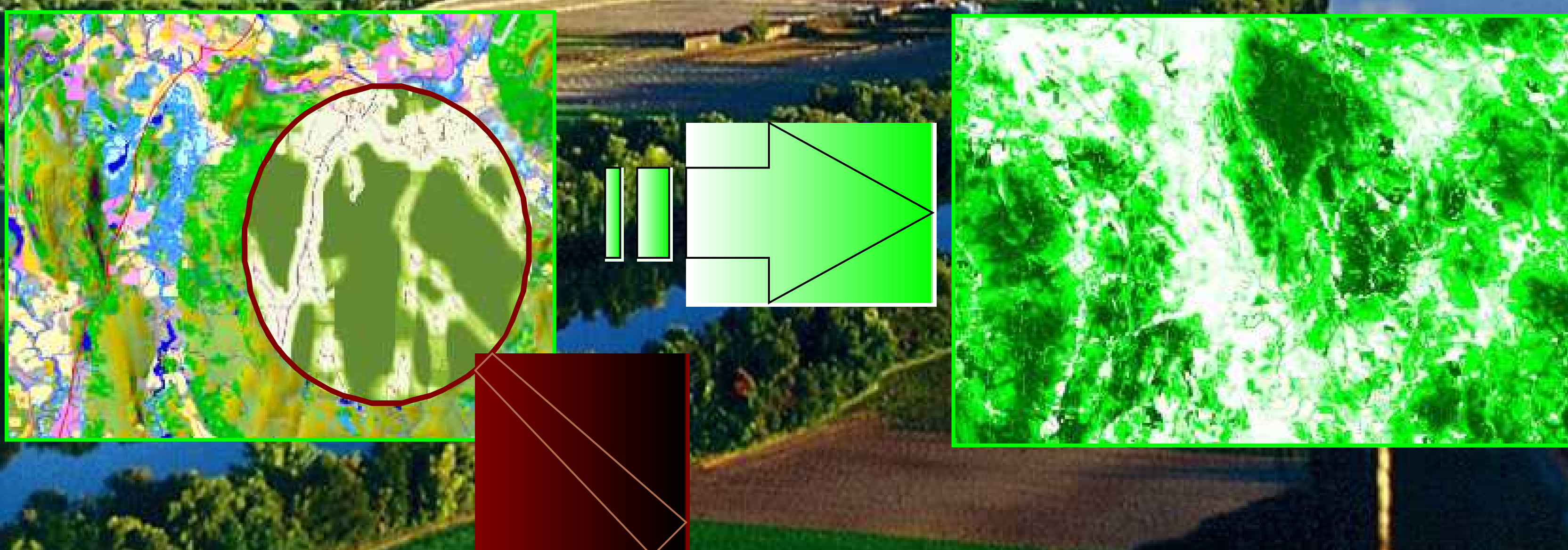
Designing Sustainable Landscapes in the Northeast
A project of the North Atlantic Landscape Conservation Cooperative

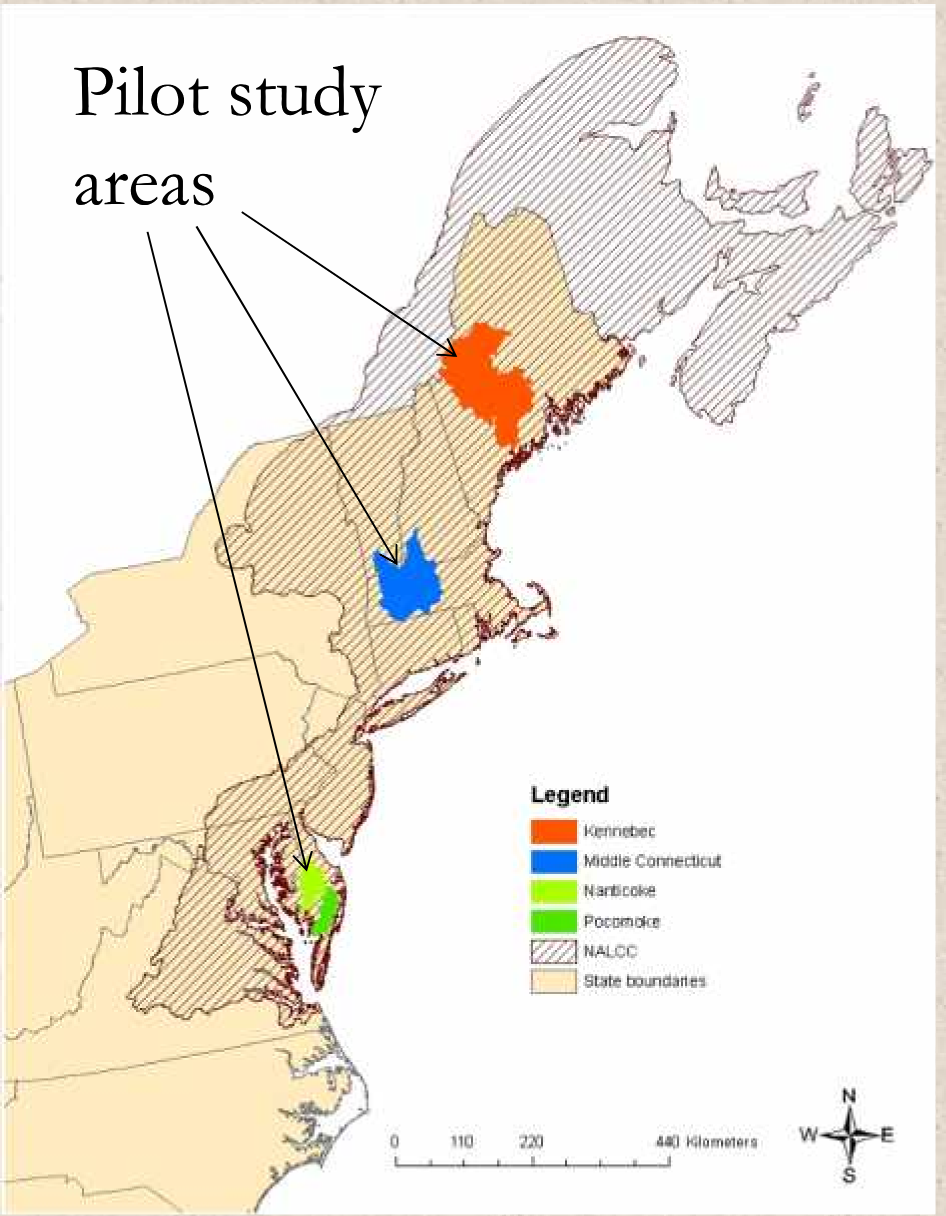
Scientific Advisory Committee Meeting
March 8, 2013



Purpose & Need

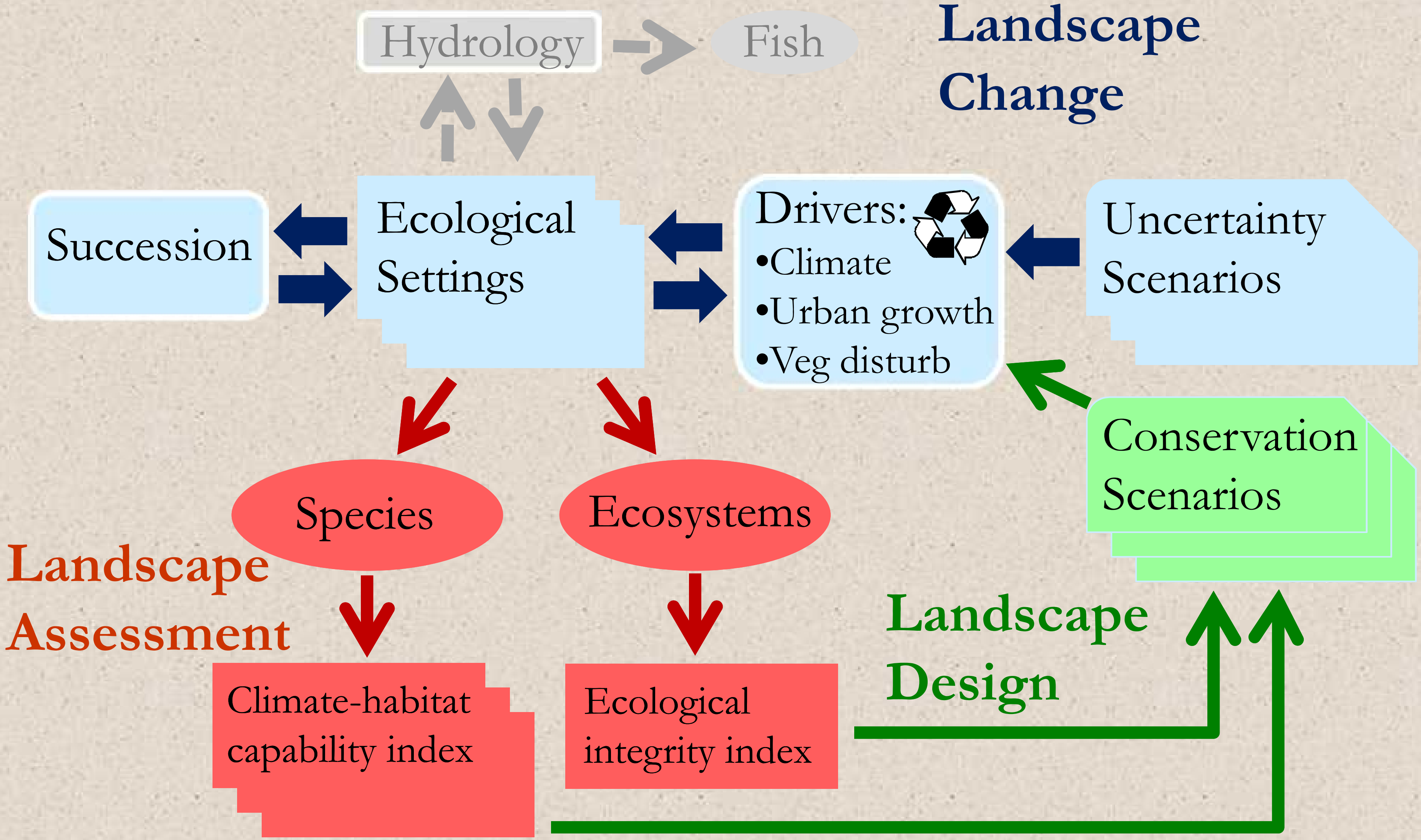
The **purpose** of this project is to:

- Assess the capability of current and potential future landscapes in the Northeast to provide integral ecosystems and suitable habitat for a suite of representative species, and provide guidance for strategic habitat conservation



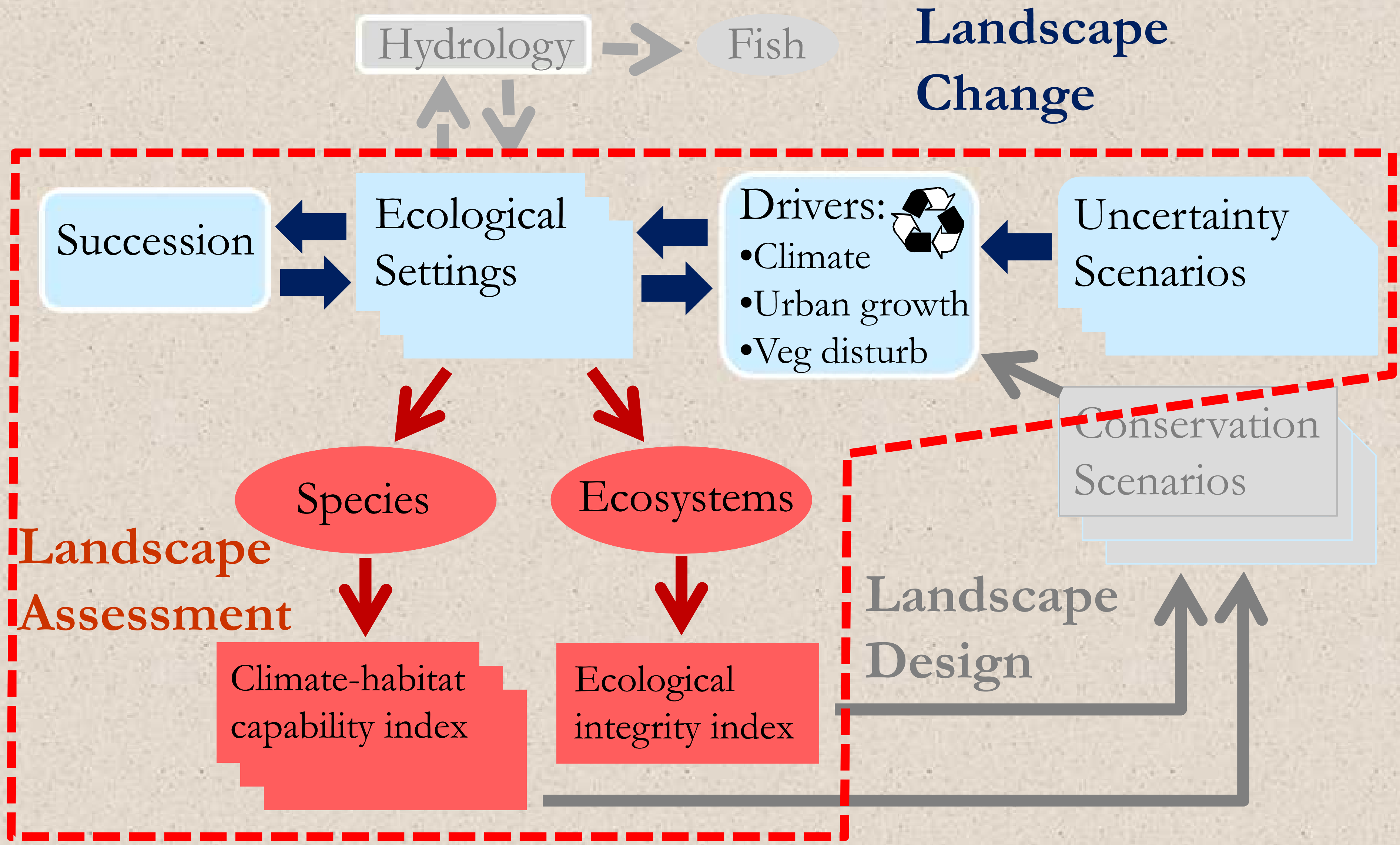
The Approach

LCAD model



Phase 1 Results

LCAD Model Development

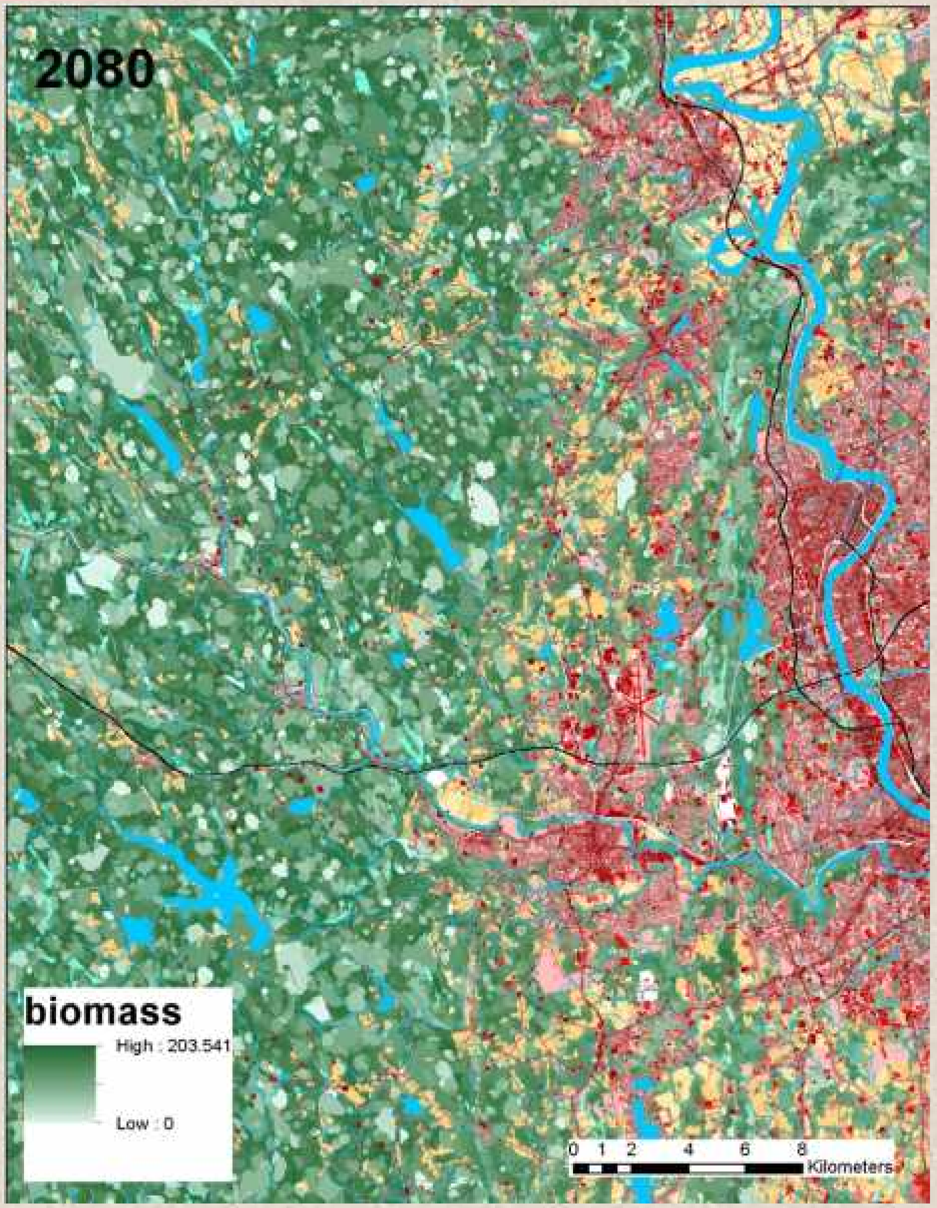


Phase 1 Results

Landscape Change Model

SRES A2 Scenario

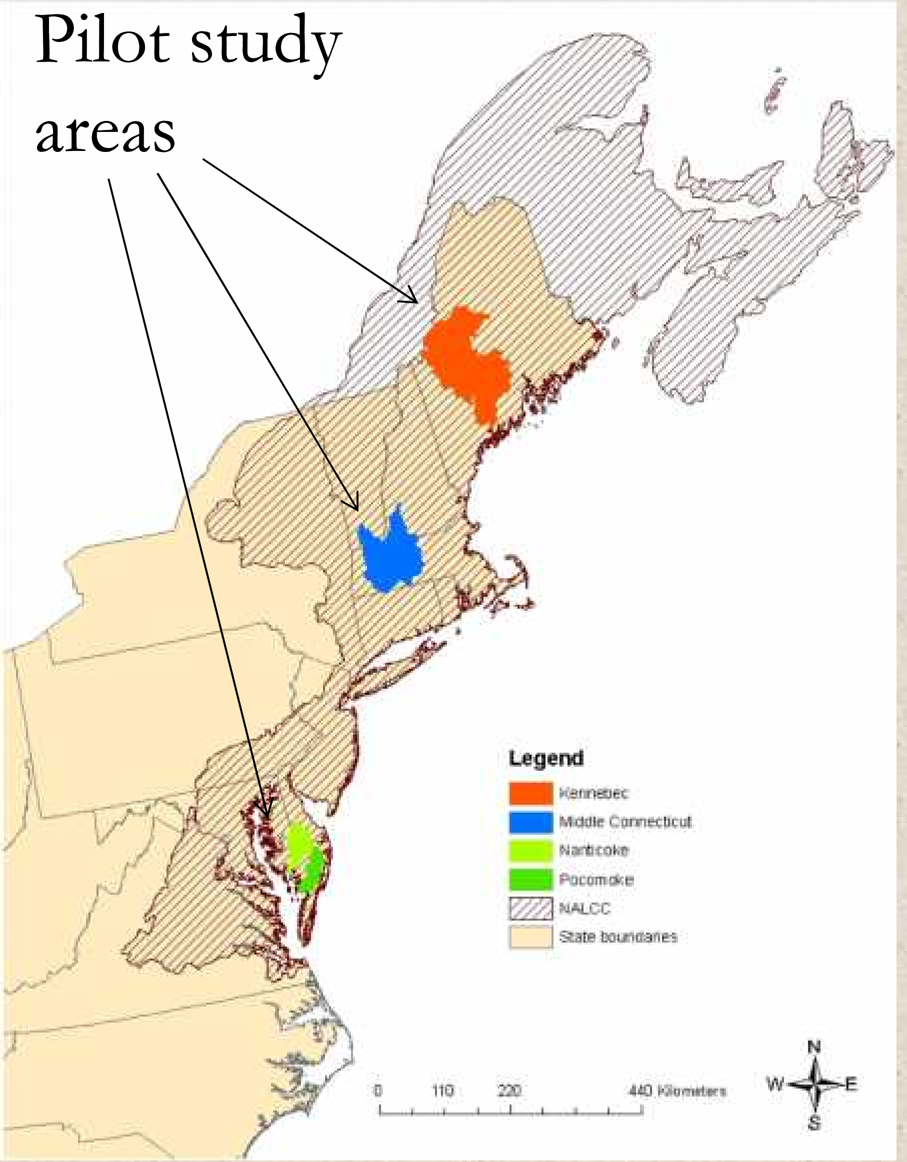
- Combined climate change, urban growth and generic vegetation disturbance and succession into a stochastic, dynamic landscape change simulation
- 70 year projection (2010-2080) at 10-year intervals
- 9 simulation runs (3 times each under 3 SRES scenarios) to capture future uncertainty



Phase 1 Results

Pilot Study Areas

- Completed the Landscape *Change* and *Assessment* for three pilot study areas:
  - *Kennebec River watershed*
  - *Middle Connecticut River watershed*
  - *Pocomoke and Nanticoke River watersheds*

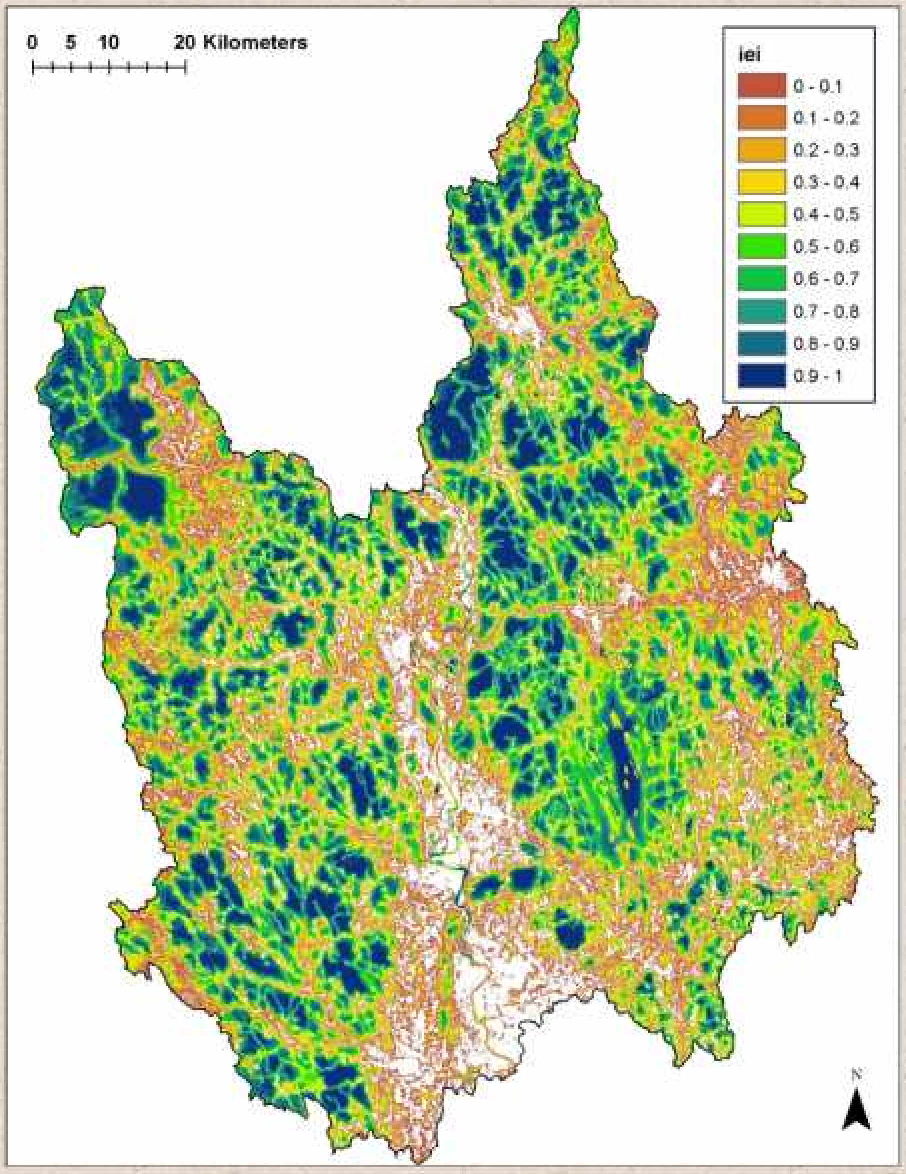


Phase 1 Results

Ecological Integrity

- Index of Ecological Integrity (IEI)… composite of 13 separate quantile-scaled *intactness* and *resiliency* metrics

Larger values indicate greater *intactness* and *resiliency* and thus greater "ecological integrity"

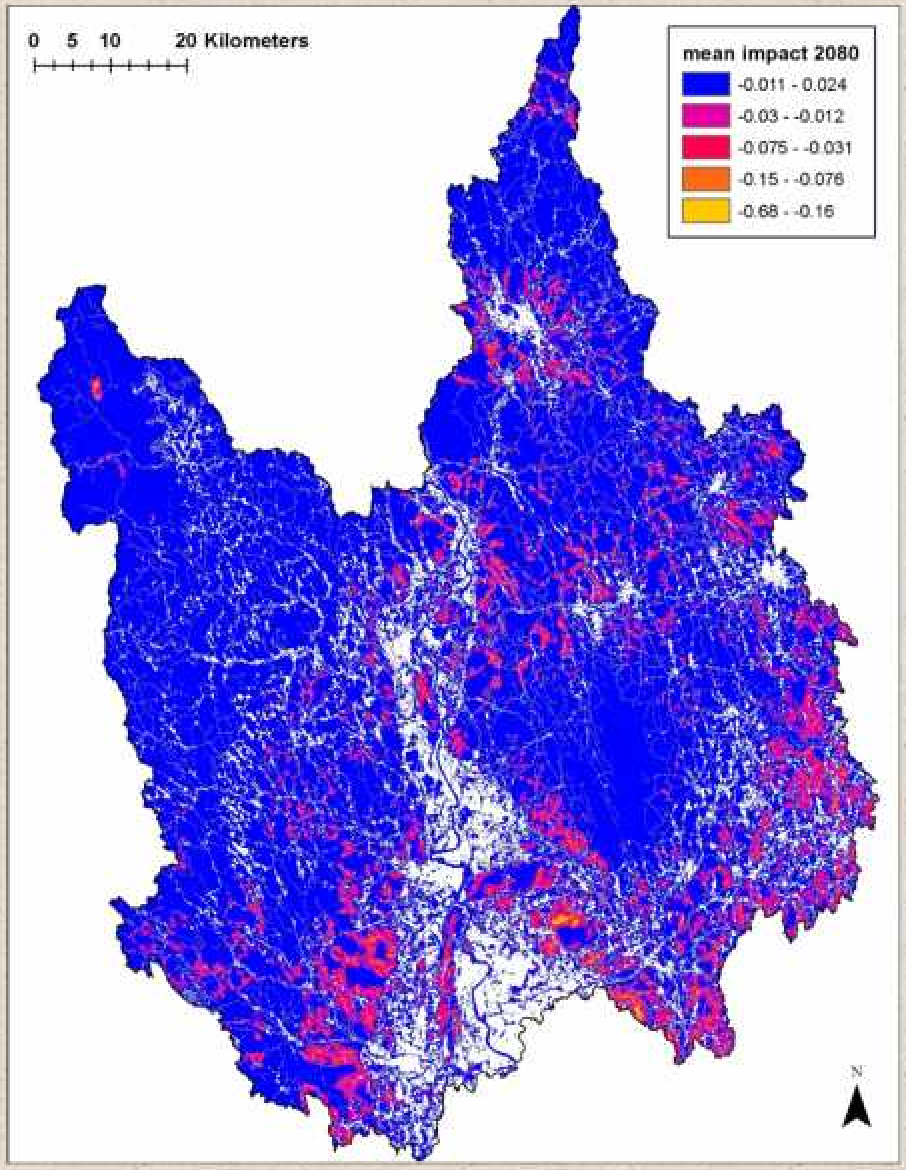


Phase 1 Results

Ecological Integrity

- Index of Ecological Impact… composite of 13 separate <u>delta</u>-scaled *intactness* and *resiliency* metrics

Larger negative values indicate effective loss of *ecological integrity* between current and future timesteps?

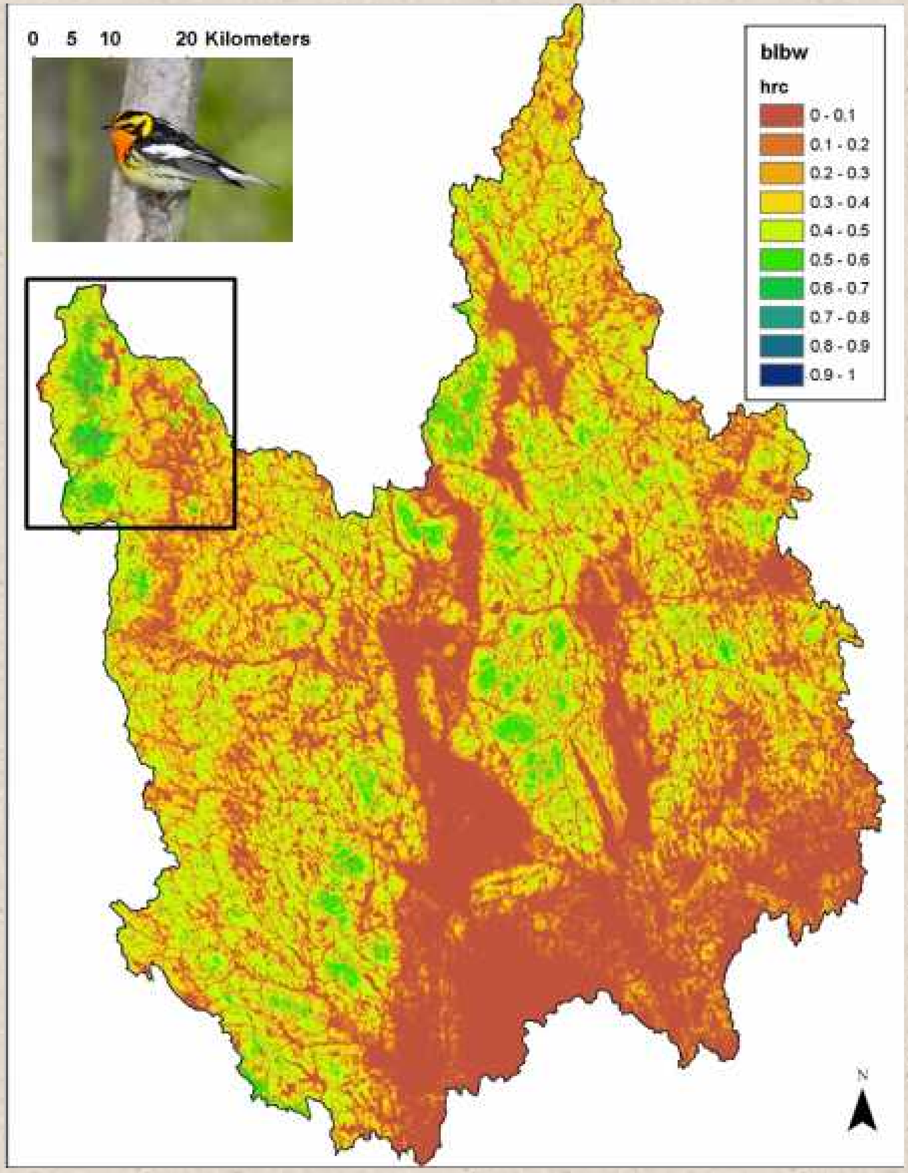


Phase 1 Results

Representative Species

- Habitat Capability Index (HRC)… reflects the *quantity*, *quality* and *accessibility* of habitat within a potential homerange centered on each cell

Where is the capable habitat likely to be in 2080 given uncertainty in climate and urban growth?

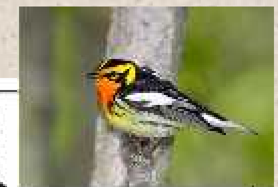


Phase 1 Results

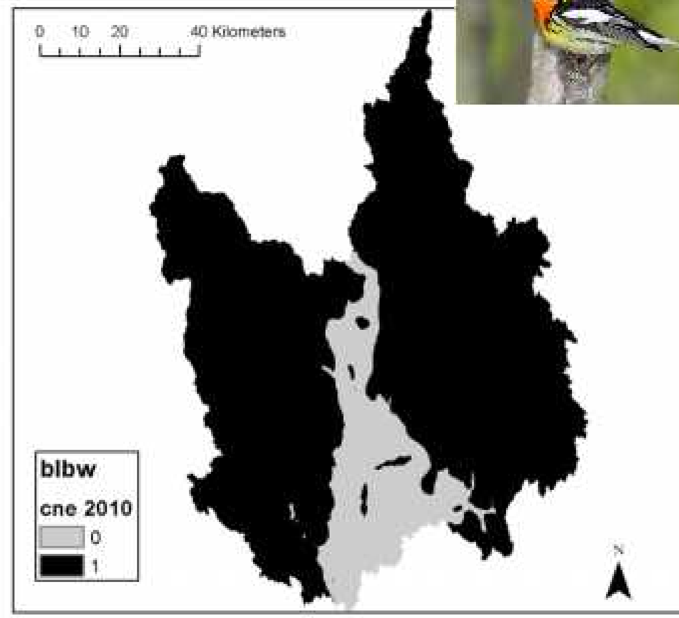
Representative Species

- Climate Niche Envelope… binary climate model capturing 95-98% of the species' known occurrences today

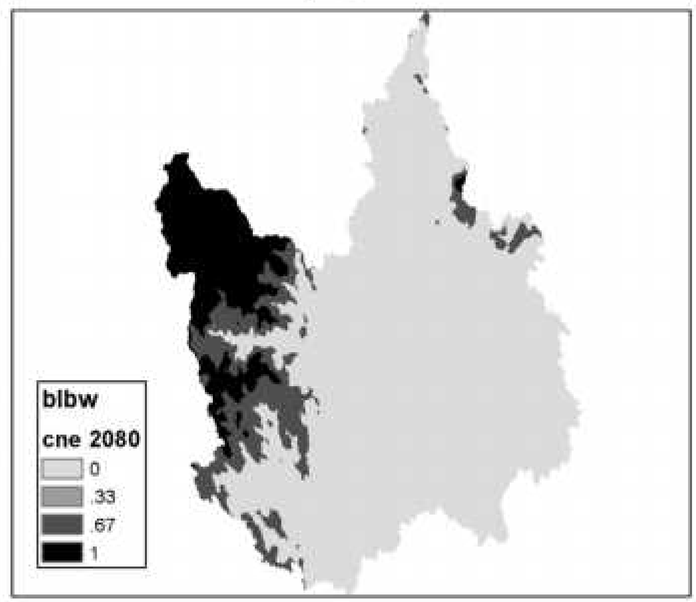
Where will the climate be suitable for the species in the future based on their current distribution in relation to climate?



2010



2080

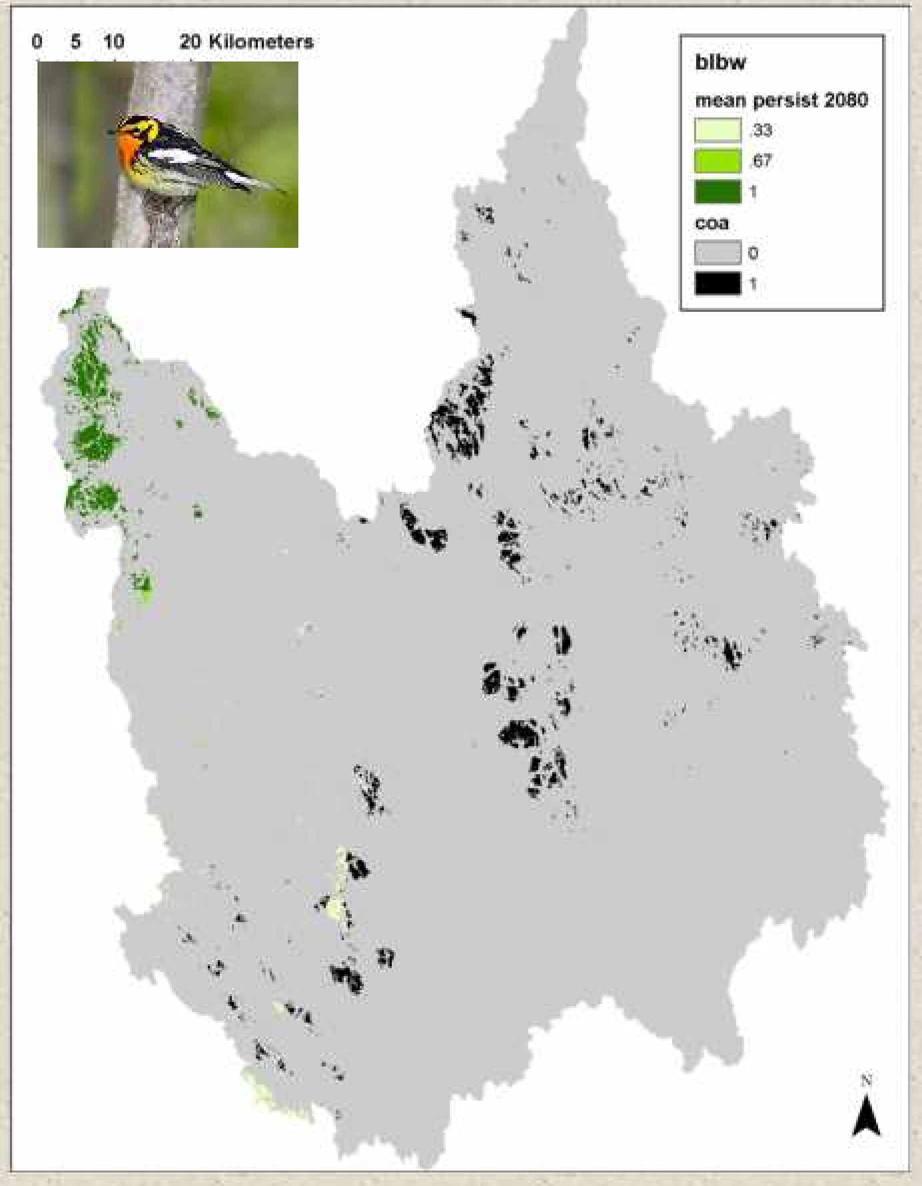


Phase 1 Results

Representative Species

- Habitat-Climate Uncertainty
  - *Zone of Persistence*
  - *Zone of Contraction*
  - *Zone of Expansion*

Where within the species' current optimal area is the habitat and climate likely to remain suitable in the future?



Phase 1 Results

Representative Species

- Landscape Capability Indices

Max HRC equivalent hectares

What is the change in landscape capability if the species' response to climate change is immediate range contraction?

Species	2010 (ha)	2080 (Δ)
blbw	184,281	0.21
blpw	943	0.48
nowa	14,734	0.54
mawr	3,633	0.98
oven	424,205	0.98
lowa	16,651	0.99
woth	398,441	0.99
rsha	182,978	1.01

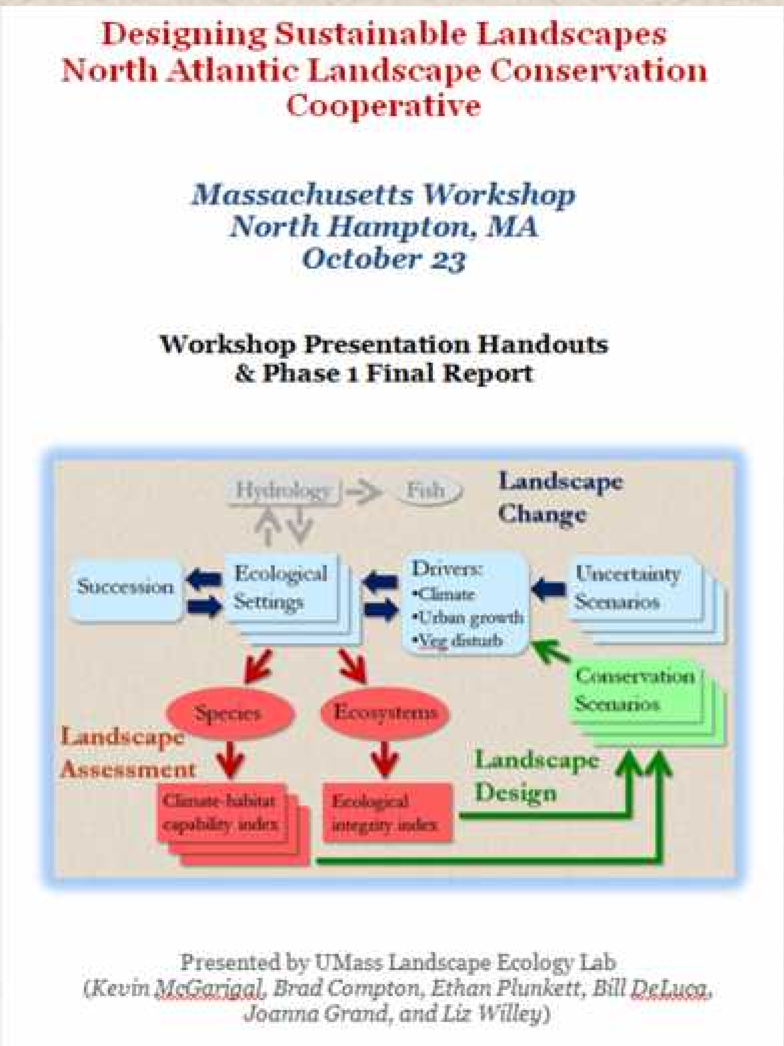
Most vulnerable

Least vulnerable

Phase 1 Results

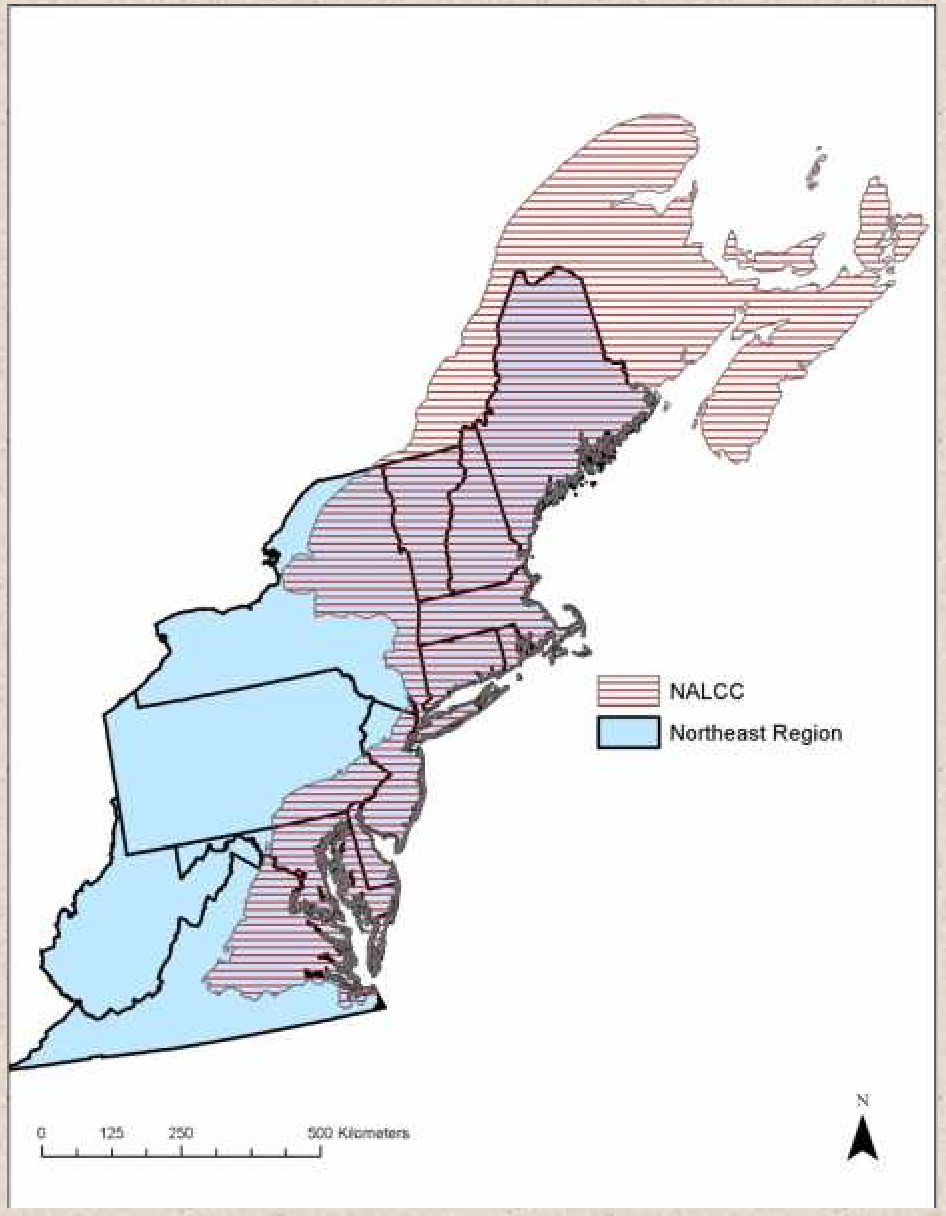
Manager Workshops

- New Gloucester, Maine (October 9)
- Princess Anne, Maryland (October 16)
- North Hampton, Massachusetts (October 23)



Phase 2 Focus

1. Extend the geographic scope to the entire Northeast (13 states & DC)

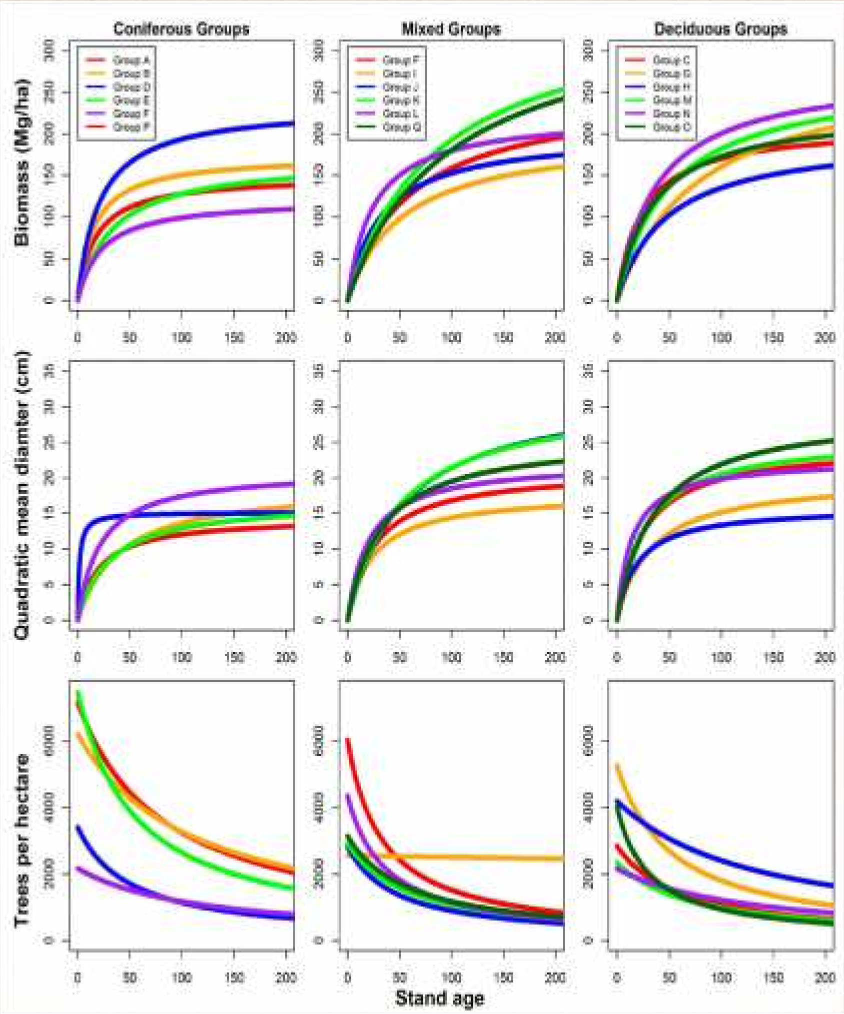


Phase 2 Focus

2. Improve vegetation disturbance-succession model

<u>Phase 1 approach:</u>

- Growth trajectories for select vegetation attributes derived from statistical models of FIA point data
- Current condition of cells based on imputation of FIA stand age

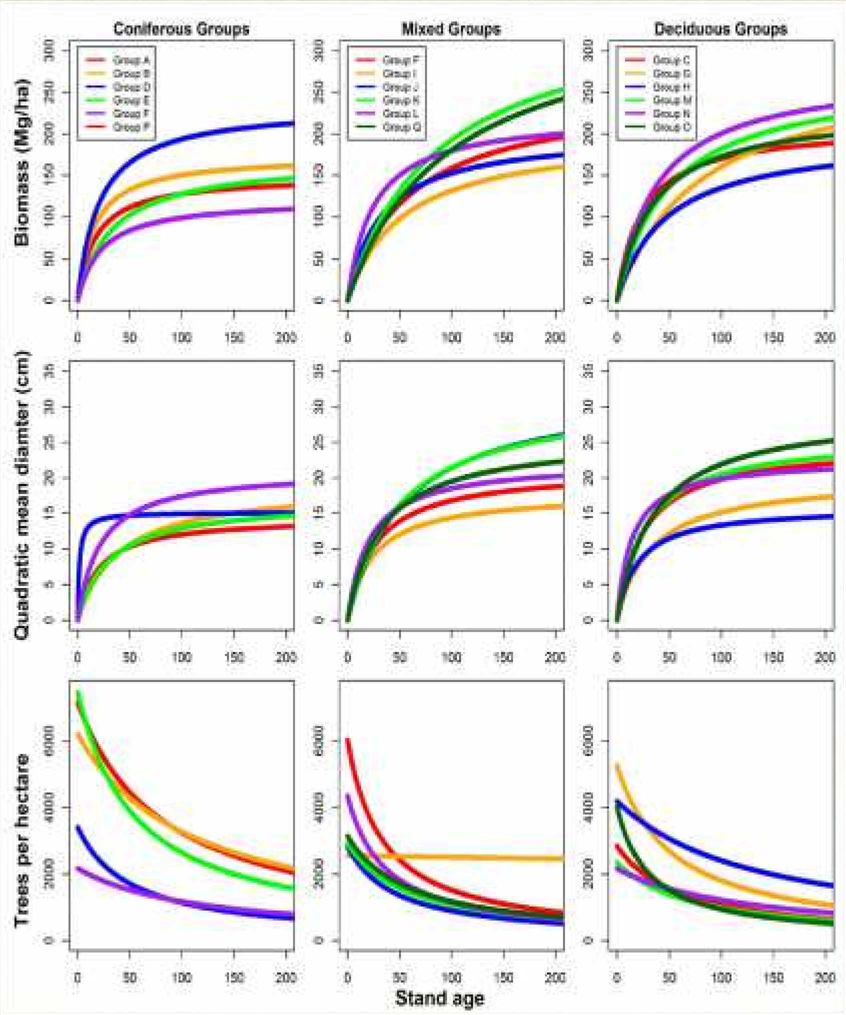


Phase 2 Focus

2. Improve vegetation disturbance-succession model

<u>Phase 1 limitations:</u>

- Growth and disturbance are <u>stand age</u>-dependent
- Vegetative attributes must always be on <u>average</u> trajectory
- Does not account for site <u>covariates</u> that influence growth rates



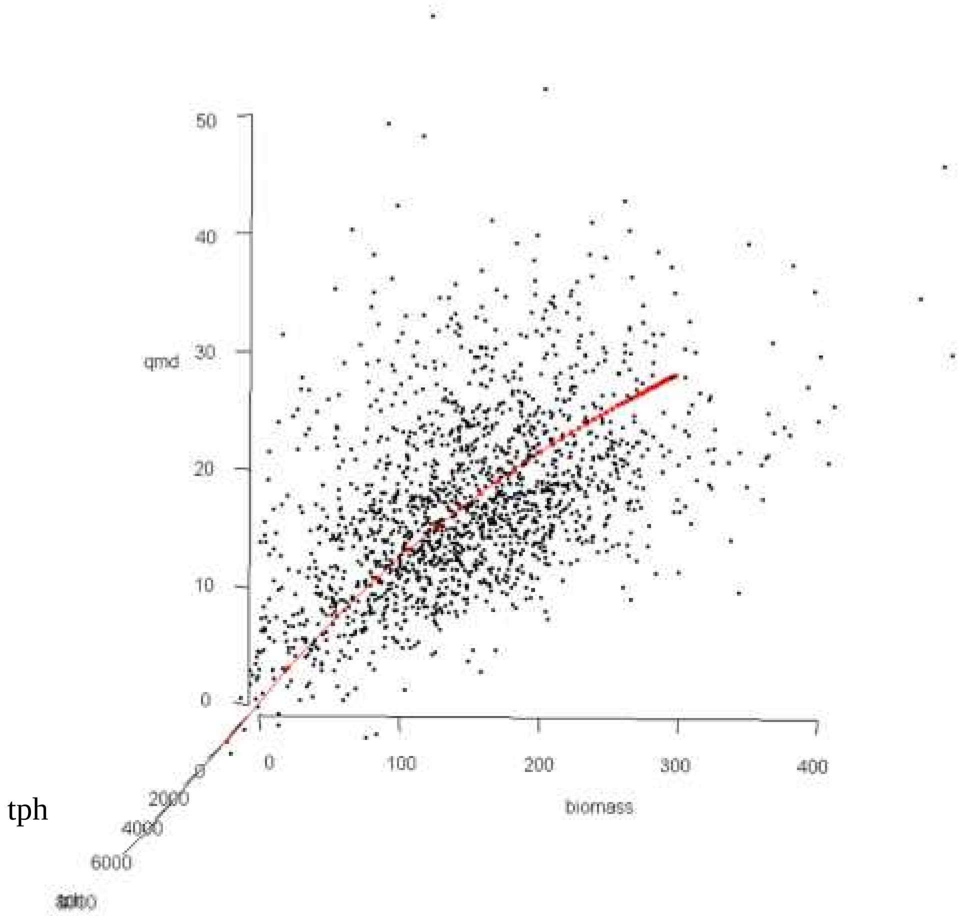
Phase 2 Focus

2. Improve vegetation disturbance-succession model

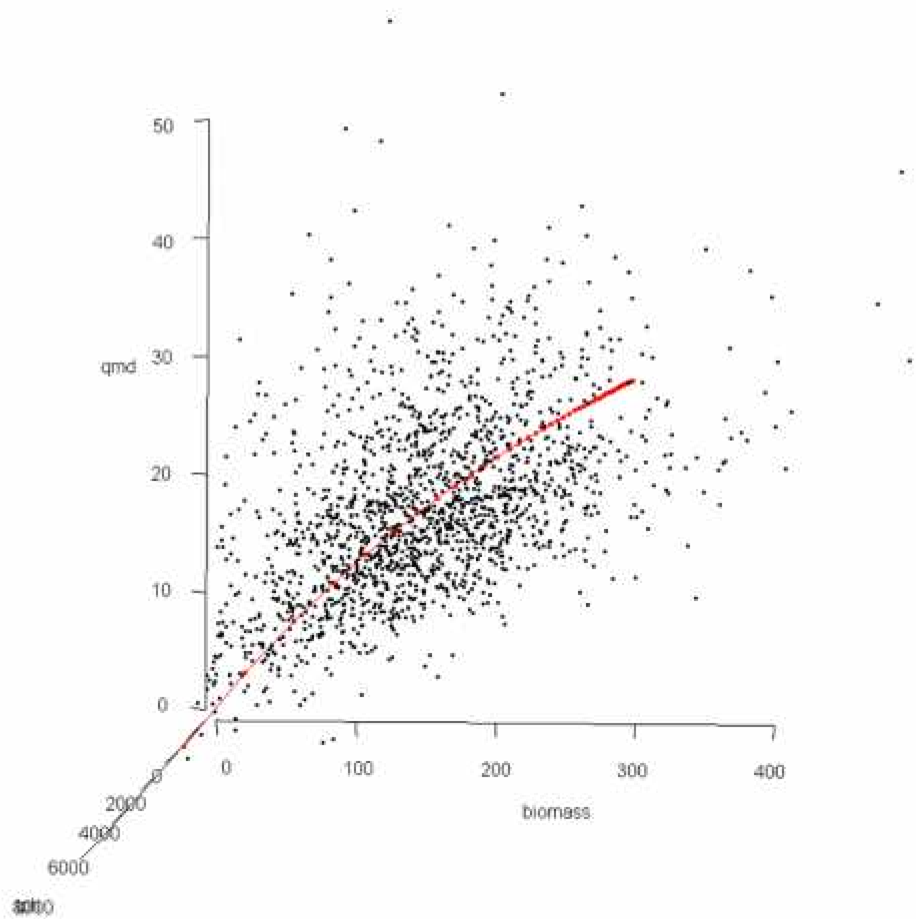
Phase 2 approach:

- Use starting conditions for vegetation attributes (biomass, qmd, and stem density) directly rather than basing on the average modeled from imputed stand age
- Use the covariation in all three vegetative attributes and the variation in settings variables to better predict change at each site

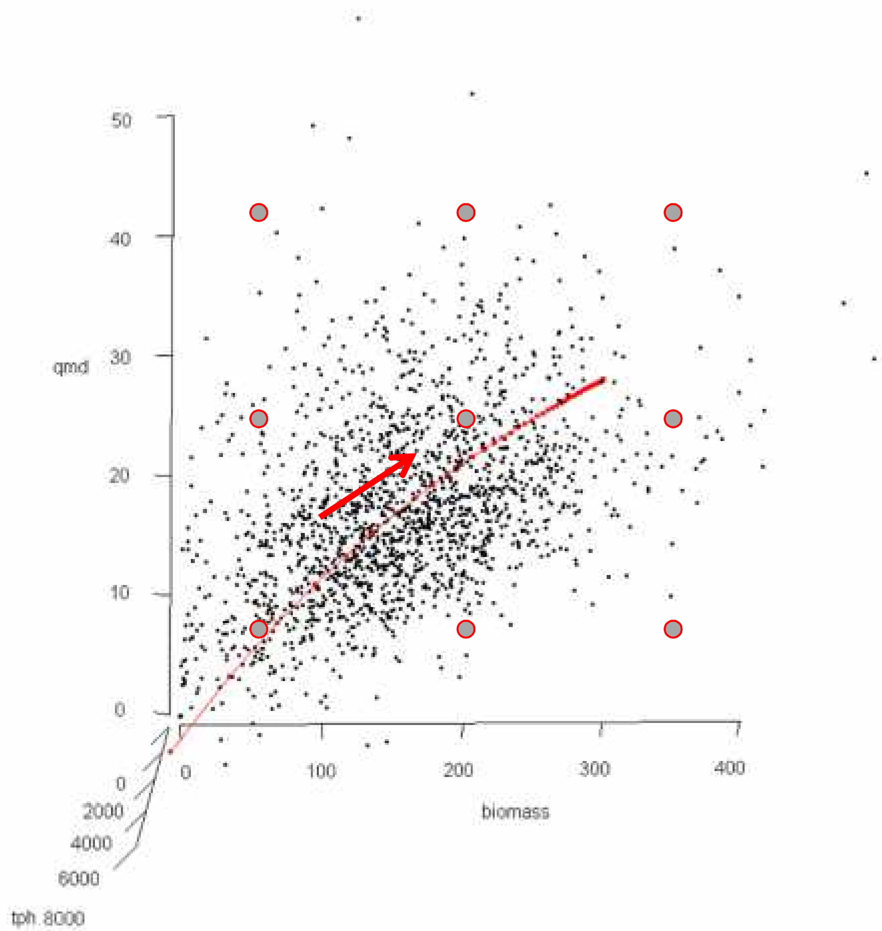
Phase 2 Focus



Phase 2 Focus



Phase 2 Focus



Phase 2 Focus

2. Improve vegetation disturbance-succession model

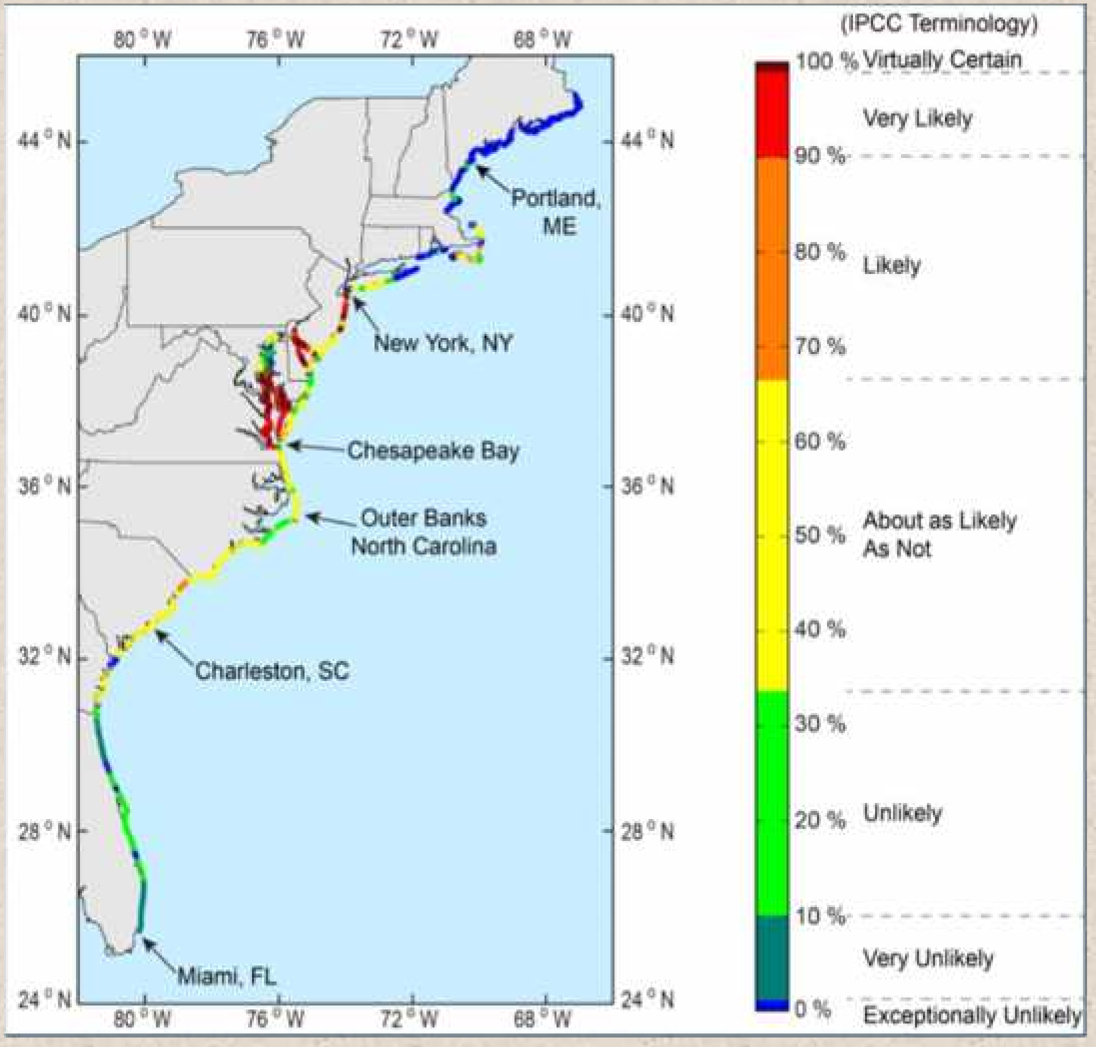
Phase 2 strengths:

- Remains an empirical approach; the statistical models are simple: few parameters and no magic
- Allows for heterogeneous, non-stationary response to covariates (the vegetative attributes and setting variables)
- Allows disturbances to be defined on the basis of how they will affect each of the vegetation attributes (ideal for future silvicultural treatments)

Phase 2 Focus

3. Incorporate output of sea level rise model (Rob Thieler's lab)

- Initial work will provide inundation and landform change stressor metrics, which we will incorporate into IEI/Impact
- Longer term work will map shifting distribution of ecological systems



Phase 2 Focus

4. Develop 20 additional species' models and improve LC metrics

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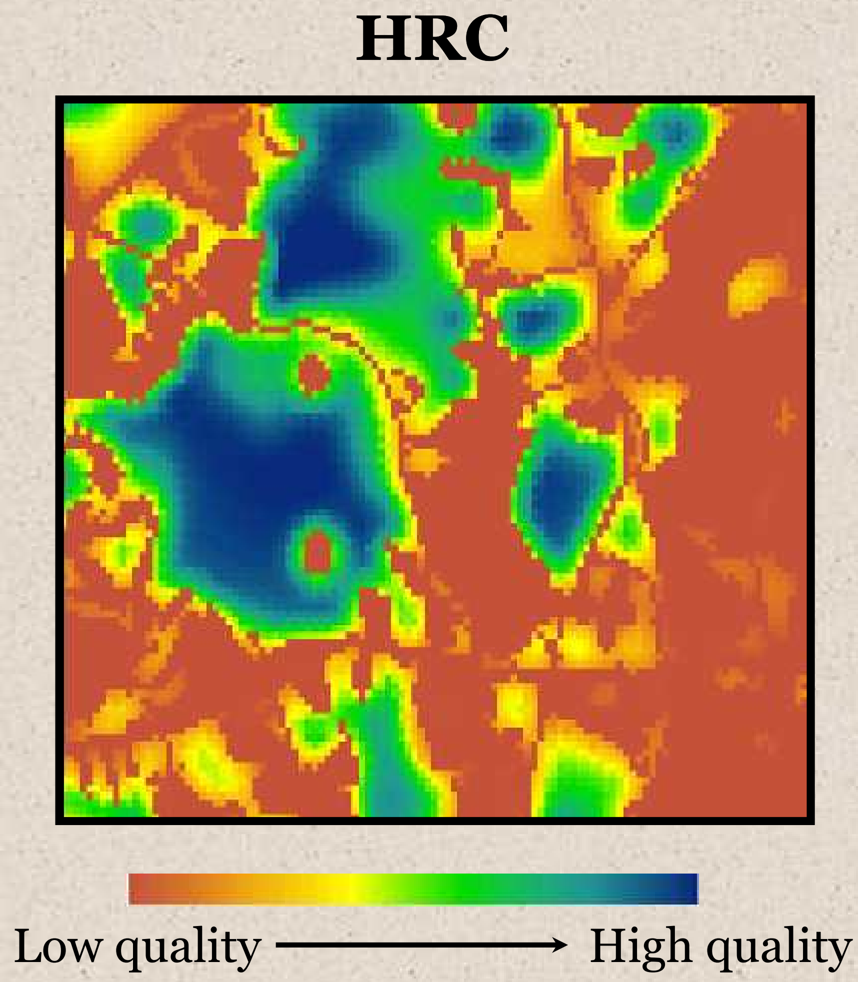
Phase 1 approach:

- LC was based on habitat capability (HRC)
- Future change measured by proportional Δ LC under 3 climate response assumptions



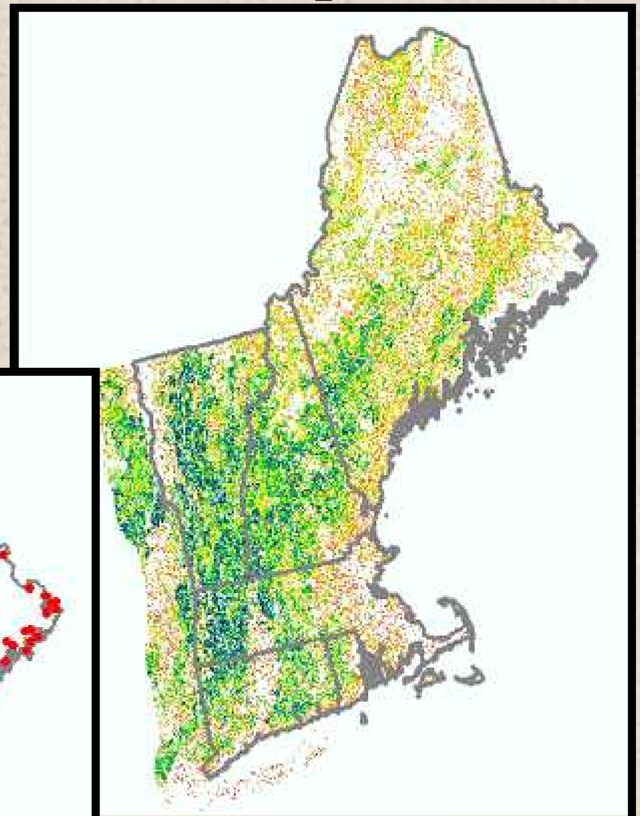
Phase 2 Focus

4. Develop 20 additional species' models and improve LC metrics

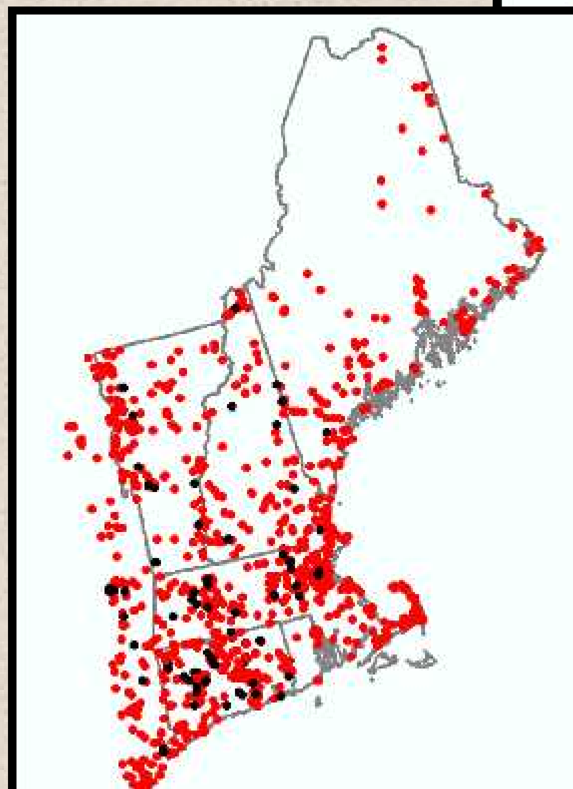
<u>Phase 1 limitations:</u>

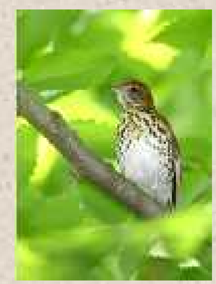
- Does not account for probability of occupancy

Habitat capability



Pres/absence





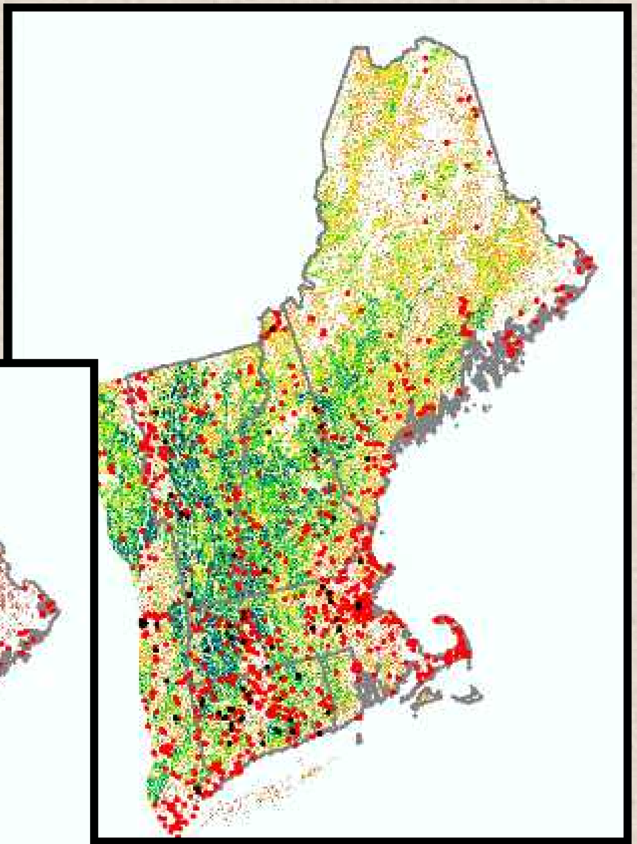
Phase 2 Focus

4. Develop 20 additional species' models and improve LC metrics

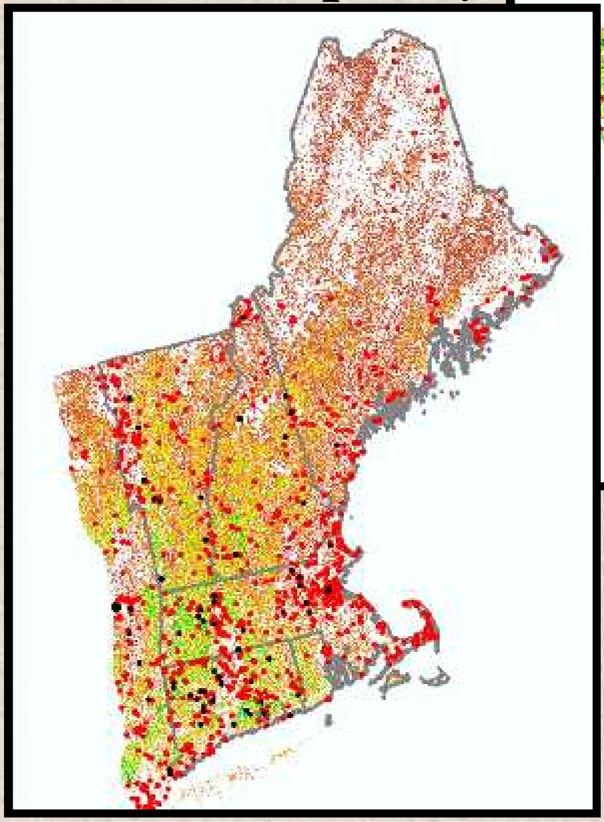
<u>Phase 2 approach:</u>

- Model probability of <u>occupancy</u> from habitat, climate and biogeographic covariates

Habitat capability



Prob. occupancy



Phase 2 Focus

4. Develop 20 additional species' models and improve LC metrics

Wood Thrush:

Habitat-based approach:

- $LC_{current}$ = 2,111,035

Occupancy-based approach:

- $LC_{current}$ = 490,474

Phase 2 strengths:

- Empirically-based
- Accounts for variability among species in range of HRC values via species-specific prob. of occurrence
- Accounts for spatial variability in species' occurrence across its range; does not assume uniform saturation of capable habitat

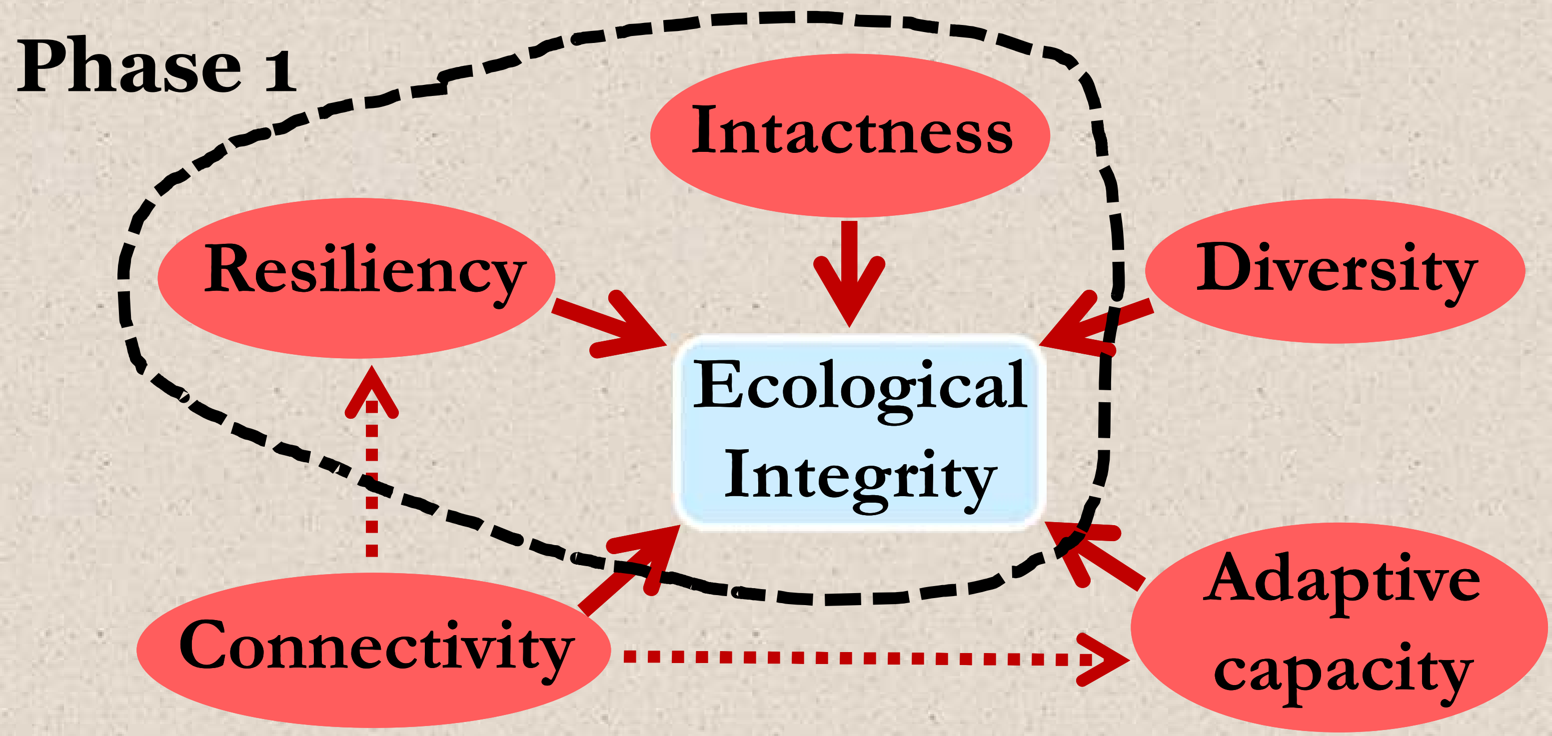
Phase 2 Focus

5. Evaluate the representativeness of representative species: do they work?

- How well does each representative species' occupancy model predict the distribution of other priority species within the corresponding habitat cluster?
- Compare average within-cluster performance to average among-cluster performance

Phase 2 Focus

6. Implement remaining components of landscape ecological integrity assessment (adaptive capacity, diversity and regional connectivity)



Phase 2 Focus

6. Local vs regional connectivity

Local

Homerange, dispersal

Metric:

Connectedness

...a spatial metric that assesses the value land attains from being *locally connected* to nearby land in similar settings

Regional

Multi-generation dispersal, gene flow, range shift

Metrics:

Network connectivity

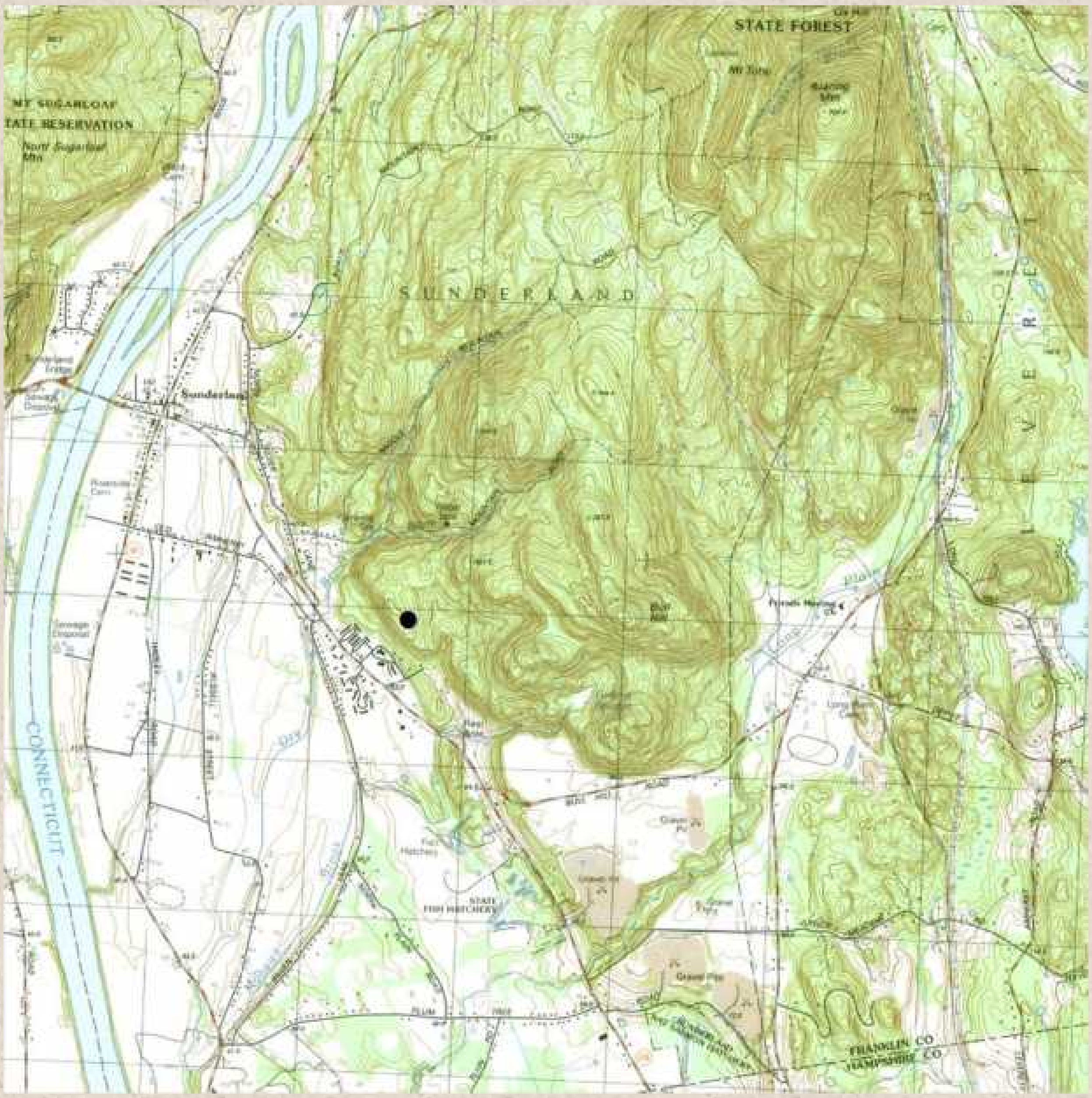
...a summary of the probability of connectivity across the entire landscape among "conservation nodes"

Conductance

...a spatial metric representing the probability of connectivity among nodes

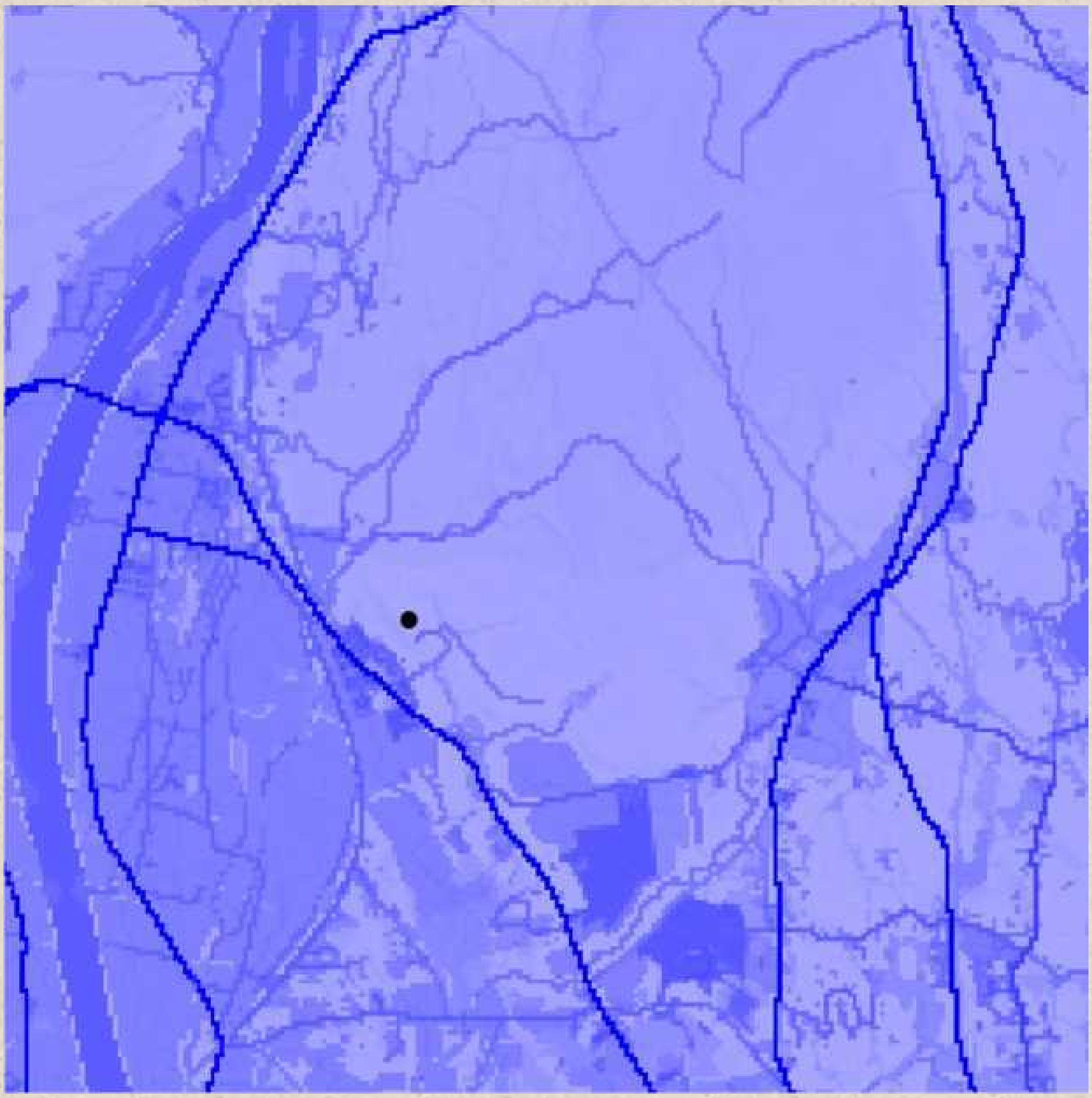
Phase 2 Focus

6. Local connectivity



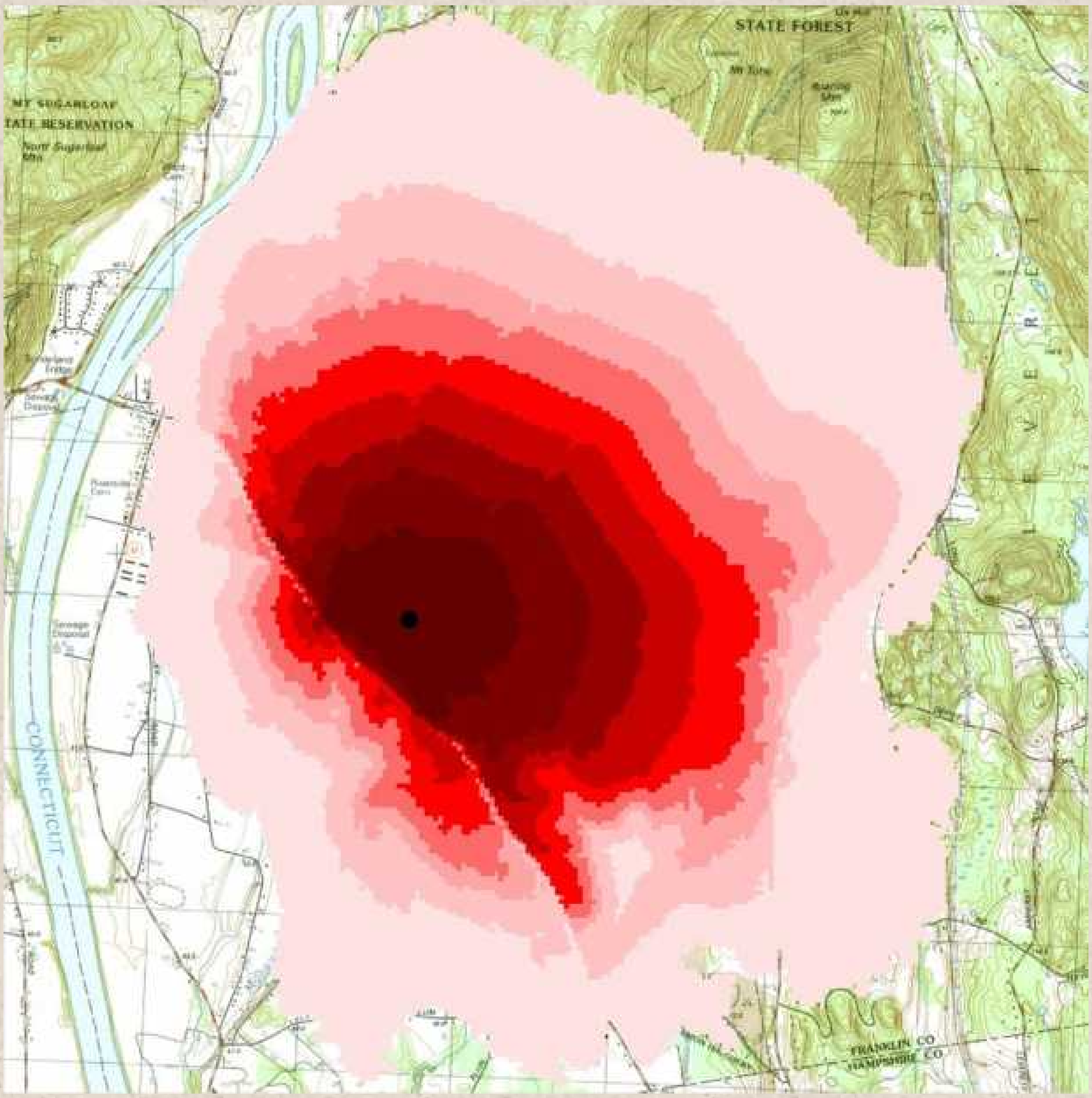
Phase 2 Focus

6. Local connectivity
    - Dynamic resistance surface



Phase 2 Focus

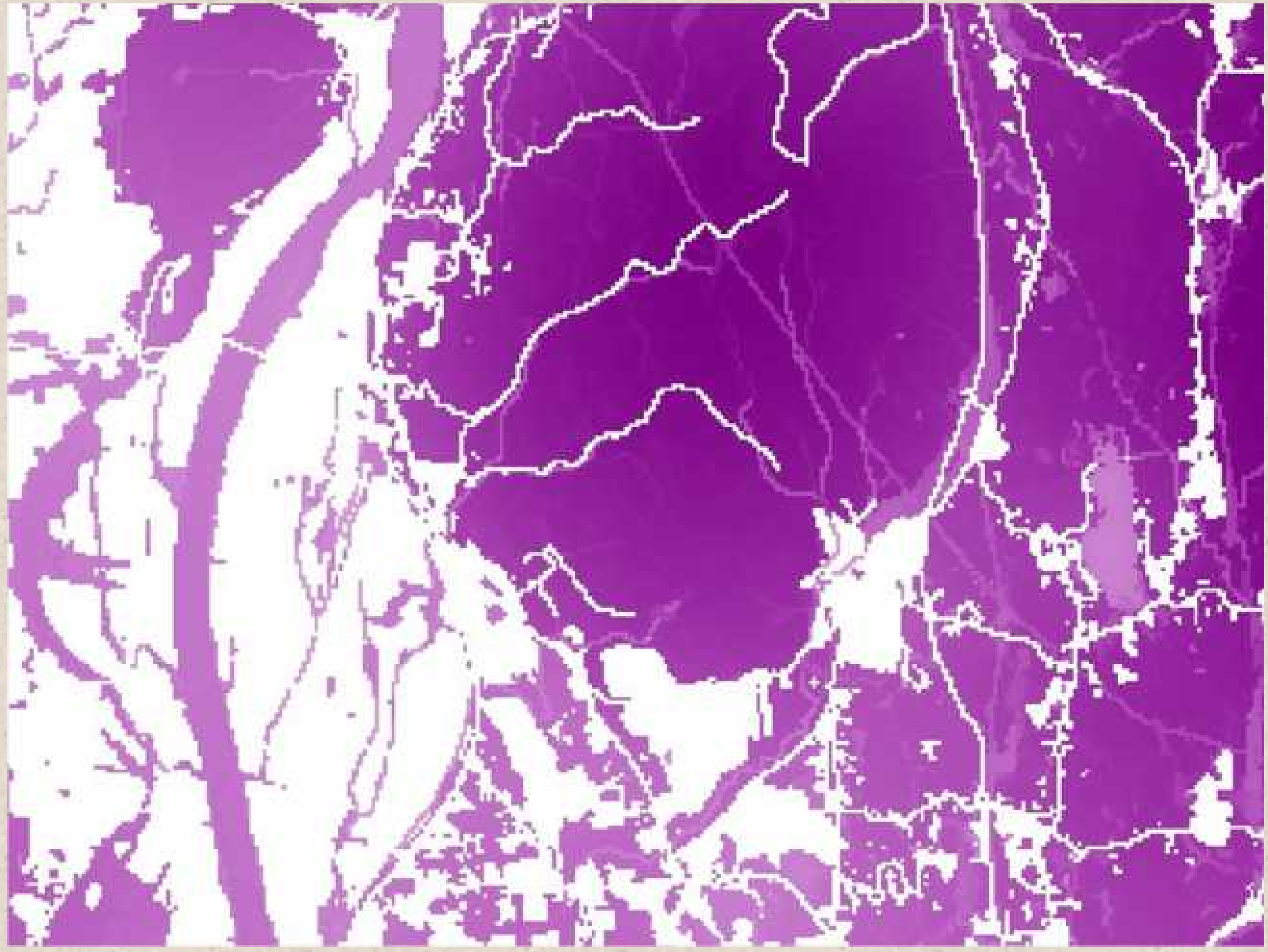
6. Local connectivity
   - Resistant kernel



Phase 2 Focus

6. Local connectivity

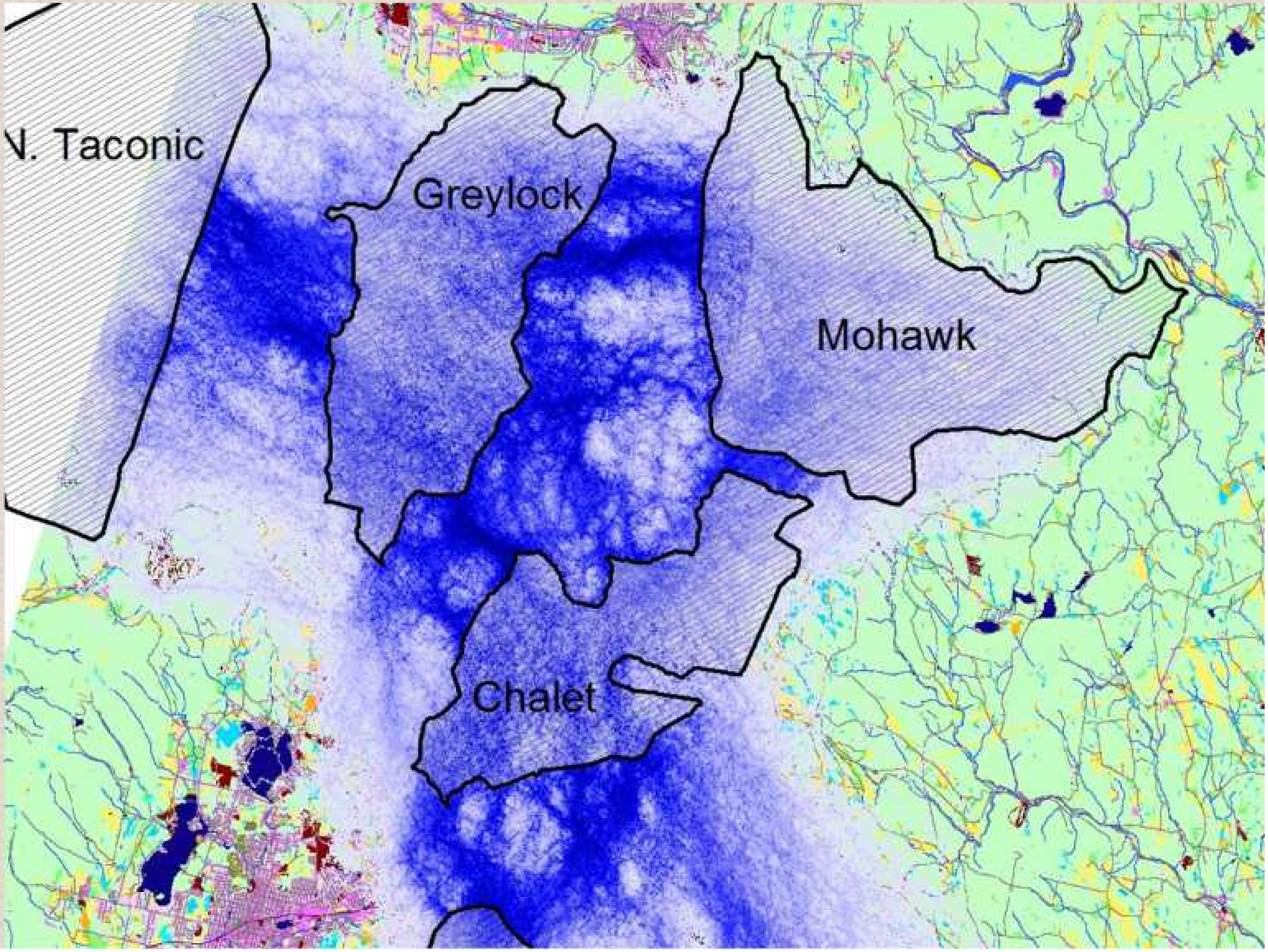
Connectedness Metric



Phase 2 Focus

6. Regional connectivity

Conductance metric

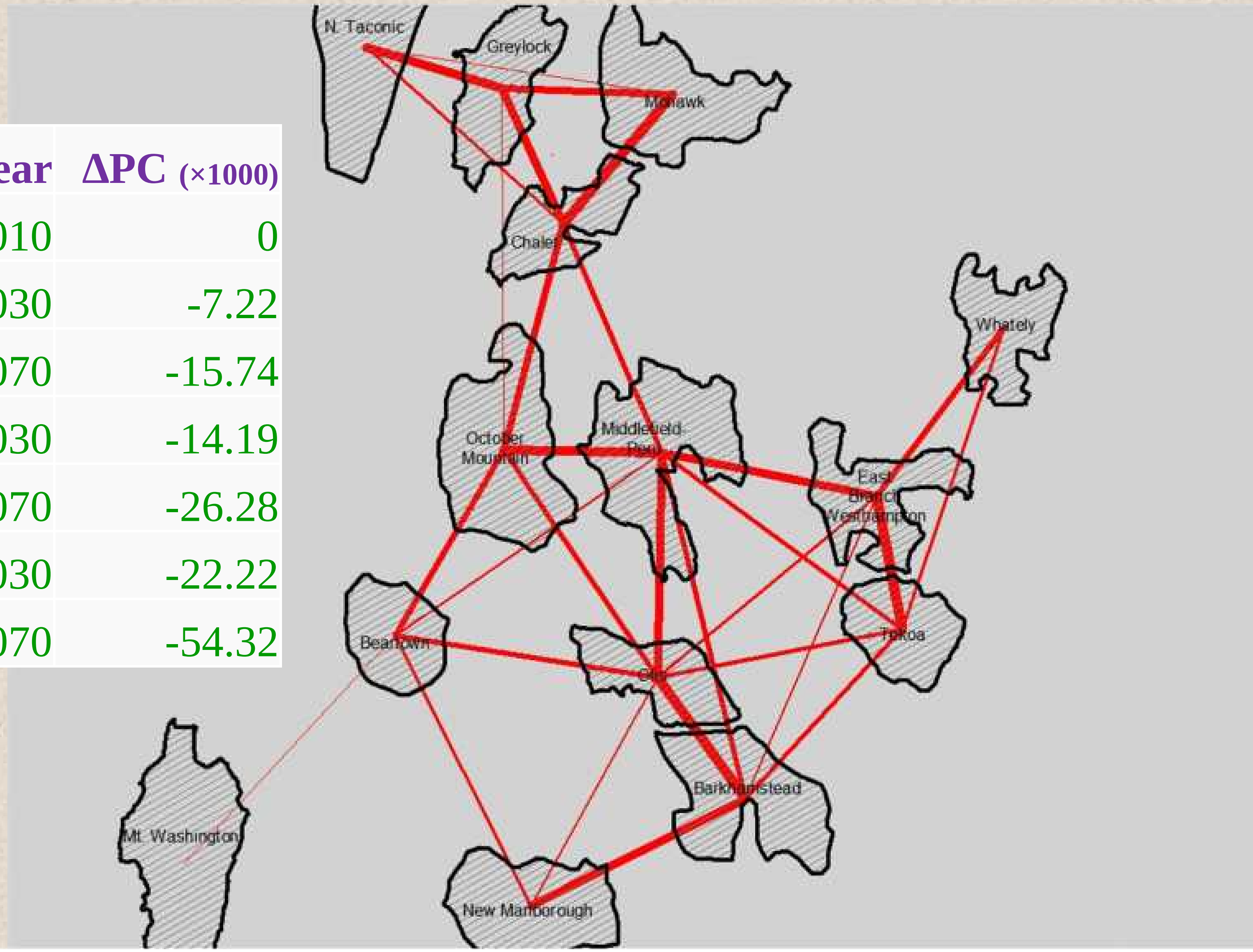


Phase 2 Focus

6. Regional connectivity

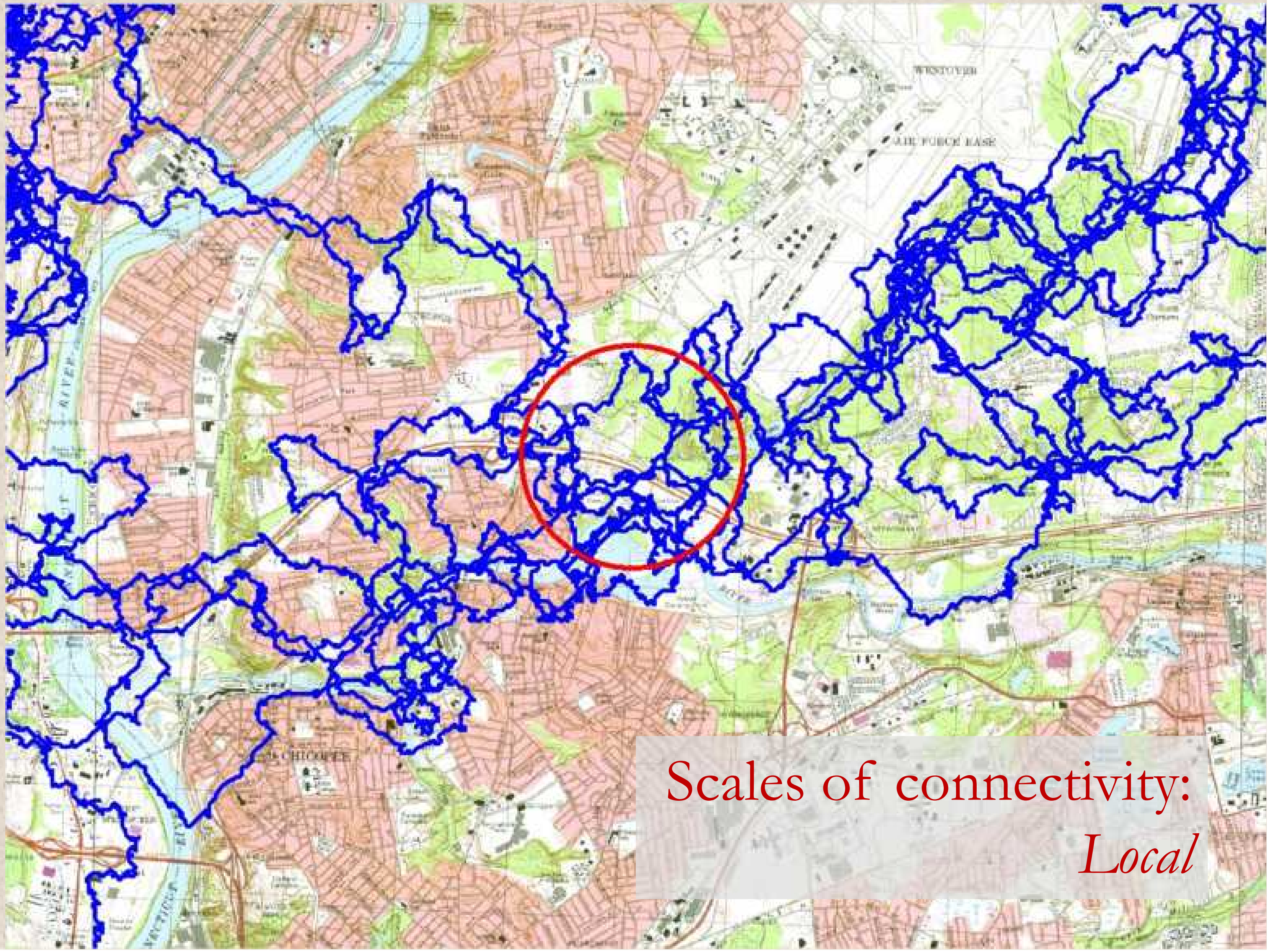
Network connectivity metric

Scenario	Year	ΔPC (×1000)
Base	2010	0
B1	2030	-7.22
	2070	-15.74
A1B	2030	-14.19
	2070	-26.28
A2	2030	-22.22
	2070	-54.32



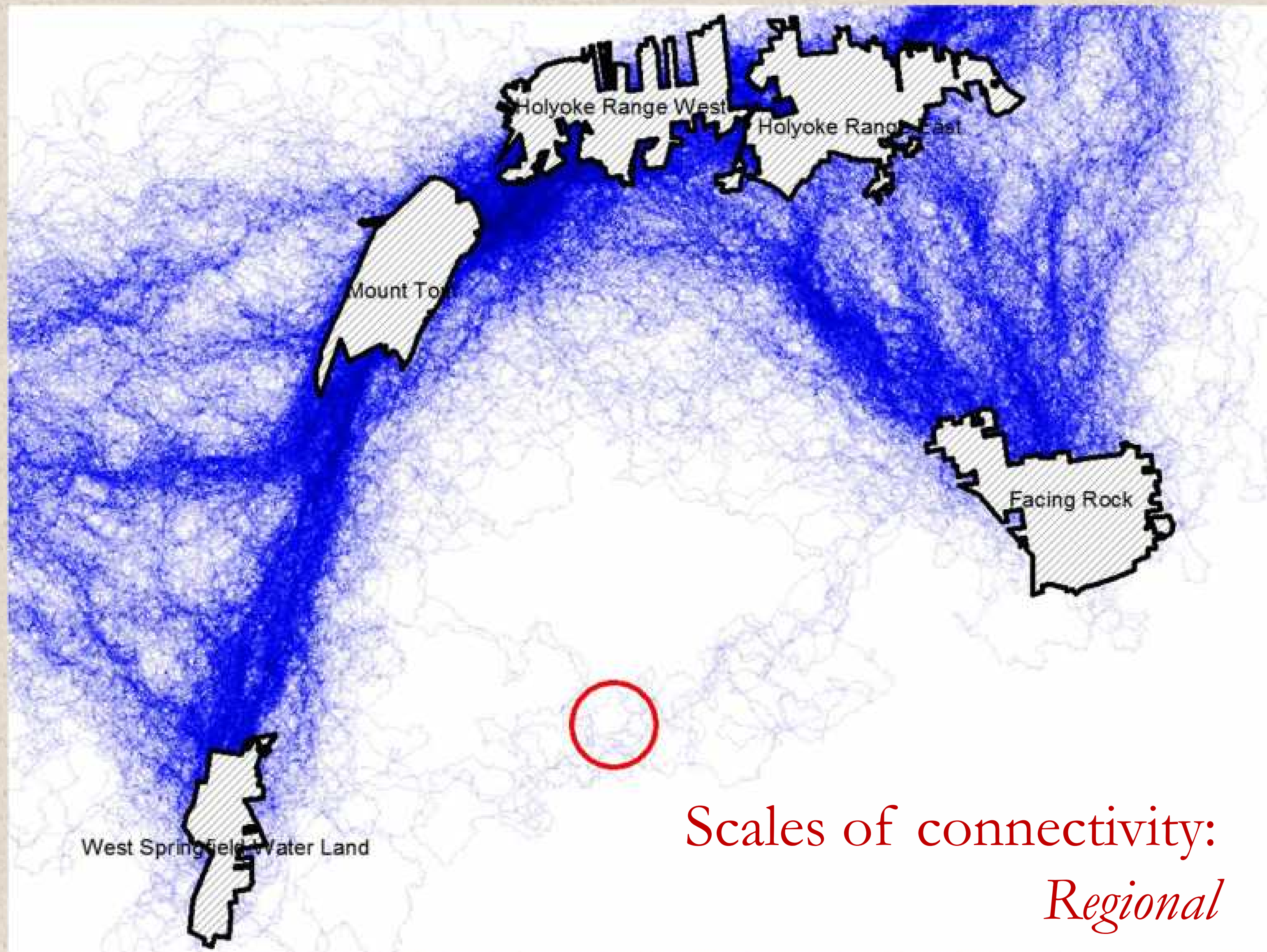
Phase 2 Focus

6. Local vs Regional connectivity



Phase 2 Focus

6. Local vs Regional connectivity



Scales of connectivity:
Regional

Phase 2 Focus

7. Develop landscape design component

The ultimate purpose of this project is to provide guidance for *strategic habitat conservation* (a.k.a. "landscape design")

Land Protection

Land Management

Ecological Restoration

Phase 2 & Beyond Science Needs

1. Compile species' presence/absence datasets across the region
2. Improved mapping of vegetation structure for current condition
3. Continuously updated downscaled climate data (NECSC)

For More Information

- **Project website:**

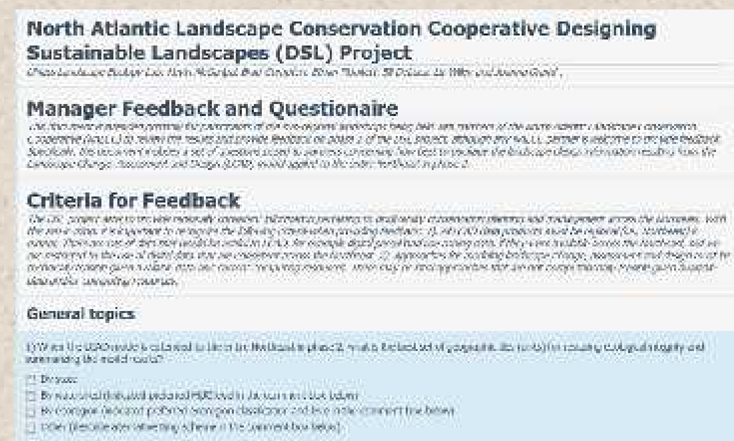
  www.umass.edu/landeco/research/nalcc/nalcc.html

Links to documents:

- **Overview**
- **Technical docs**

Feedback:

- **Manager online survey**



- **Personal contact:**

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  413-577-0655

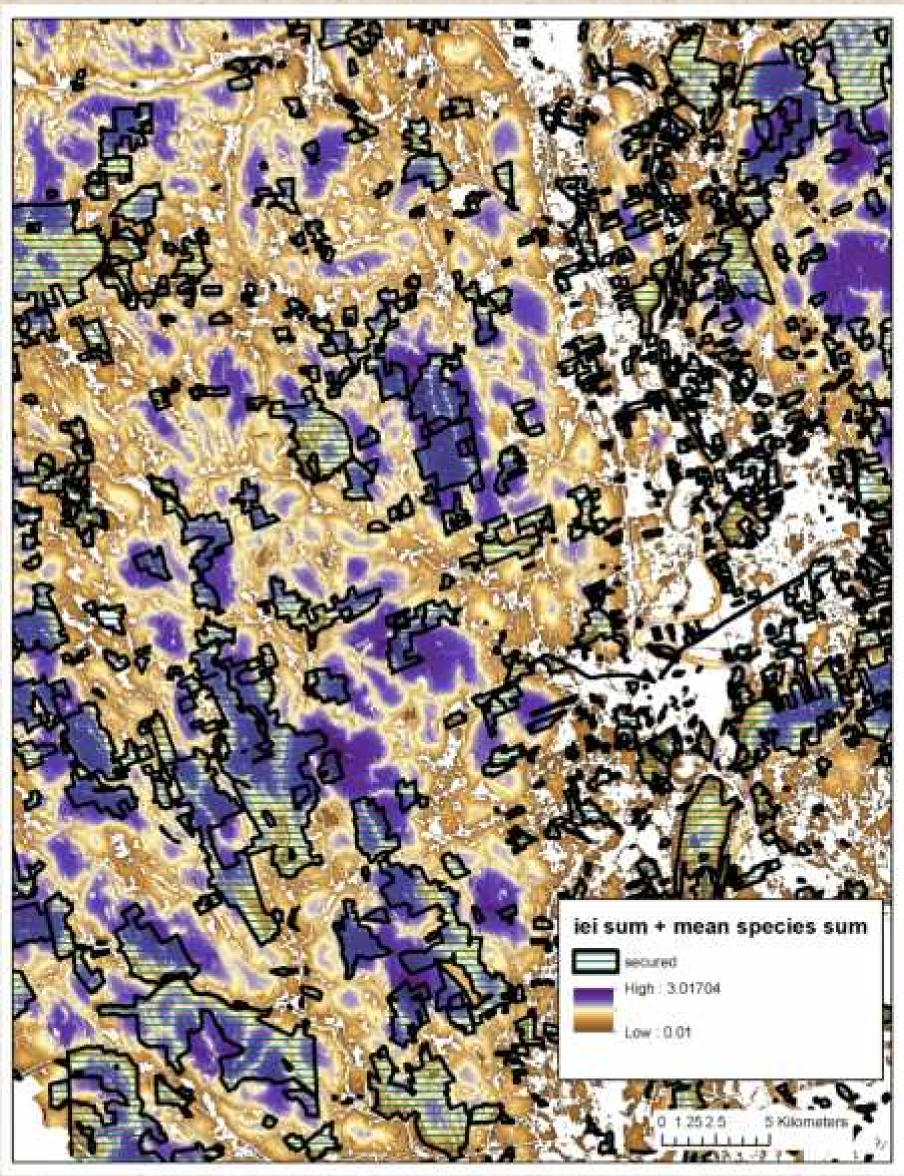
The Approach

Landscape Design

Land protection

- **Overlay analysis**

  Overlay LCAD coarse & fine filter results to identify priorities for land protection



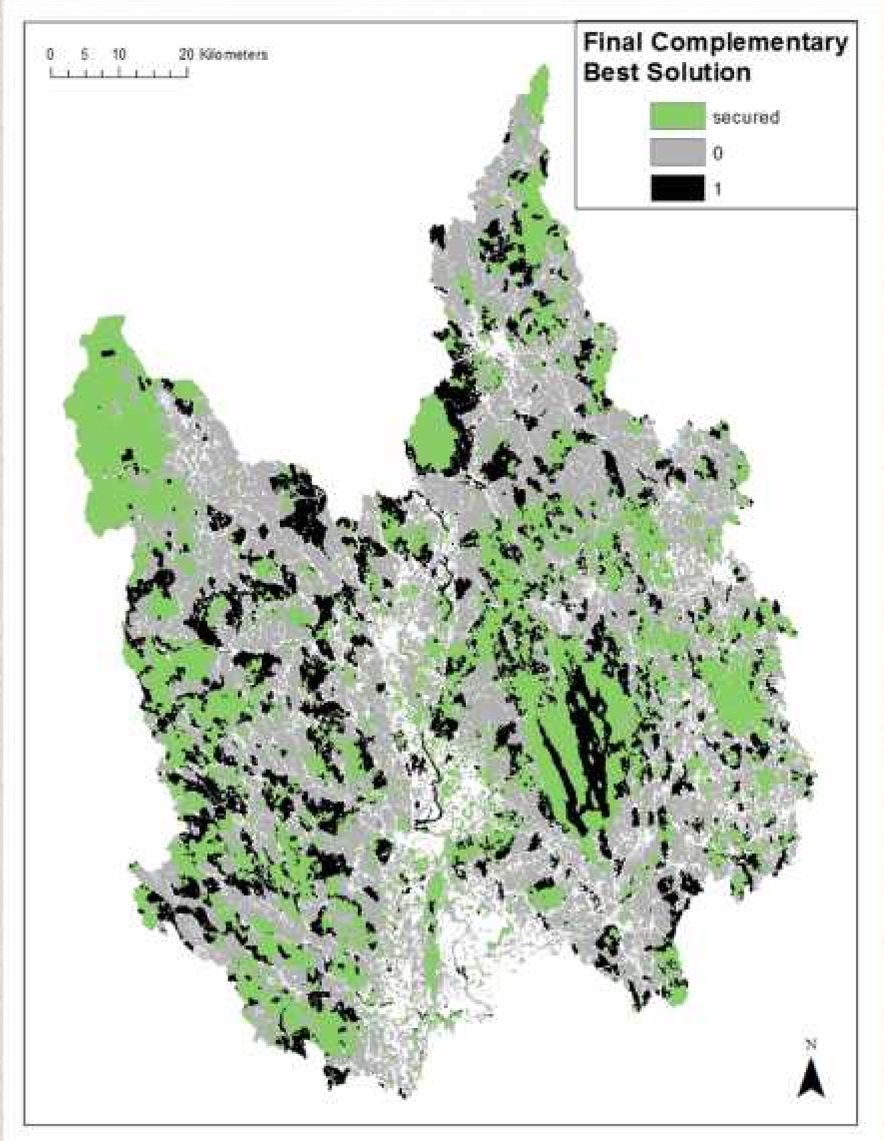
The Approach

Landscape Design

Land protection

- **Optimal reserve design (Marxan)**

  Find reserve network(s) that achieves coarse- and/or fine-filter conservation targets



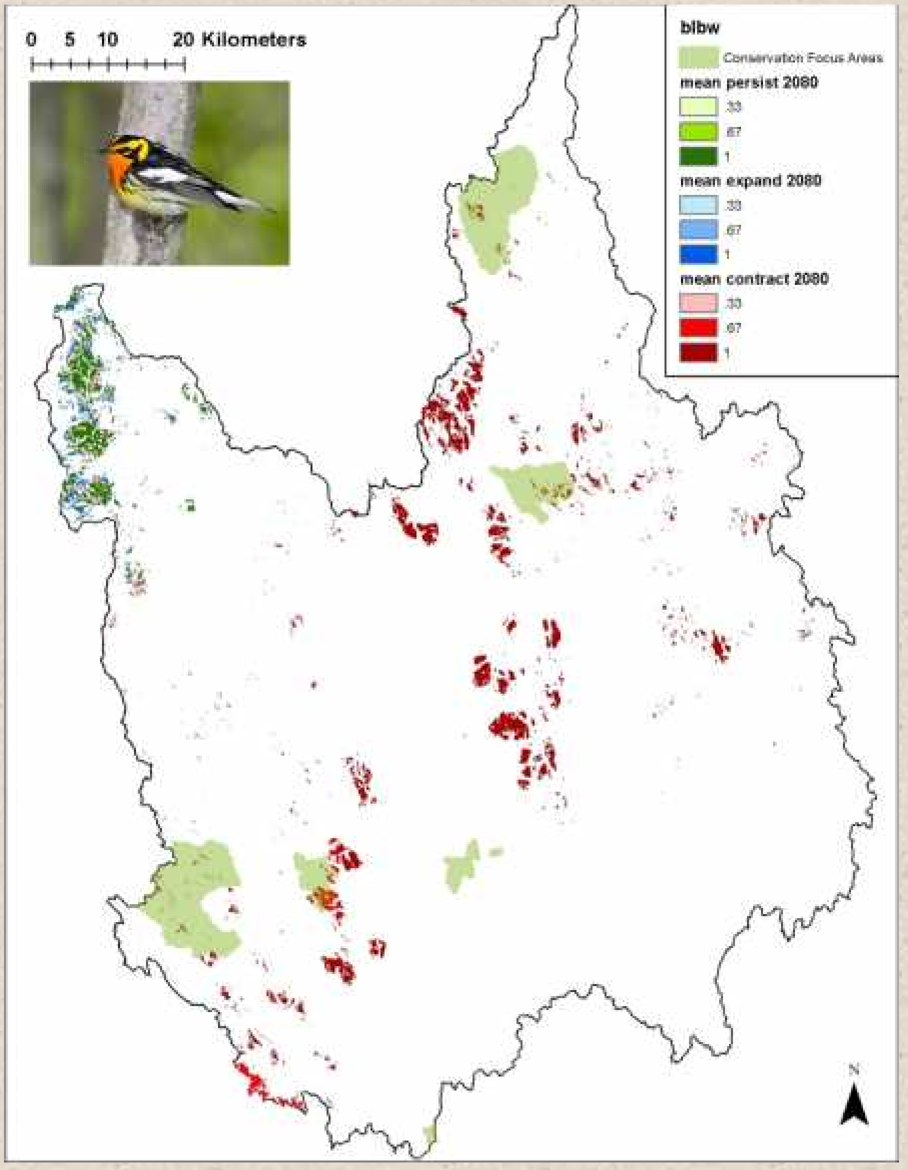
The Approach

Landscape Design

Land management

- **How important is the *focal management area* within the region in maintaining the *persistence* of each species?**

FMA Persistence index = % of persistence zone within FMA



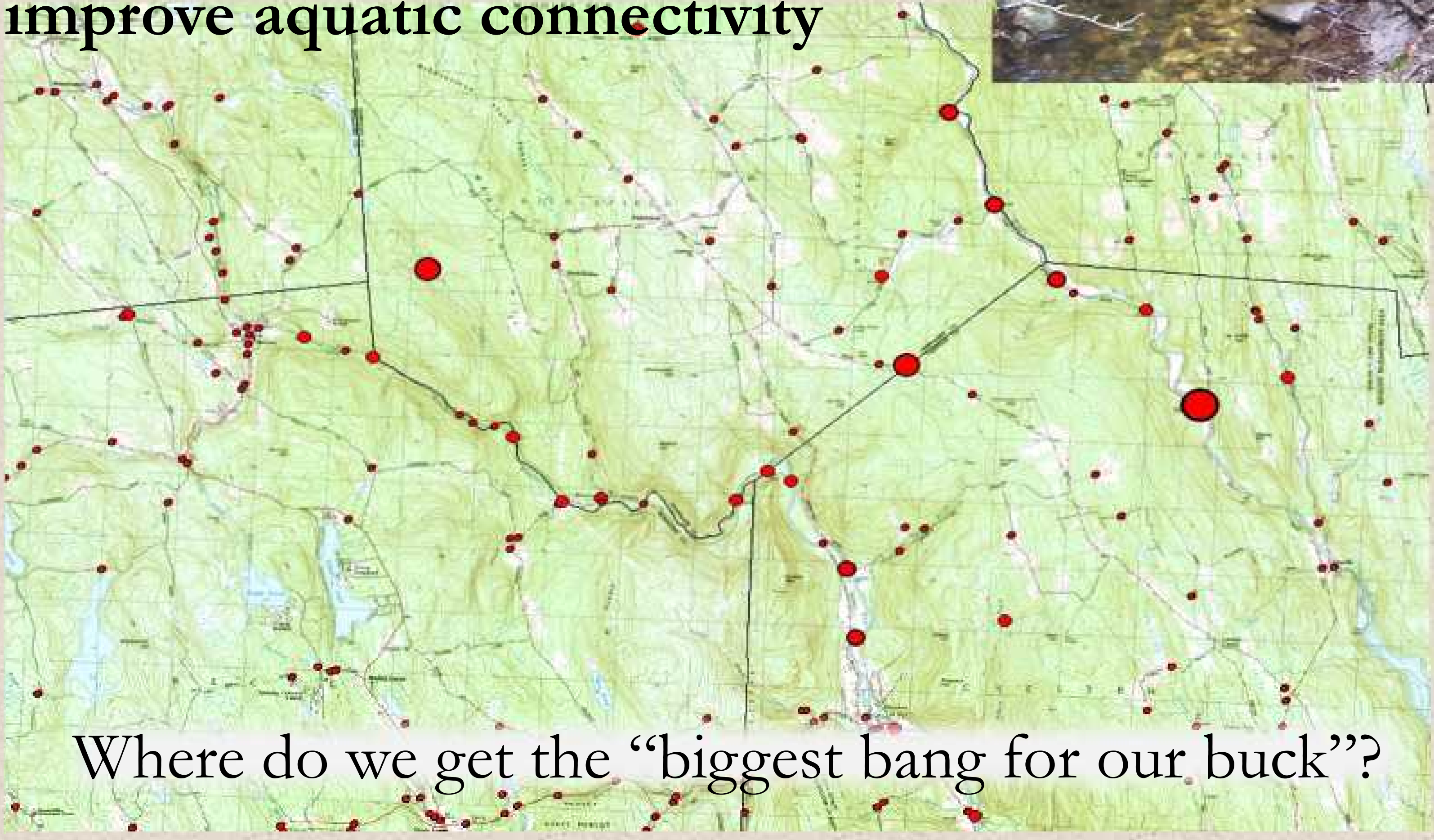
Blackburnian warbler = 1%
Marsh wren = 9%

The Approach

Landscape Design

Ecological restoration

- **Prioritizing road-stream crossings to improve aquatic connectivity**



Where do we get the "biggest bang for our buck"?