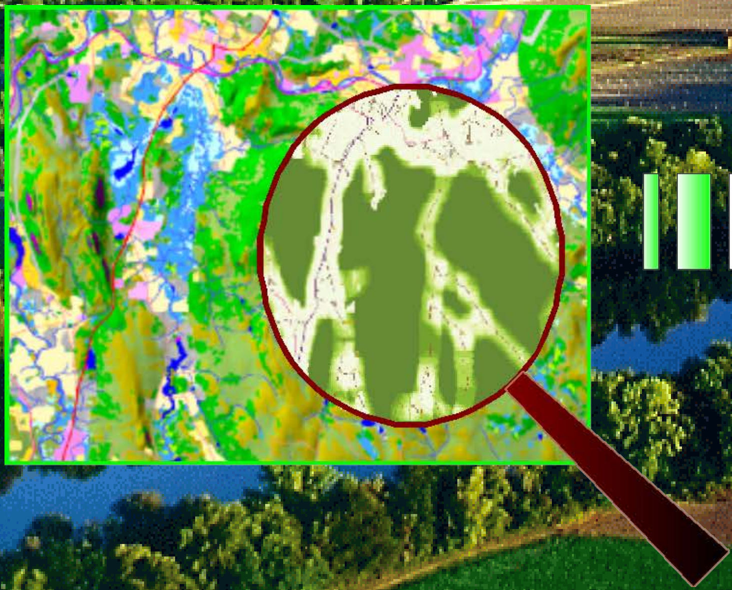
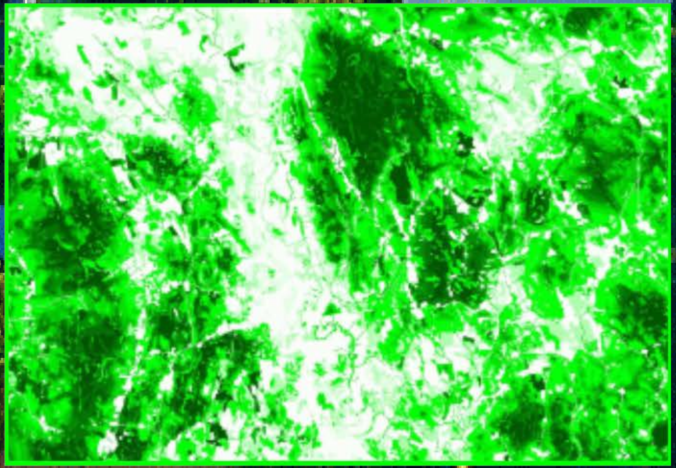
Designing Sustainable Landscapes in the Northeast

A project of the North Atlantic Landscape Conservation Cooperative & Northeast Climate Science Center

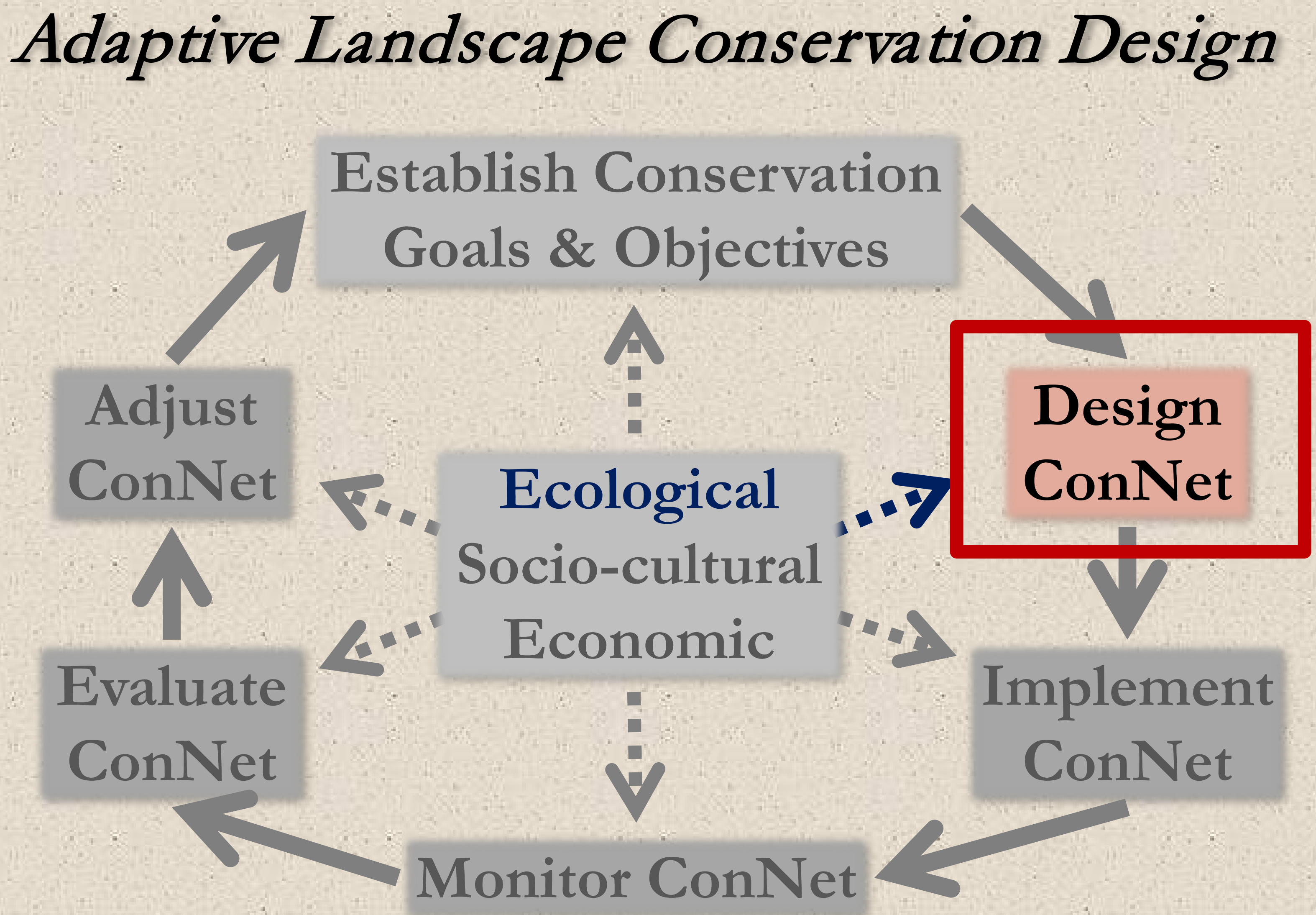
Landscape Conservation Design
September 26, 2014





Landscape Conservation Design

Step 2: Design Conservation Network



Landscape Conservation Design

Step 2: Design Conservation Network

Design Steps:

1. Select (tiered) *core* areas
2. Create core area *buffers*
3. Prioritize <u>within</u> buffered cores
4. Assess *connectivity* among cores
5. Prioritize <u>among</u> core areas
6. Prioritize <u>among</u> linkages
7. Prioritize <u>within</u> linkages
8. Identify *restoration* opportunities
9. Determine *management* needs

Current focus

- Field verification at all steps
- Socio-cultural and economic considerations at all steps

Step 2: Design Conservation Network

Create (buffered) core areas

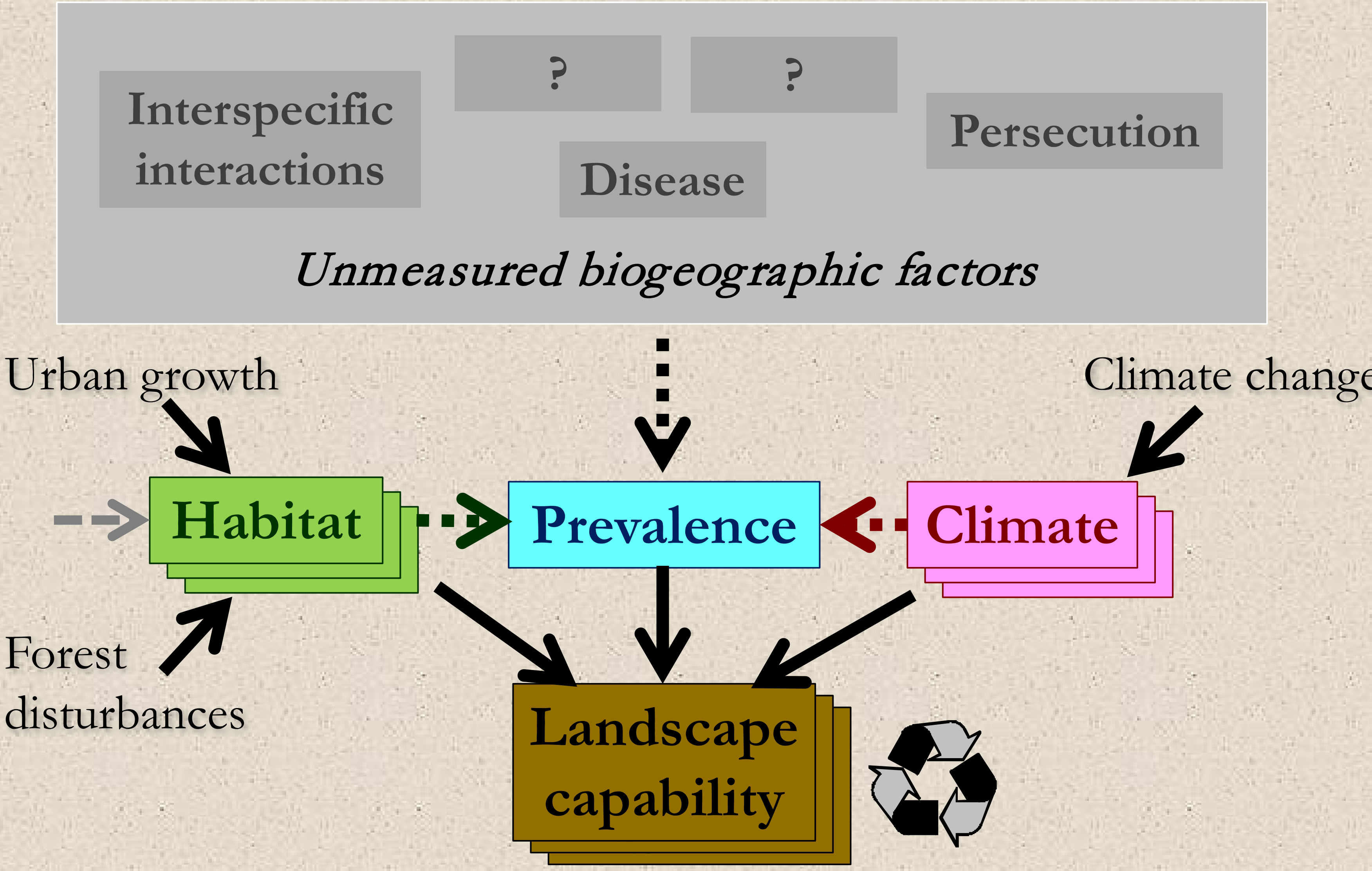
Core area scenarios:

- Ecosystem approach (coarse filter)… based solely on ecosystem conditions
- Species approach… based solely on focal species considerations
- Combined ecosystem-species approach… based on the complement of ecosystems and focal species

Current focus

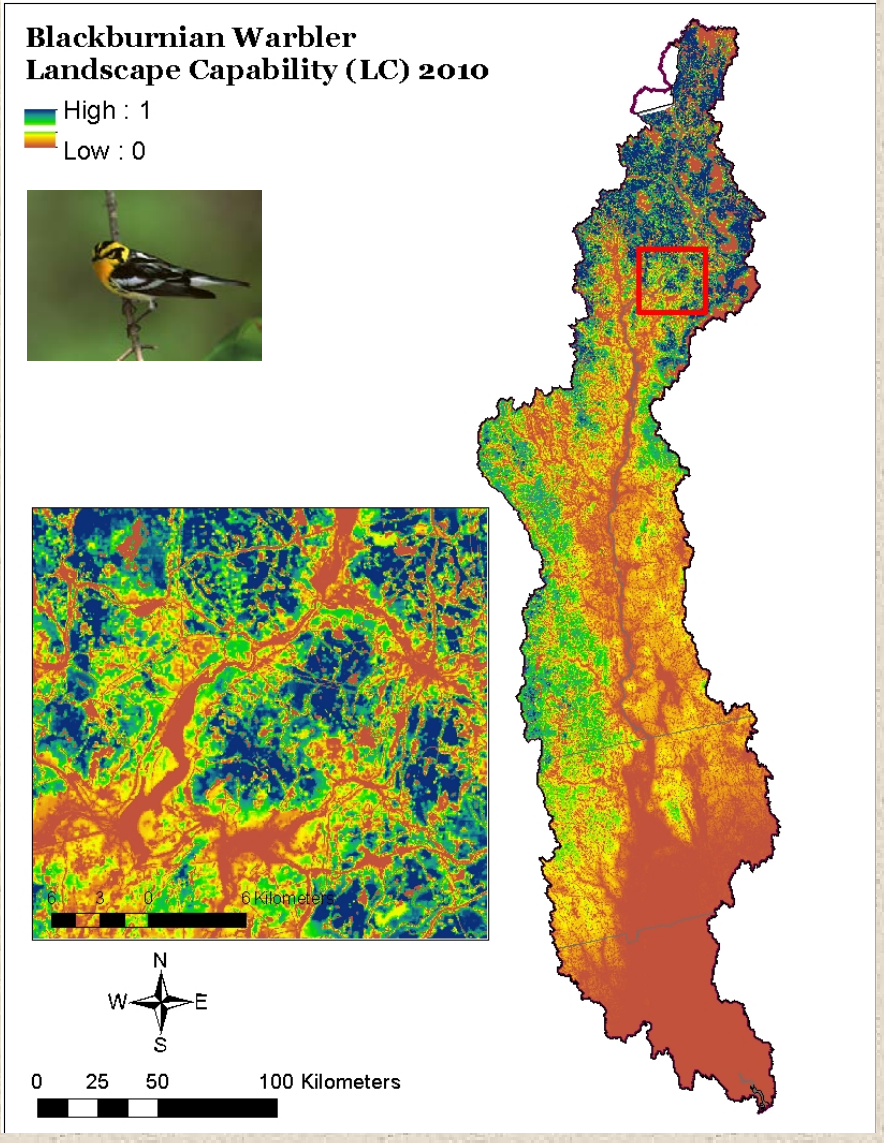
Species Landscape Capability Index

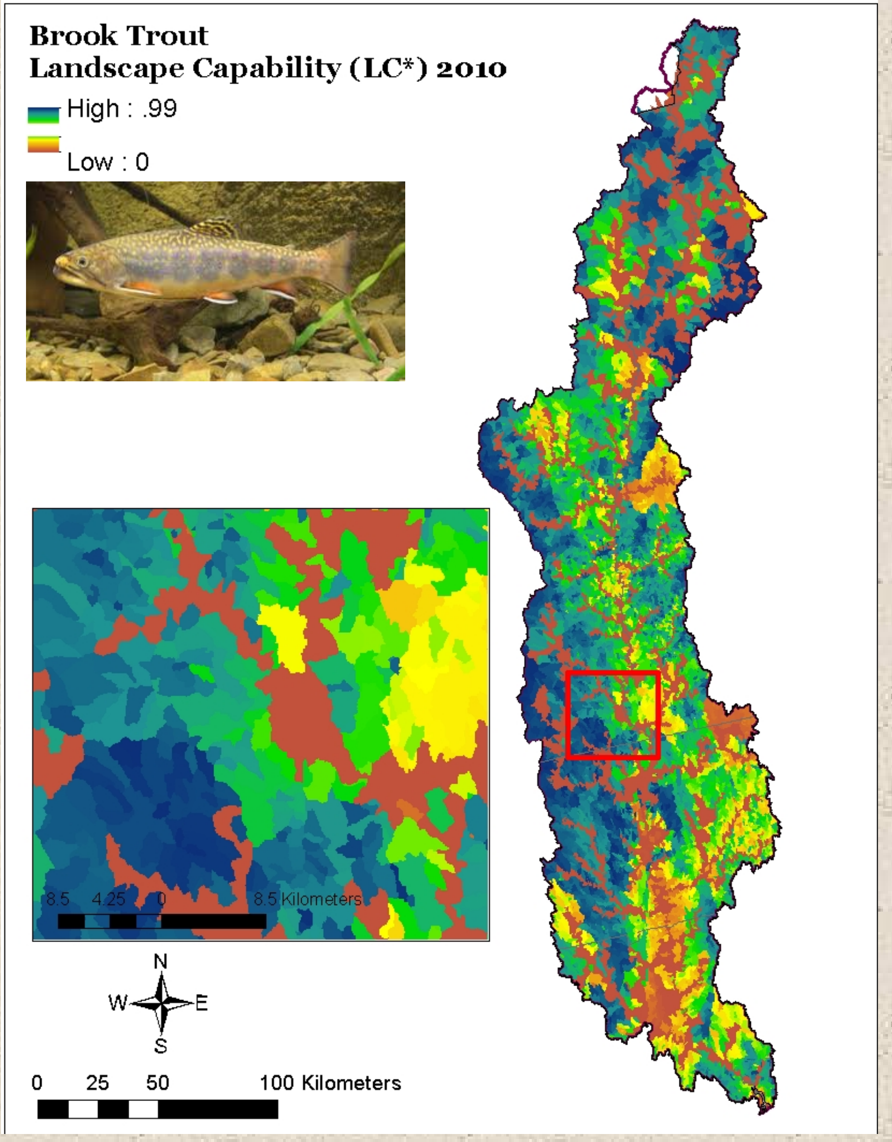
Conceptual framework



Species Landscape Capability Index

LC examples





Species Landscape Change Assessment

Spatial indices

- Grids depicting relative magnitude of persistence, vulnerability or expansion of landscape capability due to climate change, habitat change or both
- Quantile-scaled non-zero values within project area
- Useful for prioritizing areas for species conservation (in raw-scale form) or visualizing potential future change

1. Persistence*
2. Climate persistence*
3. Climate vulnerability
4. Climate expansion
5. Habitat persistence*
6. Habitat vulnerability

*Raw-scale form can be used in species optimization

Species Landscape Change Assessment

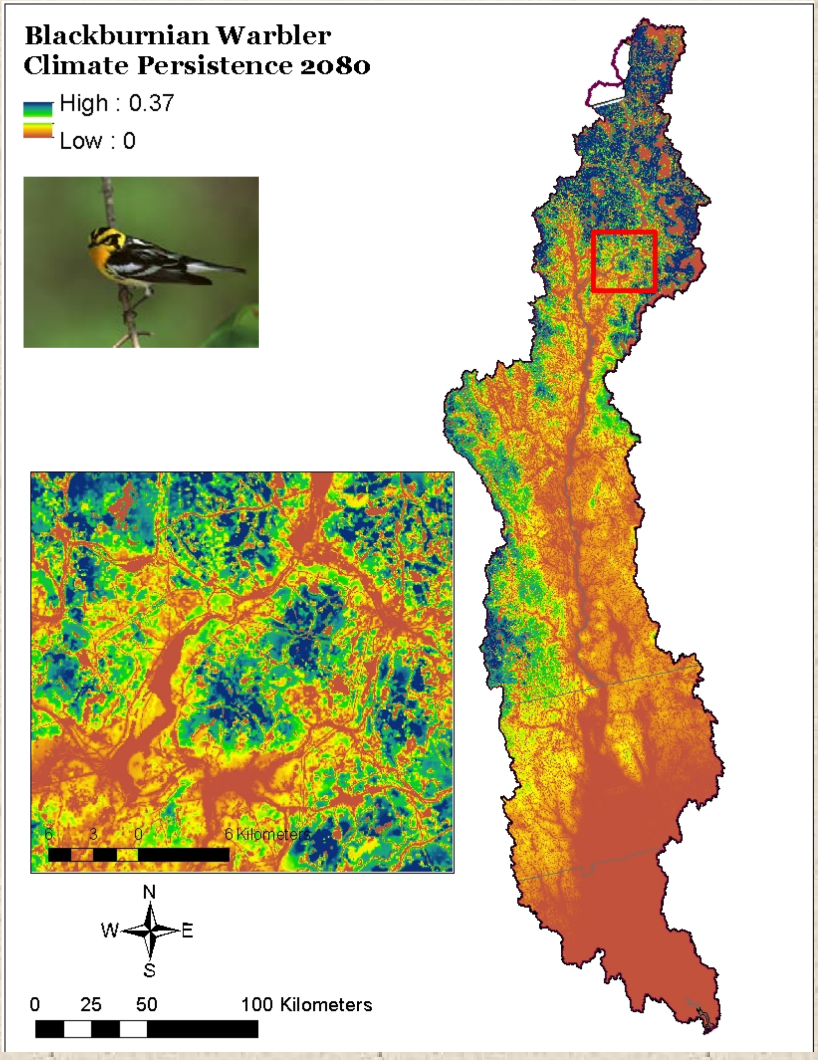
Spatial indices example

- **Climate persistence…** places with high current LC that are most likely to maintain climate suitability over time

= (current LC + future LC.climate*) / 2

* Holds HC constant

<u>Not</u> subject to the influence of future stochastic vegetation disturbances (or lack of)



Step 2: Design Conservation Network

Create (buffered) core areas

Focal species approach:

a) Select species*
b) Establish targets based on objectives
c) Create selection index
d) Select core areas to meet targets

- Representative species
- Optionally, rare species

**Under the assumption that representative species act as surrogates for other priority species*

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Step 2: Design Conservation Network

a) Select representative species

Species	Habitat Guild
American Woodcock	Young forest w/openings
Black Bear	Large tracts of forest
Blackburnian Warbler	Mature mixed forest
Blackpoll Warbler	Spruce-fir forest
Brook Trout*	Headwater creeks
Eastern Meadowlark	Pastures & grasslands
Louisiana Waterthrush	Riparian forest
Marsh Wren	Freshwater & tidal marshes
Moose	Large tracts of mixed forest w/wetlands
Northern Waterthrush	Forested wetlands
Prairie Warbler	Shrublands and savannahs
Ruffed Grouse	Young forest
Wood Duck	Swamps & floodplain forest
Wood Thrush	Mature decid. forest
Wood Turtle	Forested streams & adj. uplands

*From Letcher's group (different modeling framework)

One or more diadromous fish species under consideration (Coarse-scale binary data)

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Step 2: Design Conservation Network

a) Select rare species*

- **Terrestrial/wetland species:**
  - ✓Bat hibernacula
  - ✓Puritan and Cobblestone tiger beetles
  - New England cottontail
- **Aquatic species:**
  - ?

*Binary (presence only data)

**Contingent on availability of suitable extant digital data (i.e., existing maps)*

Step 2: Design Conservation Network

Create (buffered) core areas

Focal species approach:

a) Select species
b) Establish targets based on objectives*
c) Create selection index
d) Select core areas to meet targets

- Translate each representative species' objective into percentage of current *Landscape Capability (LC)* or probability of occupancy (brook trout)

***Under the assumption that species' objectives can be translated into landscape capability units**

Step 2: Design Conservation Network

Create (buffered) core areas

b) Establish <u>representative</u> species' targets

Species	Habitat Guild	Threats*					Responsibility		Rarity	**Weight** Sum of weighted "+" and "-" entries across 8 columns to the left (% of LC to be captured in final selection index for core areas)
		Experienced significant population loss? A: in CRW B: Range-wide (based on population trends from BBS or other source)	Facing significant habitat threats excluding development (includes 1,2,3,4): A: in CRW, B: Range-wide	Facing significant non-habitat threats (includes 5,6,7,8): A: in CRW, B: Range-wide	Climate[9] vulnerability in CRW? (based on change in climate niche envelope projected for year 2080: >50% reduction = "+")	Vulnerability to urban growth[10,11] in CRW? (based on change in LC due to urban growth projected in year 2080)	High regional responsibility for the Northeast? (based on % of total regional Landscape Capability w/i Northeast Region occurring in CRW: >10% of LC = "+")	High global responsibility? (based on % of global population in CRW; % of global population in Northeast Regional also listed for reference)	Regionally rare? (based on acres of suitable habitat within region as estimated by LC models: <1M acres = "+", >15M = "-", >50M = "--")	
	Weight contribution of criteria	A: 0.50 B: 0.25	A: 1.0 B: 0.5	A: 0.50 B: 0.25	0.5	1.0	0.50	0.25	0.5	
American Woodcock	Young forest w/openings	A: + -0.4% in BCR14 -4.9% in BCR30^ B: + -1.8%^	A: +, B: + [1,4] lack of (appropriate) disturbance/ forestry [moderate Severity, moderate Immediacy, high Spatial Extent]		0 -6.6%		A: 0 5.3% of LC in NE	0 3% in CRW 17% in NE	0 9 million acres	+2.25 (72.5%)

See terrestrial team documents for the full matrix

Step 2: Design Conservation Network

Create (buffered) core areas

b) Establish representative species' targets

Species	Habitat Guild	Target	LC units
American Woodcock	Young forest w/openings	72.5%	1,773,445
Black Bear	Large tracts of forest	40.0%	15,435,393
Blackburnian Warbler	Mature mixed forest	62.5%	3,332,391
Blackpoll Warbler	Spruce-fir forest	85.0%	282,410
Brook Trout	Headwater creeks	50.0%	642,445
Eastern Meadowlark	Pastures & grasslands	72.5%	146,087
Louisiana Waterthrush	Riparian forest	62.5%	161,503
Marsh Wren	Freshwater & tidal marshes	62.5%	13,639
Moose	Large tracts of mixed forest w/wetlands	55.0%	7,236,174
Northern Waterthrush	Forested wetlands	55.0%	145,593
Prairie Warbler	Shrublands and savannahs	50.0%	1,623
Ruffed Grouse	Young forest	45.0%	6,983,301
Wood Duck	Swamps & floodplain forest	50.0%	173,521
Wood Thrush	Mature decid. forest	55.0%	9,408,591
Wood Turtle	Forested streams & adj. uplands	80.0%	380,721

Step 2: Design Conservation Network

Create (buffered) core areas

Focal species approach:

a) Select species
b) Establish targets based on objectives
c) Create selection index*
d) Select core areas to meet targets

- Which product(s) to use?
  - ✓ Current LC
  - Persistence†
  - Climate persistence †
  - Habitat persistence †

†Raw-scale form of metric

**Requires products given in LC units for the species optimization algorithm (use raw scale grids)*

Step 2: Design Conservation Network

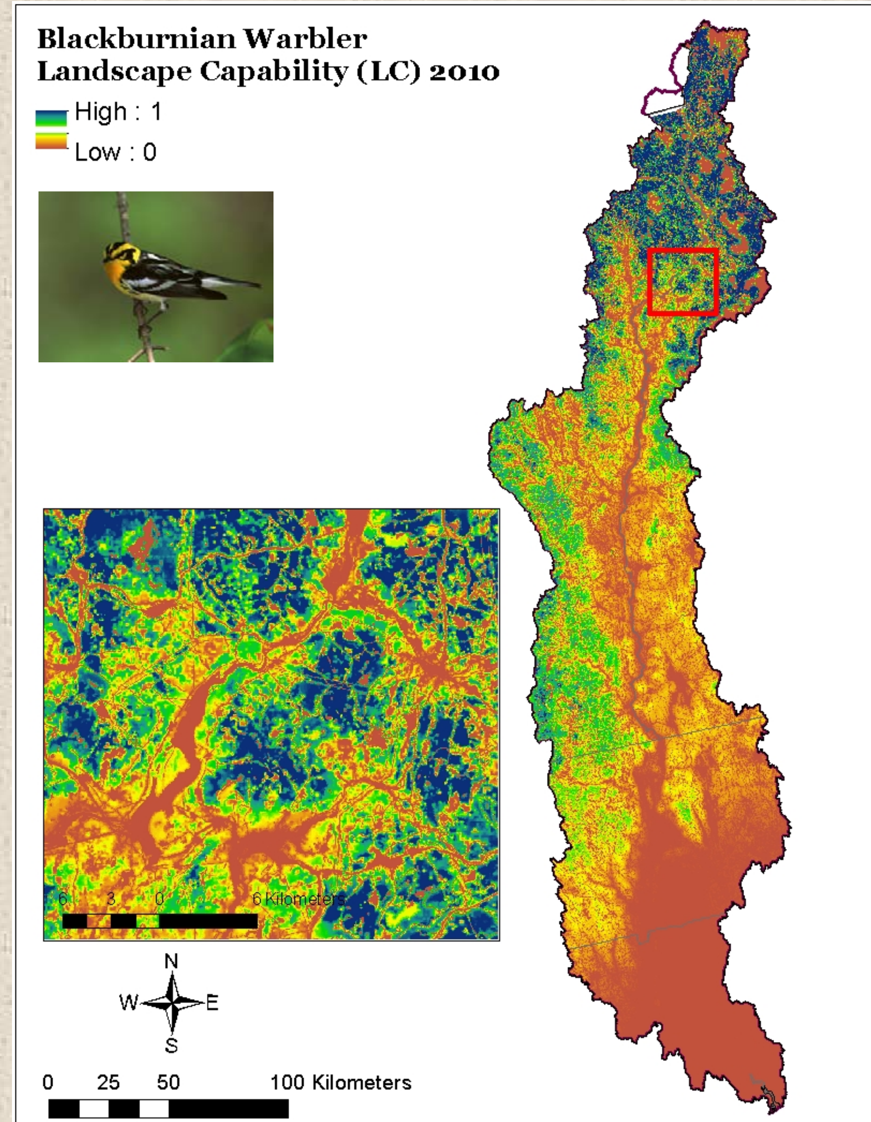
Create (buffered) core areas

c) Create selection index

For each <u>representative</u> species:

- Select spatial product (or average products):
  - ✓ Current LC
  - Persistence†
  - Climate persistence†
  - Habitat persistence†

†*Raw-scale form of metric*



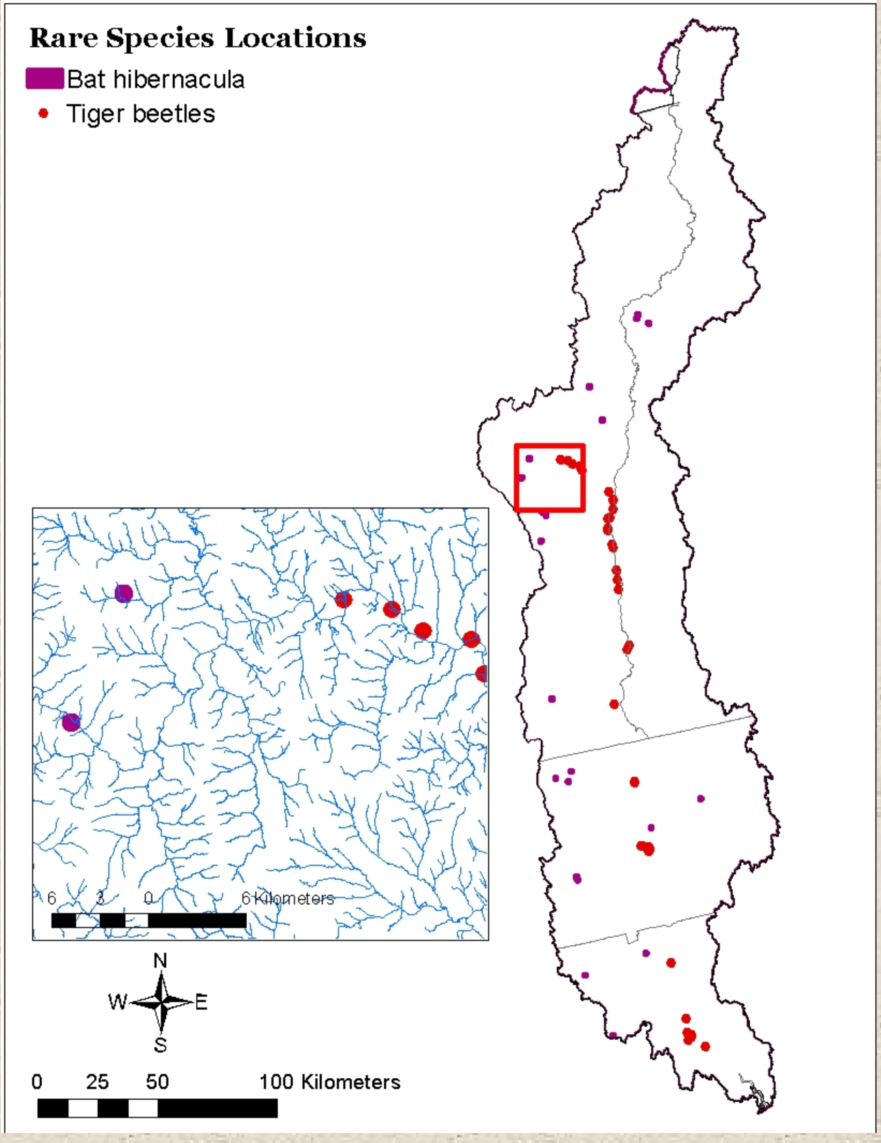
Landscape Conservation Design

Step 2: Design Conservation Network

c) Create selection index

For each rare species:

- Binary (0 vs 1) maps of critical habitat?
  - ✓ Tiger beetles
  - ✓ Bat hibernacula
  - New England cottontail?
  - Aquatics?



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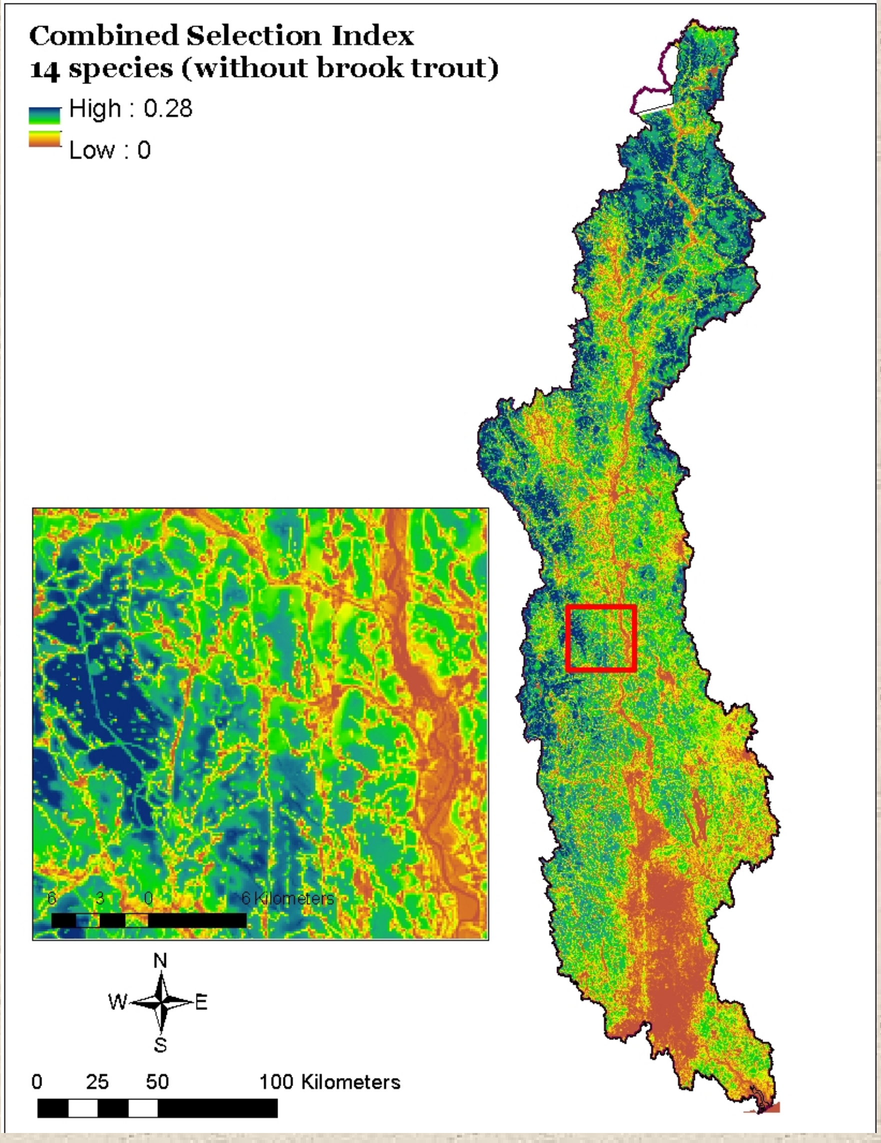
Step 2: Design Conservation Network

c) Create selection index

Combine across species:

- Standardized sum of selection index (e.g., current LC) across species
- With or without rare species?



Step 2: Design Conservation Network

Create (buffered) core areas

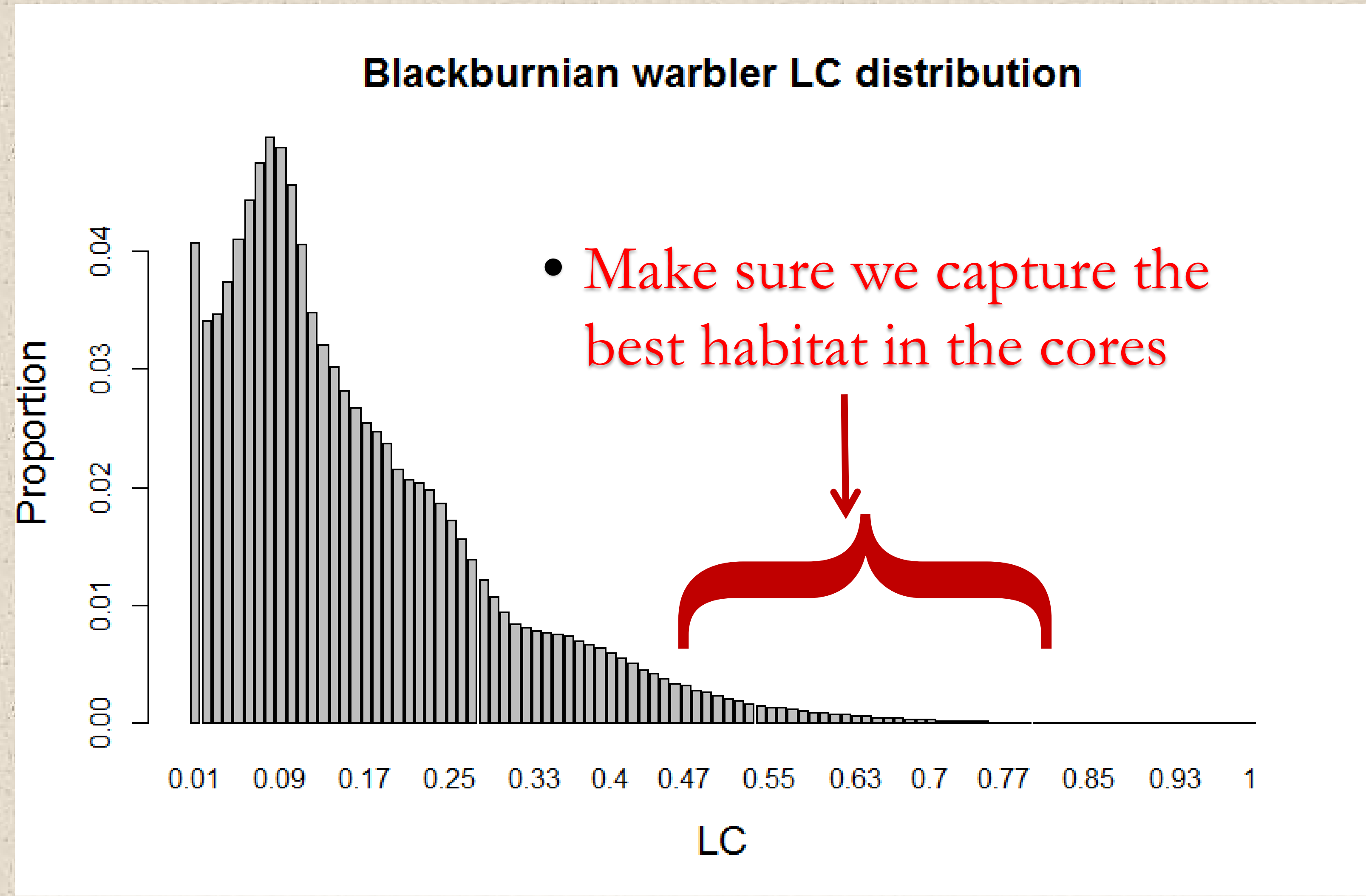
Focal species approach:

a) Select species
b) Establish targets based on objectives
c) Create selection index
d) Select core areas to meet targets

- How to achieve all species' targets in the minimum total area, while creating practical core areas that don't omit the best habitat for each species?

Step 2: Design Conservation Network

Create (buffered) core areas

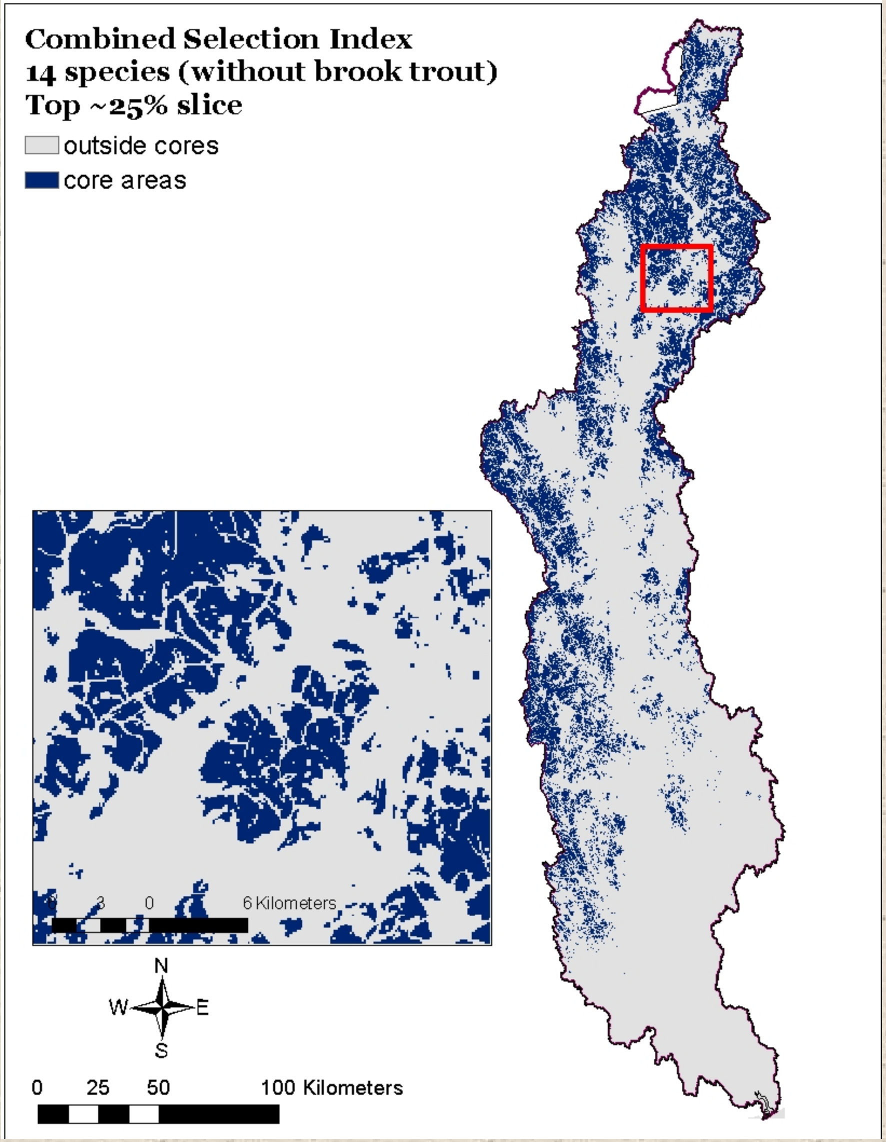


- Make sure we capture the best habitat in the cores

Landscape Conservation Design

Step 2: Design Conservation Network

- **Approach 0: Slice**
  - Slice combined selection index
  - Two fatal problems:
  - ✓ Selecting the "richest" areas does not guarantee completeness
  - ✓ Emphasizes "edges" or the juxtaposition of different habitats (greatest species' distribution overlap) at the expense of "interiors"



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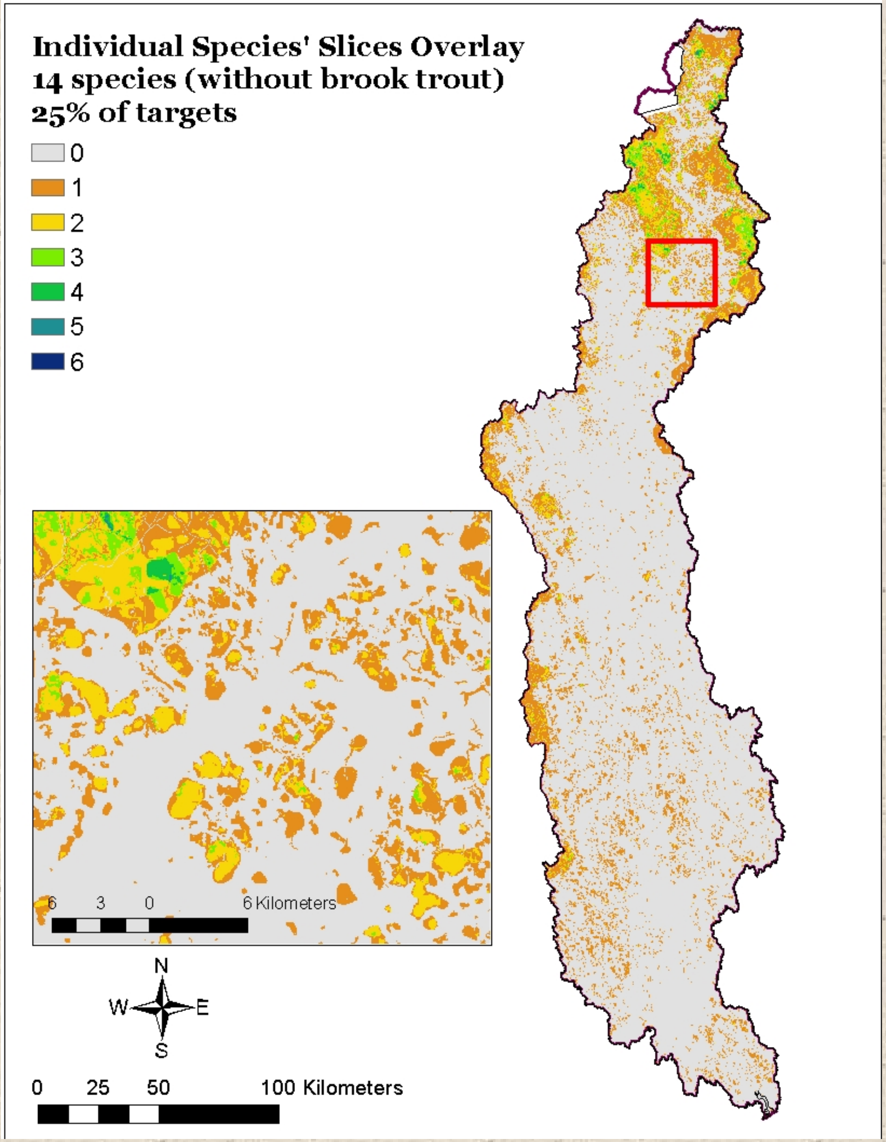
Step 2: Design Conservation Network

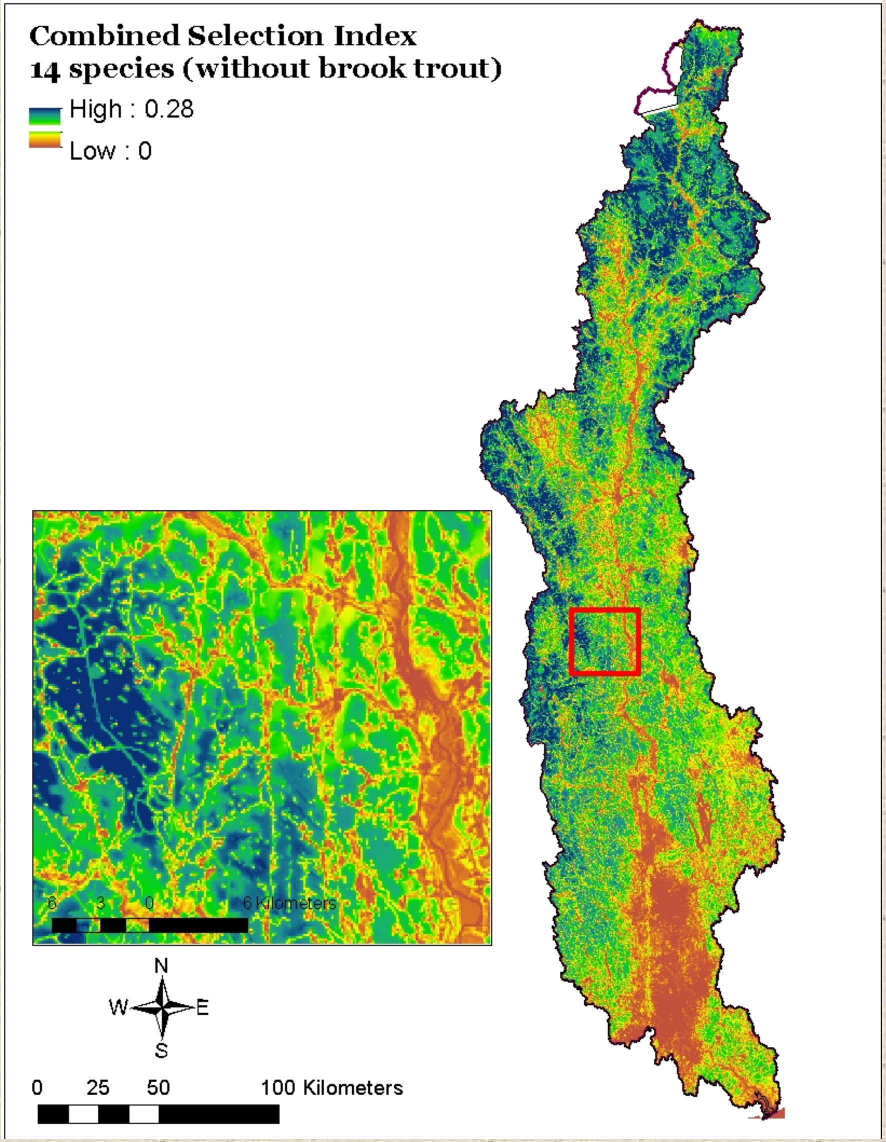
- **Approach 1: Overlay**
  - Slice each species' selection index to achieve corresponding target
  - Union the slices
  - ✓Guaranteed best locations for each species, but at cost of seeking to minimize combined area due to overlapping distributions
  - ✓Fragmented/pixelated cores



Landscape Conservation Design

Step 2: Design Conservation Network

- Approach 2: Pseudo-optimization algorithm
  - Capitalize on species' overlapping distributions to minimize total area
  - Avoid a priori designation of conservation units
  - Build cores with kernels to avoid pixelation
  - Find deterministic solution



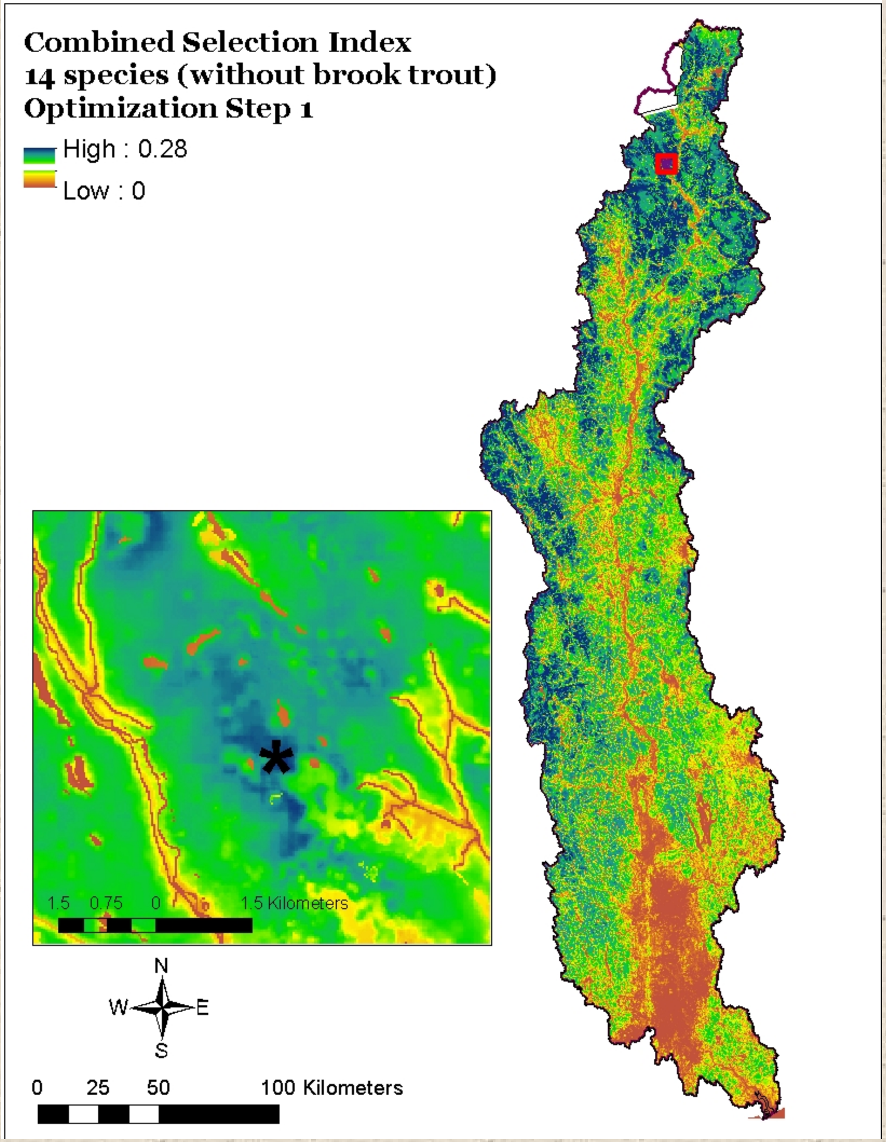
Landscape Conservation Design

Step 2: Design Conservation Network

- **Core area pseudo-optimization**

  Step 1. Select seed for core (peak of selection surface)

  - Within CTR or each HUC8 or other



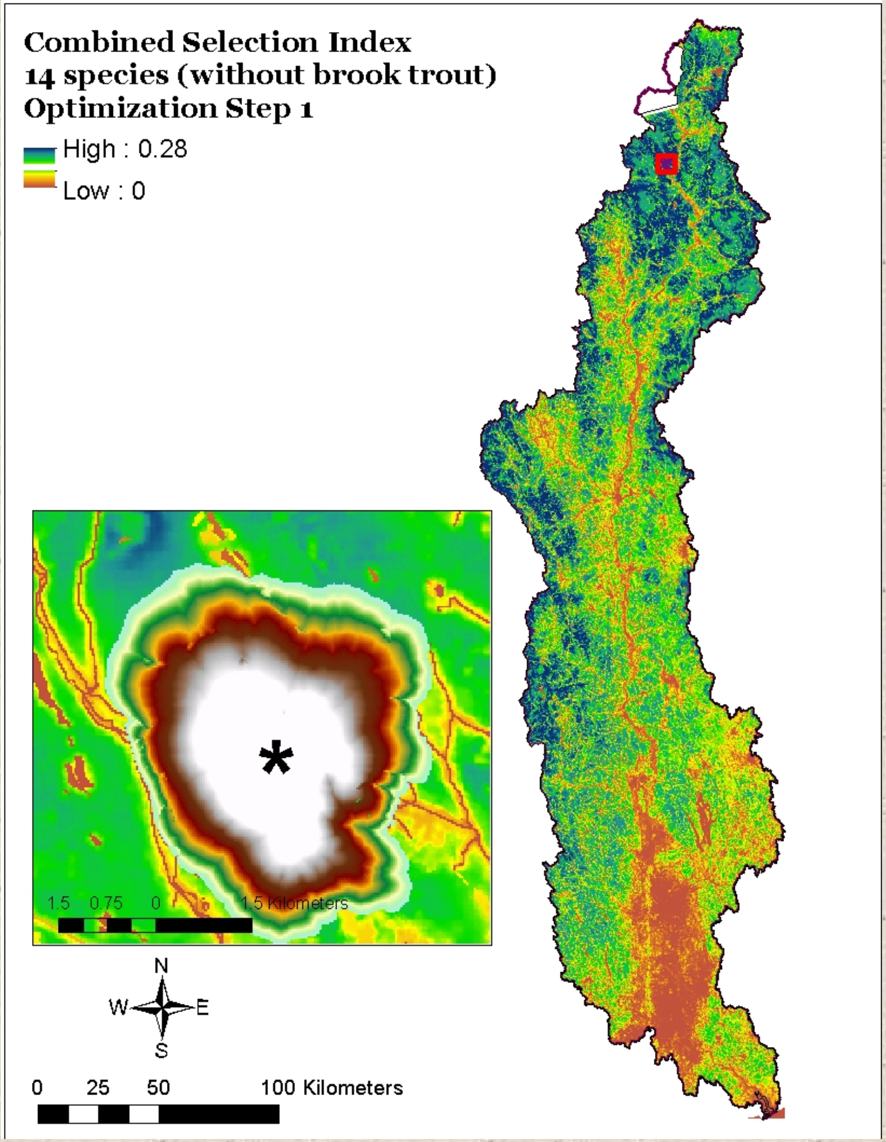
Landscape Conservation Design

Step 2: Design Conservation Network

- **Core area pseudo-optimization**

  Step 2. Build core area using resistant kernel based on selection surface

  - Bandwidth
  - Smoothness
  - Barriers
  - Minimum size



Landscape Conservation Design

Step 2: Design Conservation Network

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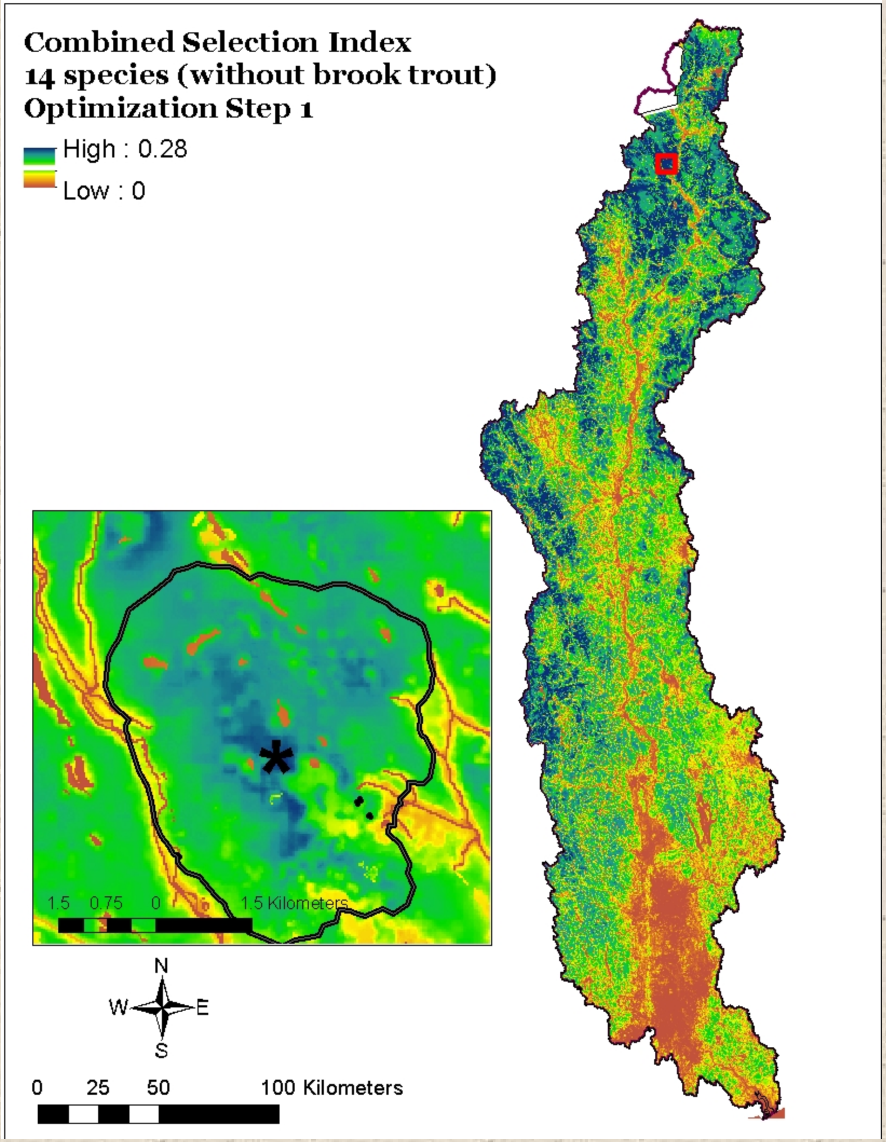

Landscape Conservation Design

Step 2: Design Conservation Network

- **Core area pseudo-optimization**
  - Step 2. Build core area using resistant kernel based on selection surface
    - Bandwidth
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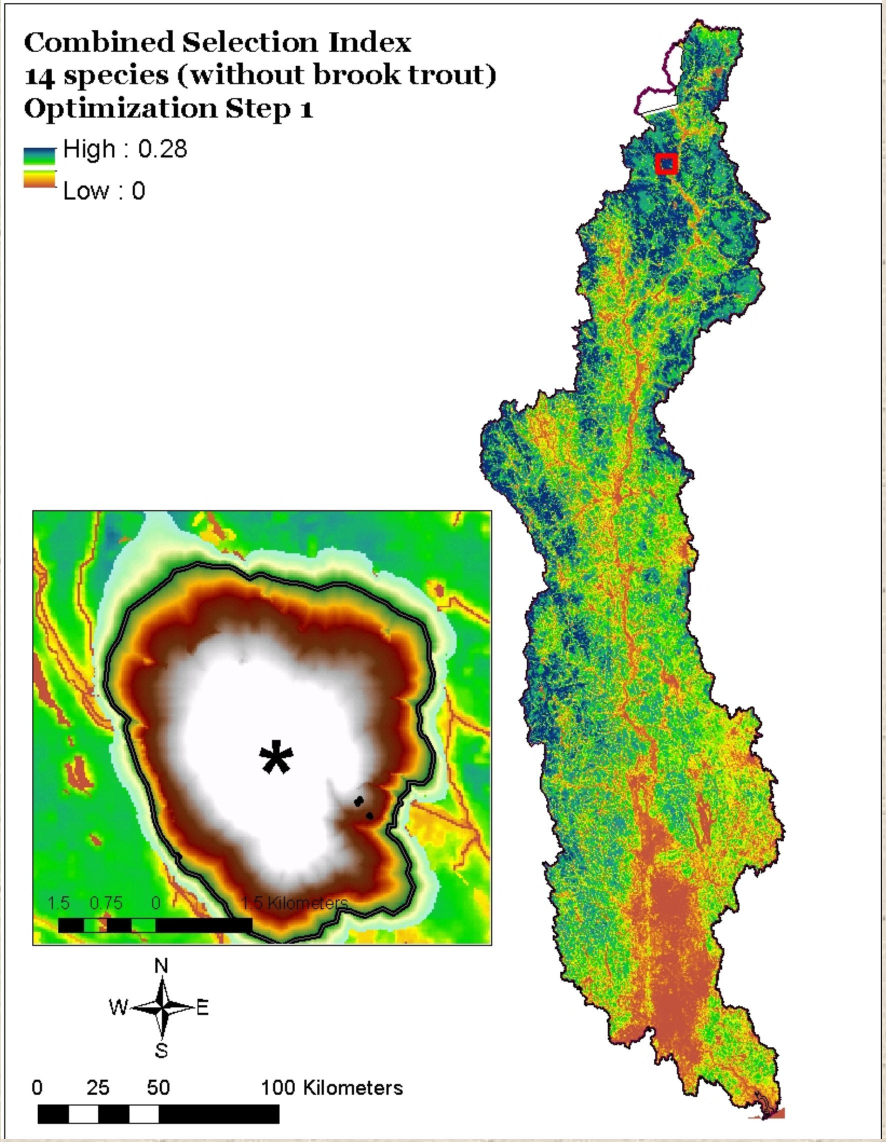
    - Barriers
    - Minimum size

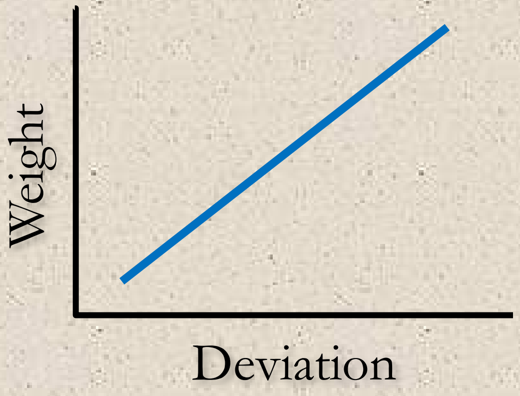


Landscape Conservation Design

Step 2: Design Conservation Network

- **Core area pseudo-optimization**

Step 3. Compute sum of LC units in core area(s) for each species and compute deviations from targets



Species	Target (LC)	Cores (LC)	% in Cores	Deviation	Weight
A	10	0	0	1	0.29
B	20	2	0.1	0.9	0.26
C	50	10	0.2	0.8	0.24
D	100	30	0.3	0.7	0.21

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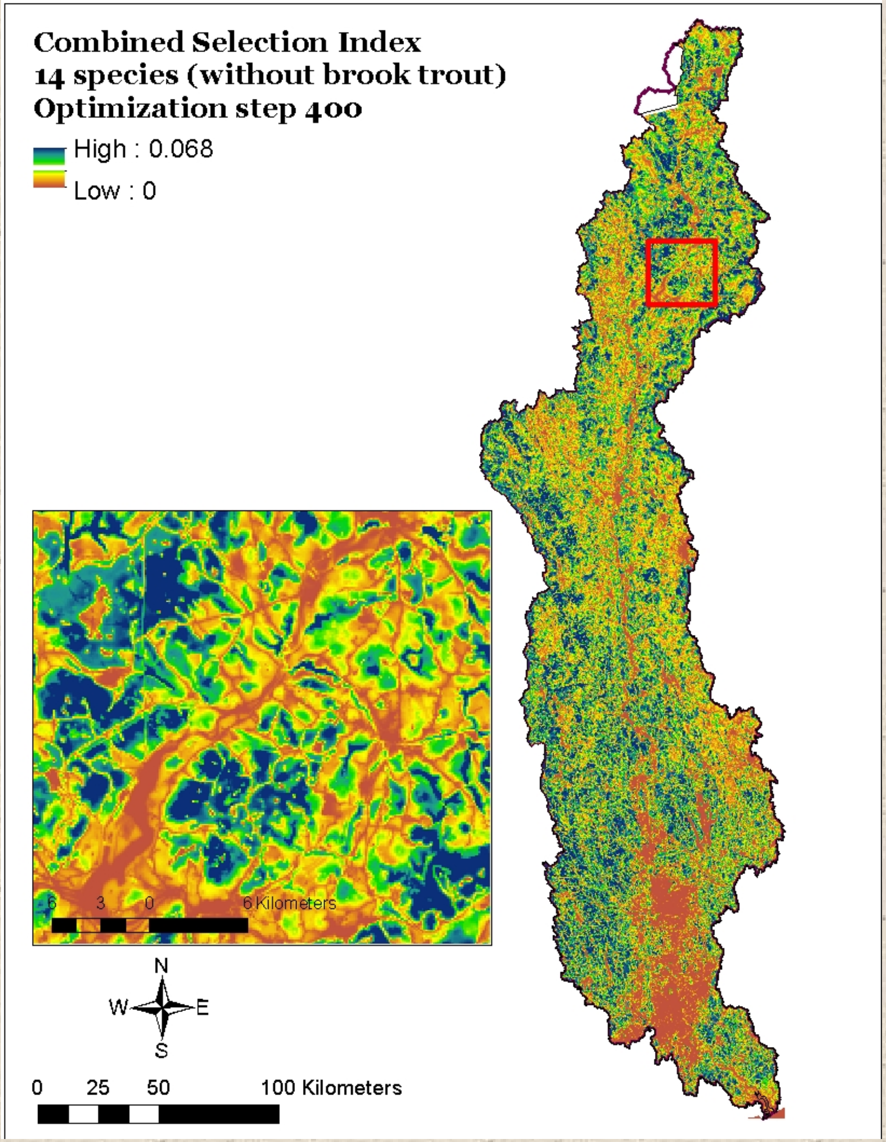
Step 2: Design Conservation Network

- **Core area pseudo-optimization**

  Step 4. Create weighted selection index to reflect species' deviations from targets



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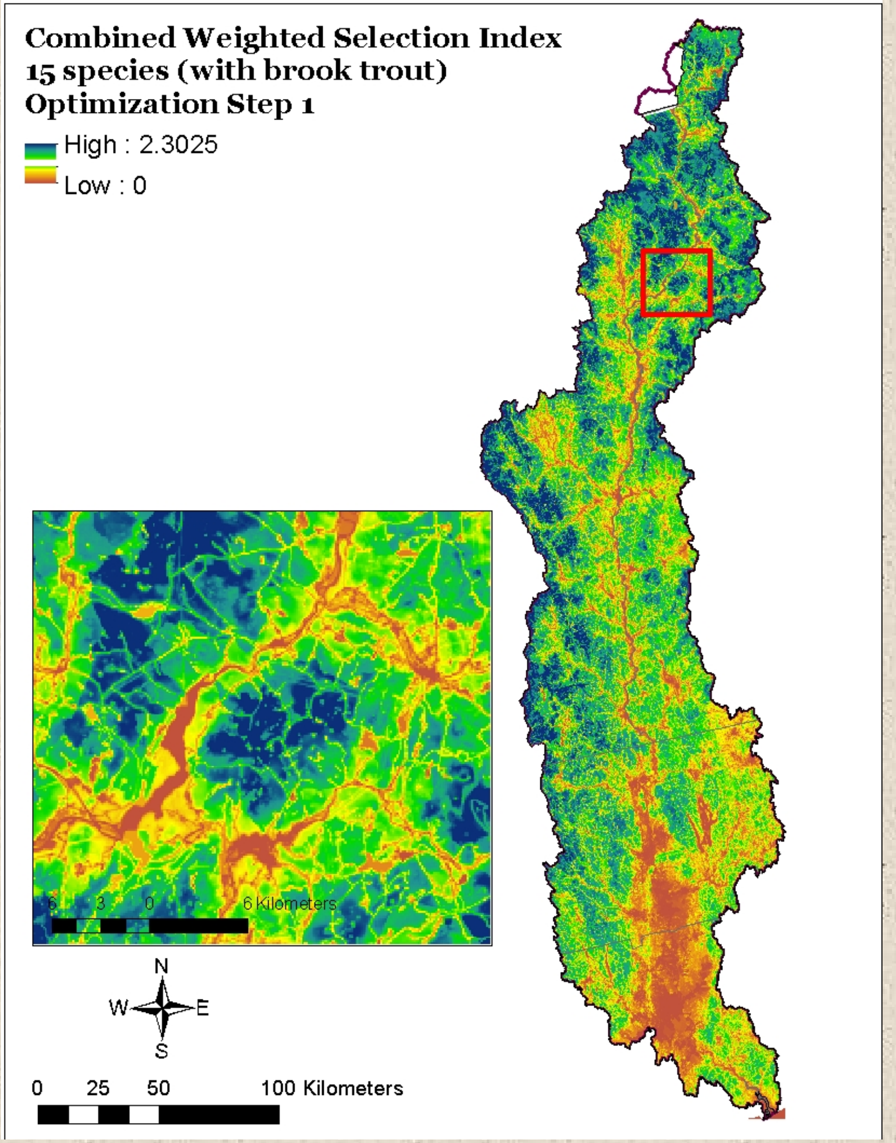
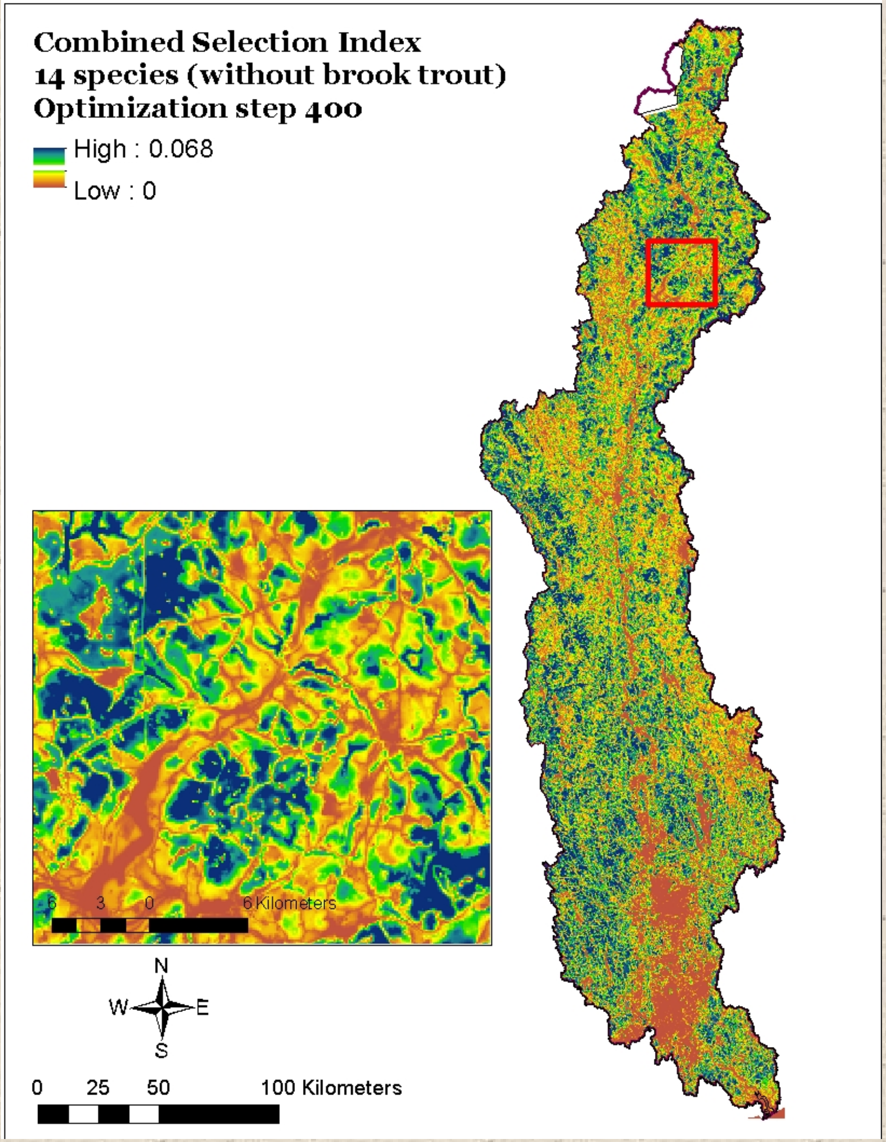
Step 2: Design Conservation Network





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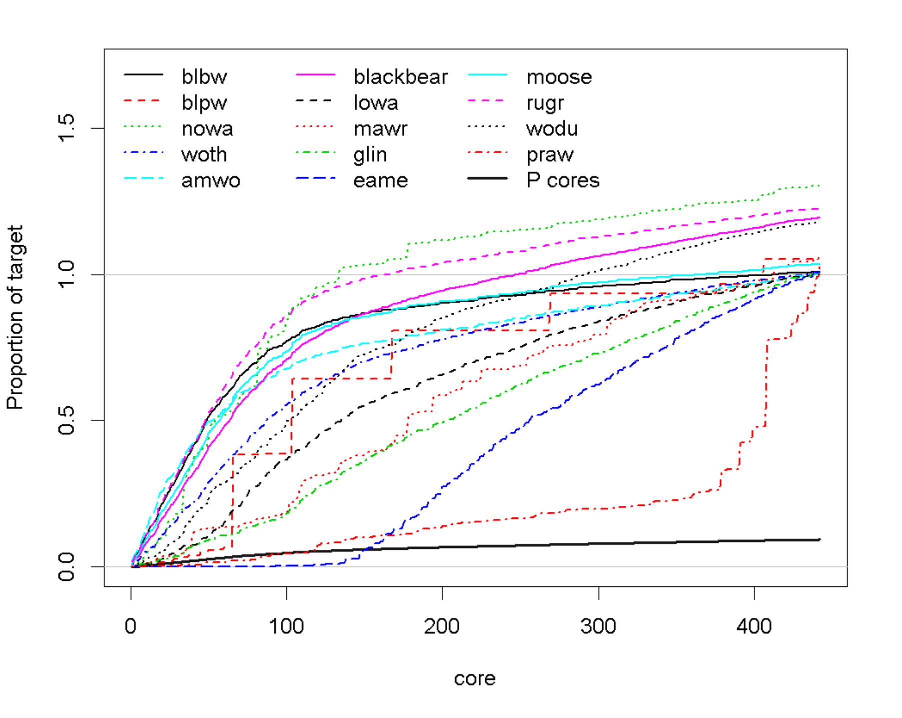
Step 2: Design Conservation Network

- **Core area pseudo-optimization**

  Step 5. Repeat steps 1-4 until all species' targets are met or a specified percentage of the landscape is included in the cores



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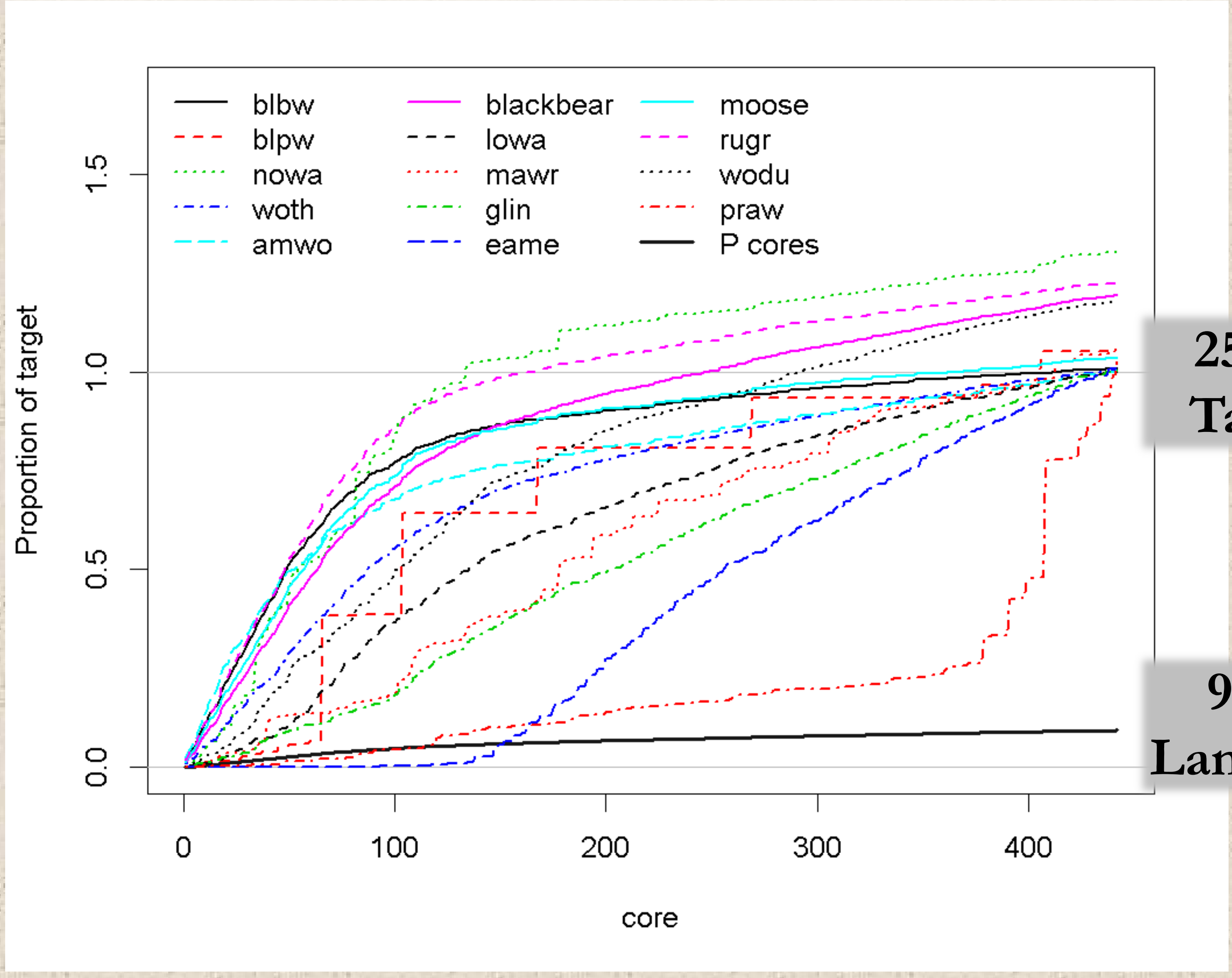
Step 2: Design Conservation Network

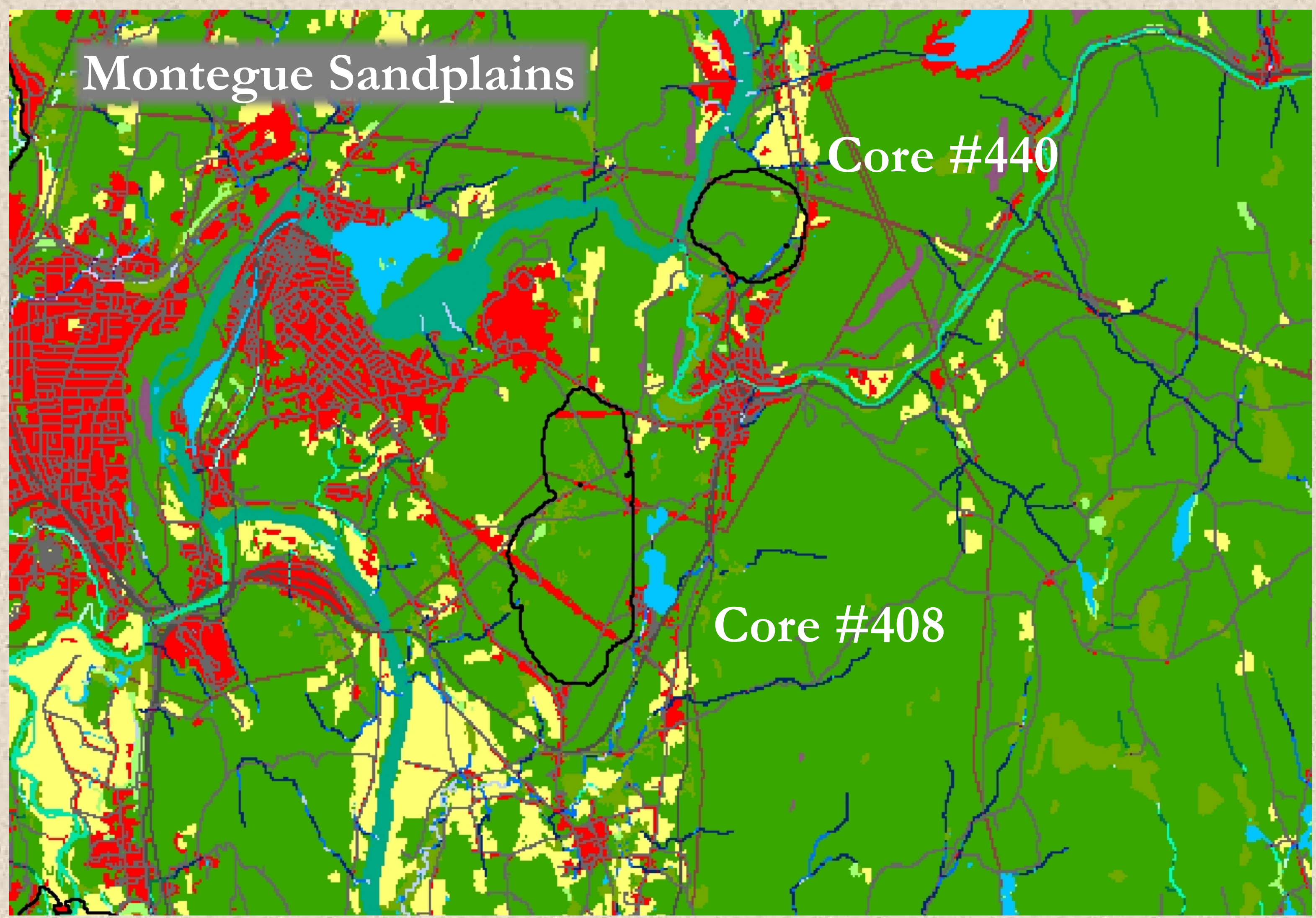


25% of Targets

9% of Landscape

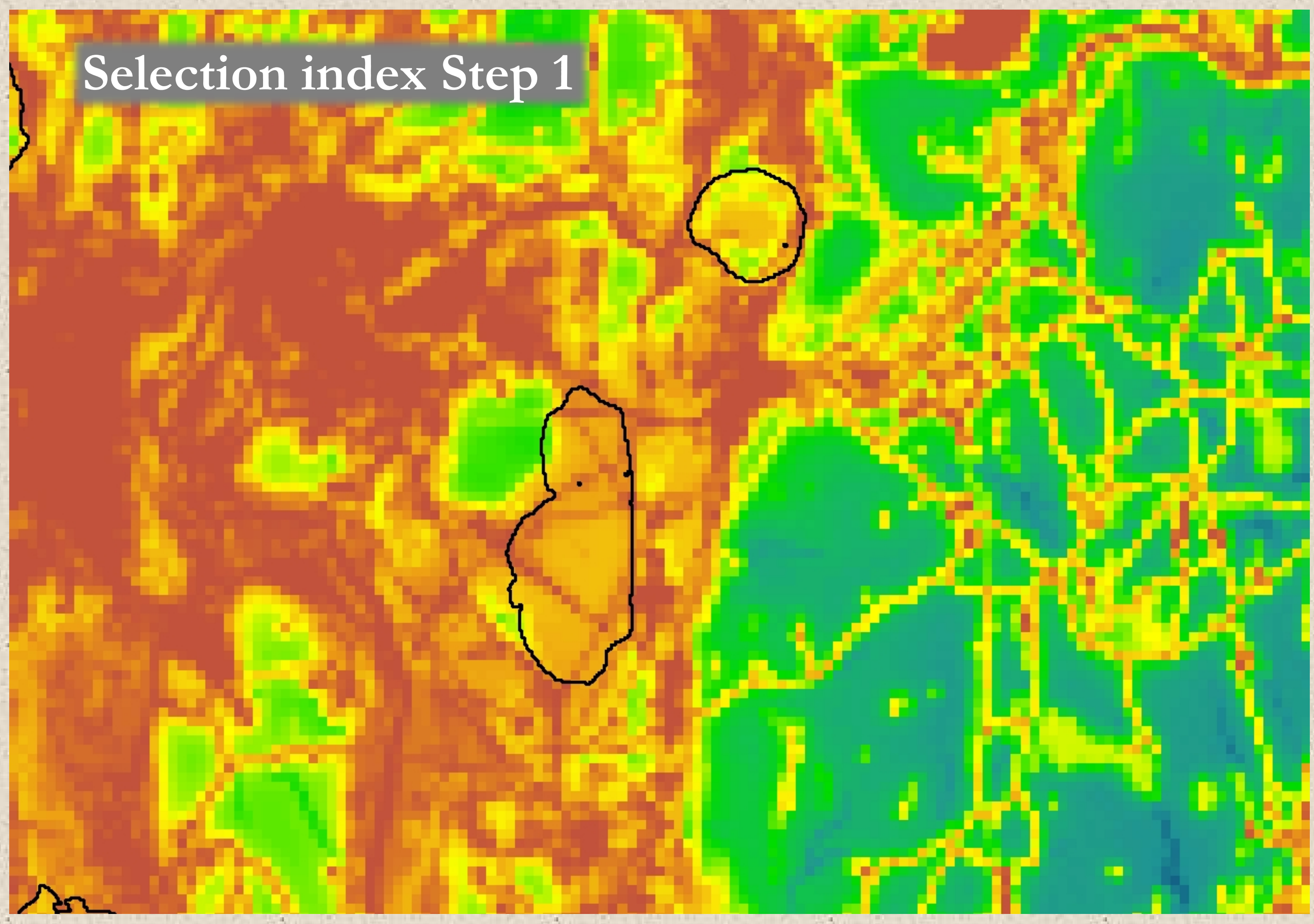
Landscape Conservation Design

Step 2: Design Conservation Network



Landscape Conservation Design

Step 2: Design Conservation Network



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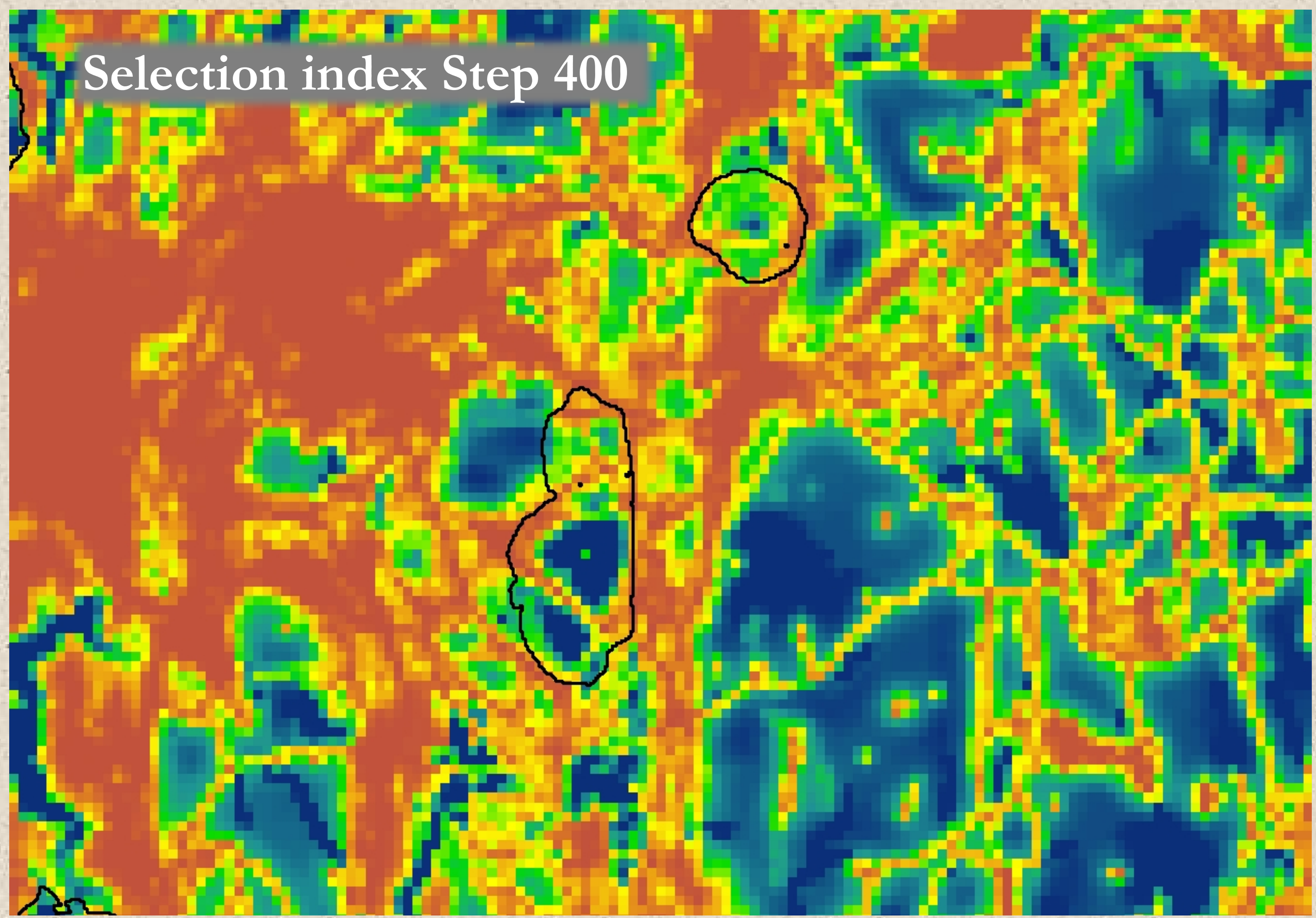
Step 2: Design Conservation Network



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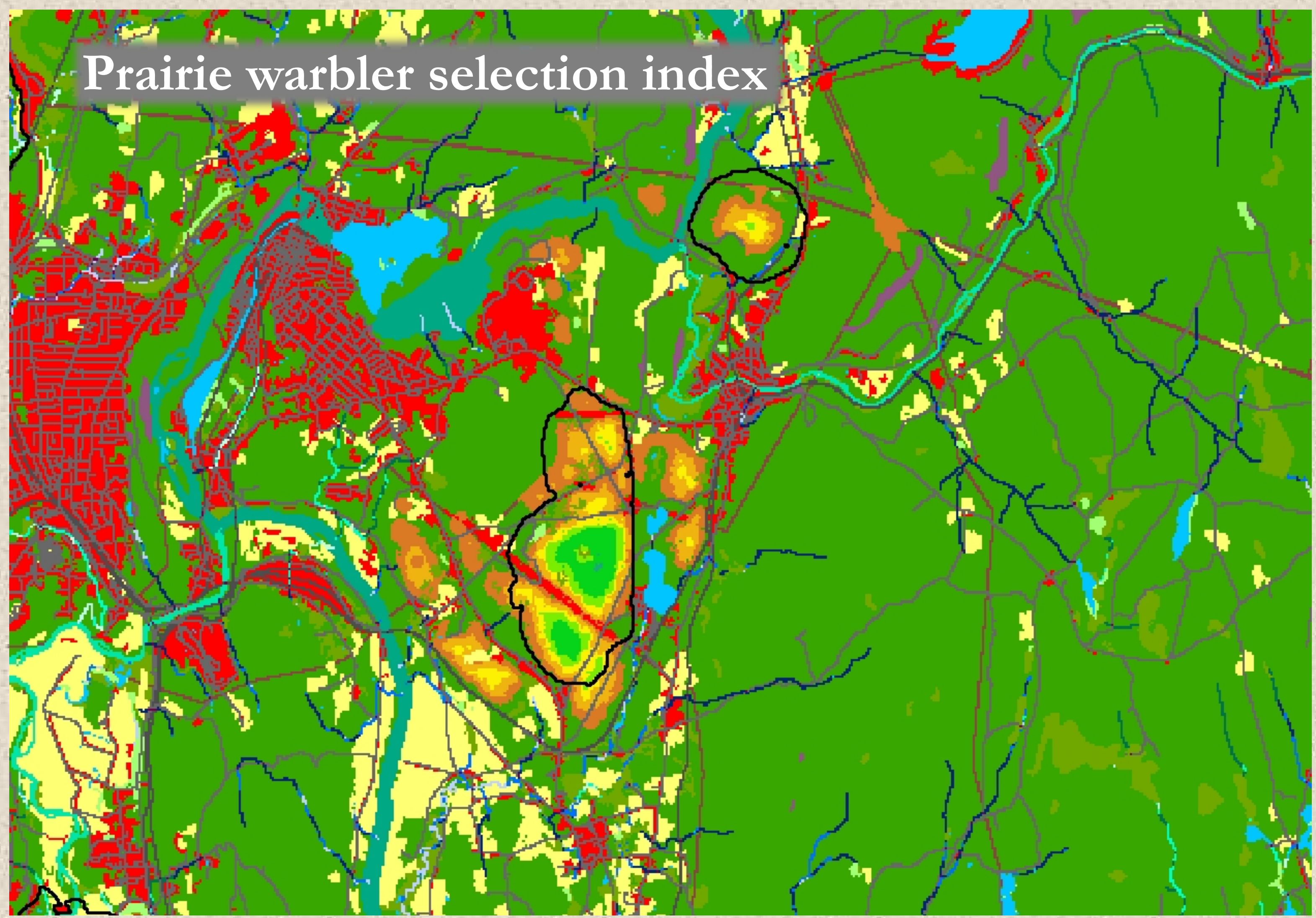

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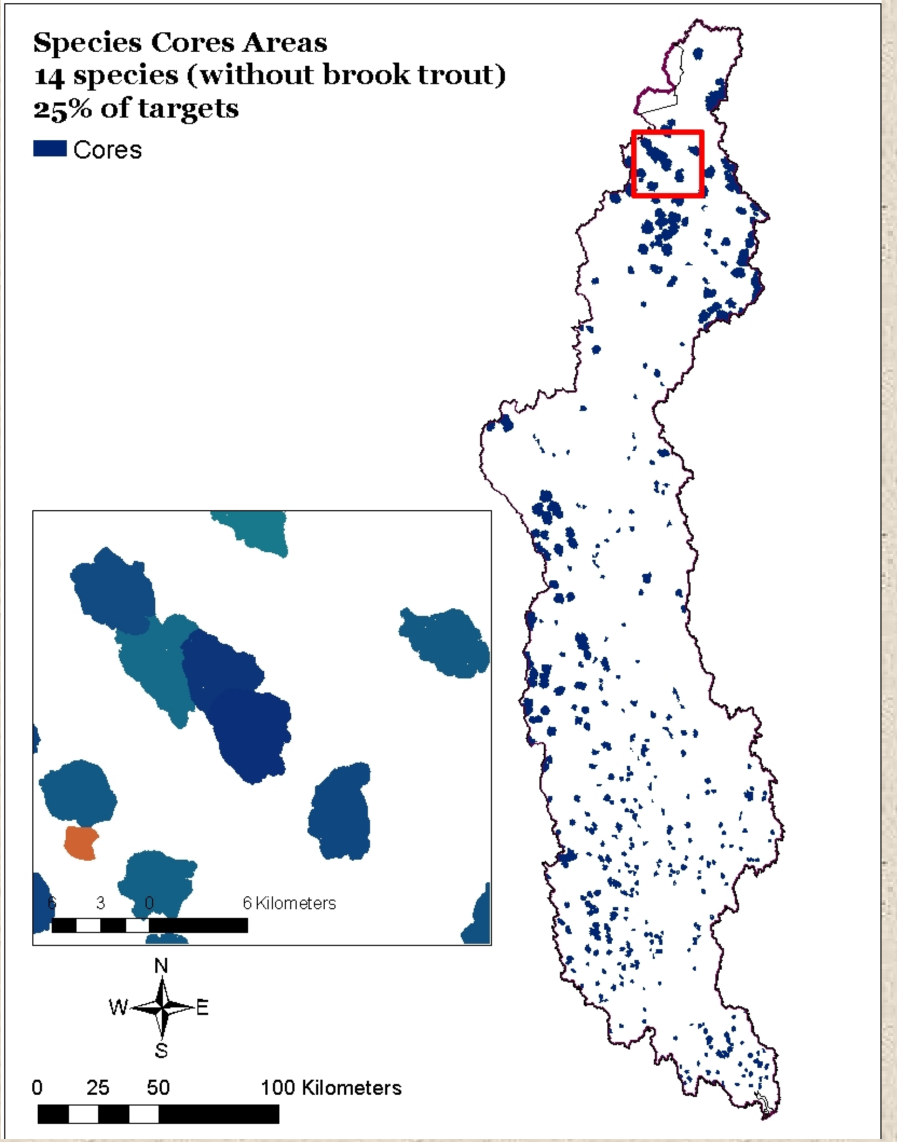
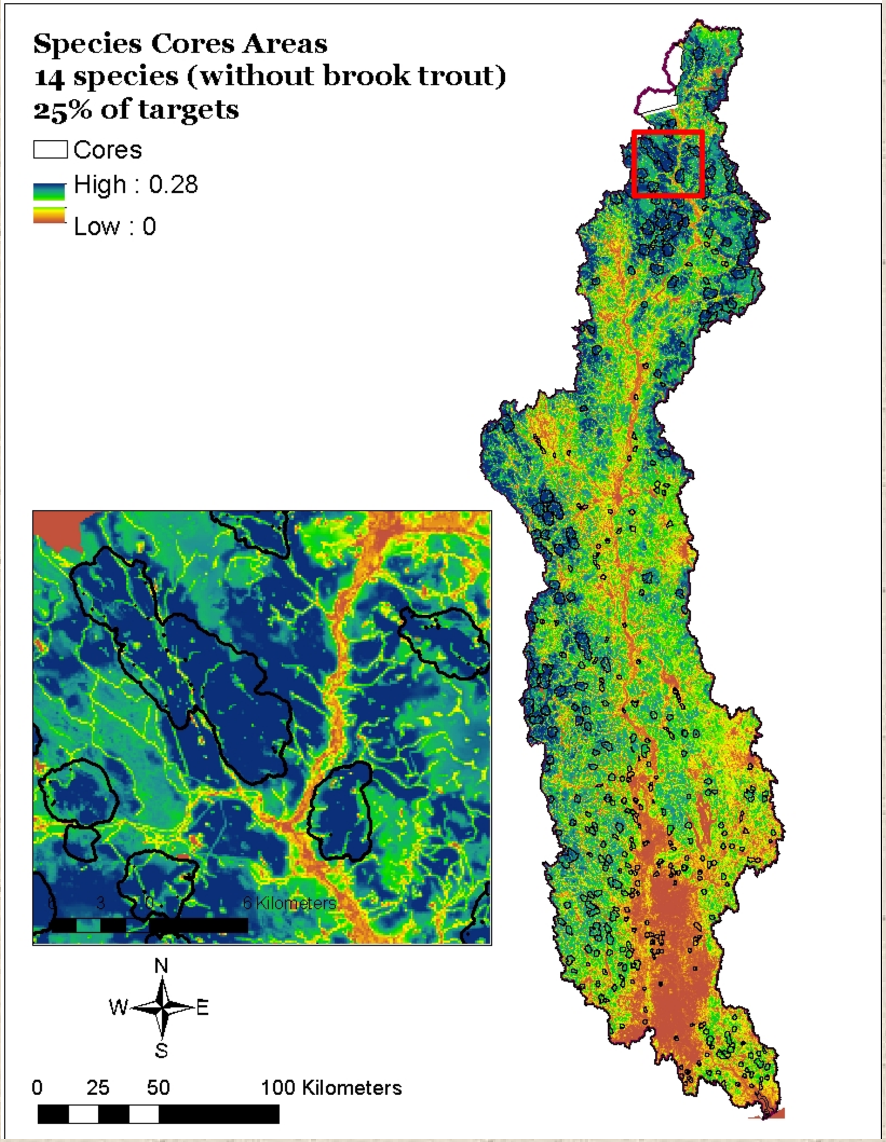
Step 2: Design Conservation Network





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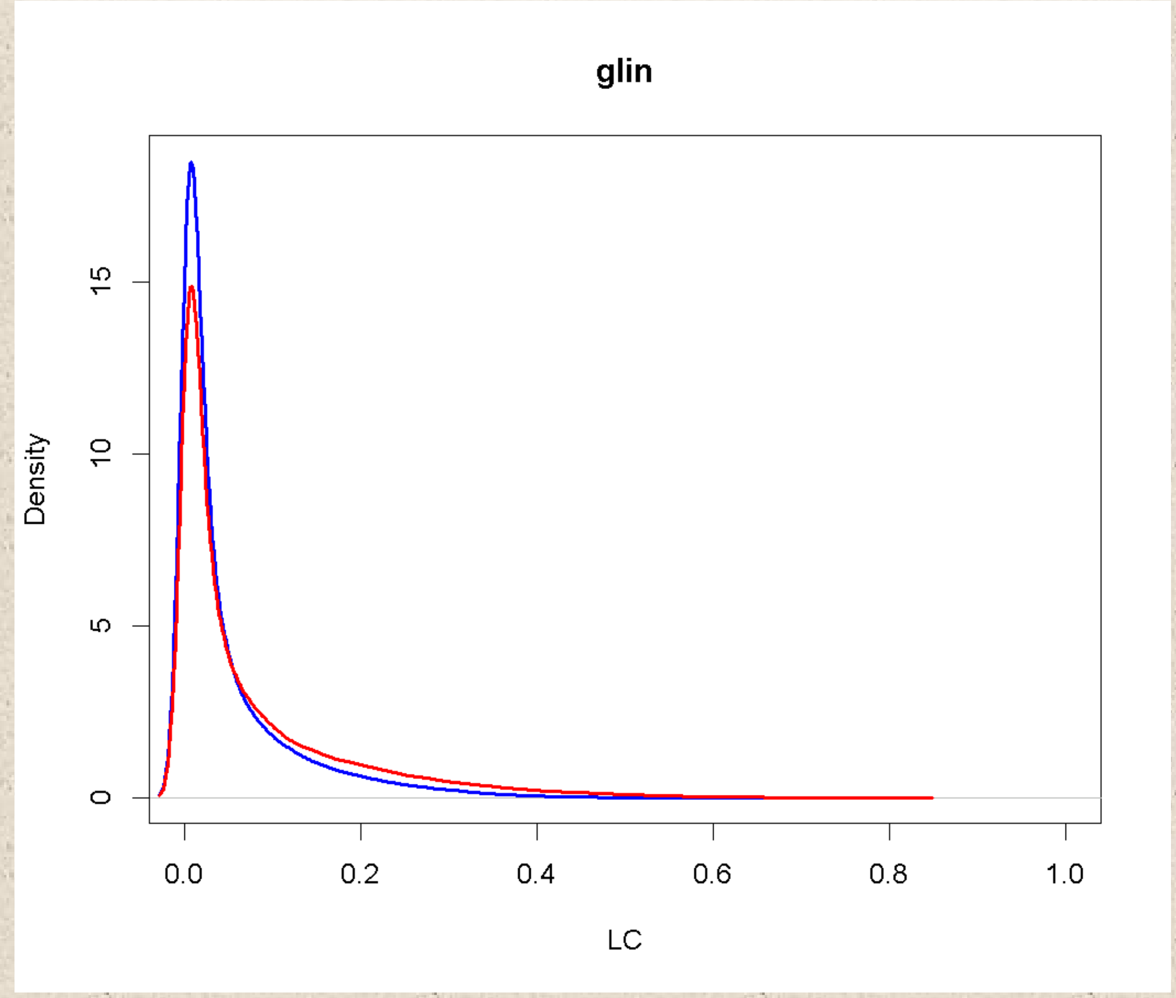
Step 2: Design Conservation Network

- Core area pseudo-optimization

  Verification of core area composition

  Landscape

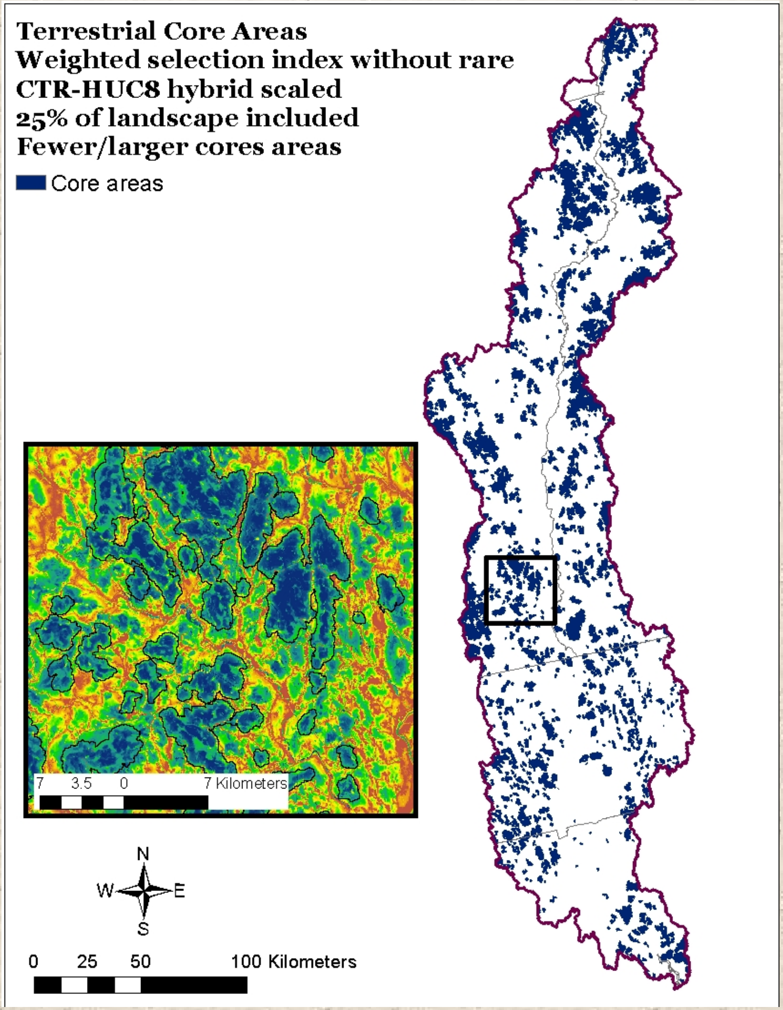
  Cores

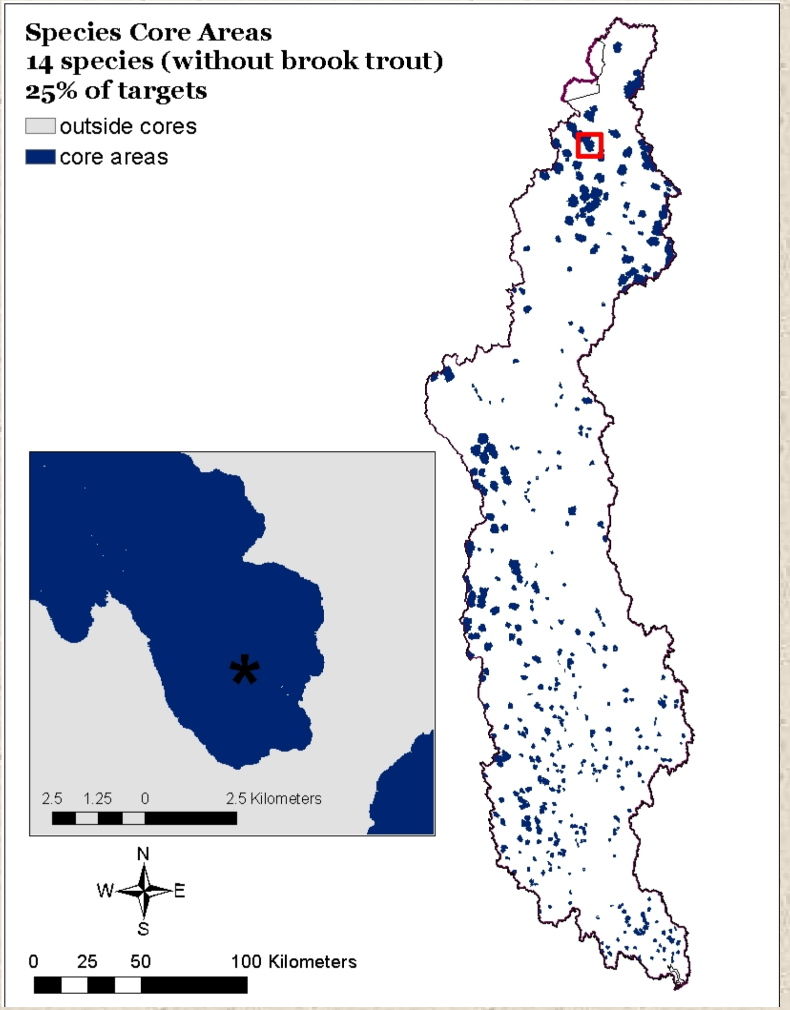


Landscape Conservation Design

Step 2: Design Conservation Network

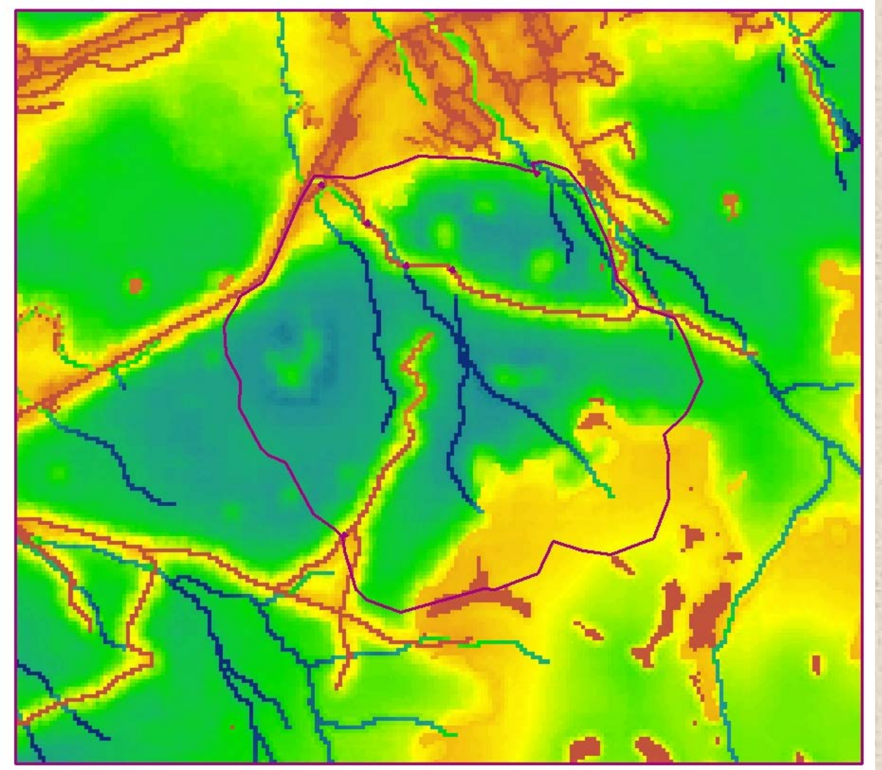
- Species-based vs ecosystem-based core areas

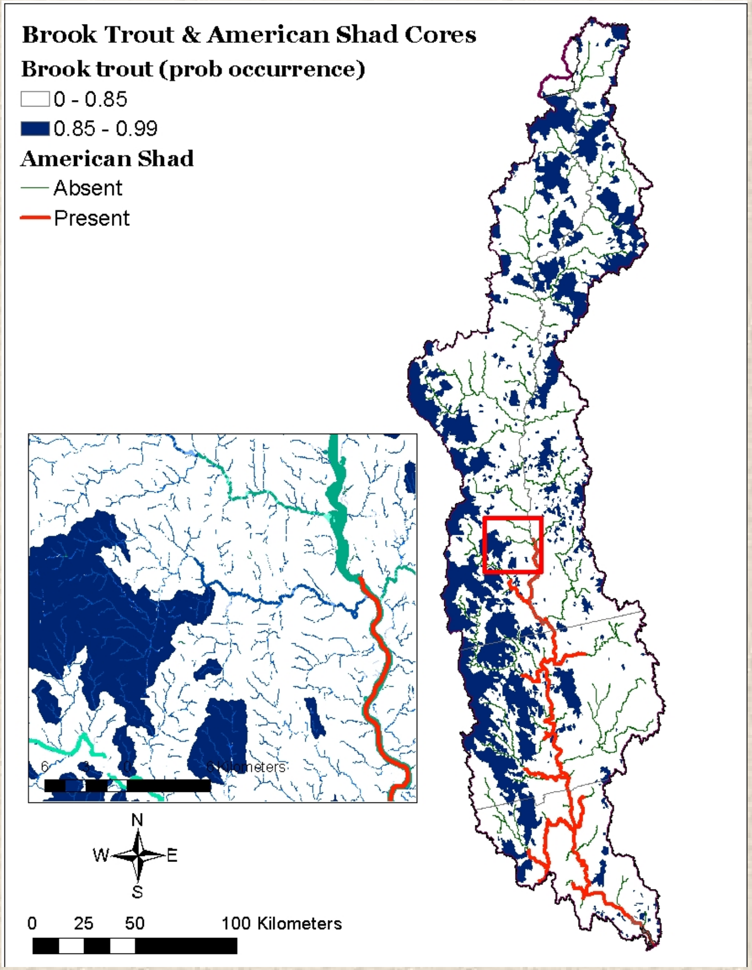




Step 2: Design Conservation Network

Q1. How to treat aquatic species?



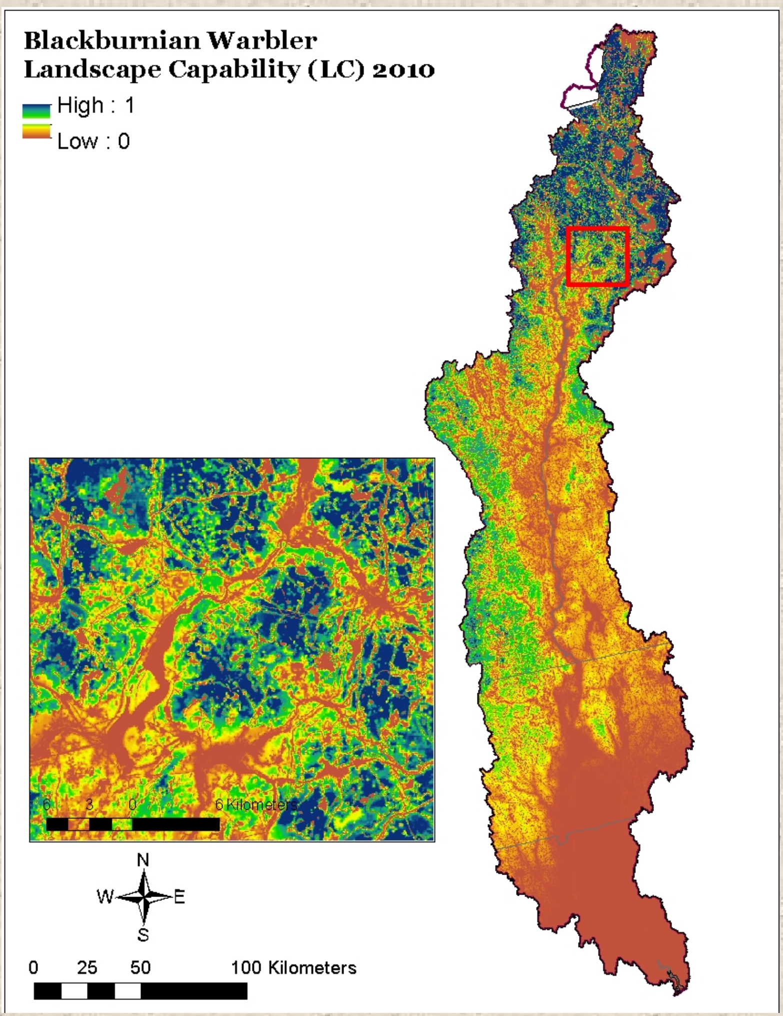


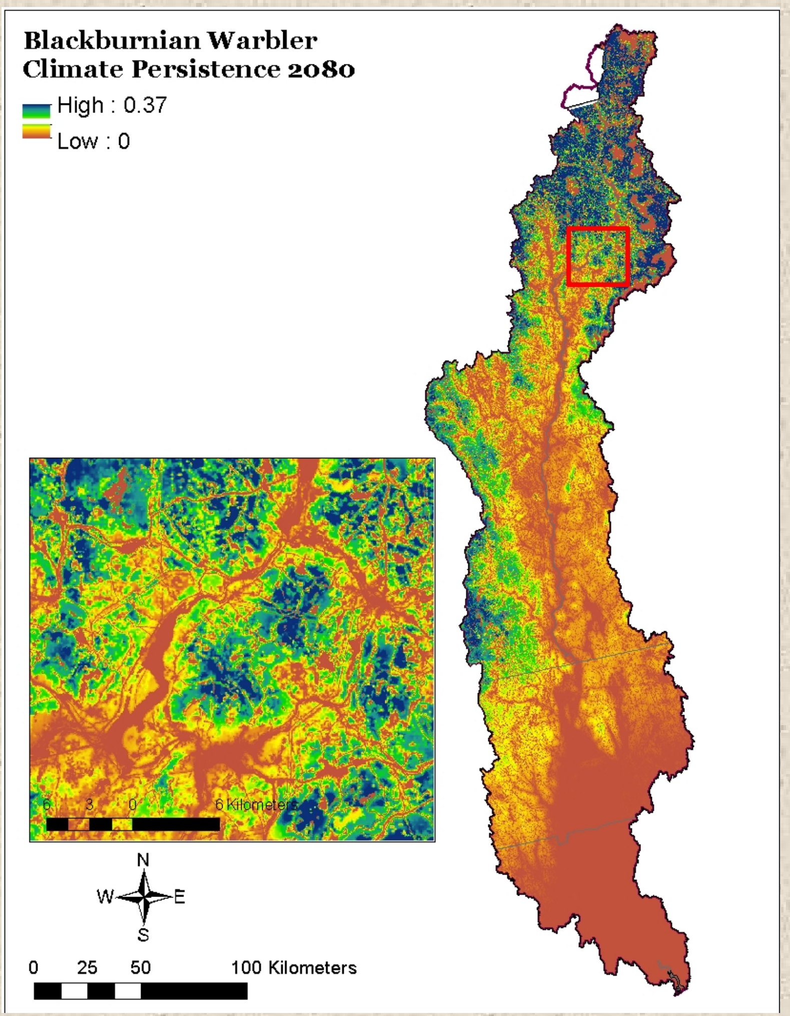
- Build brook trout cores the same way as aquatic cores?

Landscape Conservation Design

Step 2: Design Conservation Network

Q2. Which spatial product(s) to use for each species?





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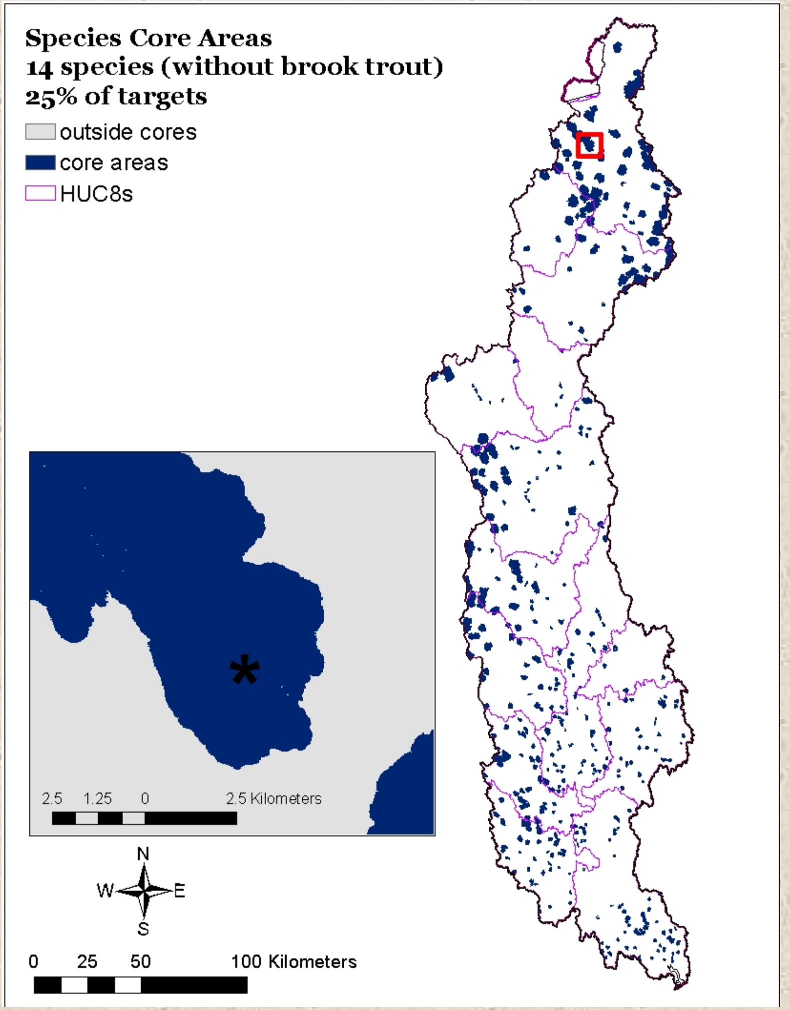
Step 2: Design Conservation Network

Q3. CTR or HUC?-based distribution of cores?

- Could build cores simultaneously within each geographic tile (e.g., HUC8) to ensure even distribution



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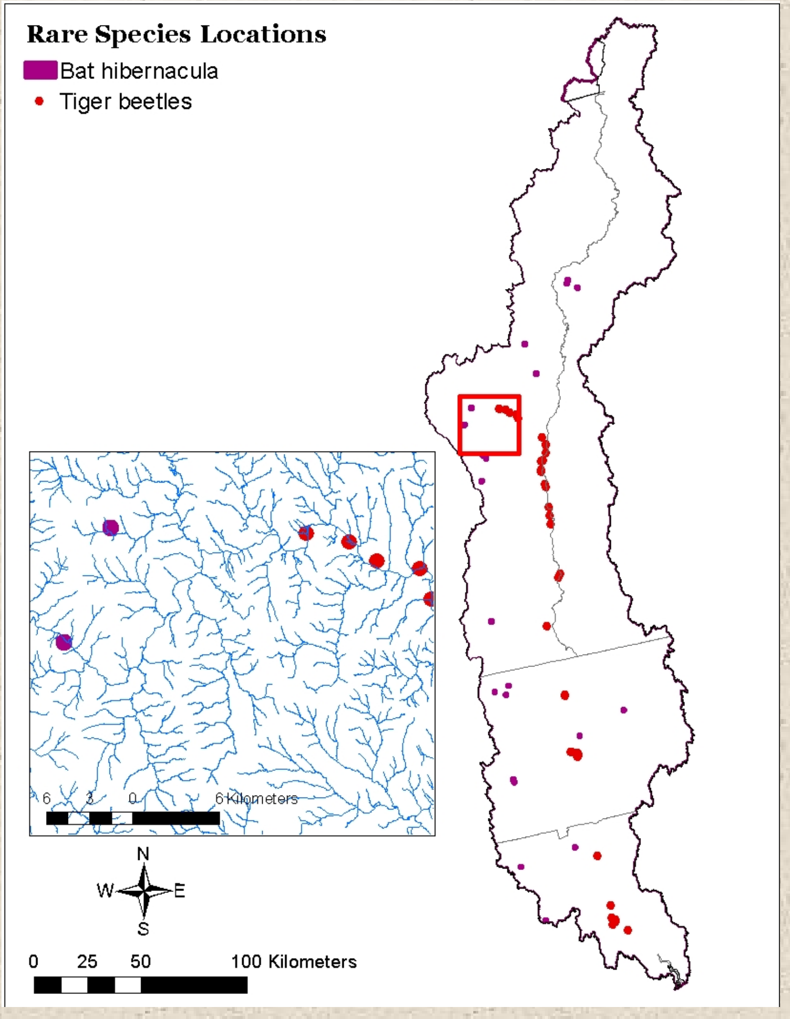
Step 2: Design Conservation Network

Q4. With or without rare species?

- Could add binary rare species grid to the selection index, target 100%, and treat like other species
- Or add rare species locations to cores post-hoc



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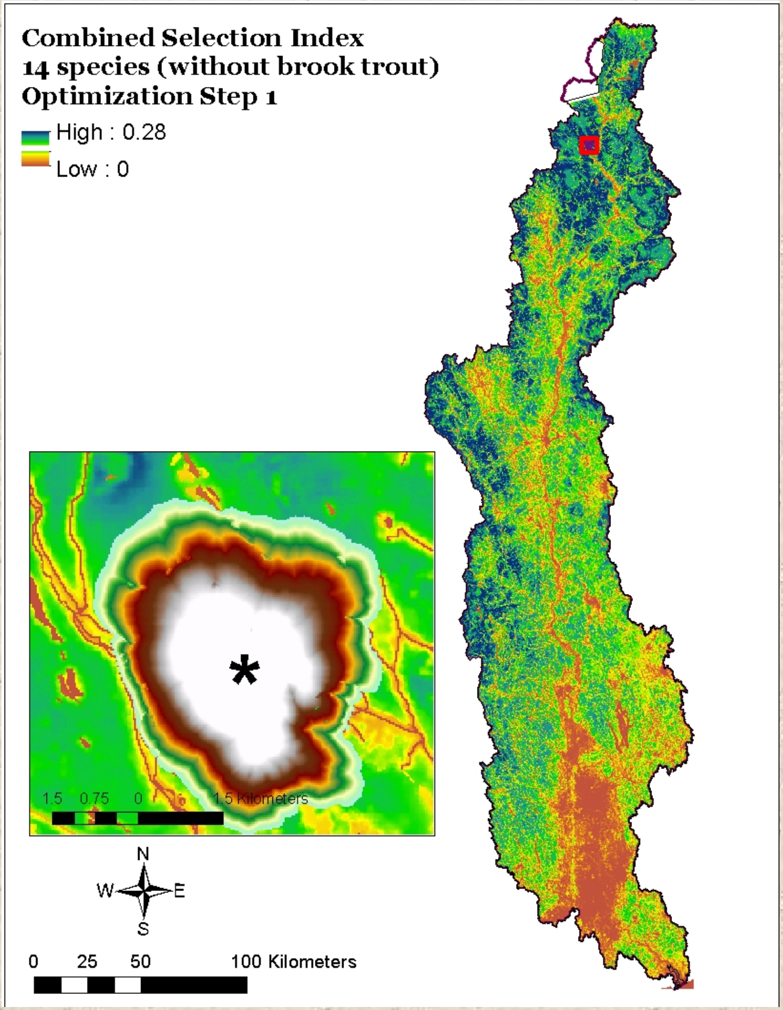
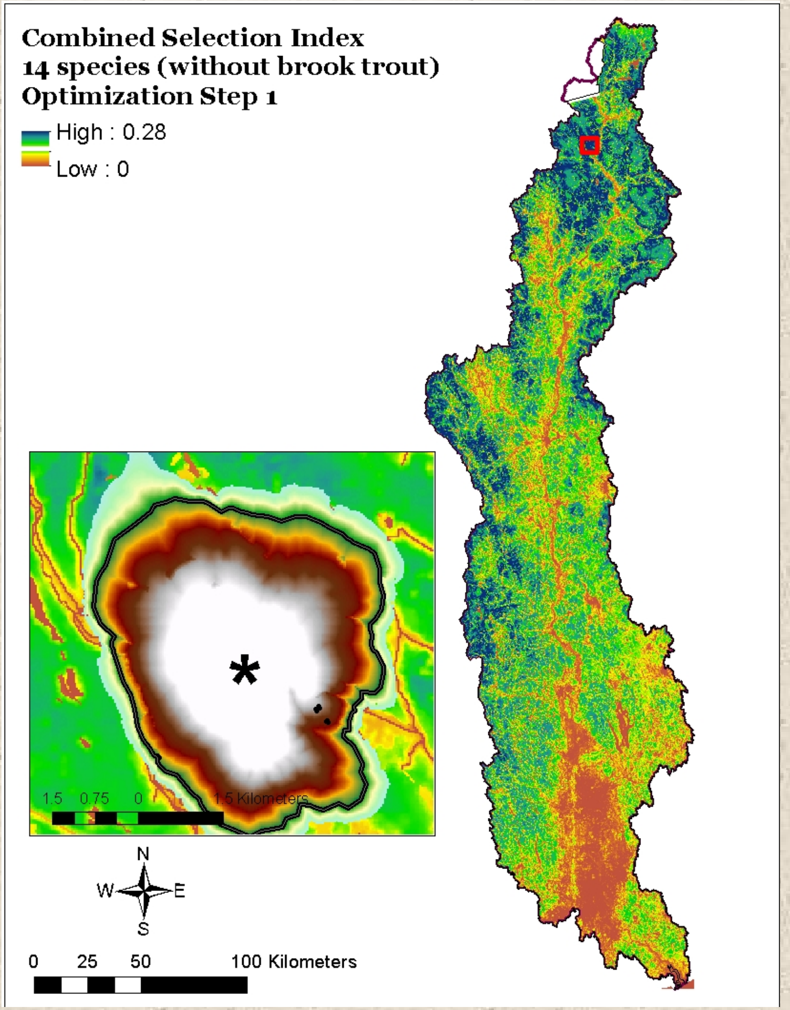
Step 2: Design Conservation Network

Q5. Fewer/larger or more smaller cores?





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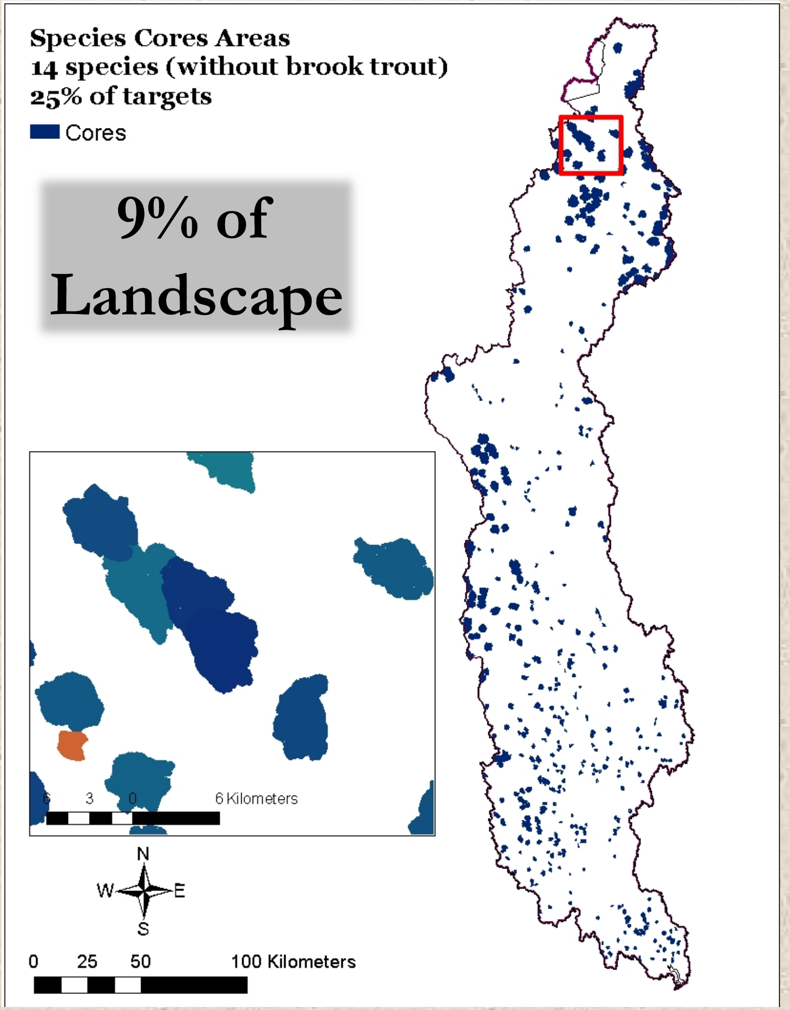
Step 2: Design Conservation Network

Q6. Meet all targets or % of landscape?

- Could build cores to meet all targets and live with the percent of the landscape in cores
- Or adjust targets downward to achieve a desired percent of the landscape in cores



Landscape Conservation Design

Step 2: Design Conservation Network

Key Decisions regarding <u>species-based</u> core areas:

- How to treat brook trout and other aquatic species?
- Which spatial products to use and how to weight them?
- CTR vs HUC8 vs other distribution?
- With or without rare species?
- Fewer/larger vs more smaller?
- Meet all targets or % of landscape to include?

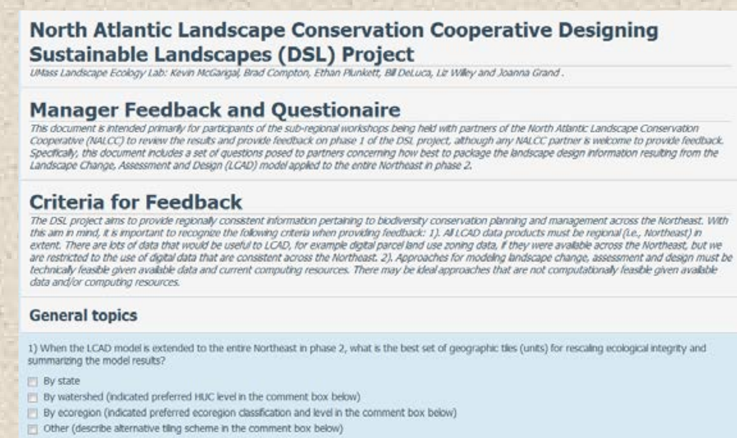
For More Information

- Project website:

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

Feedback:

- Manager online survey


North Atlantic Landscape Conservation Cooperative Designing Sustainable Landscapes (DSL) Project

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Manager Feedback and Questionaire

This document is intended primarily for participants of the sub-regional workshops being held with partners of the North Atlantic Landscape Conservation Cooperative (NALCC) to review the results and provide feedback on phase 1 of the DSL project, although any NALCC partner is welcome to provide feedback. Specifically, this document includes a set of questions posed to partners concerning how best to package the landscape design information resulting from the Landscape Change, Assessment and Design (LCAD) model applied to the entire Northeast in phase 2.

Criteria for Feedback

The DSL project aims to provide regionally consistent information pertaining to biodiversity conservation planning and management across the Northeast. With this aim in mind, it is important to recognize the following criteria when providing feedback: 1). All LCAD data products must be regional (i.e., Northeast) in extent. There are lots of data that would be useful to LCAD, for example digital parcel land use zoning data, if they were available across the Northeast, but we are restricted to the use of digital data that are consistent across the Northeast. 2). Approaches for modeling landscape change, assessment and design must be technically feasible given available data and current computing resources. There may be ideal approaches that are not computationally feasible given available data and/or computing resources.

General topics

1) When the LCAD model is extended to the entire Northeast in phase 2, what is the best set of geographic tiles (units) for rescaling ecological integrity and summarizing the model results?

- ☐ By state
- ☐ By watershed (indicated preferred HUC level in the comment box below)
- ☐ By ecoregion (indicated preferred ecoregion classification and level in the comment box below)
- ☐ Other (describe alternative tiling scheme in the comment box below)

Links to products:

- Overview
- Technical docs
- Presentations
- Results

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