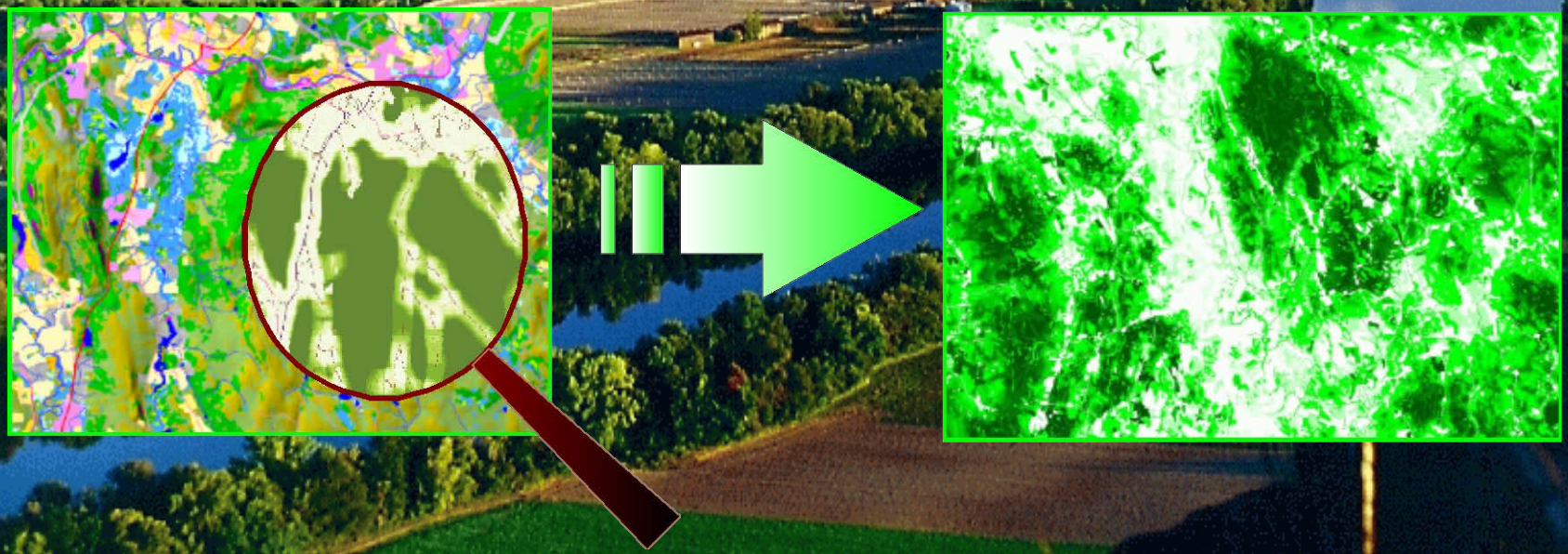
Designing Sustainable Landscapes in the Northeast

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

Landscape Conservation Design

October 31, 2014



Conservation Design Scenarios

1. Ecosystem approach… based solely on ecosystem conditions

2. Species approach… based solely on focal species considerations

3. Combined ecosystem-species approach… based on the complement of ecosystems and focal species

Conservation Design Components

- **Cores areas…** areas of (persistent) high ecological integrity or species landscape capability
- **Connectors…** areas important to the connectivity of the core areas
- **Restoration & management opportunities…** areas with high restoration or management potential
- **Conservation overlays…** areas with high conservation value for other special reasons

Illustrated below for the species scenario

Core Areas

- **Cores areas…** areas of (persistent) high ecological integrity or species landscape capability
  - **Ecological integrity…** gradients of integrity
  - **Species landscape capability…** gradients of landscape capability
  - **Vulnerability…** gradients in vulnerability to loss of local connectivity due to development
  - **Core area prioritization…** core area importance to regional connectivity
  - **Core area composition…** ecological systems and species' landscape capability

Core Areas

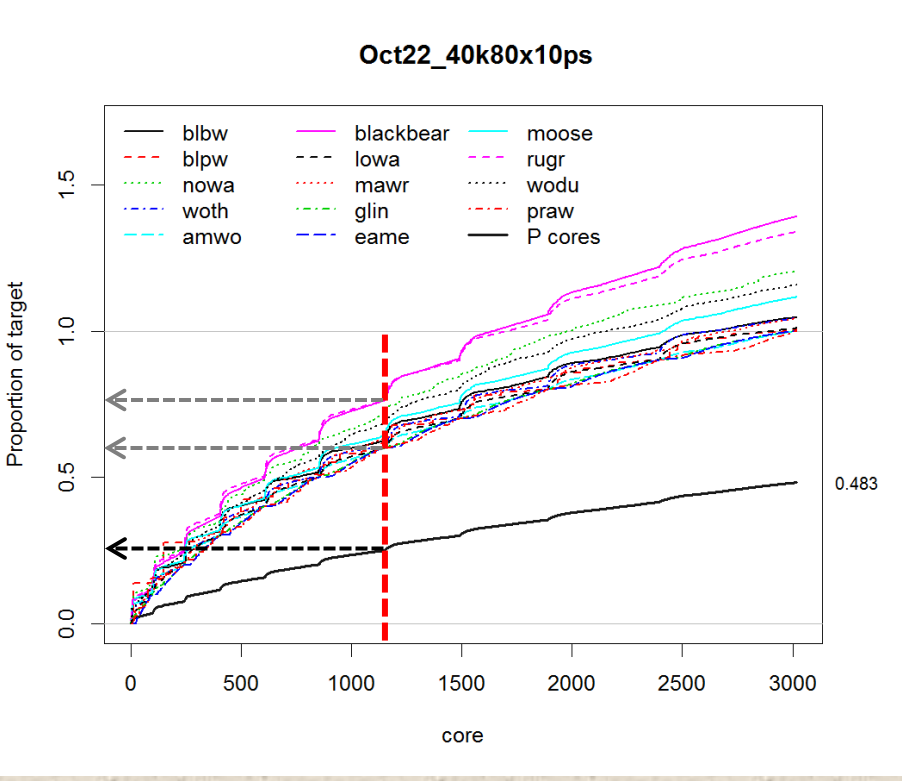
Methods (key decisions)

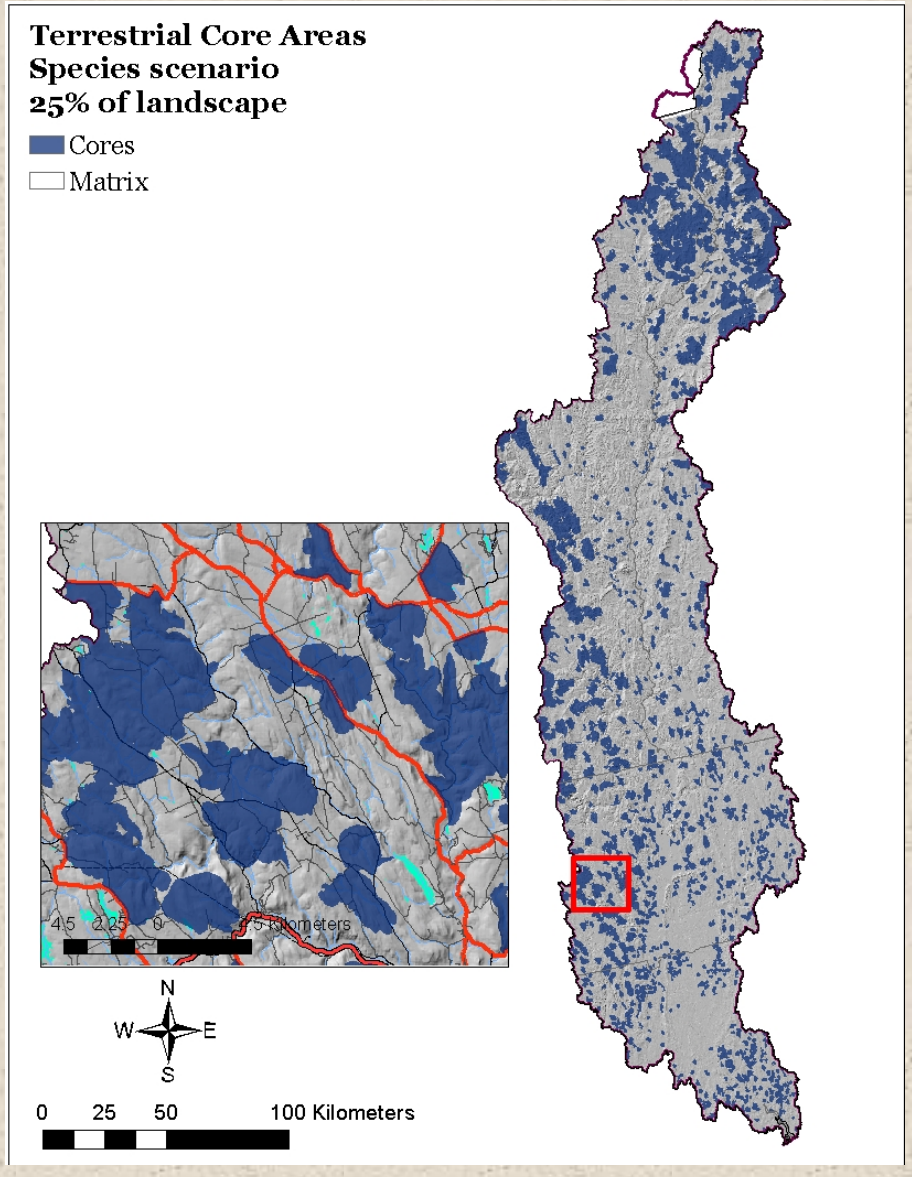
- **Terrestrial cores:**
  - **<u>Ecosystem-based</u>:**
    - ✓Weighted selection index
    - ✓Tier 1 floodplains, but not rare communities
    - ✓CTR scale*
    - ✓Fewer/larger cores
    - ✓Min ~10 acres
    - ✓25% of landscape
  - **<u>Species-based</u>:**
    - ✓Weighted species targets
    - ✓No rare species
    - ✓CTR scale
    - ✓Fewer/larger cores
    - ✓25% of landscape

***Still undecided as to the best scaling/weighting scheme to use**

Core Areas

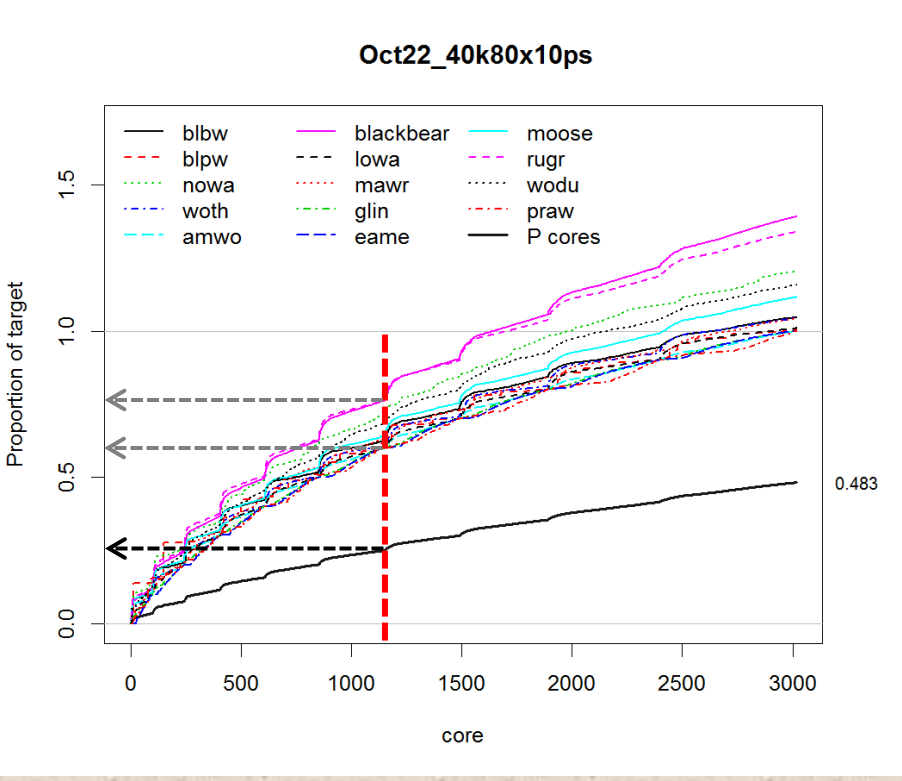
Terrestrial core area network

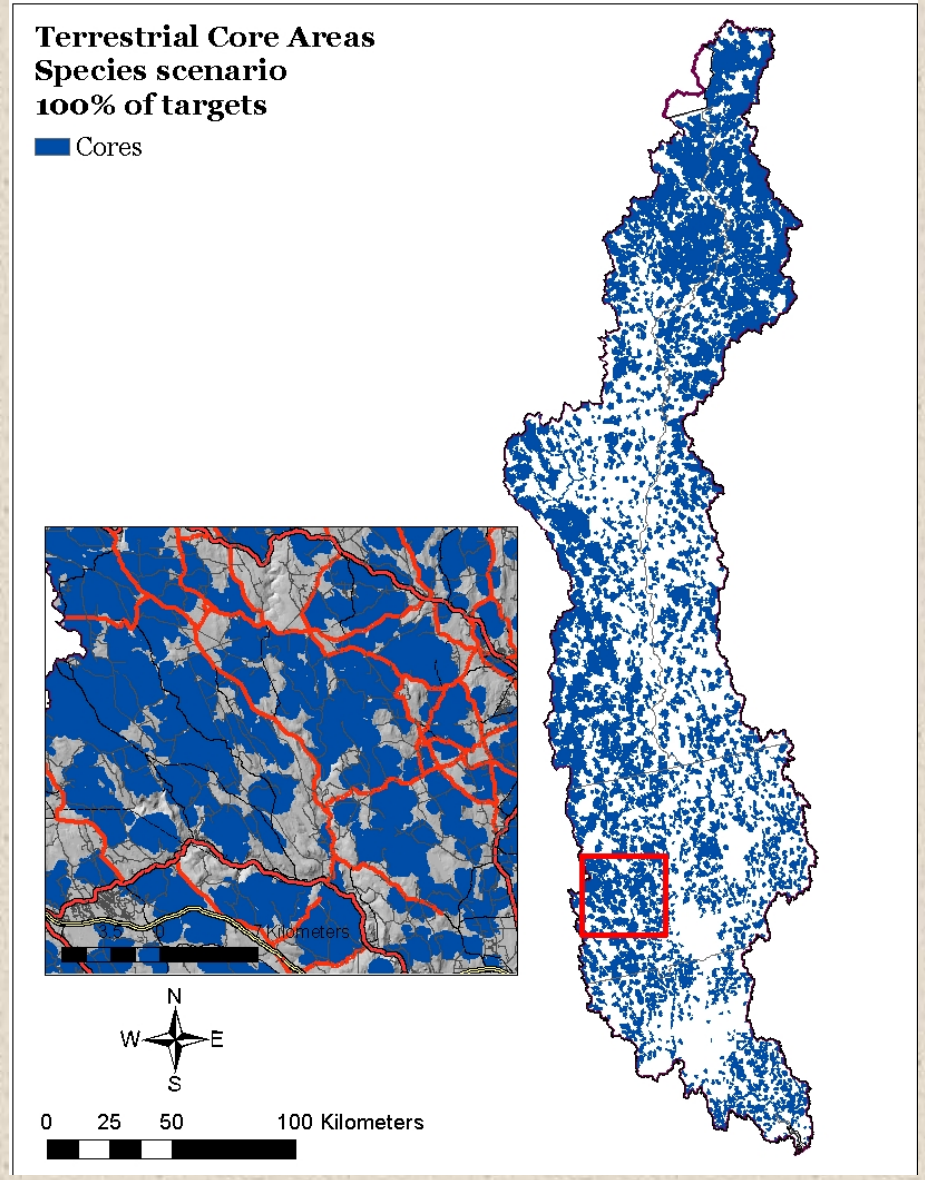




Core Areas

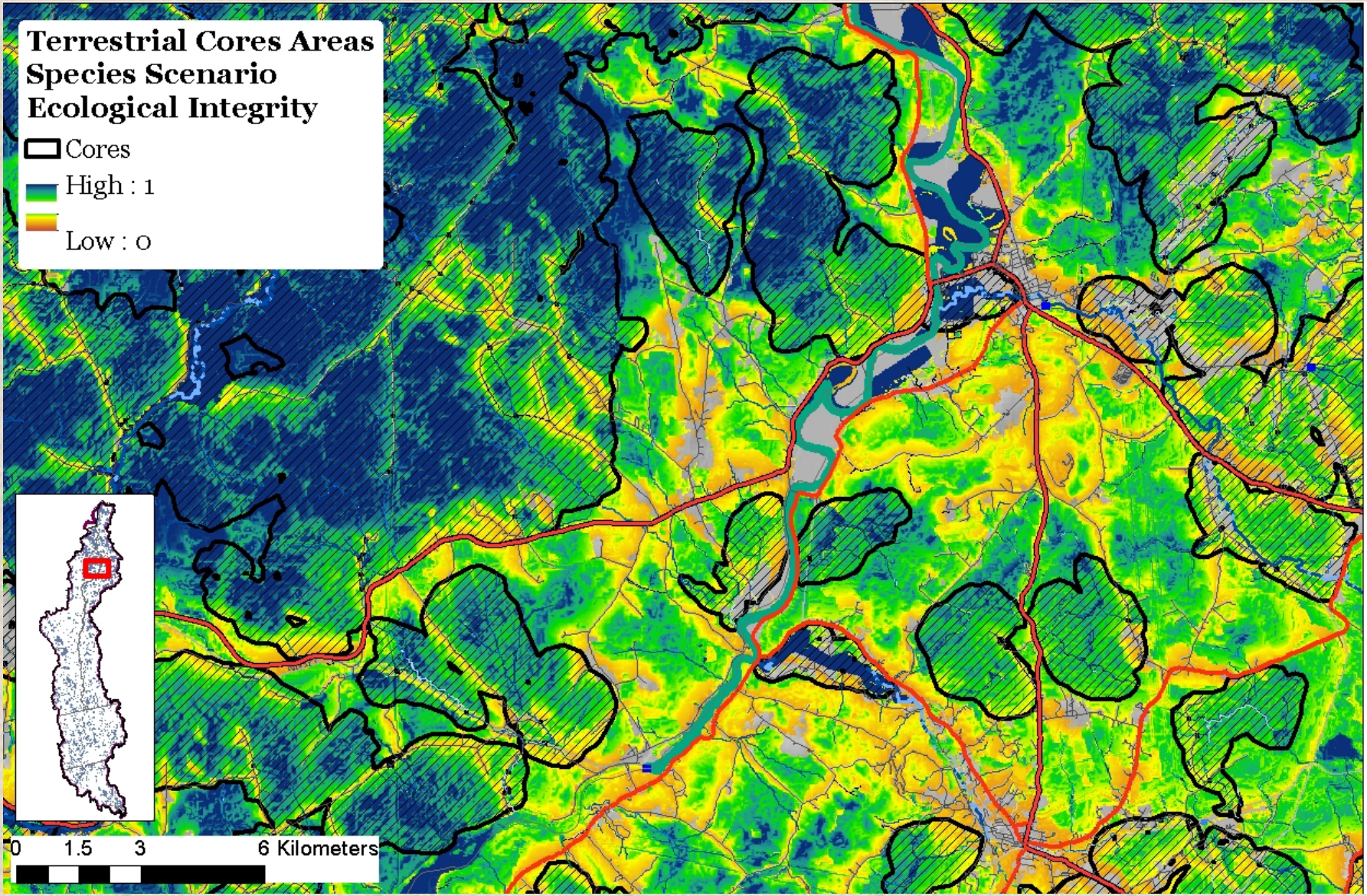
Terrestrial core area network





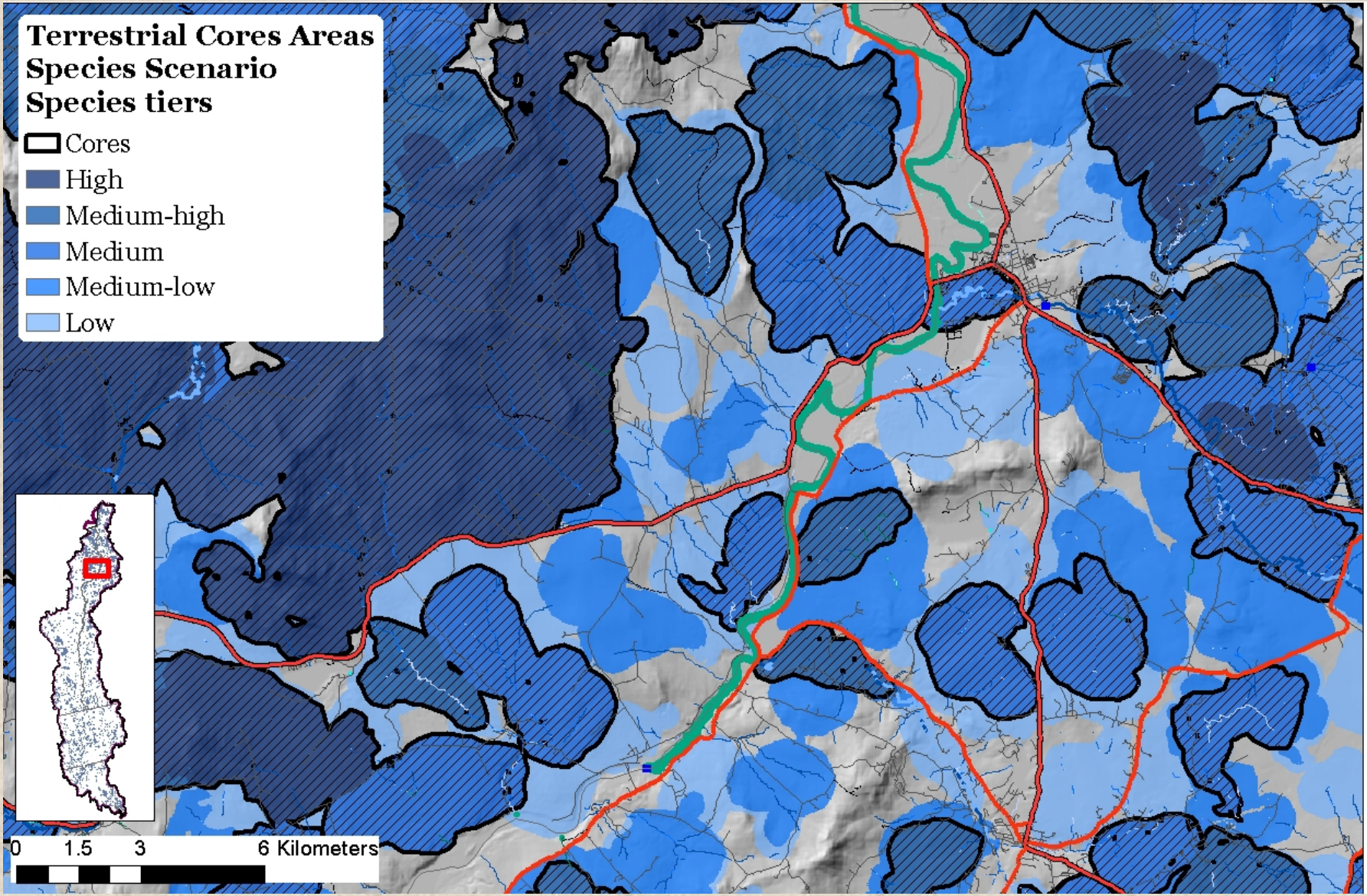
Core Areas

Ecological integrity gradients



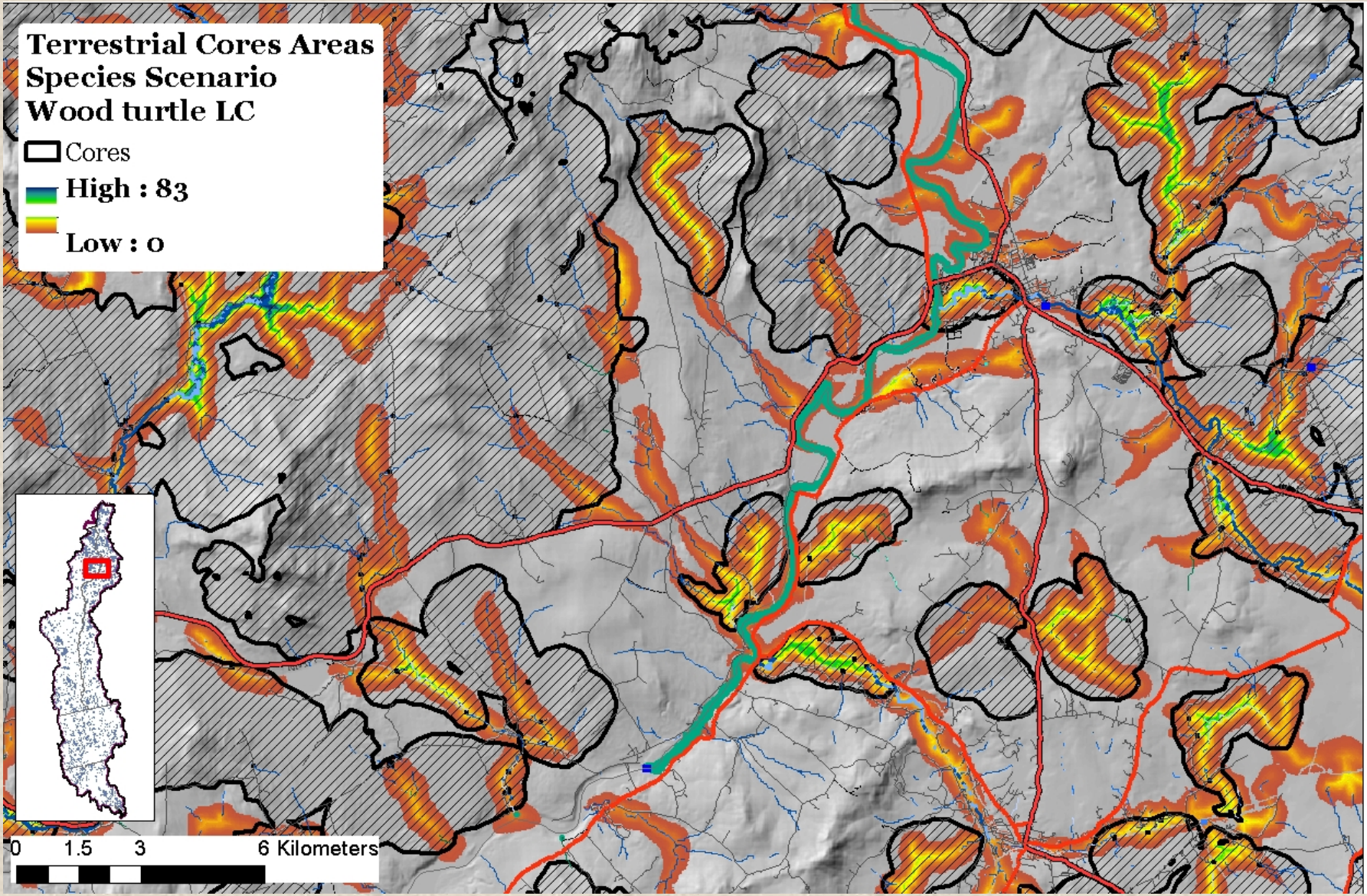
Core Areas

Species tiers



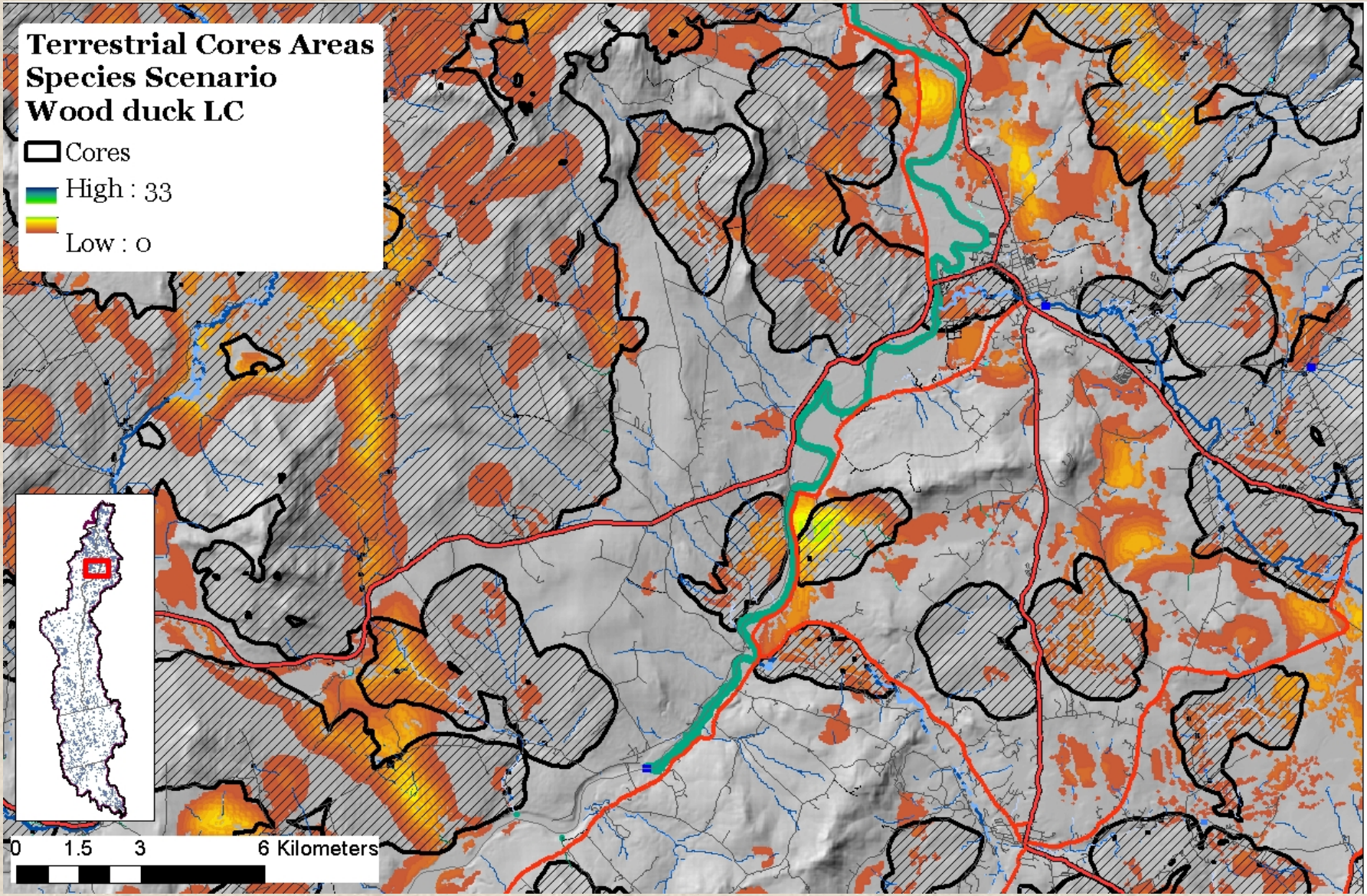
Core Areas

Species landscape capability gradients



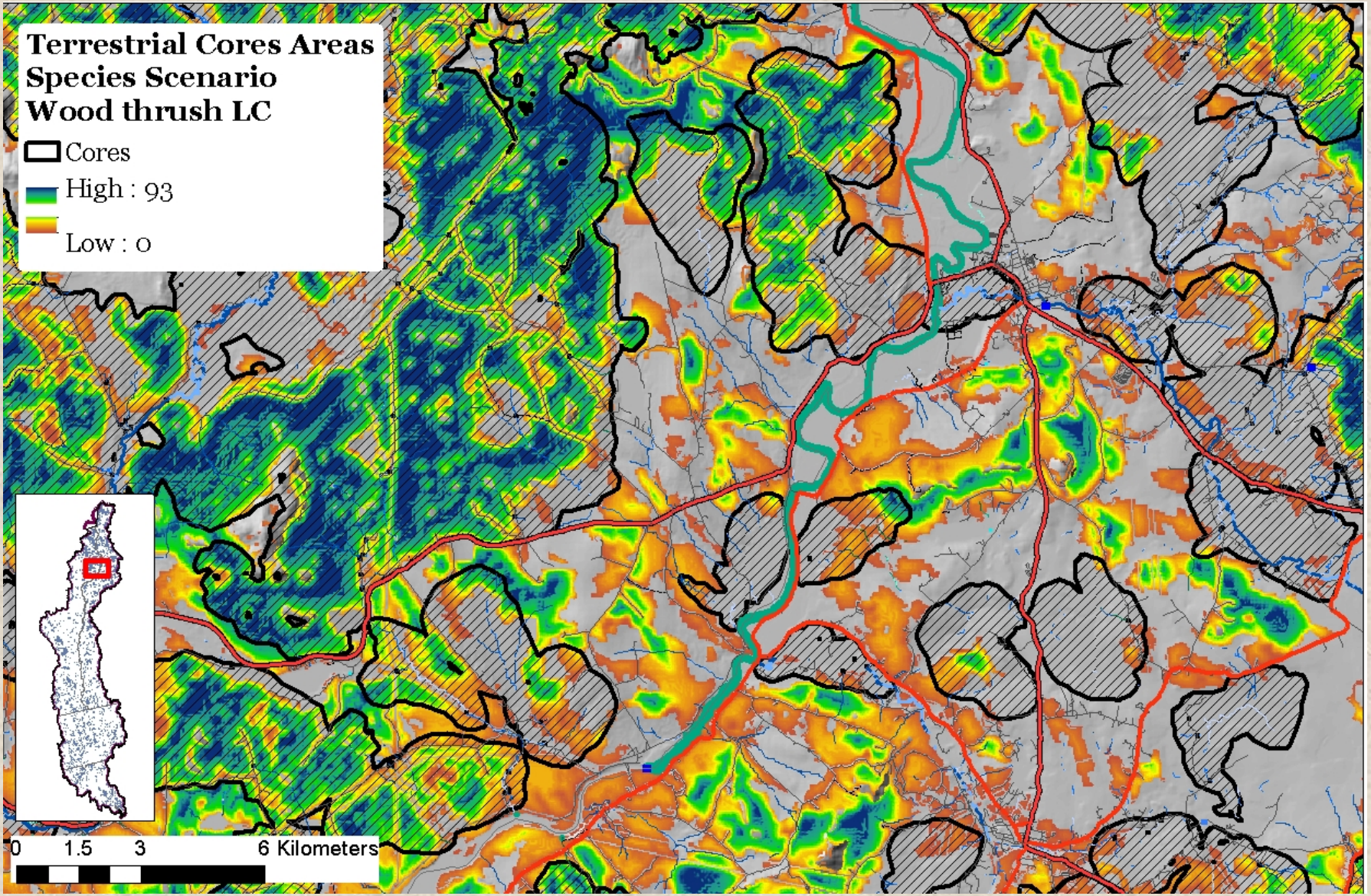
Core Areas

Species landscape capability gradients



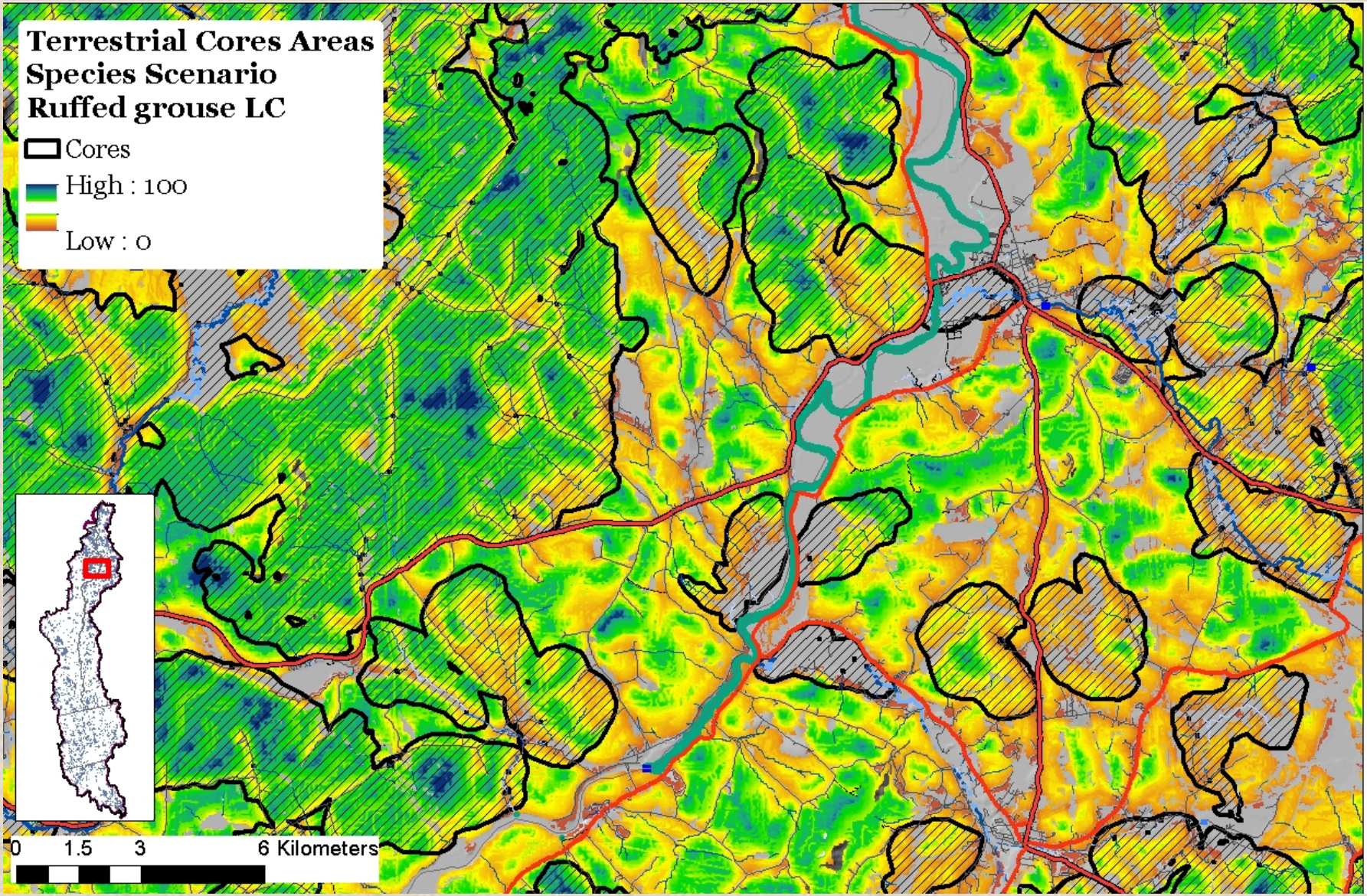
Core Areas

Species landscape capability gradients



Core Areas

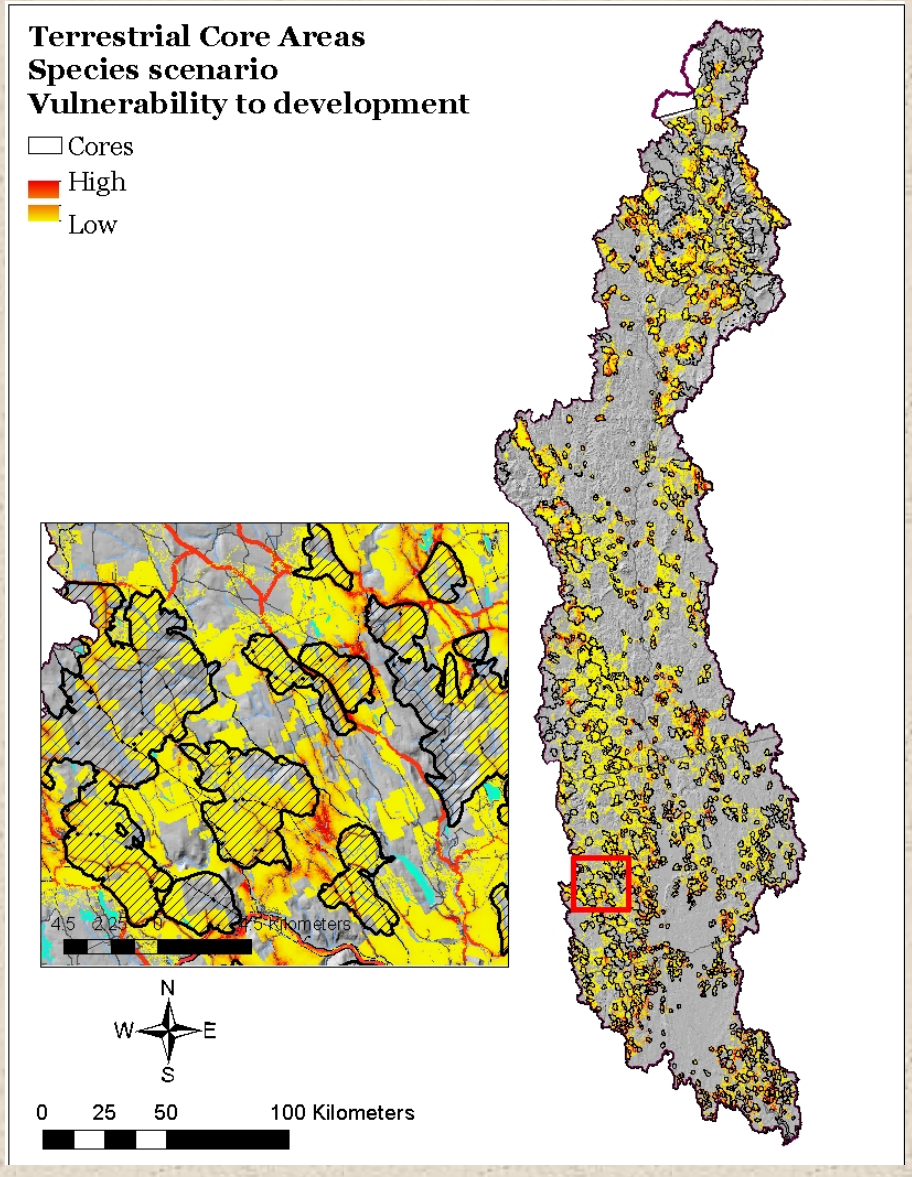
Species landscape capability gradients



Core Areas

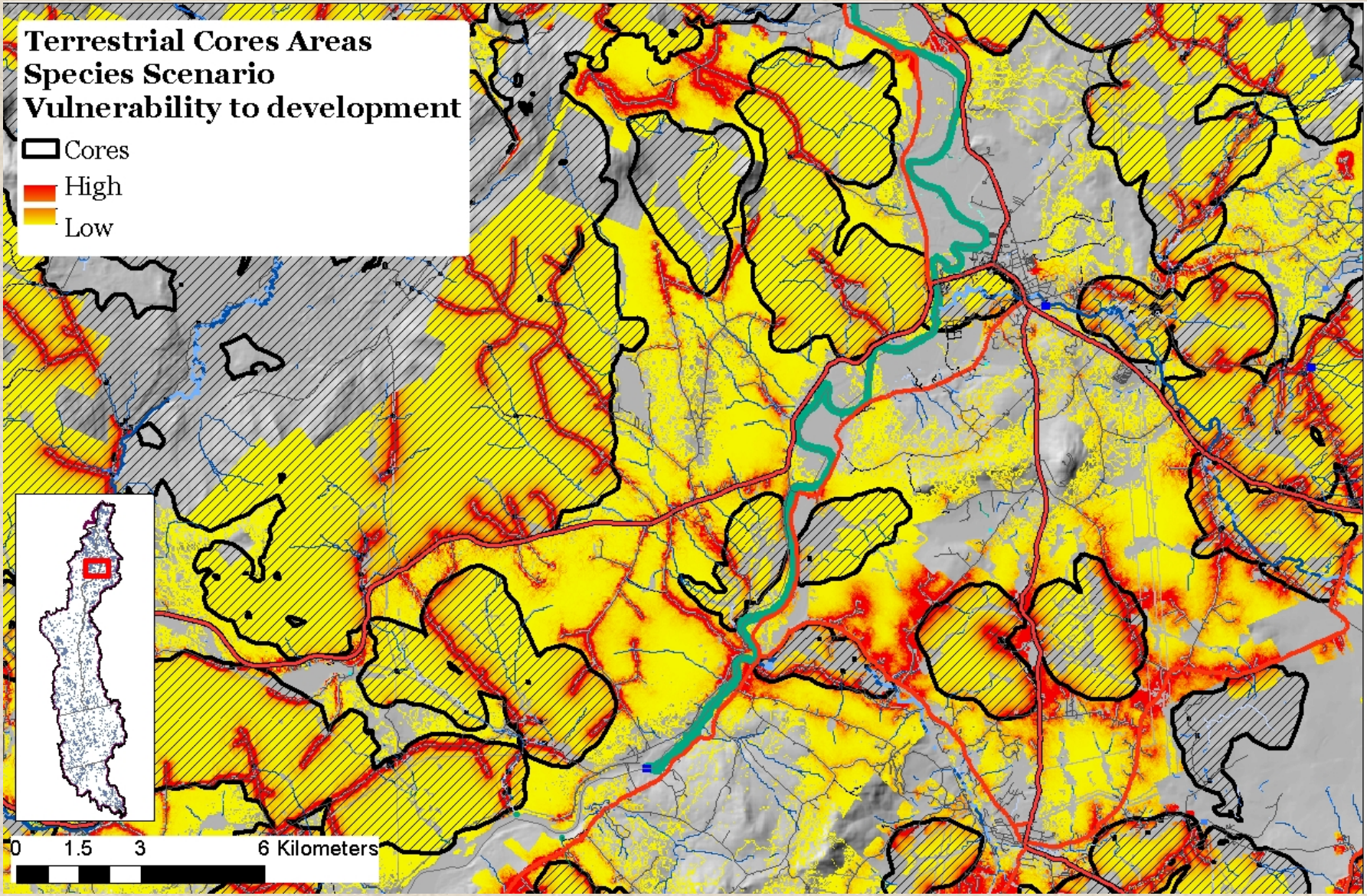
Vulnerability to development

- Relative probability of developing:
  - A cell with high local conductance within a core



Core Areas

Vulnerability to development

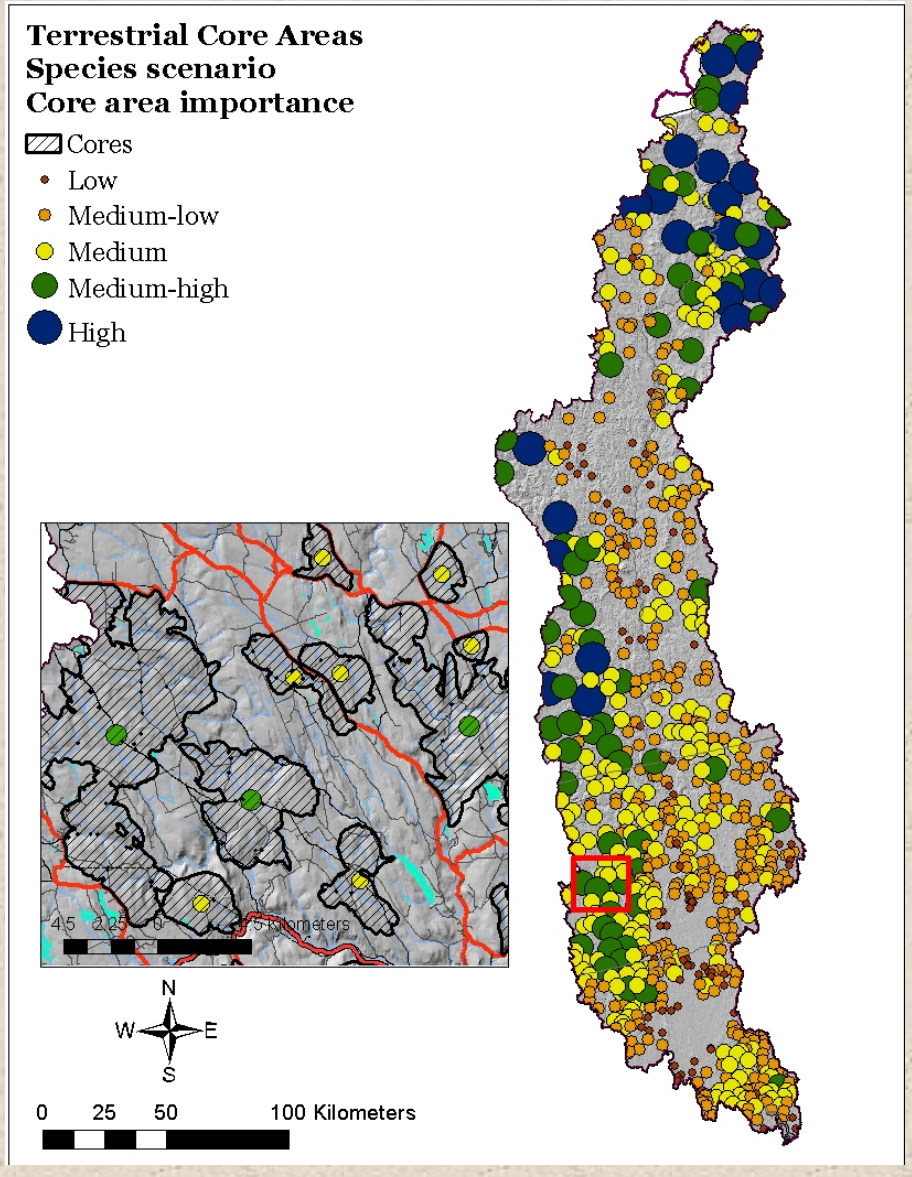


Core Areas

Terrestrial core area prioritization

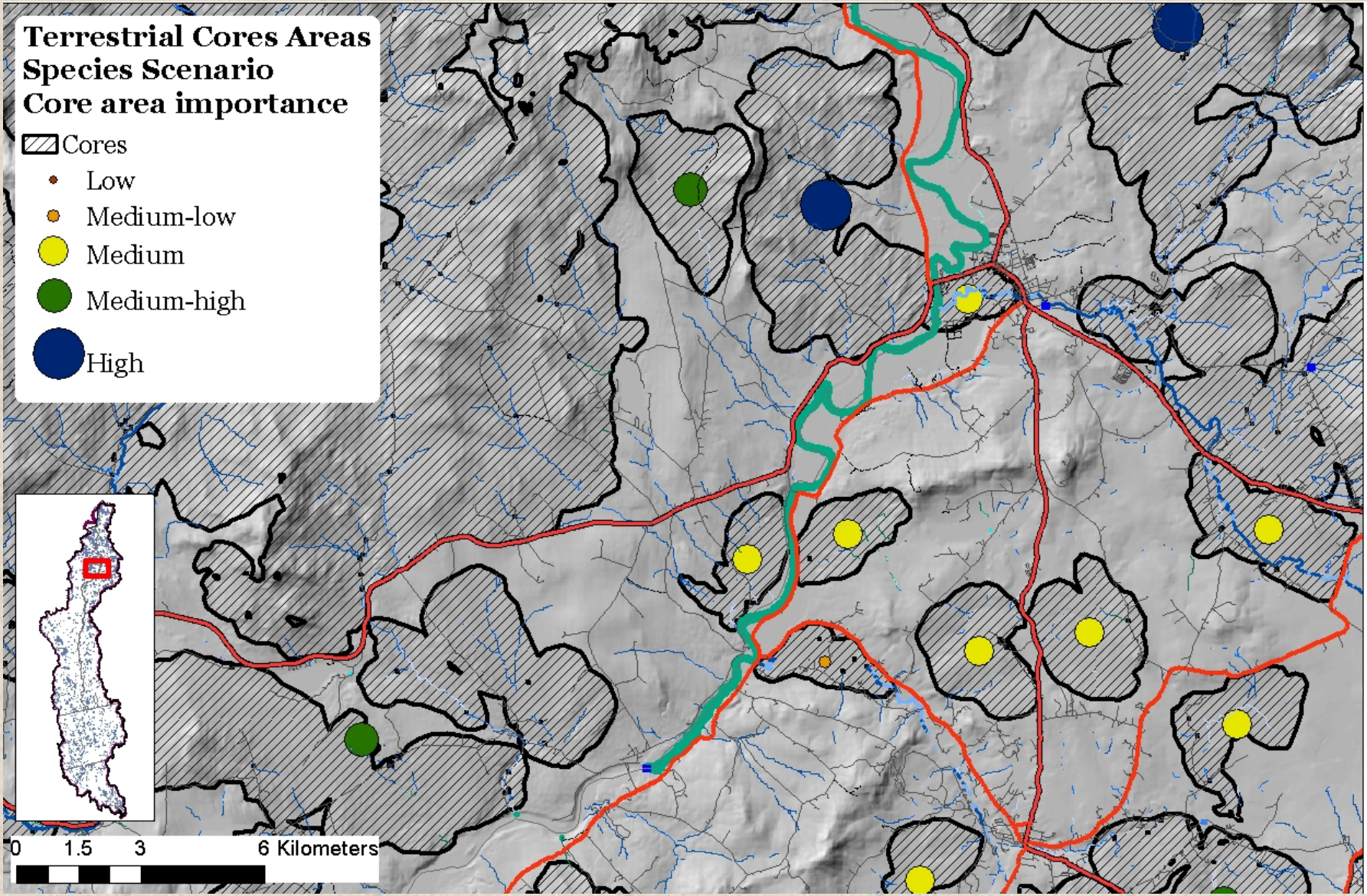
- Relative importance of each core to the regional connectivity of the core area network

Based on the network Probability of Connectivity (PC) metric (Saura and Pascual-Hortal 2007)



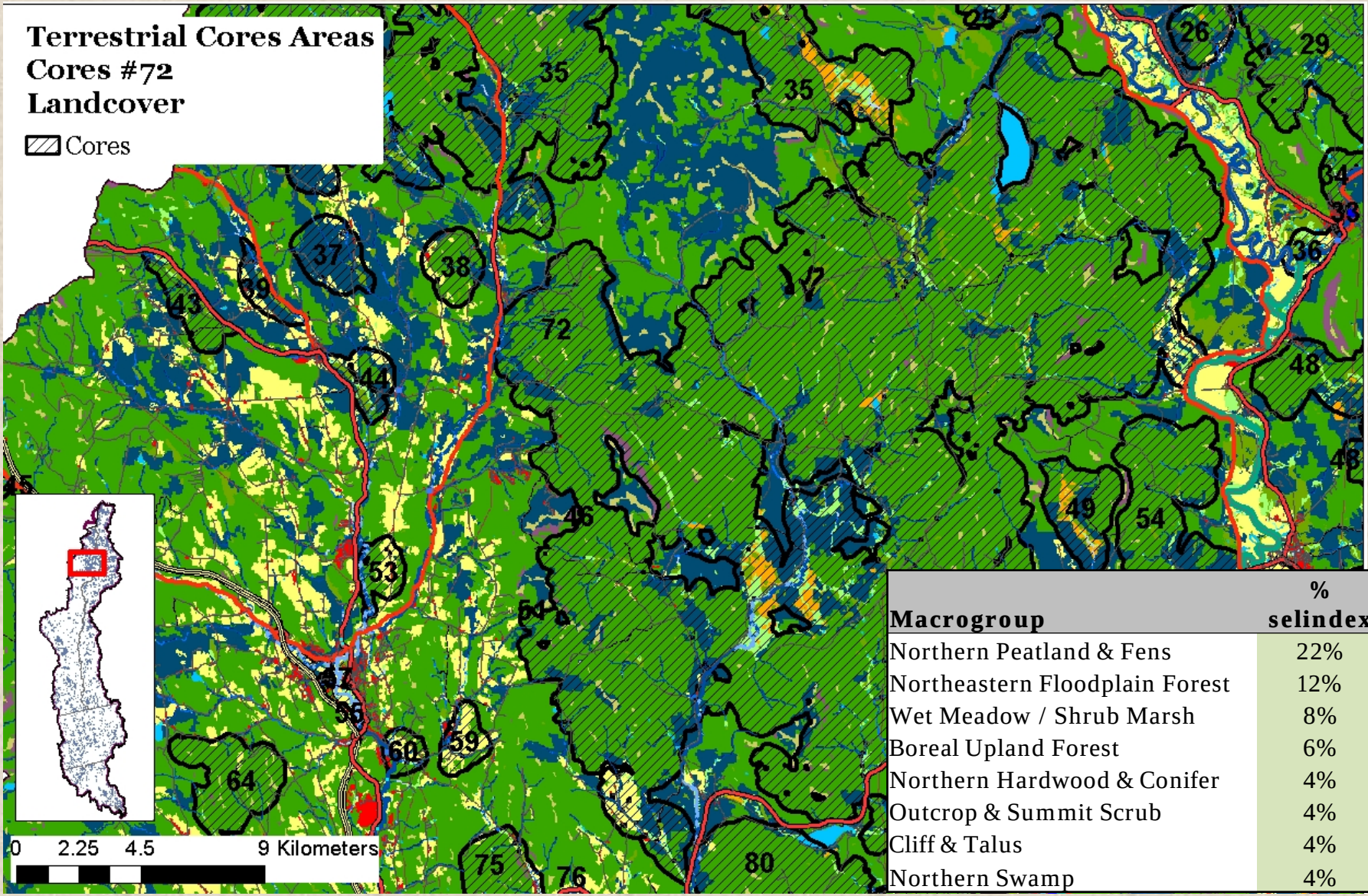
Core Areas

Terrestrial core area prioritization



Core Areas

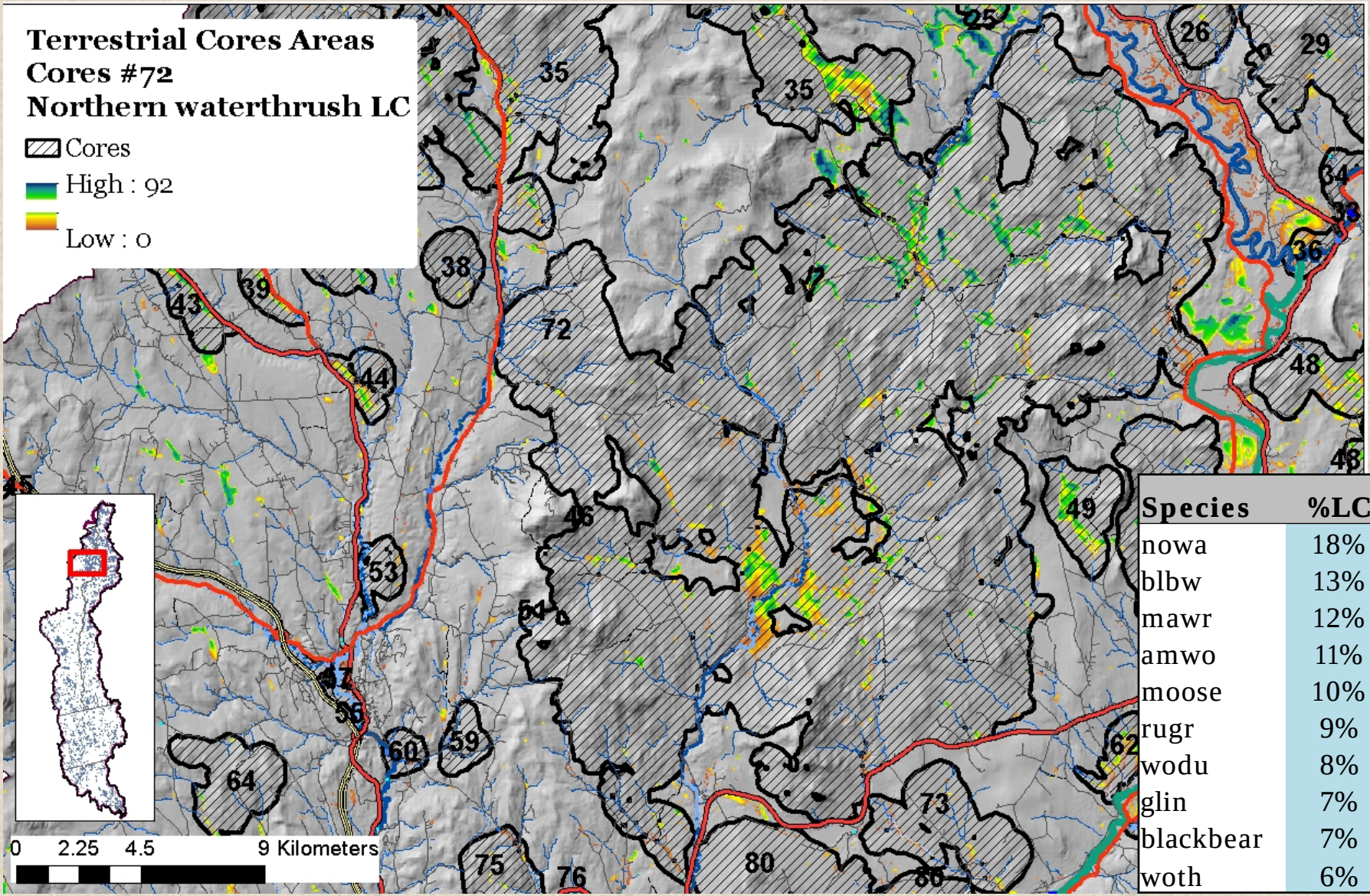
Terrestrial core area composition



Macrogroup	% selindex
Northern Peatland & Fens	22%
Northeastern Floodplain Forest	12%
Wet Meadow / Shrub Marsh	8%
Boreal Upland Forest	6%
Northern Hardwood & Conifer	4%
Outcrop & Summit Scrub	4%
Cliff & Talus	4%
Northern Swamp	4%

Core Areas

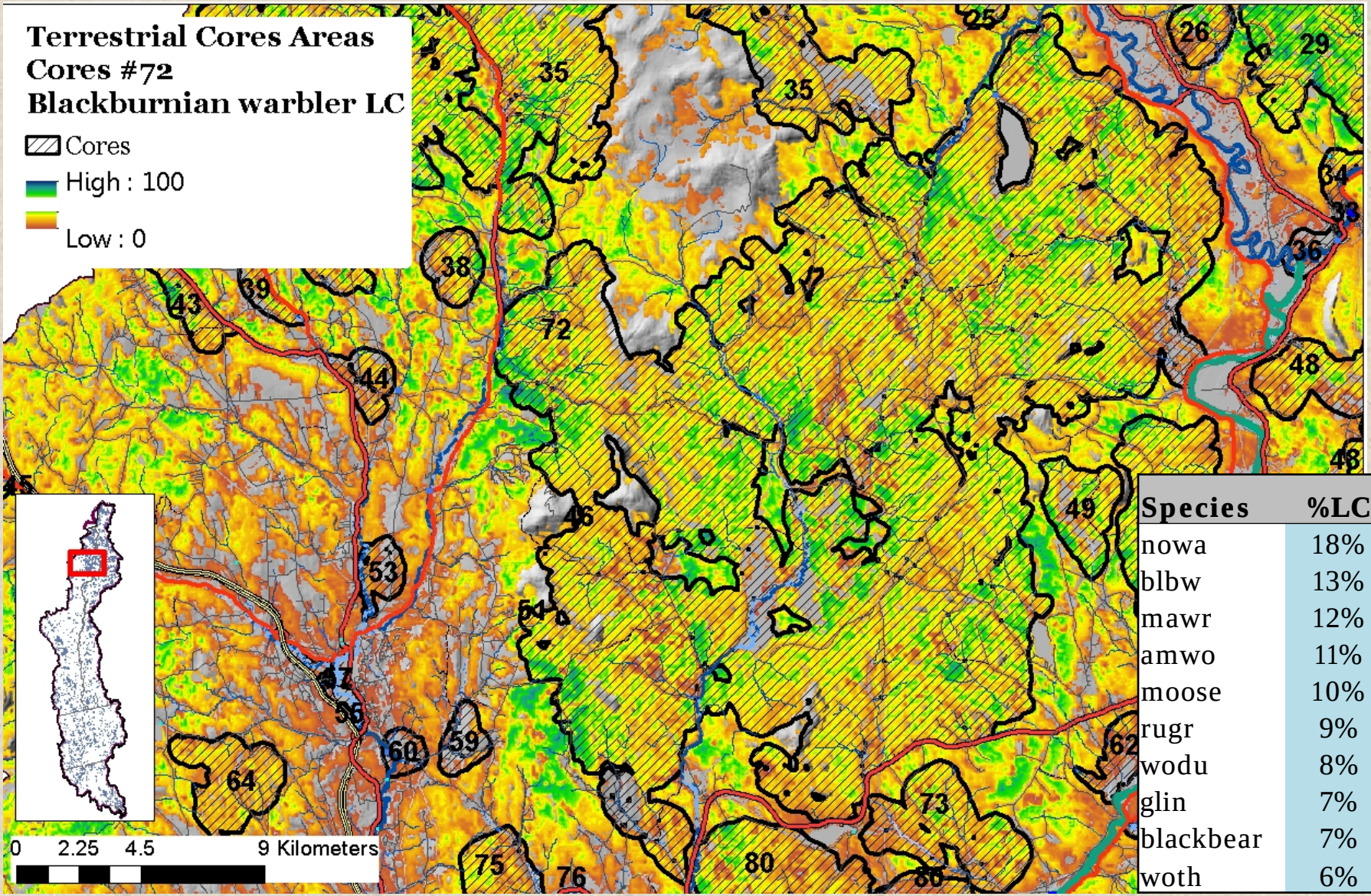
Terrestrial core area composition



Species	%LC
nowa	18%
blbw	13%
mawr	12%
amwo	11%
moose	10%
rugr	9%
wodu	8%
glin	7%
blackbear	7%
woth	6%

Core Areas

Terrestrial core area composition



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Core Areas

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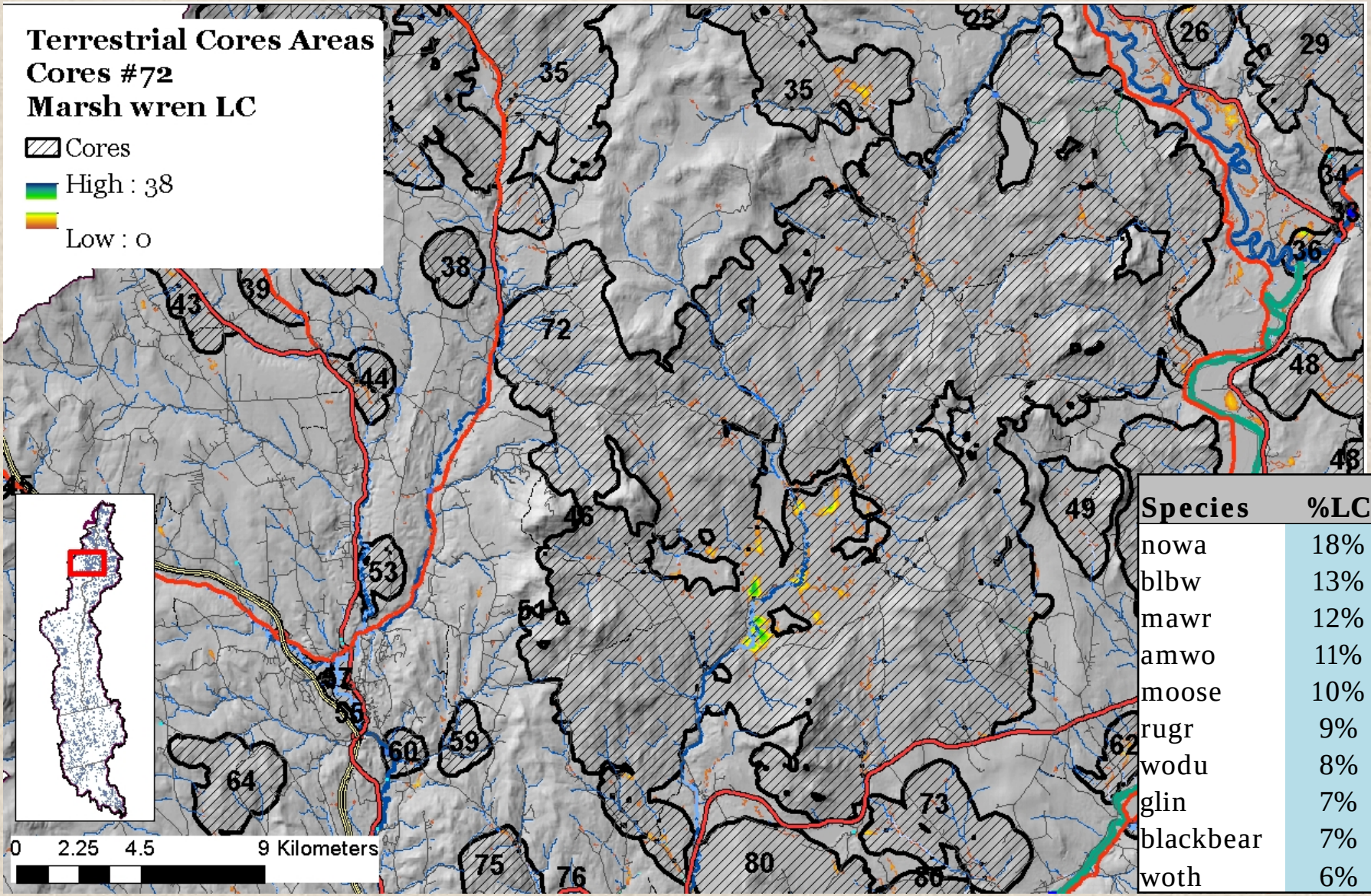

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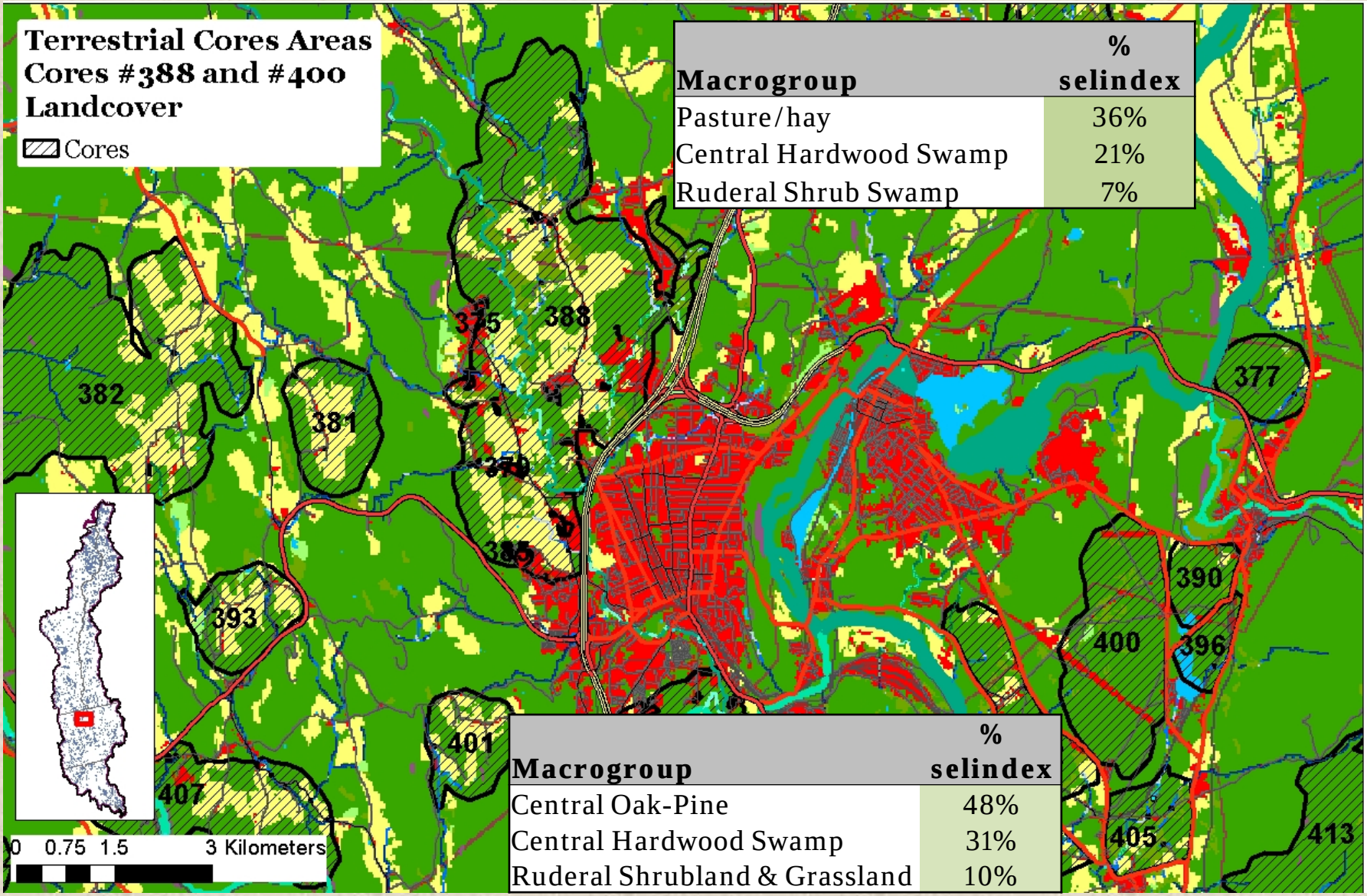
Core Areas

Terrestrial core area composition



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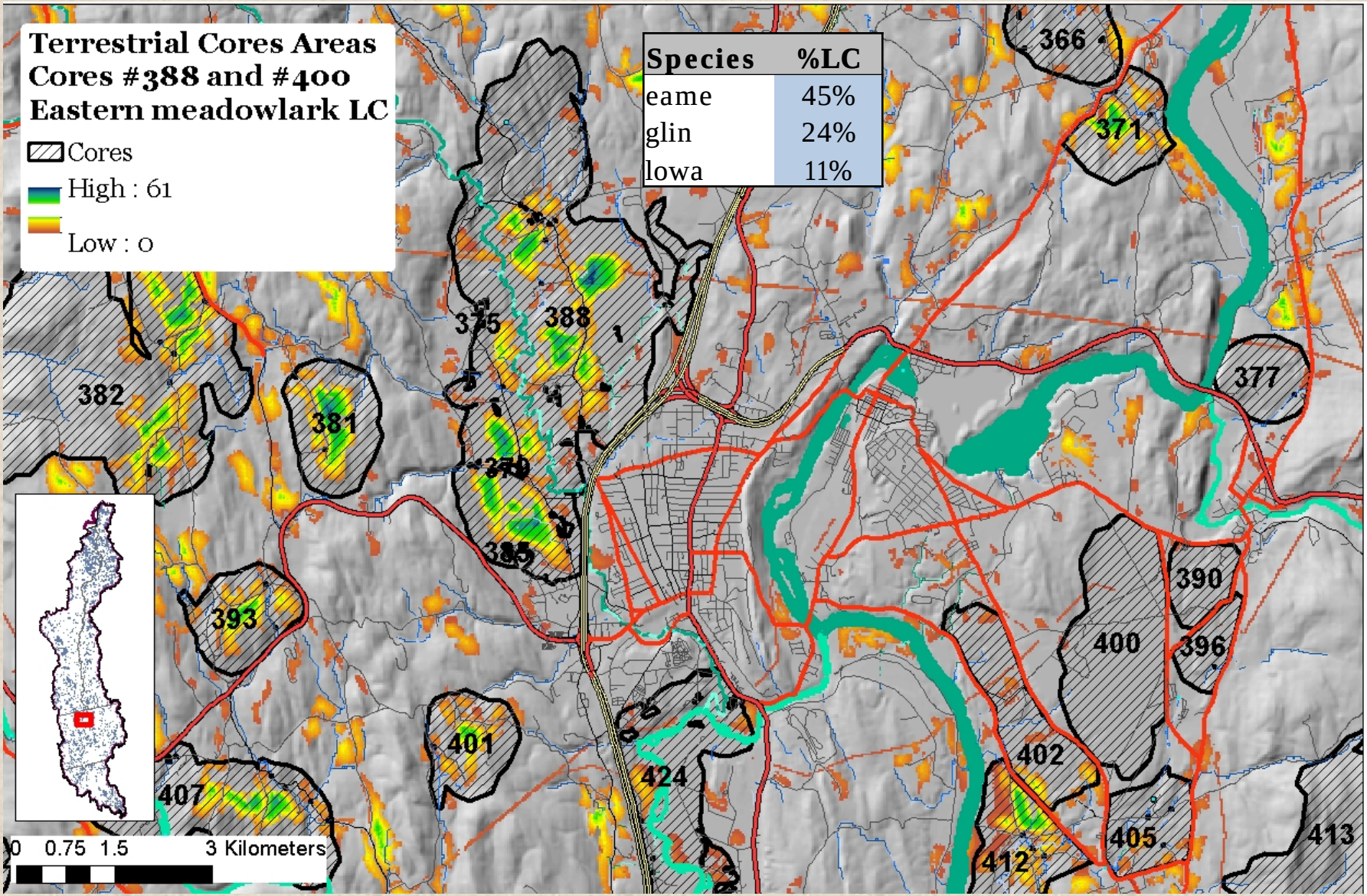
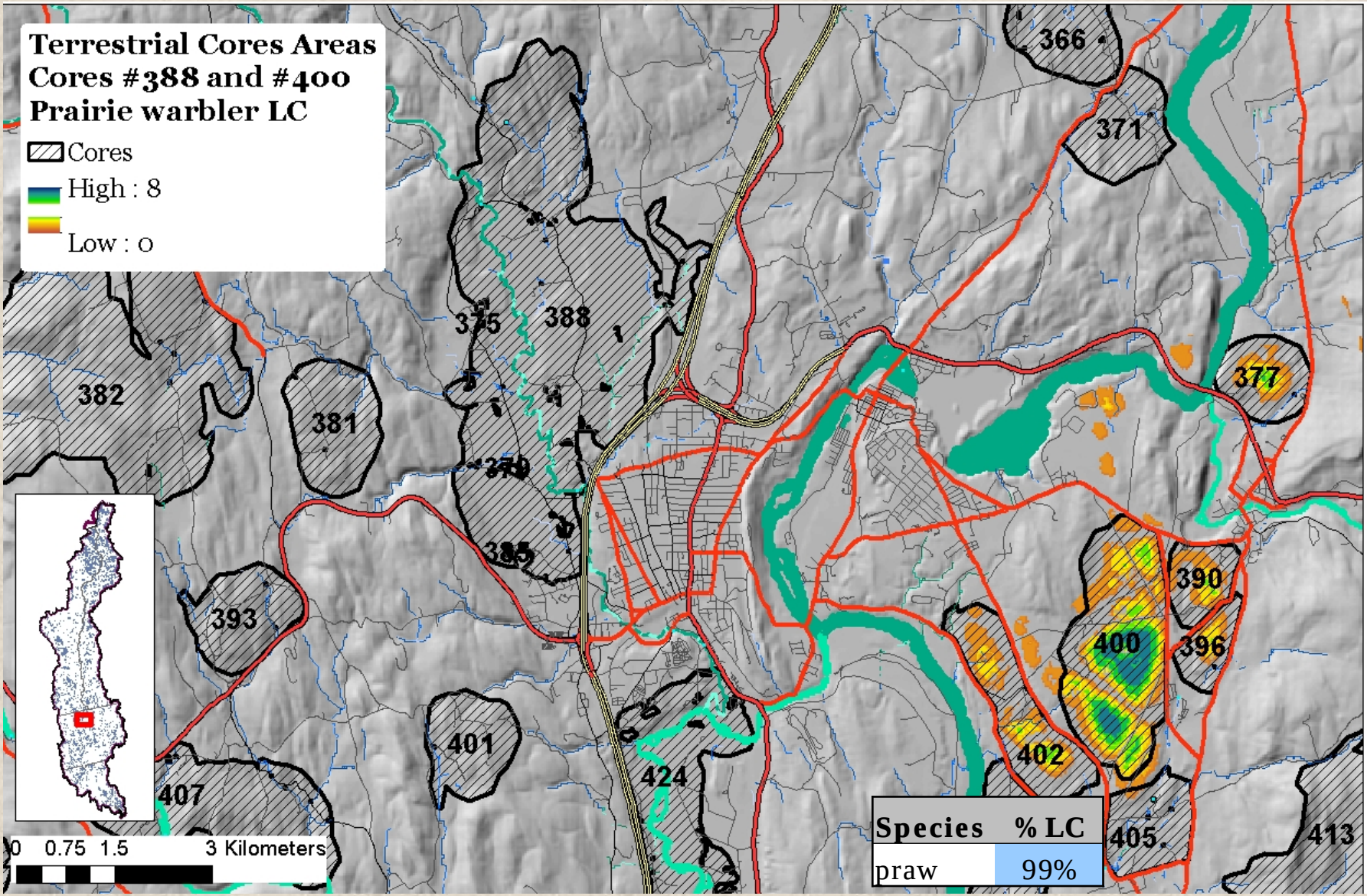


Core Areas

Terrestrial core area composition



Core Areas

Methods (key decisions)

- **Aquatic cores:**
  - **Ecosystem-based:**
    - ✓Unweighted selection index
    - ✓CTR scale
    - ✓Fewer/larger cores (networks) *
    - ✓Min 1 river km
    - ✓25% of aquascape
  - **Species-based:**
    - ✓Brook trout (headwaters)
    - ✓5 anadromous fish (rivers) + free-flowing segments
    - ✓25% of aquascape

***Still working on improvements to the ecosystem-based algorithm**

Core Areas

Aquatic core area network

- Headwaters:

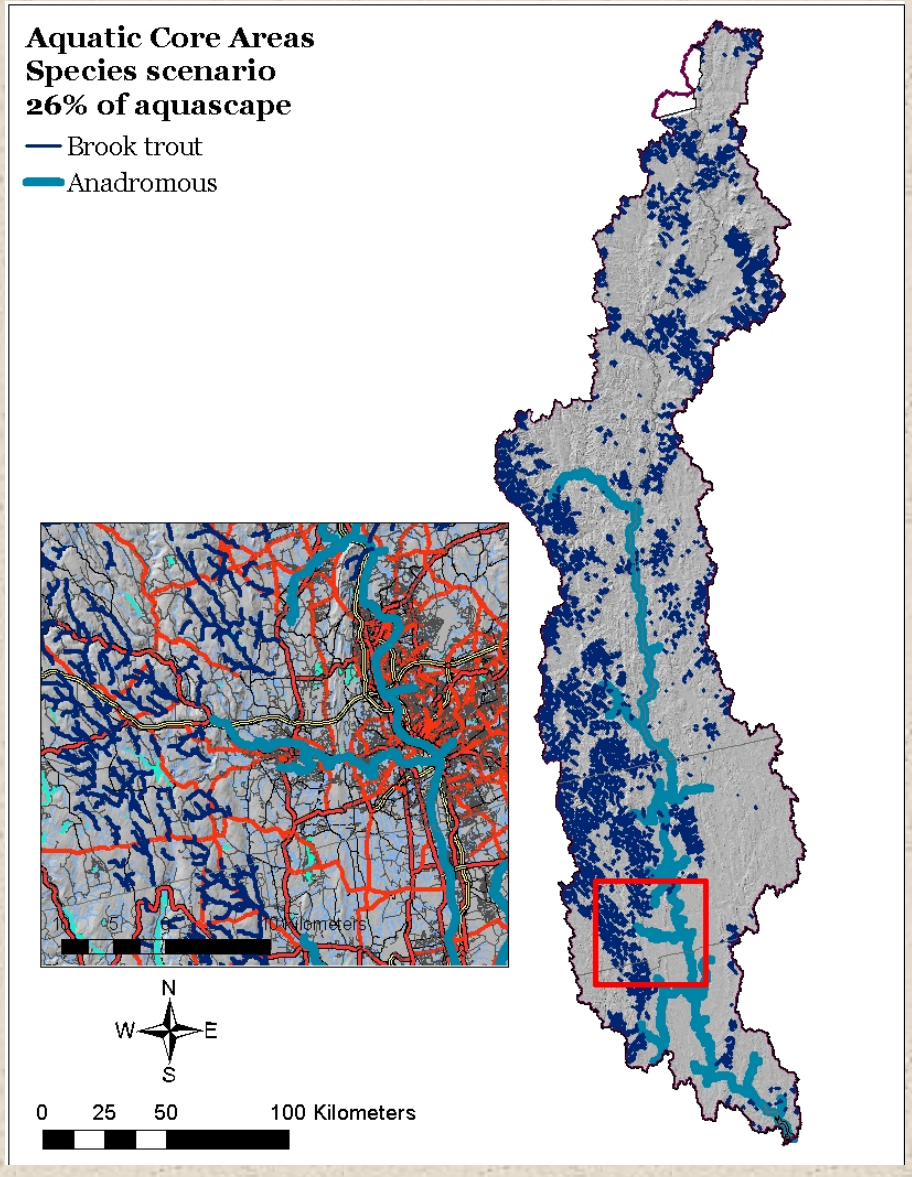
  Brook trout

  prob(occu)>0.86

- Rivers:

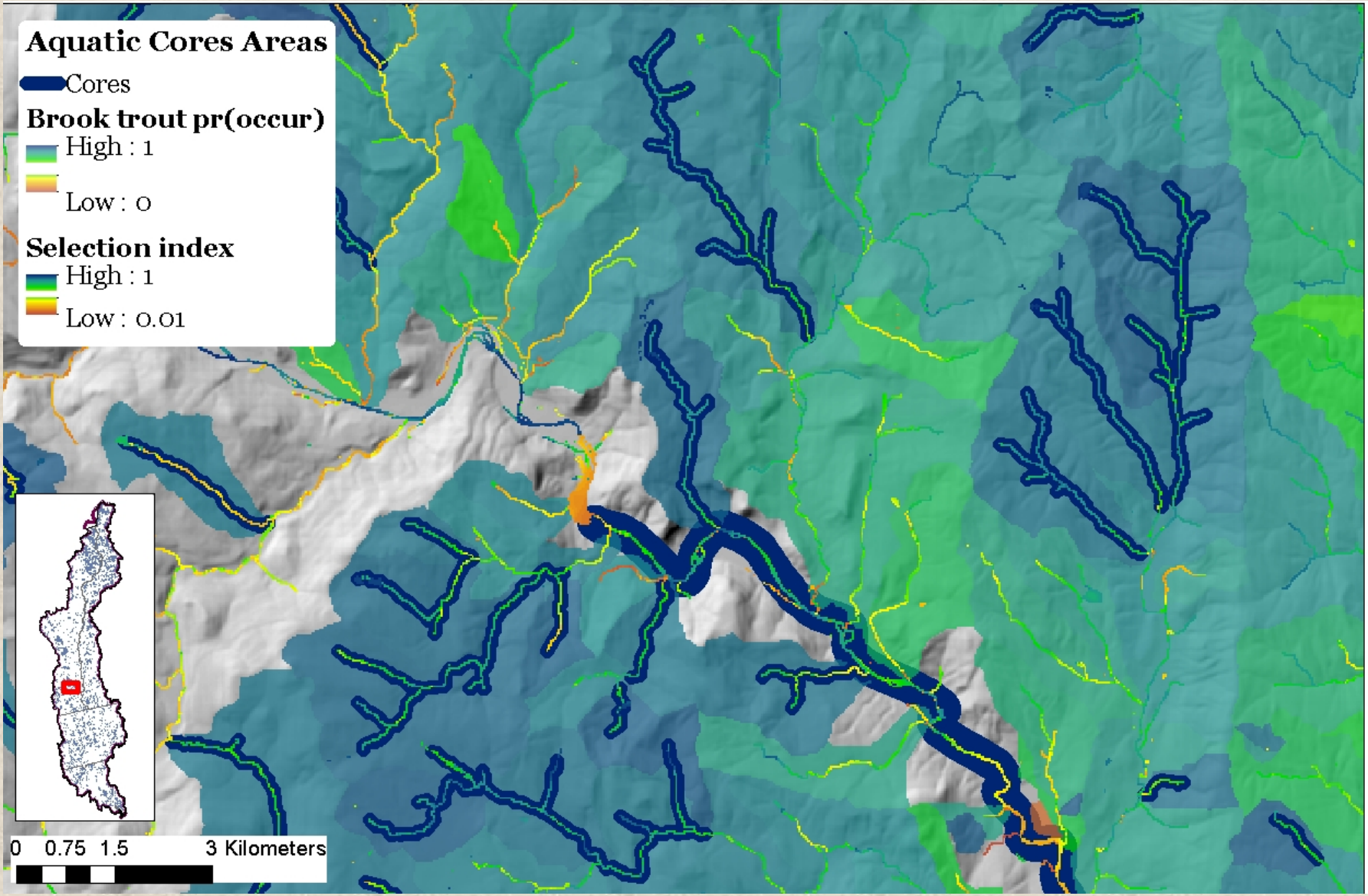
  Distribution of:

  - American shad
  - blueback herring
  - short-nose
  - Sturgeon
  - alewife
  - sea lamprey



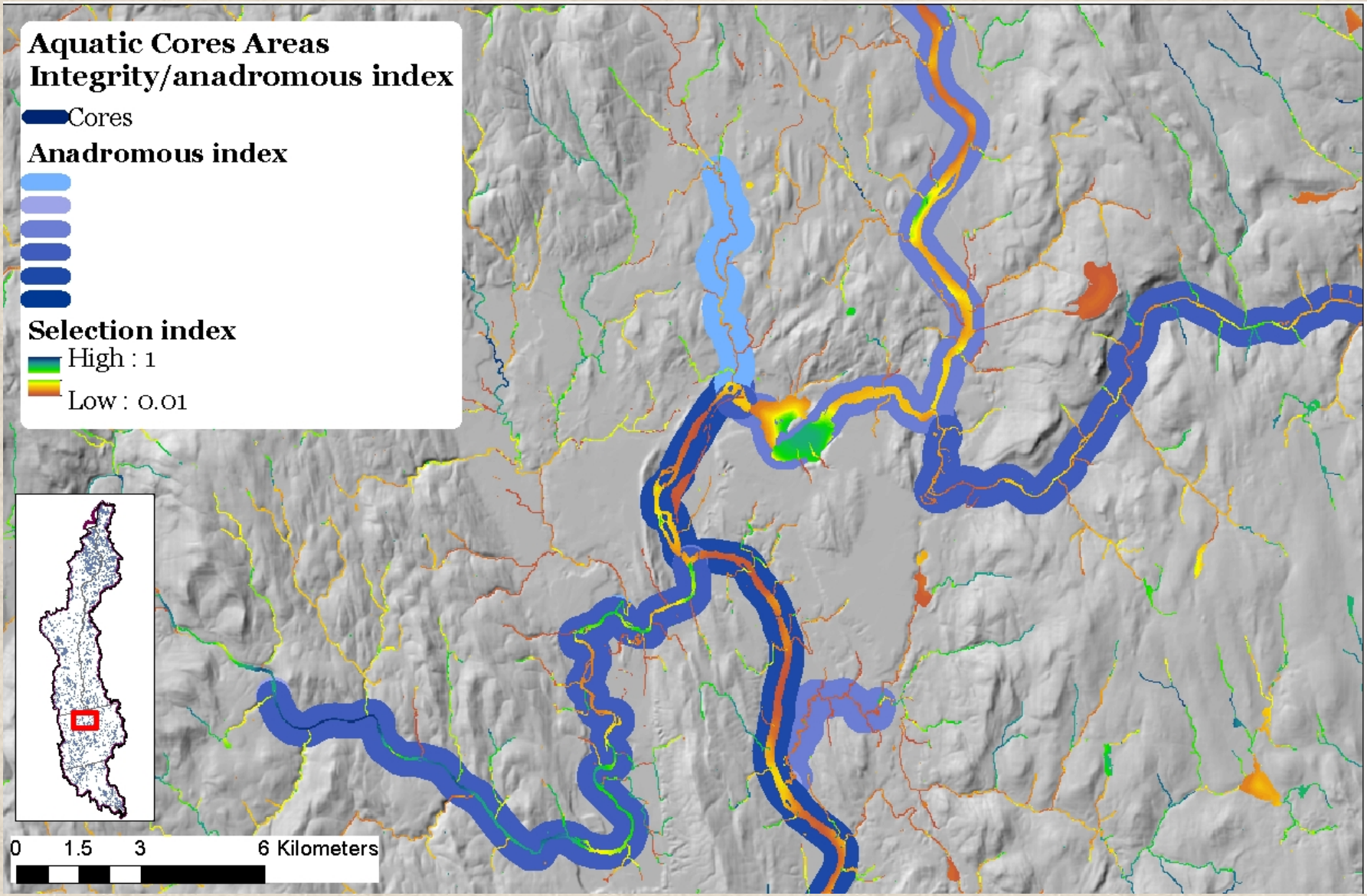
Core Areas

Ecological integrity/brook trout gradients



Core Areas

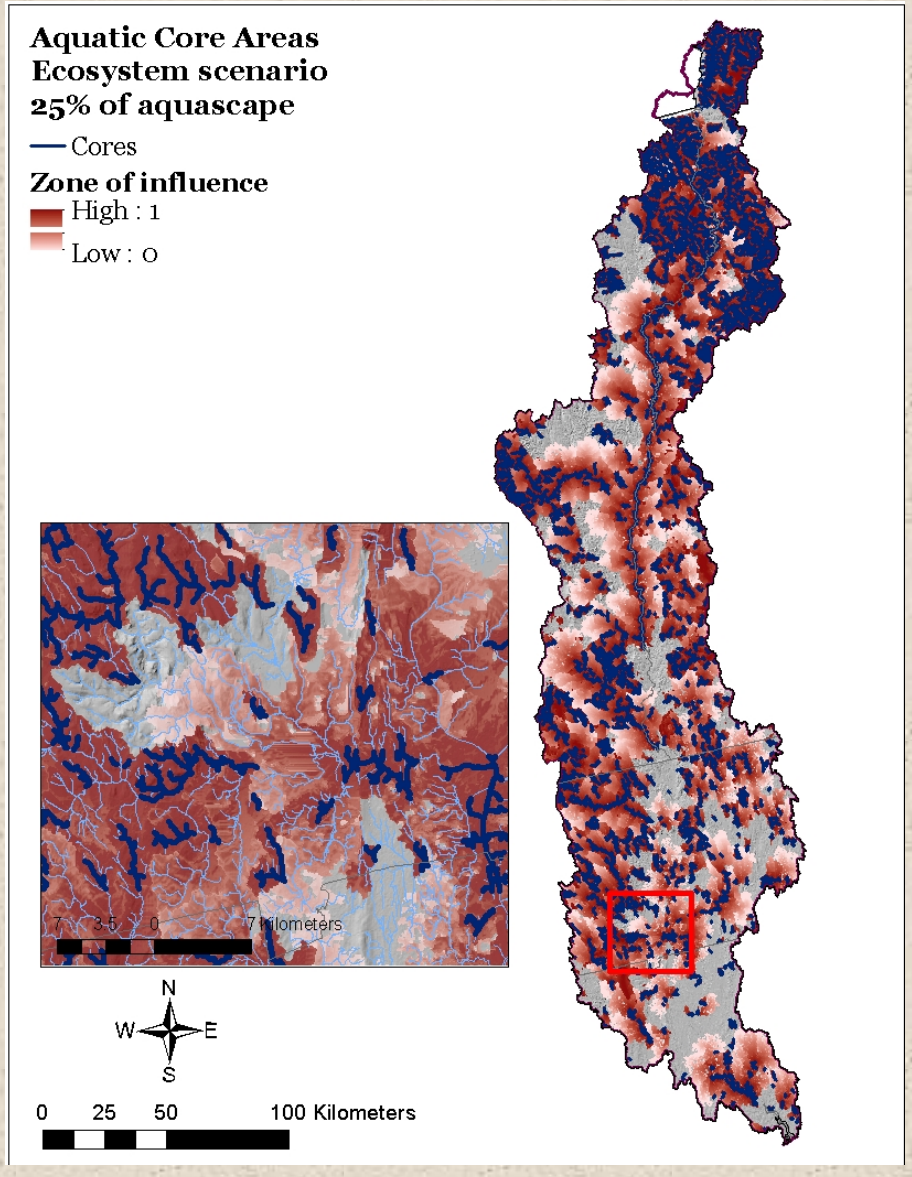
Ecological integrity/anadromous gradients



Core Areas

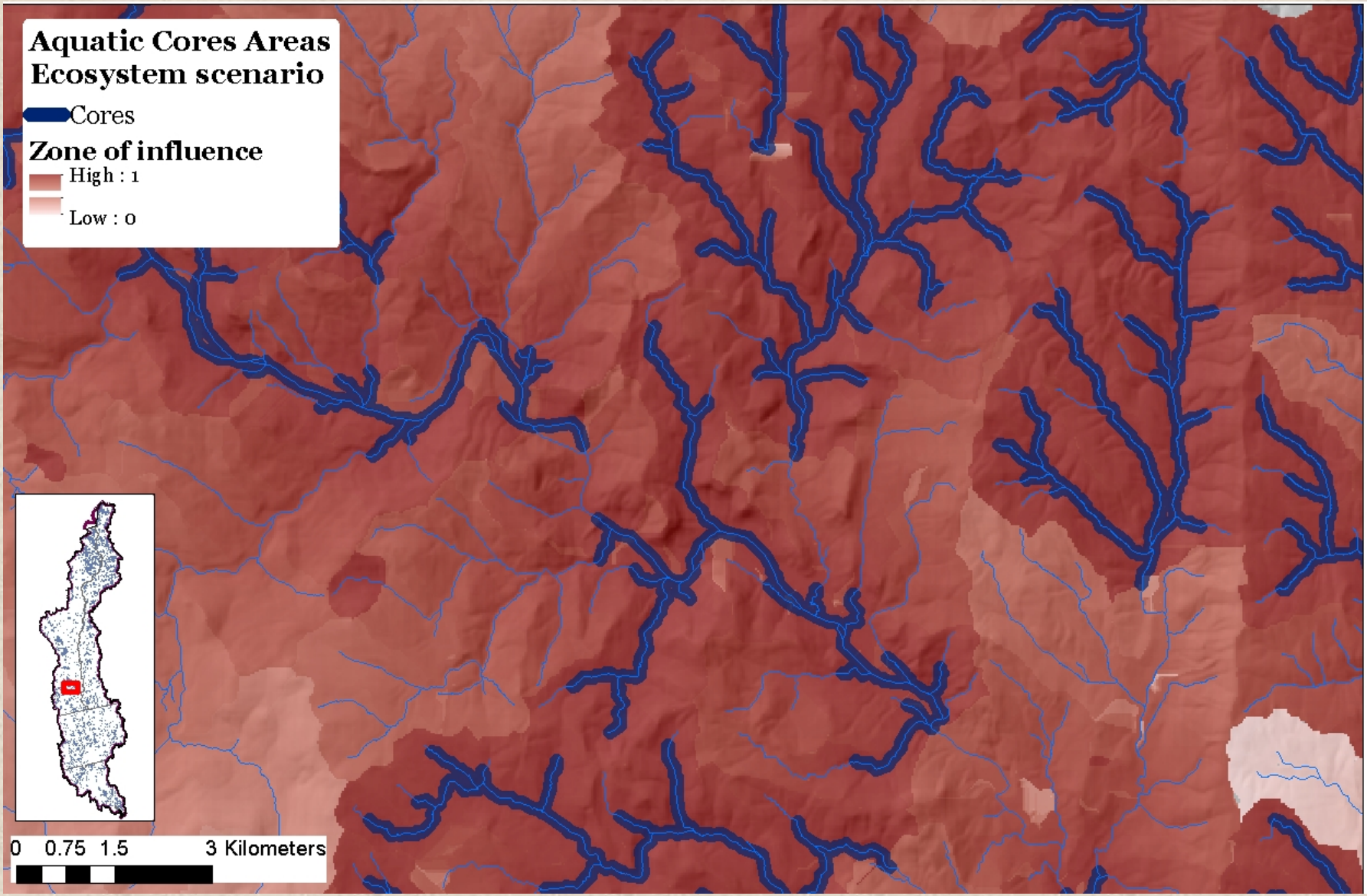
Aquatic core area zone of influence

- Constrained watershed buffer around the core representing a zone of influence



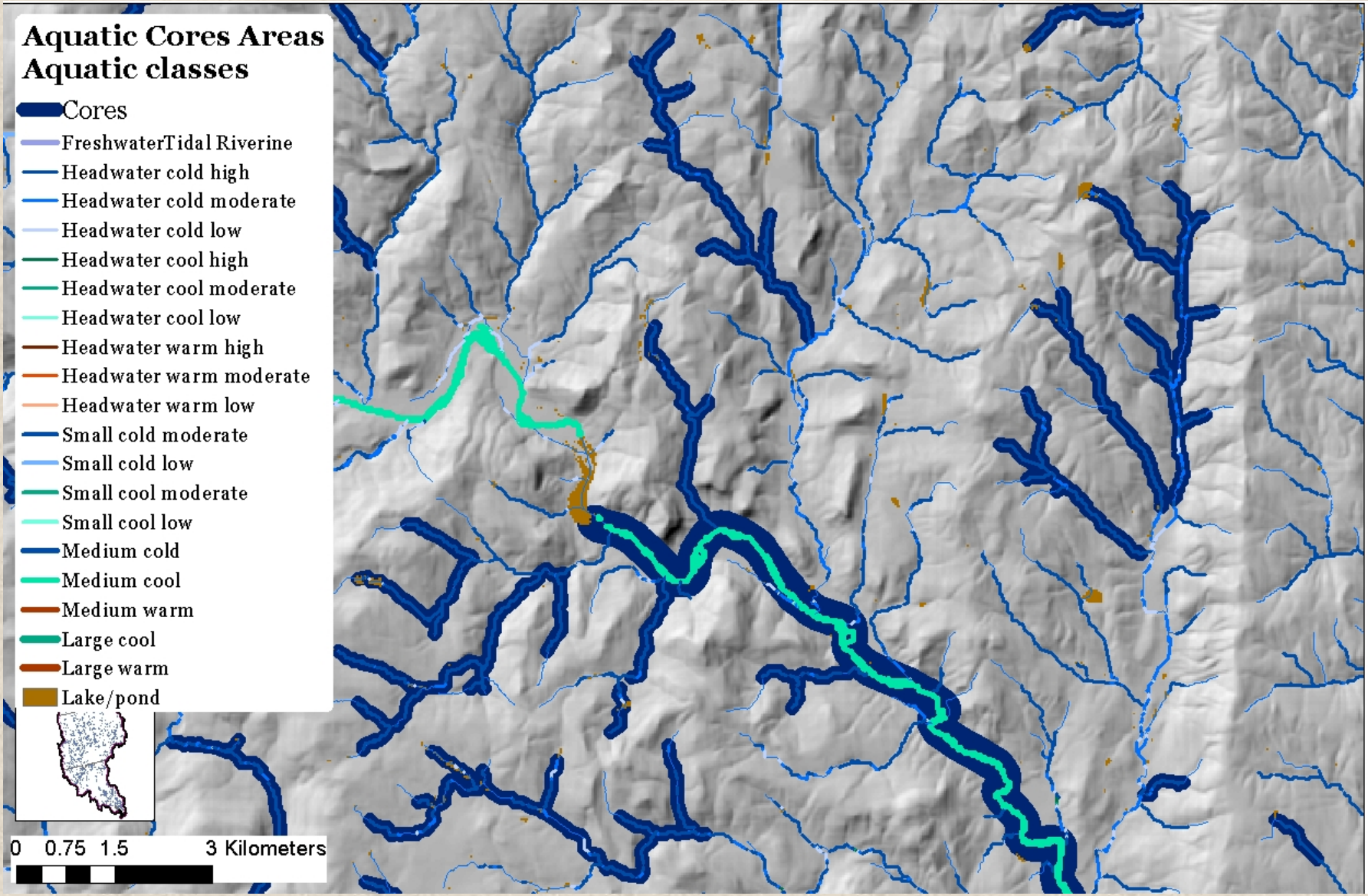
Core Areas

Aquatic core area composition



Core Areas

Aquatic core area composition



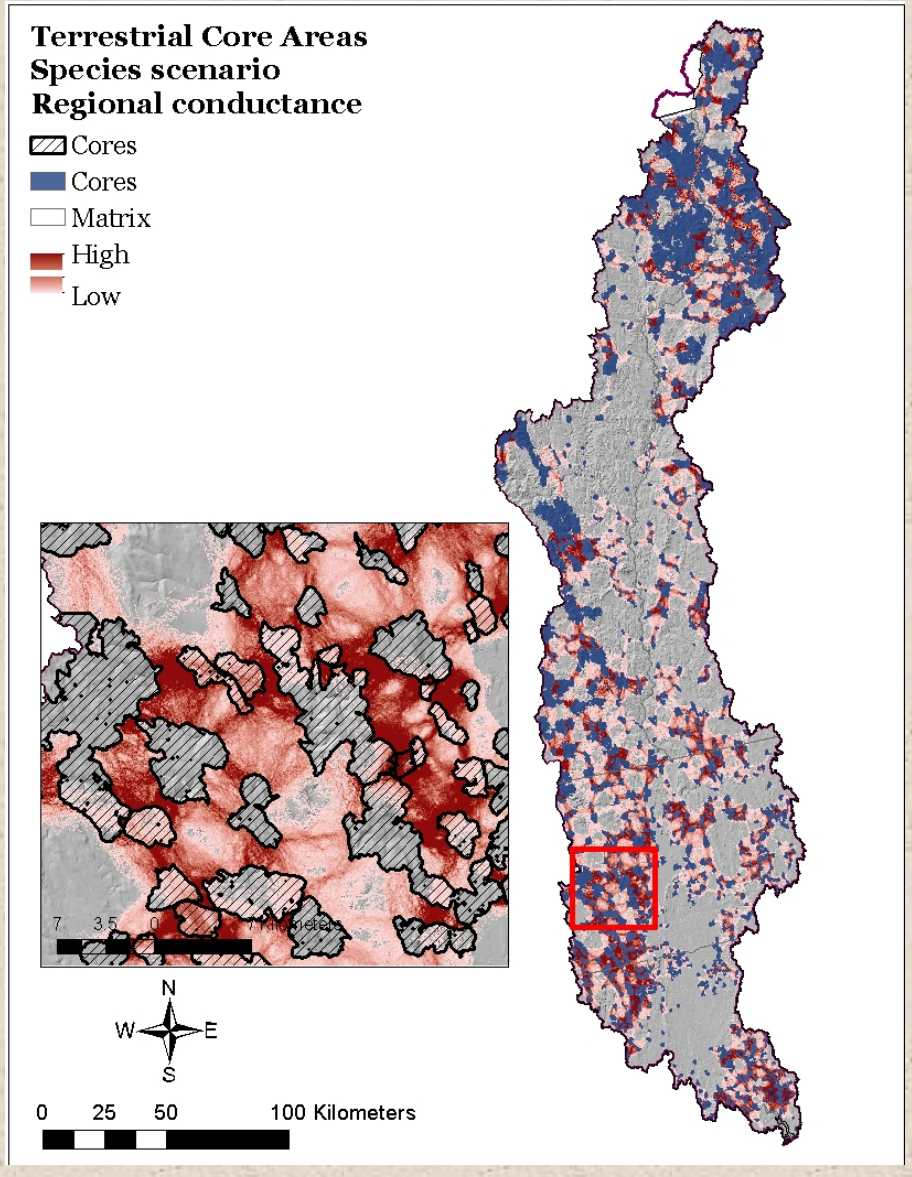
Connectors

- **Connectors…** areas important to the connectivity of terrestrial core areas
  - **Conductance…** gradients of regional conductance
  - **Irreplaceability…** gradients of irreplaceable pathways
  - **Vulnerability…** gradients in vulnerability to loss of regional conductance due to development
  - **Linkage prioritization…** linkage importance to regional connectivity

Connectors

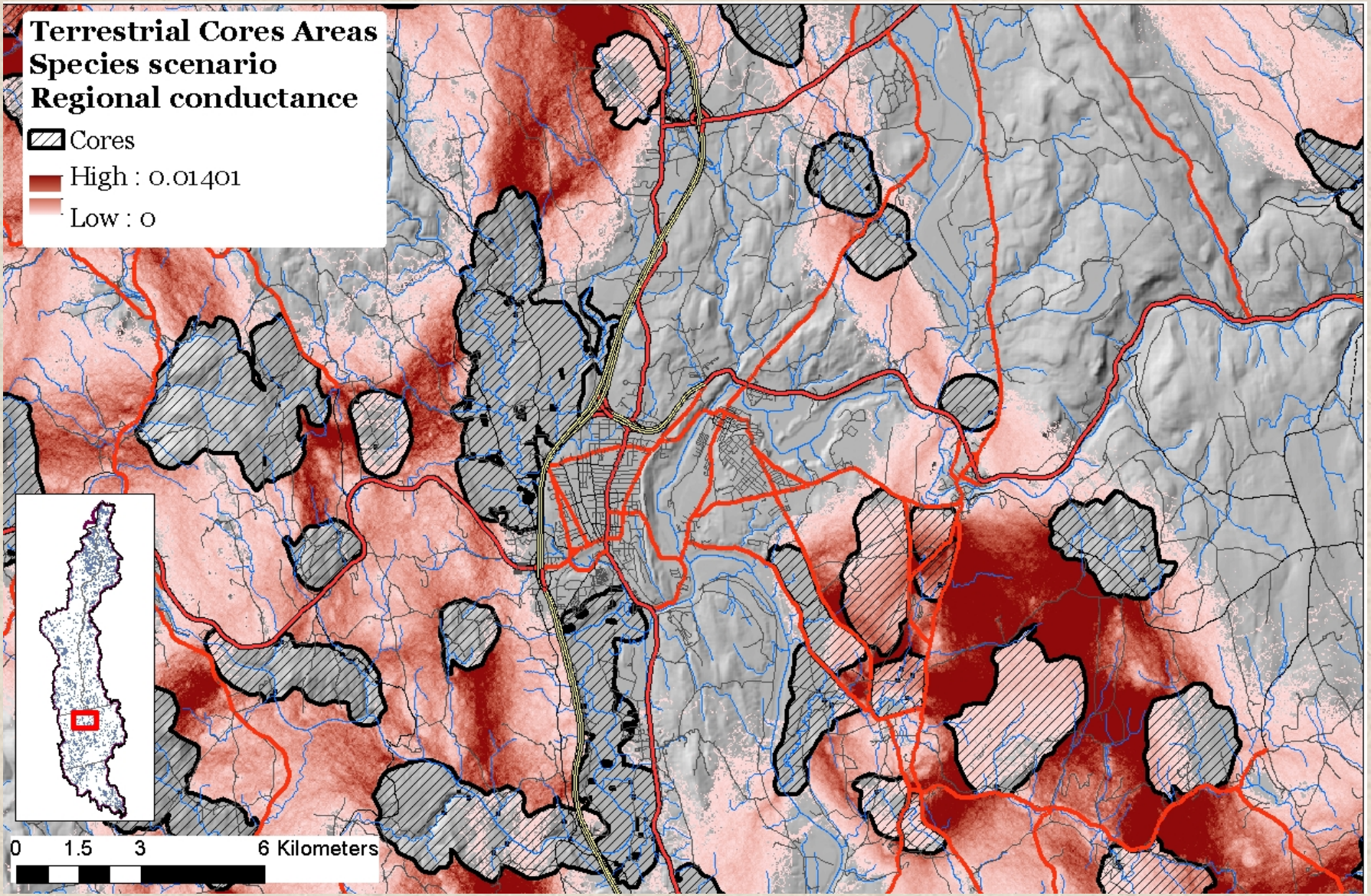
Conductance

- Relative probability of flow through a cell (function of local resistance, node size, quality and proximity)



Connectors

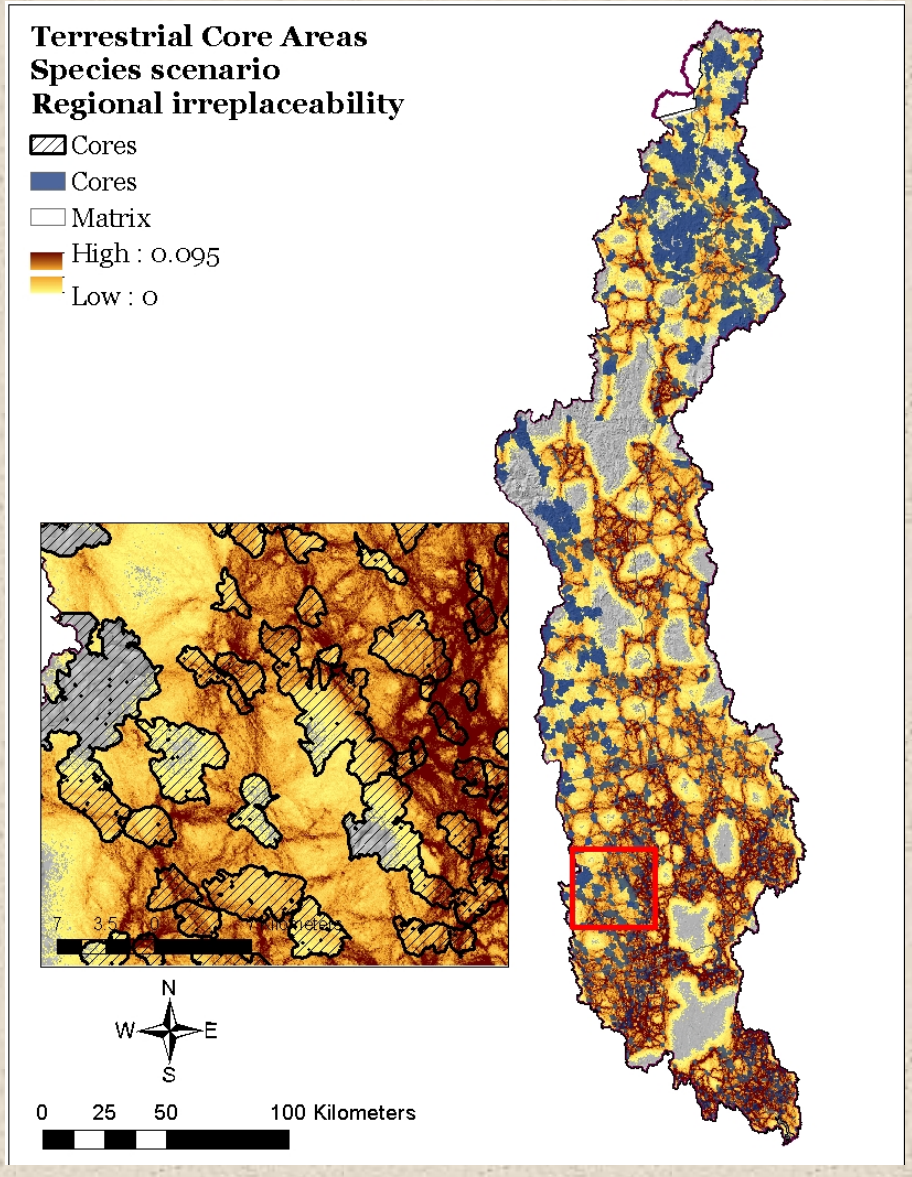
Conductance



Connectors

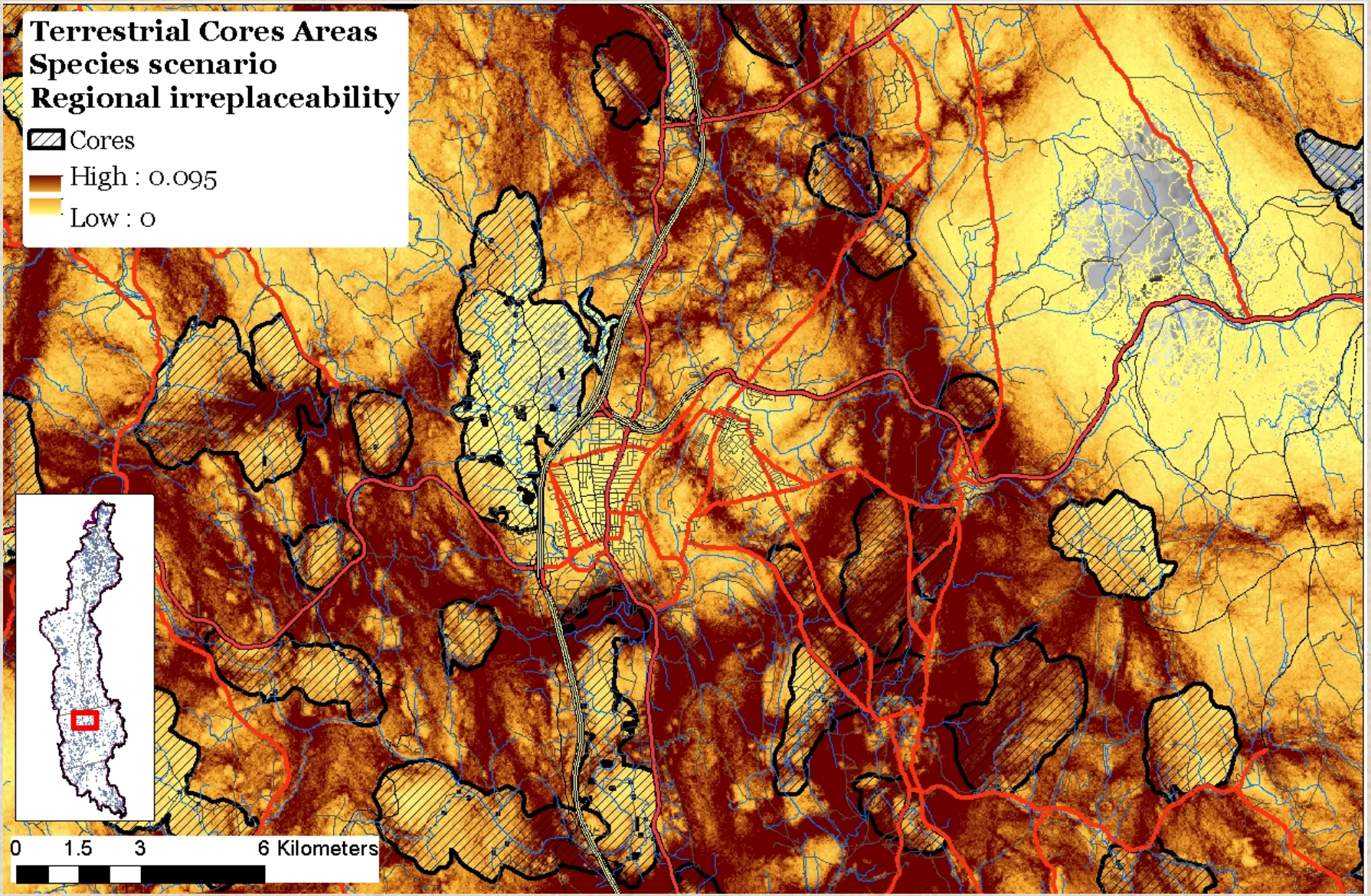
Irreplaceability

- Relative concentration of paths through a cell (function of local resistance and path irreplaceability)



Connectors

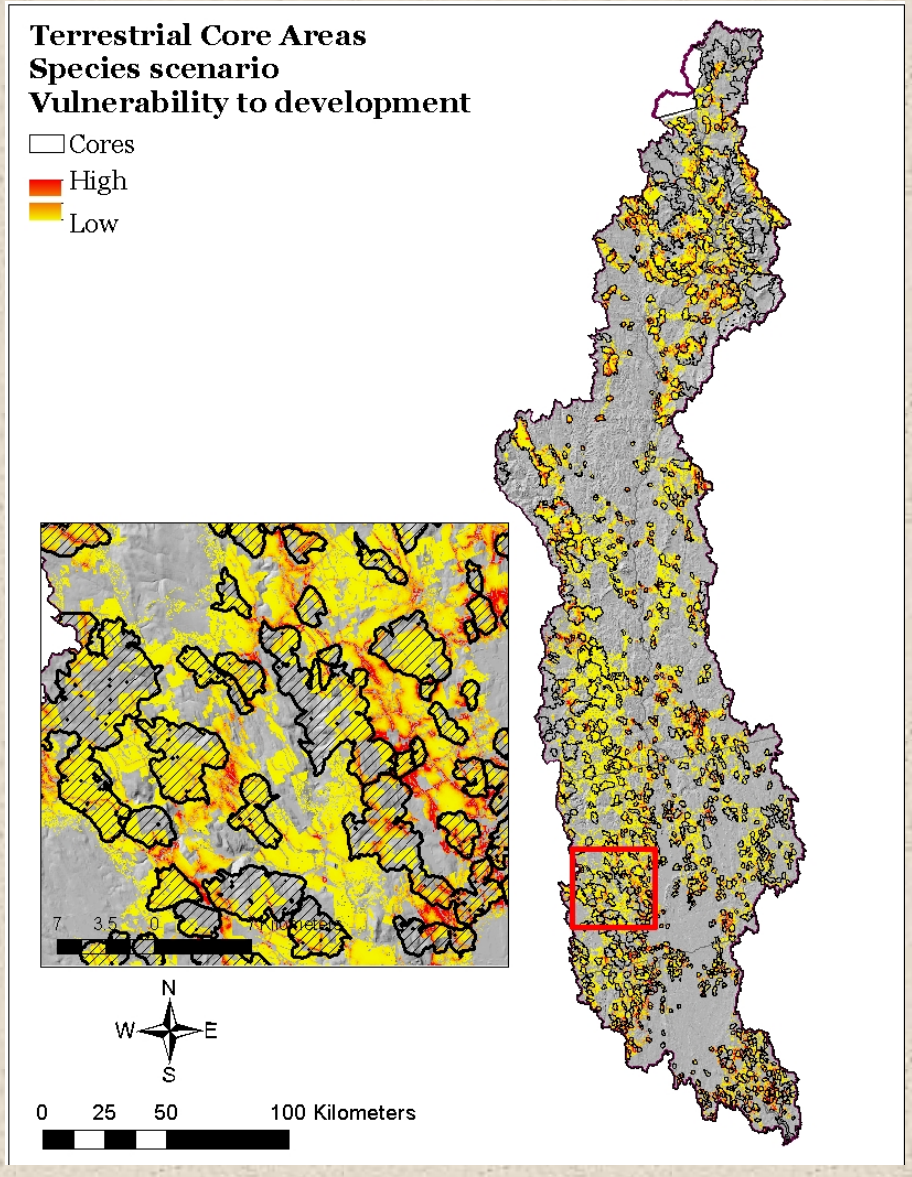
Irreplaceability



Connectors

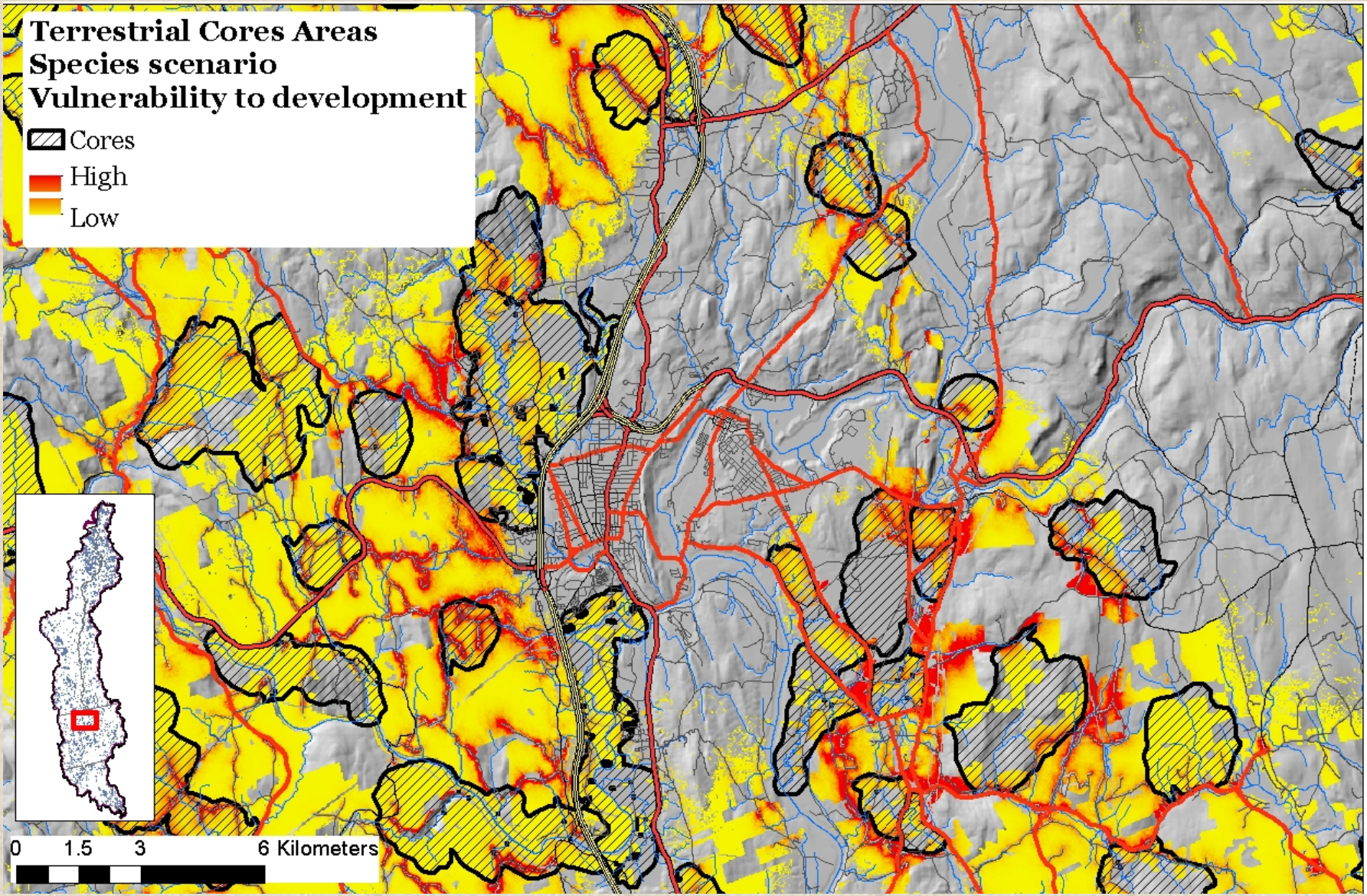
Vulnerability to development

- Relative probability of developing an irreplaceable cell that has a high relative probability of use



Connectors

Vulnerability to development

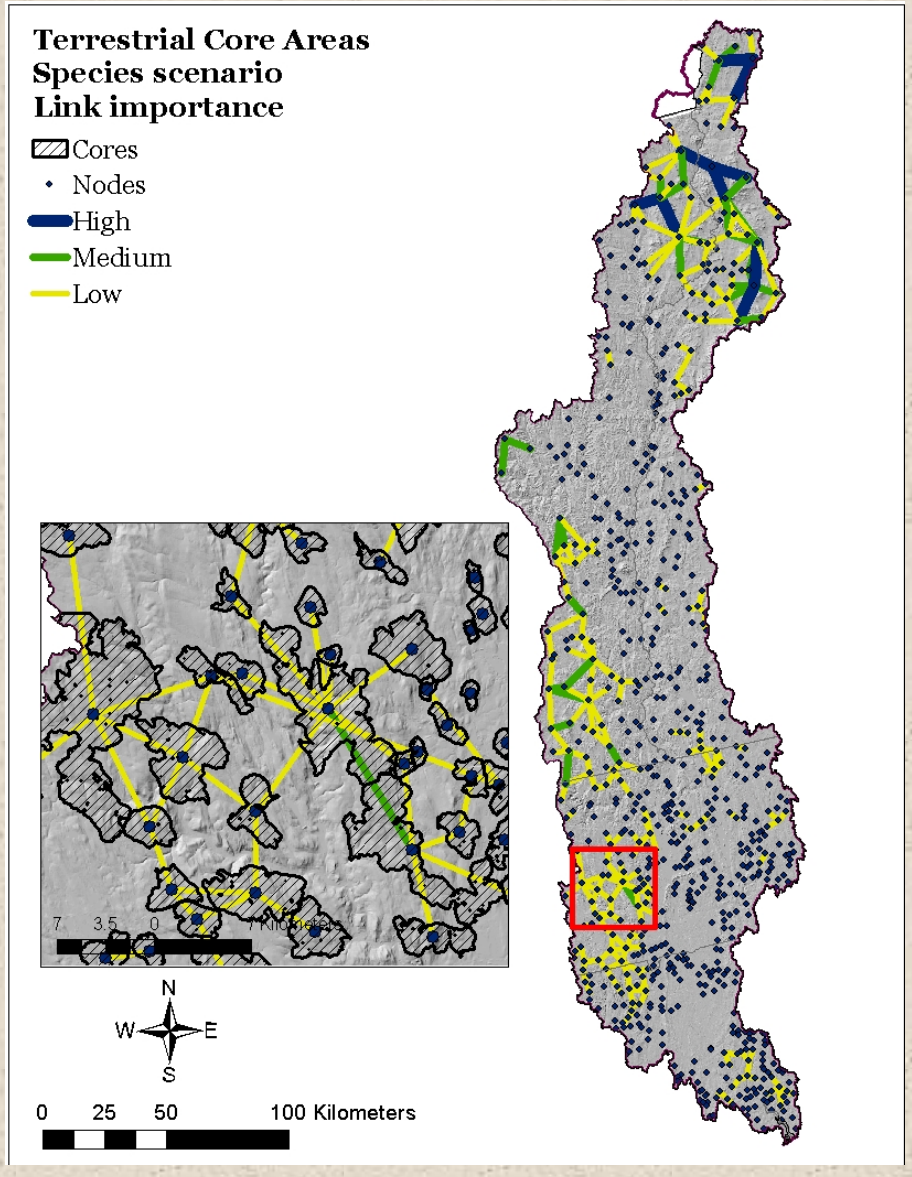


Connectors

Linkage prioritization

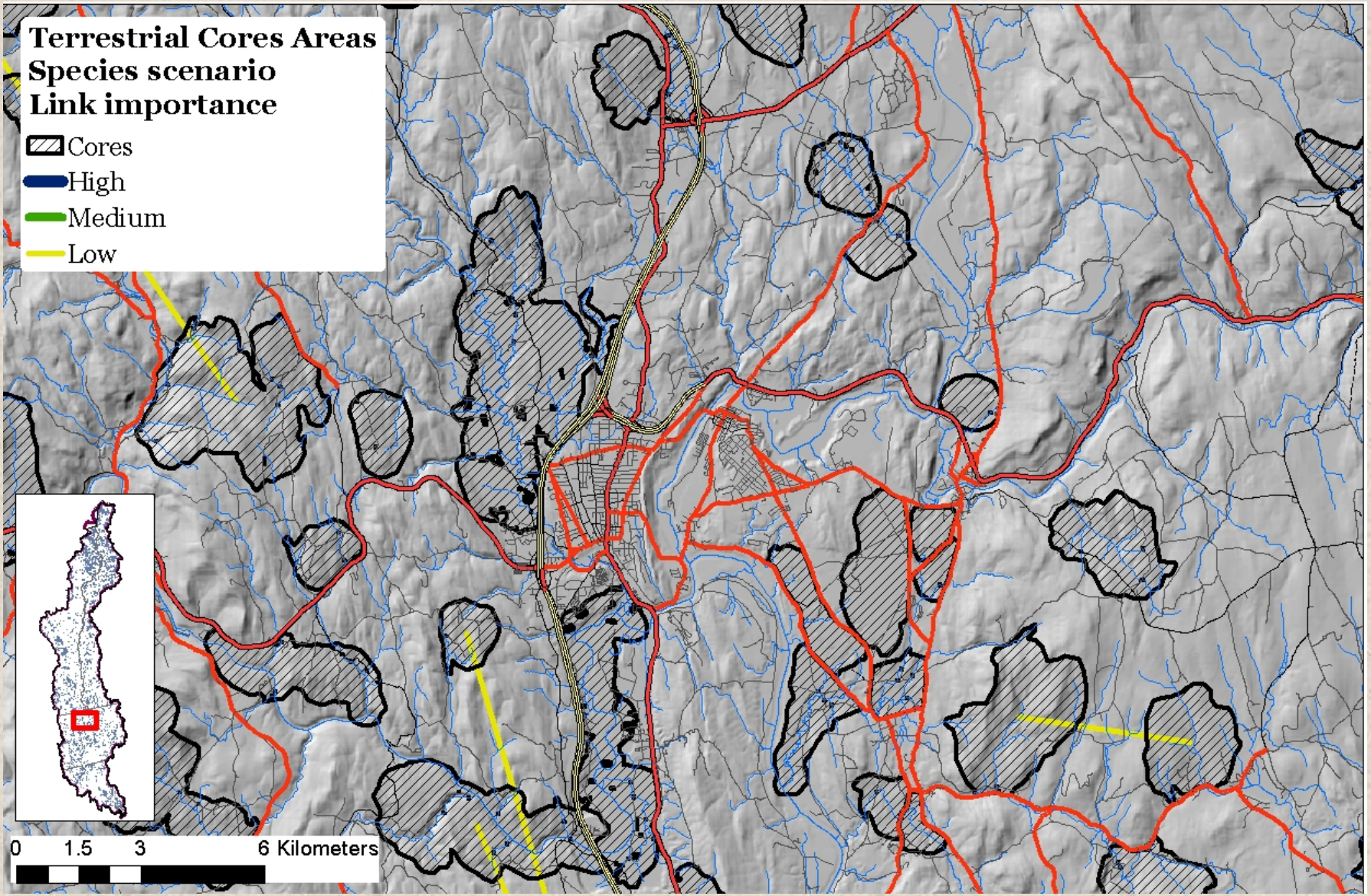
- Based on each link's contribution to the Probability of Connectivity (PC) of the network

Based on the network Probability of Connectivity (PC) metric (Saura and Pascual-Hortal 2007)



Connectors

Linkage prioritization



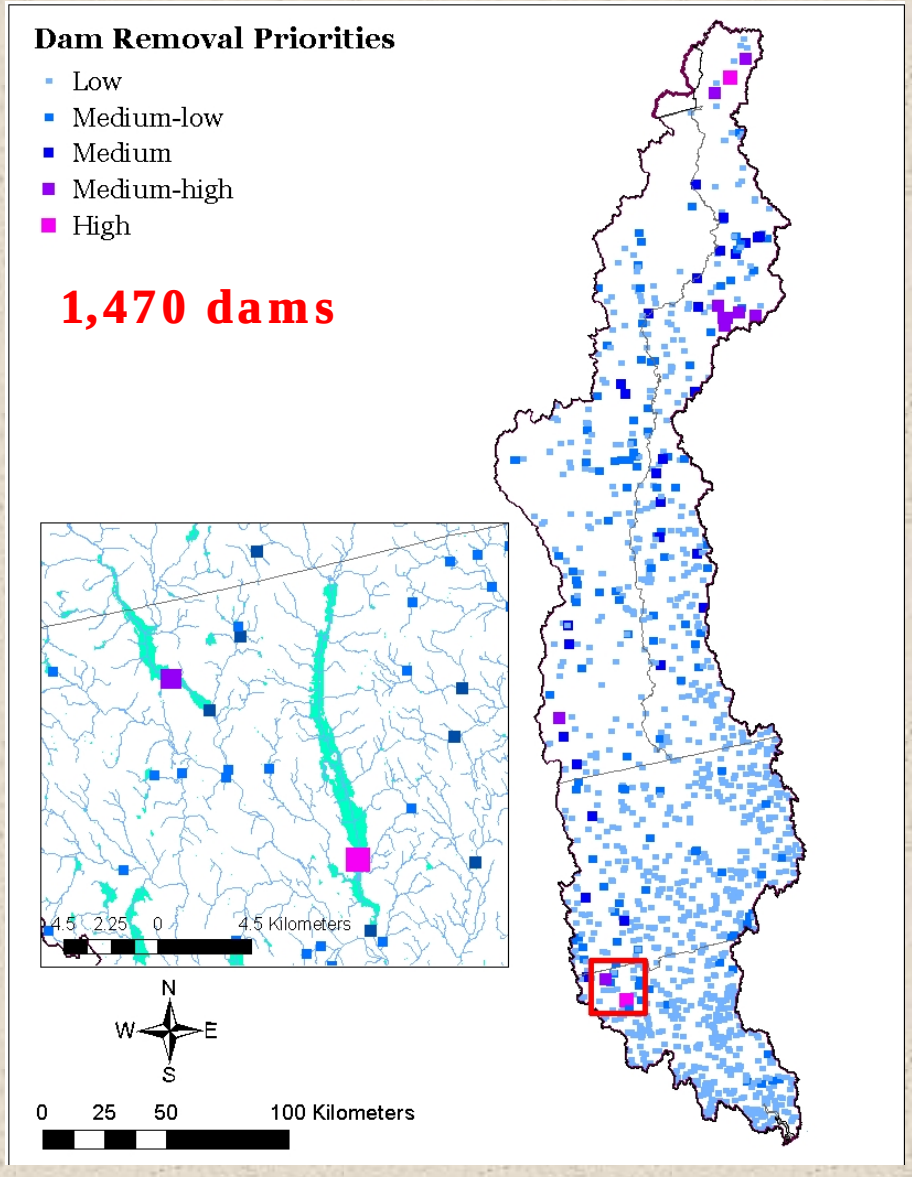
Restoration & Management

- **Restoration & management opportunities…** areas with high restoration or management potential
  - **Dam removal…** gradients in potential to improve aquatic connectivity
  - **Culvert upgrades…** gradients in potential to improve aquatic connectivity
  - **Terrestrial road passage structures…** gradients in potential to improve terrestrial connectivity
  - **Management priorities…** areas with management needs/opportunities to maintain or improve ecological integrity or species landscape capability

Restoration & Management

Dam removal

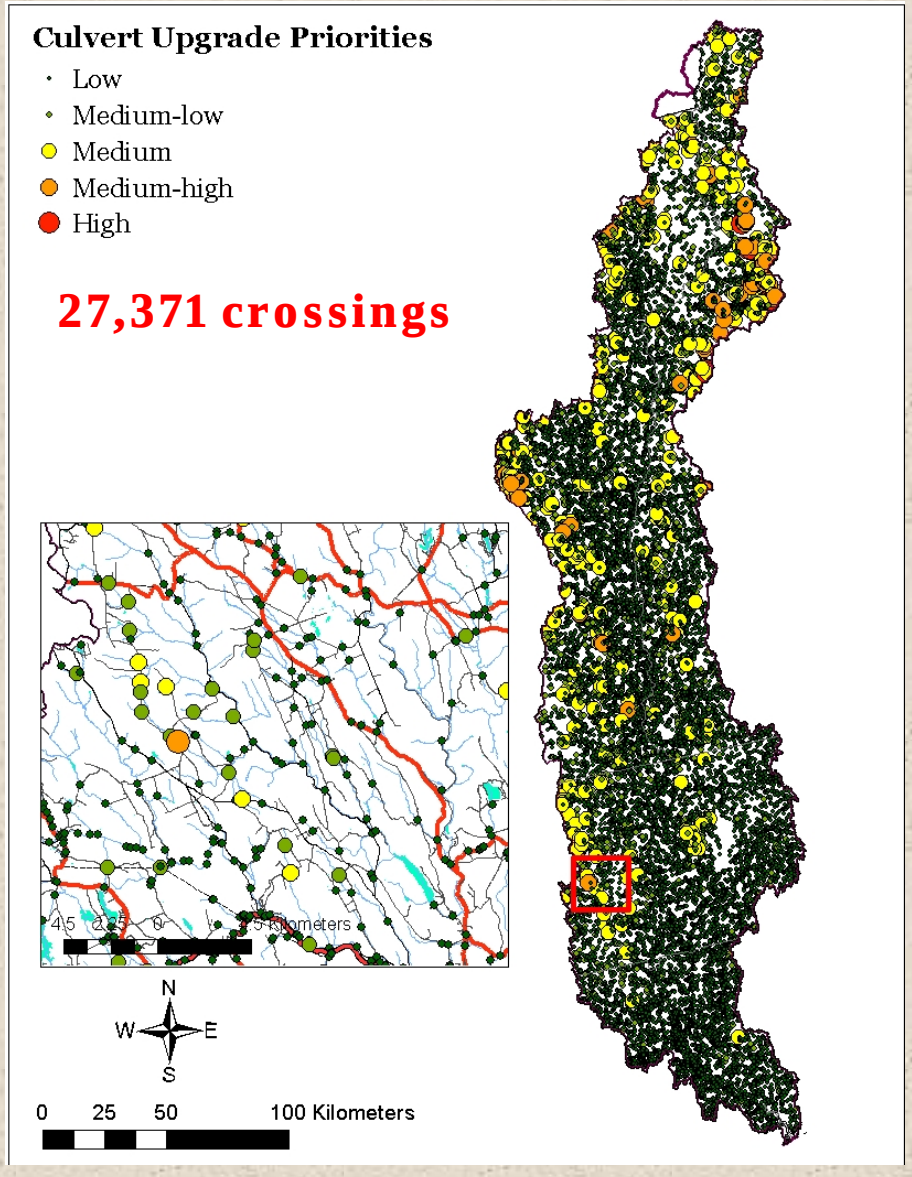
- Based on improvement in local aquatic connectedness resulting from removal of the dam (Δaqconnect)



Restoration & Management

Culvert upgrade

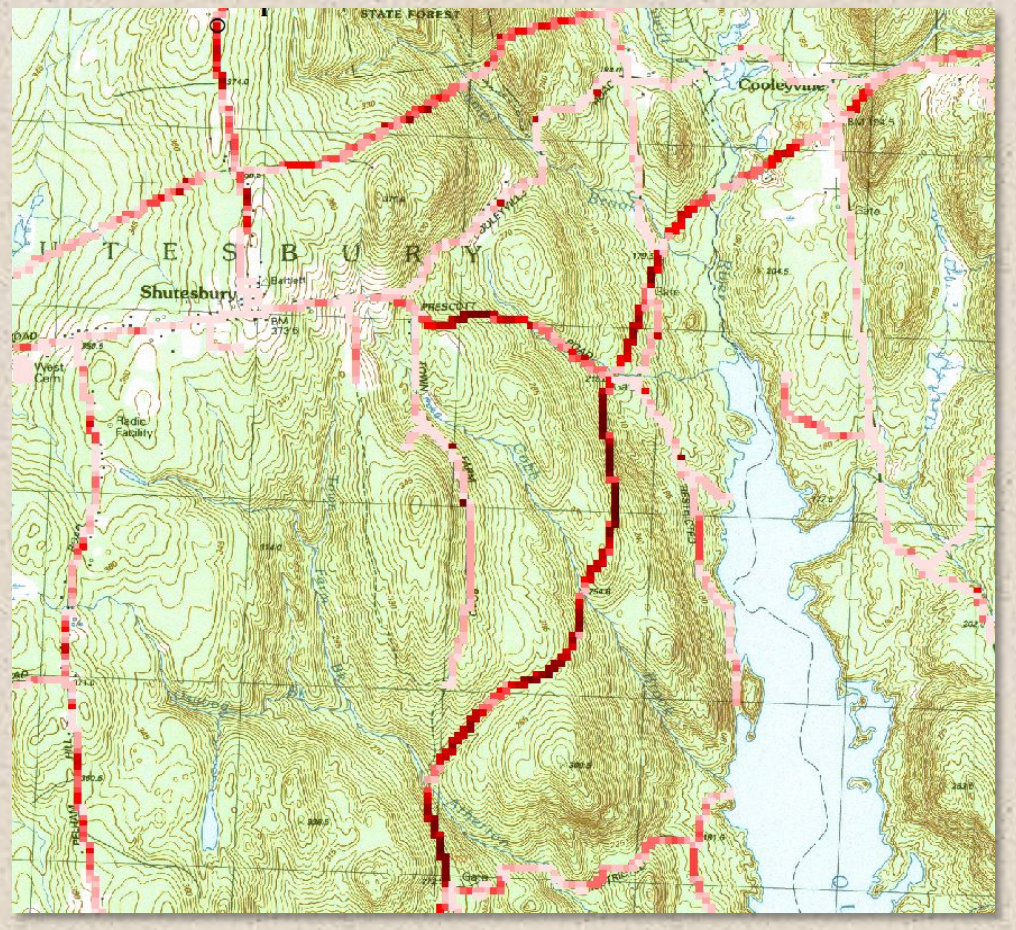
- Based on improvement in local aquatic connectedness resulting from replacing culvert with bridge (Δaqconnect)



Restoration & Management

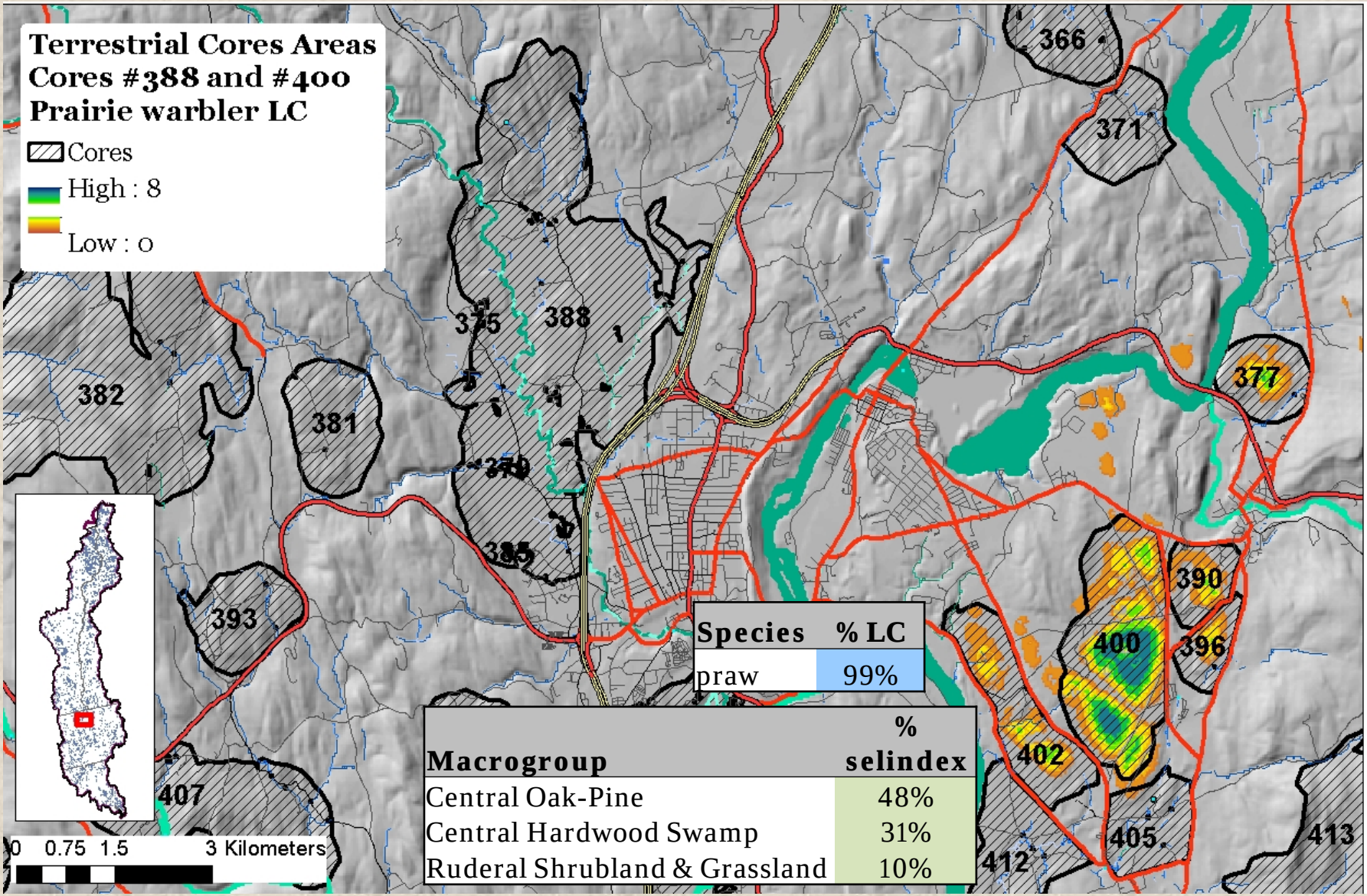
Terrestrial road passage structure

- Based on improvement in local connectedness resulting from installing a terrestrial road passage structure (Δconnect)



Restoration & Management

Management priorities



Species	% LC
praw	99%

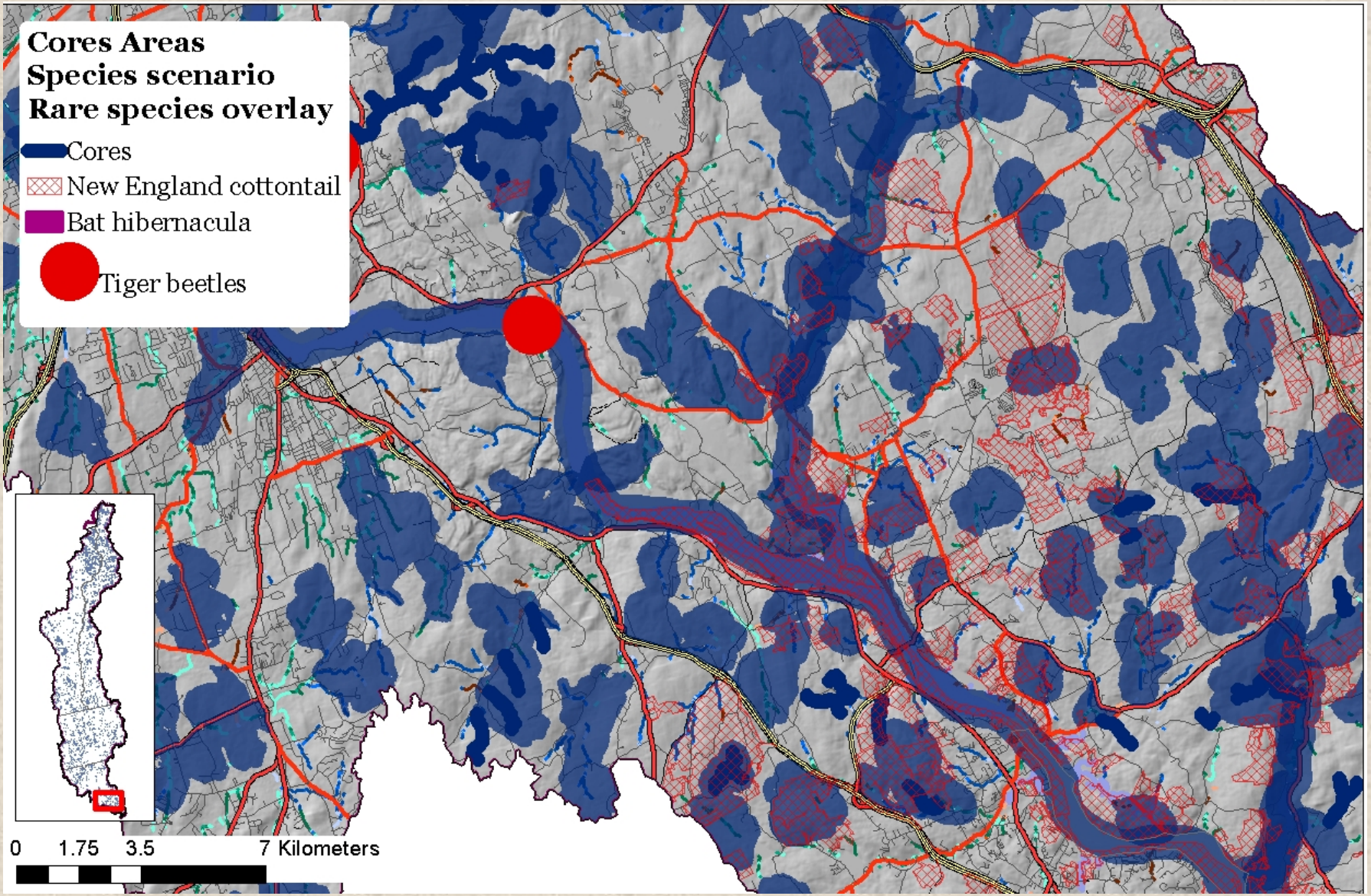
Macrogroup	% selindex
Central Oak-Pine	48%
Central Hardwood Swamp	31%
Ruderal Shrubland & Grassland	10%

Conservation Overlays

- **Conservation overlays…** areas with high conservation value for other reasons
  - **Rare communities…** places important for rare natural communities
  - **Rare species…** places important for rare species
  - **Others… (active river area?)**

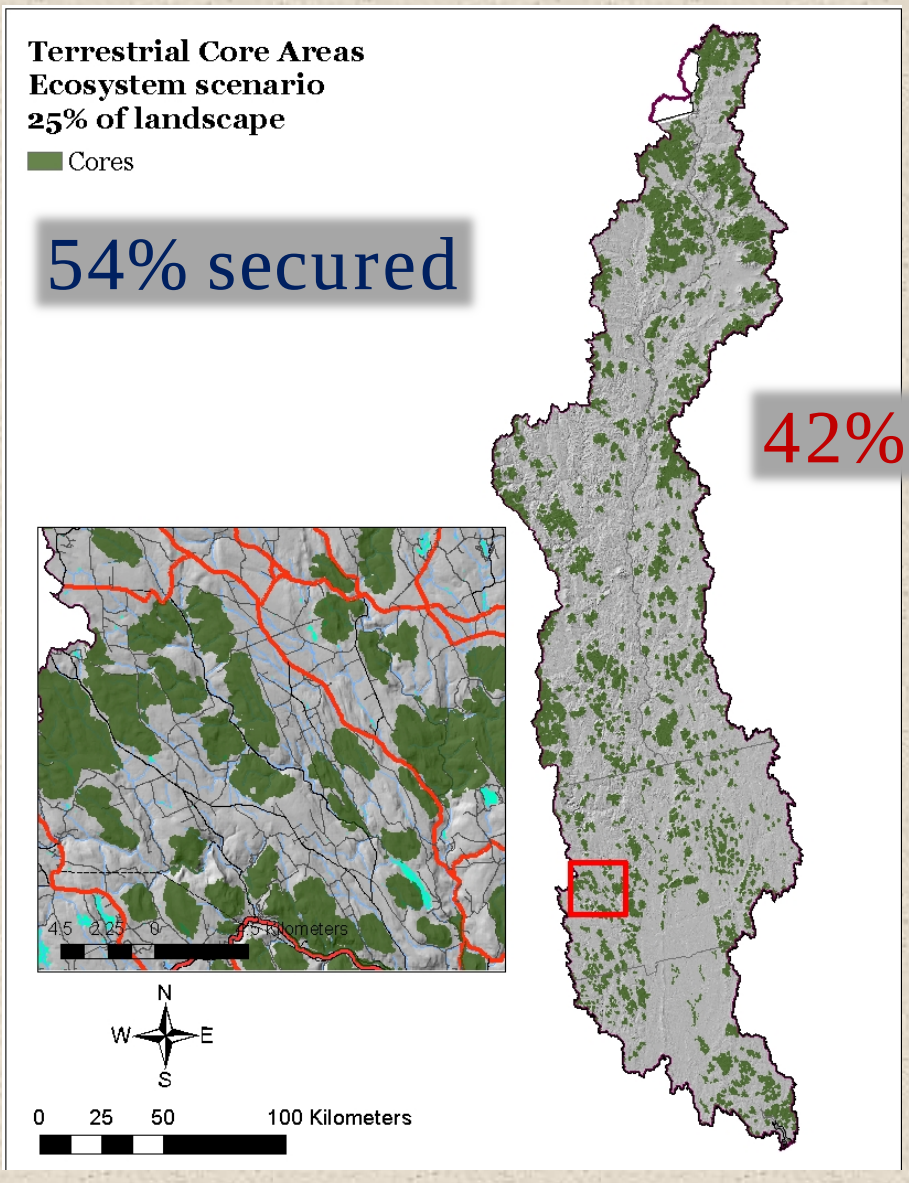
Conservation Overlays

Rare species

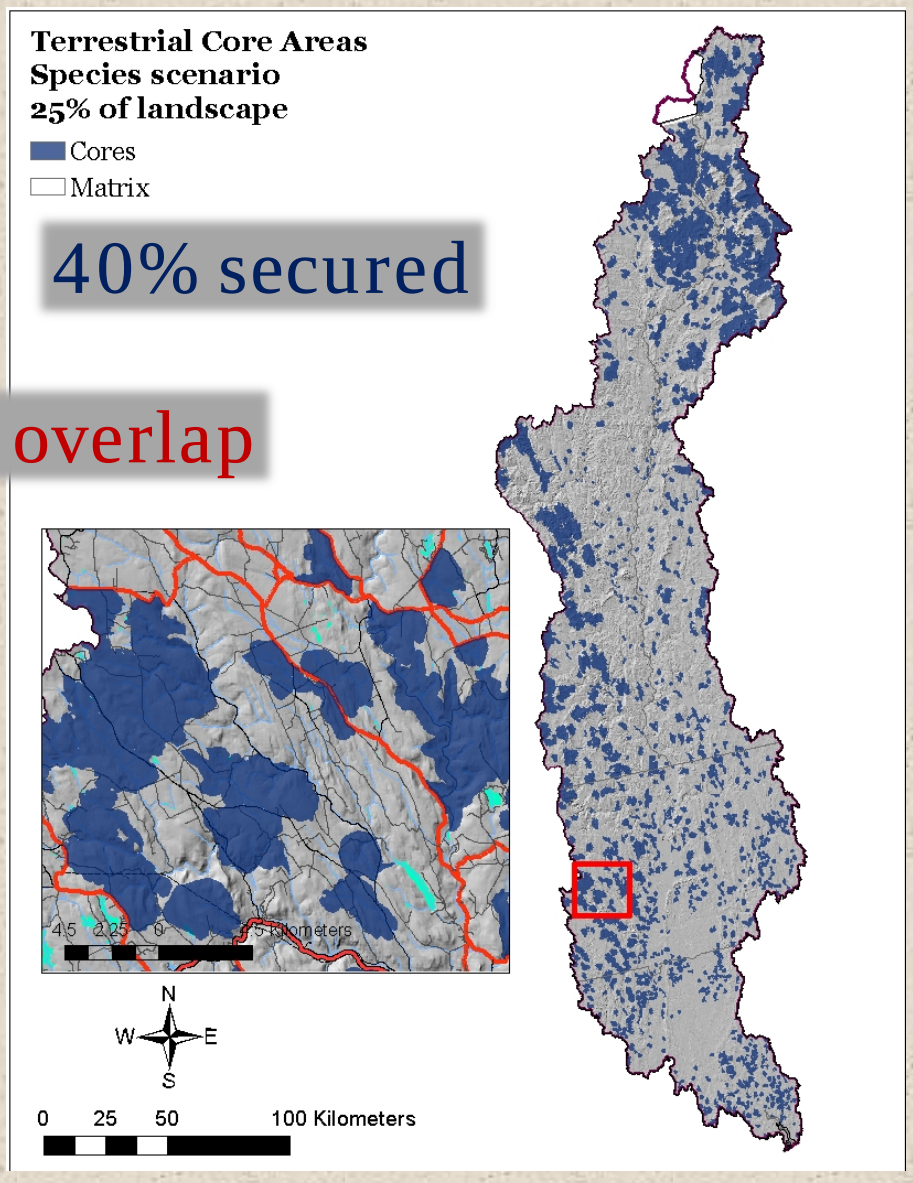


Scenario comparison

Terrestrial core area network



42% overlap



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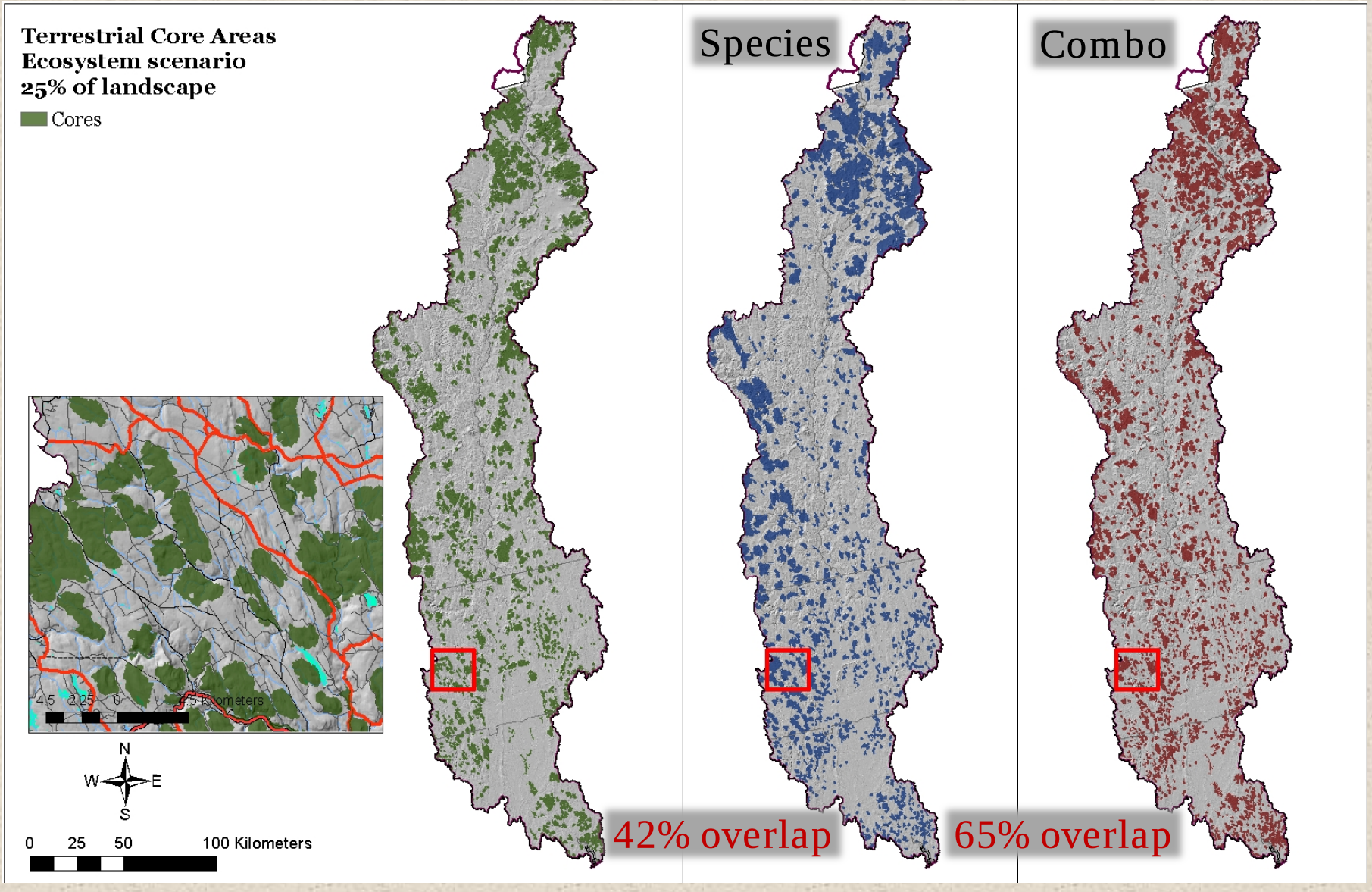

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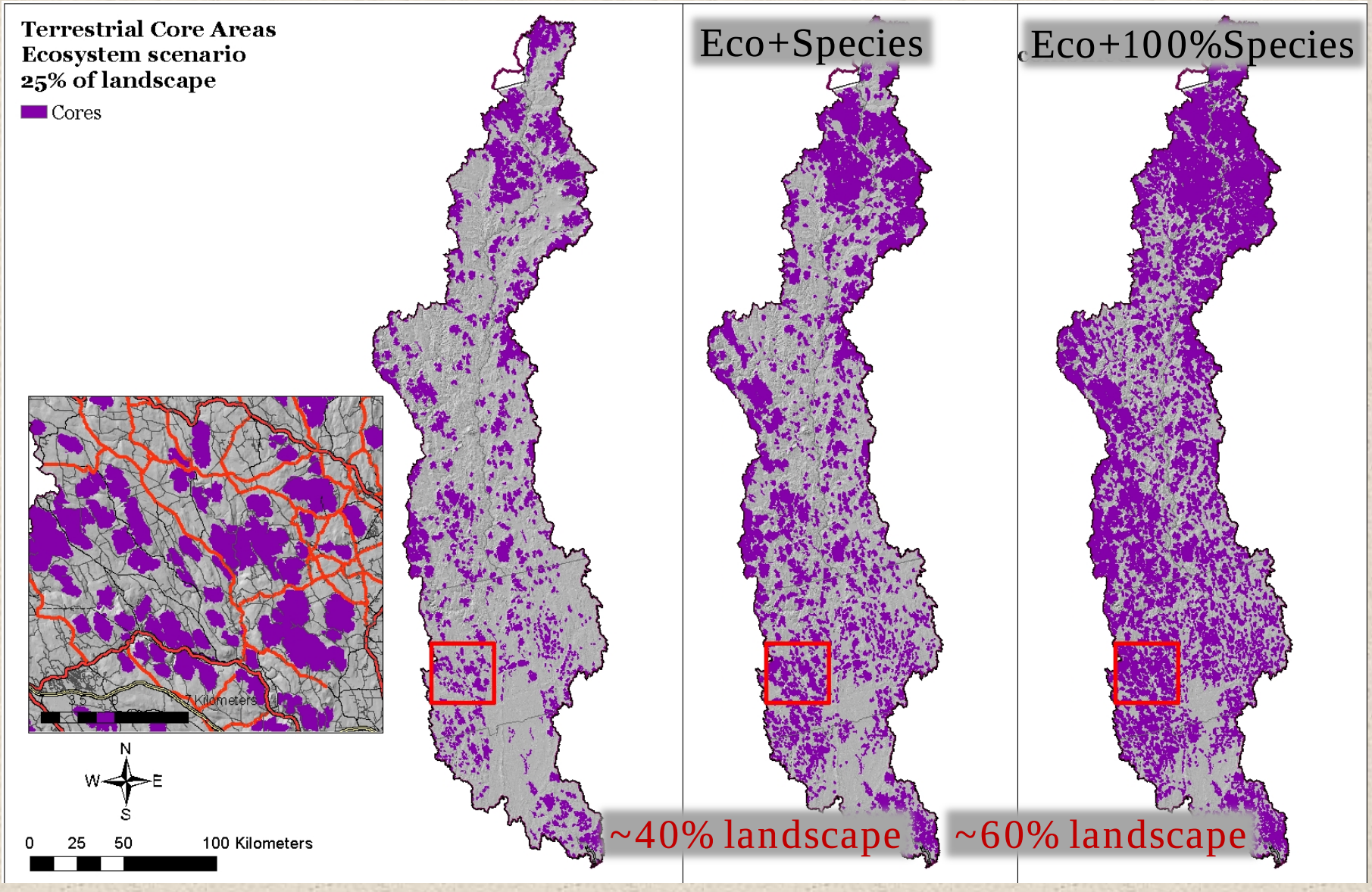

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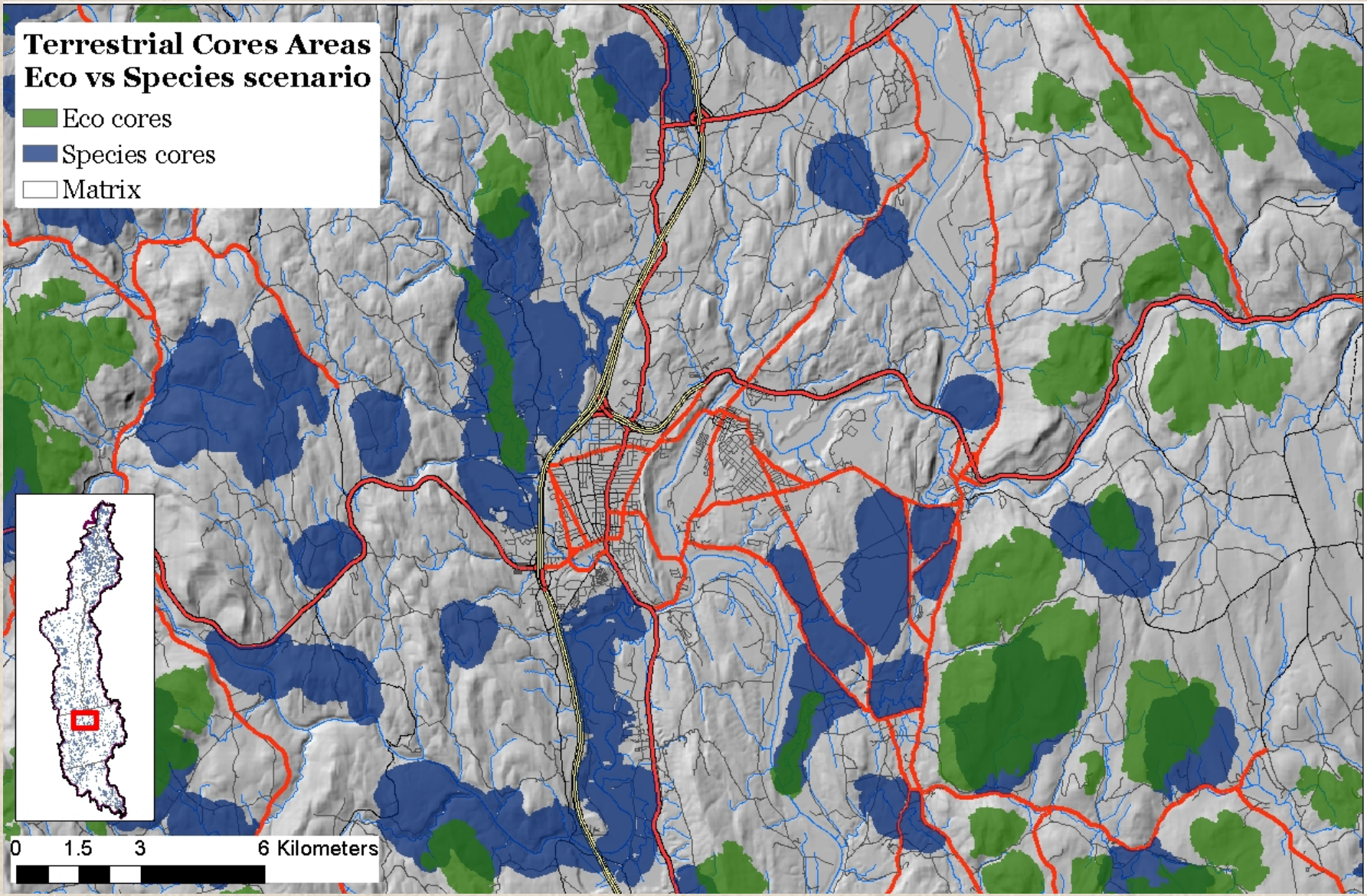

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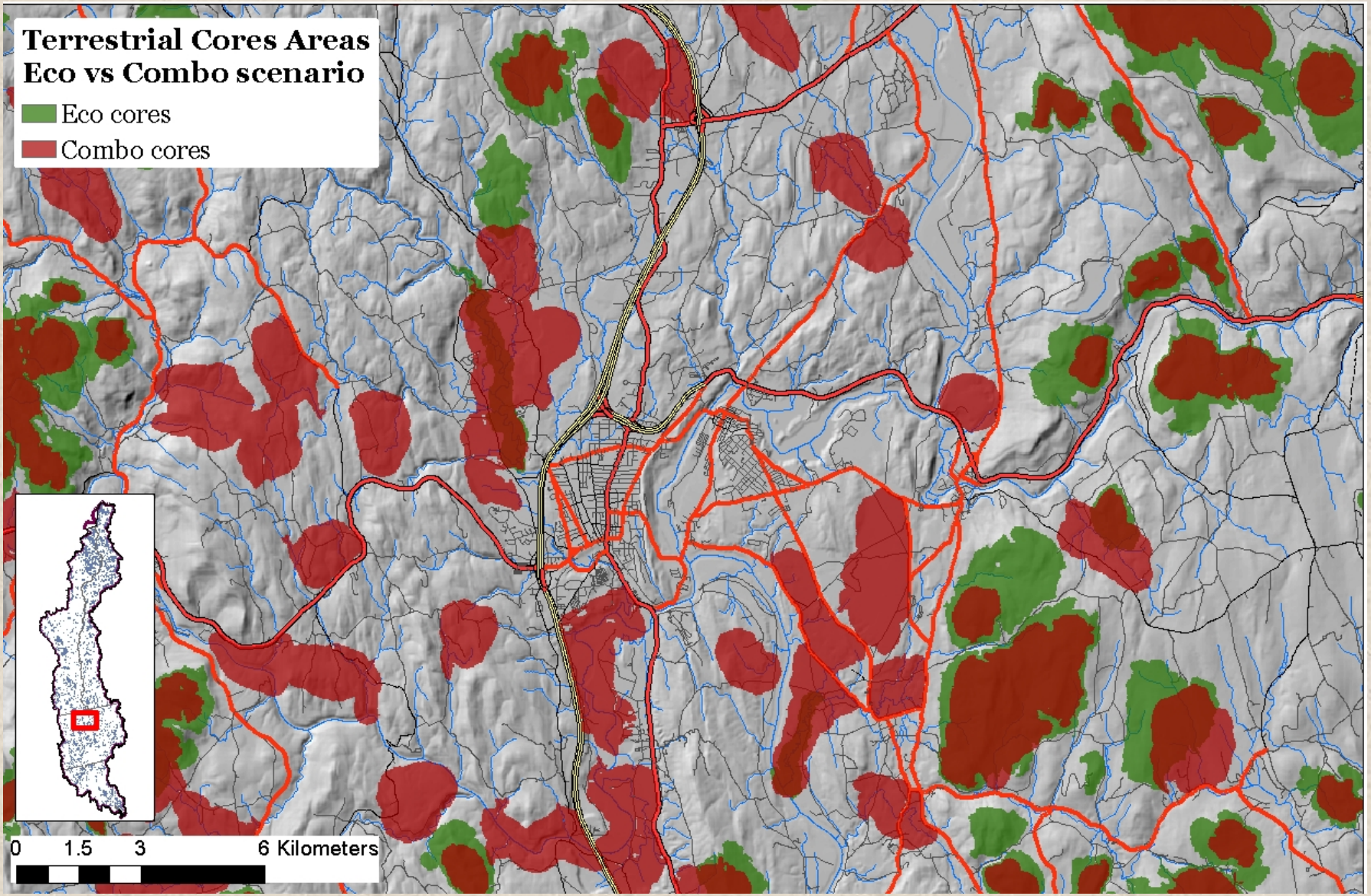
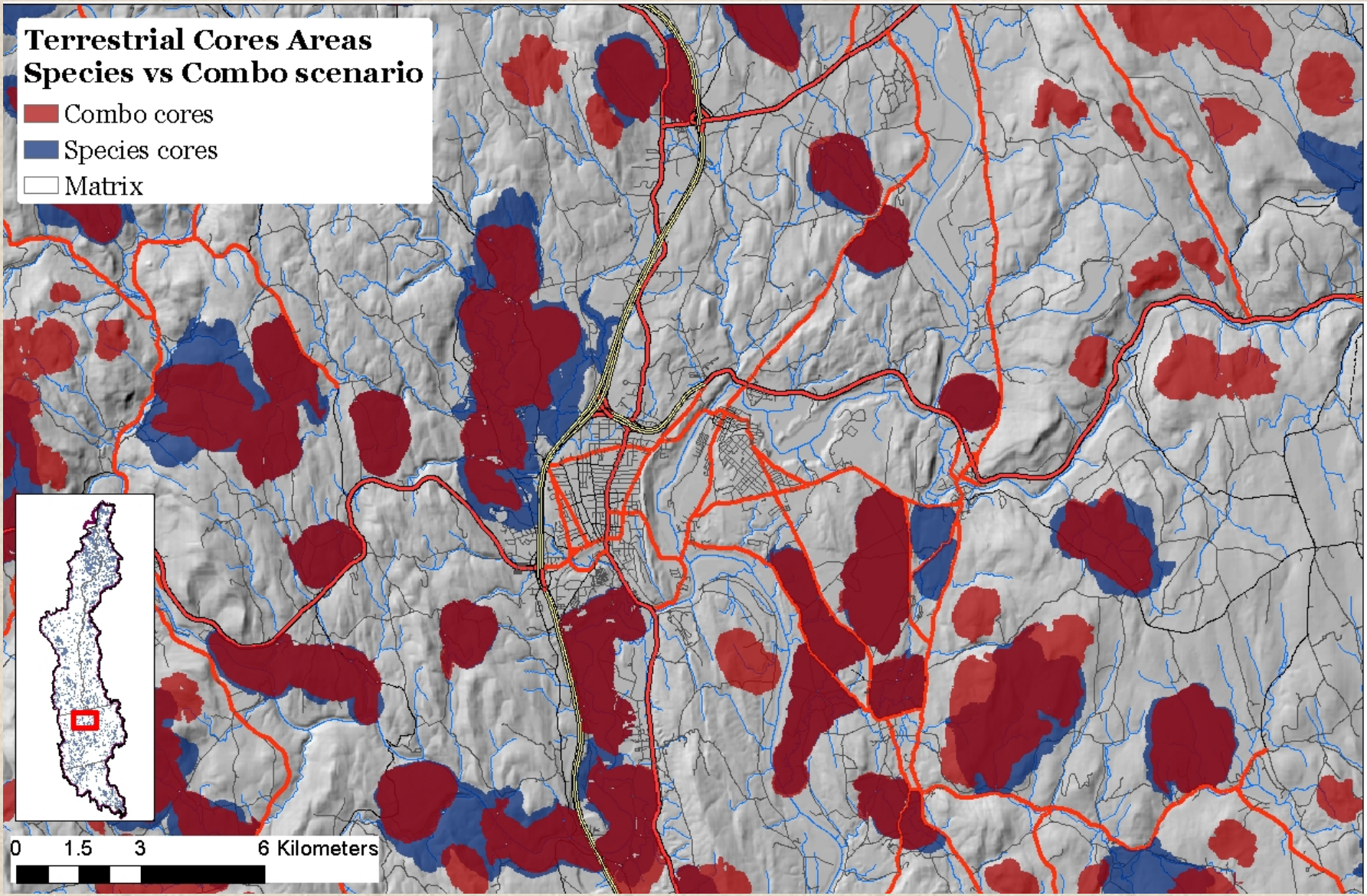


Scenario comparison

Terrestrial core area network



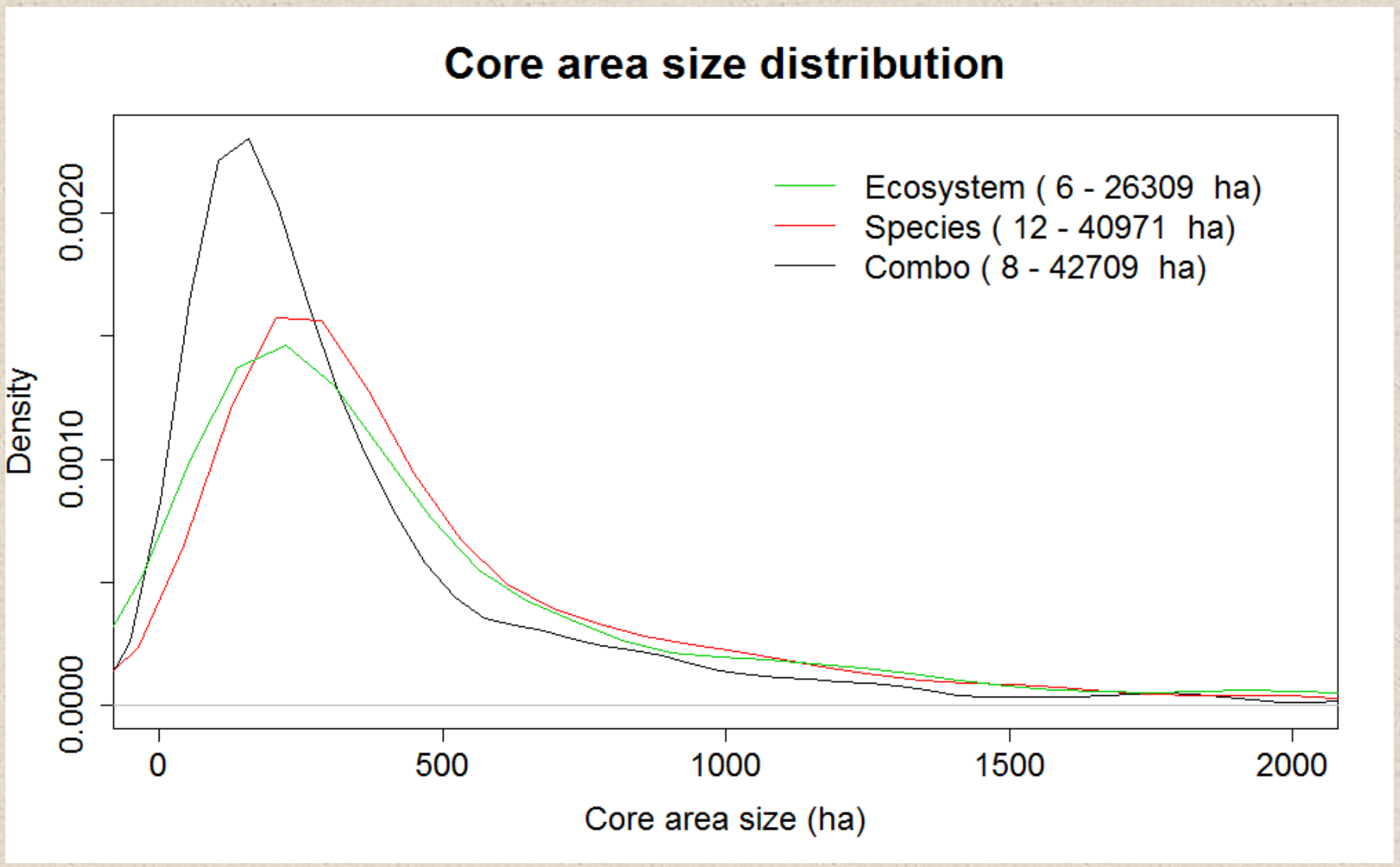
Scenario comparison

Terrestrial core area network

Species	Full target	Realized %LC		
		Ecosystem	Species	Combo
Blackpoll Warbler	85%	78%	52%	56%
Wood Turtle	80%	22%	48%	48%
American Woodcock	73%	32%	44%	44%
Eastern Meadowlark	73%	2%	44%	44%
Blackburnian Warbler	63%	37%	39%	39%
Louisiana Waterthrush	63%	29%	38%	38%
Marsh Wren	63%	39%	40%	49%
Moose	55%	37%	35%	36%
Northern Waterthrush	55%	43%	39%	47%
Wood Thrush	55%	37%	33%	34%
Prairie Warbler	50%	27%	44%	44%
Wood Duck	50%	37%	34%	39%
Ruffed Grouse	45%	35%	34%	35%
Black Bear	40%	32%	30%	32%
Average	**61%**	**35%**	**40%**	**42%**

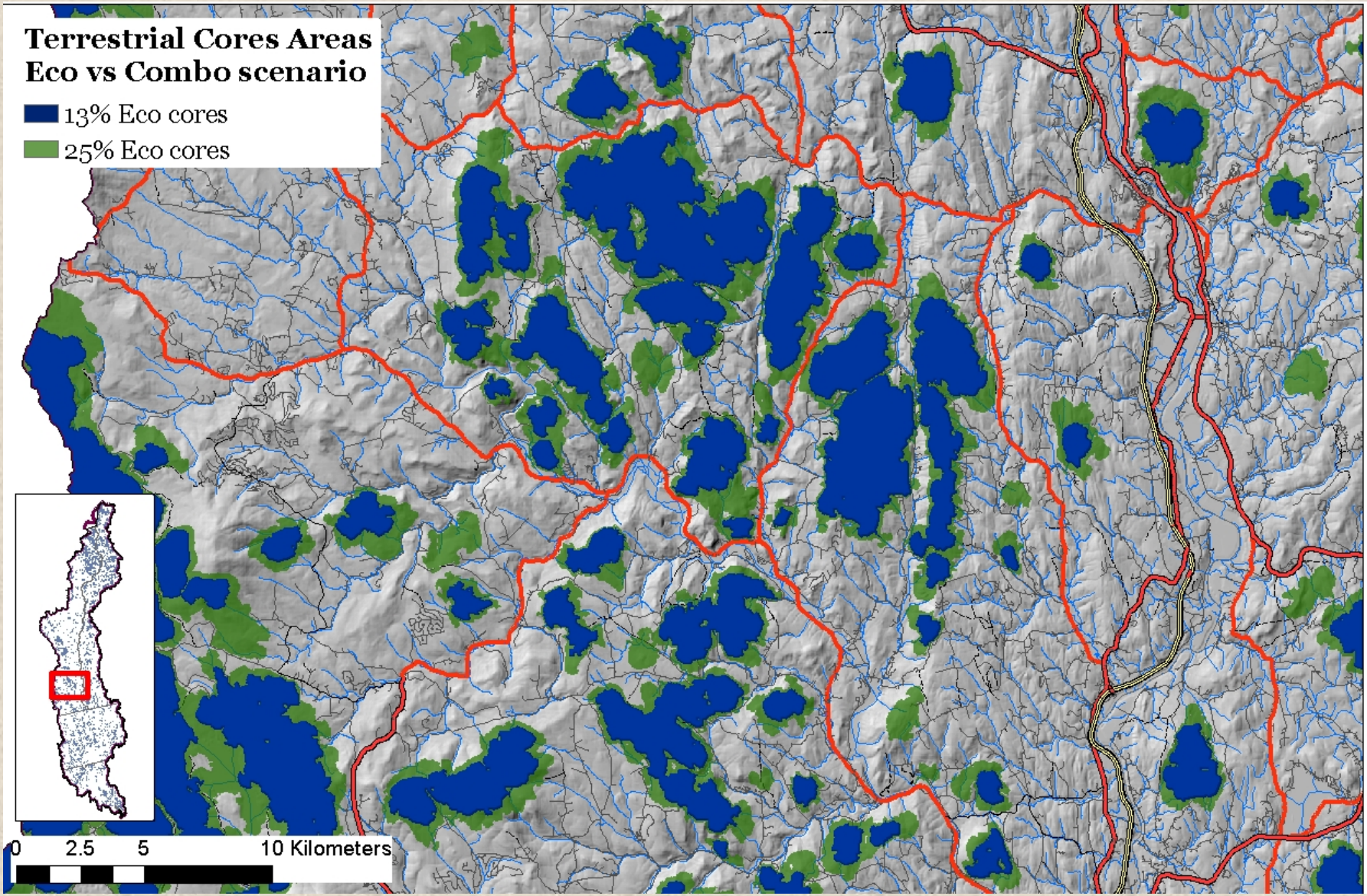
Scenario comparison

Terrestrial core area network



Scenario comparison

Terrestrial core area network



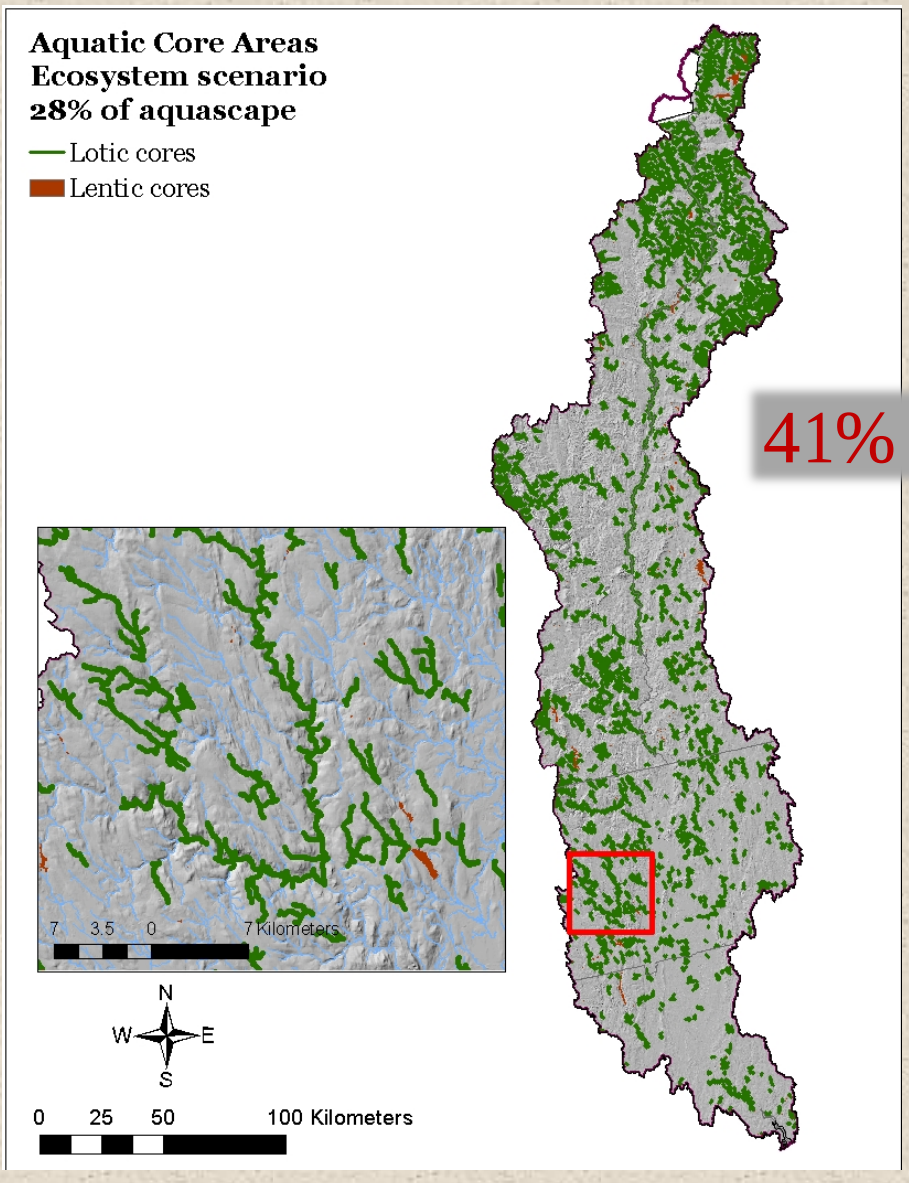
Scenario comparison

Terrestrial core area network

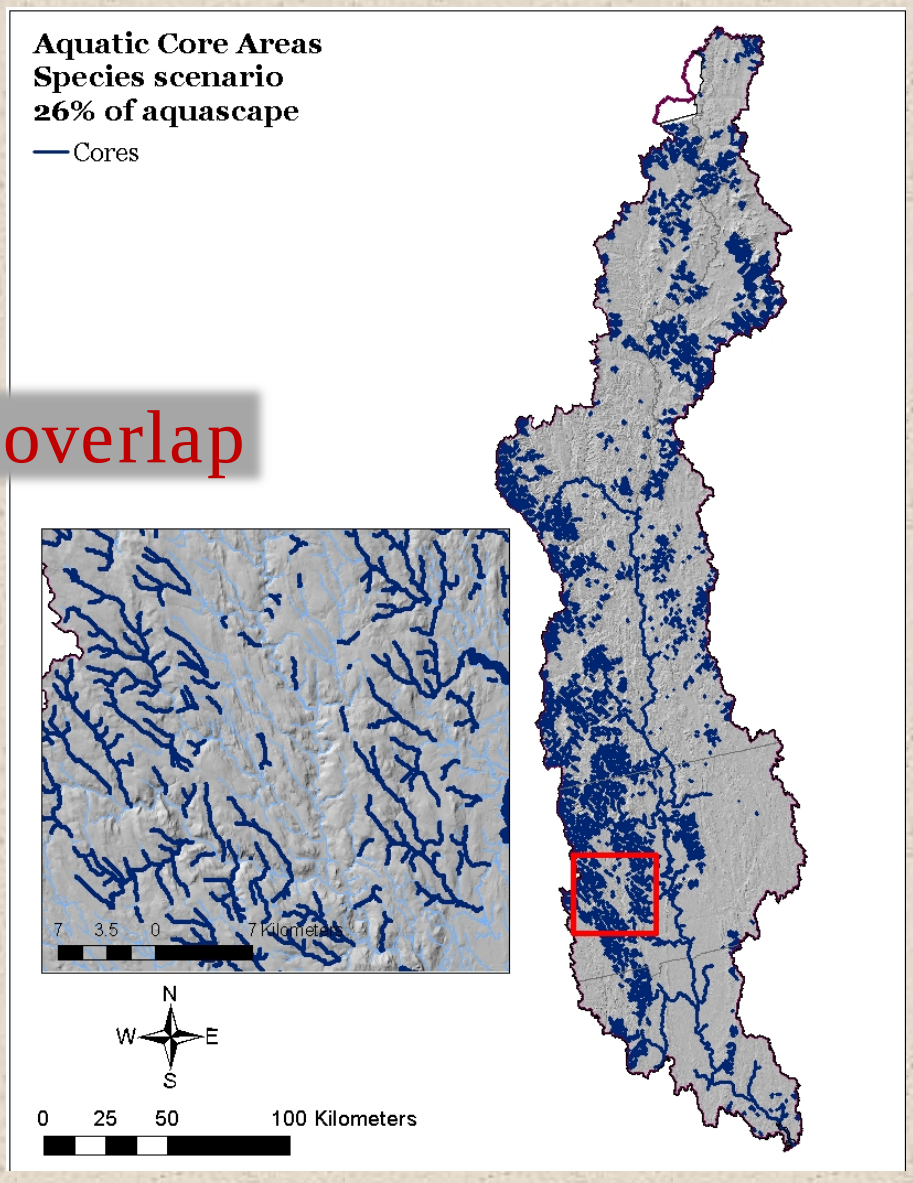
Macrogroup	CTR area (ha)	%CTR area in Cores			%CTR selindex in Cores		
		Eco	Species	Combo	Eco	Species	Combo
Northern Hardwood & Conifer	1,749,969	27	27	27	39	32	36
Boreal Upland Forest	168,630	45	38	46	54	40	51
Central Oak-Pine	145,586	43	23	40	51	24	45
Pasture/hay	135,518	2	25	25	100	43	100
Outcrop & Summit Scrub	21,155	50	33	38	60	35	46
Cliff & Talus	16,505	36	17	26	46	20	34
Ruderal Shrubland & Grassland	10,205	18	22	21	27	25	26
Glade & Barren & Savanna	680	53	30	40	63	32	48
Alpine	553	26	46	7	32	49	10
Northern Swamp	80,673	25	28	33	37	31	40
Wet Meadow / Shrub Marsh	20,960	30	37	41	35	39	45
Emergent Marsh	10,267	34	29	40	41	30	44
Central Hardwood Swamp	4,800	27	24	42	42	25	56
Northern Peatland & Fens	3,044	45	38	45	53	40	50
Ruderal Shrub Swamp	505	16	26	29	27	28	36
Northeastern Floodplain Forest	469	42	48	58	51	50	65
Lotic	85,992	22	27	28	30	32	34
Lentic	51,924	18	7	10	26	7	12
FreshwaterTidal Riverine	2,852	44	7	25	51	6	28

Scenario comparison

Aquatic core area network

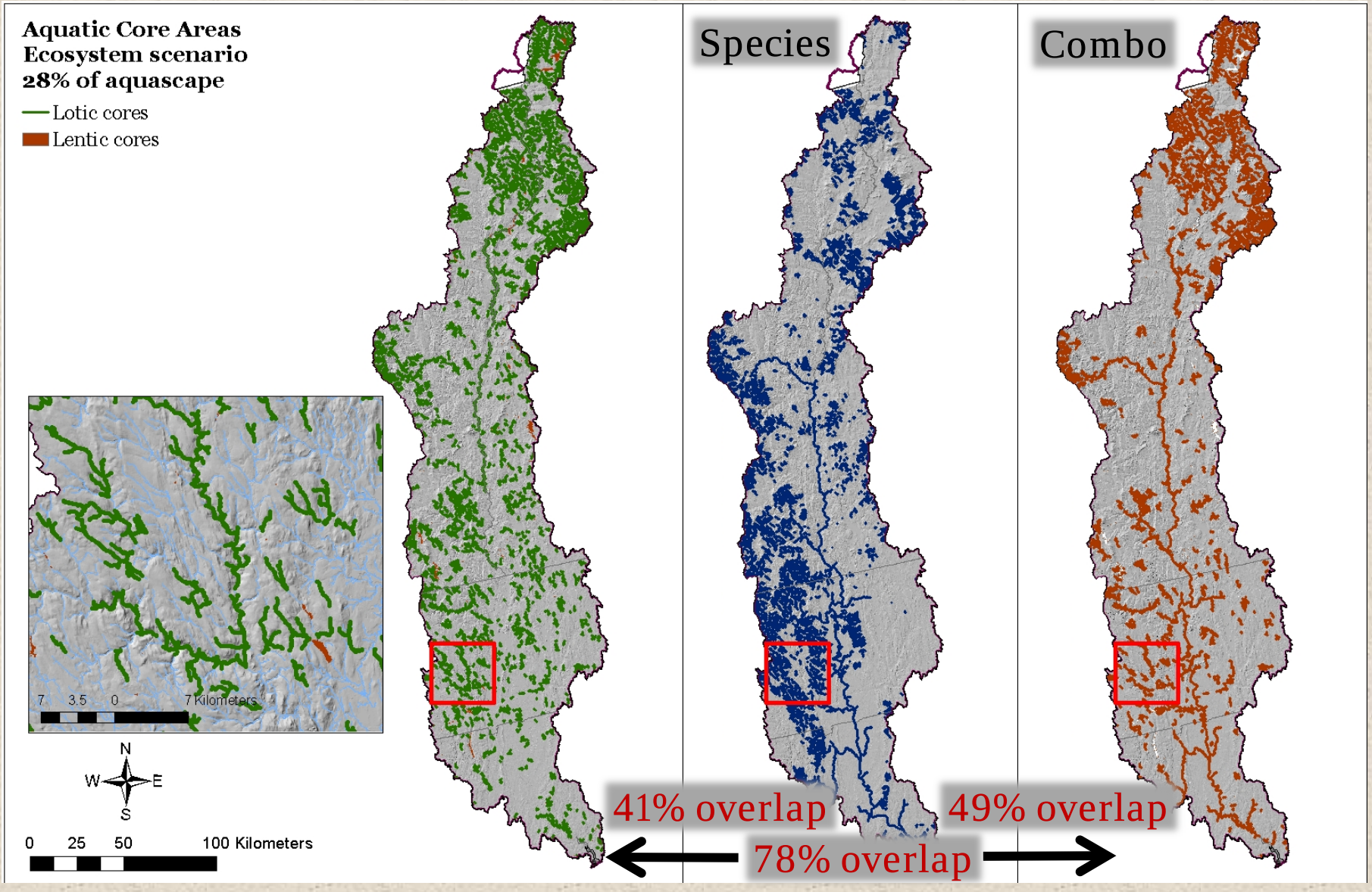


41% overlap



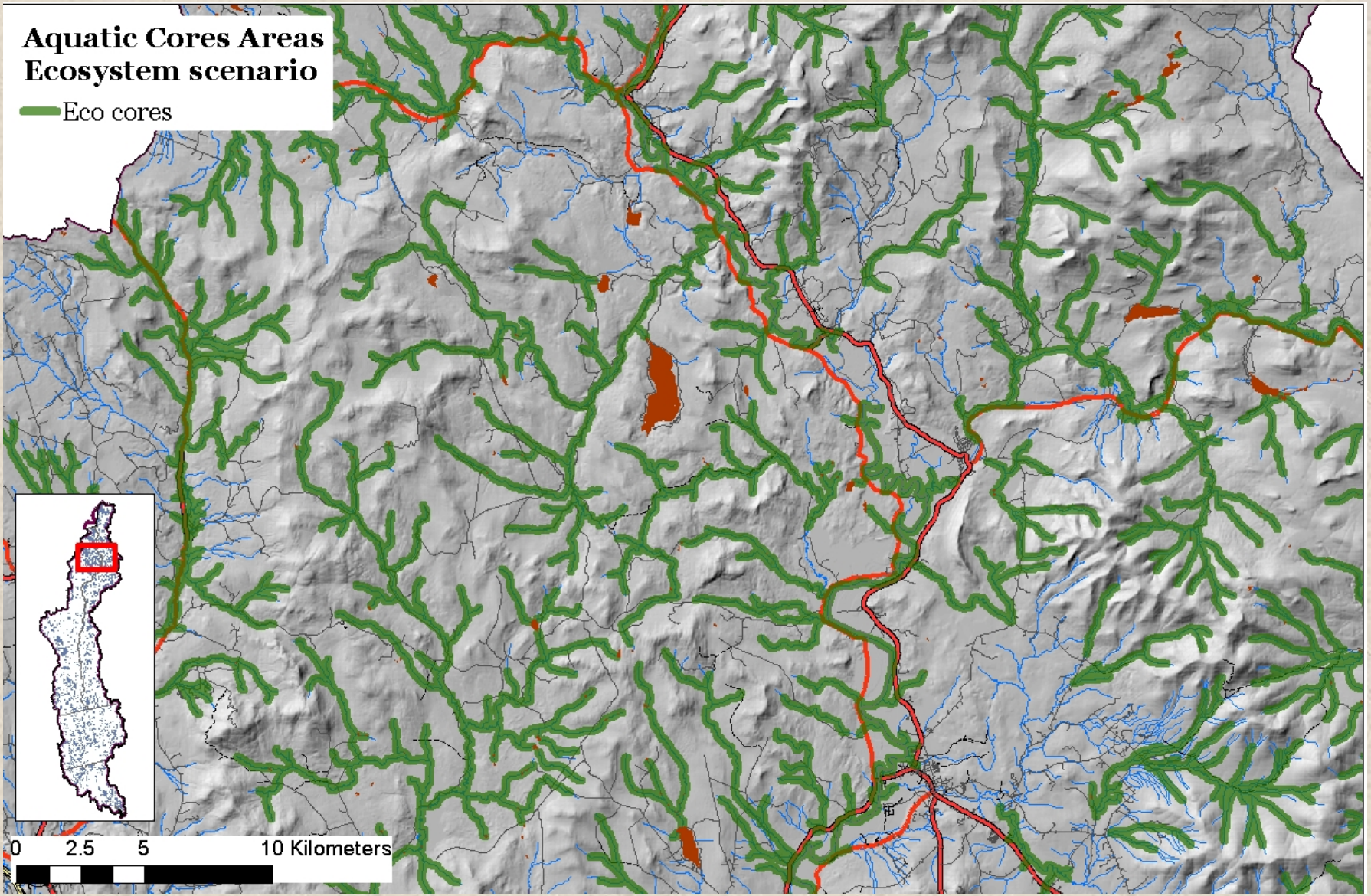
Scenario comparison

Aquatic core area network



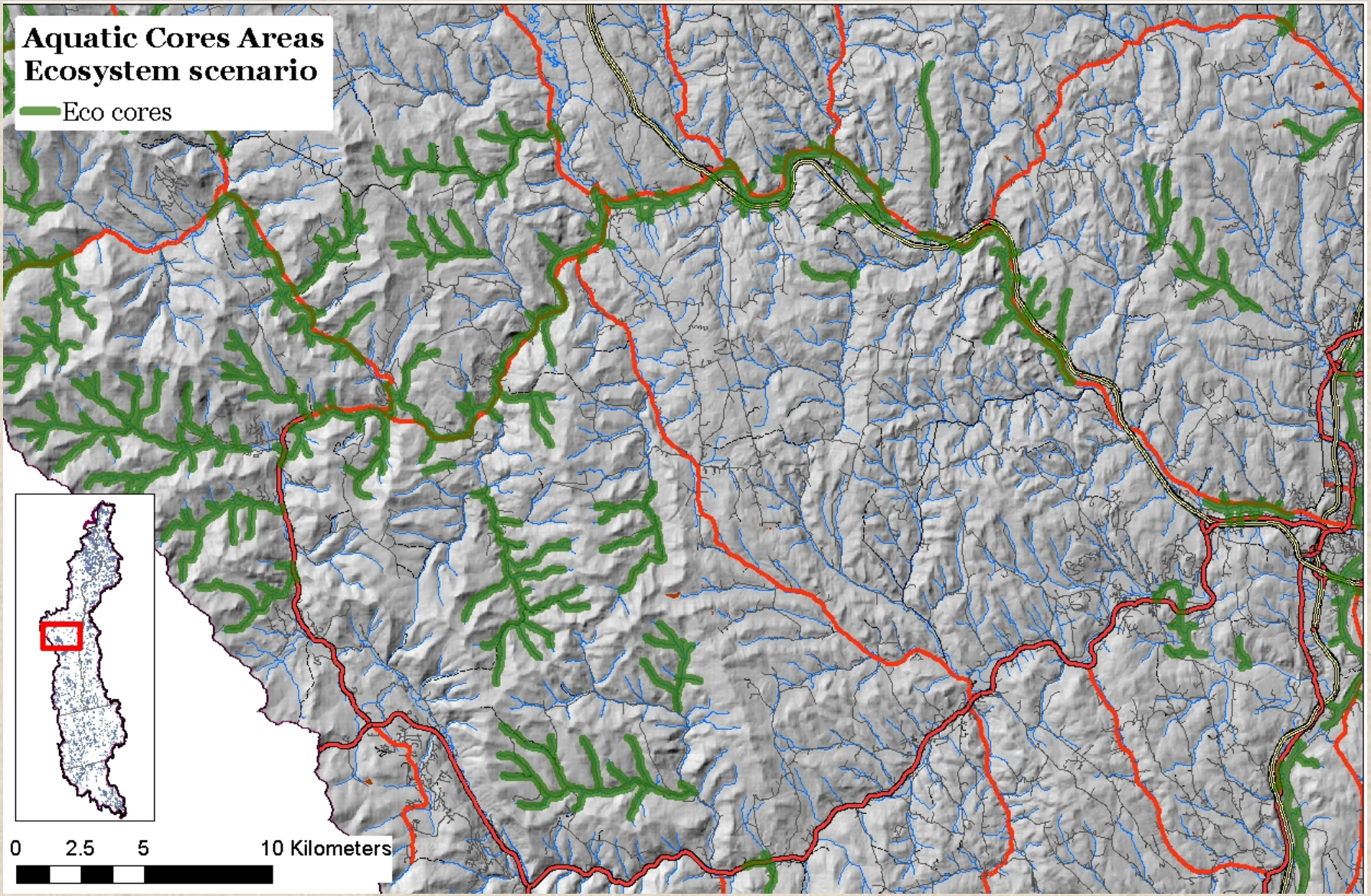
Scenario comparison

Aquatic core area network



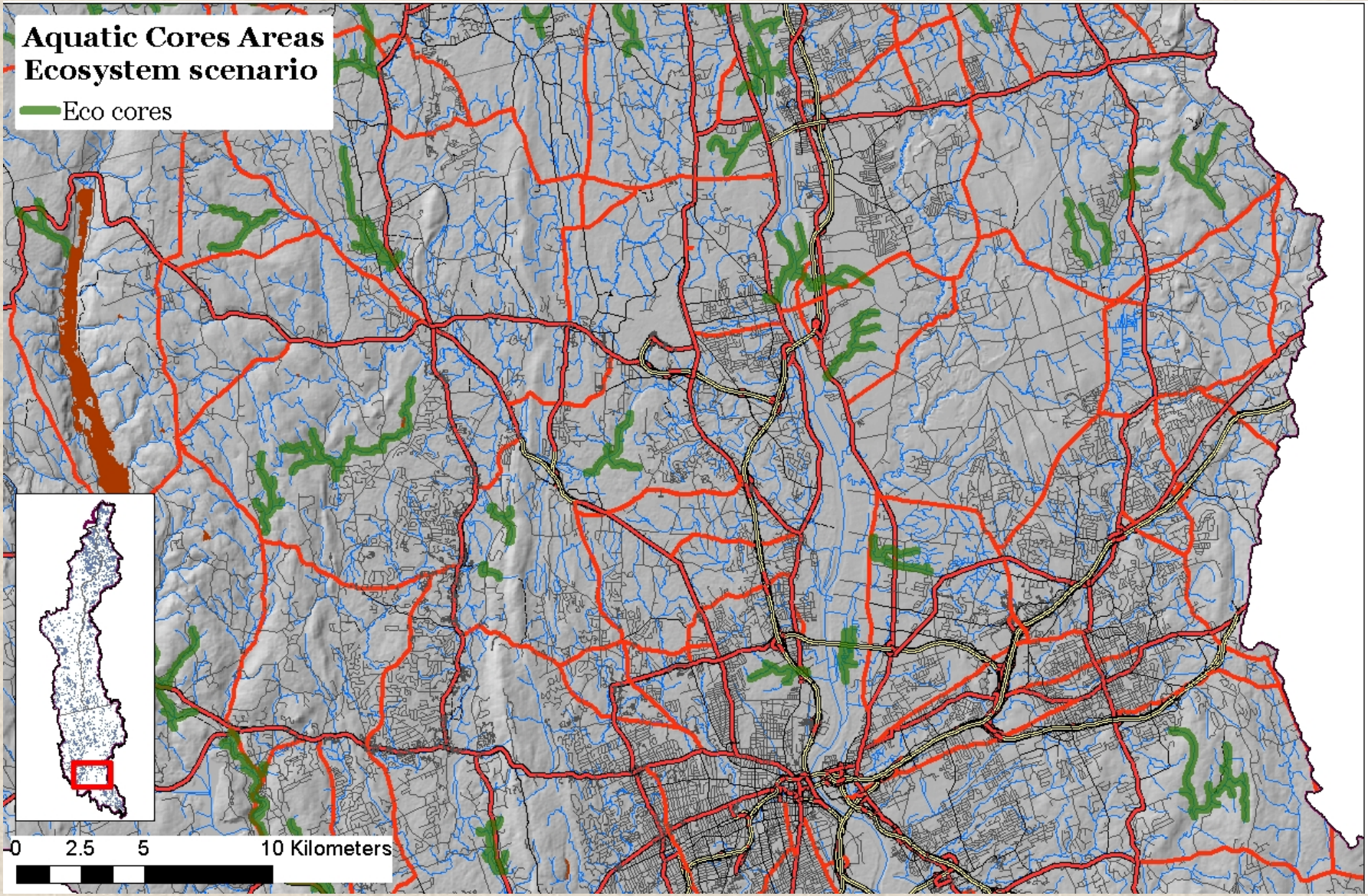
Scenario comparison

Aquatic core area network



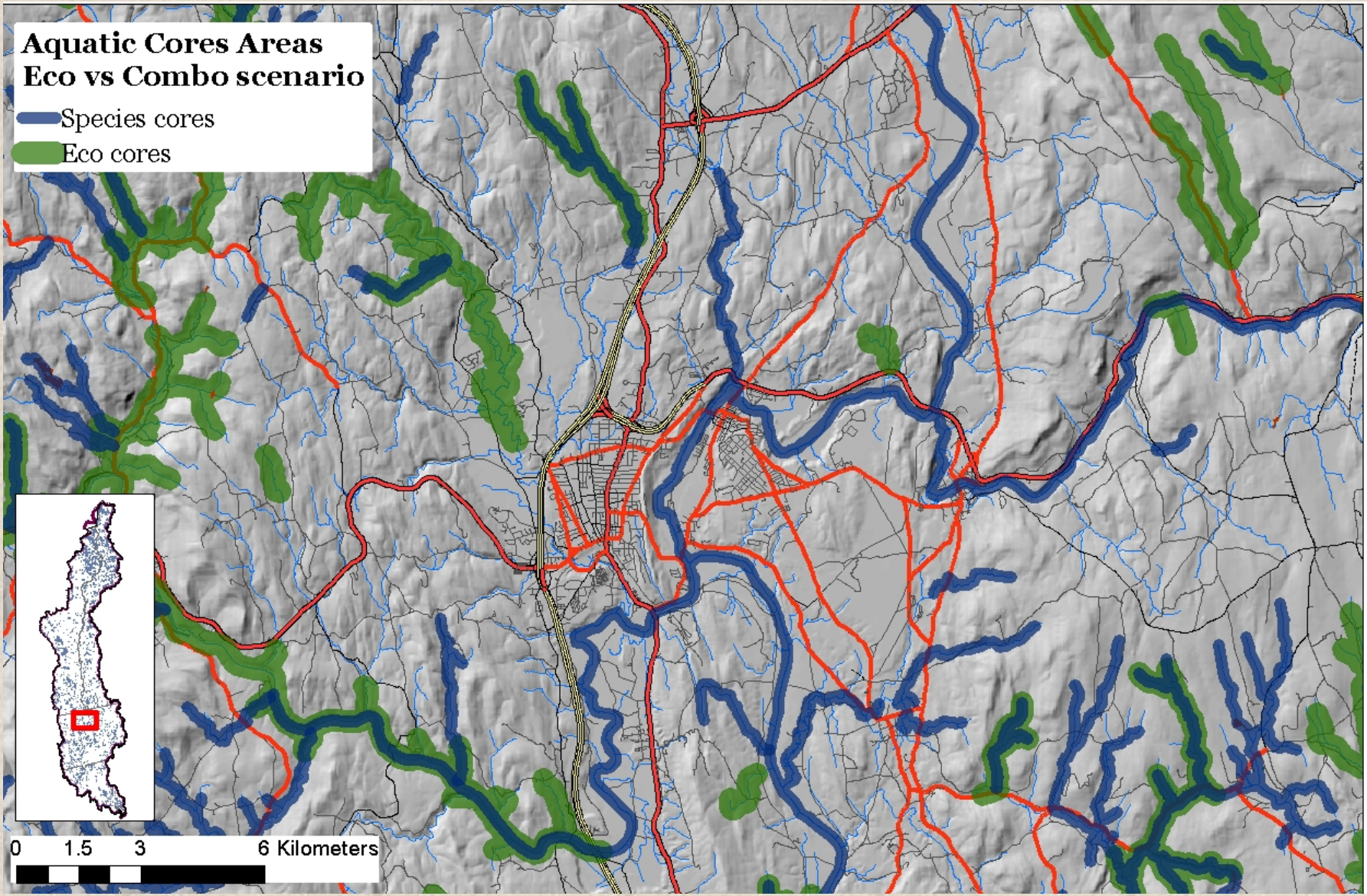
Scenario comparison

Aquatic core area network



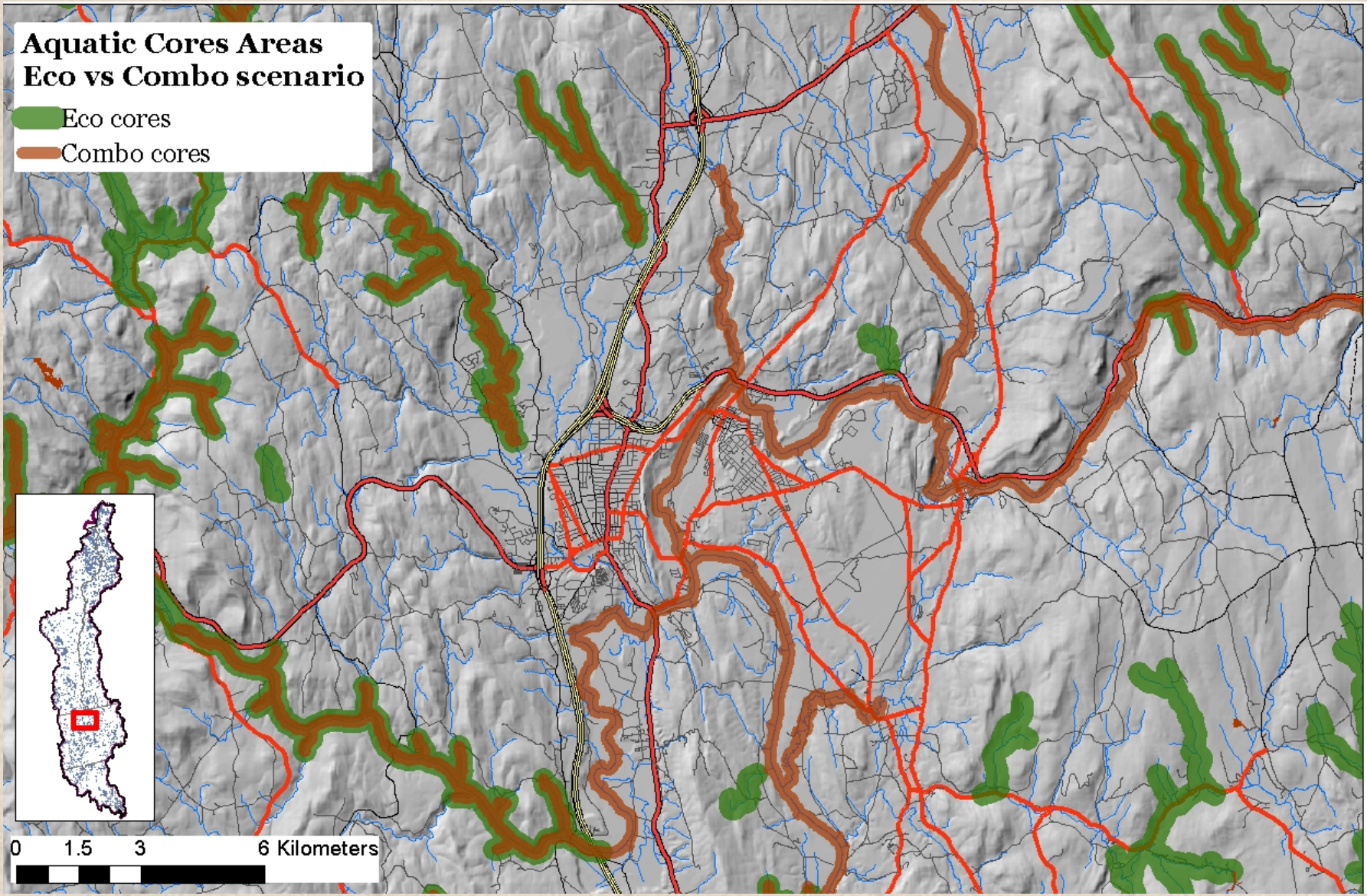
Scenario comparison

Aquatic core area network



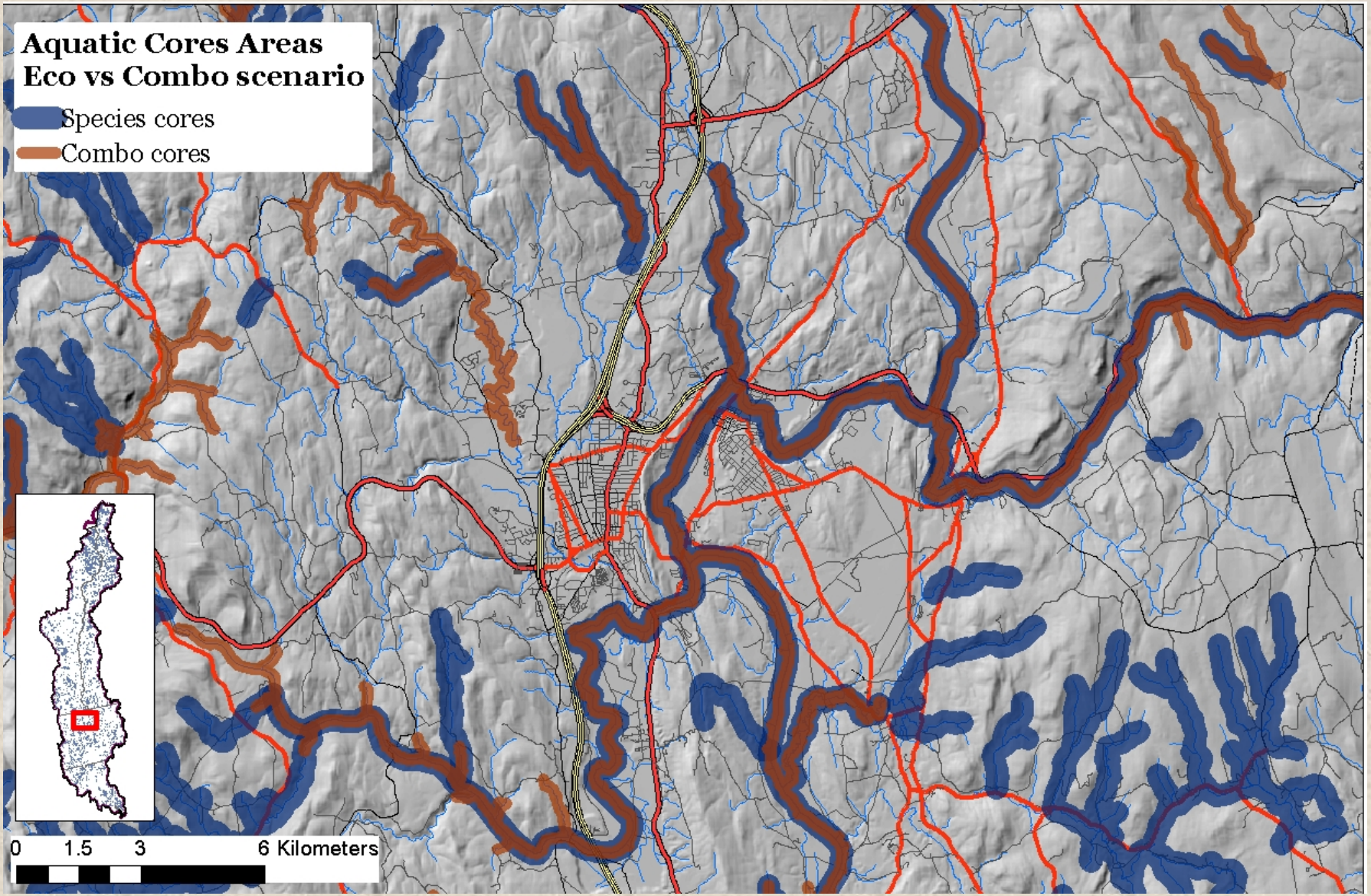
Scenario comparison

Aquatic core area network



Scenario comparison

Aquatic core area network



Scenario comparison

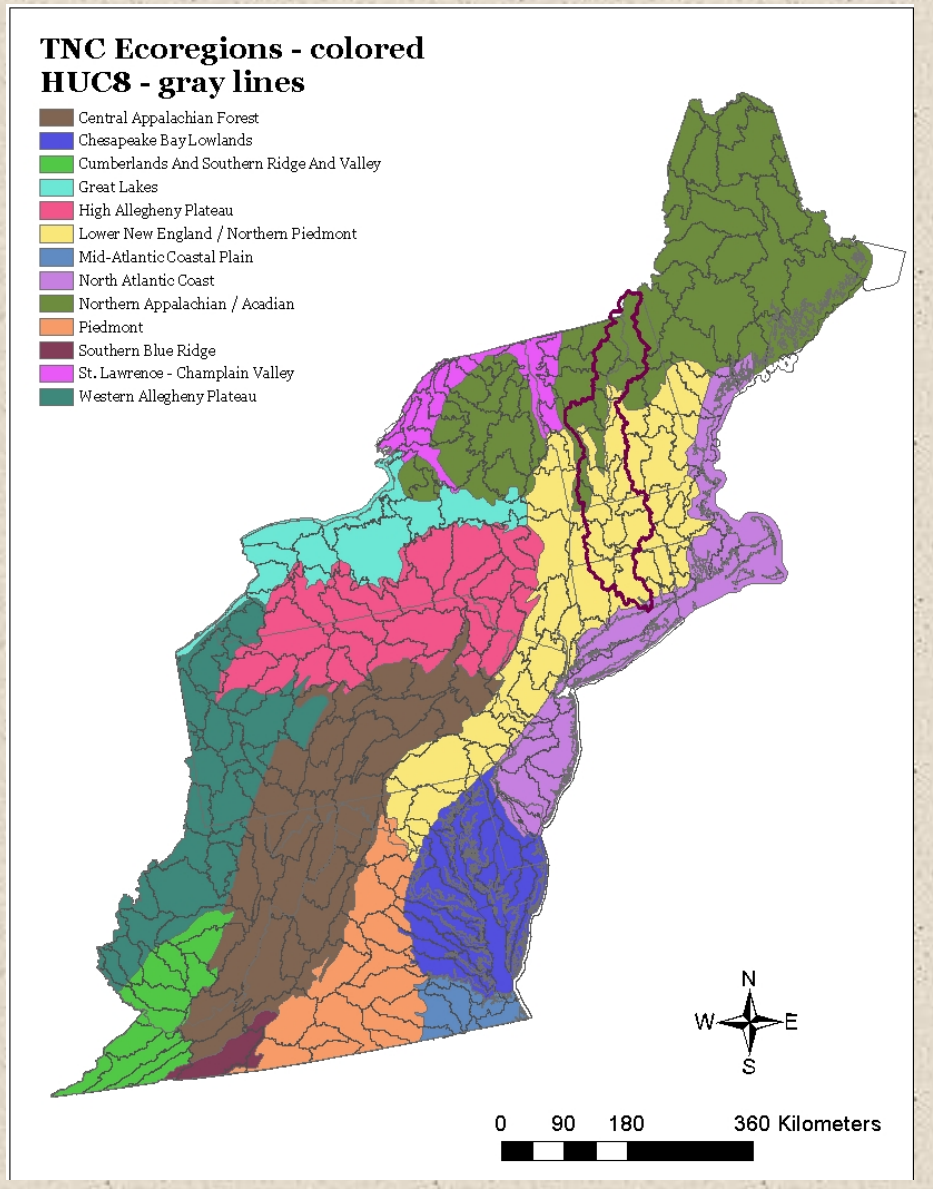
Aquatic core area network

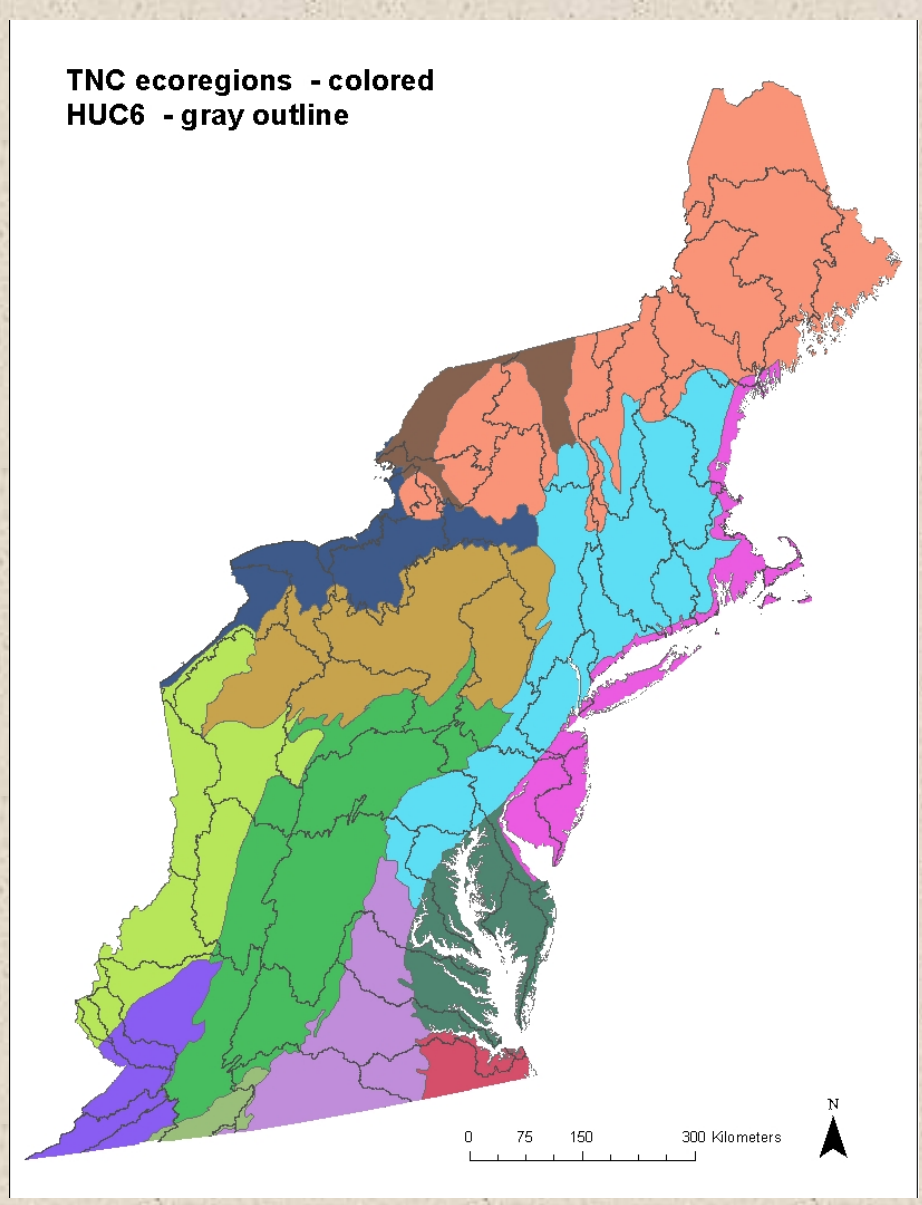
Macrogroup	CTR dist (km)	Core dist (km)			%CTR dist in Cores			%CTR selindex in Cores		
		Eco	Species	Combo	Eco	Species	Combo	Eco	Species	Combo
Stream (headwater) cold high	13,515	4,154	4,578	3,375	31	34	25	45	43	37
Stream (headwater) cold moderate	3,339	786	750	602	24	22	18	37	29	28
Stream (headwater) cold low	1,144	222	183	189	19	16	16	30	21	24
Stream (headwater) cool high	842	154	74	110	18	9	13	29	12	21
Stream (headwater) cool moderate	702	112	33	77	16	5	11	24	6	16
Stream (headwater) cool low	947	129	38	94	14	4	10	21	5	14
Stream (headwater) warm high	50	7	2	6	15	3	13	23	4	20
Stream (headwater) warm moderate	39	4	1	3	11	3	9	18	3	13
Stream (headwater) warm low	83	13	7	14	16	8	17	27	11	24
Stream (small) cold moderate	464	217	8	192	47	2	41	72	2	66
Stream (small) cold low	179	69	0	57	39	0	32	62	0	53
Stream (small) cool moderate	381	181	60	196	47	16	51	72	8	65
Stream (small) cool low	270	101	84	151	38	31	56	61	18	61
Stream (medium) cold	104	57	-	53	55	0	51	80	0	77
Stream (medium) cool	405	184	155	247	45	38	61	71	43	79
Stream (medium) warm	120	51	82	104	43	69	87	70	57	89
Stream (large) cool	392	214	239	378	55	61	96	78	42	97
Stream (large) warm	21	12	16	16	56	75	76	83	90	91
FreshwaterTidal Riverine	132	51	96	111	38	73	84	64	72	91

Next Steps

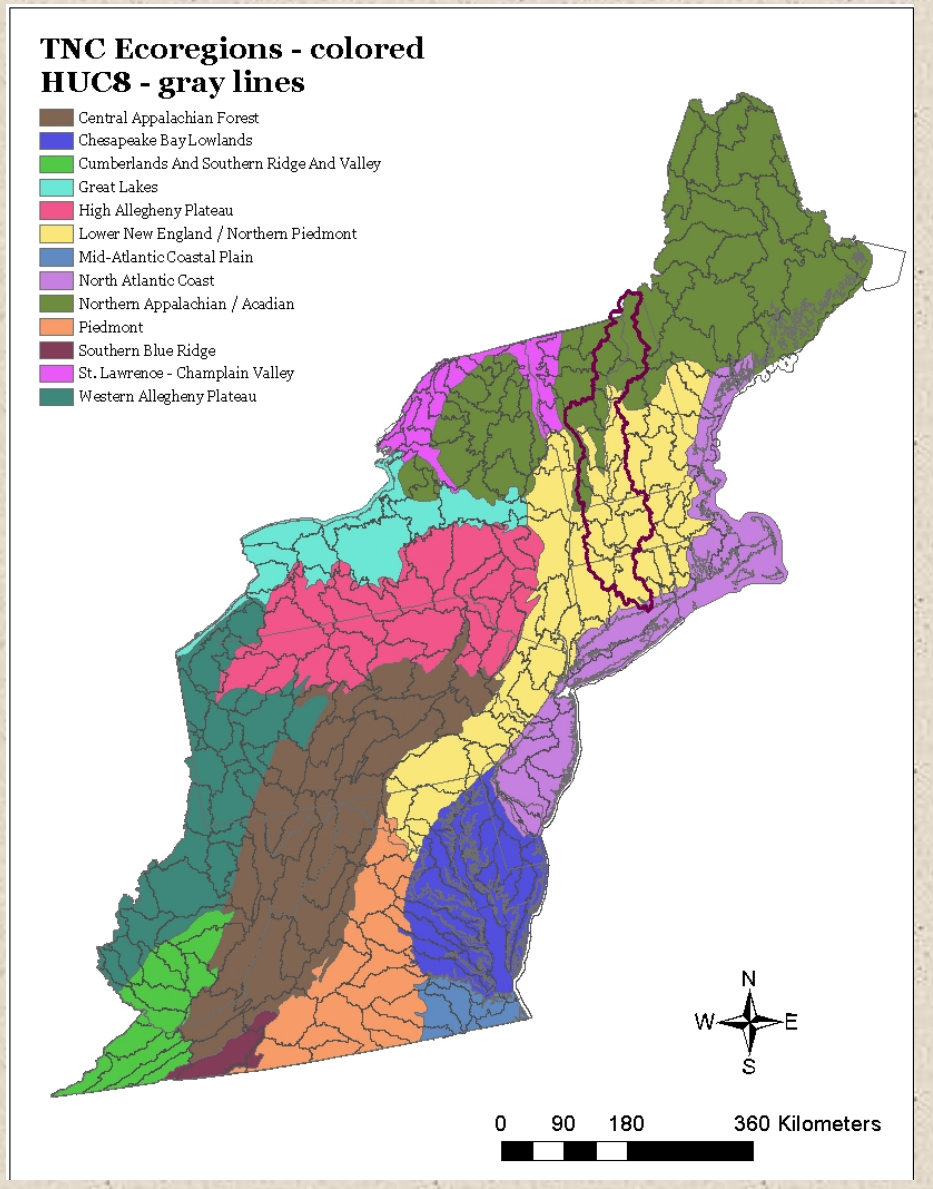
1. Resolve scaling issue
2. Incorporate future landscape change
3. Determine most effective way to describe/present results

Next Steps


TNC Ecoregions - colored
HUC8 - gray lines
Central Appalachian Forest
Chesapeake Bay Lowlands
Cumberlands And Southern Ridge And Valley
Great Lakes
High Allegheny Plateau
Lower New England / Northern Piedmont
Mid-Atlantic Coastal Plain
North Atlantic Coast
Northern Appalachian / Acadian
Piedmont
Southern Blue Ridge
St. Lawrence - Champlain Valley
Western Allegheny Plateau
N
W
E
S
0 90 180 360 Kilometers


TNC ecoregions - colored
HUC6 - gray outline
0 75 150 300 Kilometers
N

Next Steps


TNC Ecoregions - colored
HUC8 - gray lines
Central Appalachian Forest
Chesapeake Bay Lowlands
Cumberlands And Southern Ridge And Valley
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N
W
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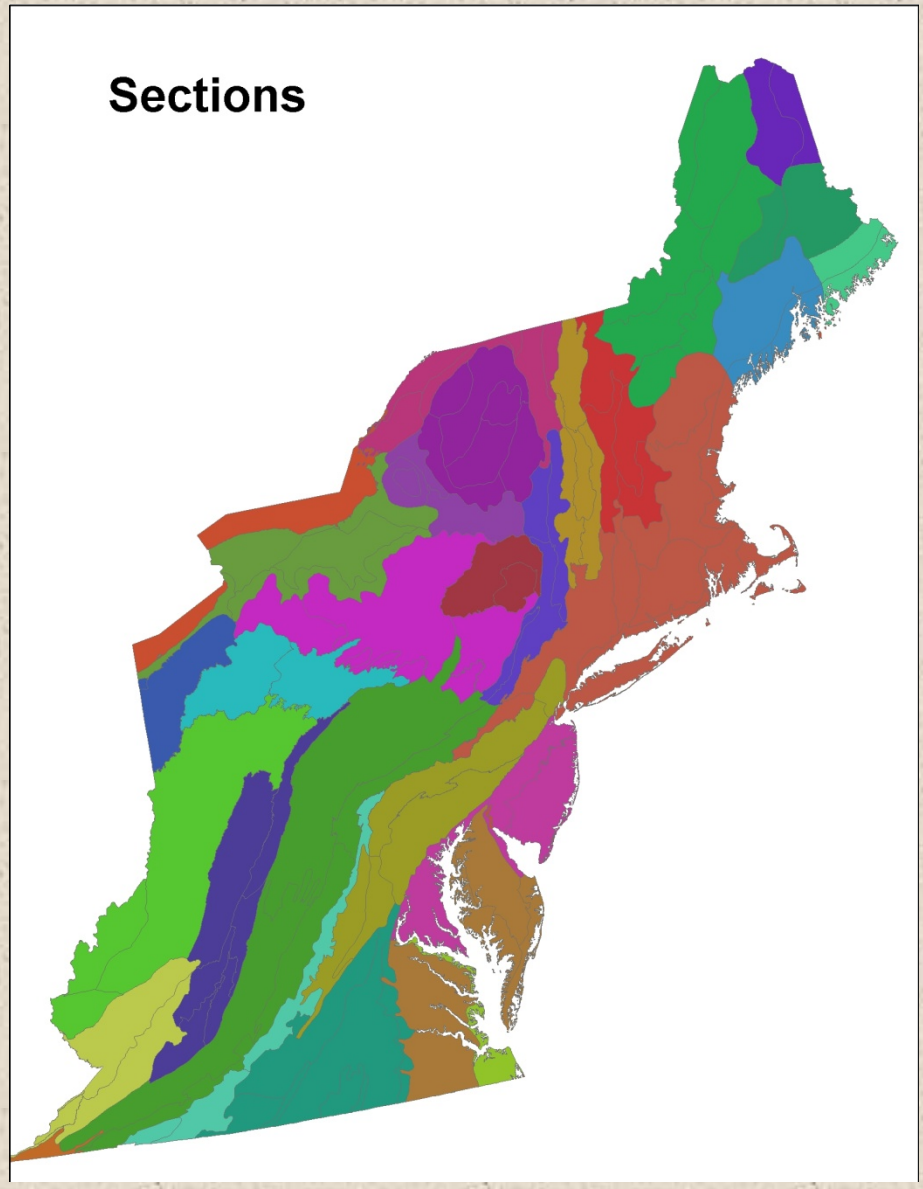
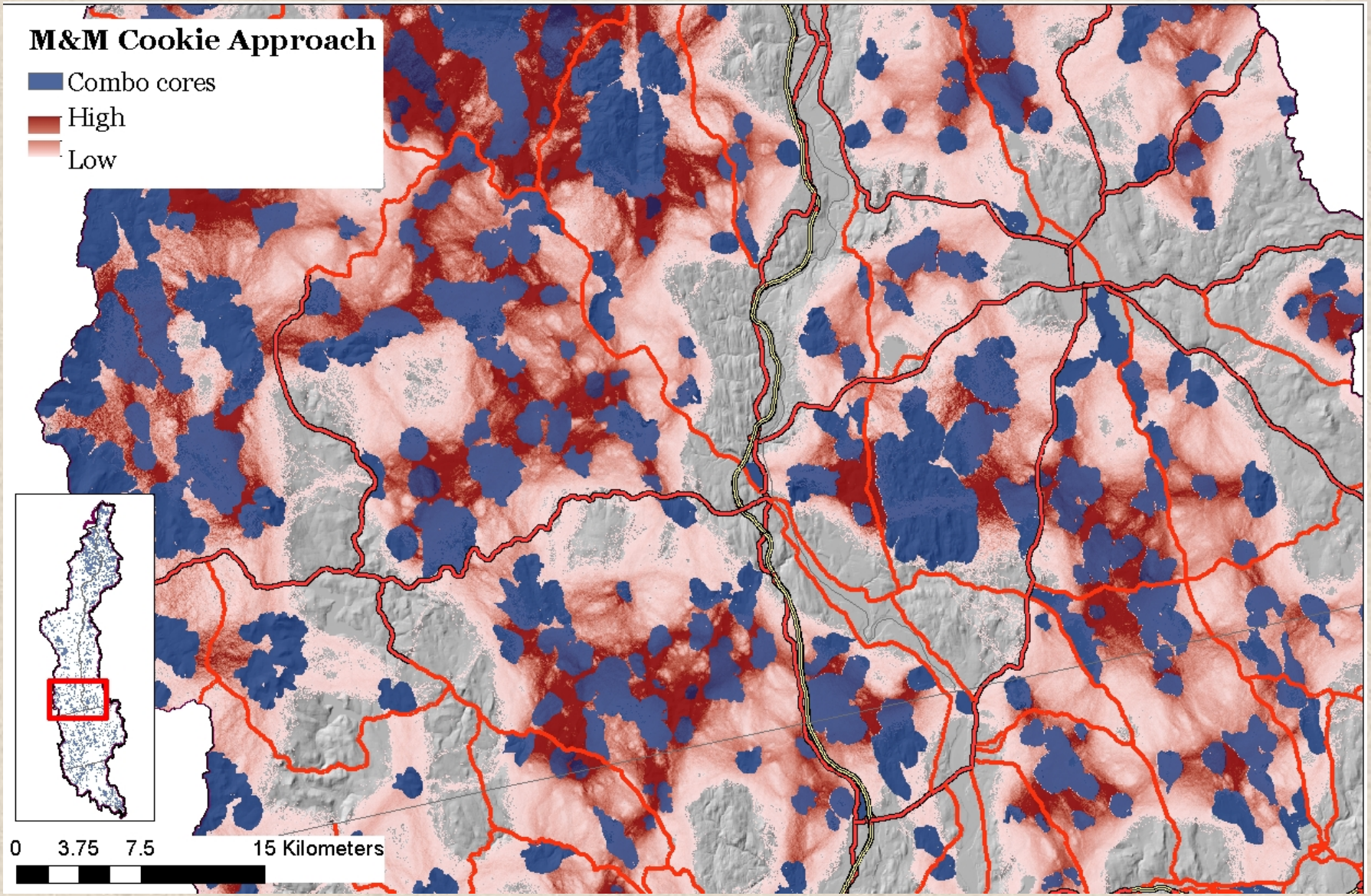
S
0 90 180 360 Kilometers


Sections

Next Steps


M&M Cookie Approach
Combo cores
High
Low
0
3.75
7.5
15 Kilometers