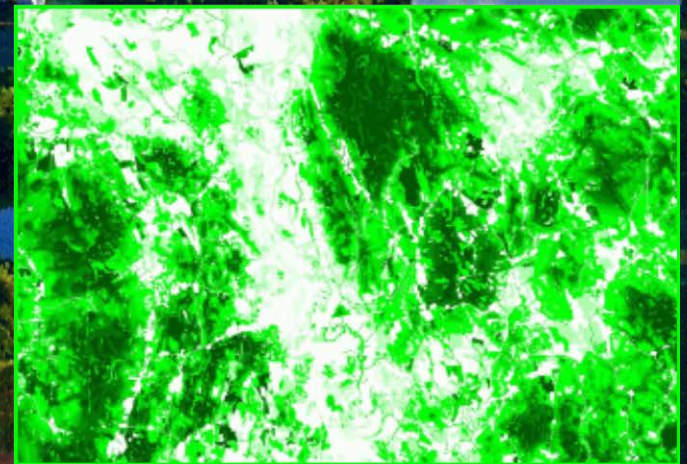
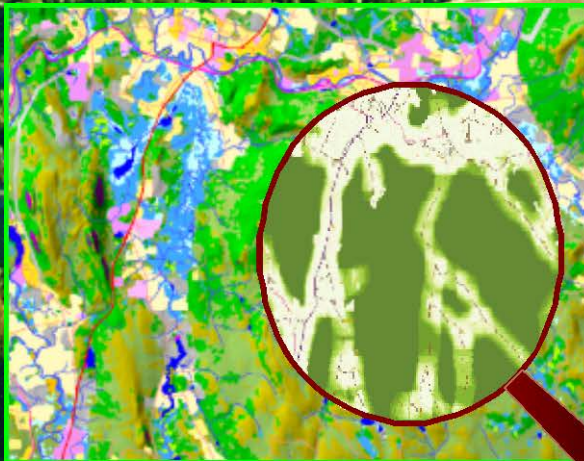


Designing Sustainable Landscapes in the Northeast

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

Landscape Conservation Design
November 21, 2014



Topics for today

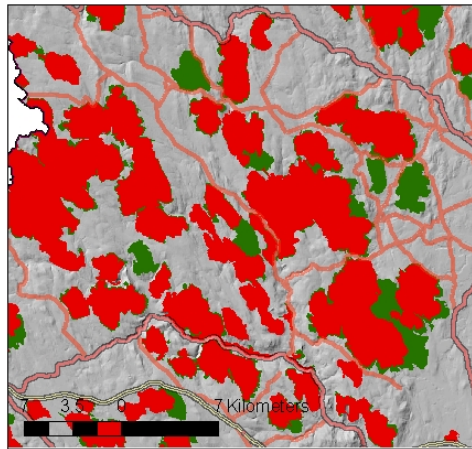
1. CTR vs HUC6
2. Macrogroup vs Group (system)
3. Combining ecosystems and species cores
4. Conservation focus areas (“cookies”)
5. Scenario comparison
6. Combining terrestrial and aquatic networks
7. Landscape change incorporation

Core Areas

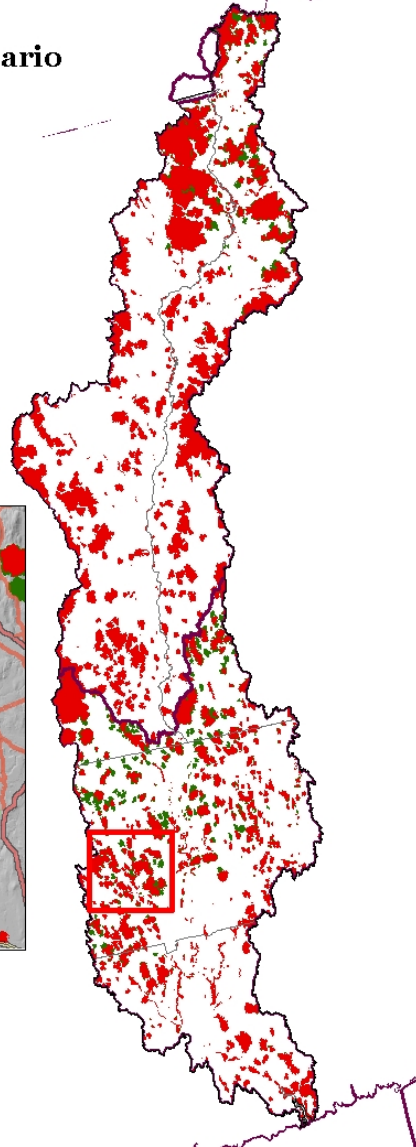
CTR vs HUC6

Terrestrial Core Areas
Ecosystem (macrogroup) scenario
25% of landscape

■ CTR scaled
■ HUC6 scaled

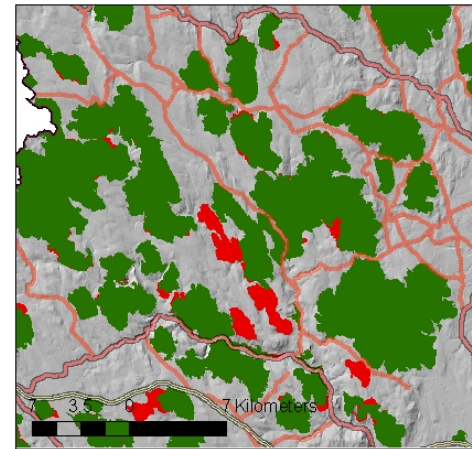


0 25 50 100 Kilometers

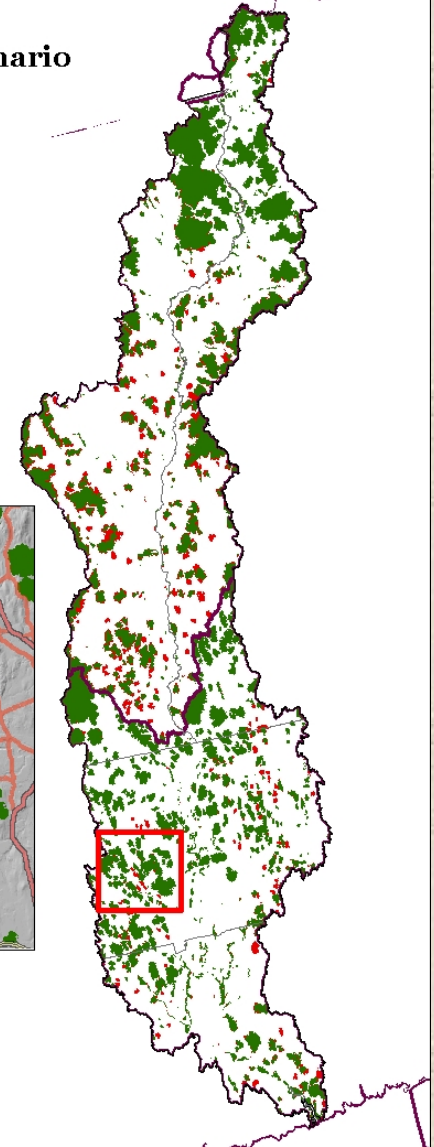


Terrestrial Core Areas
Ecosystem (macrogroup) scenario
25% of landscape

■ CTR scaled
■ HUC6 scaled



0 25 50 100 Kilometers

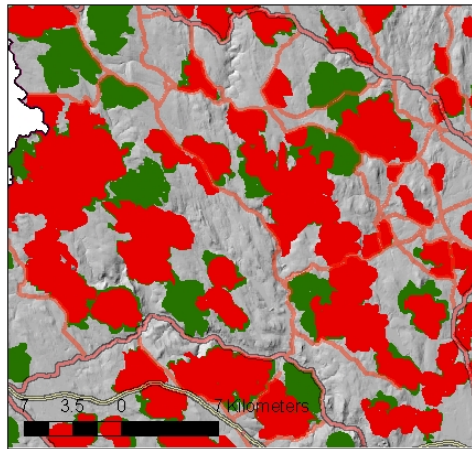


Core Areas

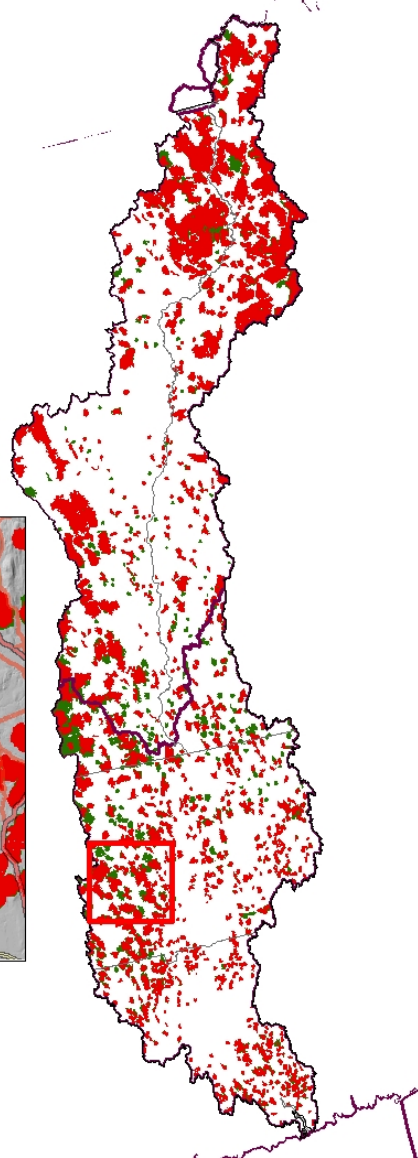
CTR vs HUC6

Terrestrial Core Areas
Species scenario
25% of landscape

■ CTR scaled
■ HUC6 scaled

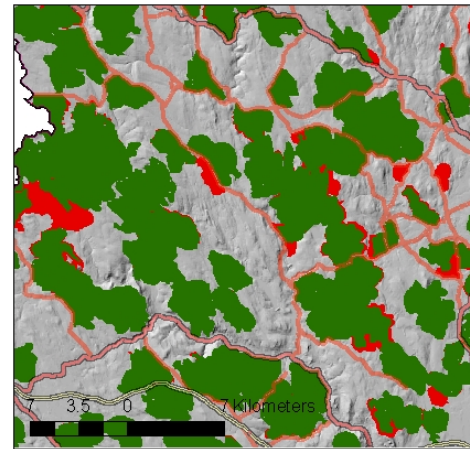


0 25 50 100 Kilometers

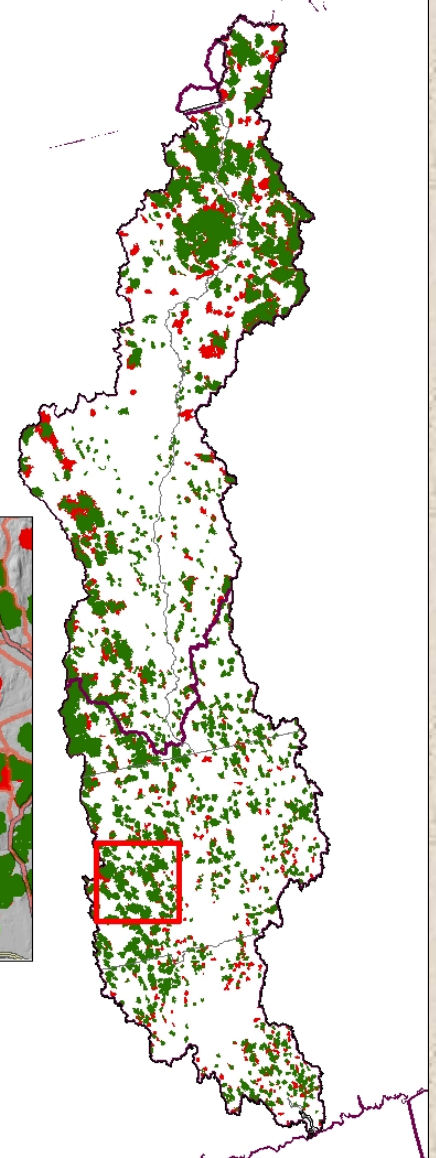


Terrestrial Core Areas
Species scenario
25% of landscape

■ CTR scaled
■ HUC6 scaled



0 25 50 100 Kilometers

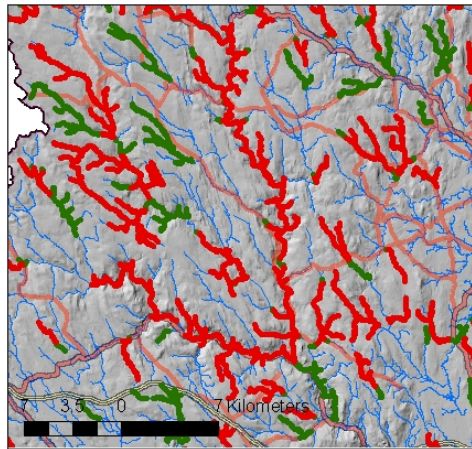


Core Areas

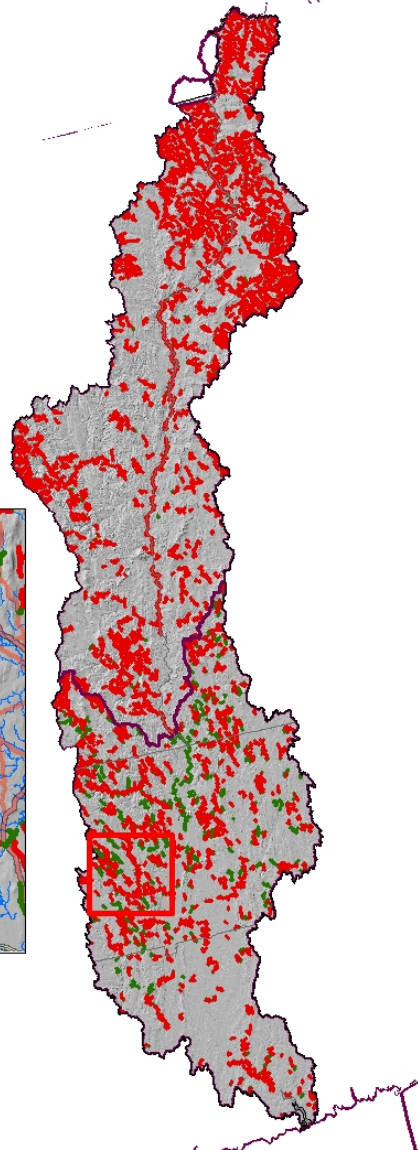
CTR vs HUC6

Aquatic Core Areas
Ecosystem scenario
25% of aquascape

- CTR scaled
- HUC6 scaled

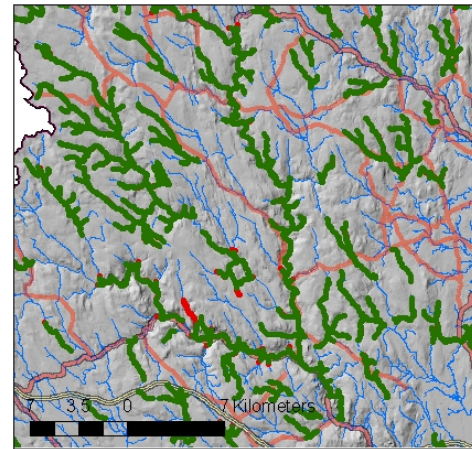


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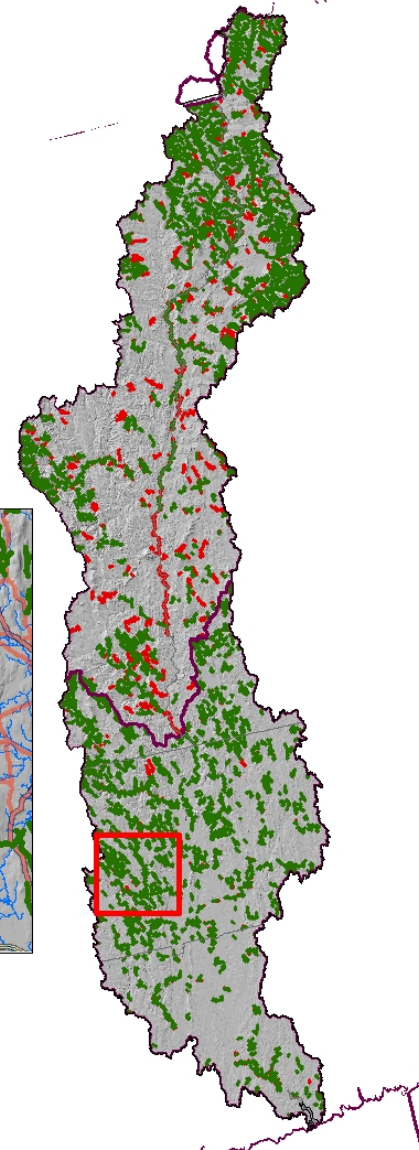


Aquatic Core Areas
Ecosystem scenario
25% of aquascape

- HUC6 scaled
- CTR scaled



0 25 50 100 Kilometers



Core Areas

CTR vs HUC6

Ecosystem-based Aquatic Core Areas

Macrogroup/group	CTR dist (km)	%CTR dist in Cores		
		CTR	HUC6	Delta
Stream (medium) cool	426	45	48	3
Stream (headwater) cool moderate	703	16	18	2
Stream (headwater) cool low	2,299	12	14	2
Stream (small) cool low	394	36	38	1
Stream (medium) warm	128	42	42	1
Stream (large) warm	150	42	42	(1)
Stream (small) cold moderate	464	47	46	(1)
Stream (small) cold low	254	46	44	(1)
Stream (headwater) cold high	13,515	31	29	(2)
Stream (small) cool moderate	382	47	44	(3)
Stream (large) cool	408	54	49	(5)
Macrogroup/group	CTR area (ha)	%CTR area in Cores		
		CTR	HUC6	Delta
Lake ¹	40,859	30	53	24
Pond	11,164	17	18	18

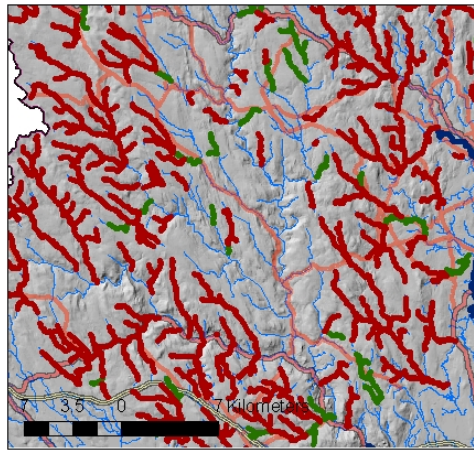
¹Difference due to inclusion of the Quabbin (comprising 19%) in the HUC6 solution

Core Areas

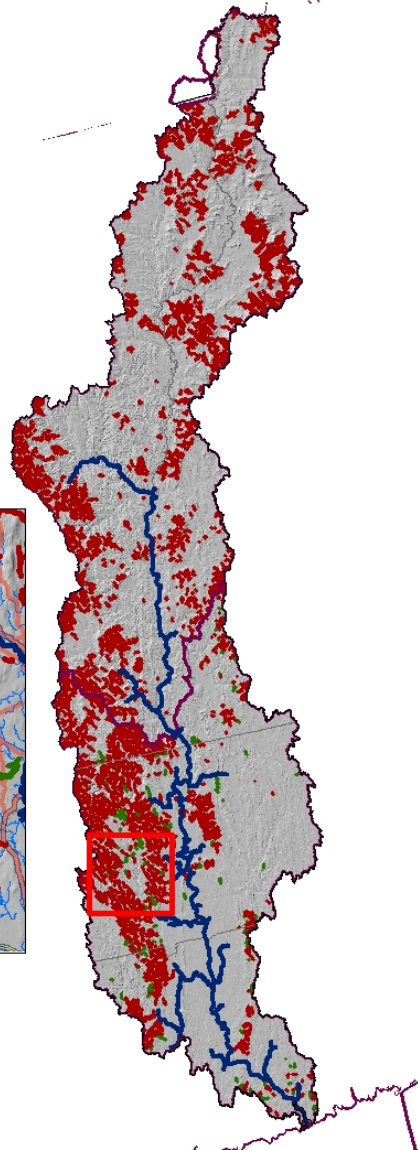
CTR vs HUC6

Aquatic Core Areas
Species scenario
25% of aquascape

- CTR scaled
- HUC6 scaled

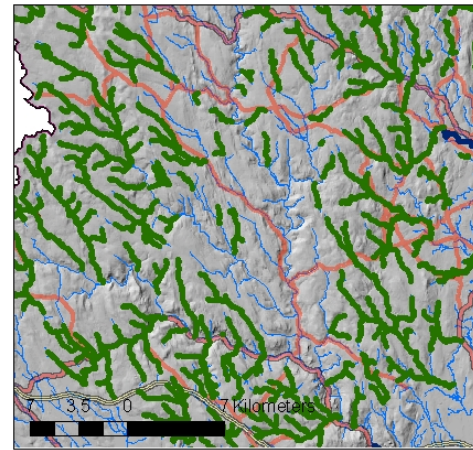


0 25 50 100 Kilometers

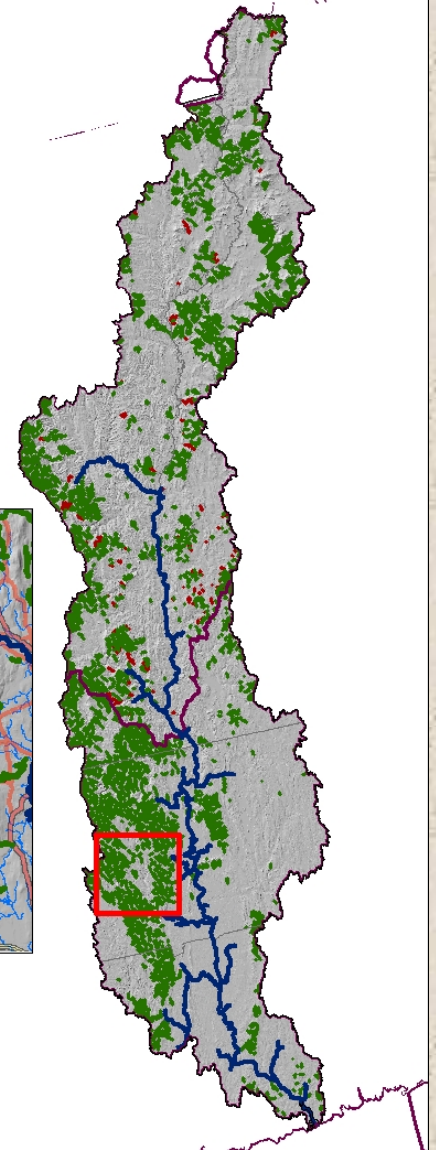


Aquatic Core Areas
Species scenario
25% of aquascape

- HUC6 scaled
- CTR scaled



0 25 50 100 Kilometers



Core Areas

CTR vs HUC6

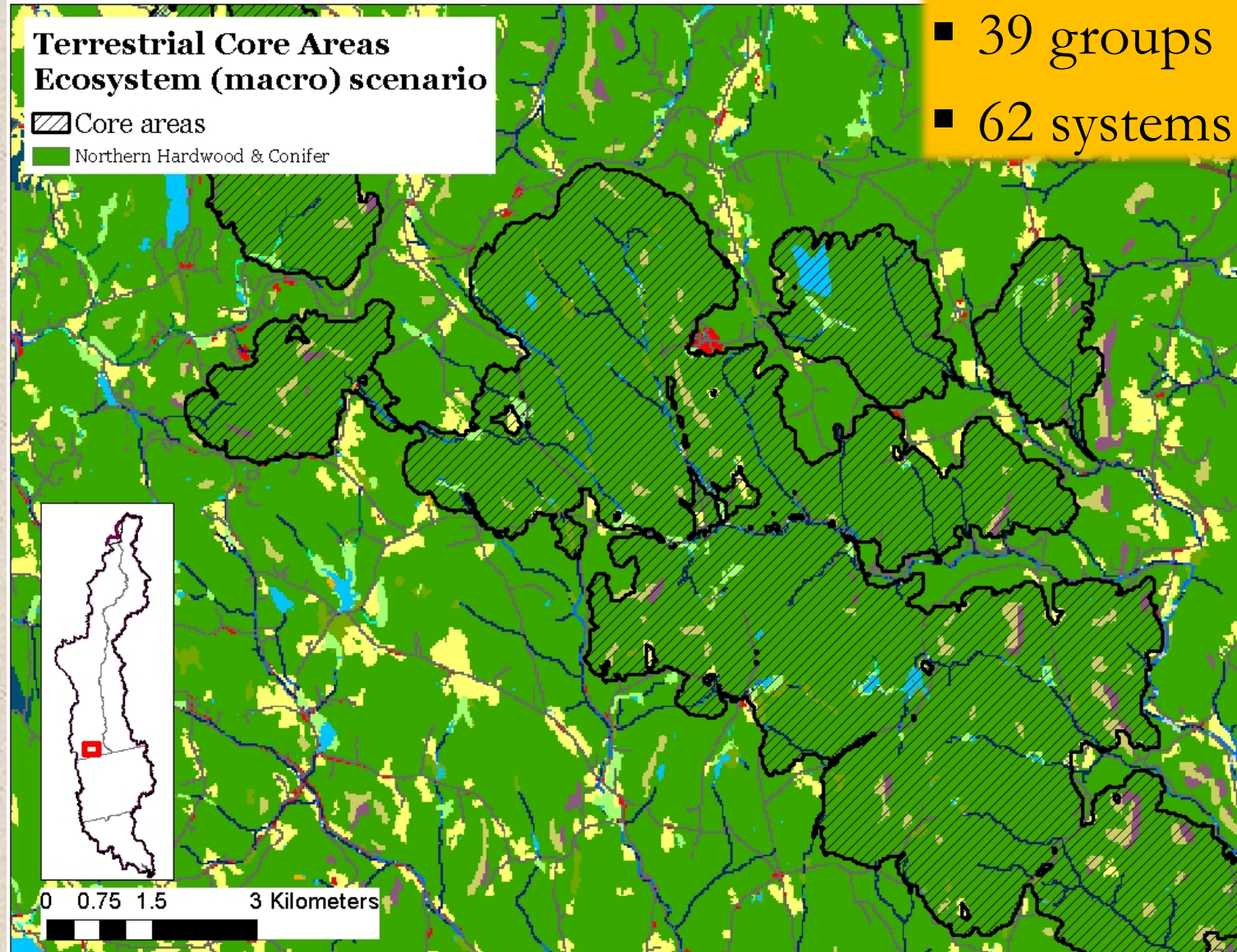
Species-based Aquatic Core Areas

Macrogroup/group	CTR dist (km)	%CTR dist in Cores		
		CTR	HUC6	Delta
Stream (headwater) cold high	13,515	34	34	(0)
Stream (headwater) cold moderate	3,339	22	23	1
Stream (headwater) cold low	4,168	22	23	1
Stream (headwater) cool high	842	9	10	1
Stream (headwater) cool moderate	703	5	6	1
Stream (headwater) cool low	2,299	4	5	1
Stream (headwater) warm high	50	3	4	0
Stream (headwater) warm moderate	39	3	3	0
Stream (headwater) warm low	159	5	5	0
Stream (small) cold moderate	464	2	2	0
Stream (small) cold low	254	1	1	0
Stream (small) cool moderate	382	16	16	0
Stream (small) cool low	394	26	26	0
Stream (medium) cold	108	0	0	0
Stream (medium) cool	426	38	38	0
Stream (medium) warm	128	66	66	0
Stream (large) cool	408	59	59	(0)
Stream (large) warm	150	68	68	0
Macrogroup/group	CTR area (ha)	%CTR area in Cores		
		CTR	HUC6	Delta
Lake	40,859	1	1	0
Pond	11,164	4	4	0

Core Areas

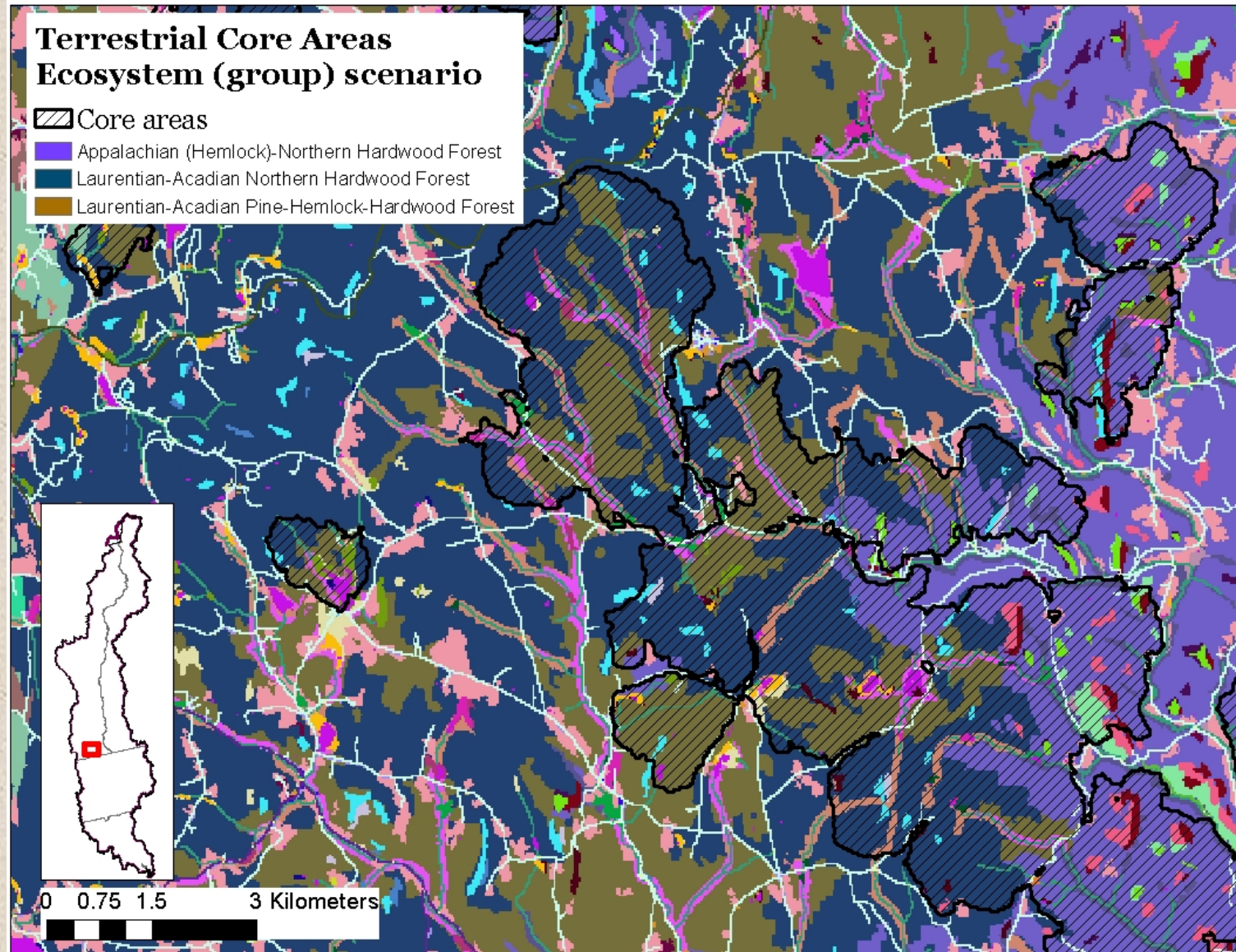
Macrogroup vs Group

- 16 macrogroups
- 39 groups
- 62 systems



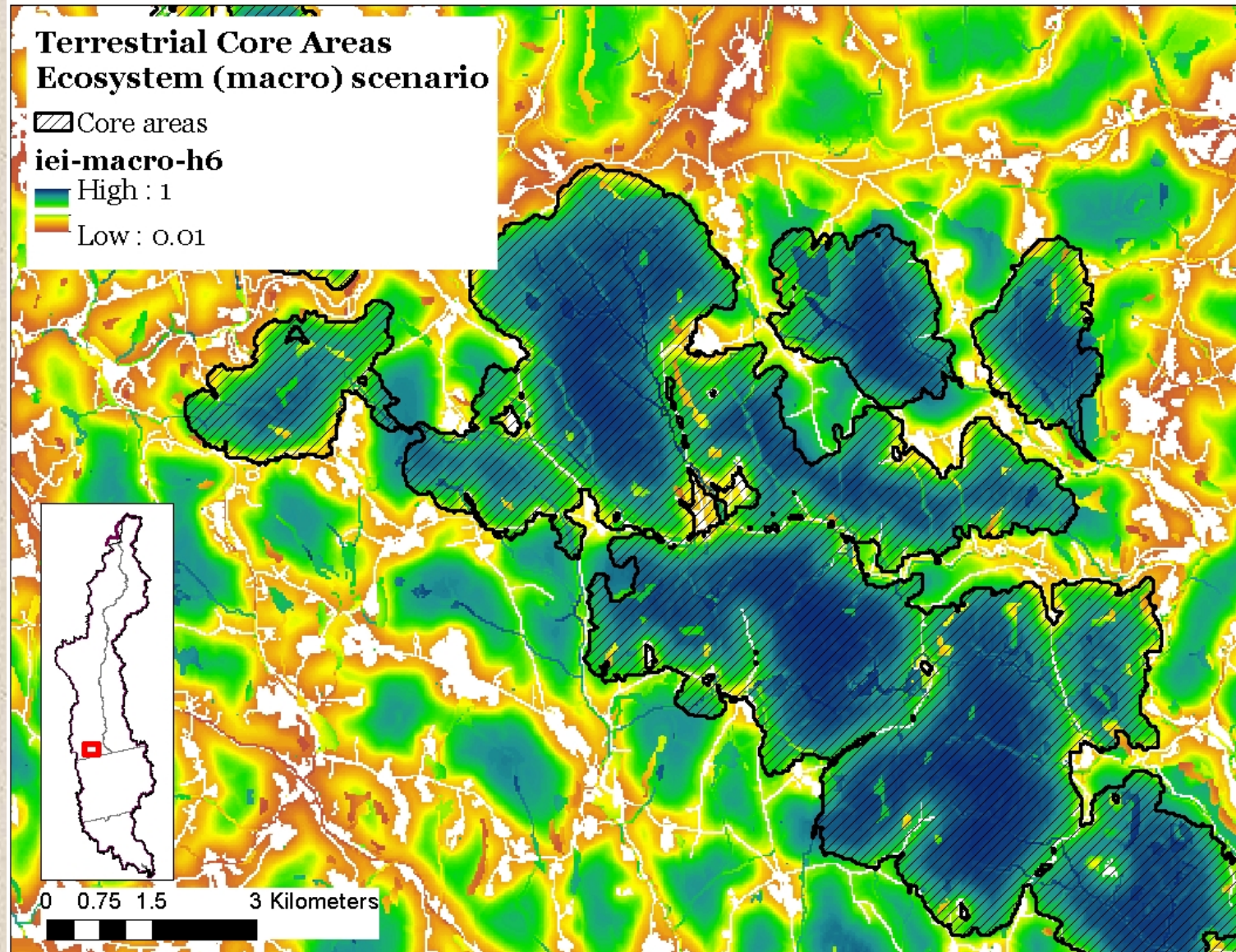
Core Areas

Macrogroup vs Group



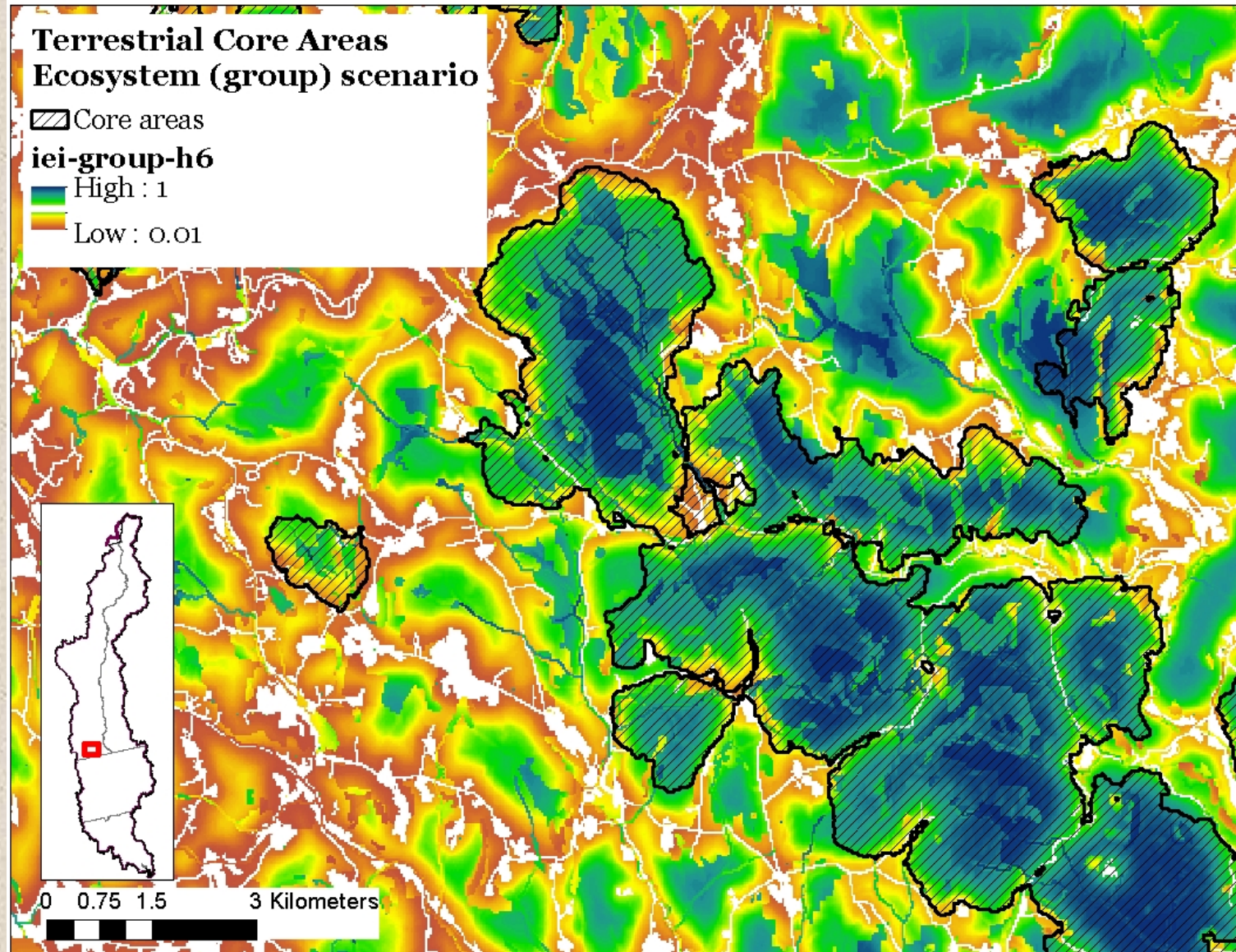
Core Areas

Macrogroup vs Group



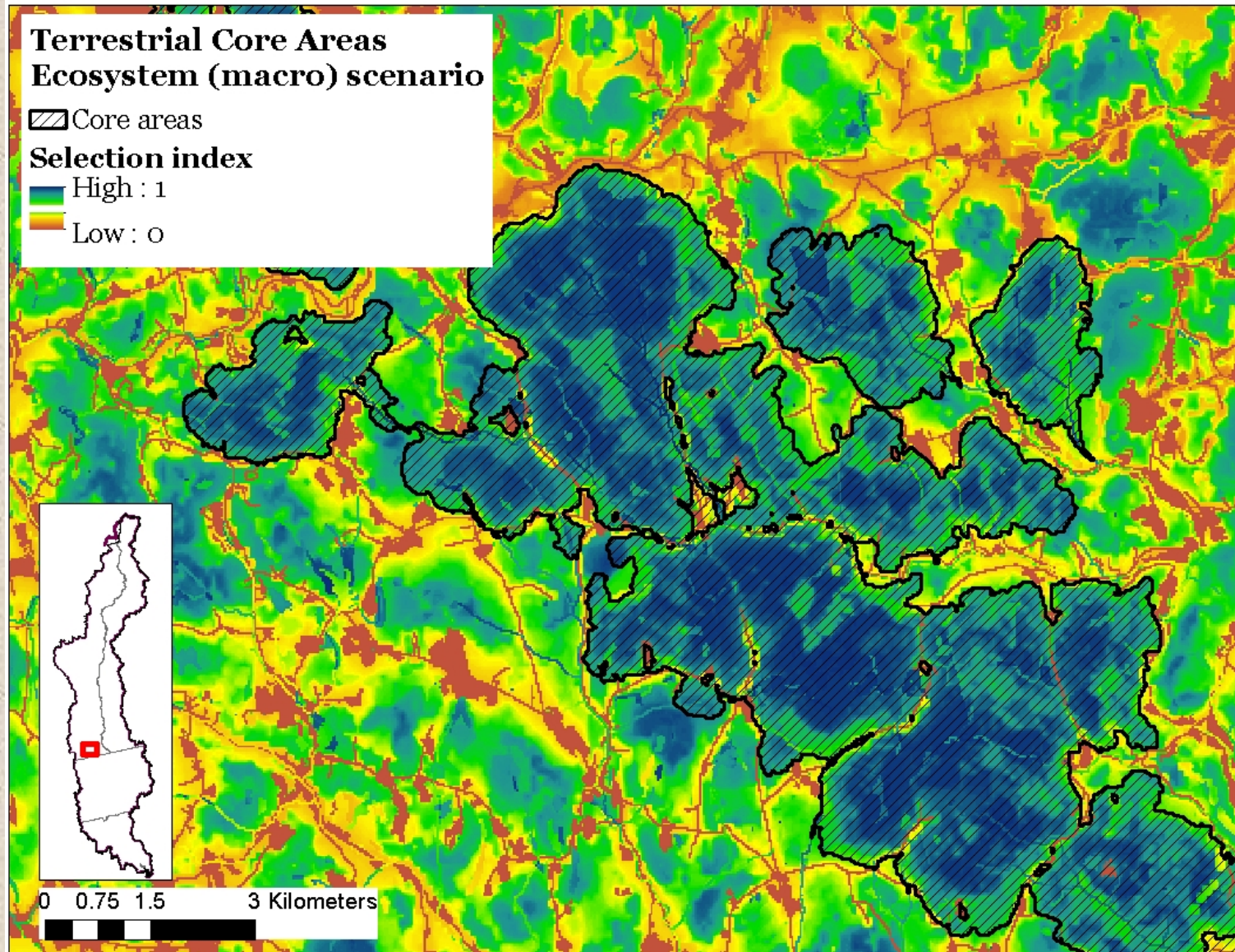
Core Areas

Macrogroup vs Group



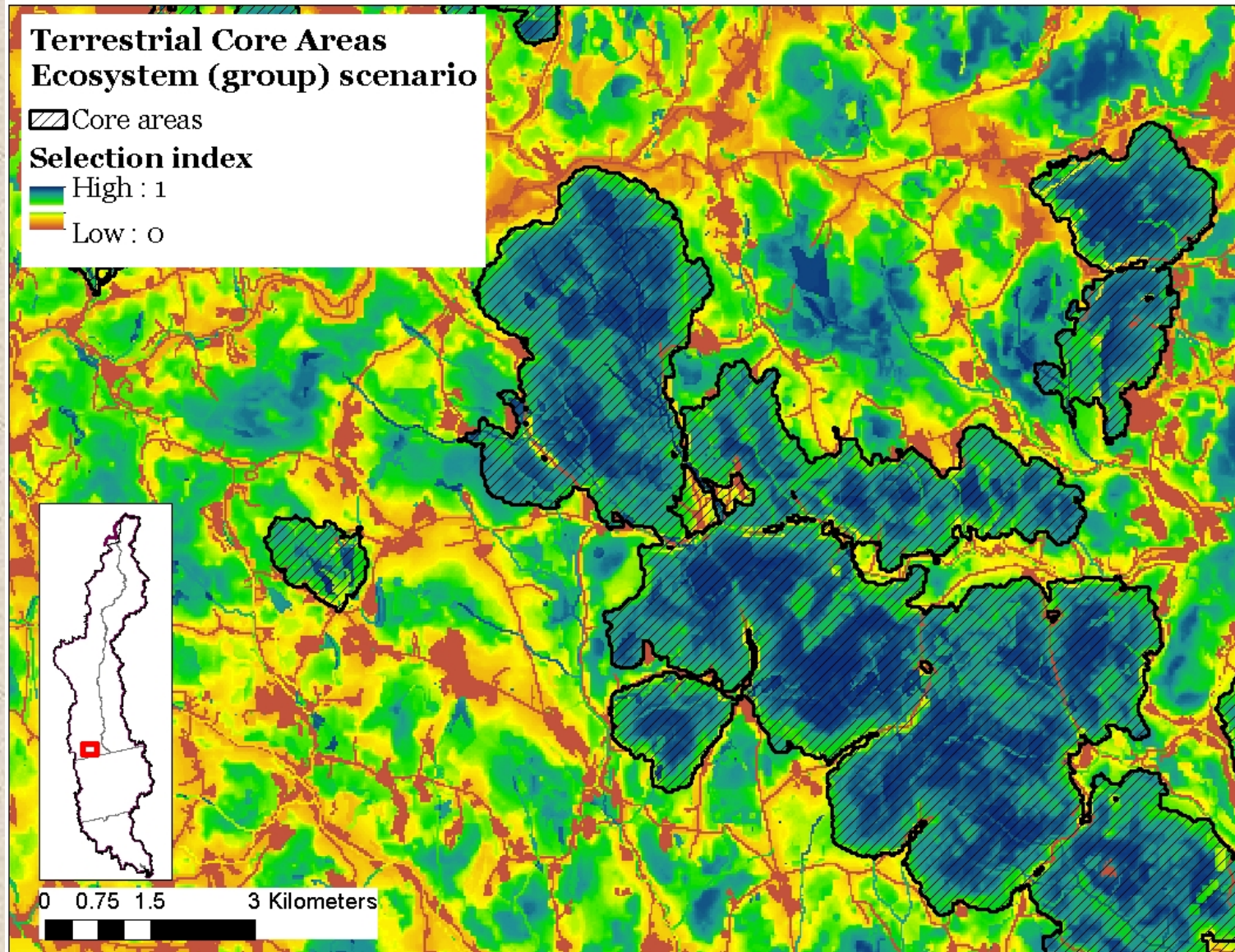
Core Areas

Macrogroup vs Group



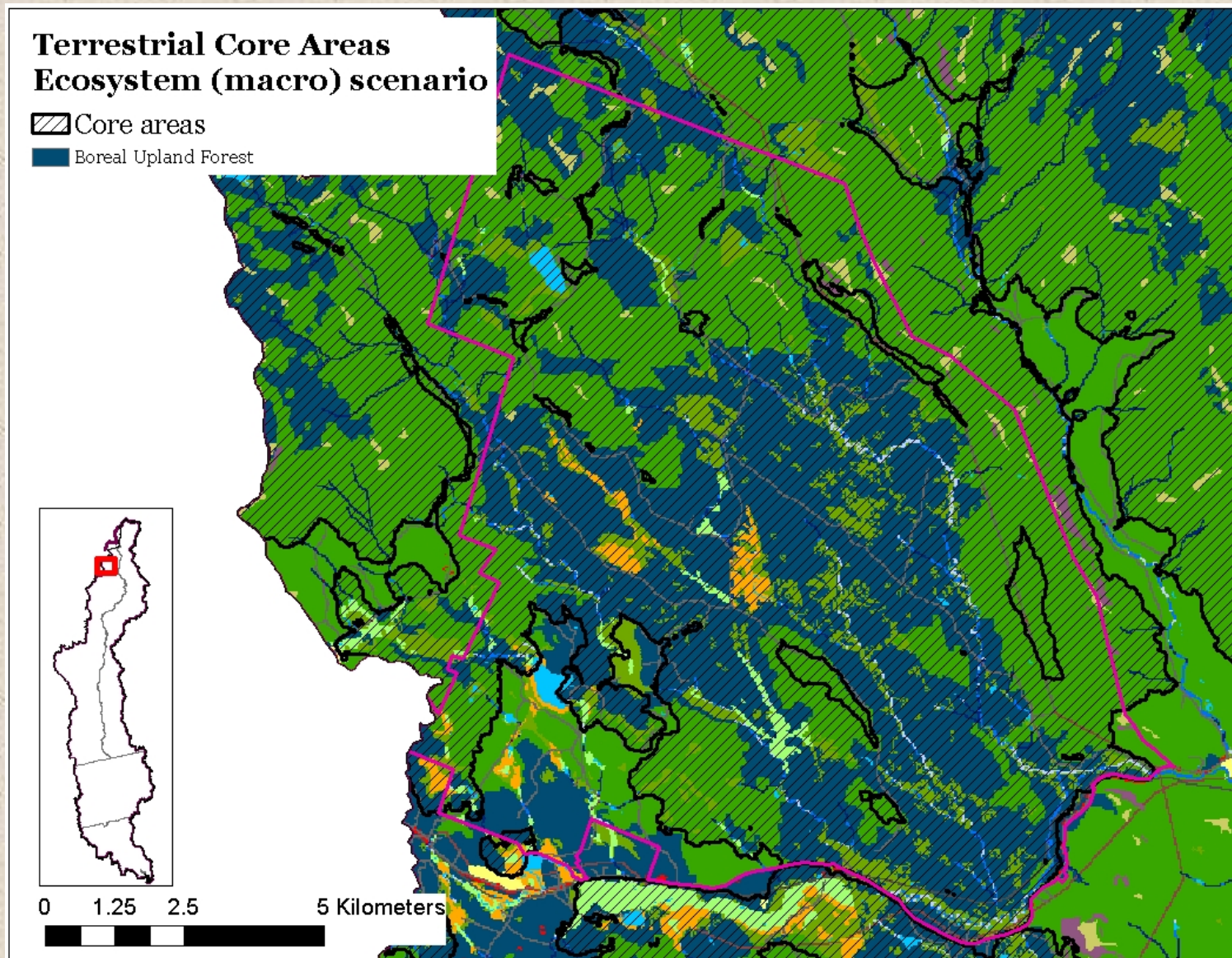
Core Areas

Macrogroup vs Group



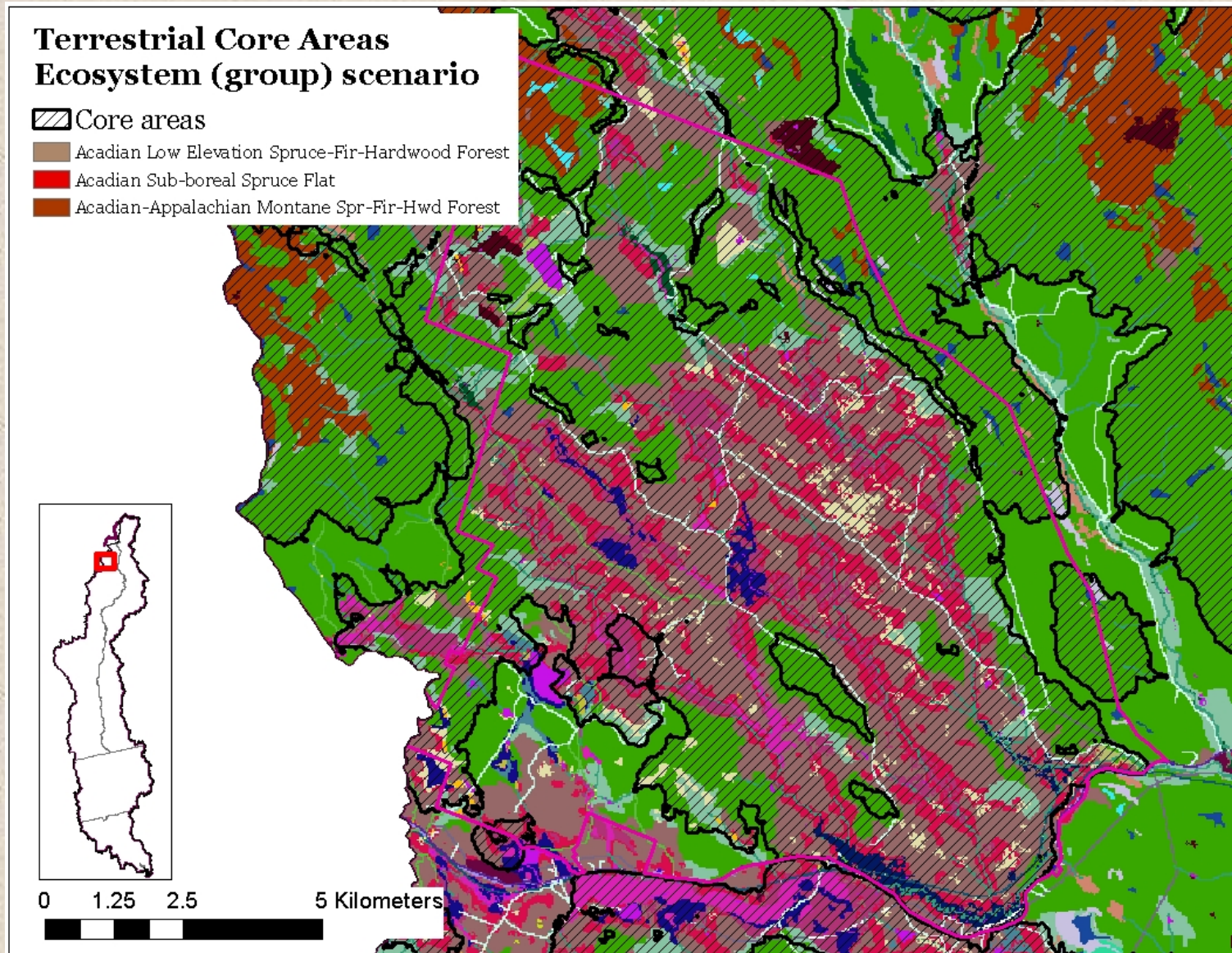
Core Areas

Macrogroup vs Group



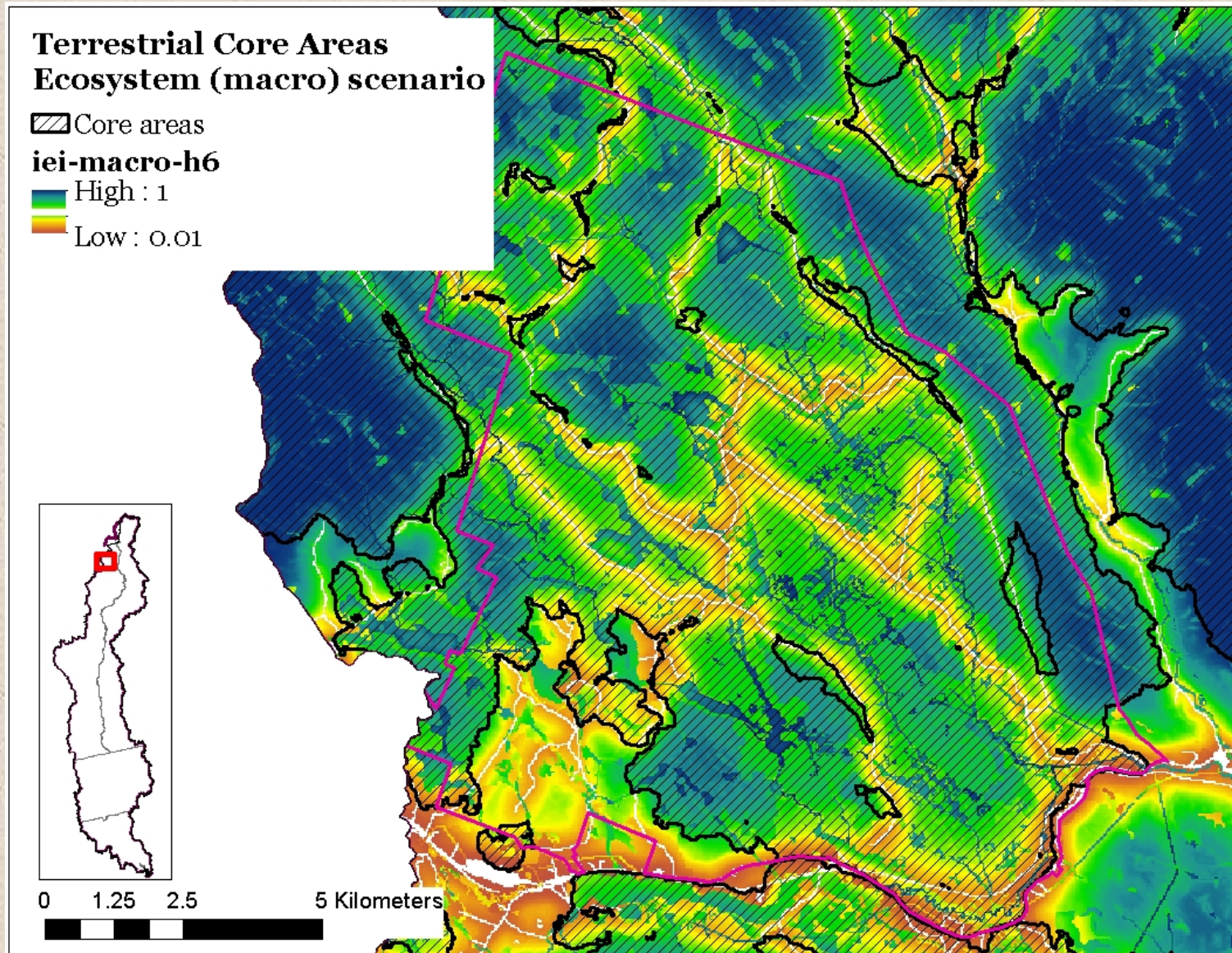
Core Areas

Macrogroup vs Group



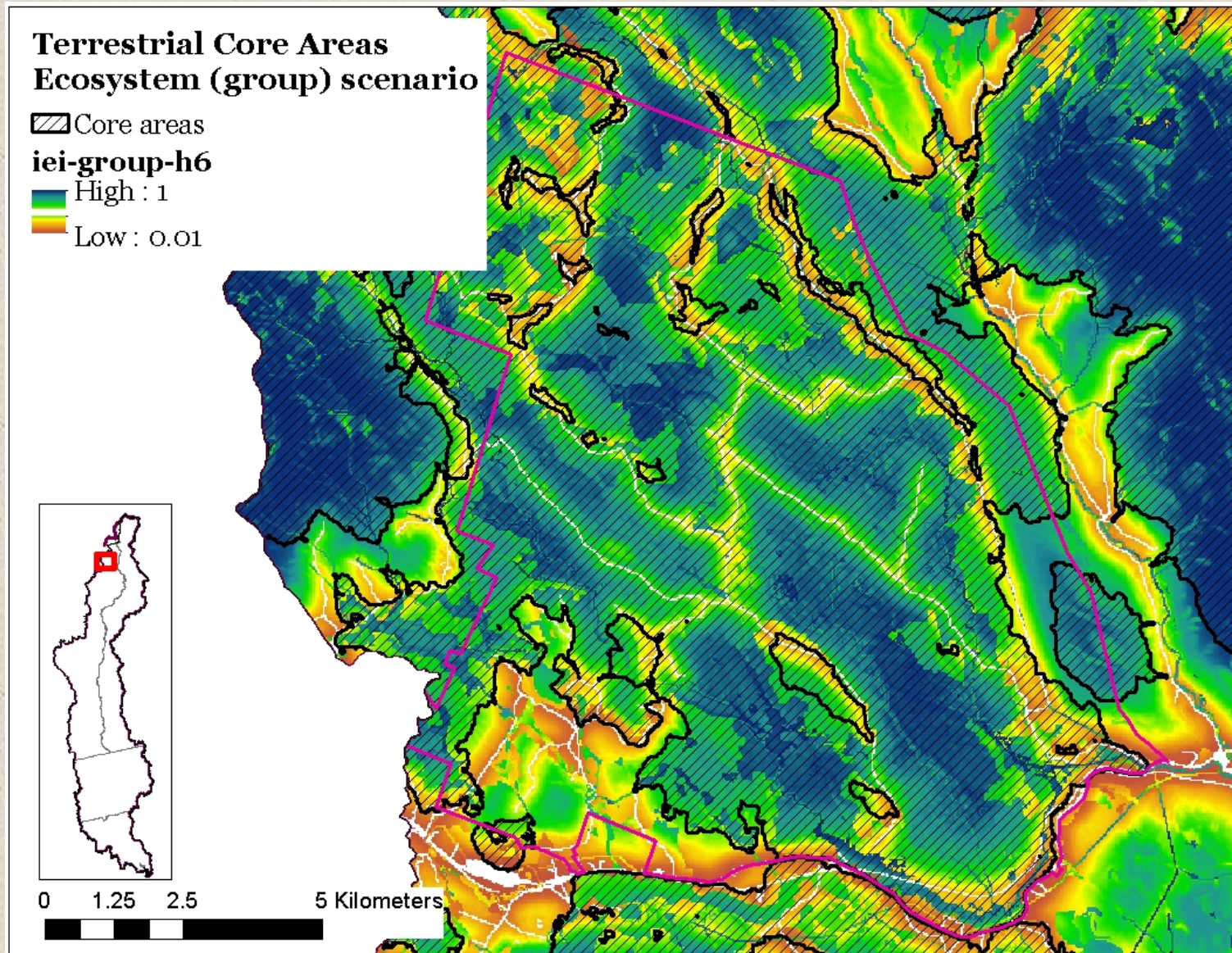
Core Areas

Macrogroup vs Group



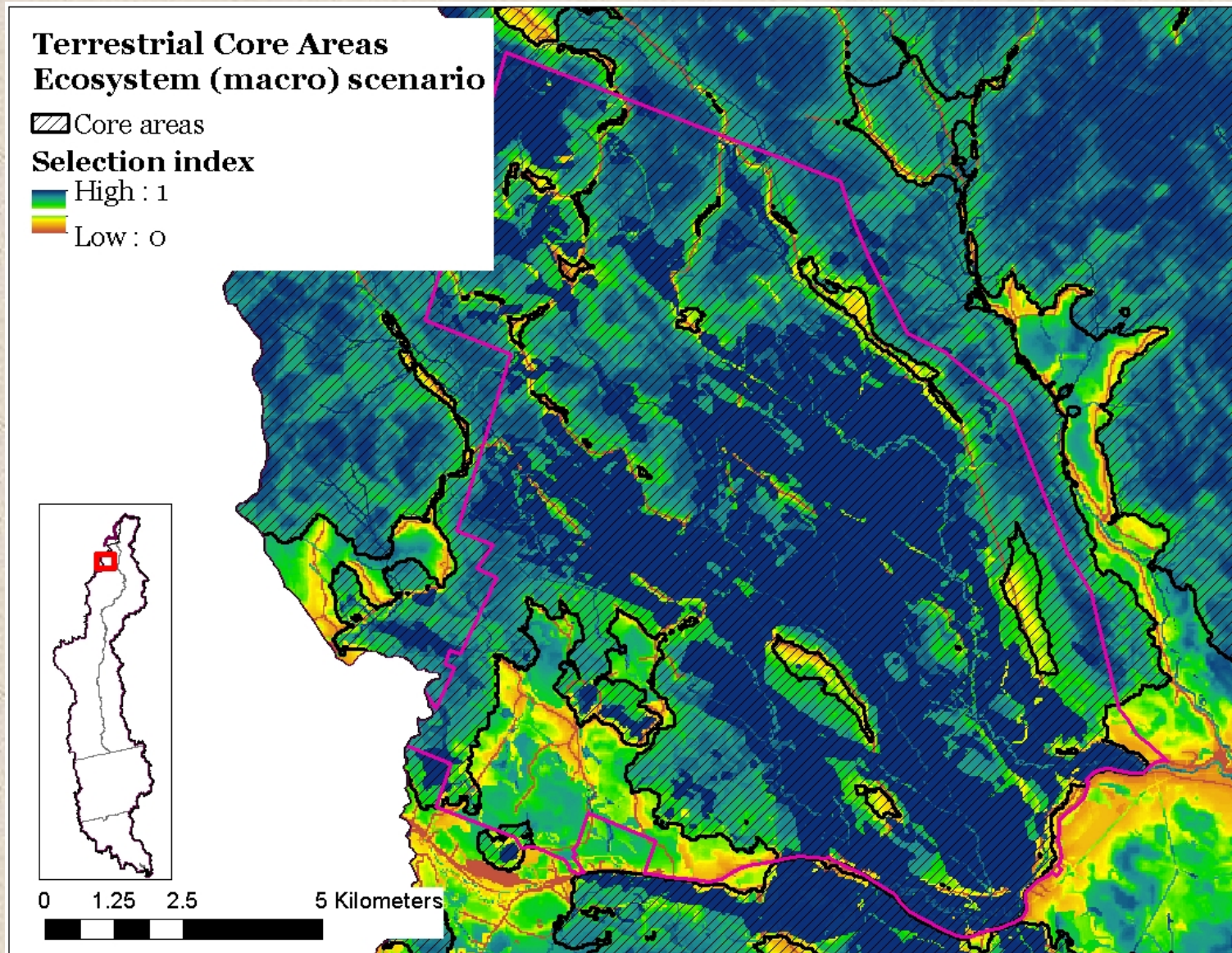
Core Areas

Macrogroup vs Group



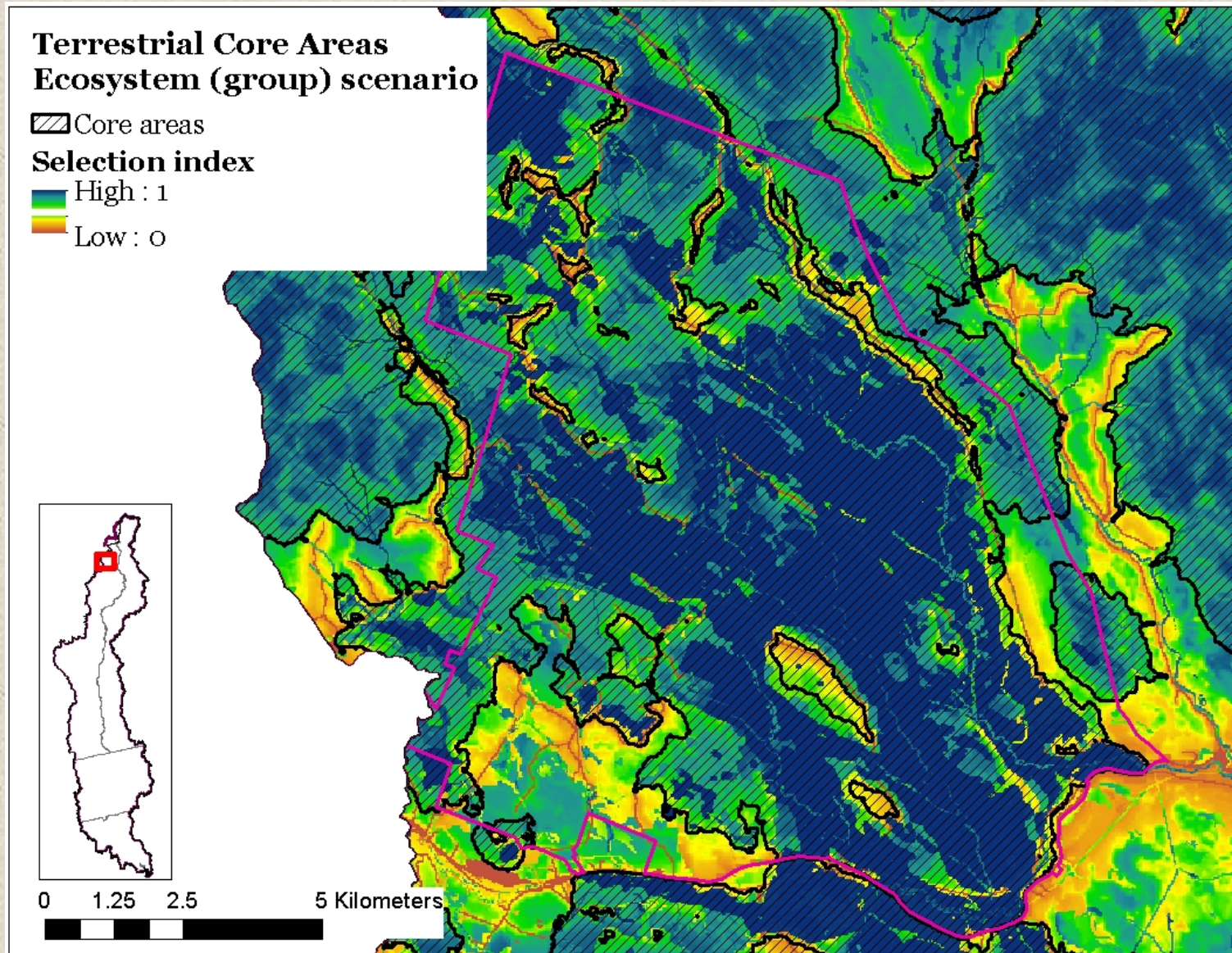
Core Areas

Macrogroup vs Group



Core Areas

Macrogroup vs Group



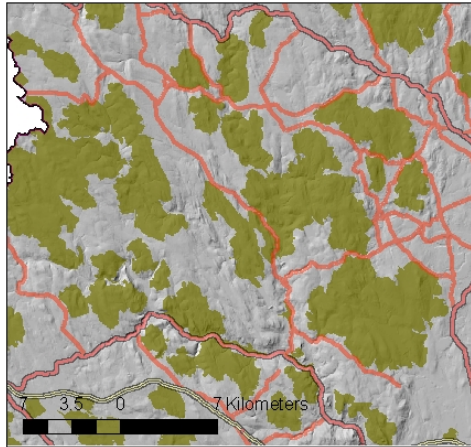
Core Areas

Macrogroup vs Group

Terrestrial Core Areas
Ecosystem (macro-HUC6) scenario
25% of landscape

■ Cores

N=715

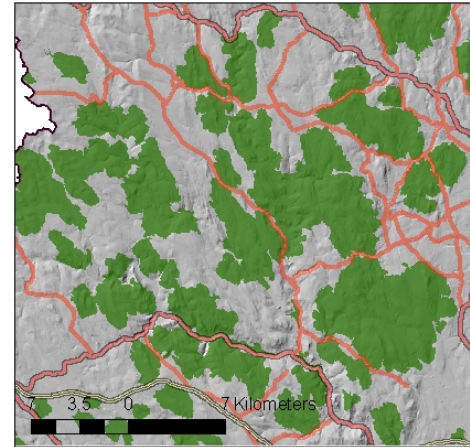


0 25 50 100 Kilometers

Terrestrial Core Areas
Ecosystem (group-HUC6) scenario
25% of landscape

■ Cores

N=806



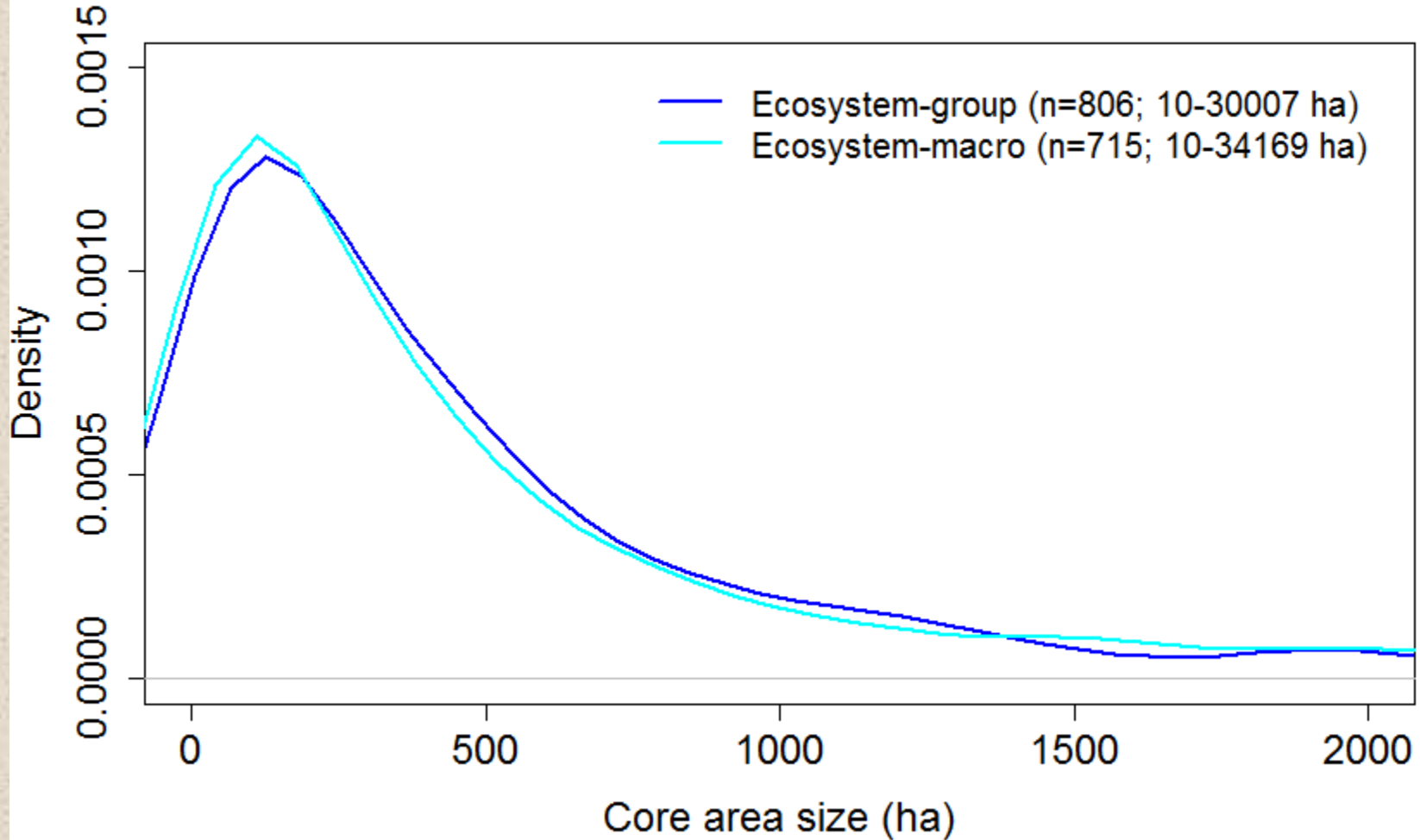
0 25 50 100 Kilometers

84% overlap

Core Areas

Macrogroup vs Group

Core area size distribution



Core Areas

Macrogroup vs Group

Ecosystem-based Terrestrial Core Areas

Macrogroup	Weight	CTR area (ha)	%CTR area in Cores		
			Eco-m	Eco-g	Delta
Glade & Barren & Savanna	1	680	30	40	10
Central Oak-Pine	1-3	145,586	24	29	5
Freshwater Tidal Riverine	1	2,852	64	67	3
Northern Swamp	1-3	80,673	29	32	3
Wet Meadow / Shrub Marsh	3	20,960	32	34	2
Boreal Upland Forest	3	168,630	50	42	(8)
Outcrop & Summit Scrub	1-3	21,155	51	43	(8)

Core Areas

Macrogroup vs Group

Ecosystem-based Terrestrial Core Areas

Group	Weight	CTR area (ha)	%CTR area in Cores		
			Eco-m	Eco-g	Delta
Northeastern Coastal and Interior Pine-Oak Forest	1	10,486	13	24	11
Central Appalachian Alkaline Glade and Woodland	1	680	30	40	10
Appalachian (Hemlock)-Northern Hardwood Forest	1	585,310	25	34	9
Central Appalachian Pine-Oak Rocky Woodland	1	5,549	38	47	9
North Atlantic Coastal Plain Hardwood Forest	1	11,833	36	44	8
North-Central Interior and Appalachian Rich Swamp	1	11,379	19	26	7
Laurentian-Acadian Pine-Hemlock-Hardwood Forest	1	390,504	12	19	7
North-Central Appalachian Acidic Swamp	1	31,630	24	30	6
North-Central Interior and Appalachian Acidic Peatland	3	200	60	65	5
Laurentian-Acadian Red Oak-Northern Hardwood Forest	1	88,298	12	17	5
Circumneutral Cliff and Talus	1	3,325	28	34	5
Northeastern Interior Dry-Mesic Oak Forest	1	110,964	19	24	5
Central Appalachian Dry Oak-Pine Forest	1	16,570	40	44	4
Freshwater Tidal Riverine	1	2,852	64	67	3
Laurentian-Acadian Large River Floodplain	3	2,677	63	65	3
Laurentian-Acadian Large River Floodplain Forest	3	3,995	50	52	2
Laurentian-Acadian Wet Meadow-Shrub Swamp	3	19,078	29	31	2
Calcareous Rocky Outcrop	3	5,567	40	38	(2)
Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp	1	27,049	35	33	(2)
Acidic Cliff and Talus	1	9,104	40	37	(3)
Laurentian-Acadian Northern Hardwood Forest	1	675,372	41	31	(9)
Acidic Rocky Outcrop	1	15,588	55	45	(10)
Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest	3	72,424	79	61	(18)

Core Areas

Macrogroup vs Group

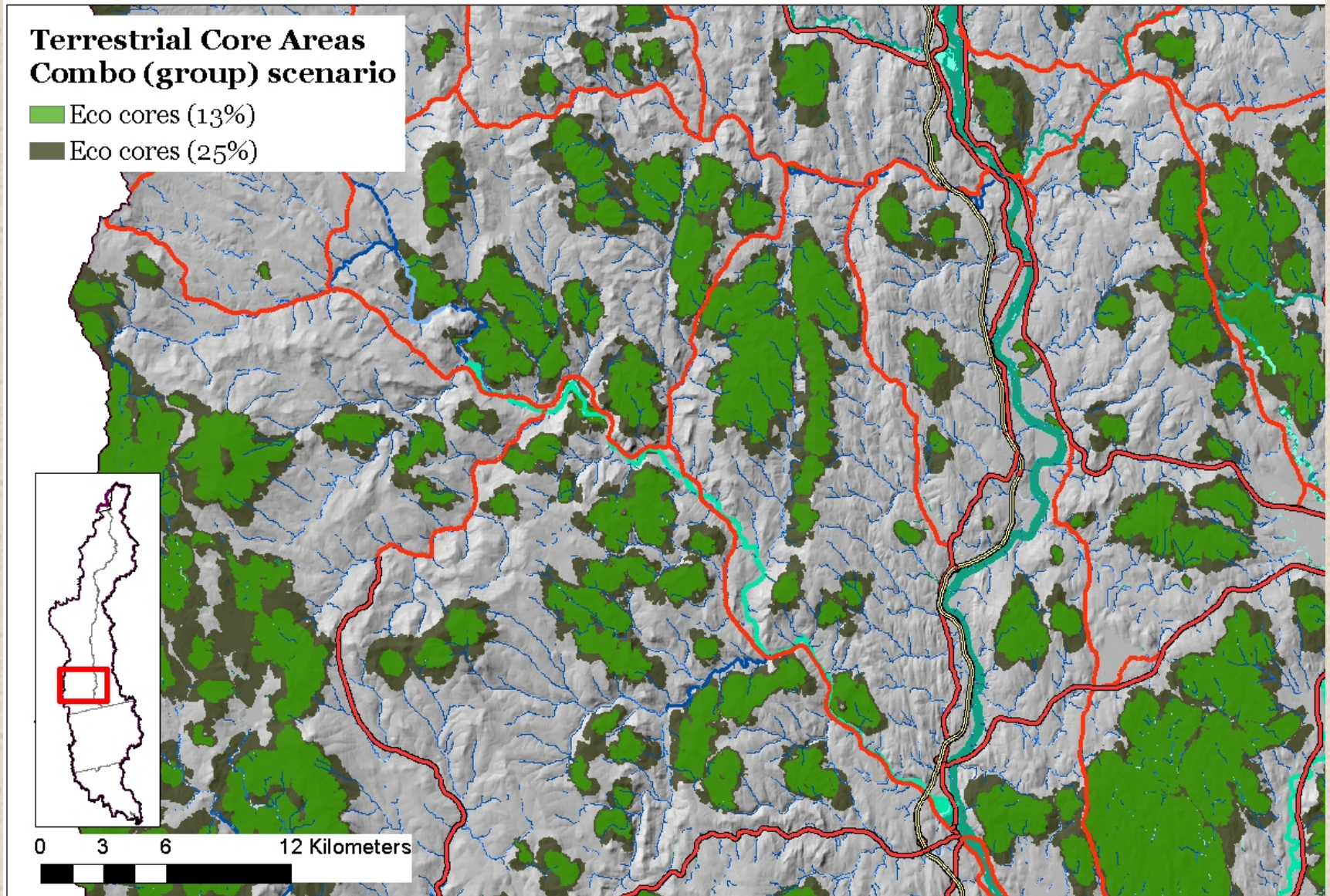
Ecosystem-based Terrestrial Core Areas

Species	Realized %LC*		
	Eco-m	Eco-g	Delta
Louisiana Waterthrush	30%	33%	3%
Prairie Warbler	29%	32%	3%
Wood Duck	38%	41%	3%
Wood Turtle	27%	29%	2%
Marsh Wren	45%	47%	2%
Wood Thrush	35%	36%	1%
Eastern Meadowlark	3%	3%	0%
Northern Waterthrush	48%	48%	0%
Black Bear	31%	31%	0%
American Woodcock	30%	29%	-1%
Moose	37%	35%	-2%
Ruffed Grouse	34%	32%	-2%
Blackburnian Warbler	37%	34%	-3%
Blackpoll Warbler	81%	61%	-20%
Average	36%	35%	-1%

*Realized with the 25% of landscape threshold

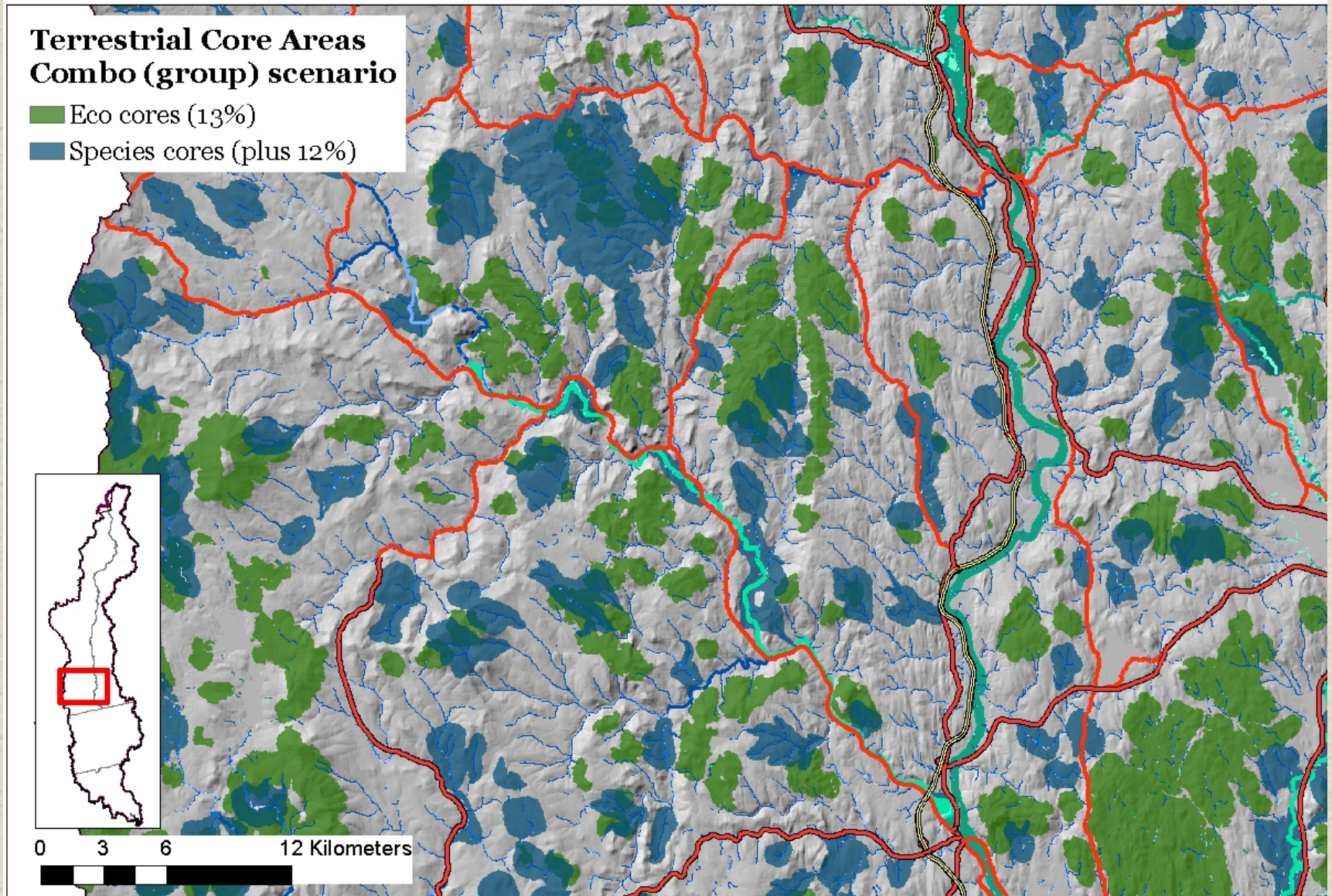
Core Areas

Combining ecosystem and species



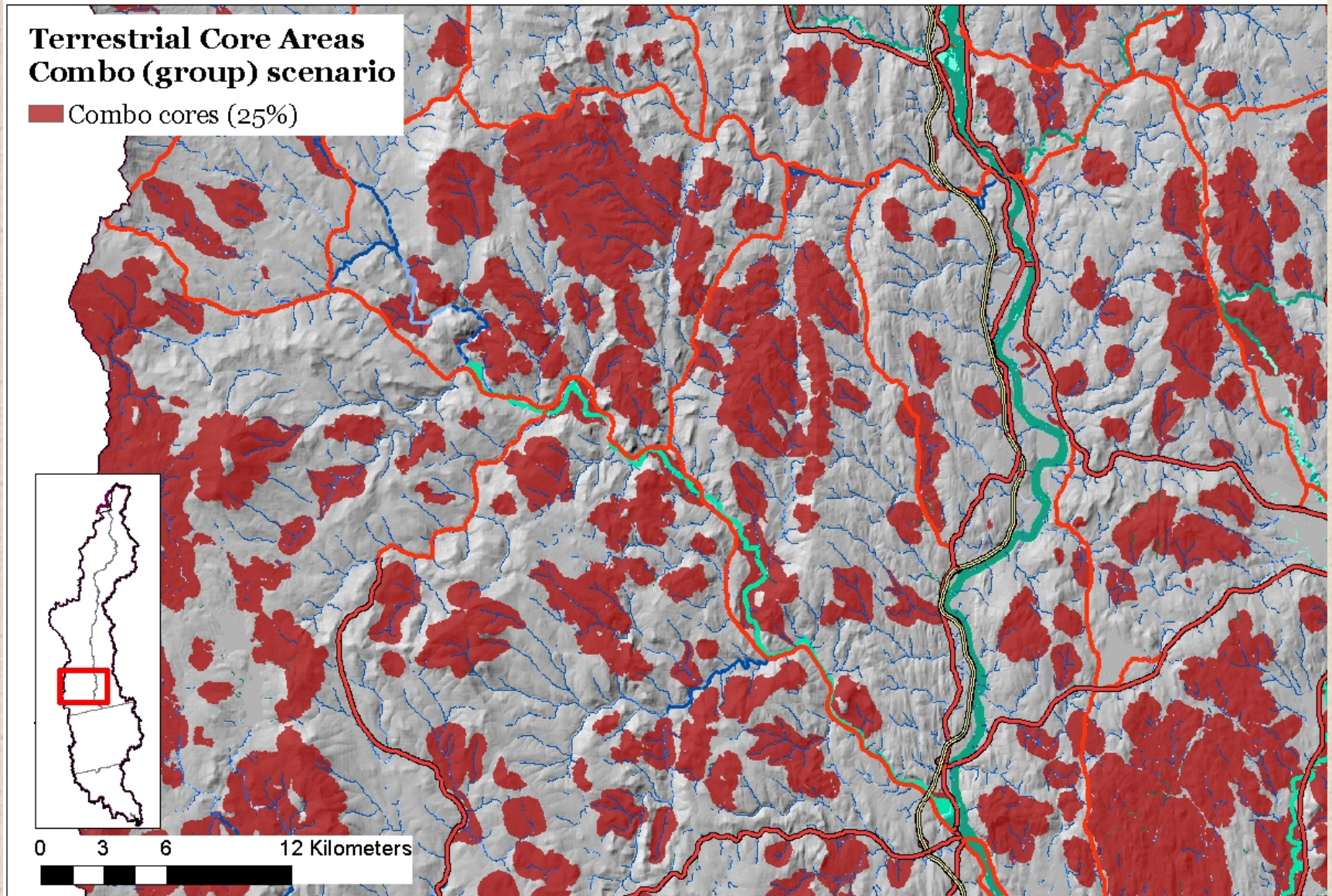
Core Areas

Combining ecosystem and species



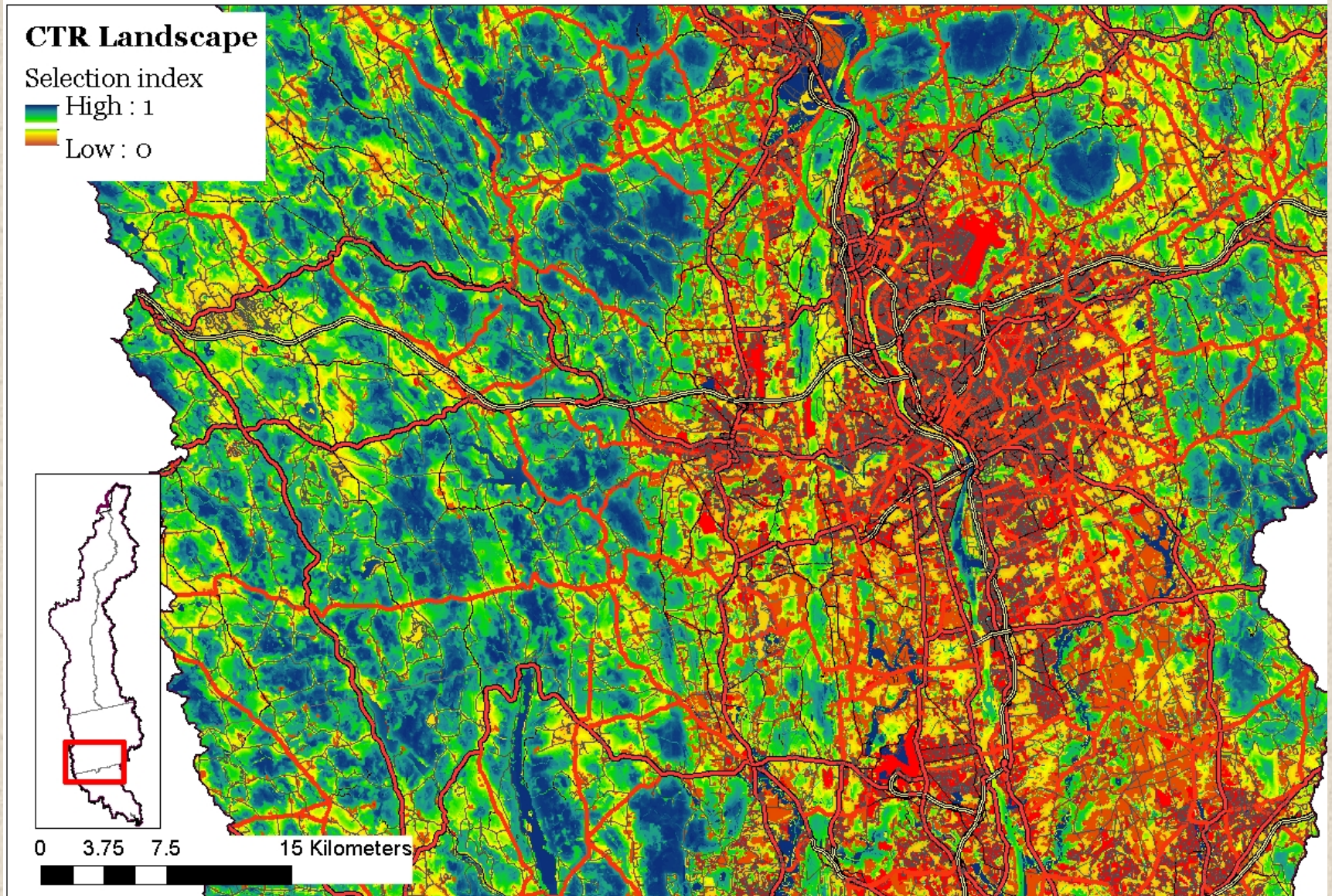
Core Areas

Combining ecosystem and species



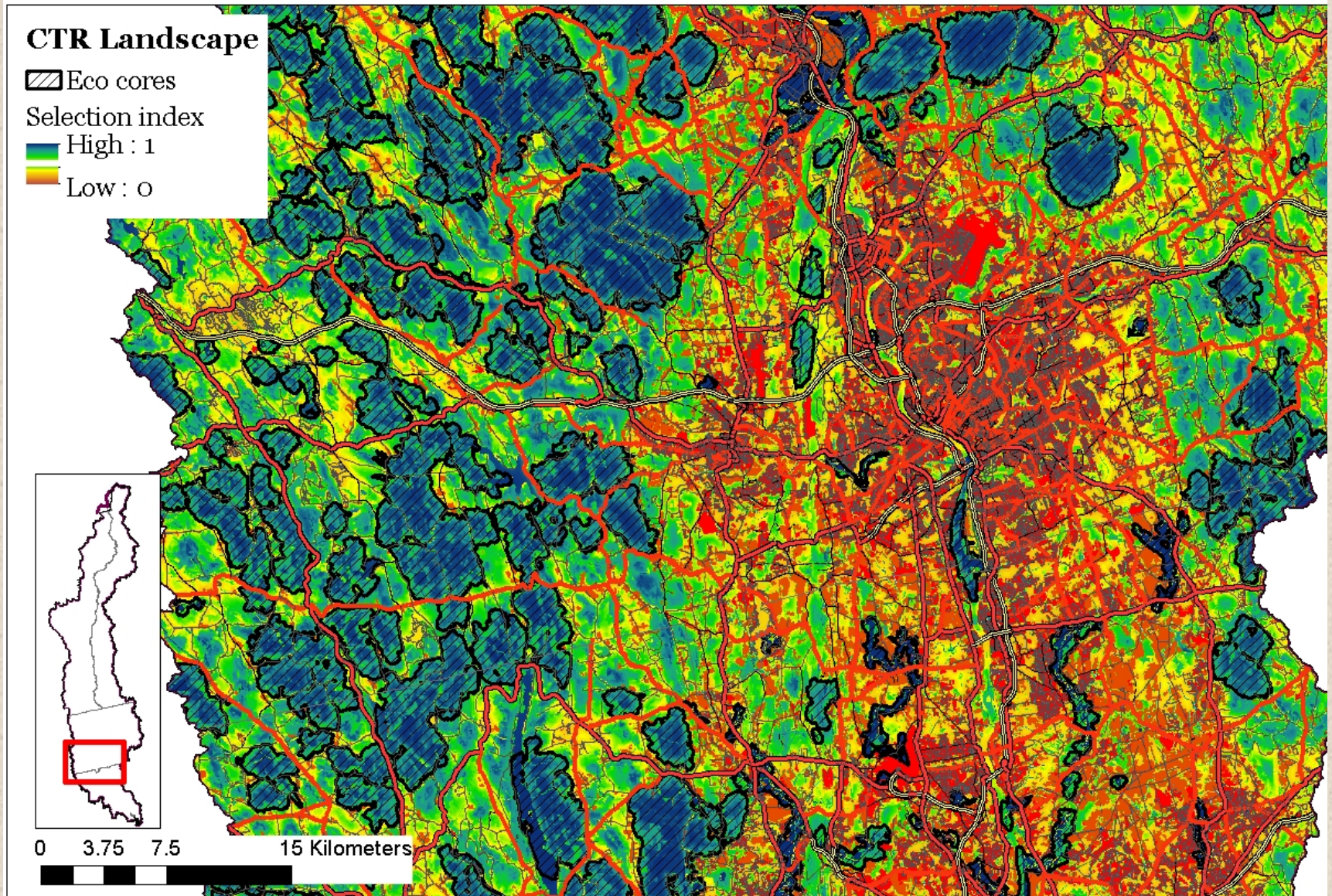
Conservation Focus Areas

“Cookies”?



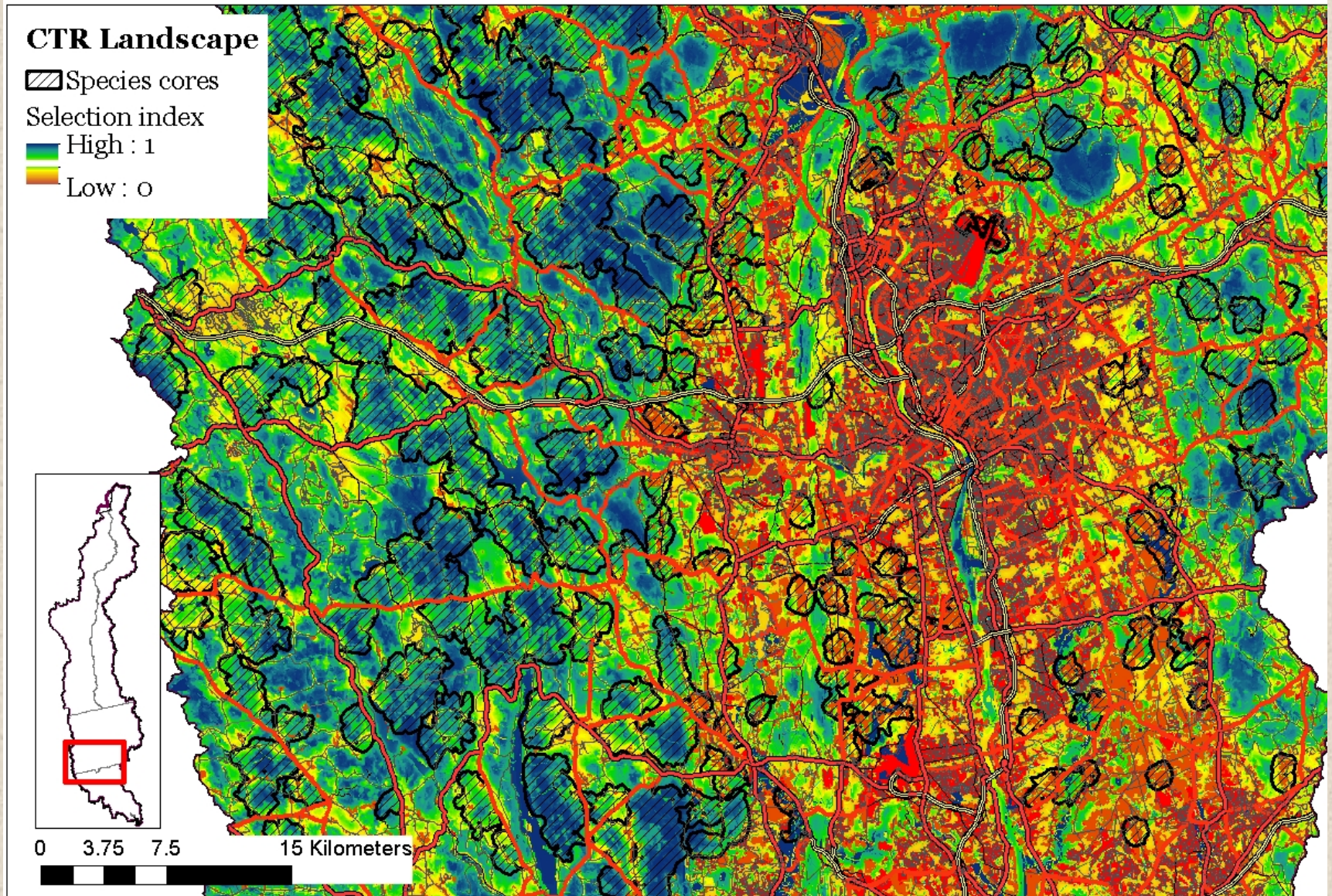
Conservation Focus Areas

“Cookies”?



Conservation Focus Areas

“Cookies”?



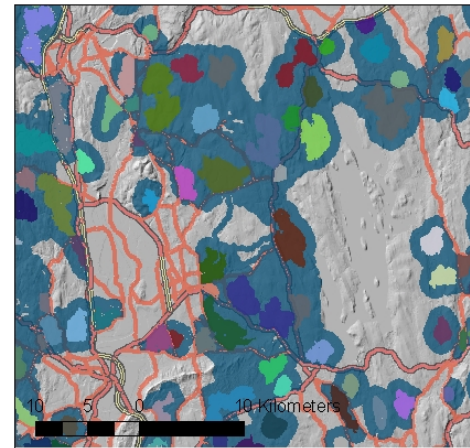
Conservation Focus Areas

“Cookies”?

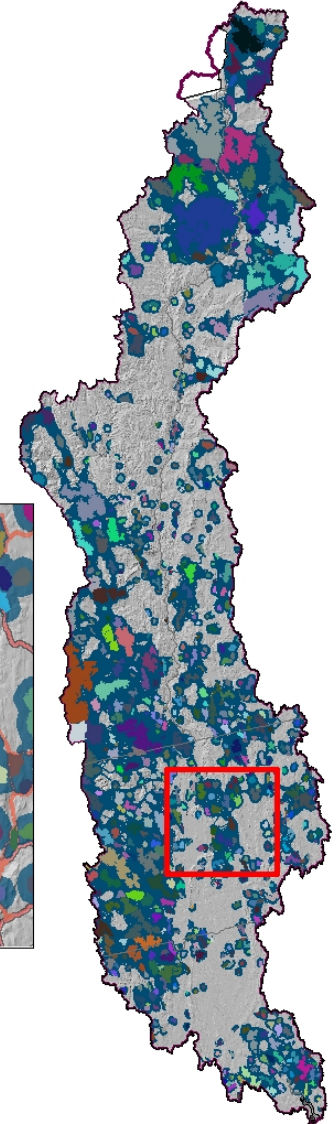
- Core areas and connectors embedded in a buffering matrix
- 1 km constrained buffer around cores
- 250 m constrained buffer around connectors

Terrestrial Core Areas
Species (HUC6) scenario
25% of landscape

■ CFAs

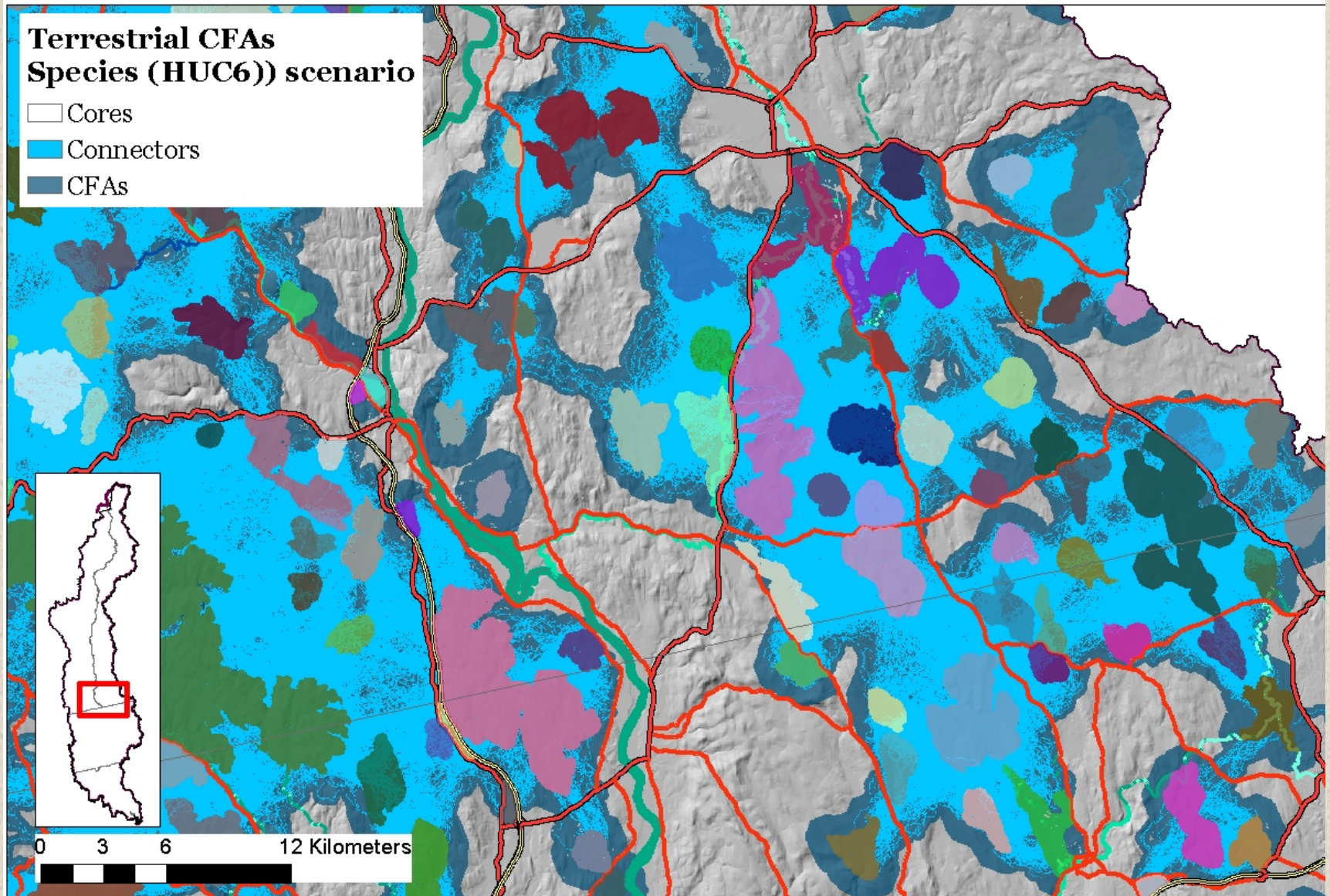


0 25 50 100 Kilometers



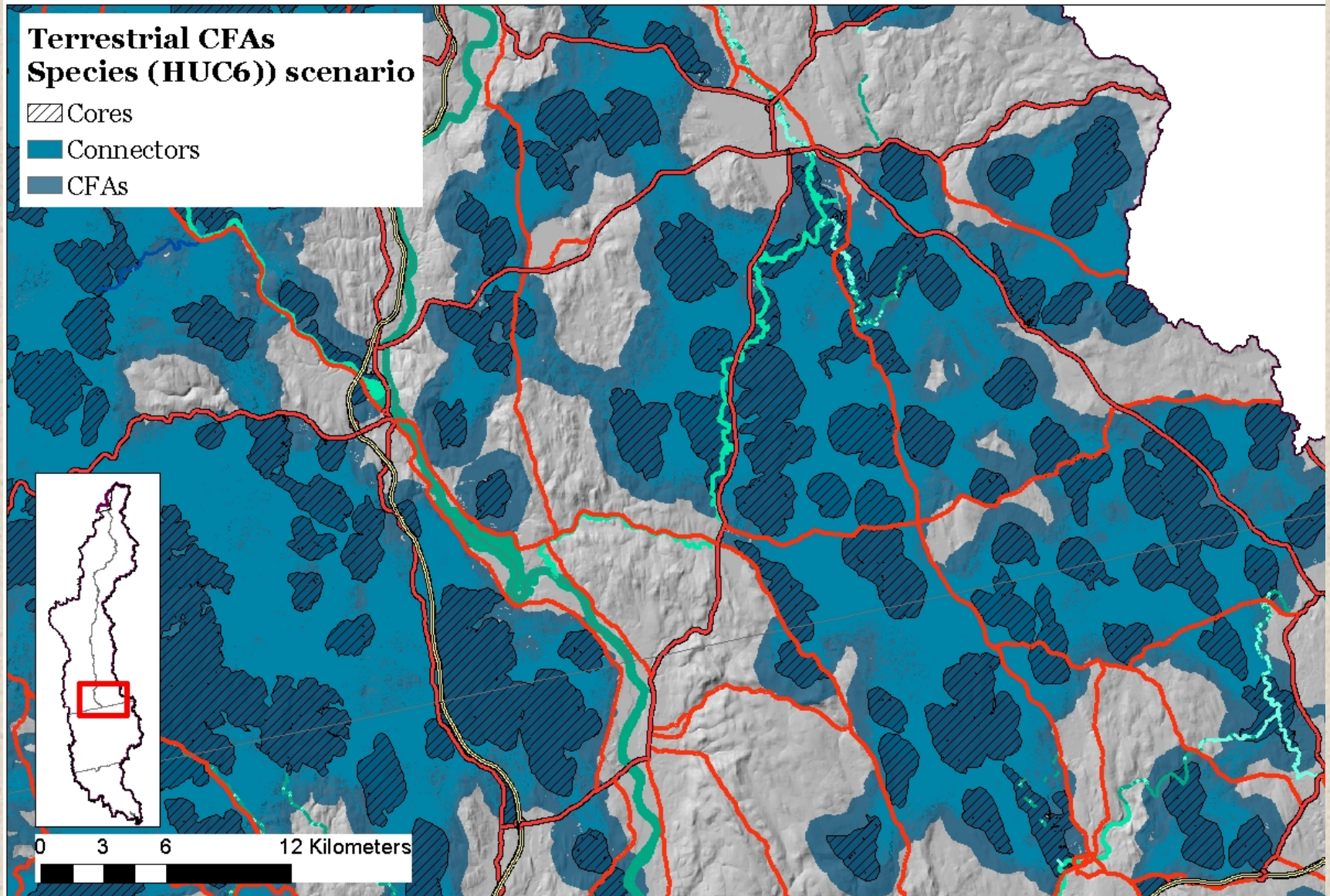
Conservation Focus Areas

“Cookies”?



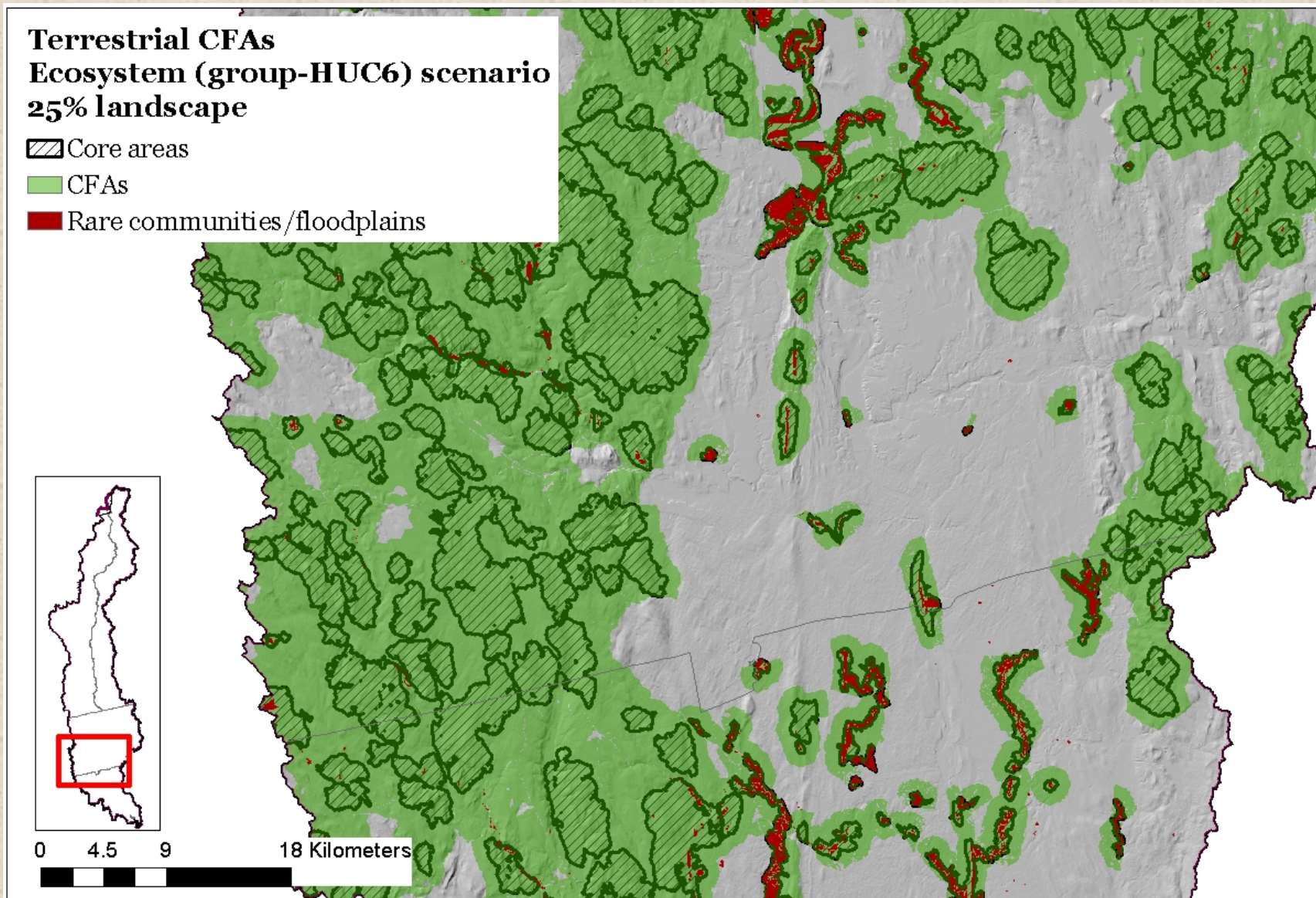
Conservation Focus Areas

“Cookies”?



Conservation Focus Areas

“Cookies”?



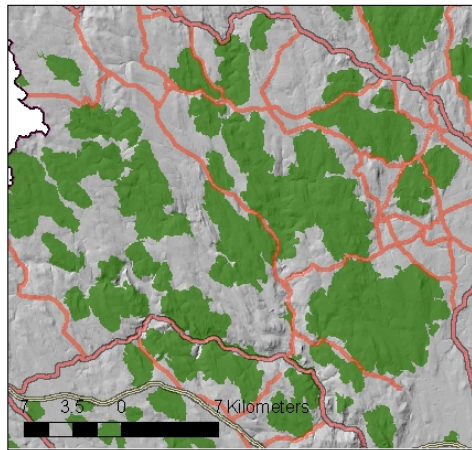
Scenario comparison

Terrestrial core area network

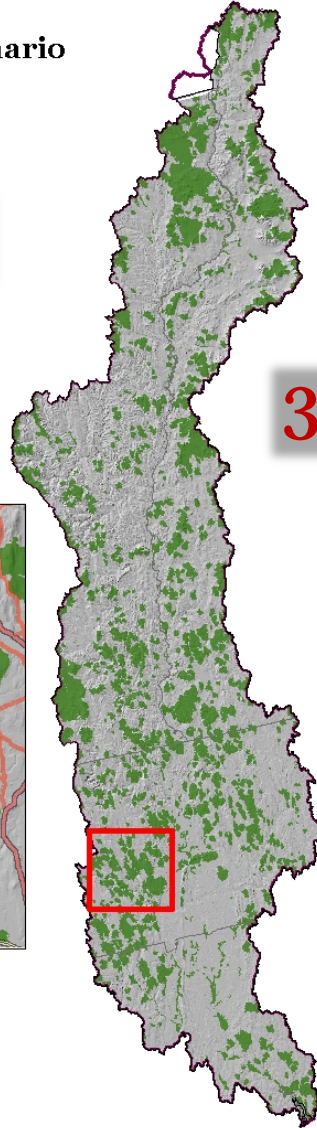
Terrestrial Core Areas
Ecosystem (group-HUC6) scenario
25% of landscape

■ Cores

52% secured



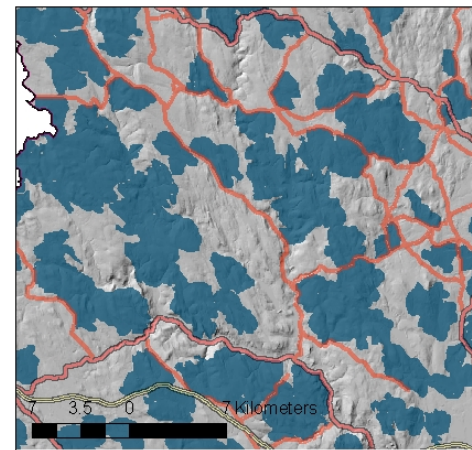
0 25 50 100 Kilometers



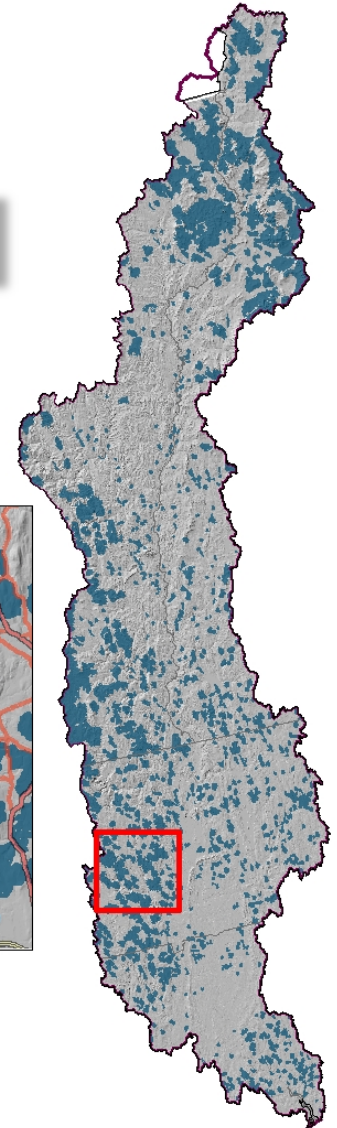
Terrestrial Core Areas
Species (HUC6) scenario
25% of landscape

■ Cores

42% secured



0 25 50 100 Kilometers



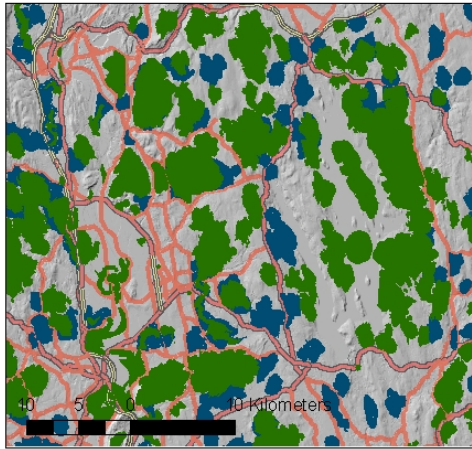
39% overlap

Scenario comparison

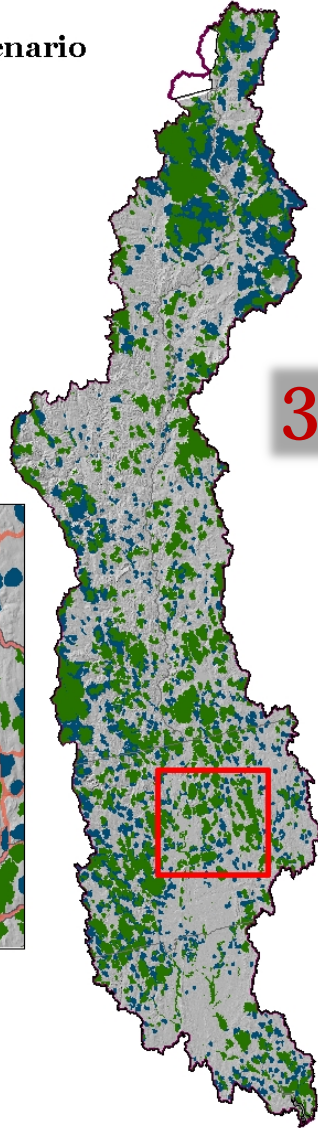
Terrestrial core area network

Terrestrial Core Areas
Eco/Species (group-HUC6) scenario
25% of landscape

- Eco Cores
- Species Cores



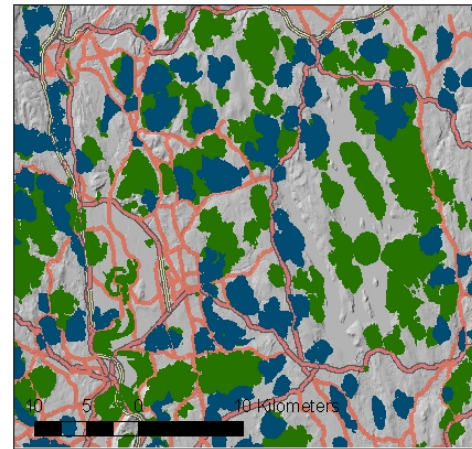
0 25 50 100 Kilometers



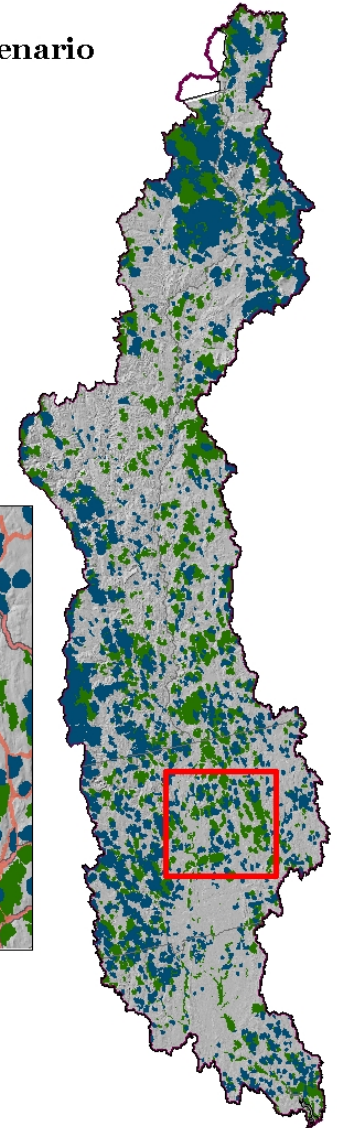
39% overlap

Terrestrial Core Areas
Eco/Species (group-HUC6) scenario
25% of landscape

- Species Cores
- Eco Cores



0 25 50 100 Kilometers



Scenario comparison

Terrestrial core area network

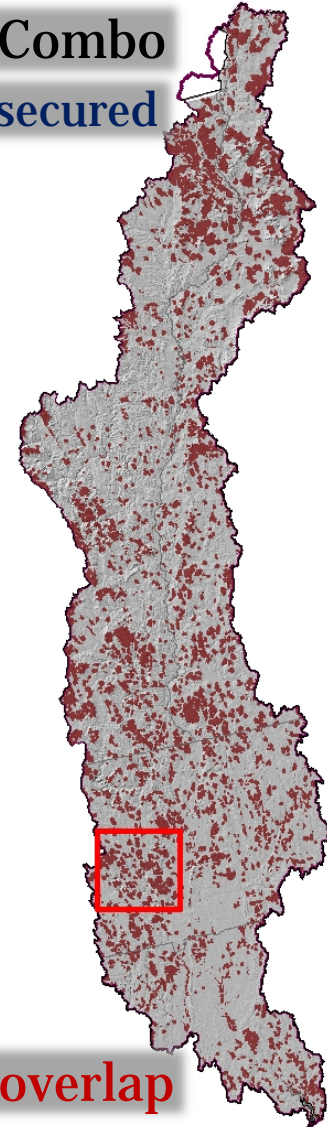
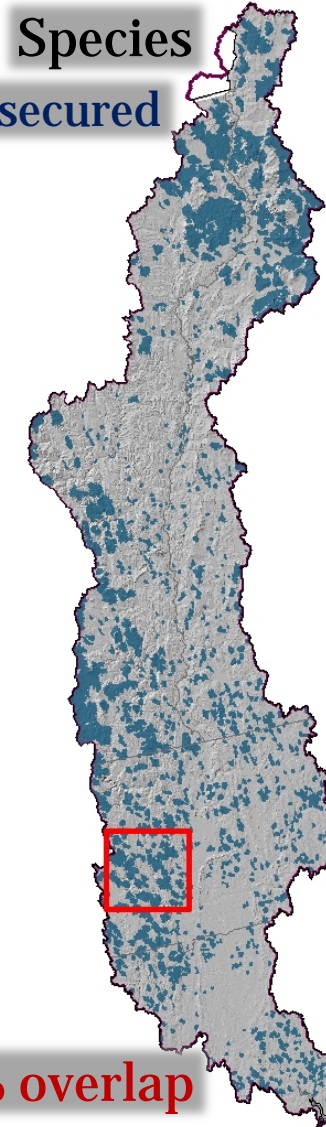
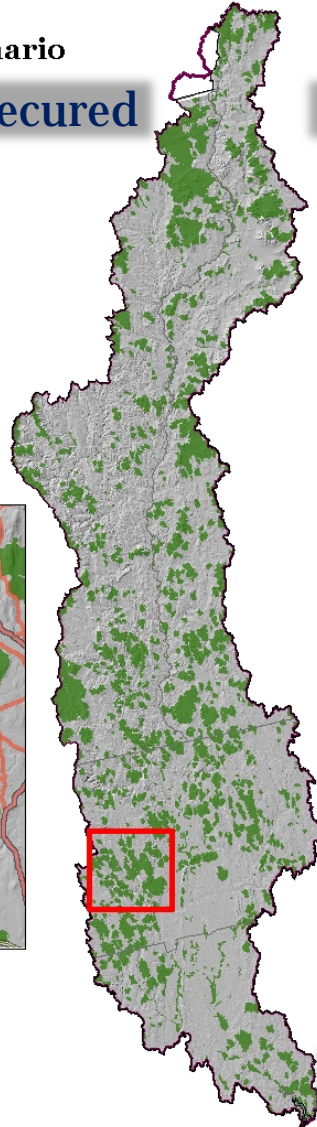
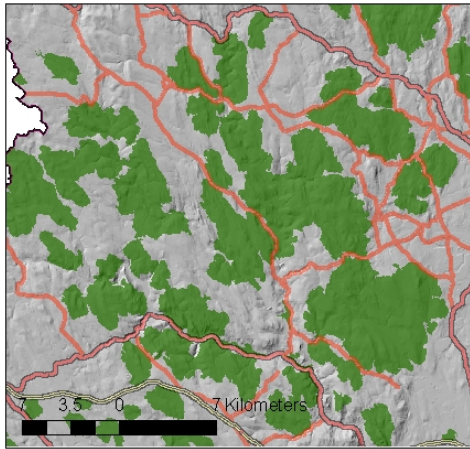
Terrestrial Core Areas
Ecosystem (group-HUC6) scenario
25% of landscape

■ Cores

52% secured

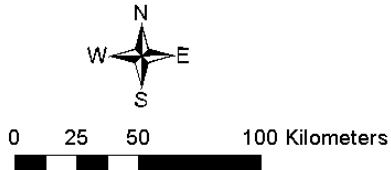
42% secured

44% secured



39% overlap

63% overlap



Scenario comparison

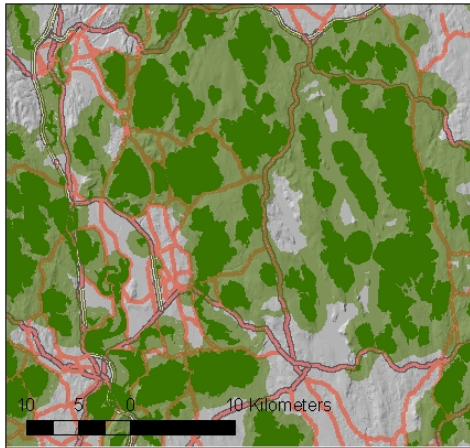
Terrestrial core area network

Terrestrial CFAs

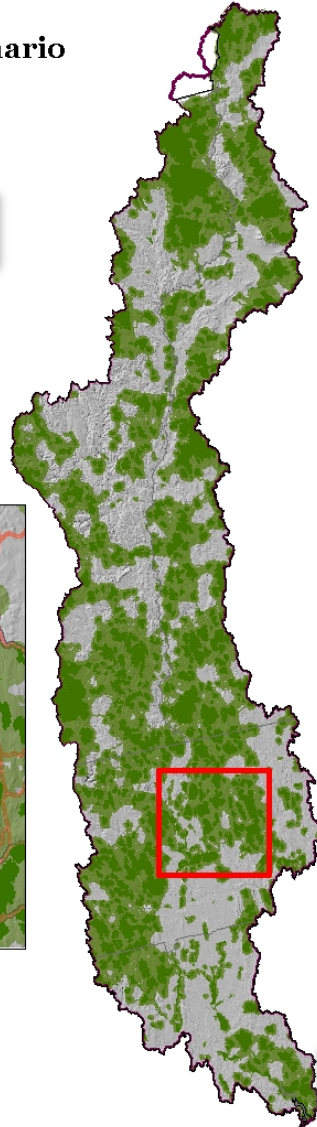
Ecosystem (group-HUC6) scenario
25% of landscape

- Eco Cores
- CFAs

66% landscape

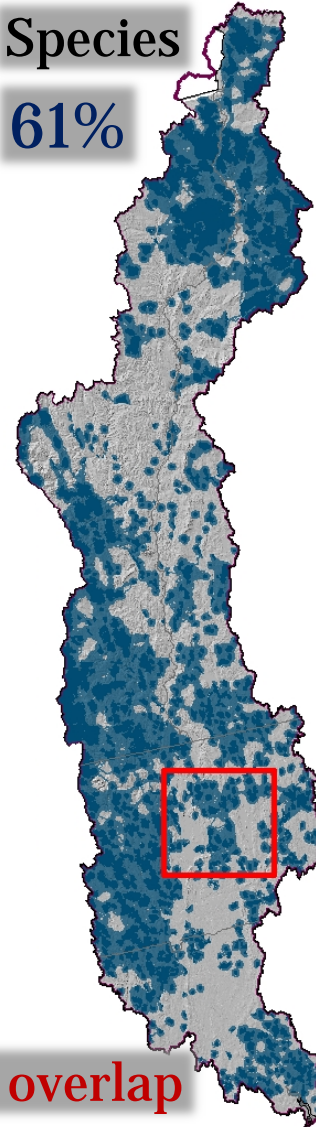


0 25 50 100 Kilometers



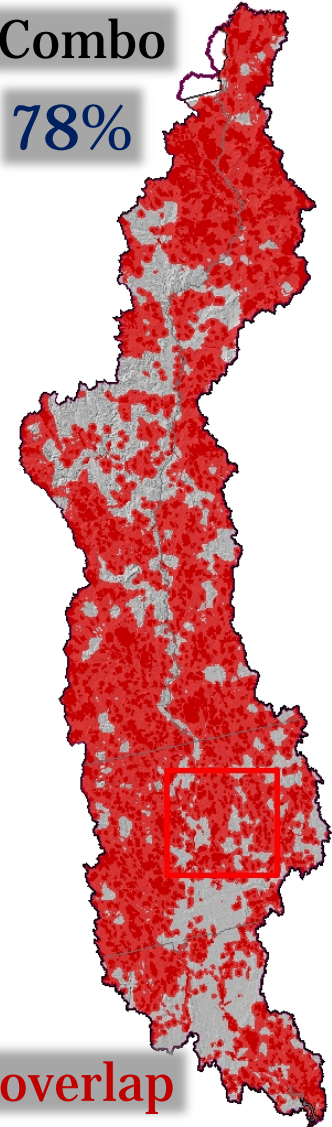
Species

61%



Combo

78%



69% overlap

85% overlap

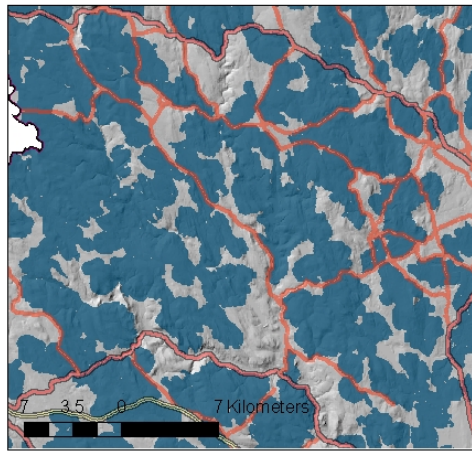
Scenario comparison

Terrestrial core area network

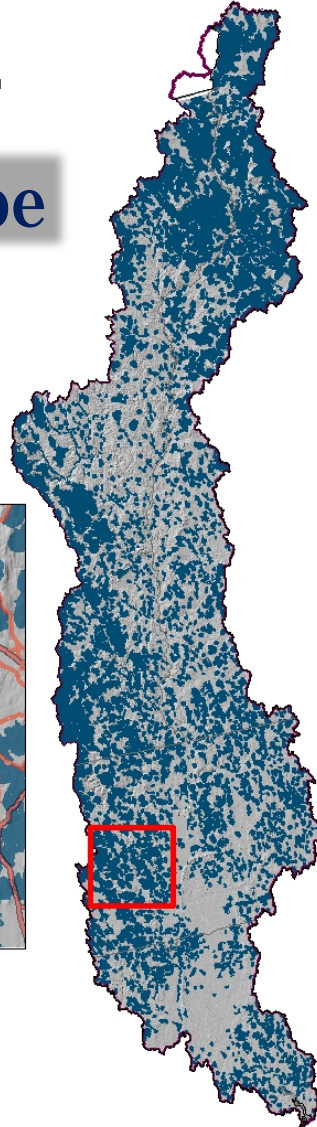
Terrestrial Core Areas
Species (HUC6) scenario
49% of landscape (full targets)

■ Cores

49% landscape



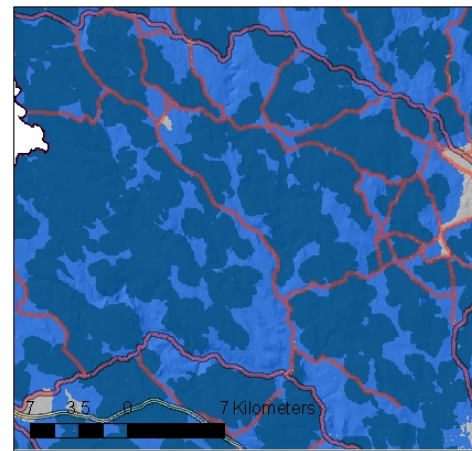
0 25 50 100 Kilometers



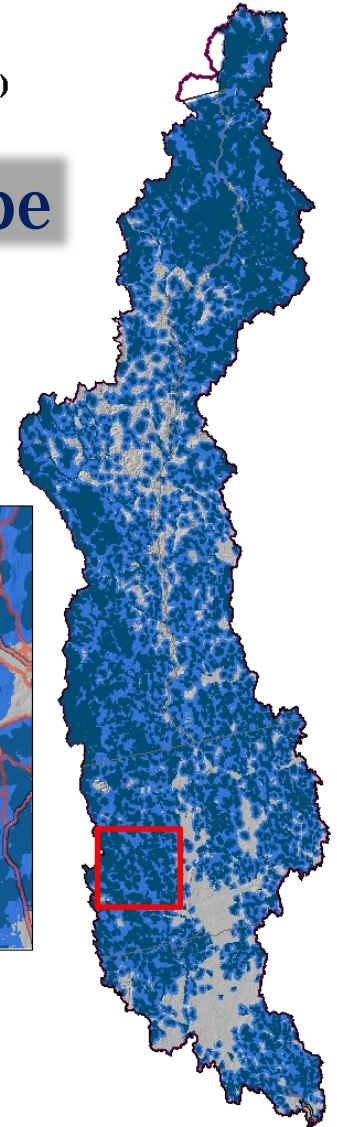
Terrestrial CFAs
Species (HUC6) scenario
49% of landscape (full targets)

■ Cores/CFAs

87% landscape



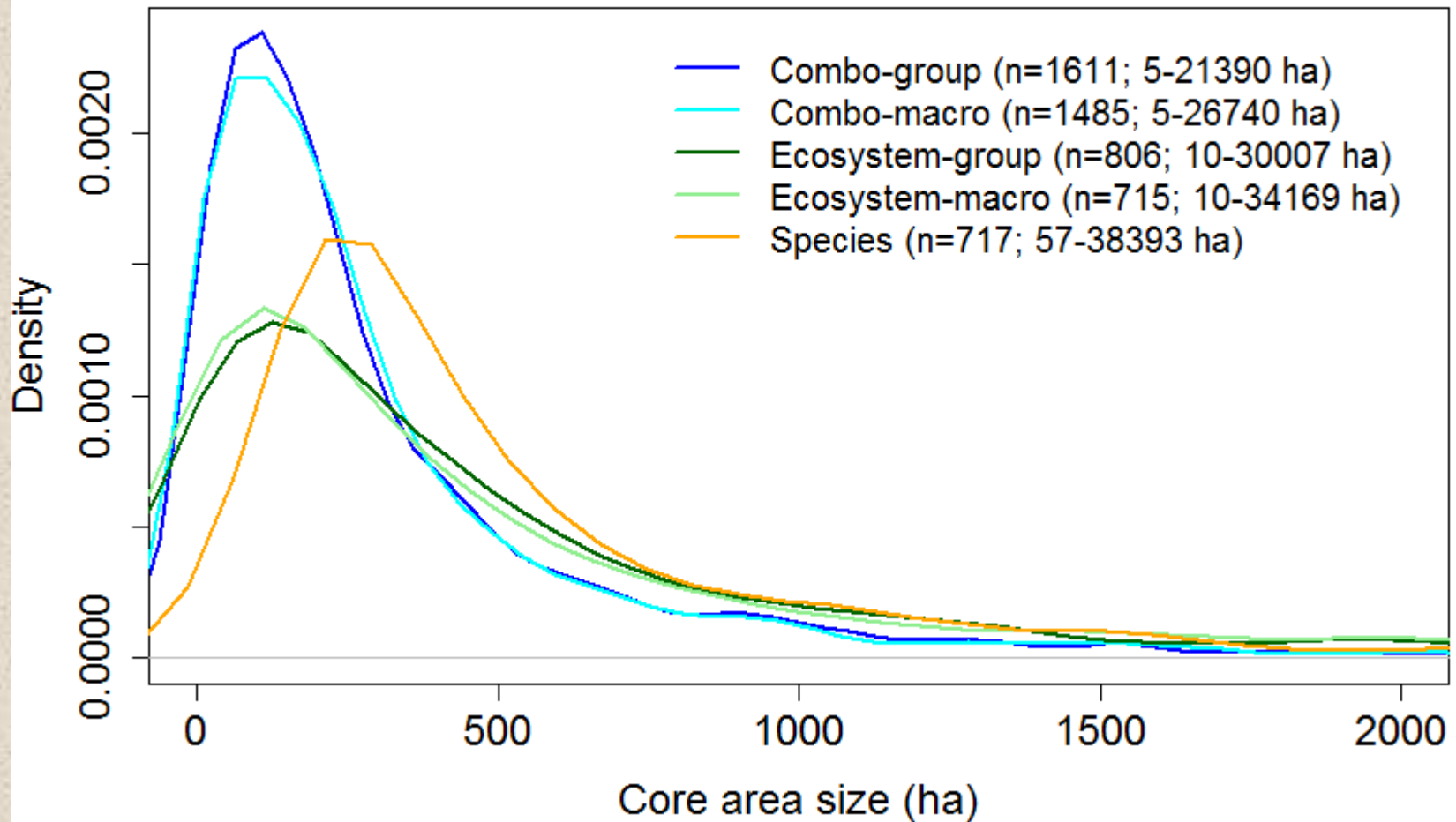
0 25 50 100 Kilometers



Scenario comparison

Terrestrial core area network

Core area size distribution



Scenario comparison

Terrestrial core area network

Terrestrial Core Areas

Macrogroup	Weight	CTR area (ha)	%CTR area in cores			%CTR selindex in Cores		
			Eco	Species	Combo	Eco	Species ²	Combo
Alpine	3	553	100	63	99	100	61	100
Cliff & Talus	1-3	16,505	36	16	27	46	18	36
Glade & Barren & Savanna	1	680	40	32	34	50	35	42
Outcrop & Summit Scrub	1-3	21,155	43	31	33	54	32	41
Ruderal Shrubland & Grassland	1	10,205	19	22	22	27	26	27
Coastal Grassland & Shrubland	3	22	33	0	17	31	0	16
Boreal Upland Forest	3	168,630	42	34	39	50	36	45
Central Oak-Pine	1-3	145,586	29	21	26	38	24	33
Northern Hardwood & Conifer	1	1,749,969	29	28	27	41	31	35
Central Hardwood Swamp	1	4,800	38	21	45	52	22	58
Coastal Plain Peat Swamp	1	78	100	0	100	100	0	100
Northeastern Floodplain Forest	3	469	49	41	54	59	45	63
Northern Swamp	1-3	80,673	32	28	36	44	31	45
Emergent Marsh	3	10,267	38	29	41	44	31	46
Ruderal Shrub Swamp	1	505	23	23	31	34	26	40
Wet Meadow / Shrub Marsh	3	20,960	34	36	41	40	38	46
Northern Peatland & Fens	3	3,044	64	41	66	71	43	73
Total		2,234,103	30	27	28	41	31	36

Scenario comparison

Terrestrial core area network

Terrestrial Core Areas

Species	% of Current Total LC			
	Target	Eco	Species	Combo
Blackpoll Warbler	85	61	52	45
Wood Turtle	80	29	46	44
American Woodcock	73	29	42	38
Eastern Meadowlark	73	3	41	40
Blackburnian Warbler	63	34	38	34
Louisiana Waterthrush	63	33	38	35
Marsh Wren	63	47	39	55
Moose	55	35	35	33
Northern Waterthrush	55	48	41	52
Wood Thrush	55	36	34	32
Prairie Warbler	50	32	43	42
Wood Duck	50	41	36	39
Ruffed Grouse	45	32	33	31
Black Bear	40	31	31	30
Average	61	35	39	39

*Realized with the 25% of landscape threshold

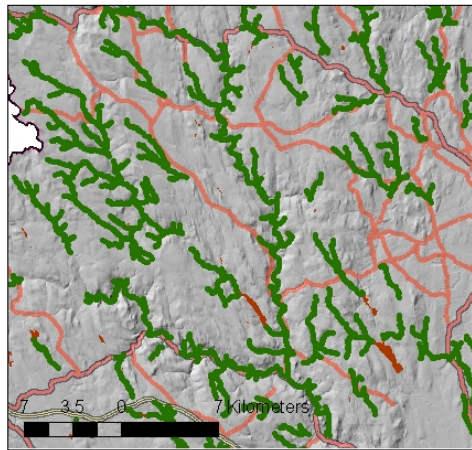
Scenario comparison

Aquatic core area network

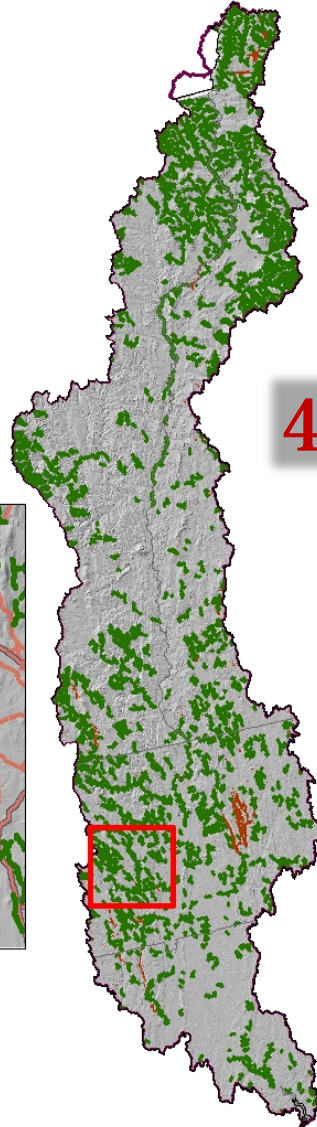
**Aquatic Core Areas
Ecosystem (HUC6) scenario
28% of riverscape**

- Lotic cores
- Lentic cores

N=813
1-3,262 km



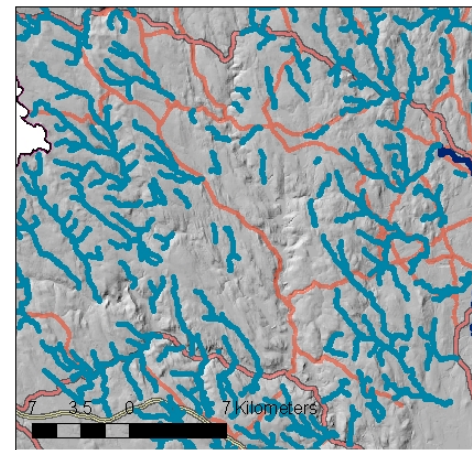
0 25 50 100 Kilometers



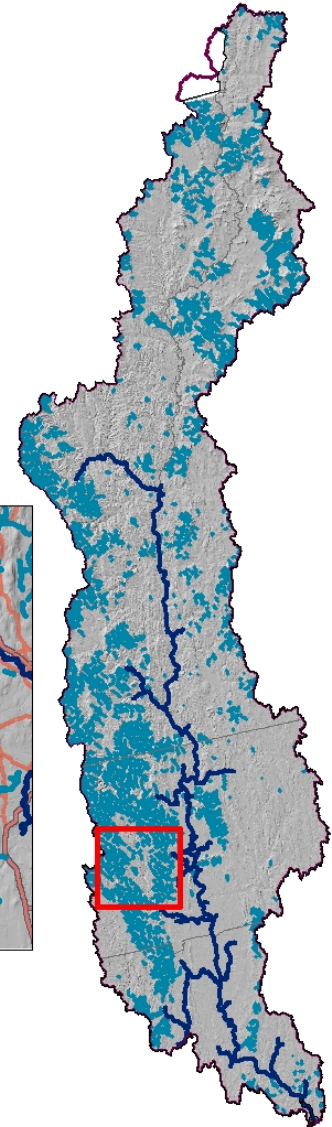
**Aquatic Core Areas
Species (HUC6) scenario
26% of riverscape**

- Lotic cores

N=727
1-133 km



0 25 50 100 Kilometers



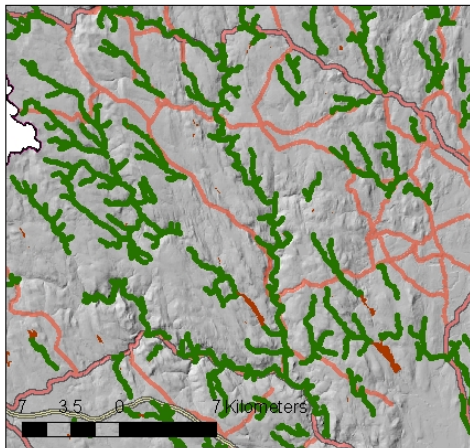
43% overlap

Scenario comparison

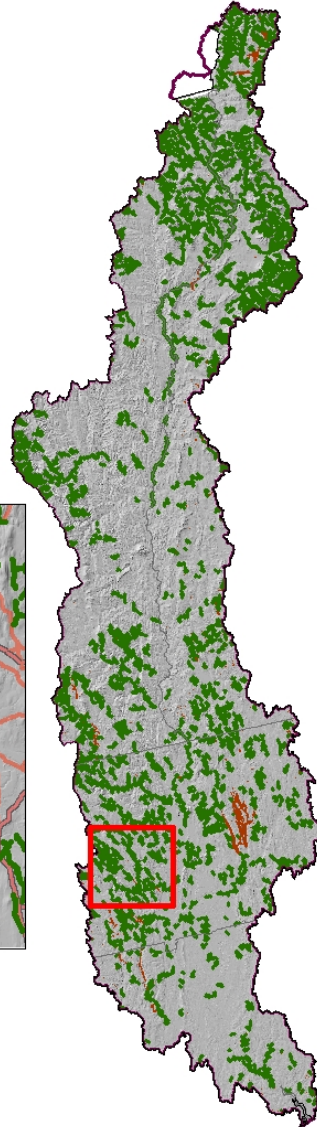
Aquatic core area network

Aquatic Core Areas
Ecosystem (HUC6) scenario
28% of riverscape

- Lotic cores
- Lentic cores



0 25 50 100 Kilometers



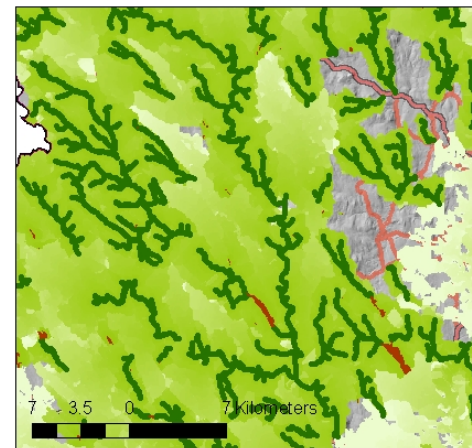
Aquatic CFAs
Ecosystem (HUC6) scenario
28% of riverscape

- Lotic cores
- Lentic cores

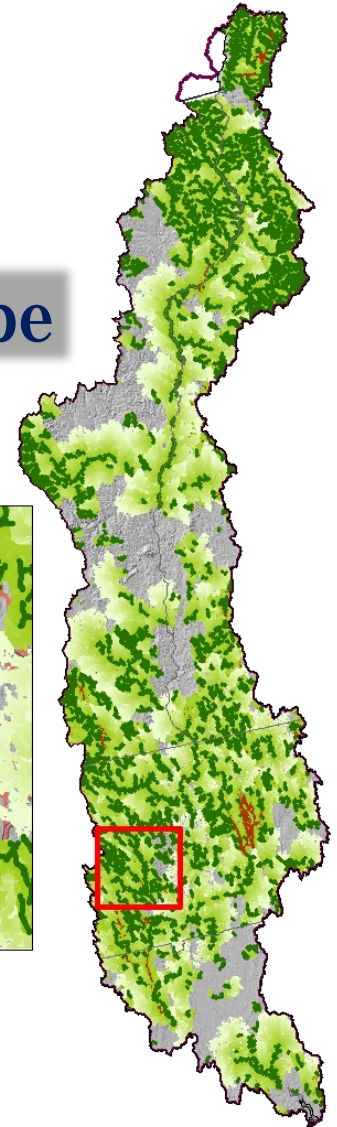
CFAs



78% landscape



0 25 50 100 Kilometers



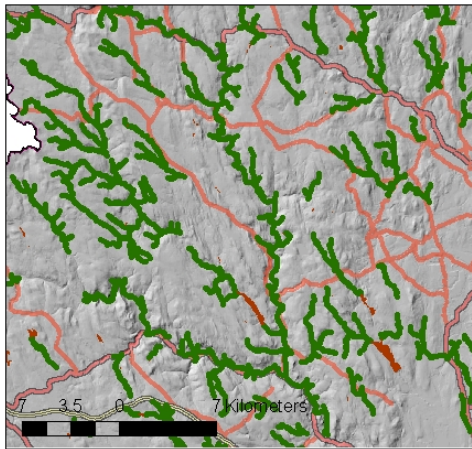
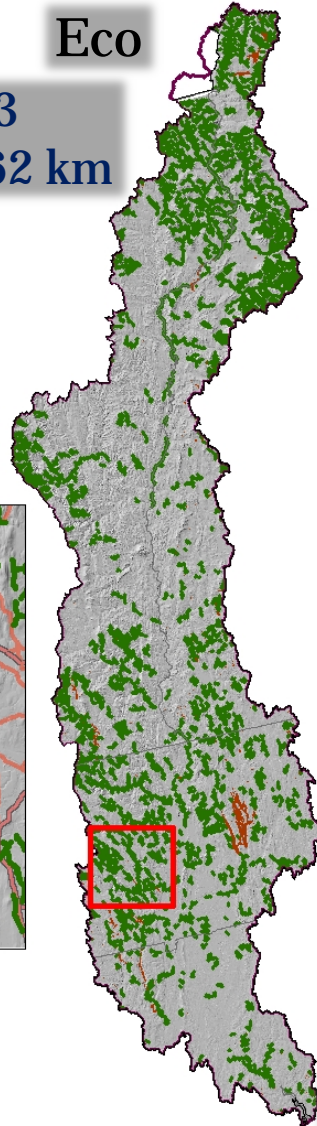
Scenario comparison

Aquatic core area network

Aquatic Core Areas
Ecosystem (HUC6) scenario
28% of riverscape

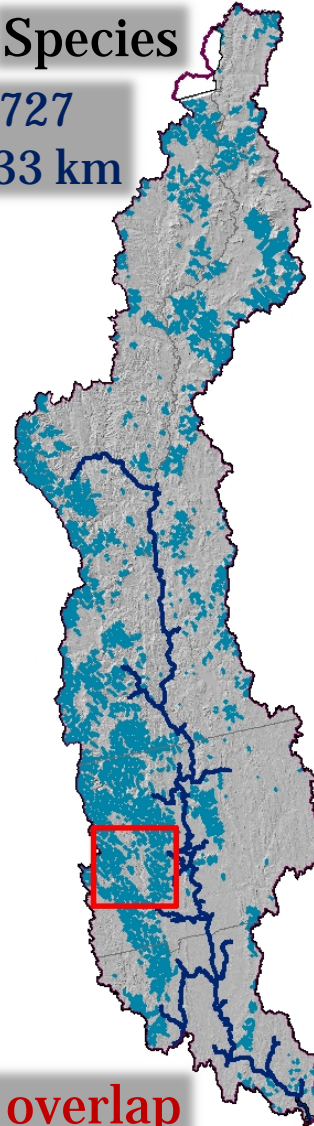
- Lotic cores
- Lentic cores

N=813
1-3,262 km



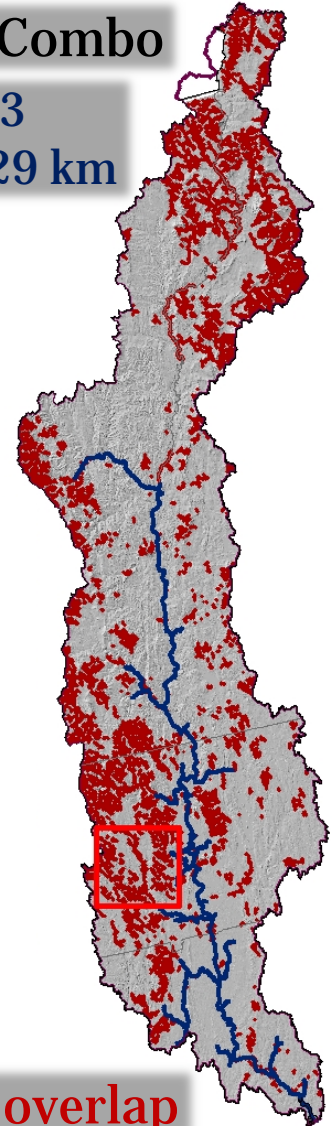
Species

N=727
1-133 km



Combo

N=793
1-3,329 km

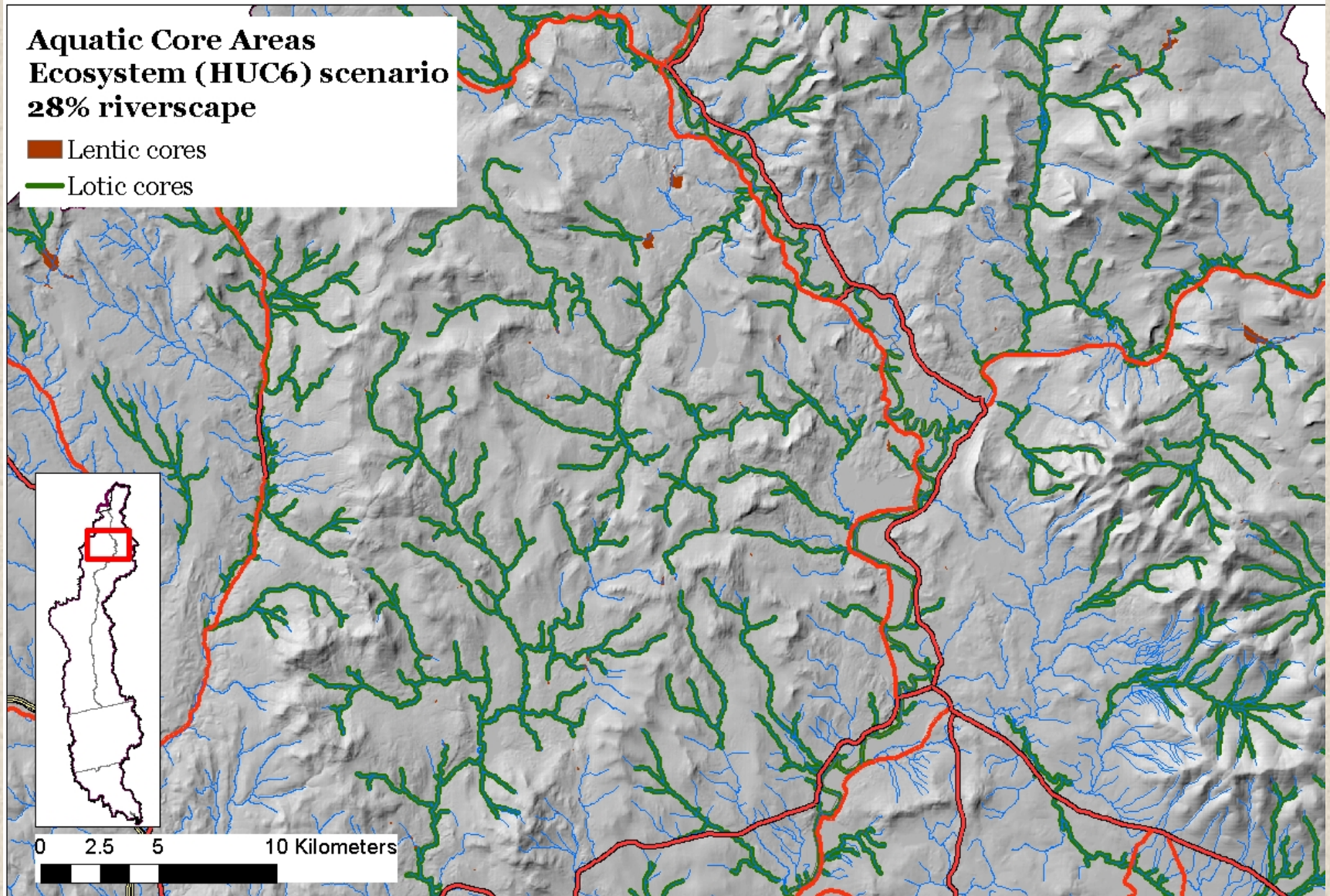


43% overlap

69% overlap

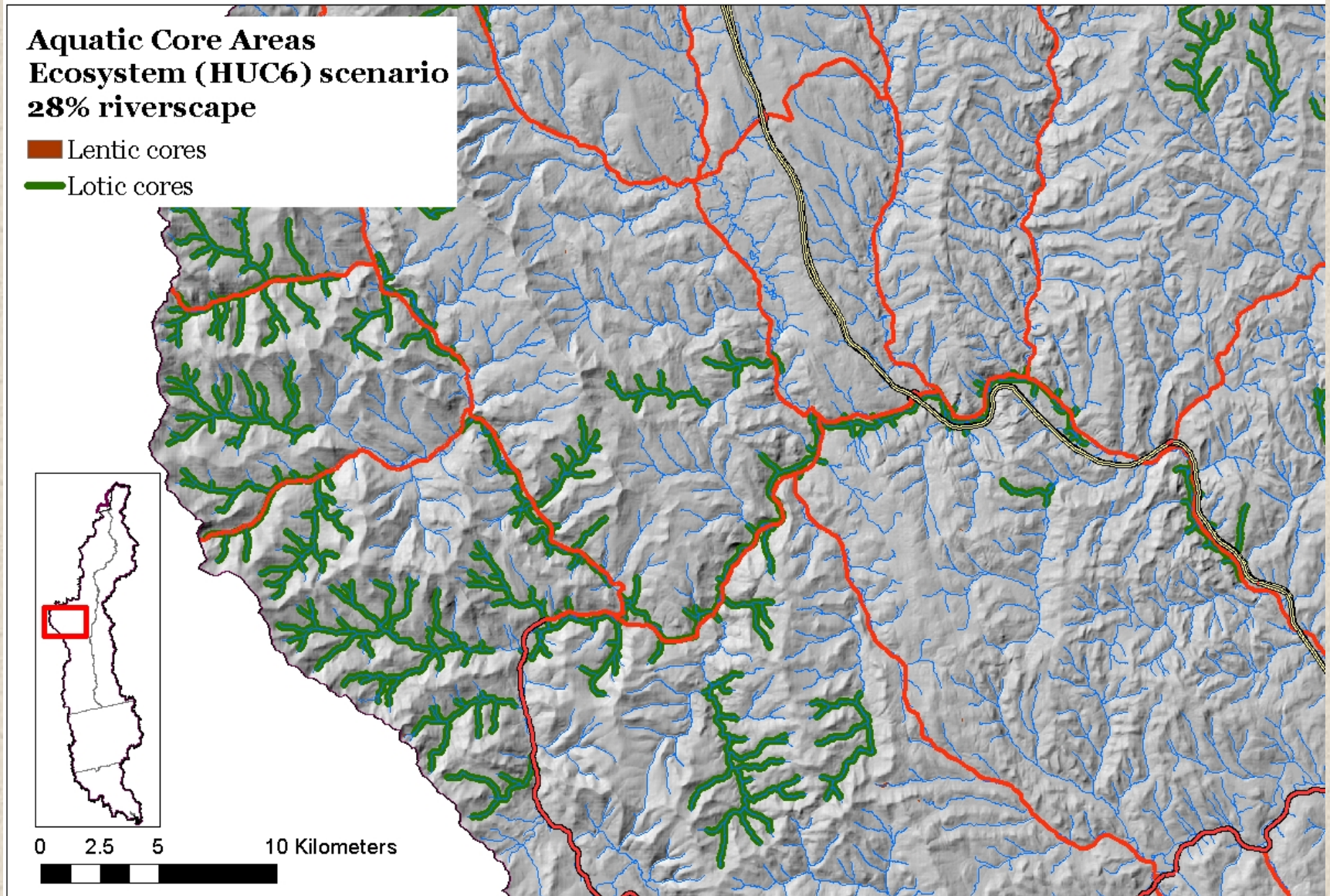
Scenario comparison

Aquatic core area network



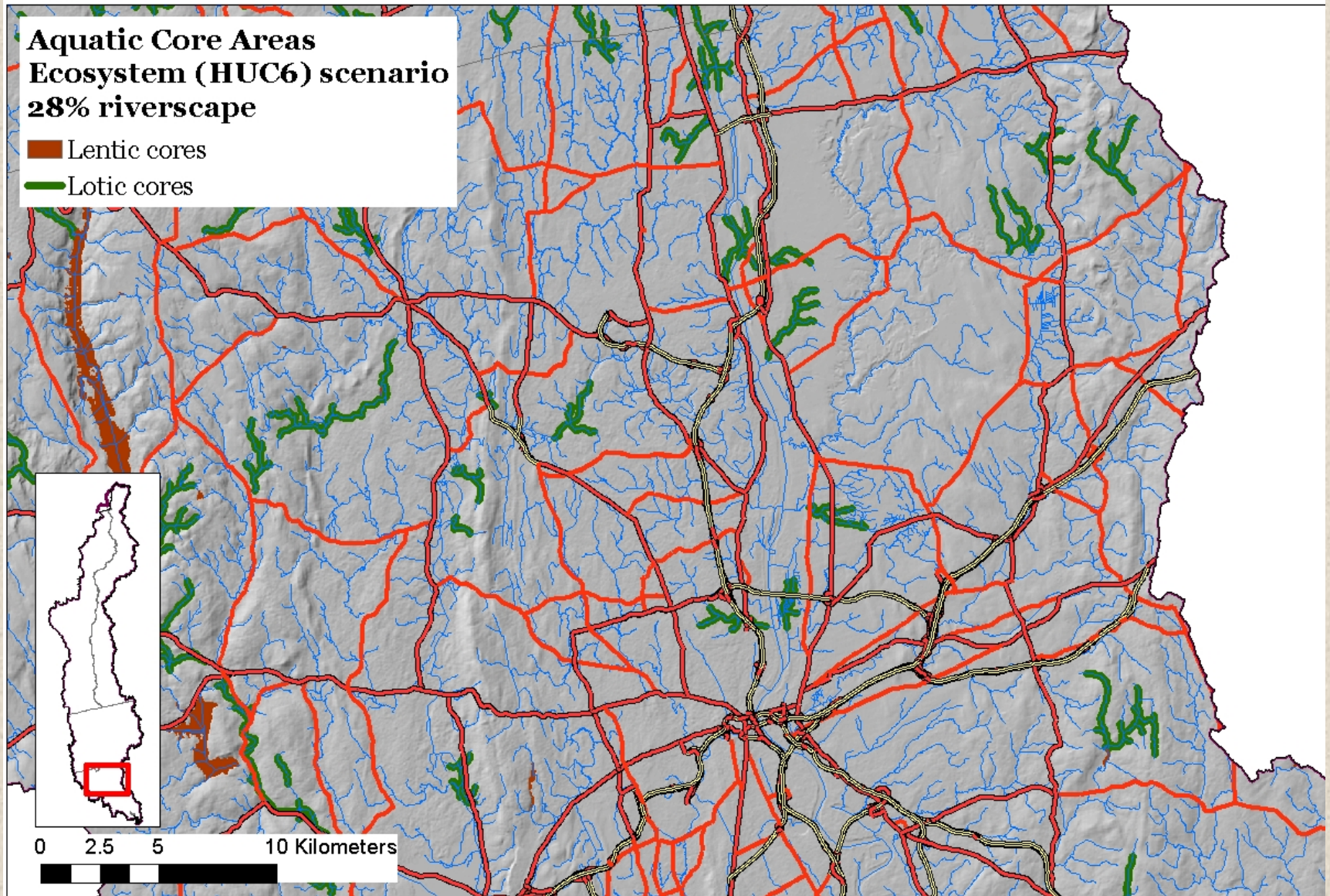
Scenario comparison

Aquatic core area network



Scenario comparison

Aquatic core area network



Scenario comparison

Aquatic core area network

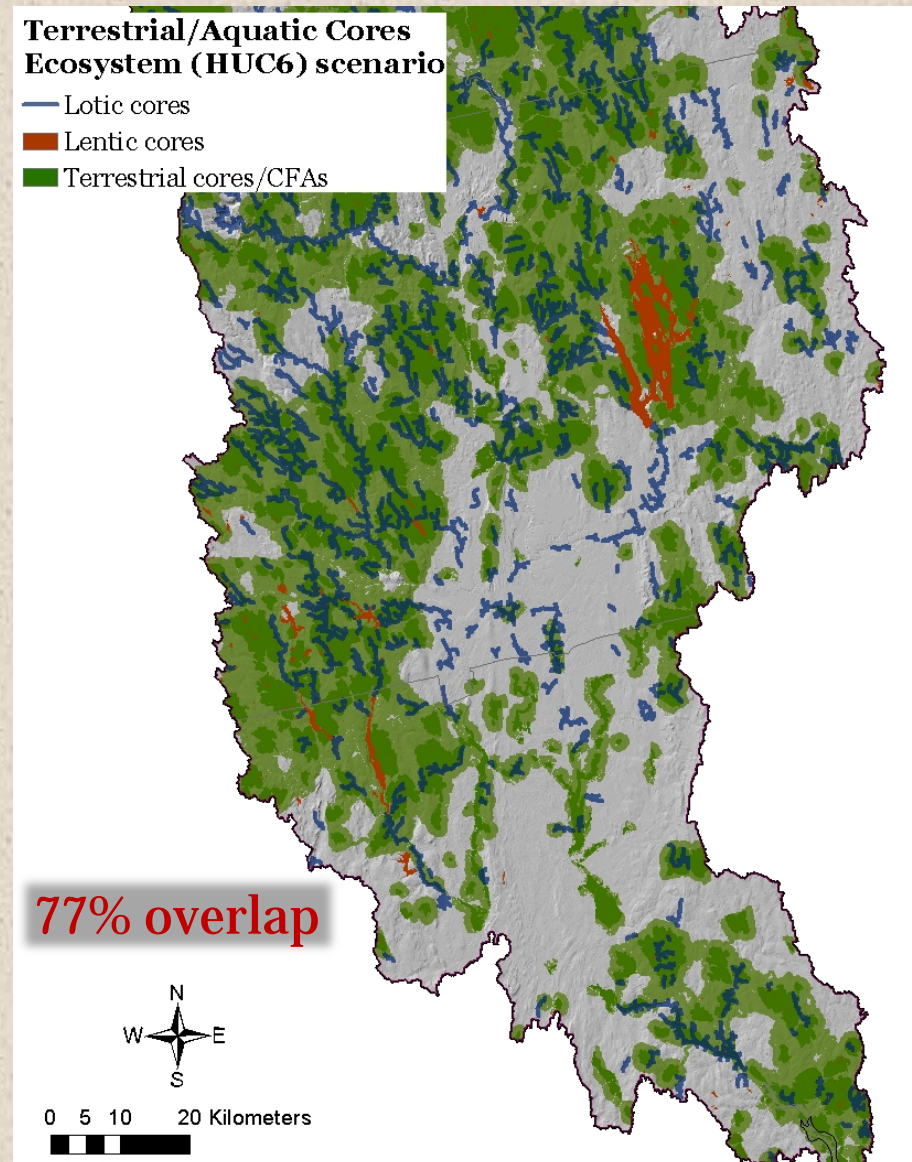
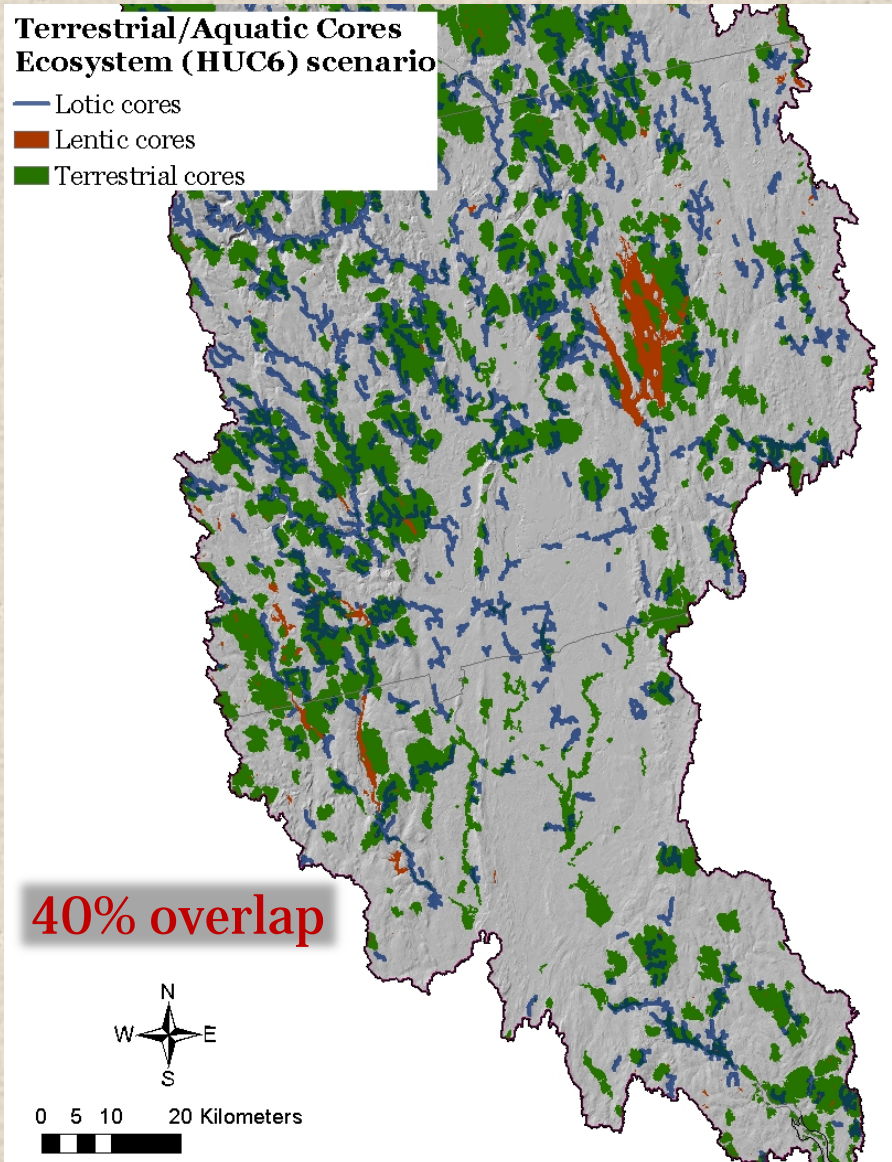
Aquatic Core Areas

Macrogroup/group	CTR dist (km)	%CTR dist in Cores			%CTR selindex in Cores		
		Eco	Species	Combo	Eco	Species	Combo
Stream (headwater) cold high	13,515	29	34	32	43	43	43
Stream (headwater) cold moderate	3,339	24	23	23	37	30	33
Stream (headwater) cold low	4,168	26	23	26	37	30	36
Stream (headwater) cool high	842	18	10	14	29	13	22
Stream (headwater) cool moderate	703	18	6	12	27	8	17
Stream (headwater) cool low	2,299	14	5	9	23	8	15
Stream (headwater) warm high	50	15	4	10	24	4	16
Stream (headwater) warm moderate	39	11	3	9	18	3	13
Stream (headwater) warm low	159	12	5	9	21	9	16
Stream (small) cold moderate	464	46	2	36	70	2	57
Stream (small) cold low	254	44	1	37	66	1	57
Stream (small) cool moderate	382	44	16	52	67	8	66
Stream (small) cool low	394	38	26	50	61	17	59
Stream (medium) cold	108	54	0	52	81	0	79
Stream (medium) cool	426	48	38	61	74	44	81
Stream (medium) warm	128	42	66	82	68	57	85
Stream (large) cool	408	49	59	84	71	46	85
Stream (large) warm	150	42	68	78	64	68	85
Total	27,827	28	26	29	42	33	40

Macrogroup/group	CTR area (ha)	%CTR area in Cores			%CTR selindex in Cores		
		Eco	Species	Combo	Eco	Species	Combo
Lake	40,859	53	1	53	75	1	76
Pond	11,164	18	4	18	31	6	31
Total	52,023	46	2	46	66	2	66

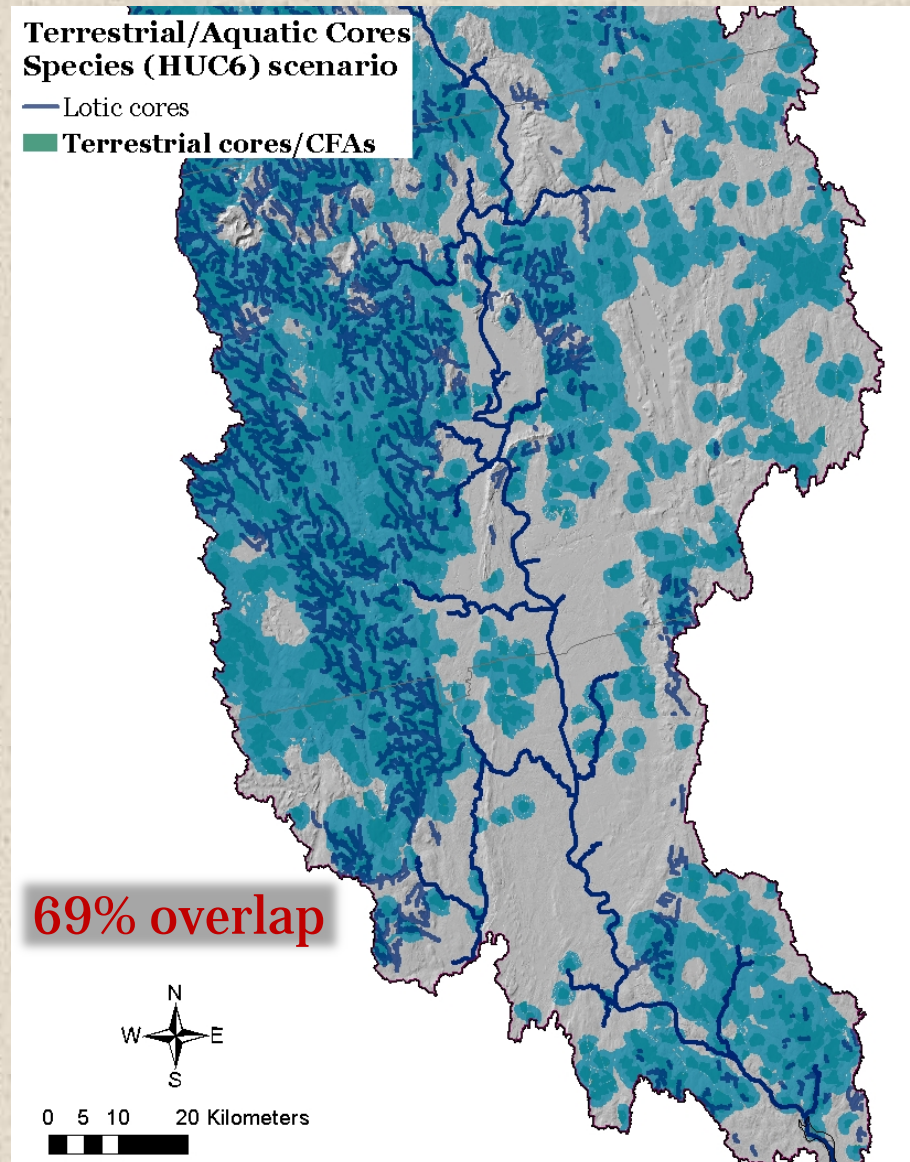
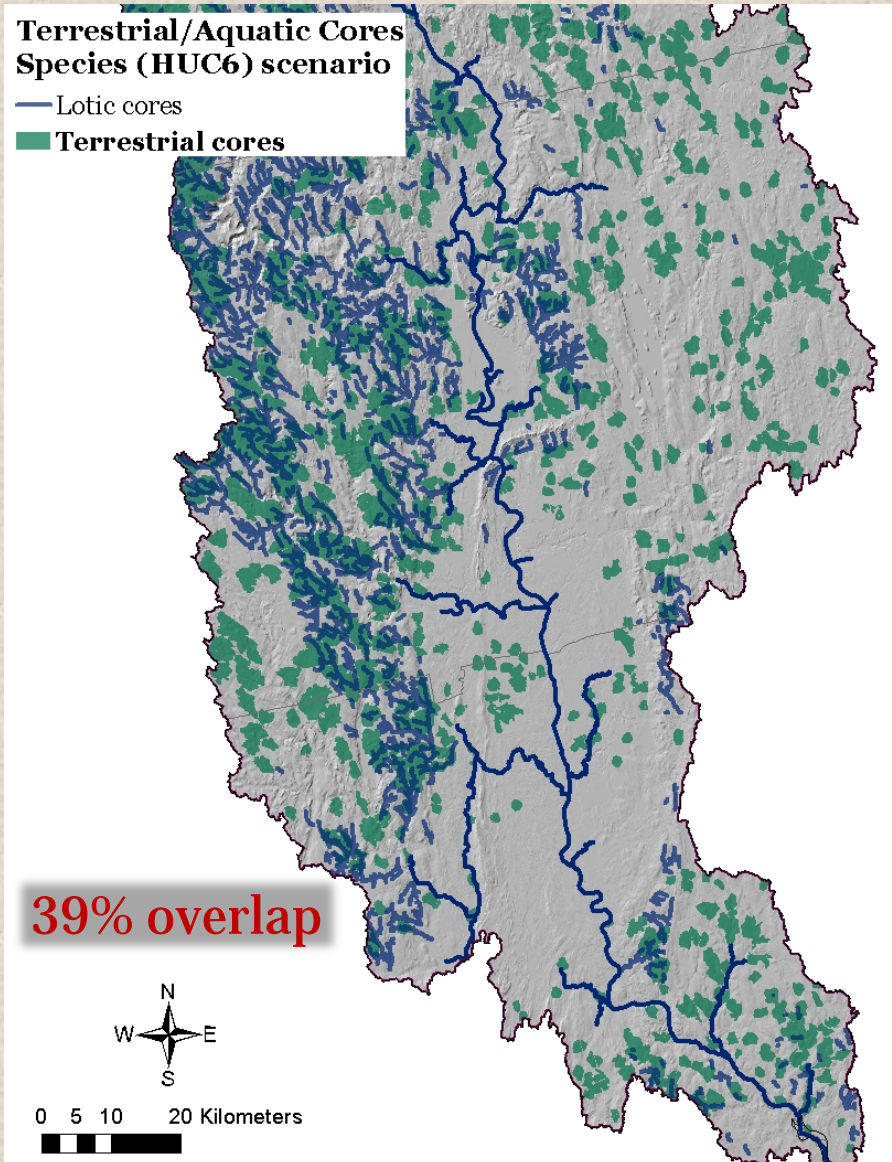
Scenario comparison

Terrestrial and aquatic core area network



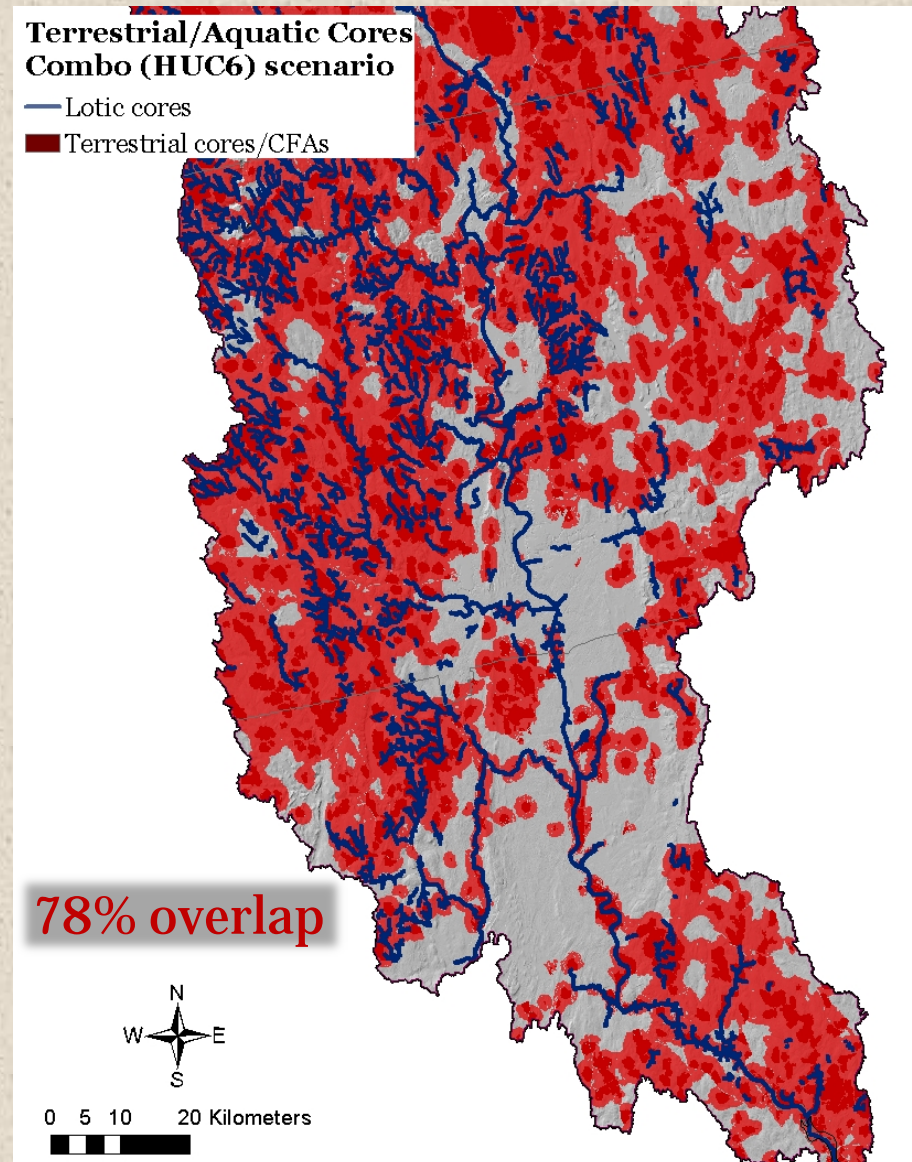
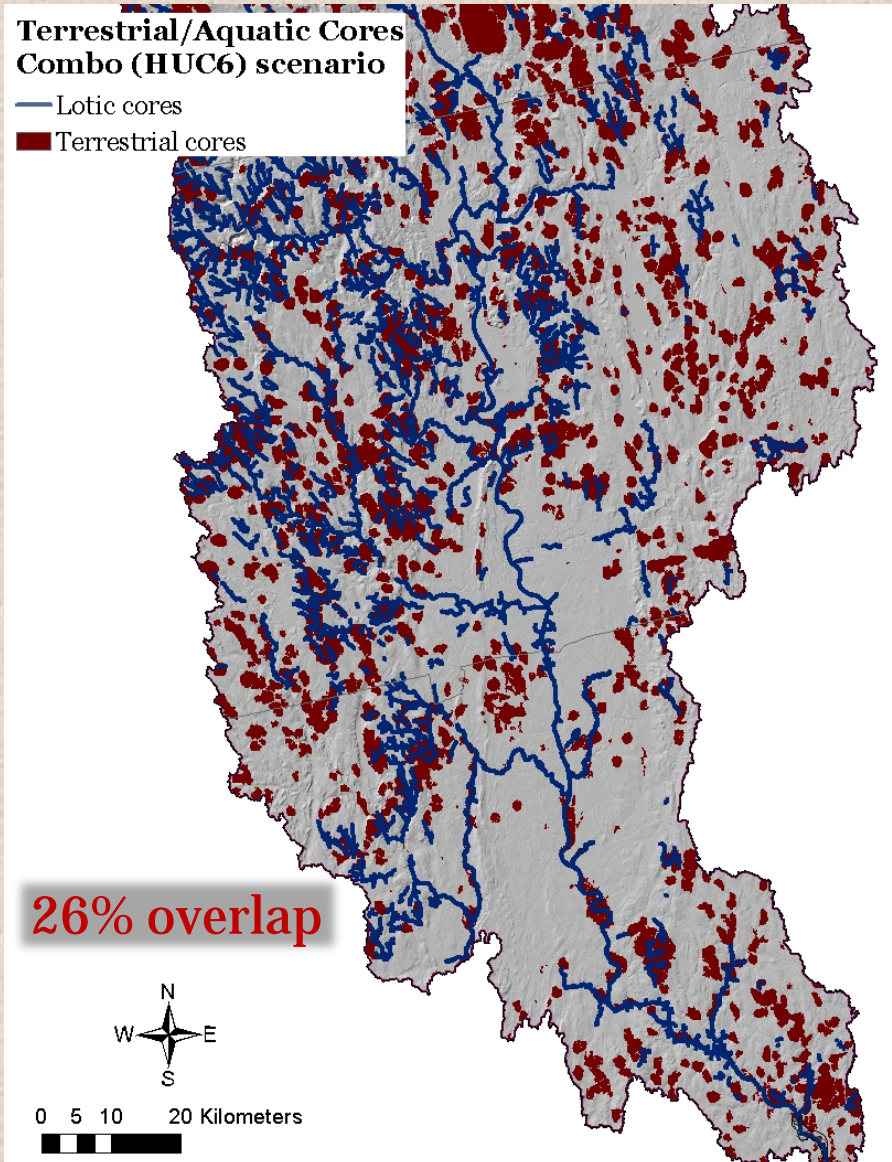
Scenario comparison

Terrestrial and aquatic core area network



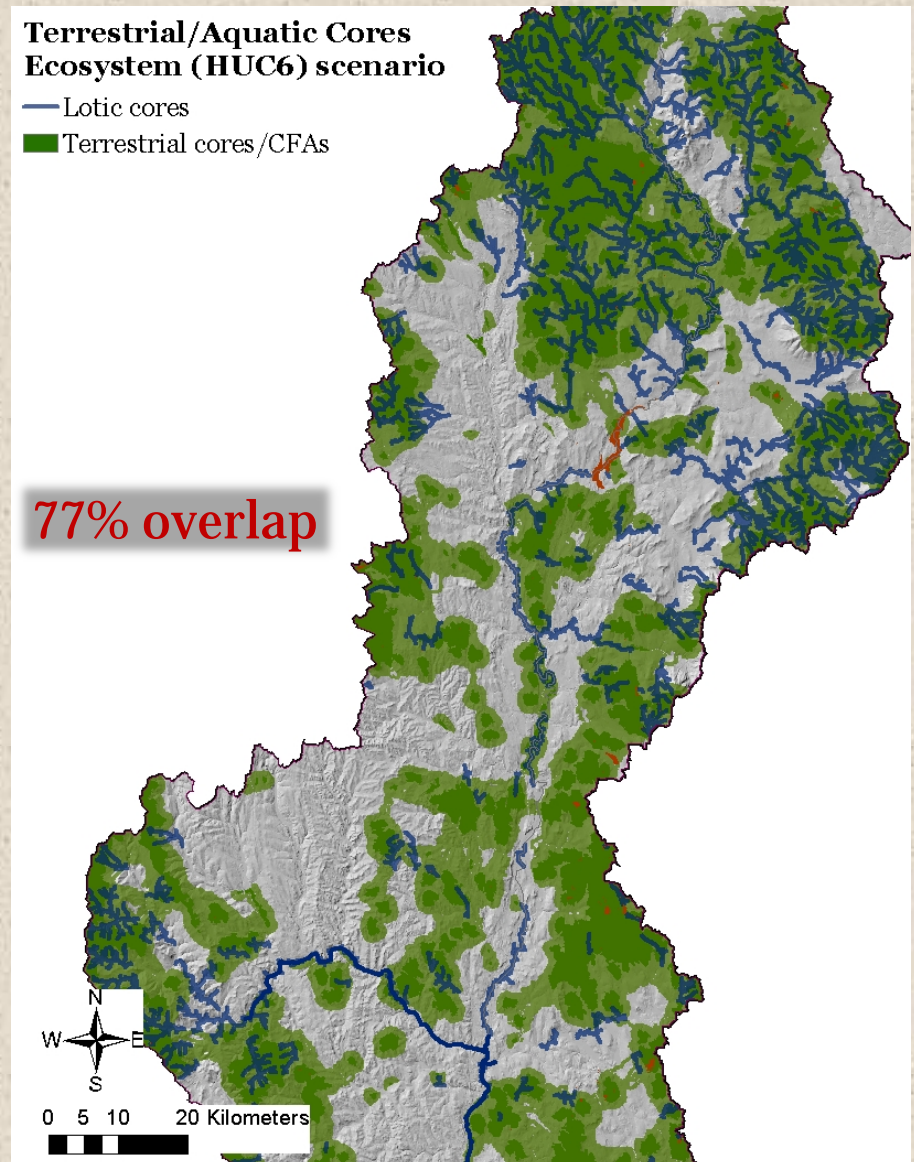
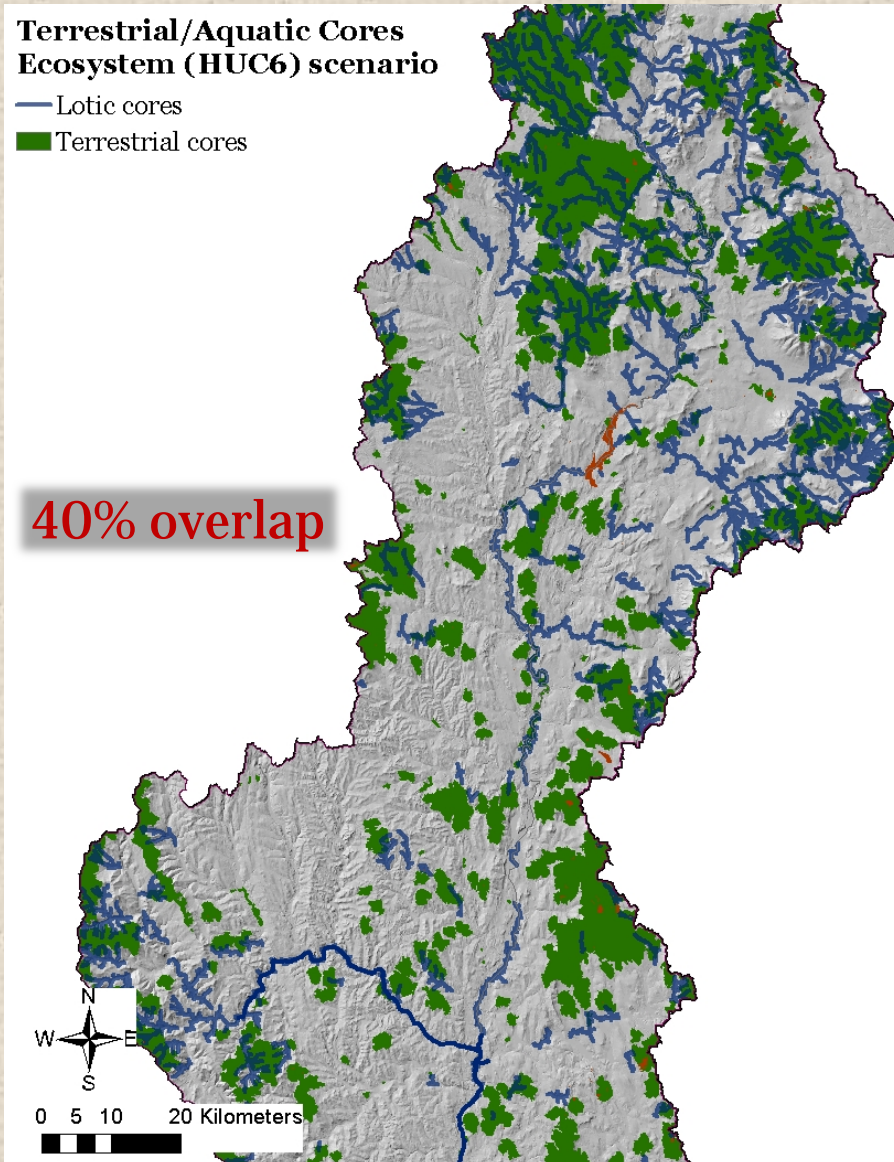
Scenario comparison

Terrestrial and aquatic core area network



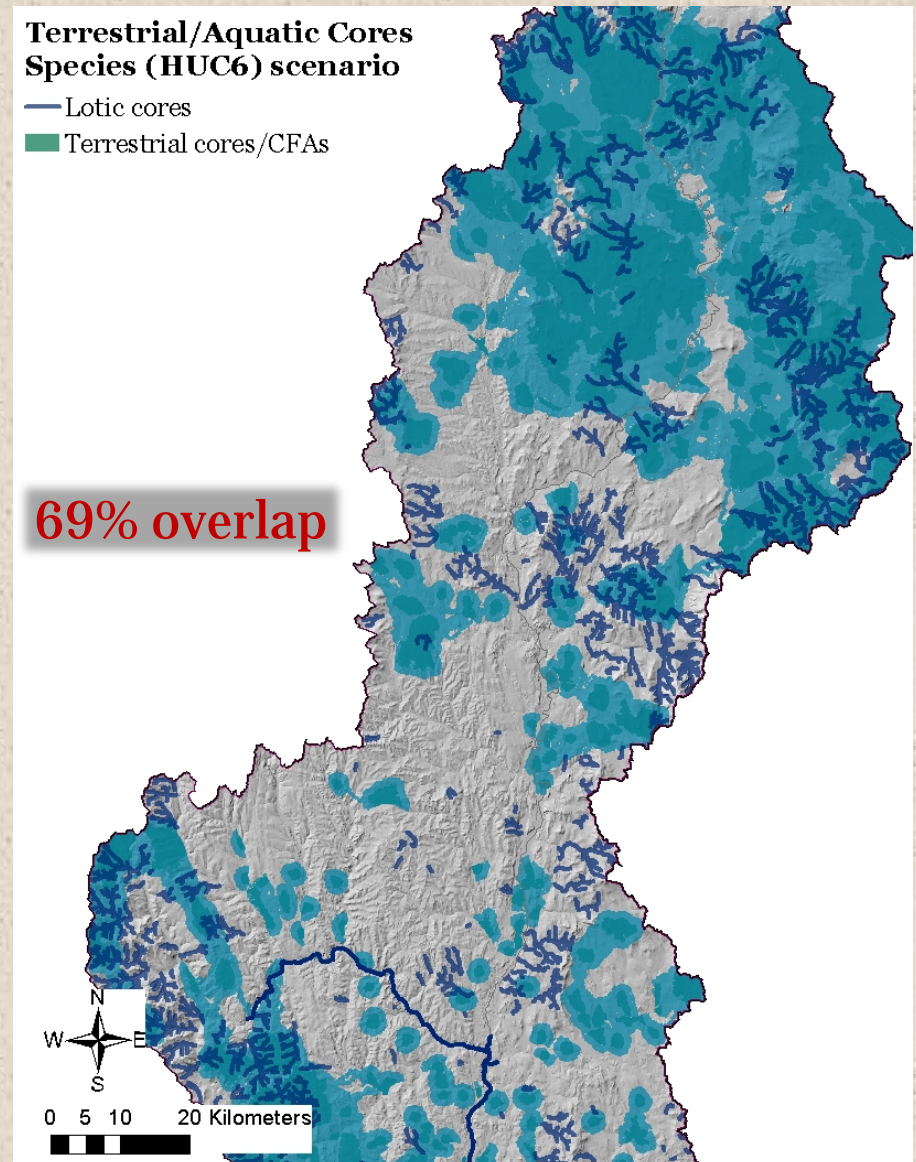
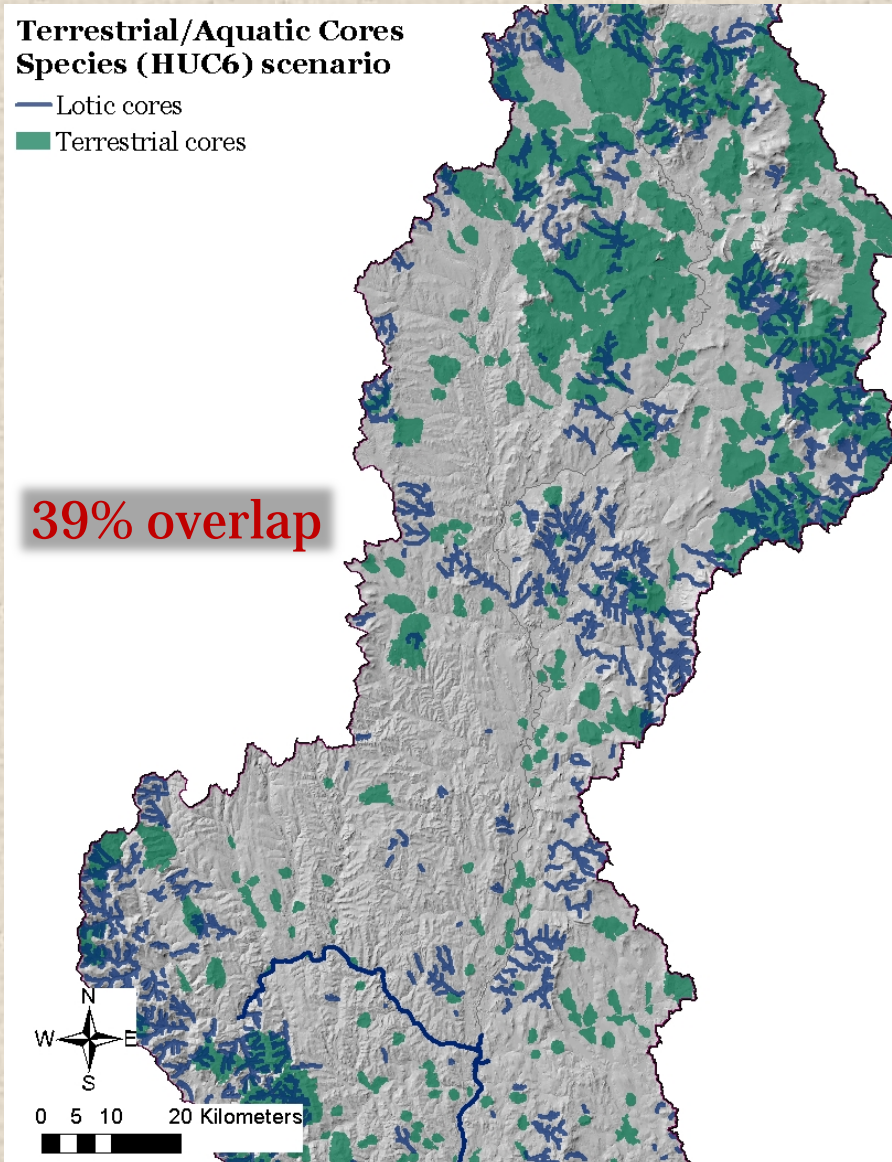
Scenario comparison

Terrestrial and aquatic core area network



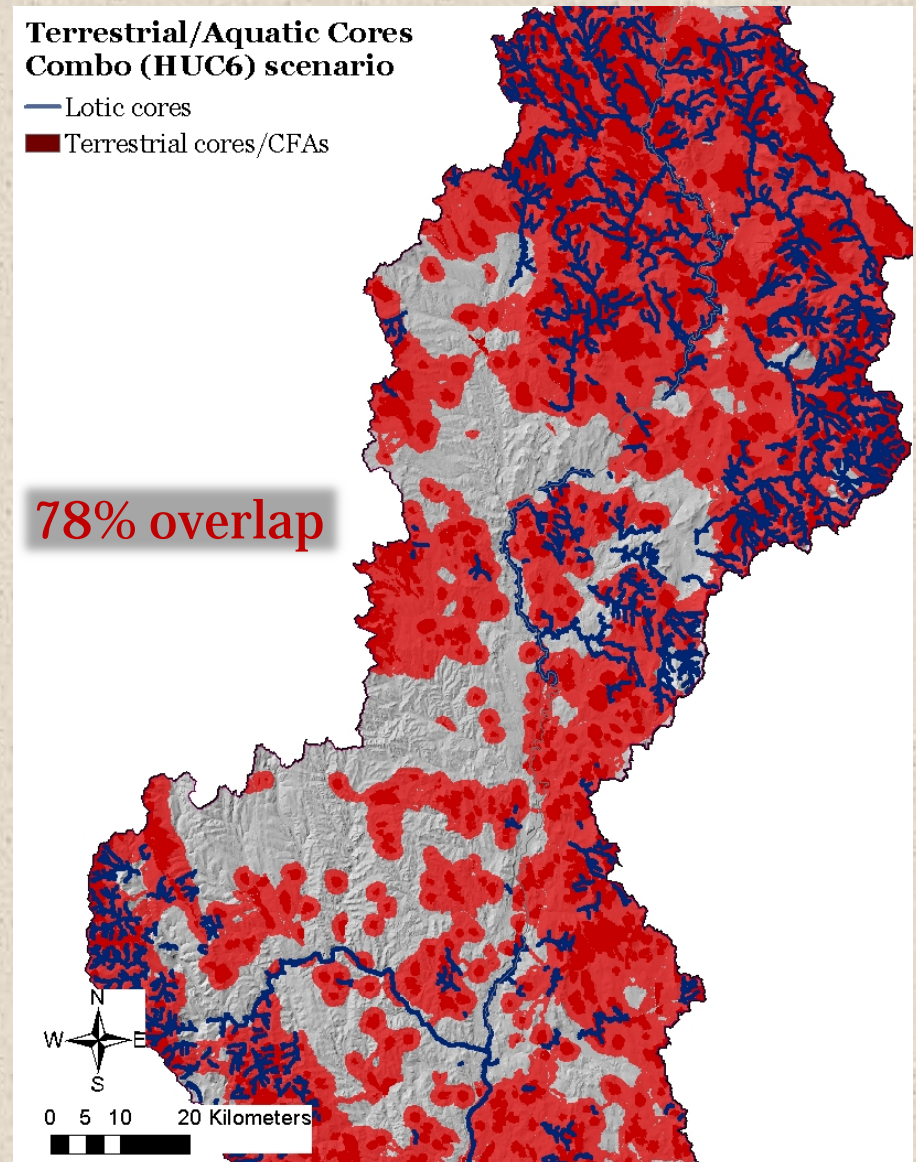
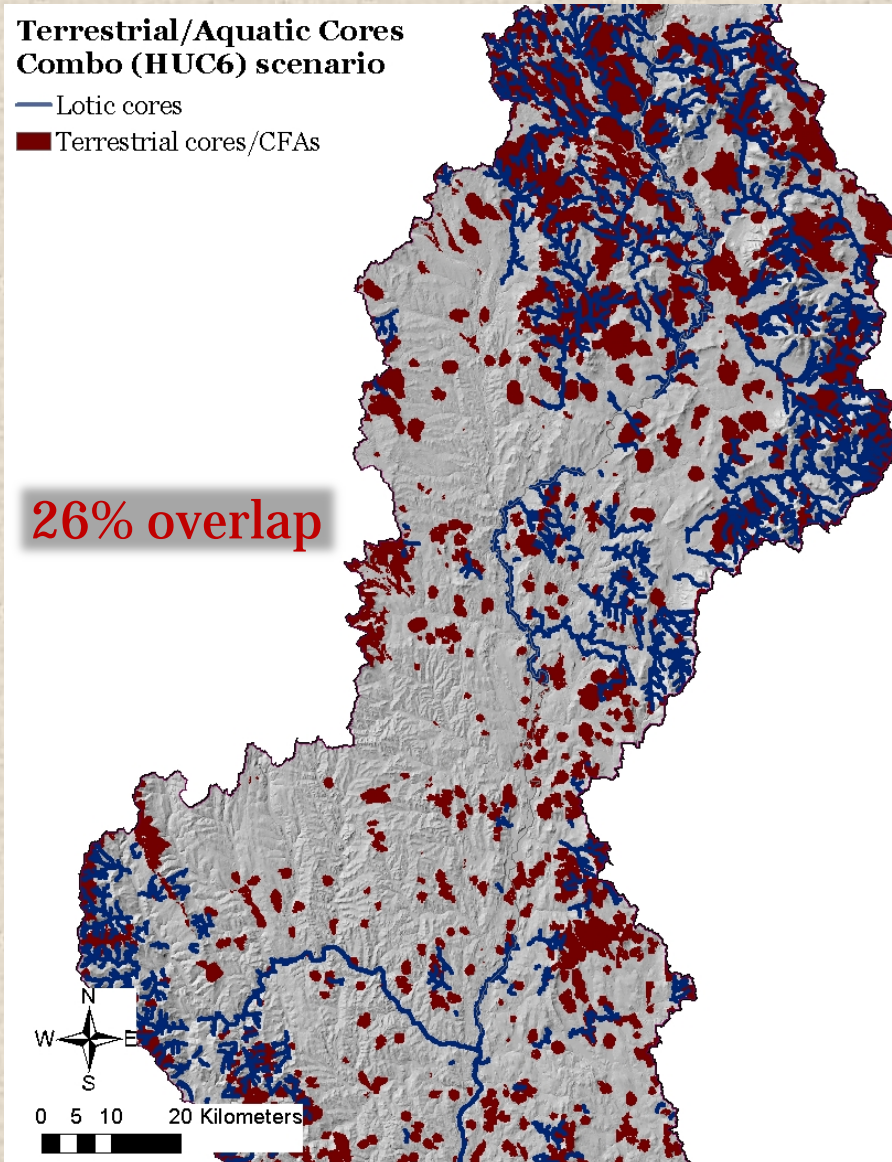
Scenario comparison

Terrestrial and aquatic core area network



Scenario comparison

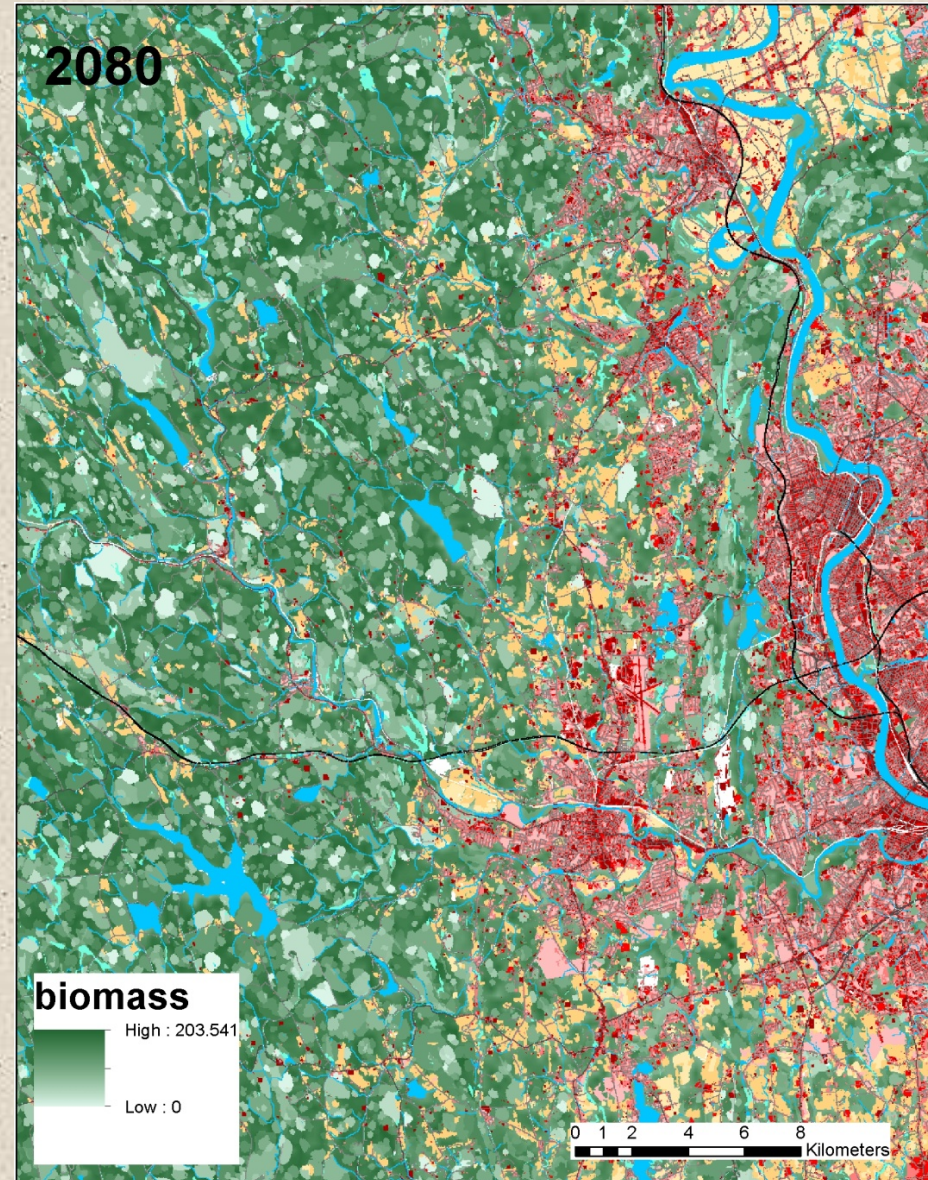
Terrestrial and aquatic core area network



Next Steps

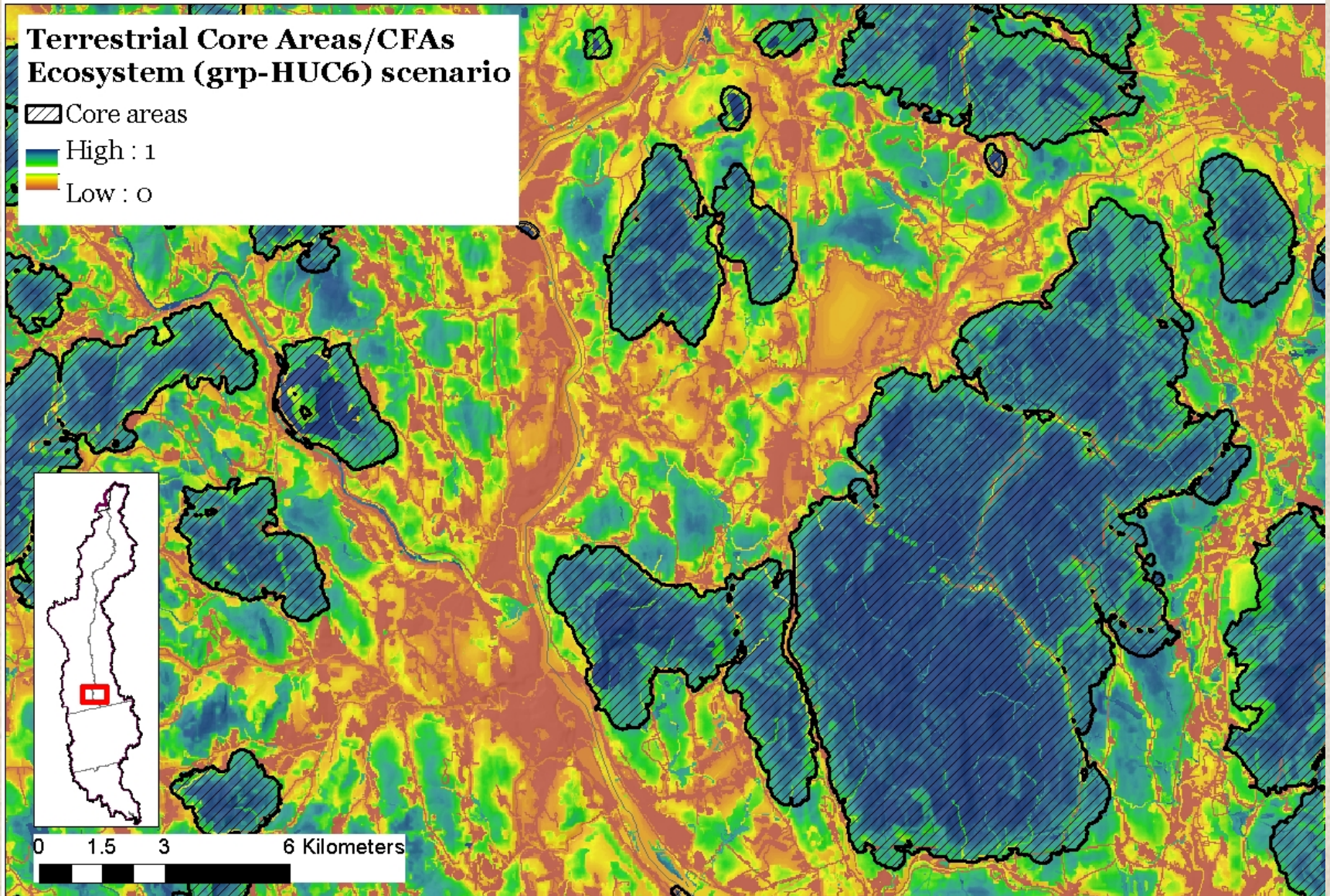
Incorporating landscape change

- Landscape change currently consists of:
 - Climate change
 - Urban growth
 - Generic vegetation disturbance and succession
- Strategies:
 - Low risk
 - Preventative (defensive)



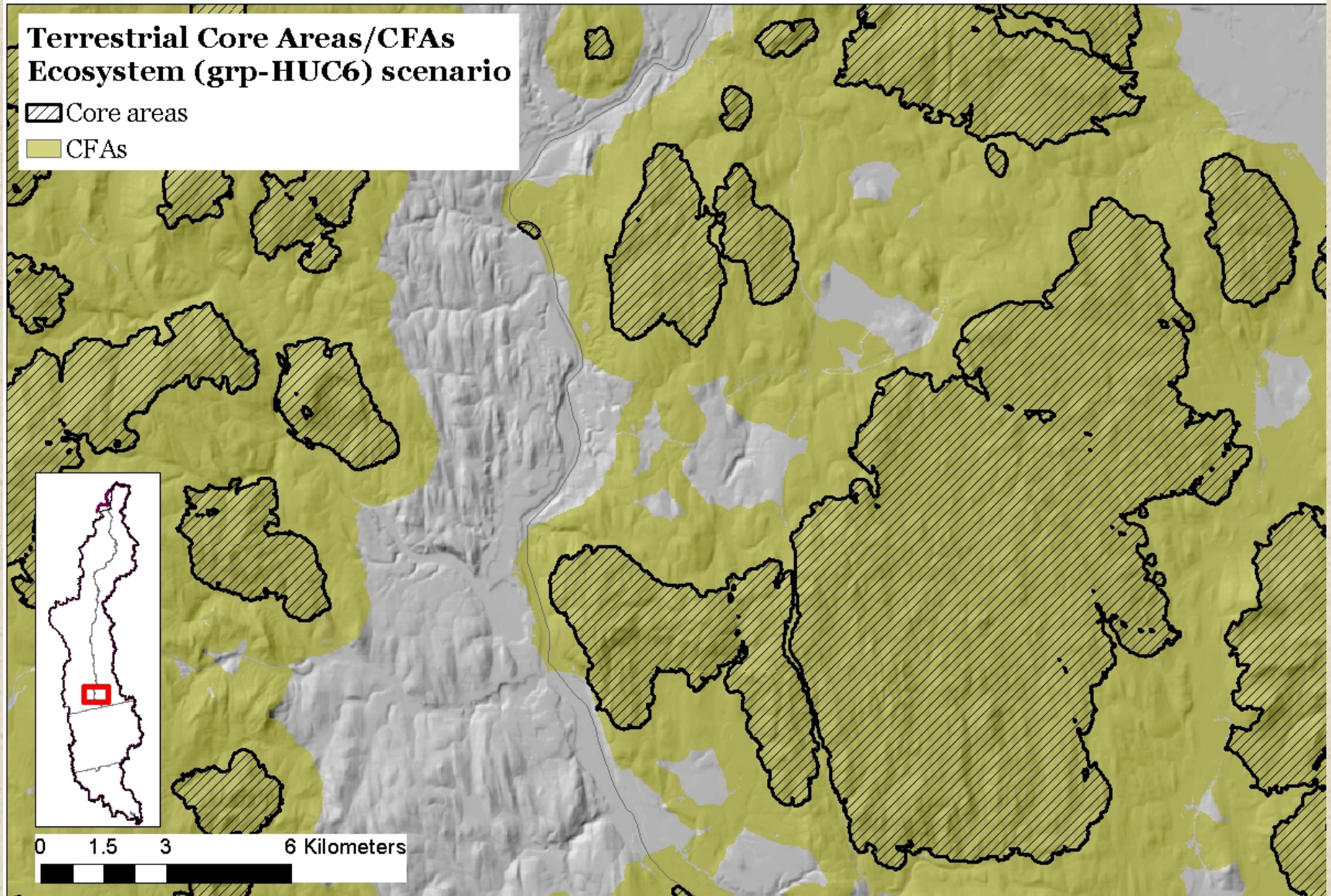
Next Steps

Ecosystem-based approach



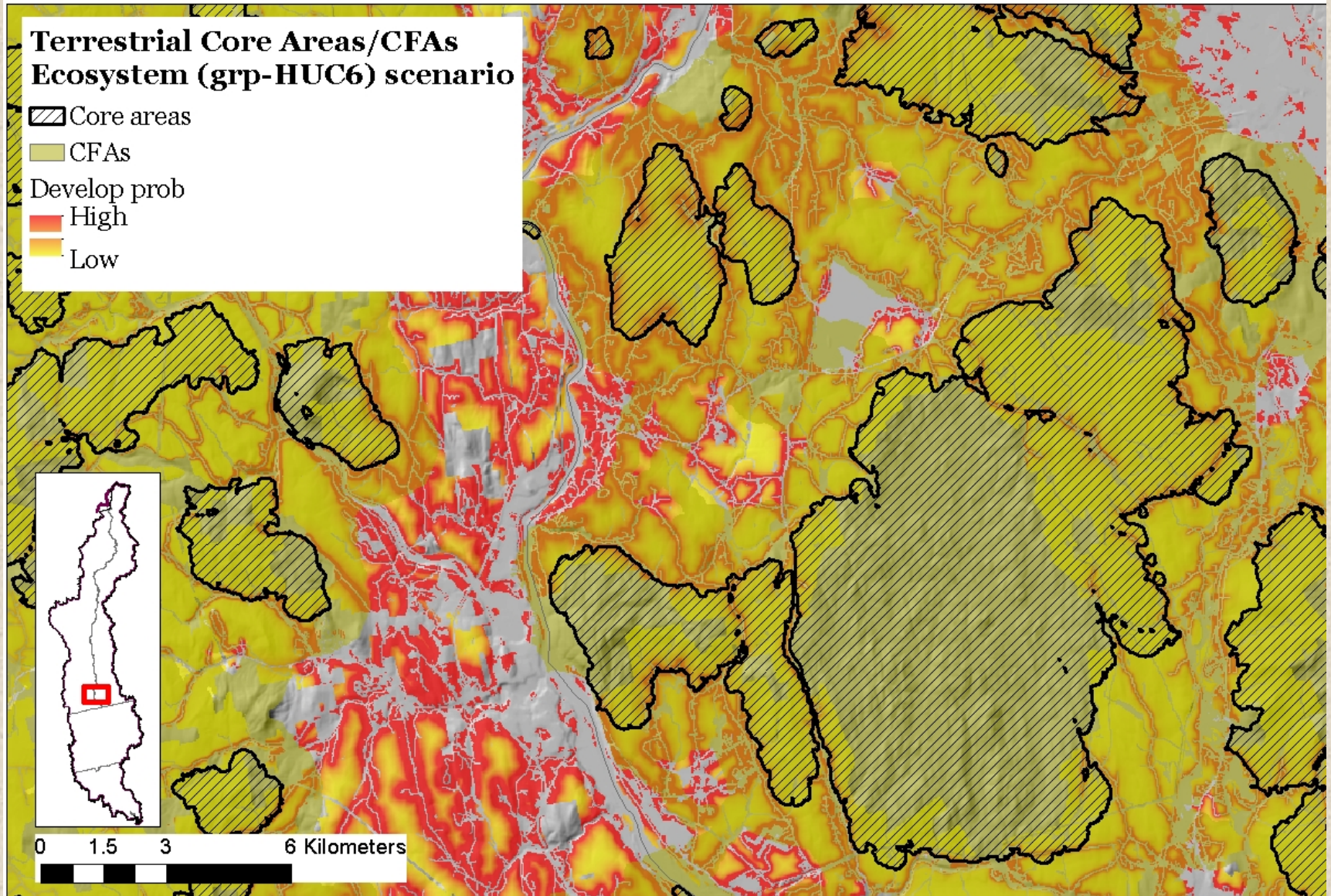
Next Steps

Ecosystem-based approach



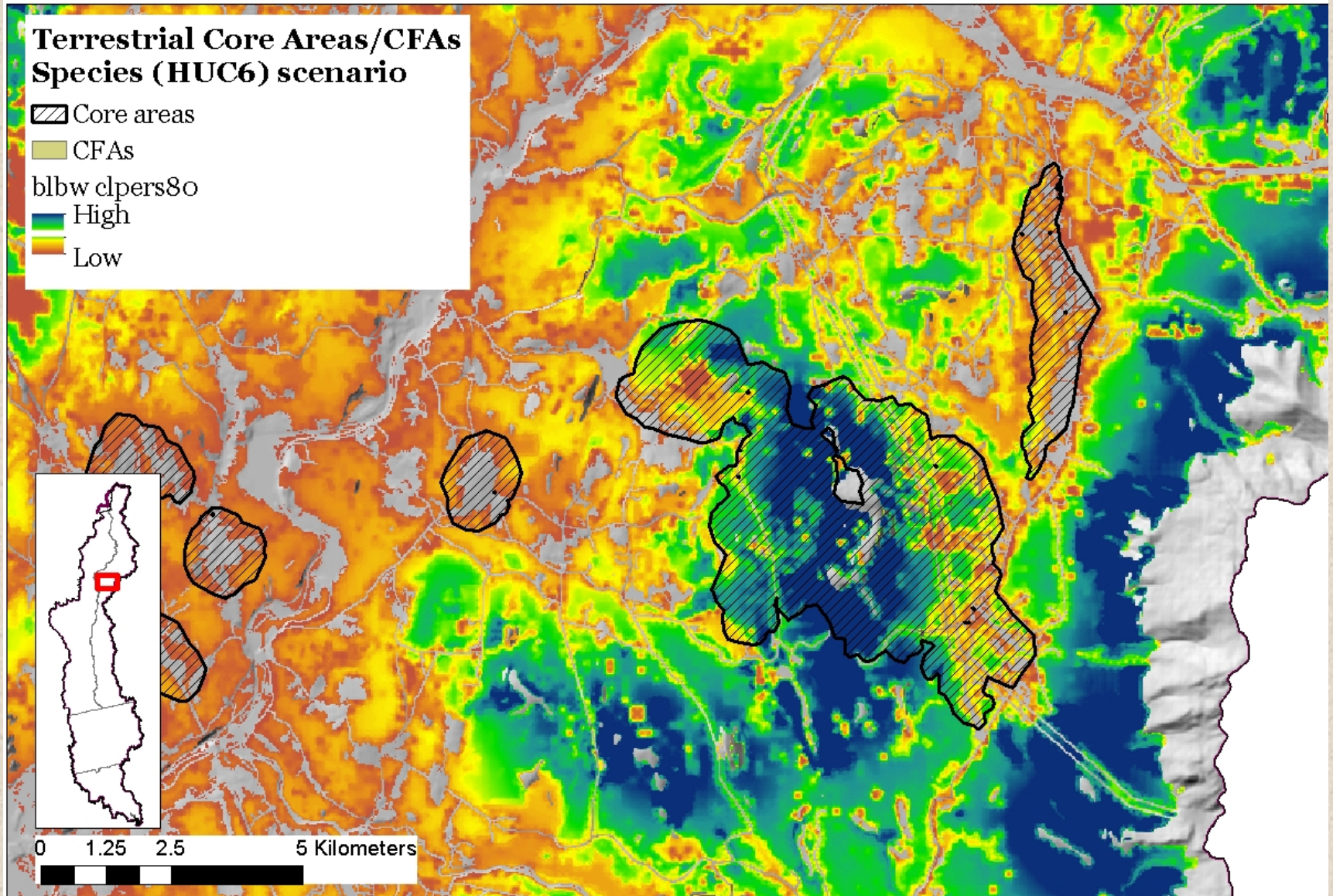
Next Steps

Ecosystem-based approach



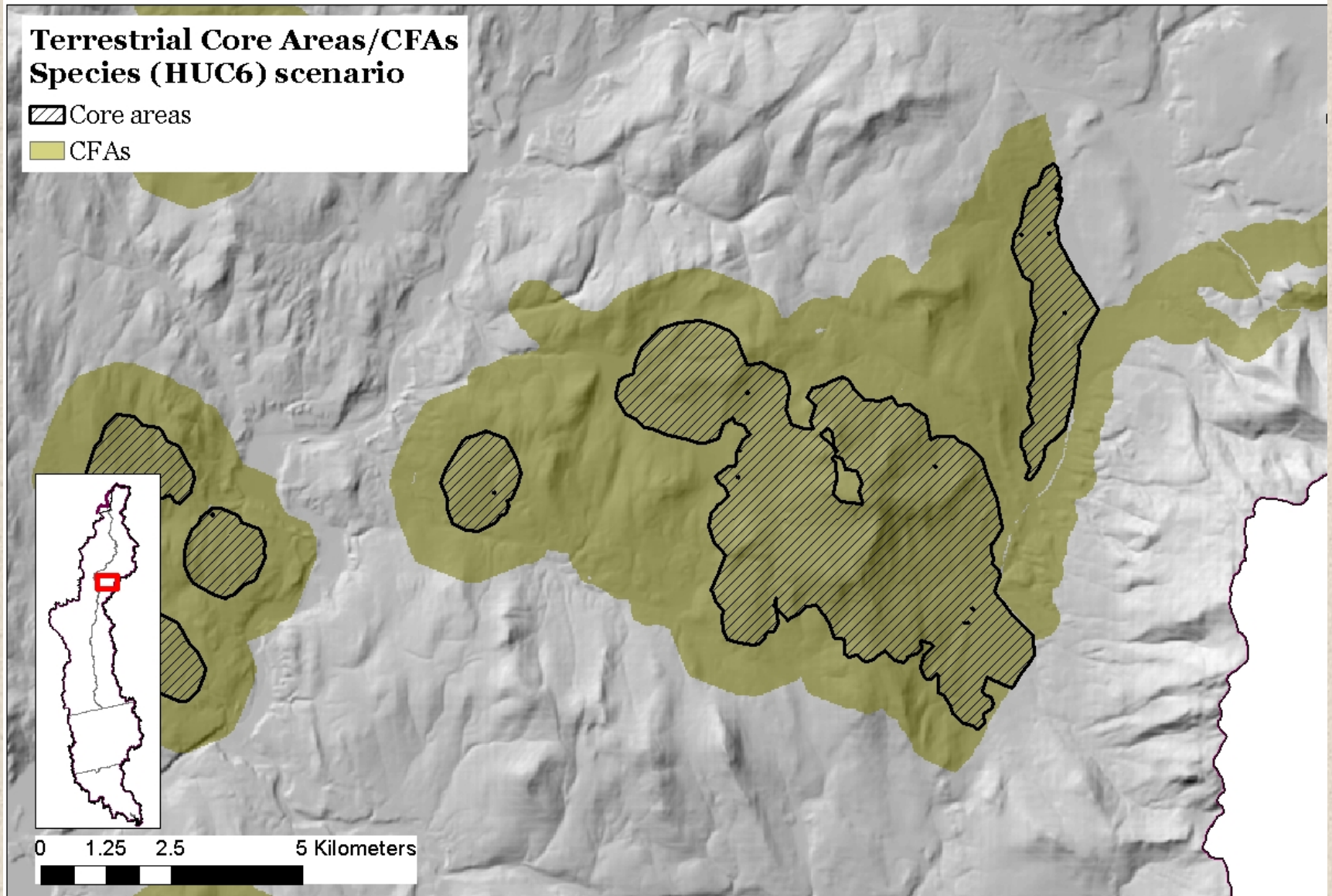
Next Steps

Terrestrial species-based approach



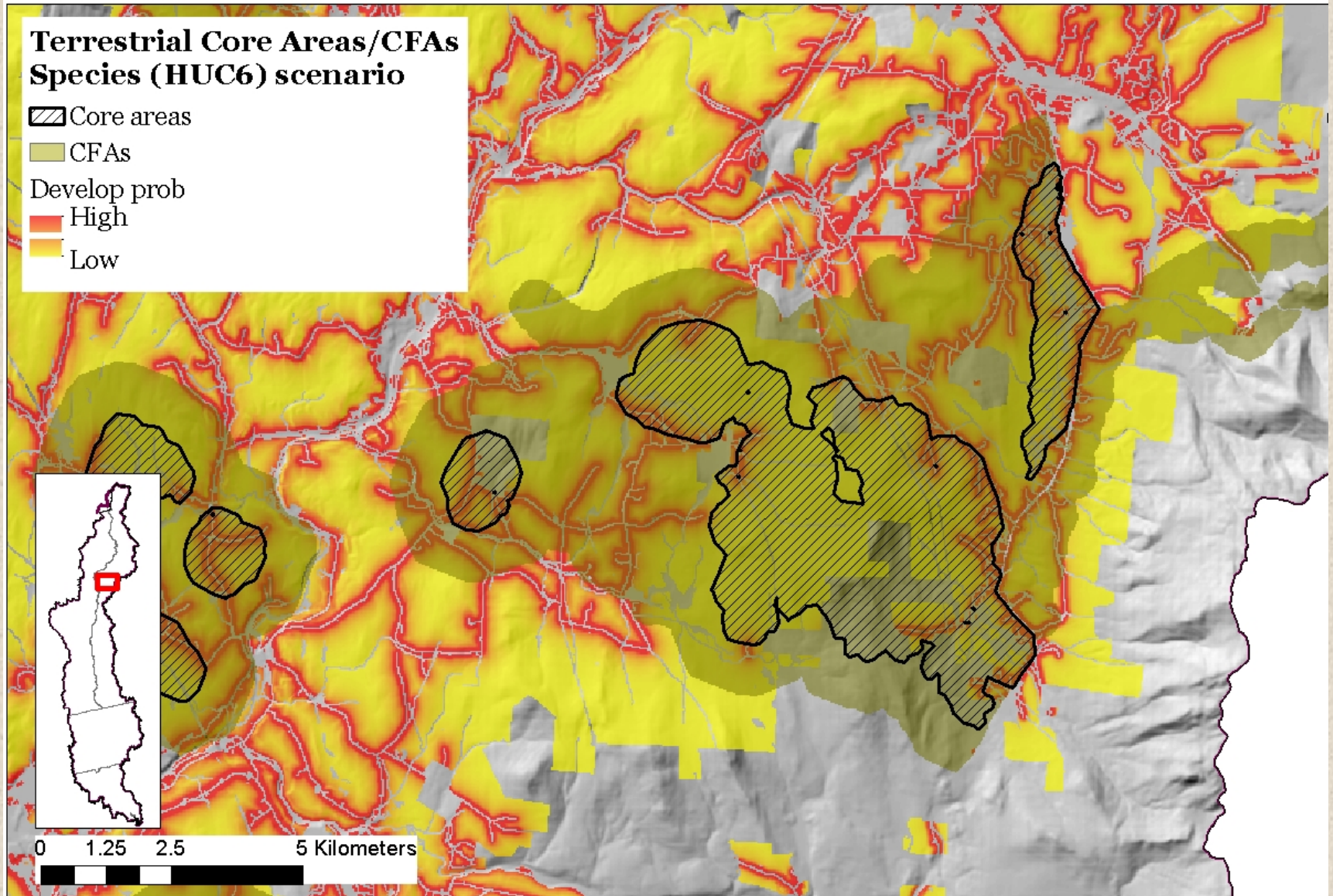
Next Steps

Terrestrial species-based approach



Next Steps

Terrestrial species-based approach

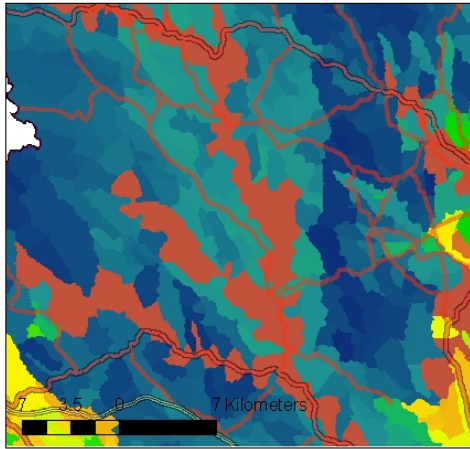


Next Steps

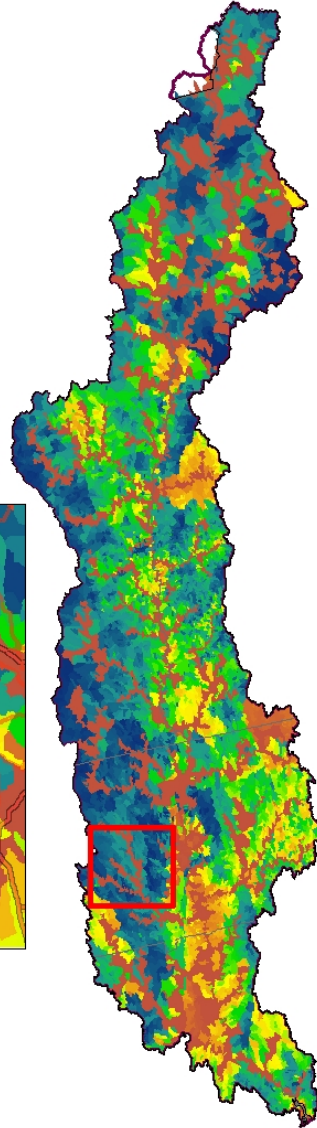
Brook trout species-based approach

Brook trout prob(occupancy)

High : .99
Low : 0

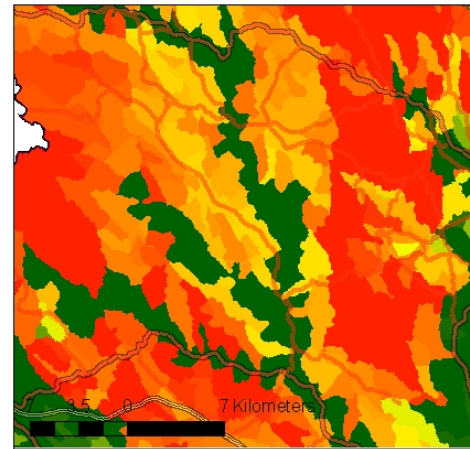


0 25 50 100 Kilometers



Brook trout occupancy temp sensitivity

High : .99
Low : 0



0 25 50 100 Kilometers

