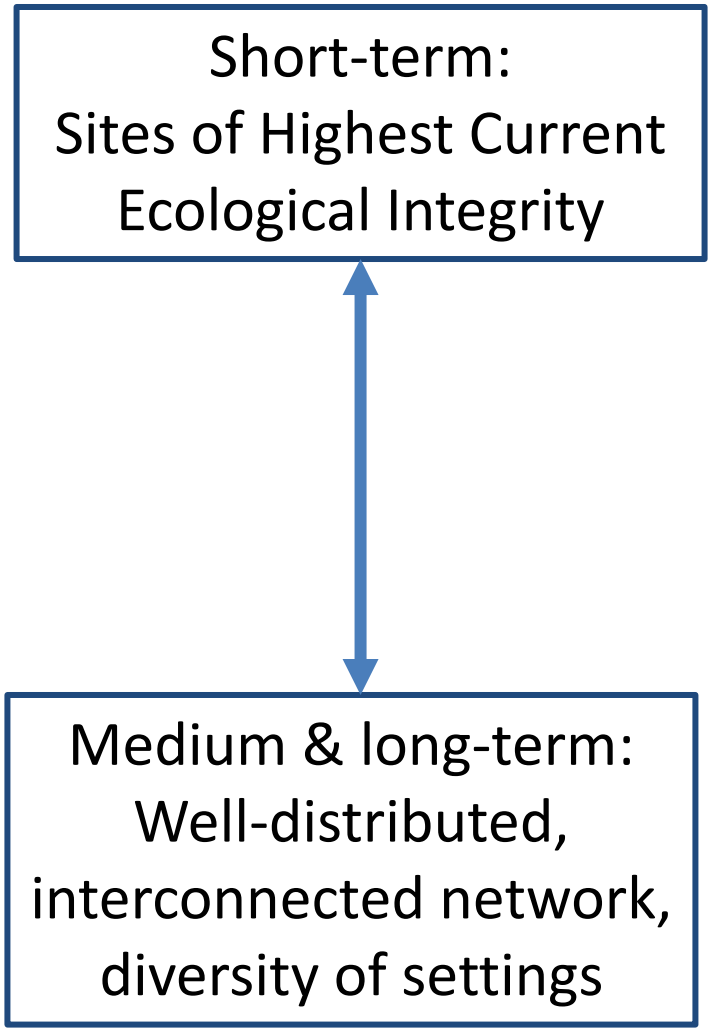
How Climate Change is Addressed in Connecticut River Watershed LCD

Time scale	Ecological processes and species movements	Climate strategy in Landscape Conservation Design
Short-term: Annual to a few decades	Site recovery from disturbance and recolonization	• Core areas of high current ecological integrity and resiliency (IEI local connectedness and similarity) • High quality species habitat in core areas
Medium term: Few to multiple decades (e.g., to 2080)	• Short distance dispersal and range expansion • Climate-related stress for individuals that cannot move	• Core-connector network • Stream resiliency • ***New:* Climate-persistent locations (refugia) for ecosystems and species**
Long term: Many decades to centuries	• Range shifts • Changed community types • Novel climate combinations • Adaptation	• Terrestrial resiliency (geophysical) in core areas (TNC) • Core-connector network including south-north connections

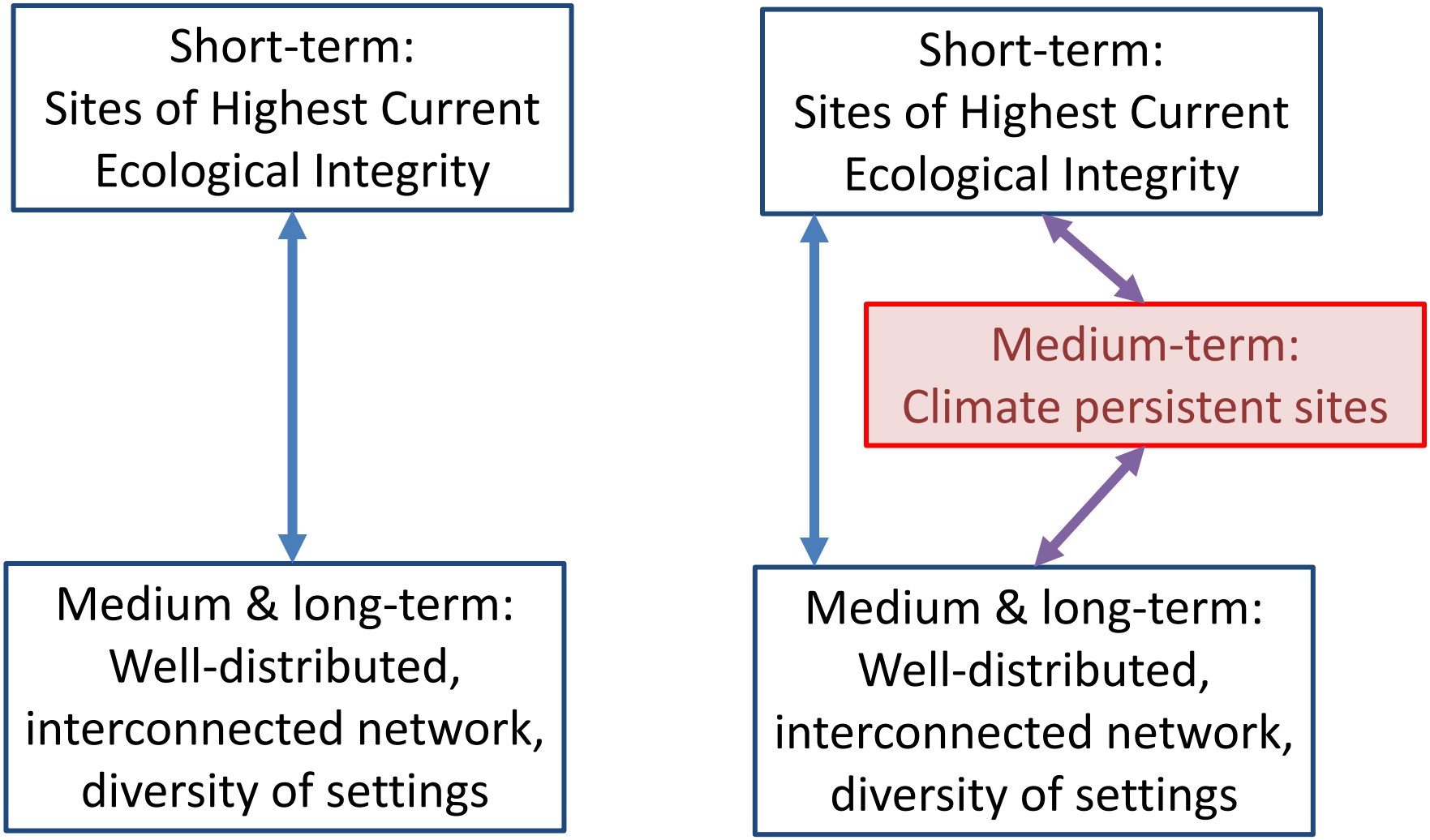
Potential Climate Change Planning Tradeoffs – We've Considered this Before



<u>How we addressed:</u>

- Average IEI and TNC resiliency
- Subwatersheds (2 HUC6s) to distribute network

Potential Climate Change Planning Tradeoffs



Discussion points – adding the new climate components

- Results as expected: new core areas to encompass *areas where ecosystems and species currently exist on the landscape* that are likely to be more resilient to climate in the medium term (decades)

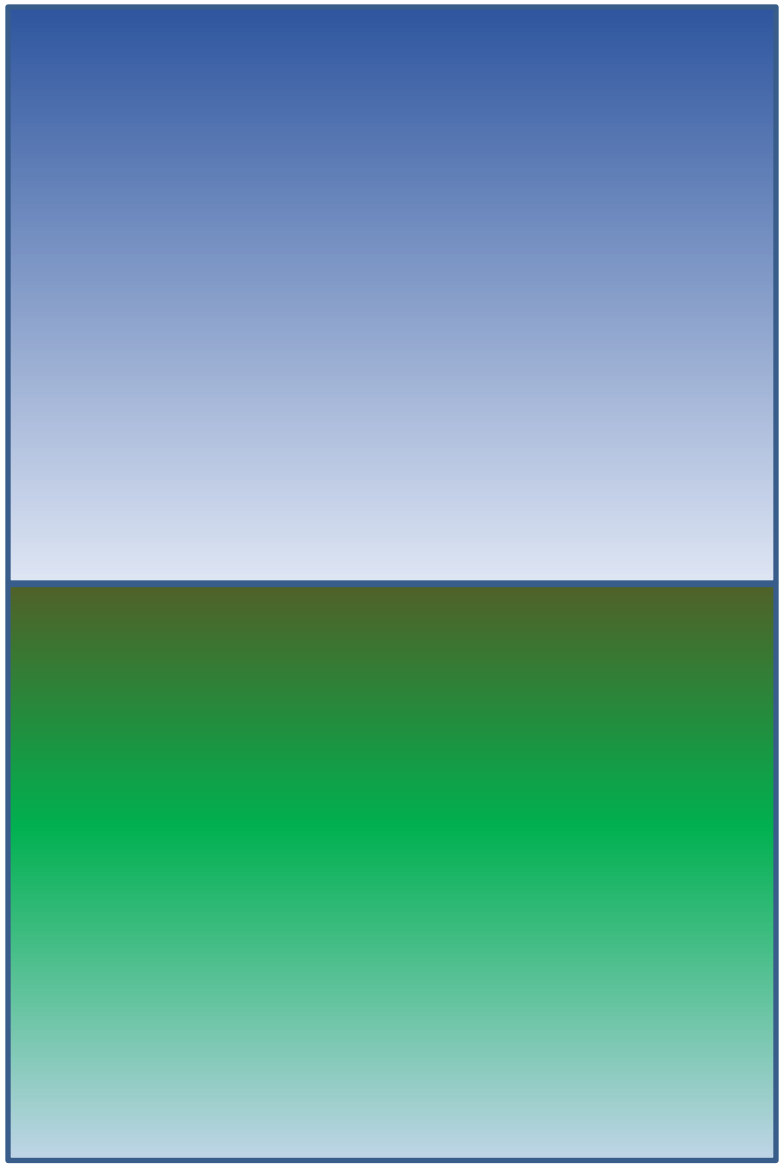
Discussion points – adding the new climate components

- Results as expected: new core areas to encompass *areas where ecosystems and species currently exist on the landscape* that are likely to be more resilient in the medium term (decades)
- Notable results
  - Loss of some core areas in southern and low elevation areas of HUCs, and corresponding increase in northern and high elevation areas
  - Some resulting areas of less network connectivity
  - Reduced representation of southern ecosystem types
  - Some changes in species representation
- Factor not modeled – potential for species & communities to move northward

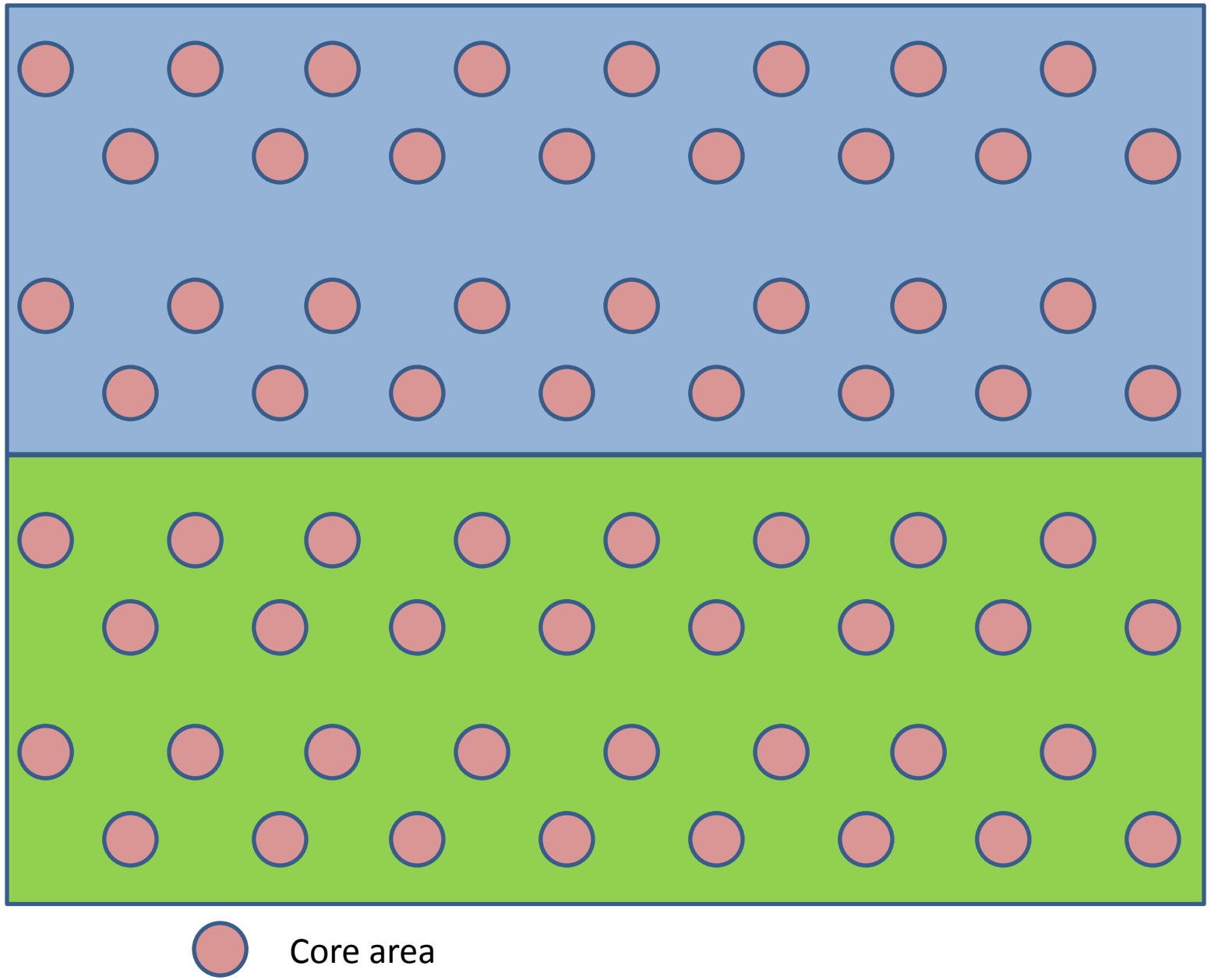
Why we see these changes

Boundary between 2 (HUC6) watersheds, 2 ecosystem types, or 2 species

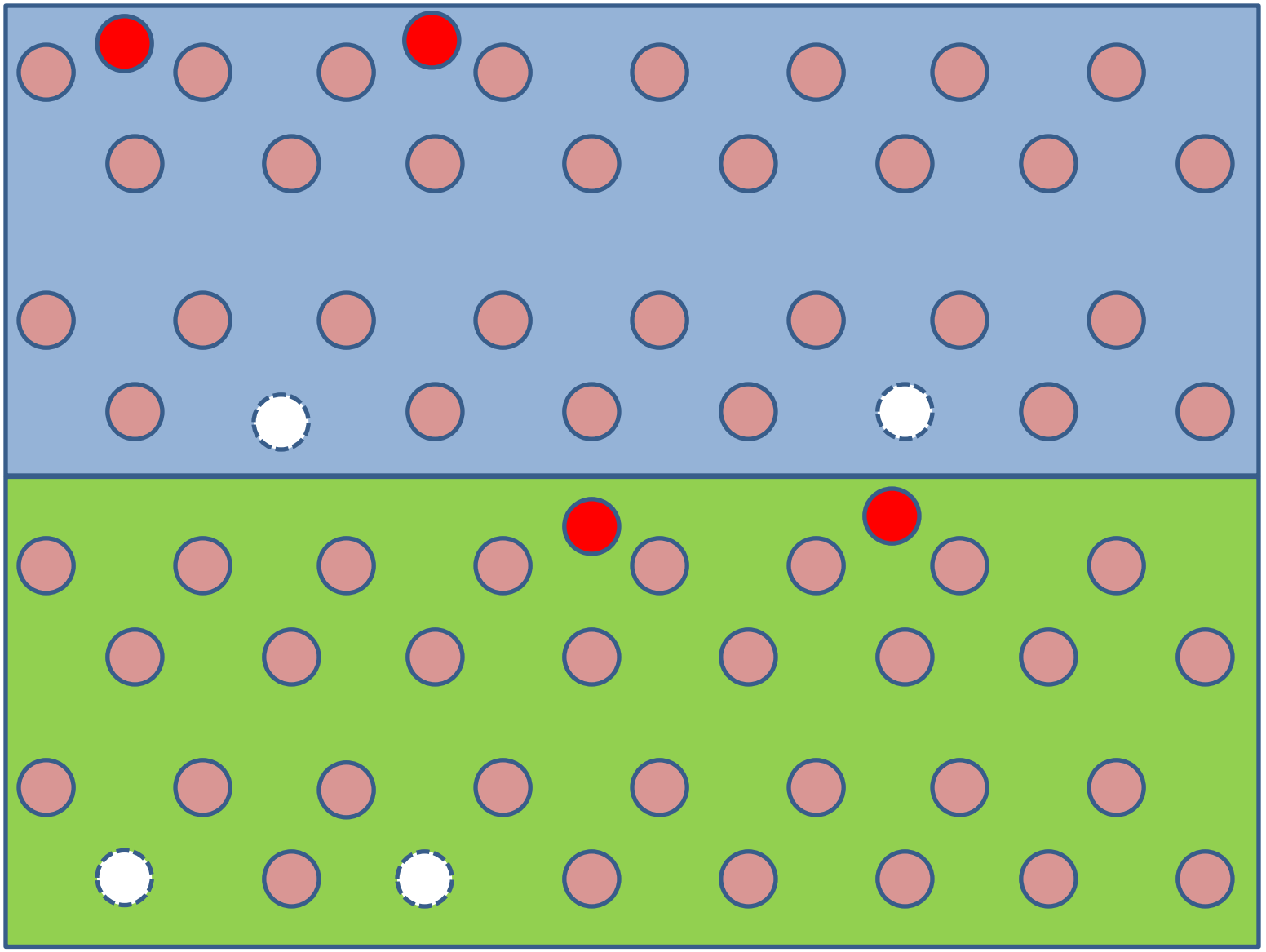
Effect of climate stressor on resilience – darker = less climate-stressed



Conceptual distribution of core areas – evenly distributed north to south



North-south geographical shift induced by climate stress effects on integrity

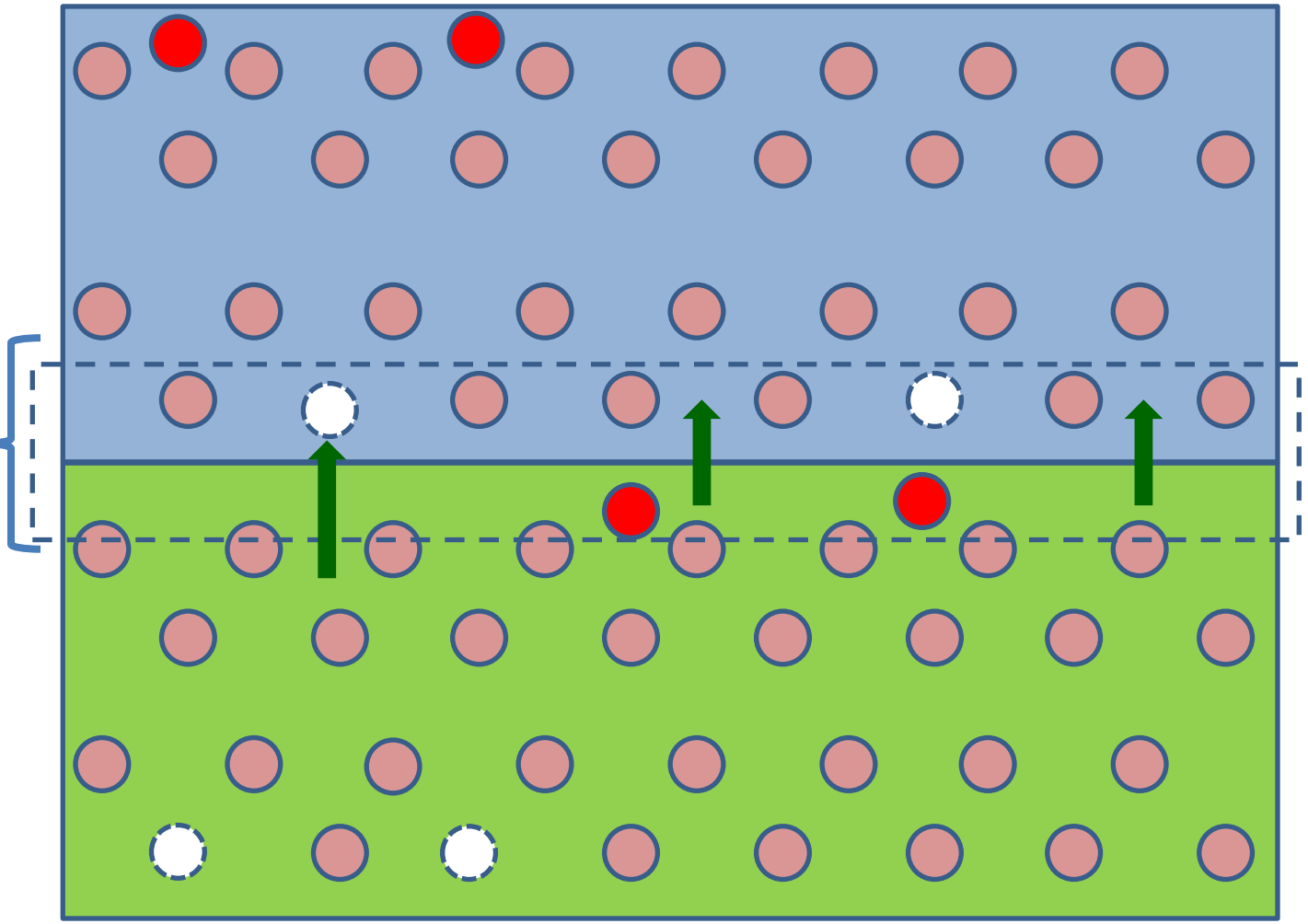


Cores that are dropped

Cores that are added; lower current integrity but less future climate stress

North-south geographical shift induced by climate stress effects on integrity

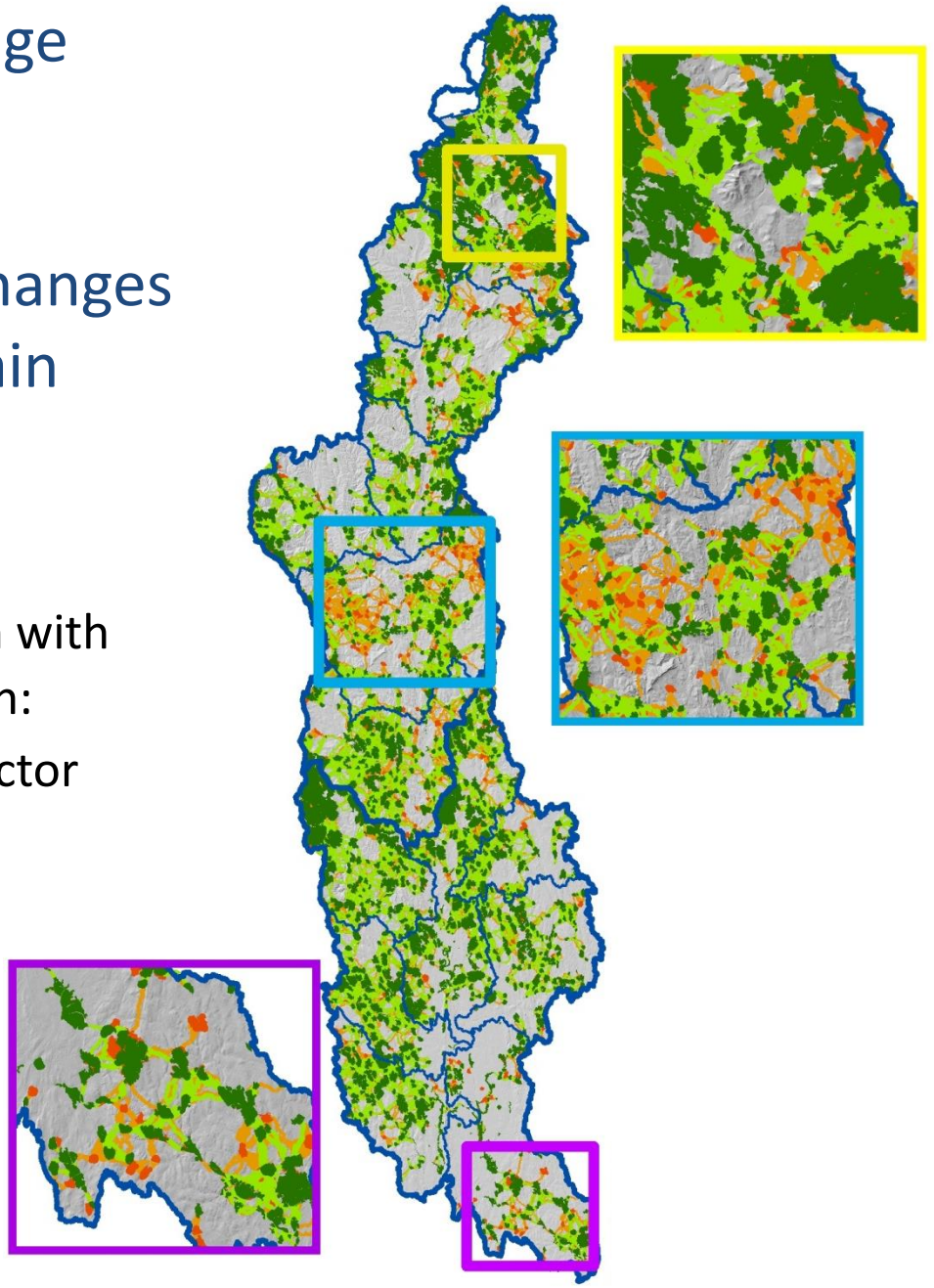
Boundary effects:
no accounting for
potential of species
need to move north
of current locations



Design with climate change persistence vs. previous network:
85% overlap in design; changes are concentrated in certain areas

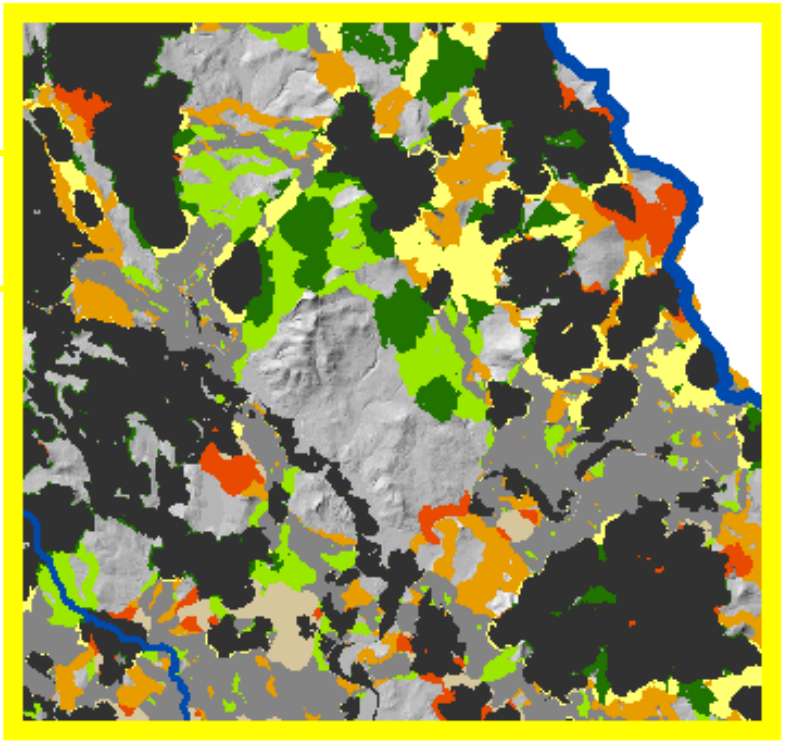
Green: core-connector design with climate persistence, overlain on:

Orange: previous core-connector network



Areas with large changes

Northern watershed

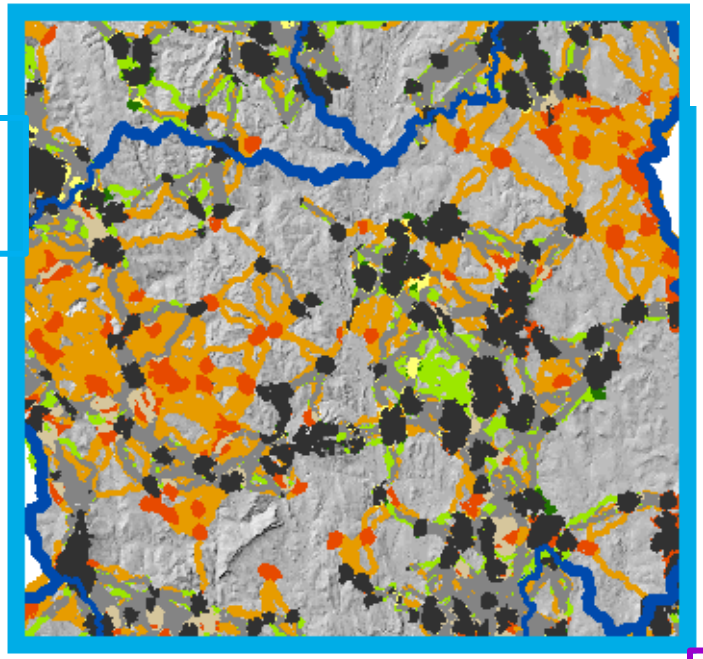


Black: overlap between 2 designs (retained in both)

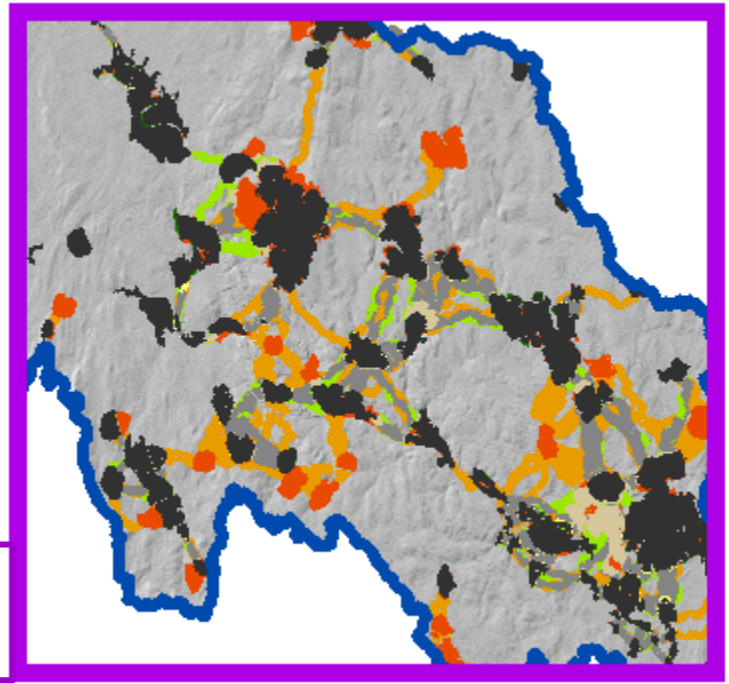
Green: only in core-connector design with climate persistence:

Orange: only previous core-connector network

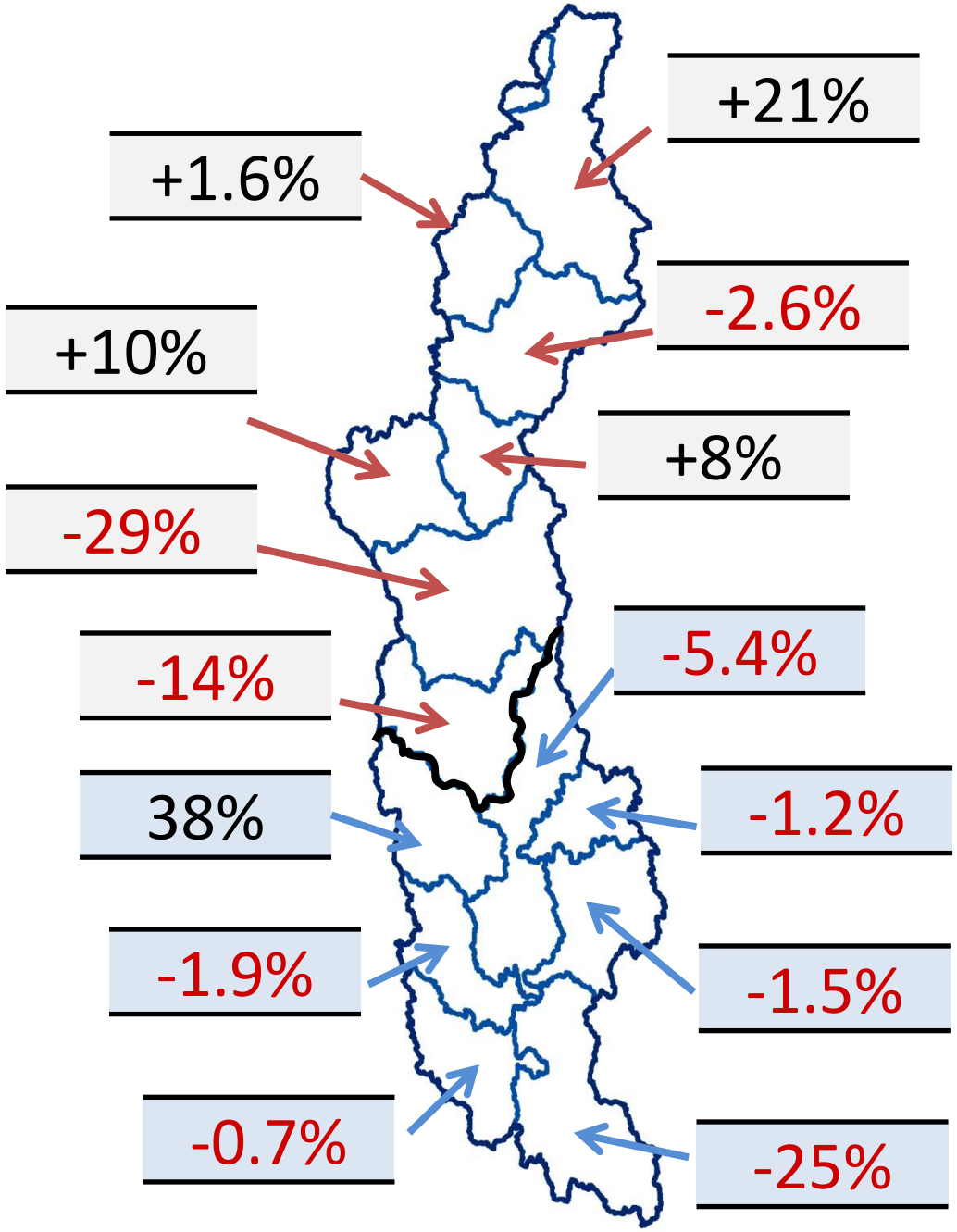
N. Central watershed



Southern watershed



Changes in Amount of Core Area



State	Previous core acreage	Climate-persist core acreage	Acreage Change
Conn.	167,500	143,000	-24,500
Mass.	434,800	431,300	-3,400
VT	622,100	635,000	+12,900
NH	558,000	574,900	+16,900

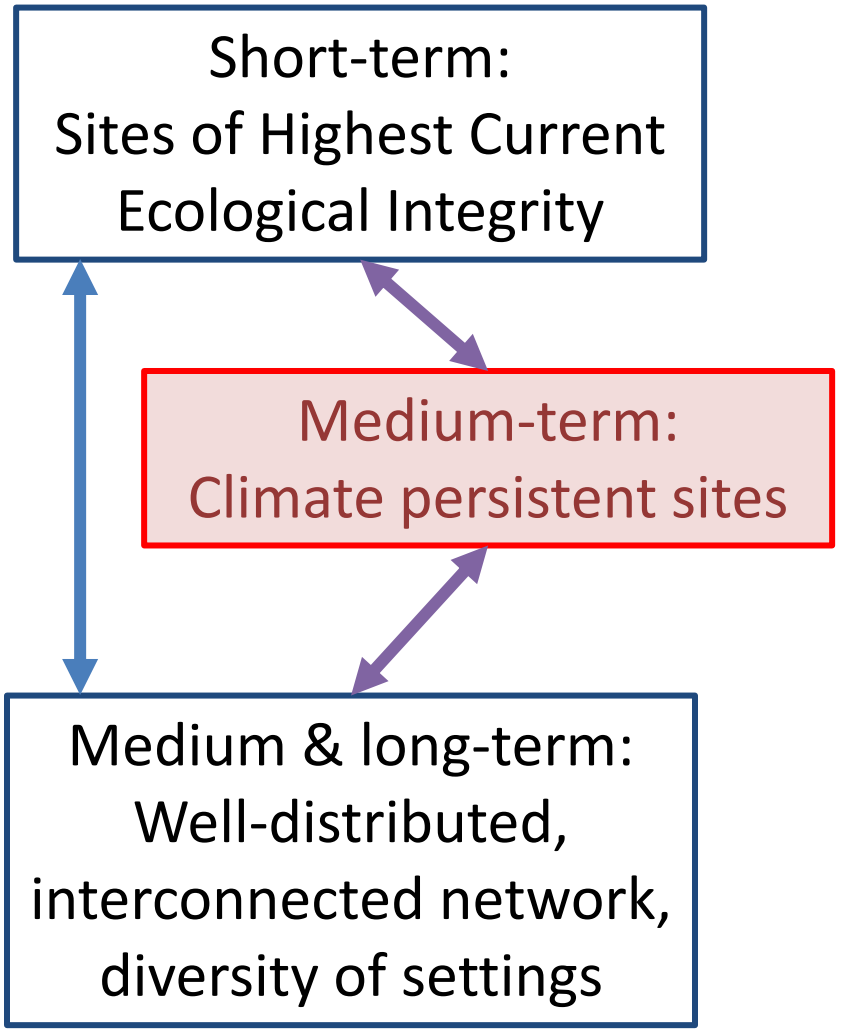
Ecosystems with ≥ 1,000 acre change from Current to C2080

Ecological system	Cur. % in cores	C2080 % in cores	Acre change
Laurentian-Acadian Pine-Hemlock-Hardwood Forest	19.3%	17.3%	-19,170
Appalachian (Hemlock)-Northern Hardwood Forest	30.6%	29.7%	-13,097
Northeastern Interior Dry-Mesic Oak Forest	22.5%	18.7%	-10,302
North Atlantic Coastal Plain Hardwood Forest	39.1%	32.6%	-1,887
North-Central Appalachian Acidic Swamp	31.5%	28.7%	-2,191
Laurentian-Acadian Wet Meadow-Shrub Swamp	35.8%	32.5%	-1,557
North-Central Interior and Appalachian Rich Swamp	26.8%	21.3%	-1,564
Northeastern Coastal and Interior Pine-Oak Forest	30.1%	25.1%	-1,301
Acidic Rocky Outcrop	38.8%	43.6%	1,869
Laurentian-Acadian Red Oak-Northern Hardwood Forest	15.8%	16.6%	1,762
Acadian Sub-boreal Spruce Flat	38.3%	45.8%	3,149
Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest	52.5%	61.2%	15,446
Acadian Low Elevation Spruce-Fir-Hardwood Forest	30.0%	38.0%	15,645
Laurentian-Acadian Northern Hardwood Forest	30.0%	32.1%	35,344

Species habitat representation: Current – C2080 (Landscape Capability = LC)

Species	Target LC	Current LC	Climate2080 LC	Difference
Prairie Warbler	50%	36%	27%	-9%
Eastern Meadowlark	73%	34%	26%	-8%
Wood Turtle	80%	39%	34%	-5%
Marsh Wren	63%	52%	49%	-3%
Louisiana Waterthrush	63%	31%	29%	-2%
American Woodcock	73%	33%	31%	-2%
Wood Duck	50%	39%	39%	0%
Wood Thrush	55%	33%	33%	0%
Black Bear	40%	30%	30%	0%
Ruffed Grouse	45%	31%	33%	+2%
Moose	55%	33%	36%	+3%
Northern Waterthrush	55%	50%	53%	+3%
Blackburnian Warbler	63%	33%	38%	+5%
Blackpoll Warbler	85%	51%	67%	+16%

Potential Climate Change Planning Tradeoffs



Alternatives

1. Use the new design with climate-stressor metrics
2. Use the previous core-connector design
   - Provide stressor and climate-resilient data as part of package
   - Use climate-resilience to inform prioritization of cores and connectors
3. Combine the two approaches
   - Select the higher of current (2010) IEI and future (2080) IEI with climate stressors to generate network

Ecosystems with more than 1,000 acre change from Current to Climate Combo Scenario

Ecological system	Cur. % in cores	Combo% in cores	Acre change
Laurentian-Acadian Pine-Hemlock-Hardwood Forest	19.3%	16.6%	-26,398
Appalachian (Hemlock)-Northern Hardwood Forest	30.6%	29.1%	-22,453
Northeastern Interior Dry-Mesic Oak Forest	22.5%	19.7%	-7,638
North-Central Interior and Appalachian Rich Swamp	26.8%	21.4%	-1,524
North-Central Appalachian Acidic Swamp	31.5%	28.1%	-2,623
Laurentian-Acadian Wet Meadow-Shrub Swamp	35.8%	32.0%	-1,771
Laurentian-Acadian Red Oak-Northern Hardwood Forest	15.8%	15.0%	-1,706
Northeastern Coastal and Interior Pine-Oak Forest	30.1%	24.5%	-1,464
Acidic Rocky Outcrop	38.8%	43.3%	1,742
Acadian Sub-boreal Spruce Flat	38.3%	45.9%	3,184
Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest	52.5%	59.9%	13,099
Acadian Low Elevation Spruce-Fir-Hardwood Forest	30.0%	38.9%	17,463
Laurentian-Acadian Northern Hardwood Forest	30.0%	33.0%	49,331

Species habitat representation: Current – ClimateCombo (Landscape Capability = LC)

Species	Target LC	Current LC	Cl. Combo LC	Difference
Prairie Warbler	50%	36%	28%	-8%
Eastern Meadowlark	73%	34%	26%	-8%
Wood Turtle	80%	39%	34%	-5%
Marsh Wren	63%	52%	48%	-4%
Louisiana Waterthrush	63%	31%	29%	-2%
American Woodcock	73%	33%	31%	-2%
Wood Duck	50%	39%	39%	0%
Wood Thrush	55%	33%	33%	0%
Black Bear	40%	30%	30%	0%
Ruffed Grouse	45%	31%	33%	+2%
Moose	55%	33%	36%	+3%
Northern Waterthrush	55%	50%	52%	+2%
Blackburnian Warbler	63%	33%	38%	+5%
Blackpoll Warbler	85%	51%	62%	+11%

Alternative	Pros	Cons
1. New network with climate persistence	• Explicit consideration of medium-term climate persistence • Substantial overlap with January version	• Loss of low elevation and southern core areas and systems • Lower connectivity in some areas • More complex
2. Previous network	• Higher connectivity and better distribution of network than climate persistence version	• Medium-term climate persistence not built into network; may be less used as separate products
3. Combined	• Explicit consideration of medium-term climate persistence with better core area distribution and connections	• Most complex • Not all issues with climate persistence version resolved