope range shifts.
Riparian habitat and resilience

IDENTIFYING PRIORITY RIPARIAN AREAS FOR CLIMATE ADAPTATION
Riparian habitat as resilient sites

- Resilient sites analysis coincidentally identified many riparian corridors as key landscape features in providing climate adaptation due to:
  - Microclimates cooler (5-20°C) and more humid (10-15% higher) than surrounding areas
  - Often high densities of wetlands (contributing to more microclimates)
  - Great regulation/protection of riparian habitat leading to higher local connectivity scores
Why raise the profile of riparian habitat in our climate resilience models?

- High species richness and associated/obligate species
- Regulation/protection of riparian habitat coupled with high conversion rates of surrounding areas leading to *de facto* corridors
- Often higher densities of wetlands, allowing “leapfrog” dispersal for dispersal-limited wetland species
Riparian habitat as climate corridors
Approach to identifying riparian habitat protection priorities

- Model based on Active River Area (meander belt, riparian wetlands, and 100-yr floodplain)
- Omitted small headwater streams as riparian areas not easily differentiated from surrounding forest
- Four classes:
  - Creek
  - Small River
  - Medium River
  - Large River
- 30-m scale analysis
Riparian unit attributes

- **Size** of riparian unit in acres: *Larger patch size, higher value for biodiversity*

- **Regional flow** from Circuitscape modeling (anthropogenic resistance only): *High flow indicates concentrated species movement*

- **Contrast**. Local connectedness in riparian unit compared to surrounding buffer (2.5km for creeks and small rivers, 5km for medium and large rivers): *Higher contrast indicates greater value of riparian habitat as refuge and for connectivity*

- **Resilience**. % of riparian area with above average resilience
Figure 3.19. All riparian units by size class. This map shows all the riparian units assessed in this study colored by their size class.
Figure 3.20. Regional flow within riparian climate corridors. This map shows the relative amount of regional flow within each riparian unit compared to the whole study area.
Final query

- Identify regionally significant riparian corridors that connect other resilient areas. Limited selection to:
  - Riparian units >1000 acres in size
  - Units that had a high percentage of area in above average regional flow
  - ...or that contained a large contiguous area of high regional flow.
Figure 3.23. Regionally significant riparian climate corridors. This map shows the riparian units with above average regional flow based on either the percent of the unit with high flow, or the size of the largest contiguous stretch of high flow.

Riparian Corridors with High Flow
- Creek Riparian Corridors
- Small River Riparian Corridors
- Medium River Riparian Corridors
- Large River Riparian Corridors

Outlines on map corridor slightly inflated for visibility.

Map Produced by TNC, Eastern Division 2010.
Bringing it all together
Resilient and Connected Landscapes
Take Home Messages

- Tool for identifying land protection priorities for TNC and partners
- Riparian habitat can play an important role in climate resilience including:
  - As resilient sites and potential refugia
  - Serving as corridors for dispersal of wetland-associated species
  - Providing corridors for movement of organisms in otherwise altered landscapes