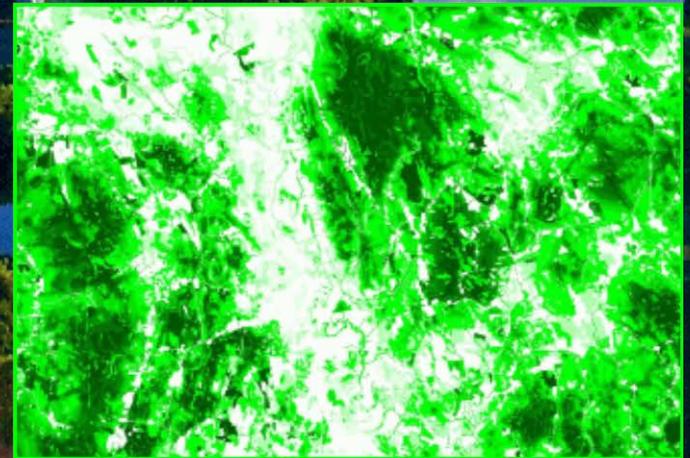
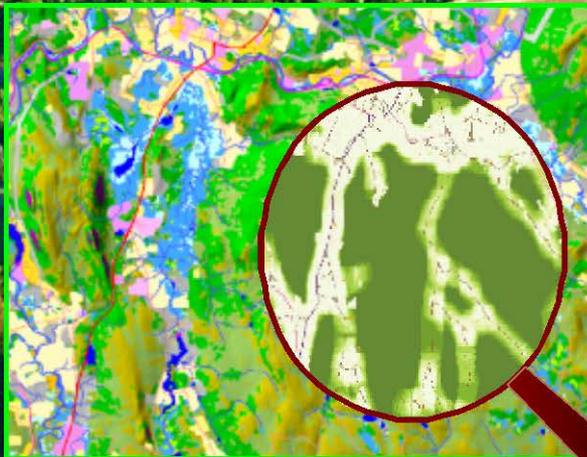


Designing Sustainable Landscapes in the Northeast

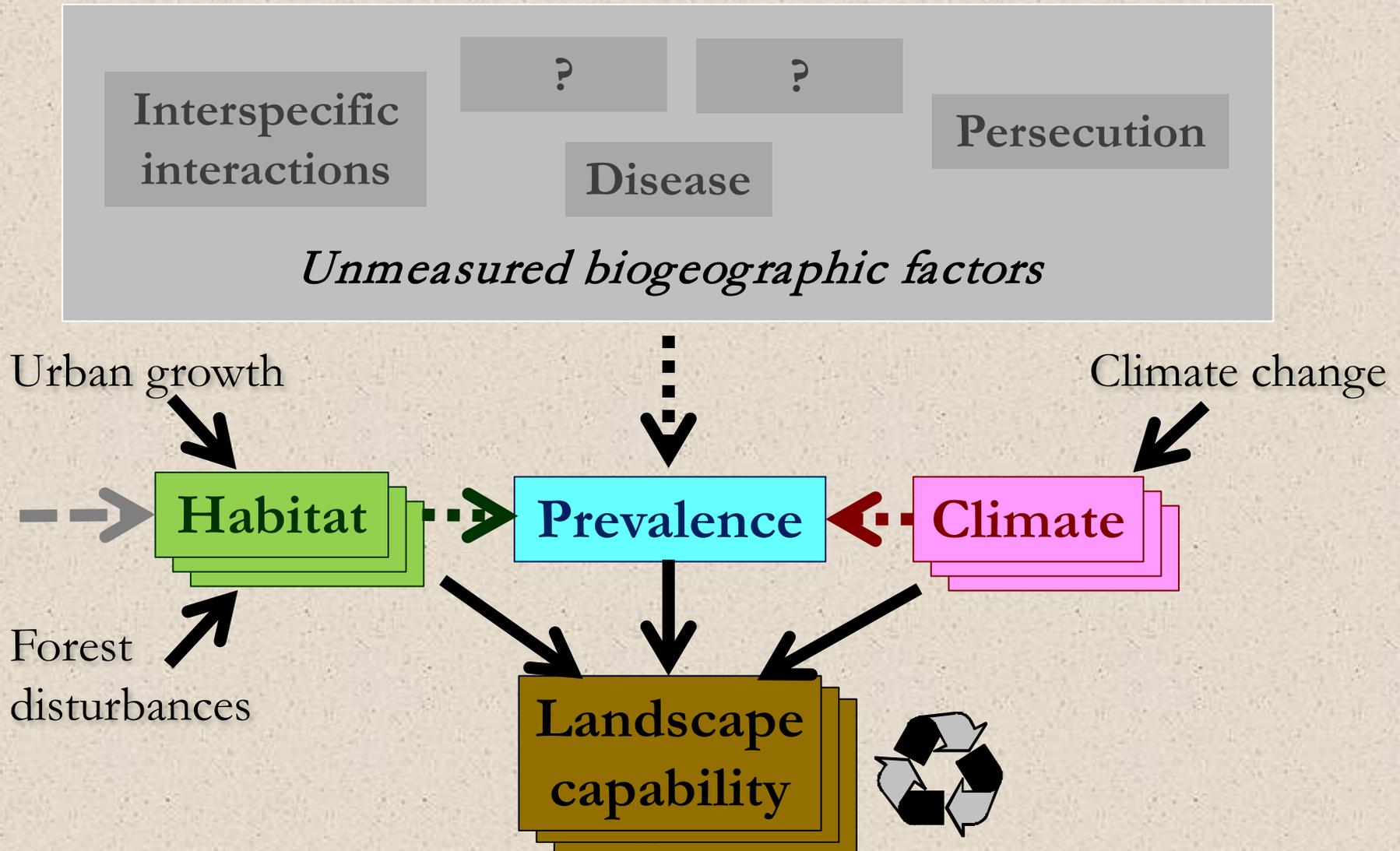
*A project of the North Atlantic Landscape
Conservation Cooperative & Northeast
Climate Science Center*

LCD Terrestrial Subgroup
June 12, 2014



Landscape Capability

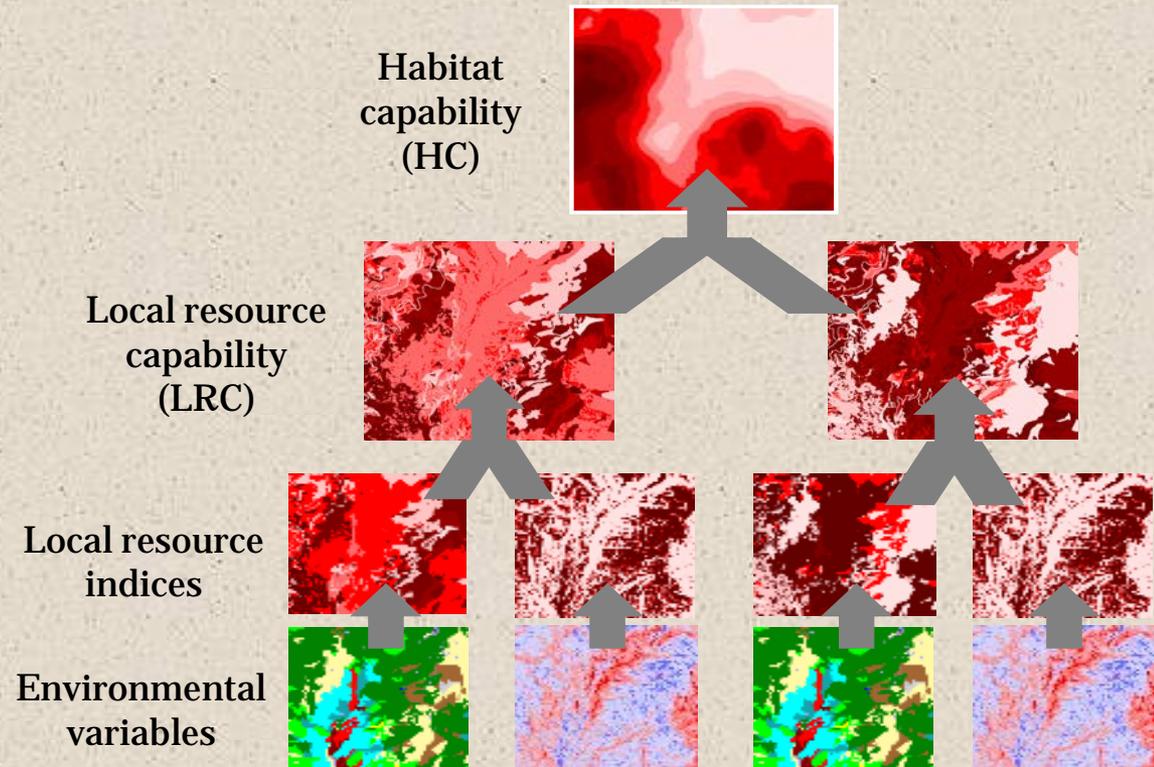
Conceptual framework



Habitat Capability

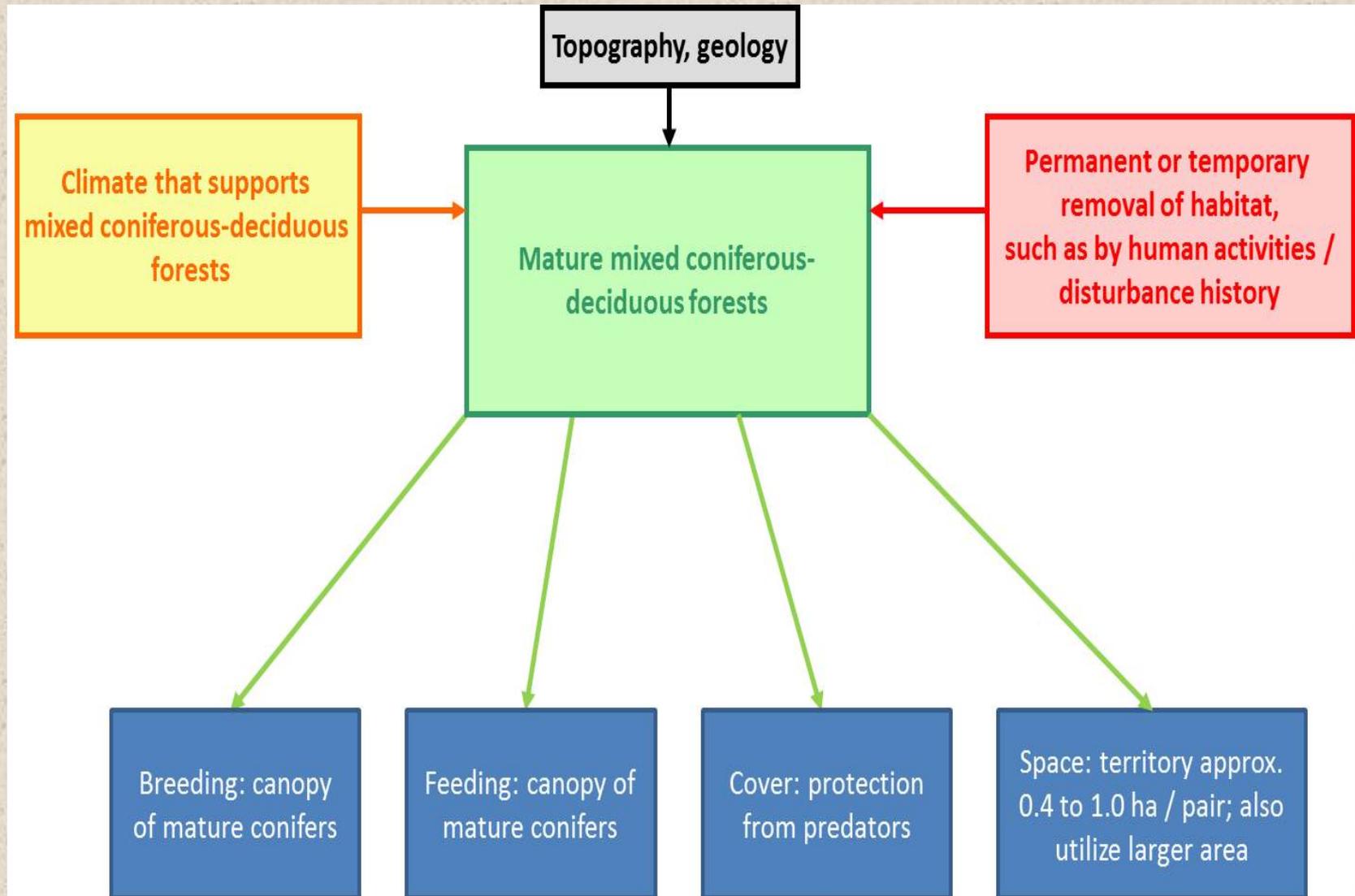
HABIT@ modeling framework

- Spatially-explicit
- Multi-scale
- Expert/empirically-derived
- Integration of local resource quantity, quality and accessibility



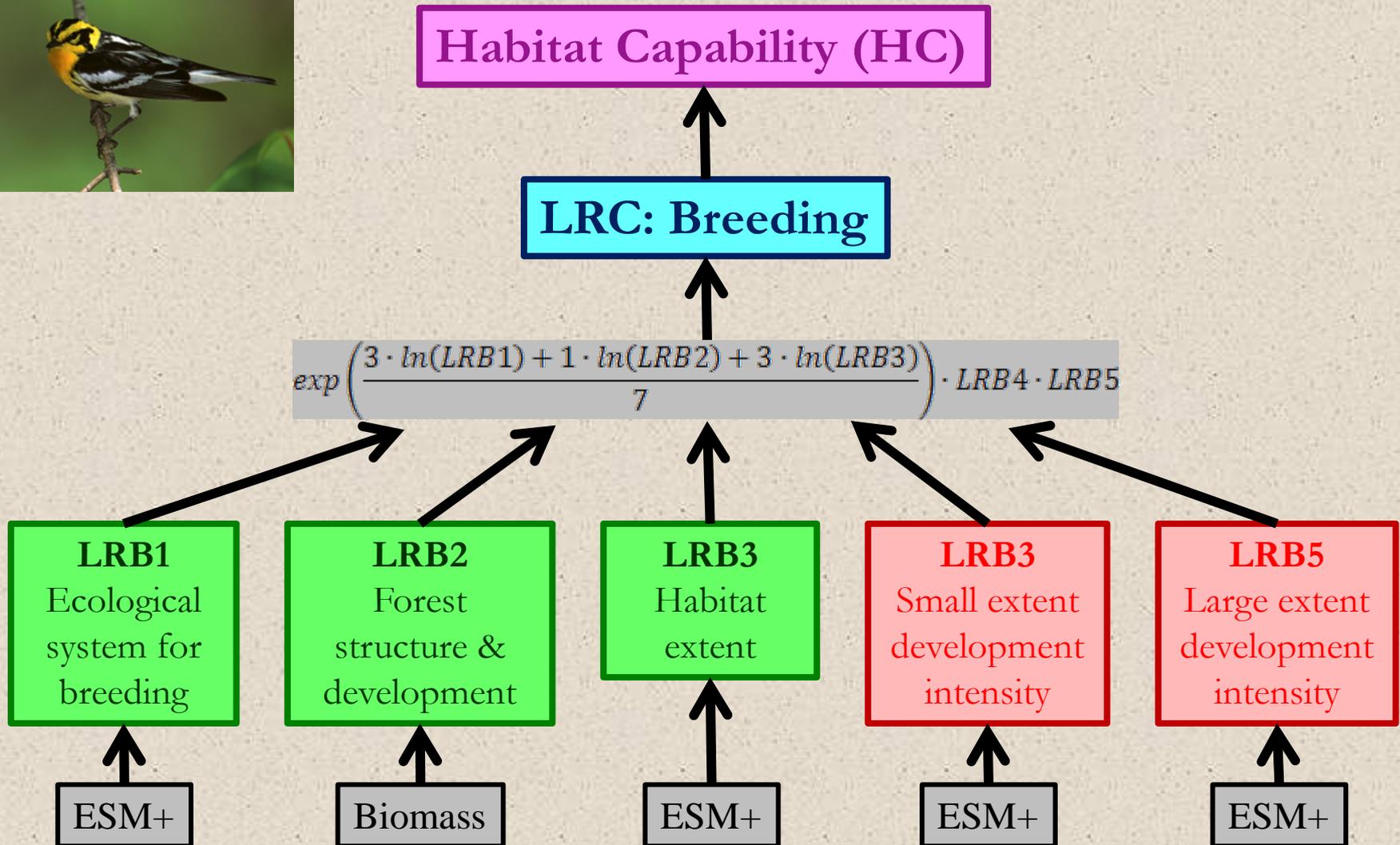
Habitat Capability

blbw habitat requirements



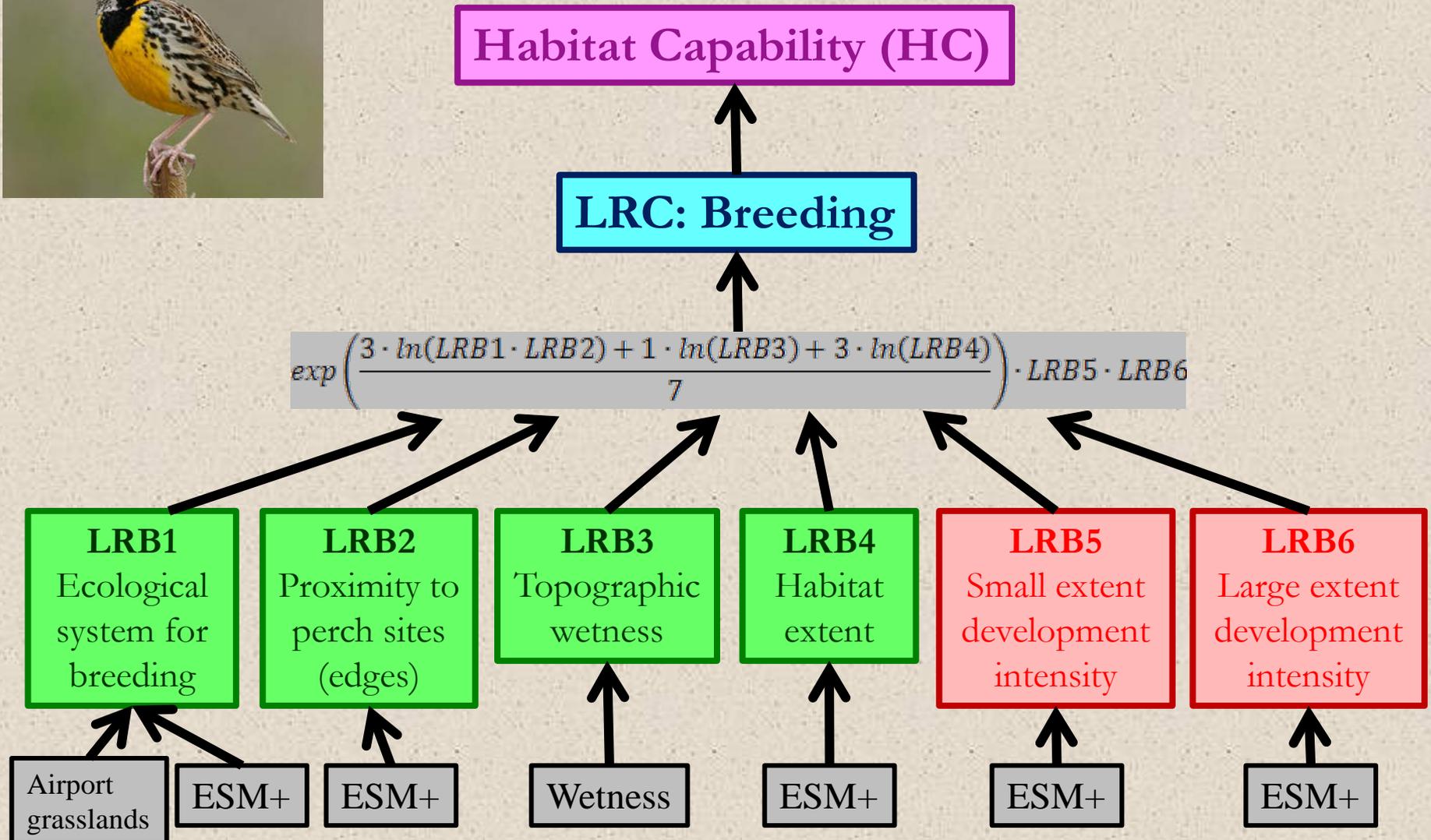
Habitat Capability

blbw HABIT@ model



Habitat Capability

same HABIT@ model



Habitat Capability

blbw HABIT@ model

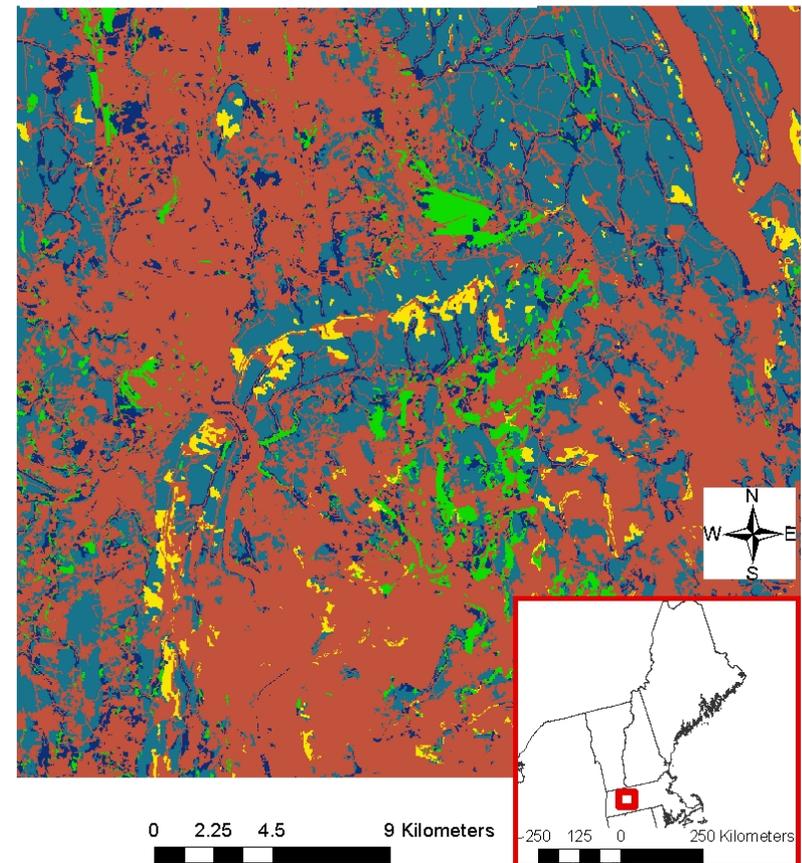


■ LRB1: Ecological system for breeding

Ecological System Description	LRB1 (breeding habitat value)
Central and Southern Appalachian Spruce-Fir Forest	1
Eastern Boreal Floodplain	1
Laurentian-Acadian Northern Hardwood Forest (high conifer variant)	1
Acadian Low Elevation Spruce-Fir-Hardwood Forest	1
N. Appalachian-Acadian Conifer-Hardwood Acidic Swamp (all variants)	1
Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (all variants)	1
Appalachian Hemlock-Northern Hardwood Forest (moist-cool)	0.85
Appalachian Hemlock-Northern Hardwood Forest (typic)	0.75
Acadian Sub-boreal Spruce Flat	0.7
Laurentian-Acadian Pine-Hemlock-Hardwood Forest (all variants)	0.7
Laurentian-Acadian Northern Hardwood Forest (typic)	0.7
Appalachian Hemlock-Northern Hardwood Forest (drier)	0.65
Laurentian-Acadian Northern Hardwood Forest (moist-cool)	0.5
North-Central Appalachian Acidic Swamp (all variants)	0.5
Laurentian-Acadian Floodplain Forest	0.3
Appalachian Dry Oak-Pine Forest	0.3
Laurentian-Acadian Red Oak-Northern Hardwood Forest	0.3
NE Interior Dry-Mesic Oak Forest (moist-cool)	0.3
Southern Appalachian Northern Hardwood Forest	0.3
Southern Appalachian Montane Pine Forest and Woodland	0.3
Southern Appalachian Low-Elevation Pine Forest	0.3
Central Appalachian Dry Oak-Pine Forest	0.3

Blackburnian Warbler LRB1: Ecological System for Breeding

High : 0.85
Low : 0



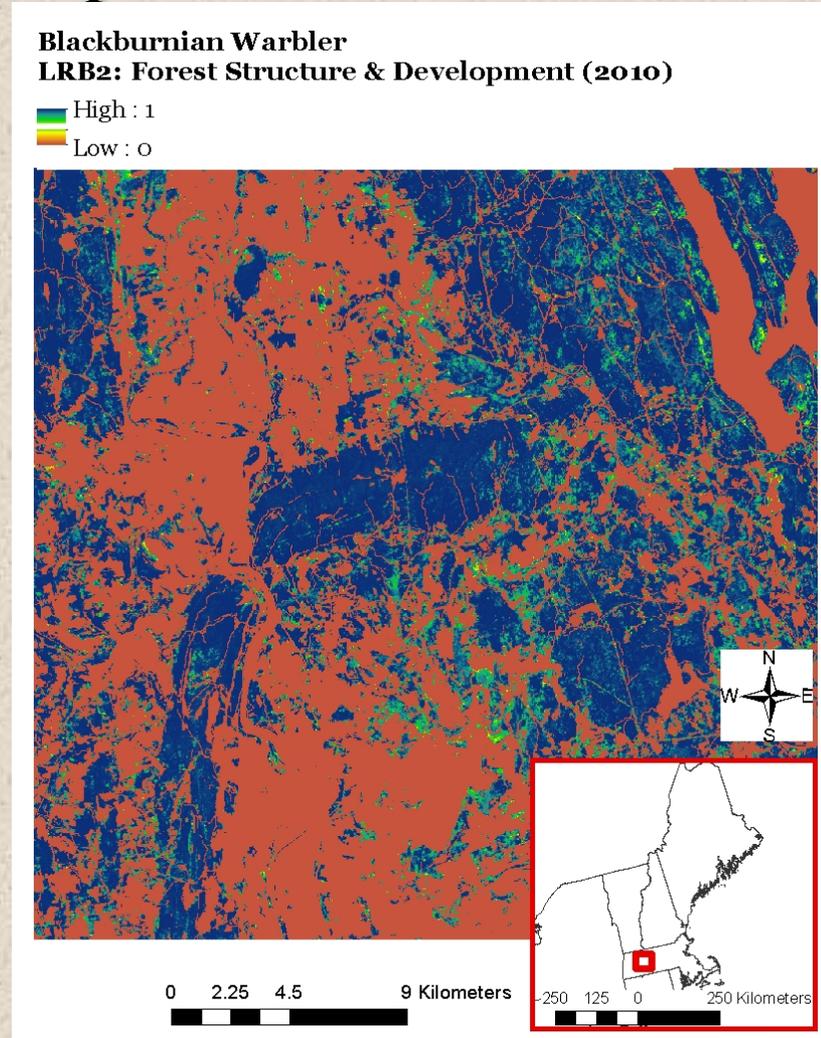
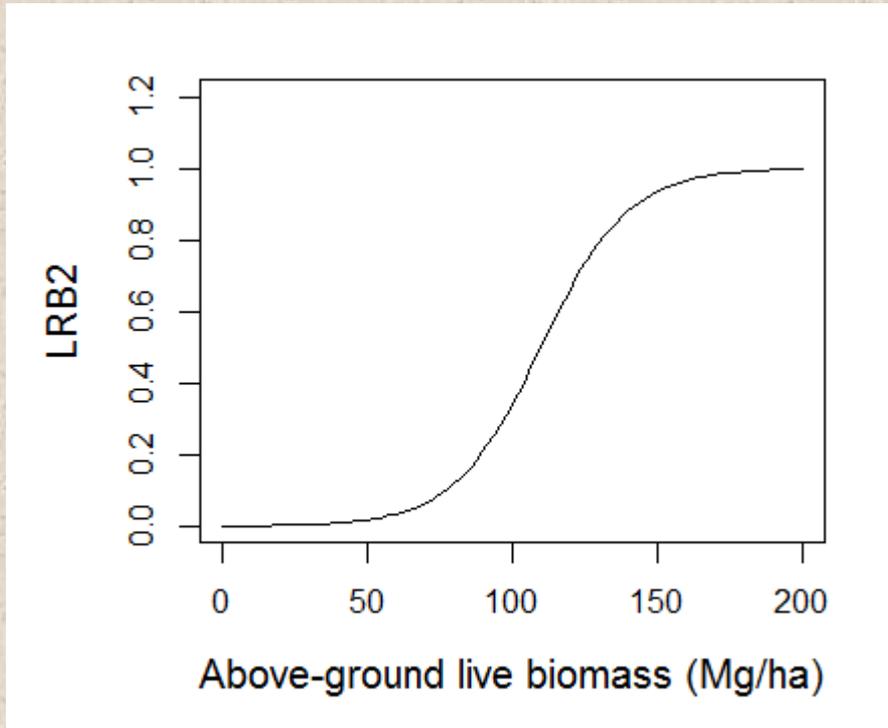
Habitat Capability

blbw HABIT@ model



▪ LRB2: Forest structure & development

= logistic function of biomass



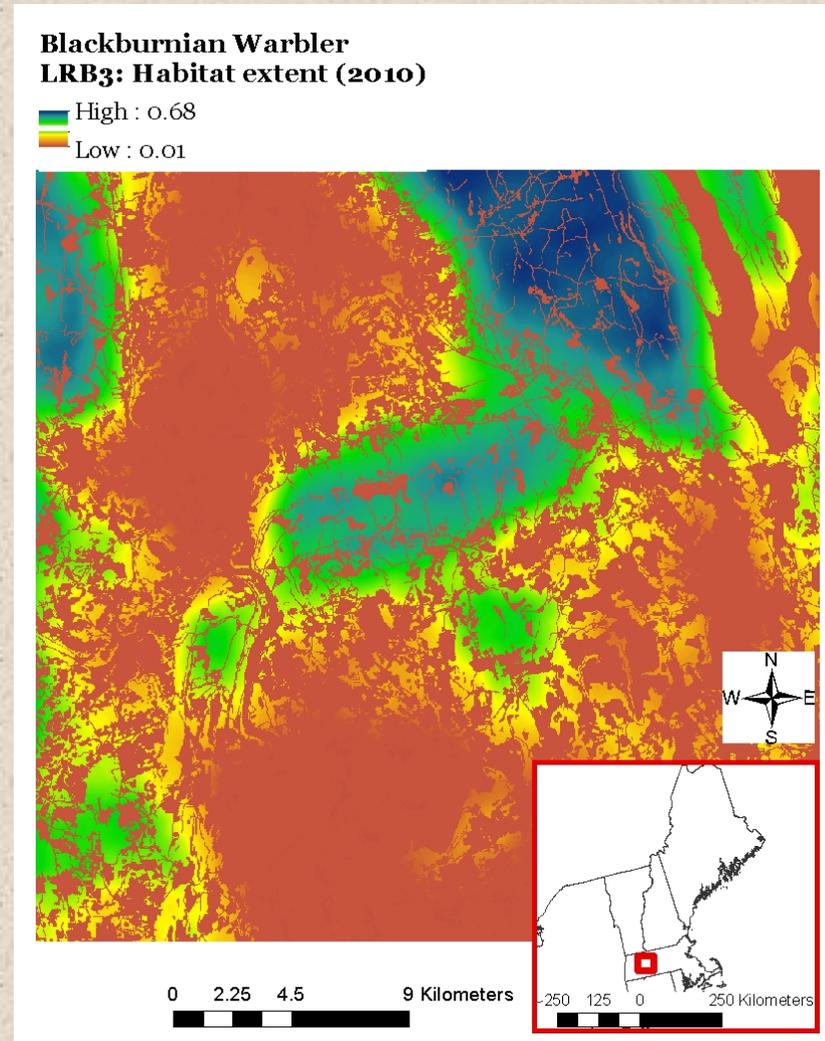
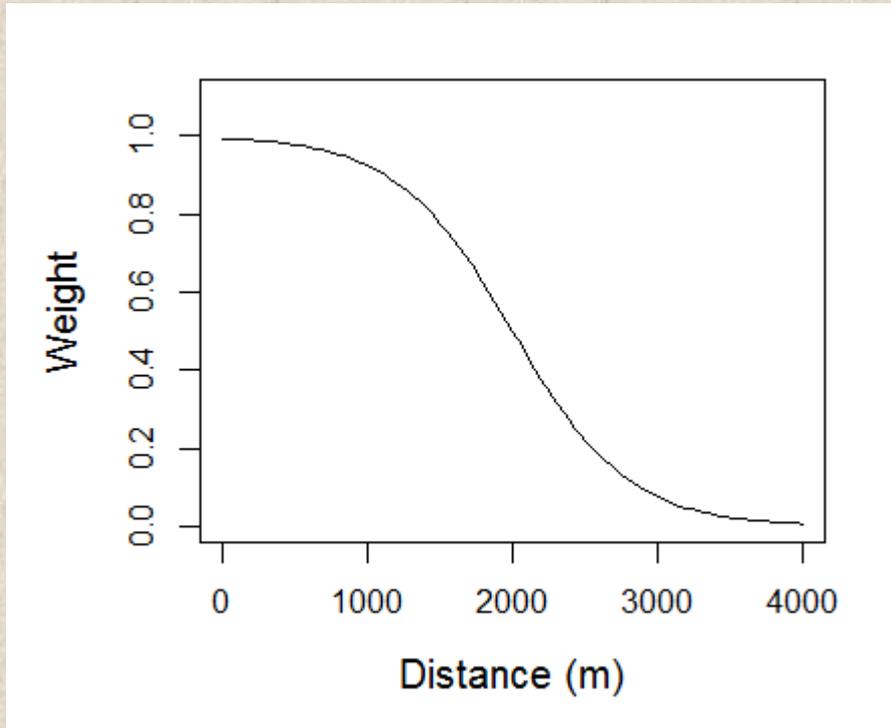
Habitat Capability

blbw HABIT@ model



▪ LRB3: Habitat extent

= kernel weighted intensity of LRB1



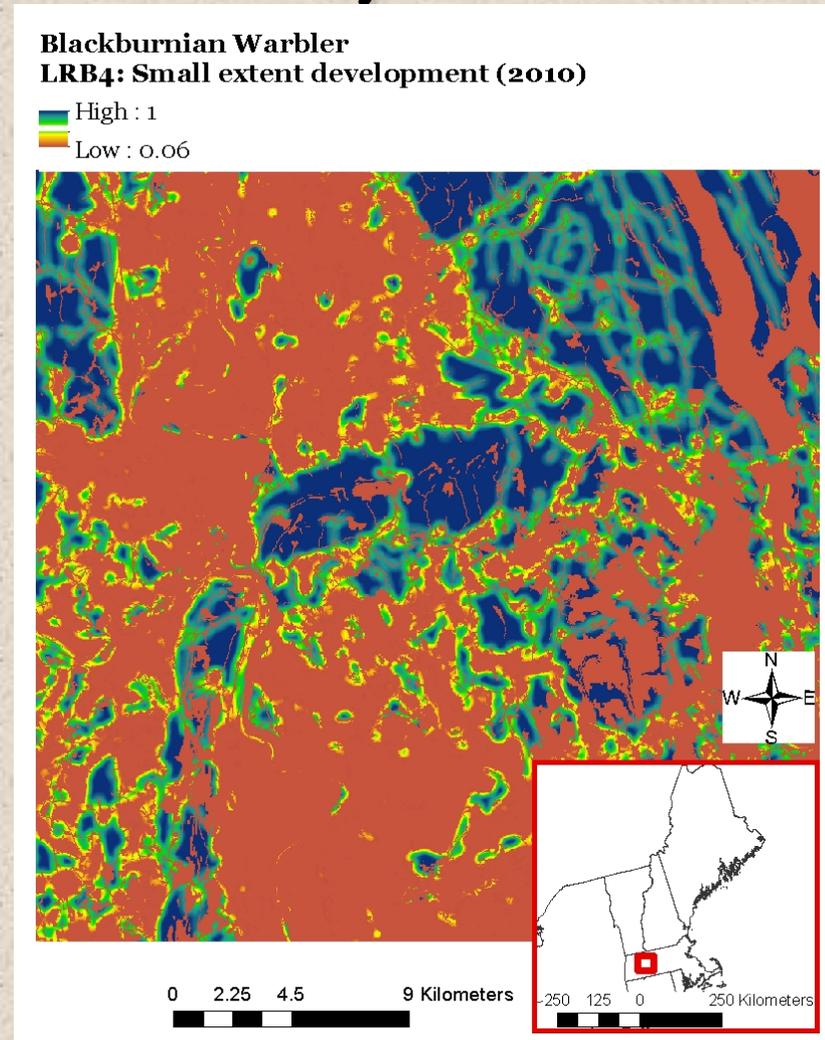
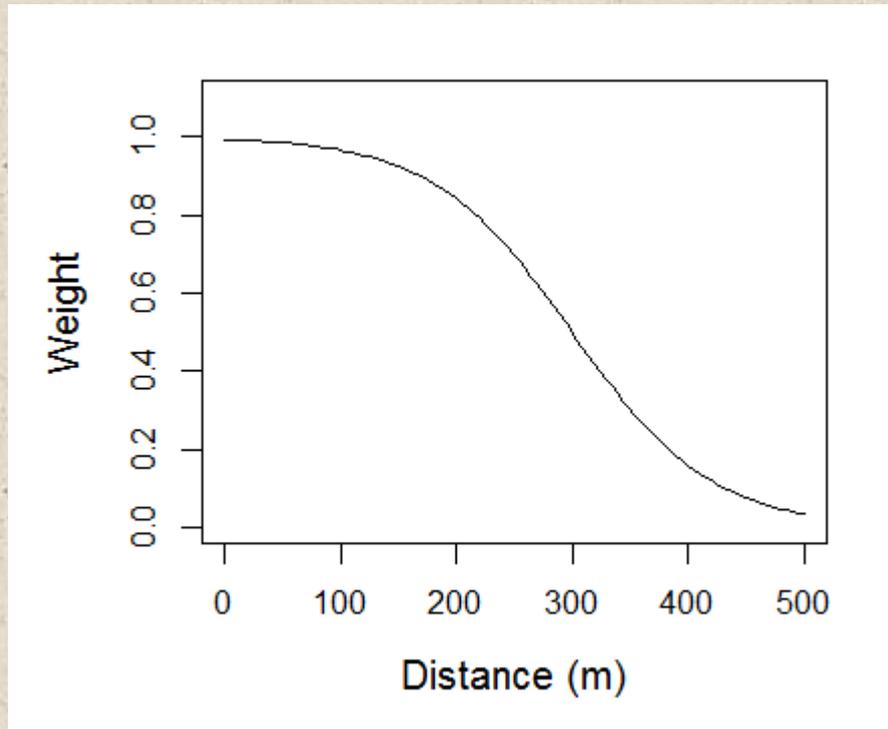
Habitat Capability

blbw HABIT@ model



- **LRB4: Small extent development intensity**

= 1 - kernel weighted intensity of development



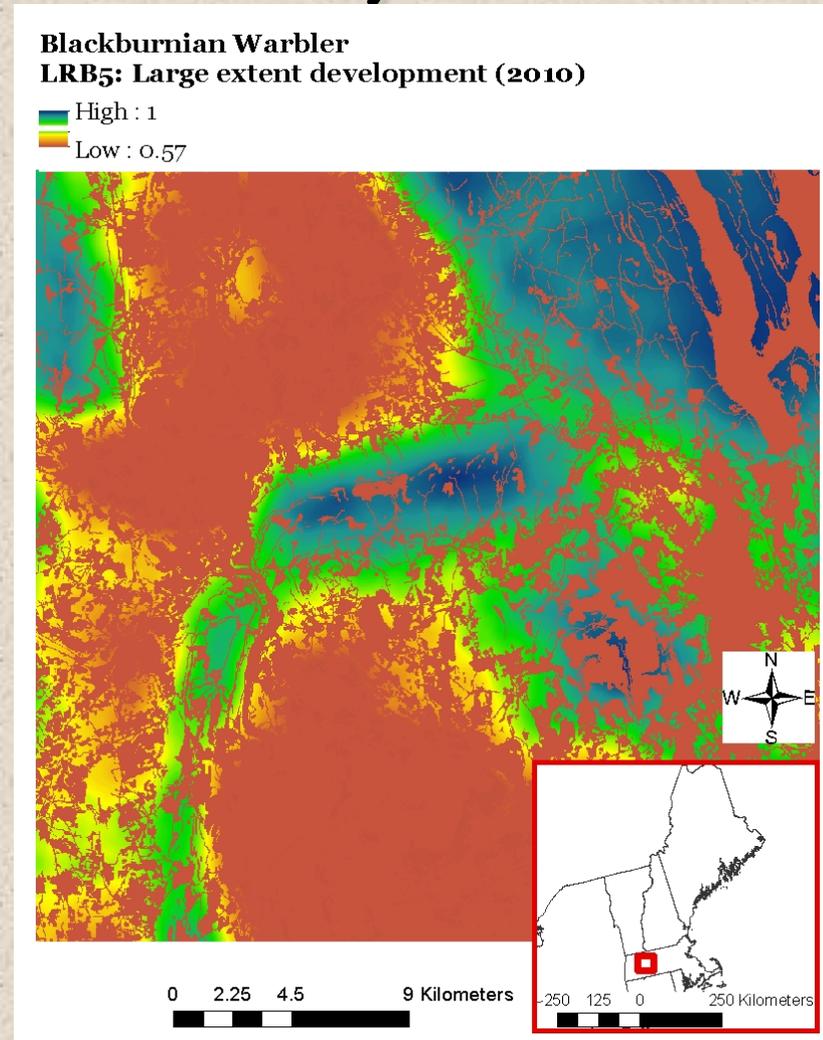
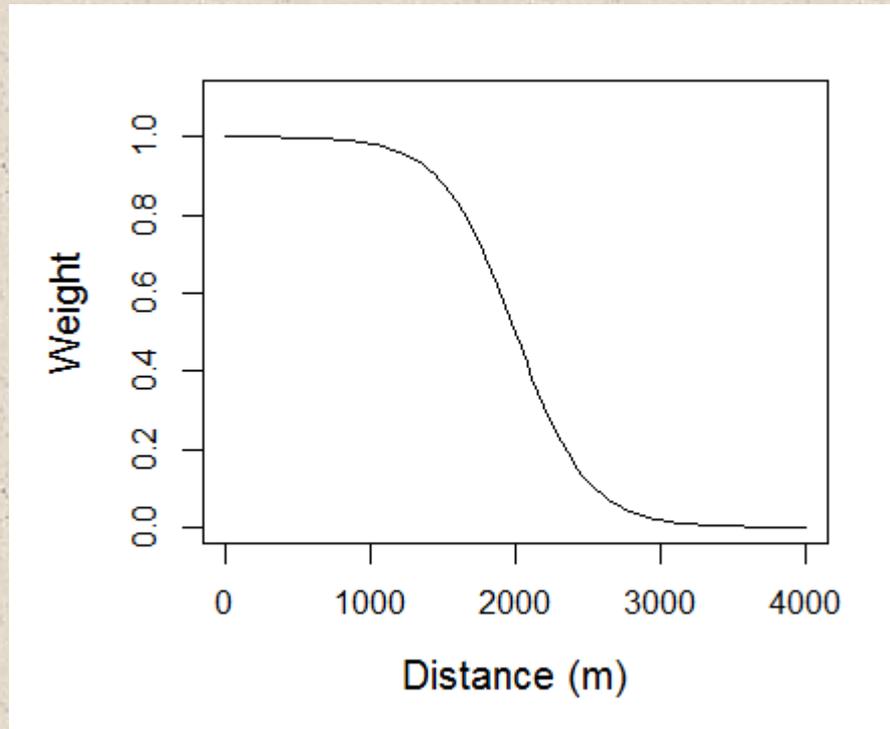
Habitat Capability

blbw HABIT@ model



- **LRB5: Large extent development intensity**

= 1 - kernel weighted intensity of development



Habitat Capability

blbw HABIT@ model

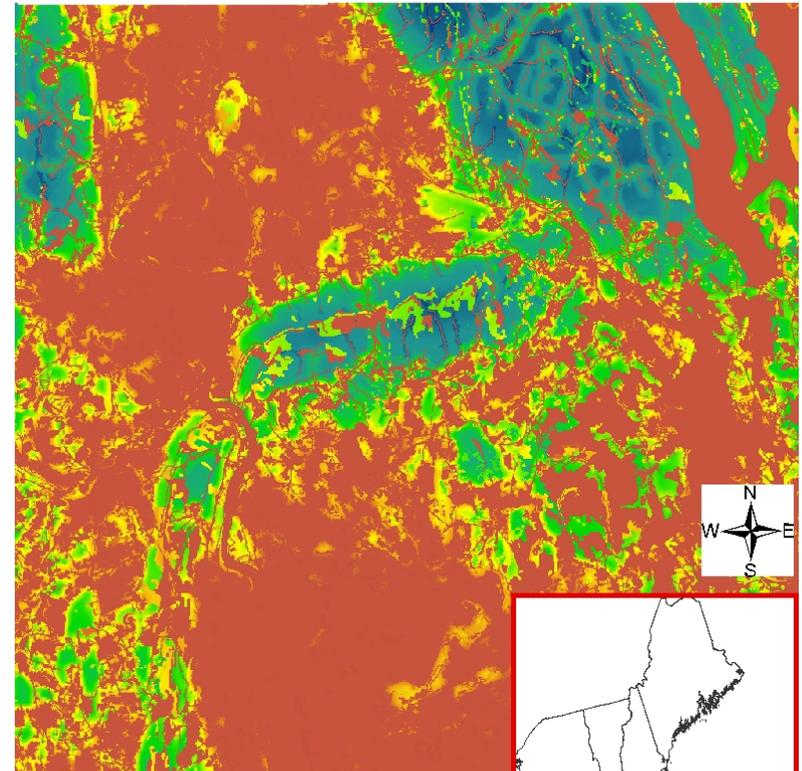


▪ LRC: Breeding

$$\exp\left(\frac{3 \cdot \ln(LRB1) + 1 \cdot \ln(LRB2) + 3 \cdot \ln(LRB3)}{7}\right) \cdot LRB4 \cdot LRB5$$

Blackburnian Warbler
LRC: Breeding (2010)

High : 0.79
Low : 0



0 2.25 4.5 9 Kilometers



-250 125 0 250 Kilometers



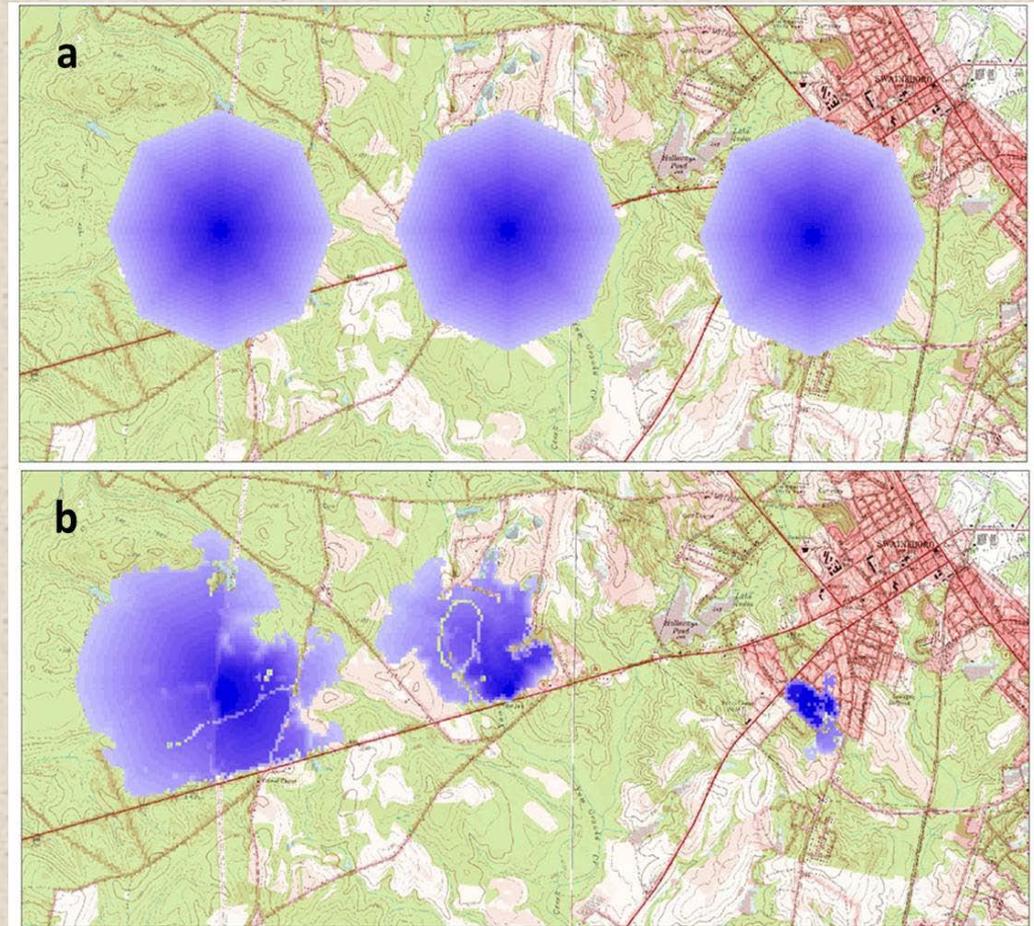
Habitat Capability

blw HABIT@ model



▪ Habitat Capability (HC)

- For each focal cell:
- Build a *homerange kernel* (resistant kernel based on resistance surface with Gaussian bandwidth = 50 m)
- Sum kernel-weighted LRC values
- Range 0-1



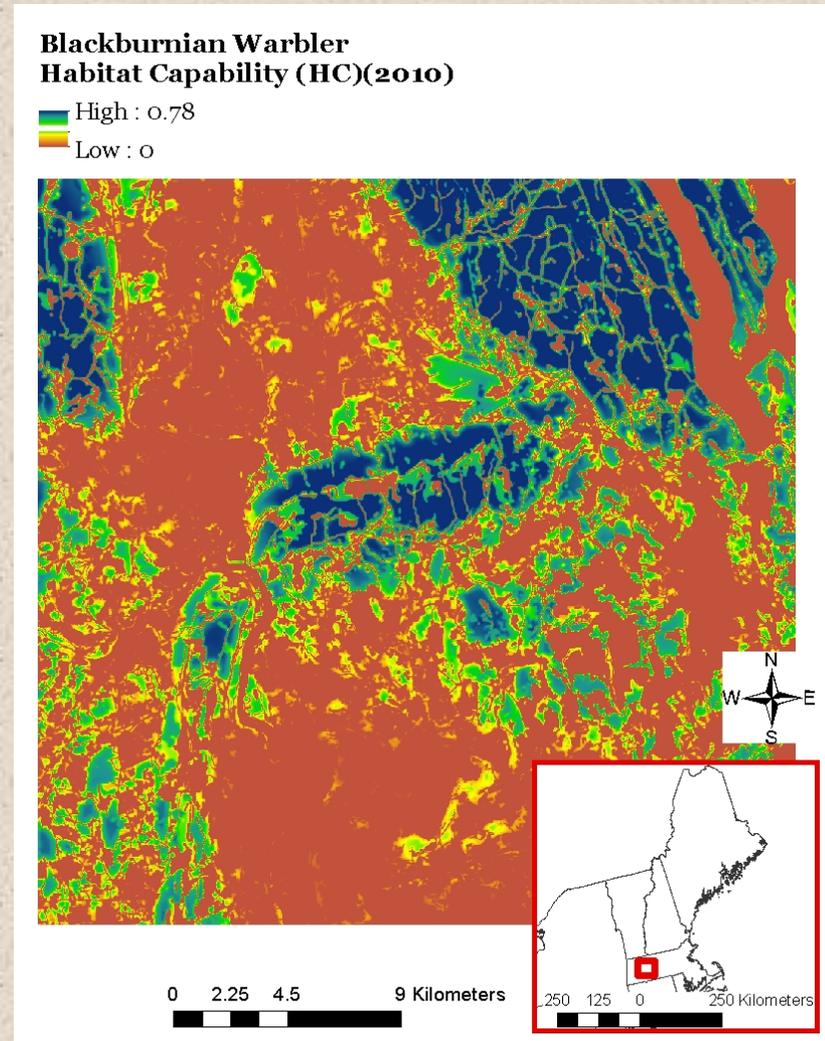
Habitat Capability

blbw HABIT@ model



▪ Habitat Capability (HC)

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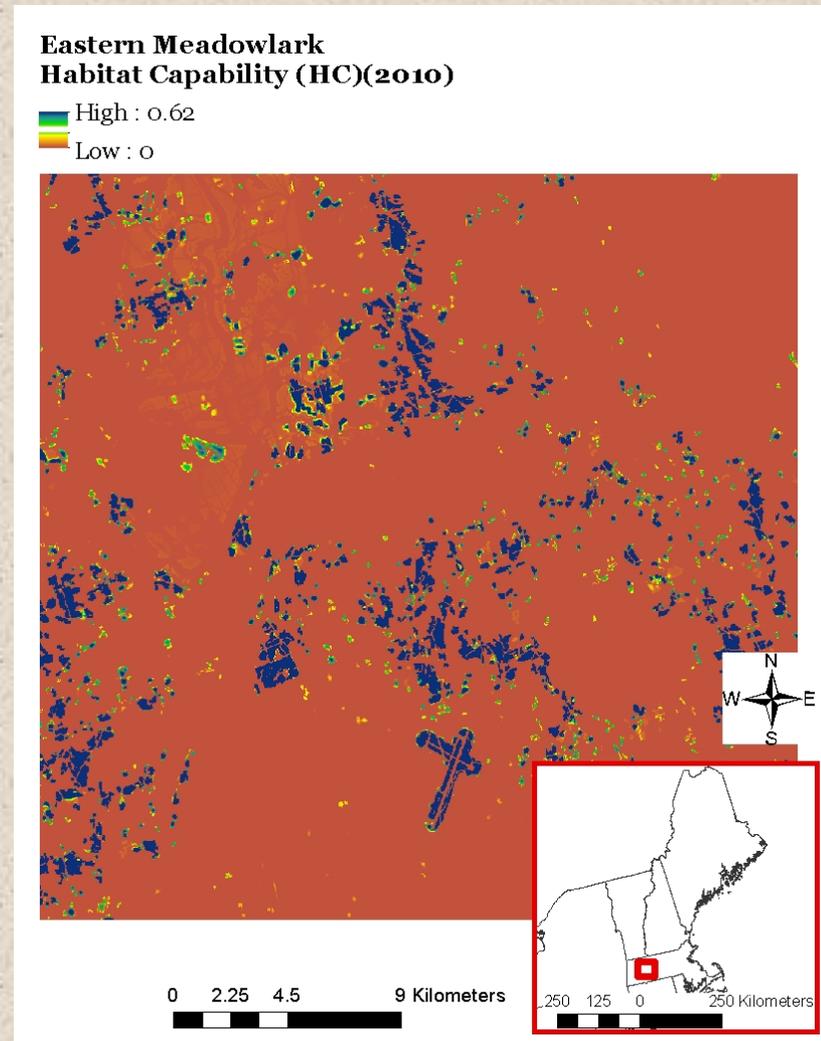
Habitat Capability

same HABIT@ model



▪ Habitat Capability (HC)

- For each focal cell:
- Build a *homerange kernel* (resistant kernel based on resistance surface with Gaussian bandwidth = 50 m)
- Sum kernel-weighted LRC values
- Range 0-1

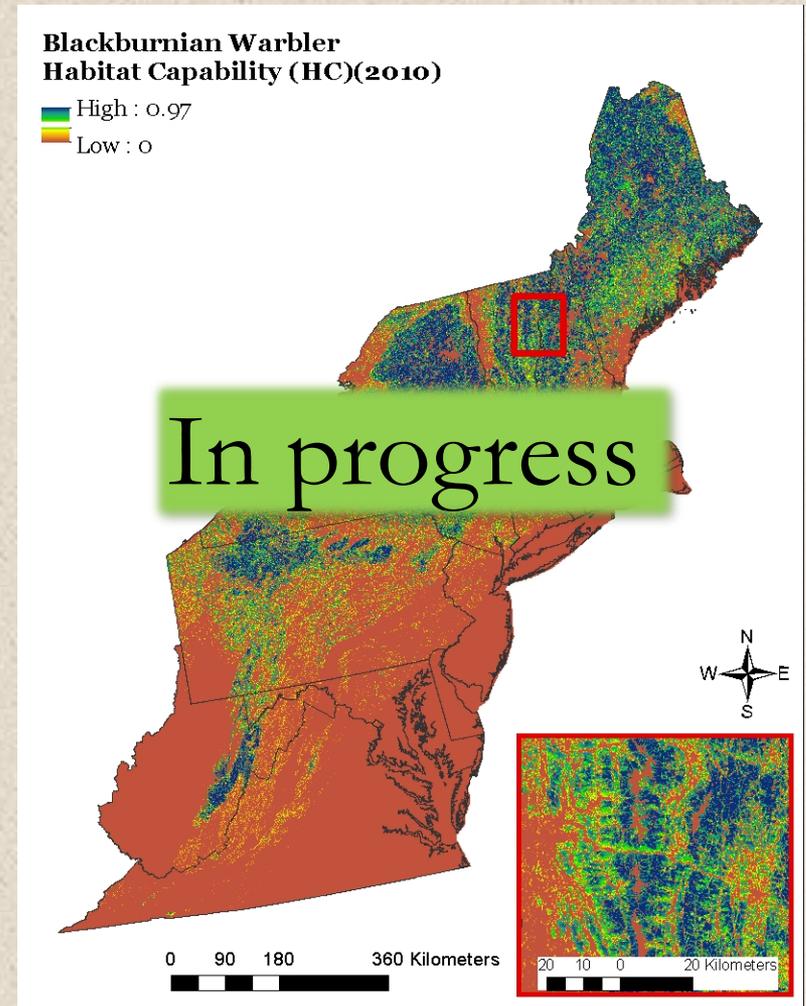
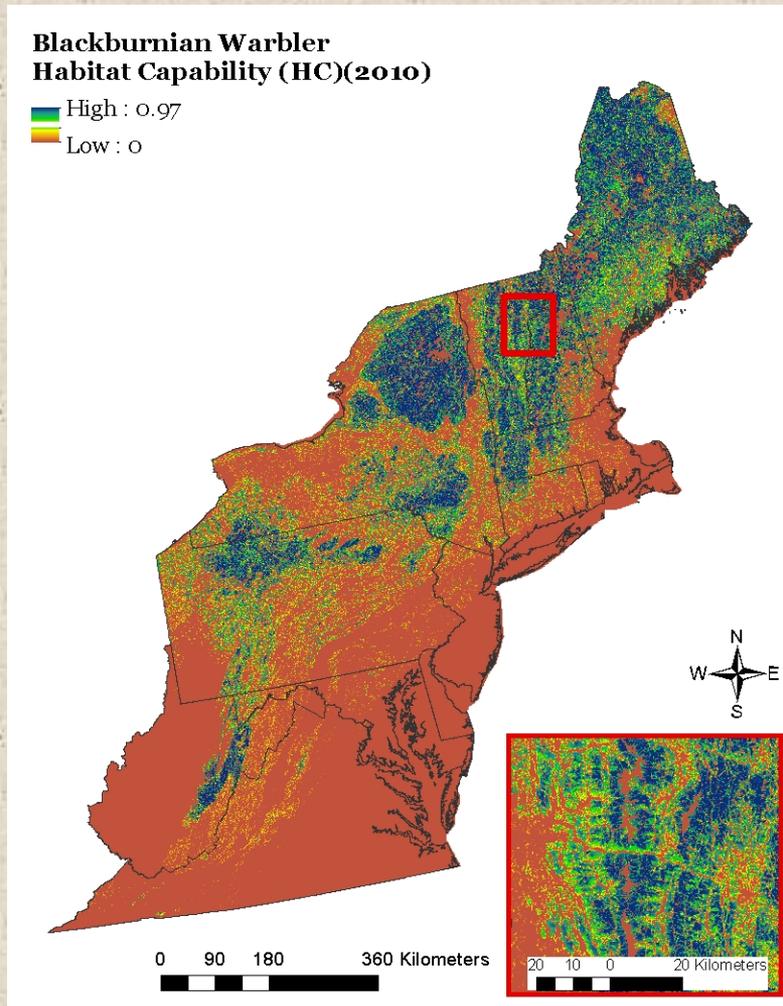


Habitat Capability

blbw HABIT@ model



Current HC vs Future HC

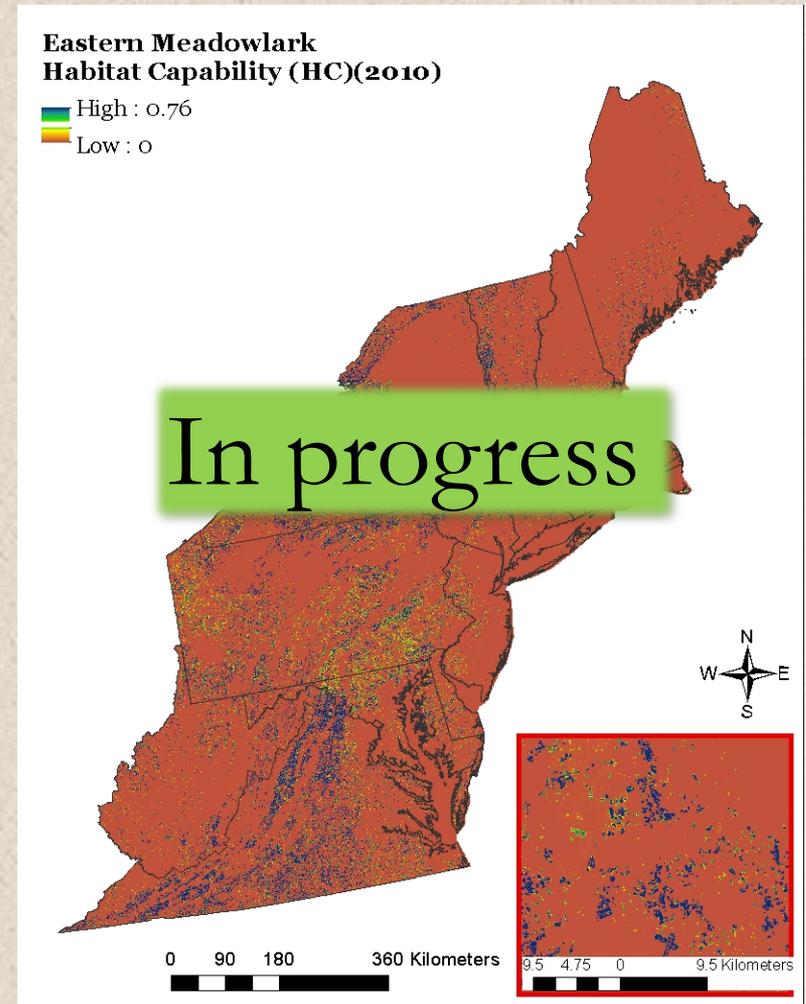
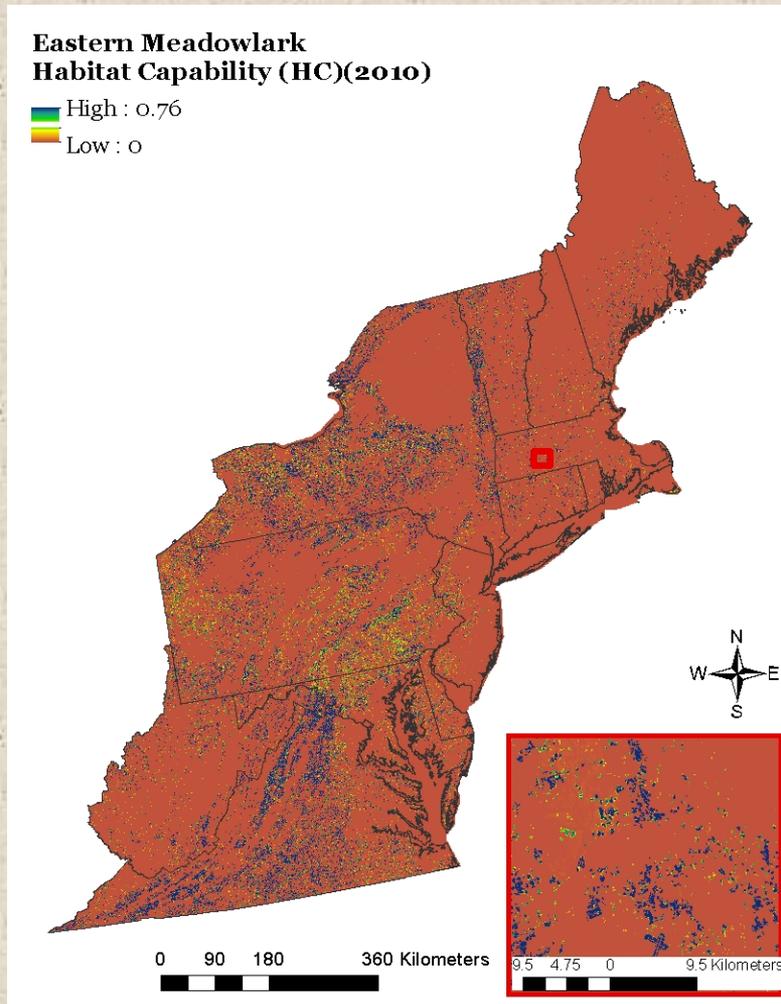


Habitat Capability

same HABIT@ model



Current HC vs Future HC



Climate Suitability

Climate niche modeling framework

- Multiple logistic regression
- Presence/absence data (BBS)
- Humid temperate domain
- Suite of climate predictors
- All subsets model selection:
 - Achieve sensitivity of 95-98%
 - Minimize commission error
- Climate Niche (CN):
 - Continuous: $\text{Pr}(\text{suitable climate})$
- Climate niche envelope (CNE):
 - Binary: (cutpoint that minimizes commission error)

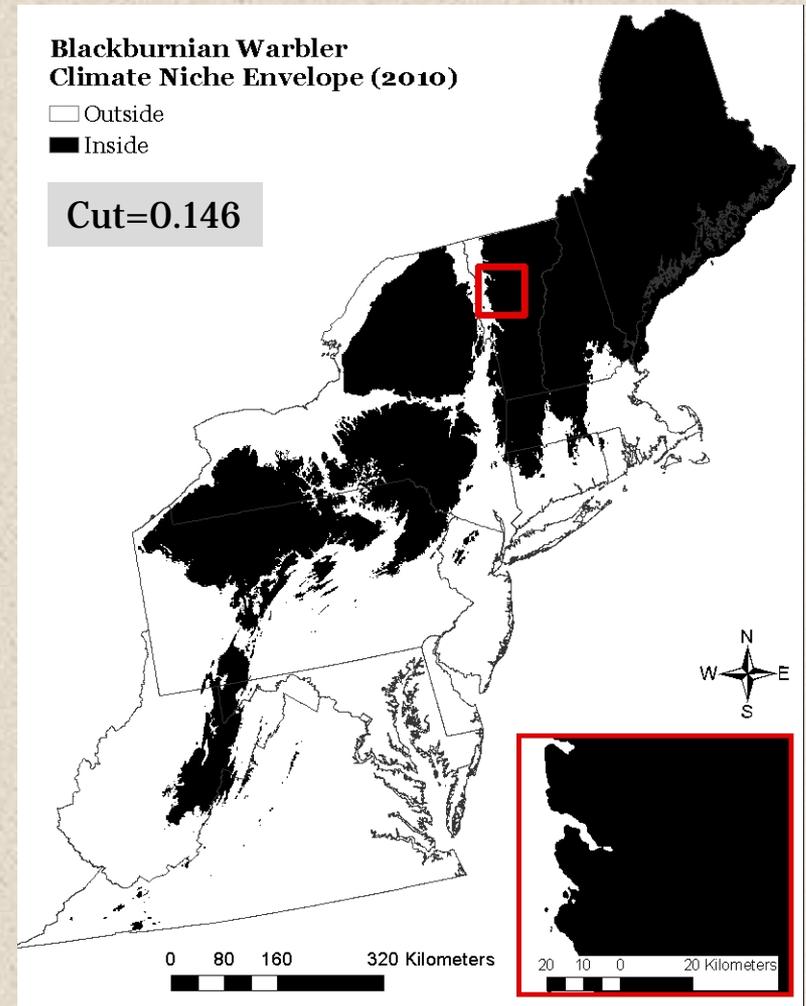
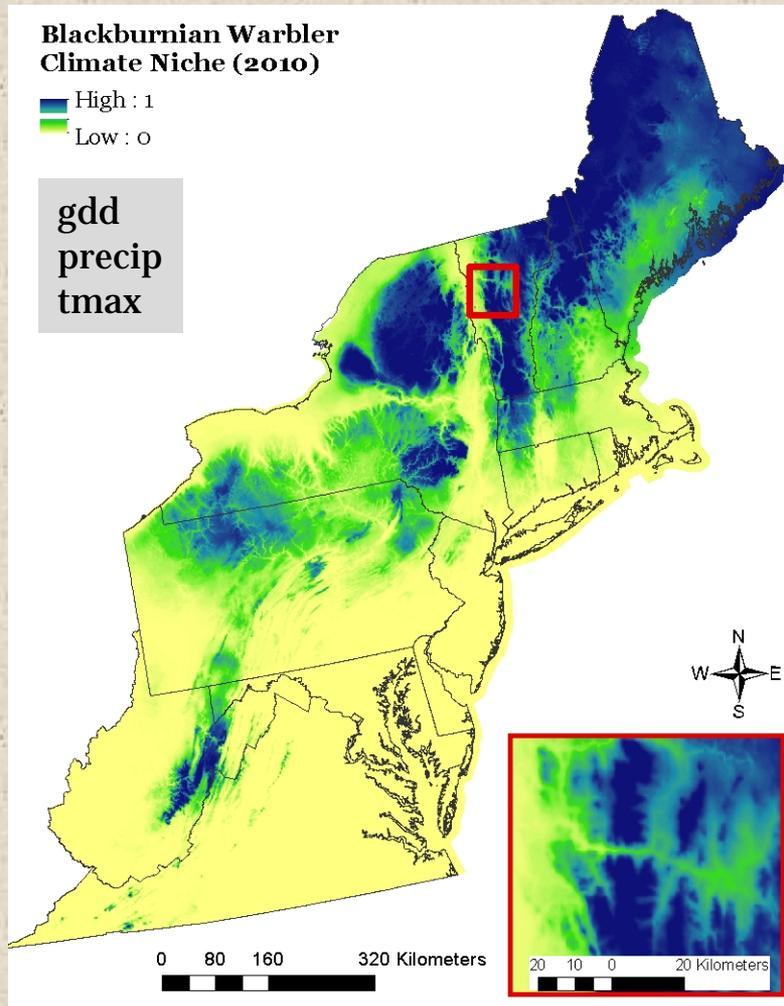


Climate Suitability

blbw climate niche model



- Climate Niche (CN) & CN Envelope (CNE)

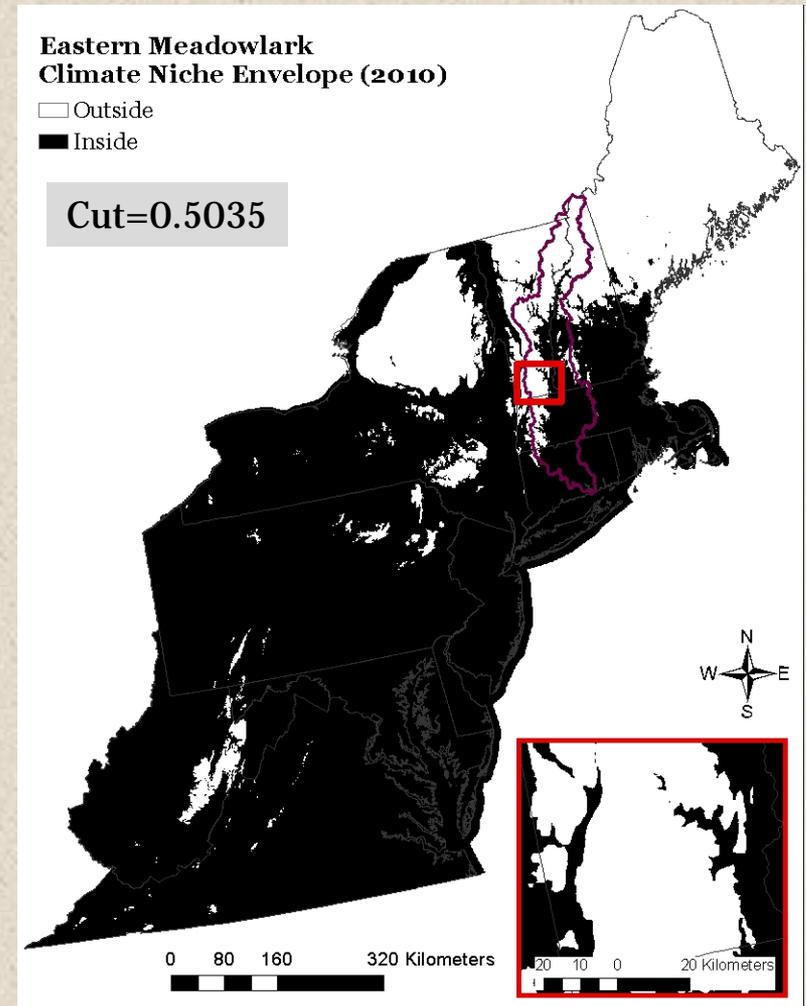
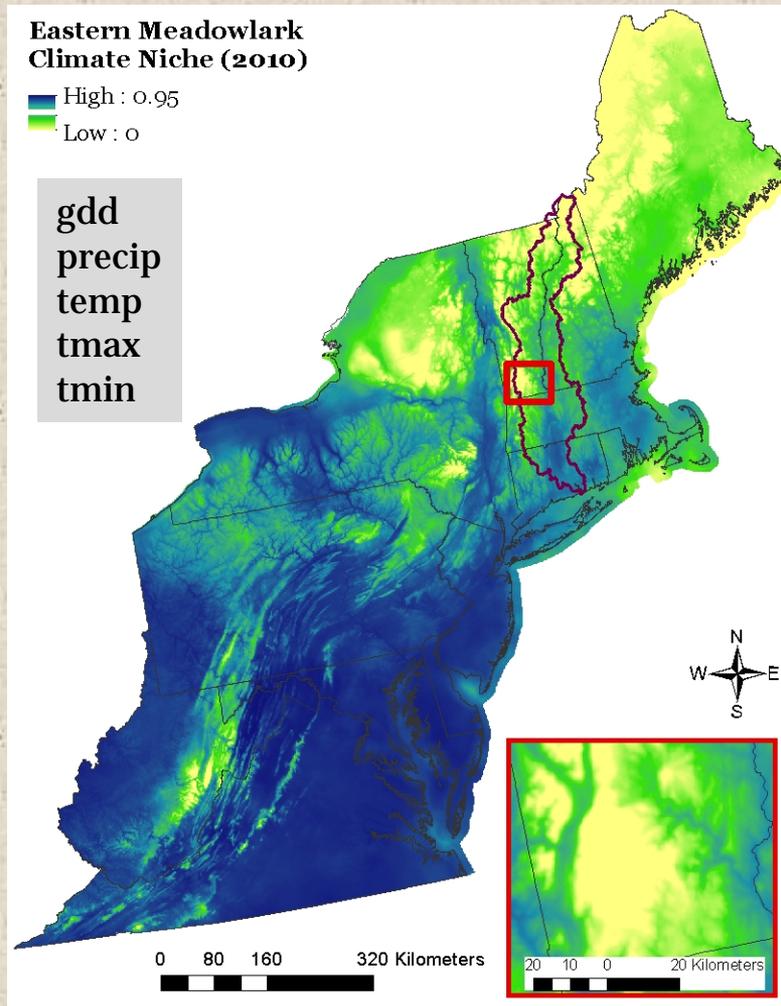


Climate Suitability

blbw climate niche model



- Climate Niche (CN) & CN Envelope (CNE)

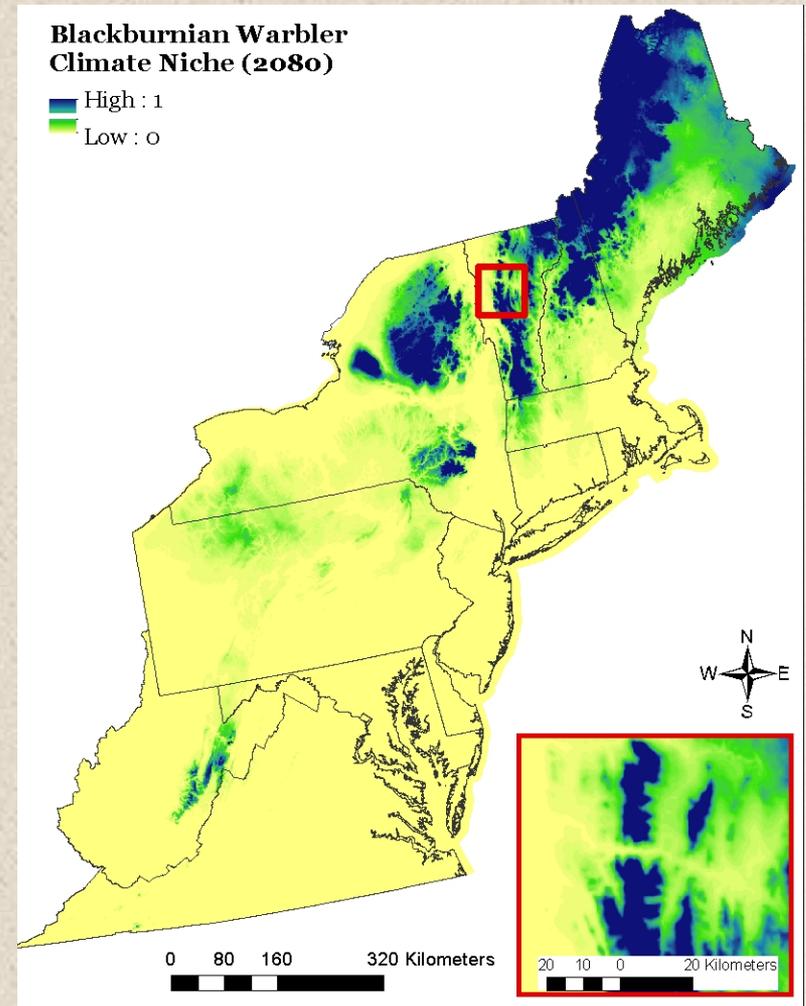
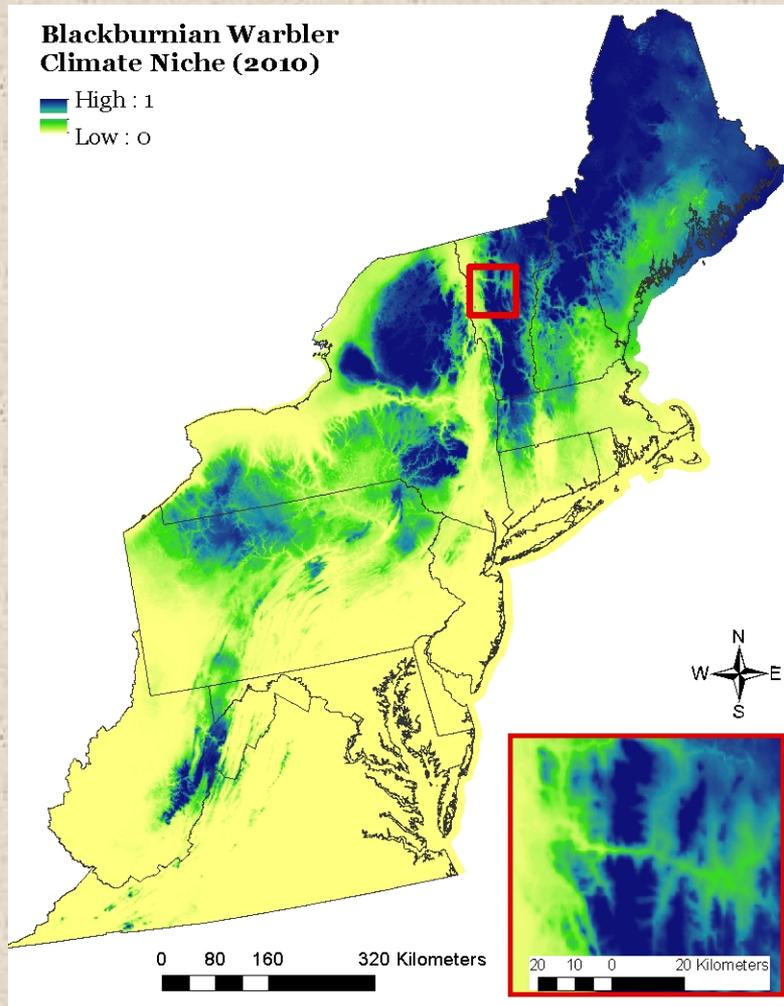


Climate Suitability

blbw climate niche model



- Current CN vs future CN

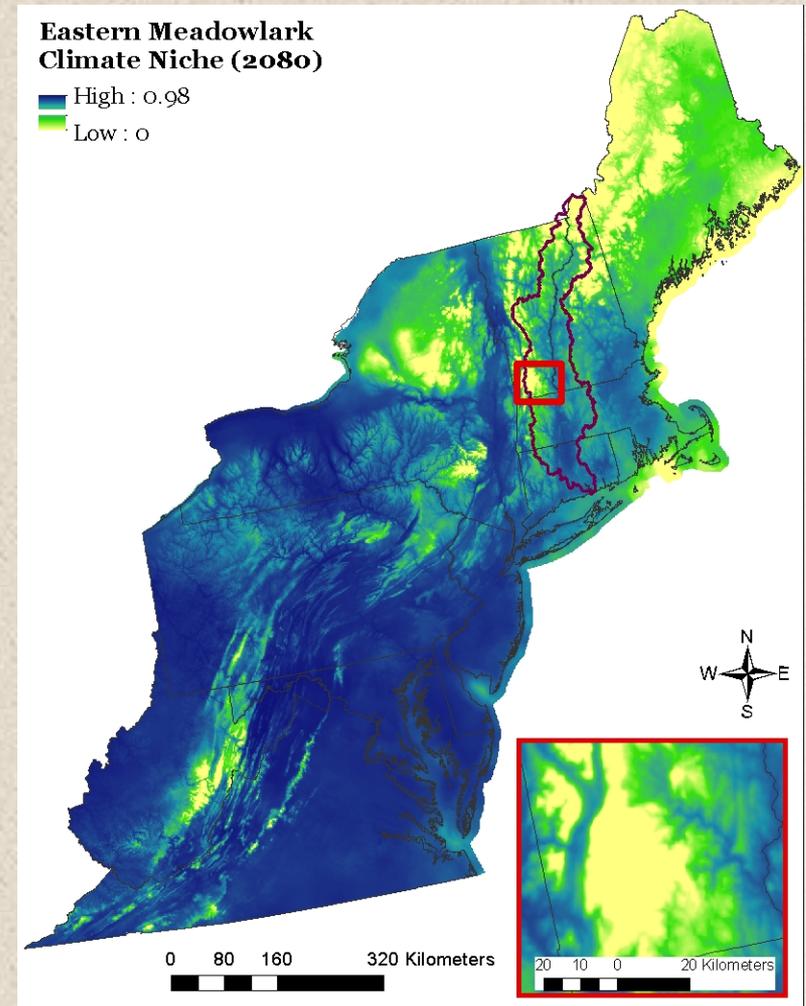
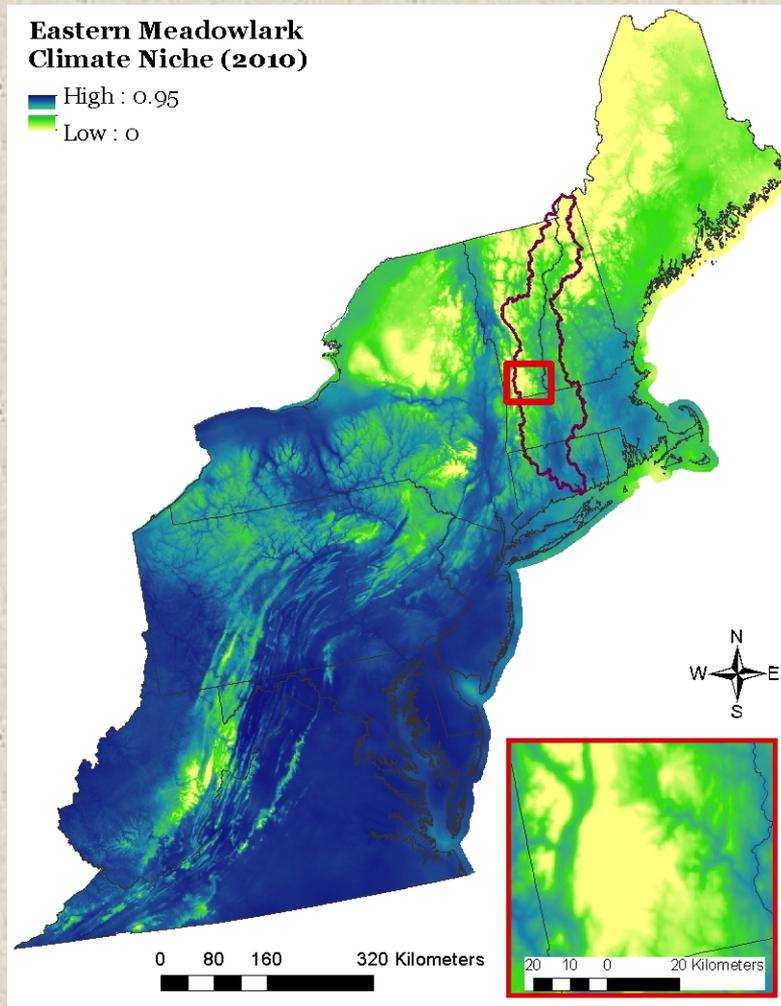


Climate Suitability

blbw climate niche model



- Current CN vs future CN



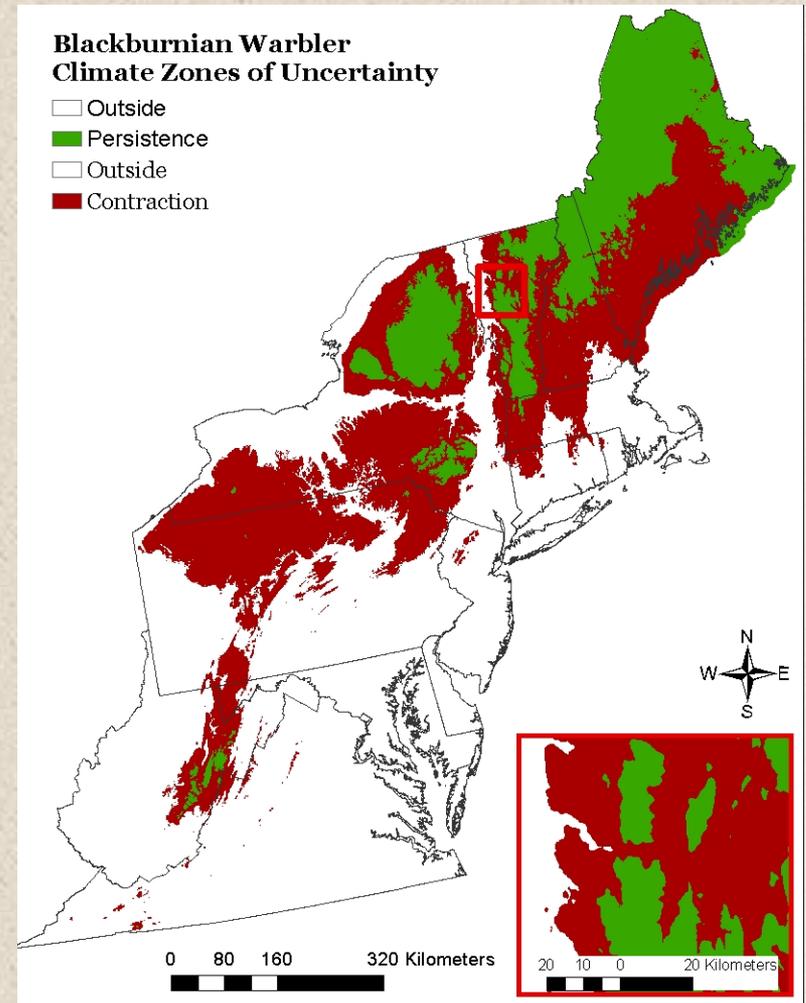
Climate Suitability

blbw climate niche model



Climate Zones of Uncertainty

- *Zone of Persistence...*
within 2010 CNE and
2080 CNE
- *Zone of Contraction...*
within 2010 CNE but
outside 2080 CNE
- *Zone of Expansion...*
Within 2080 CNE but
outside 2010 CNE



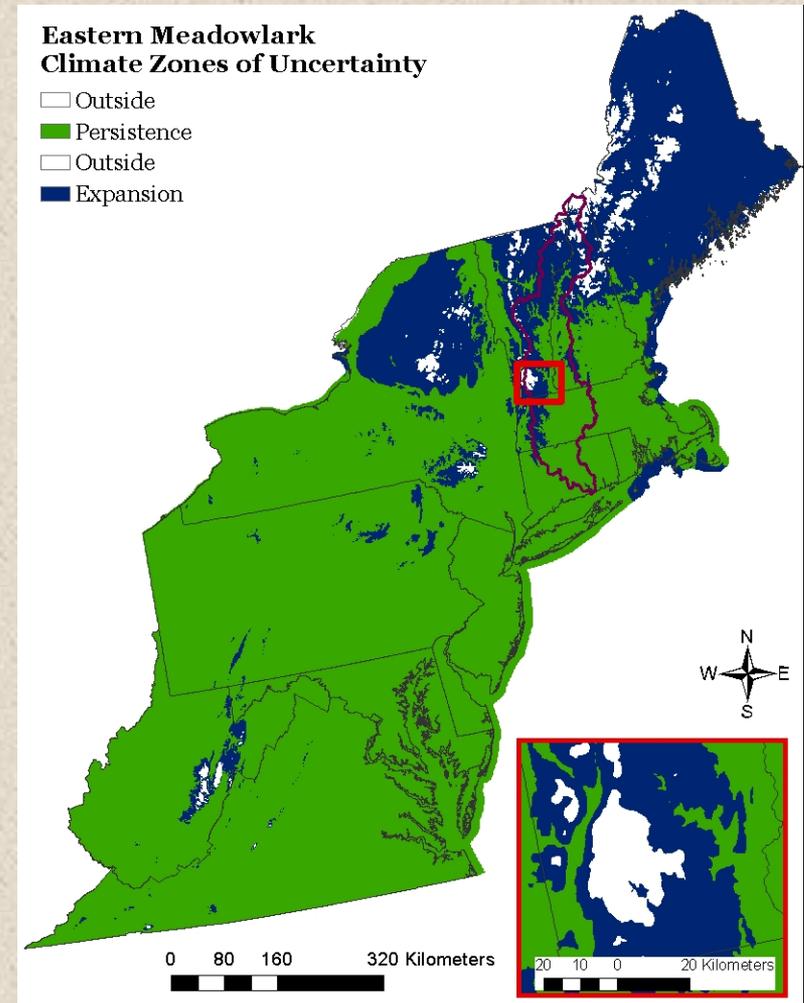
Climate Suitability

blbw climate niche model



Climate Zones of Uncertainty

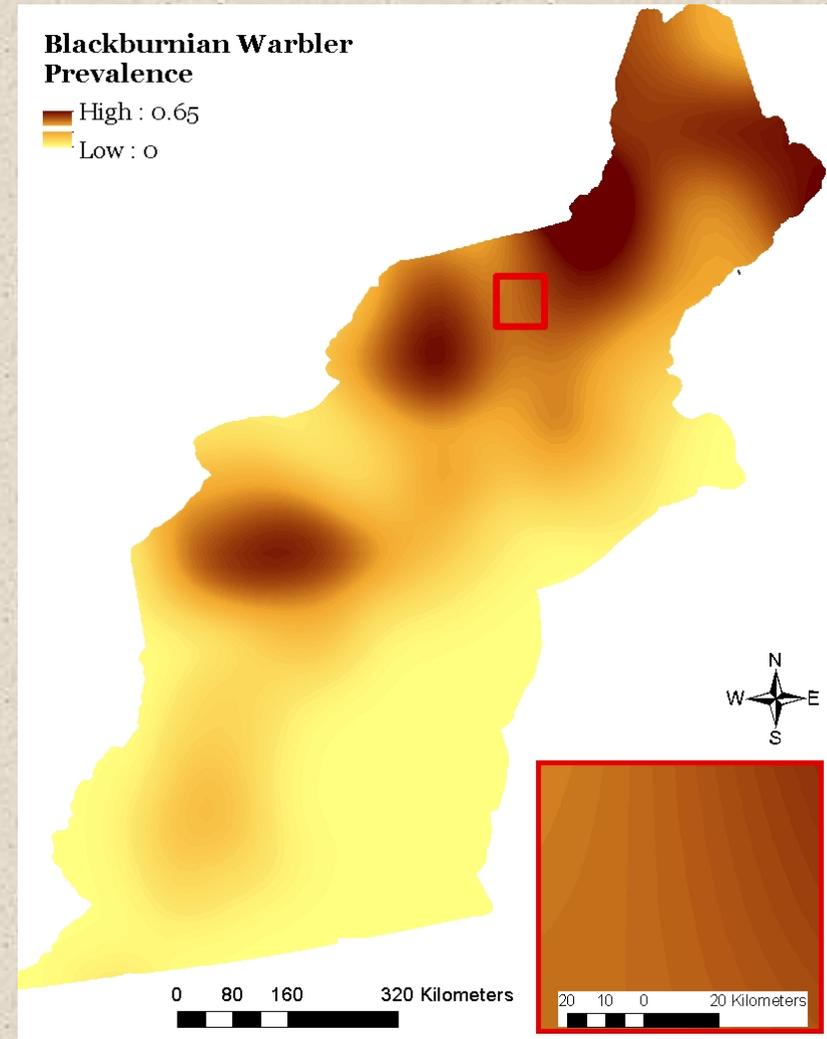
- *Zone of Persistence...*
within 2010 CNE and
2080 CNE
- *Zone of Contraction...*
within 2010 CNE but
outside 2080 CNE
- *Zone of Expansion...*
Within 2080 CNE but
outside 2010 CNE



Prevalence

Prevalence modeling framework

- Presence data (BBS)
- Proportional presence on each route segment (~8 km)
- Region subdivided into 20 km square cells
- Guassain distance-weighted (5 km bandwidth) interpolation of proportional presence
- Static: 2010 only

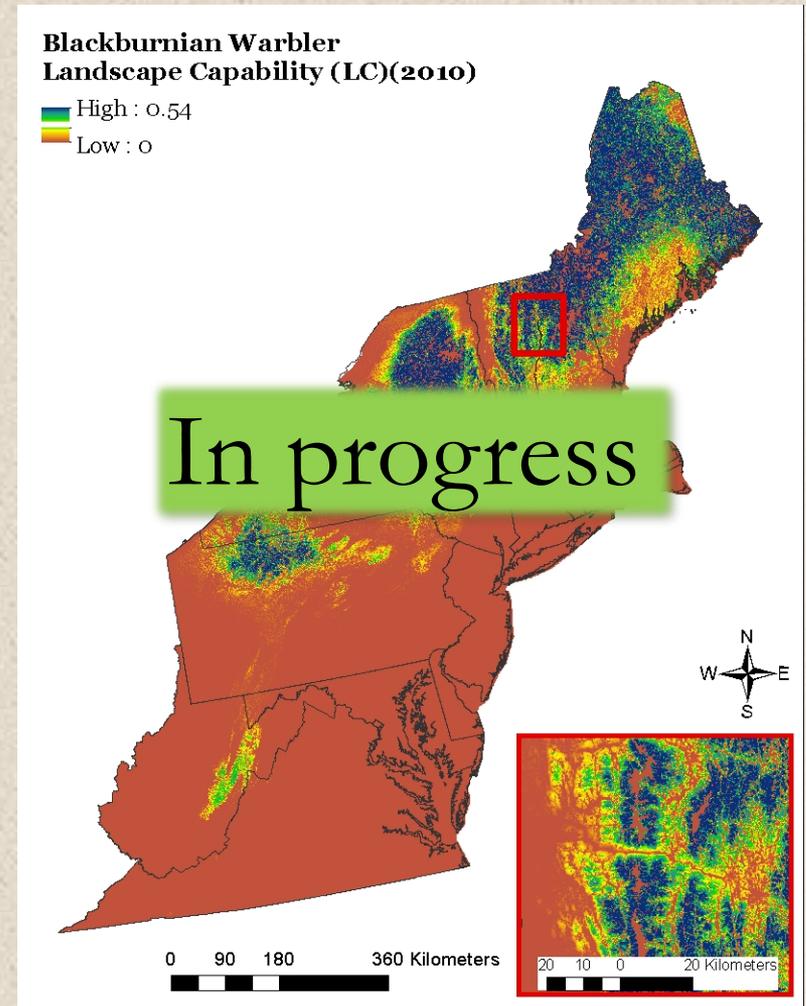
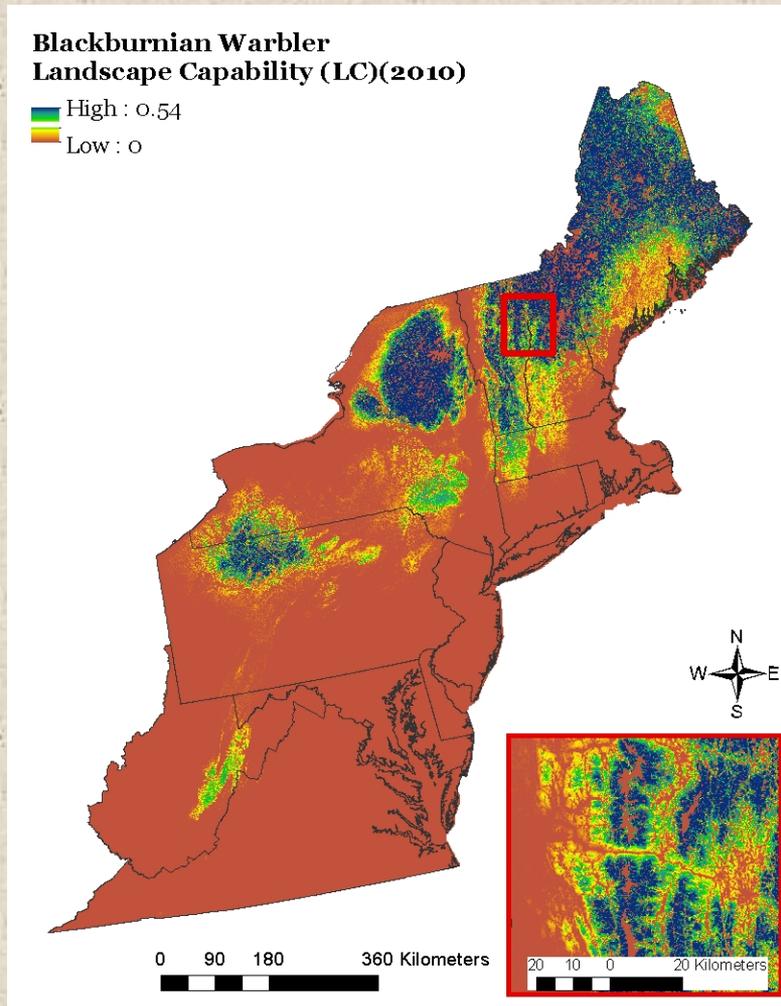


Landscape Capability

$$LC = HC \cdot CN \cdot \text{Prevalence}$$



Current LC vs future LC

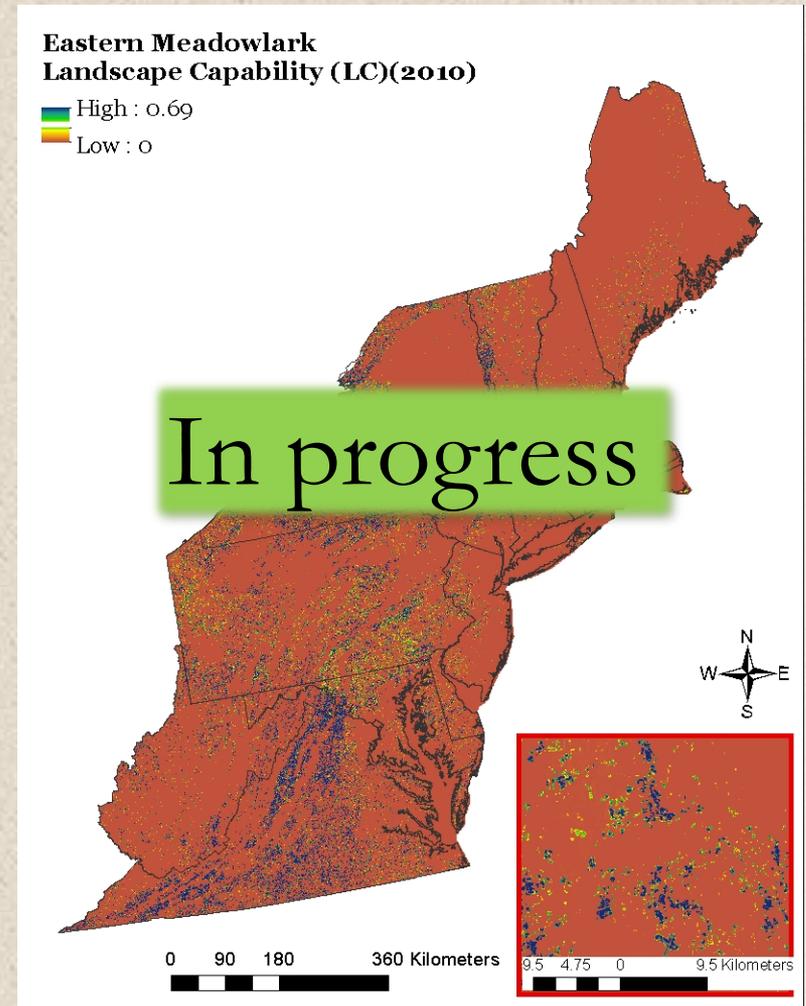
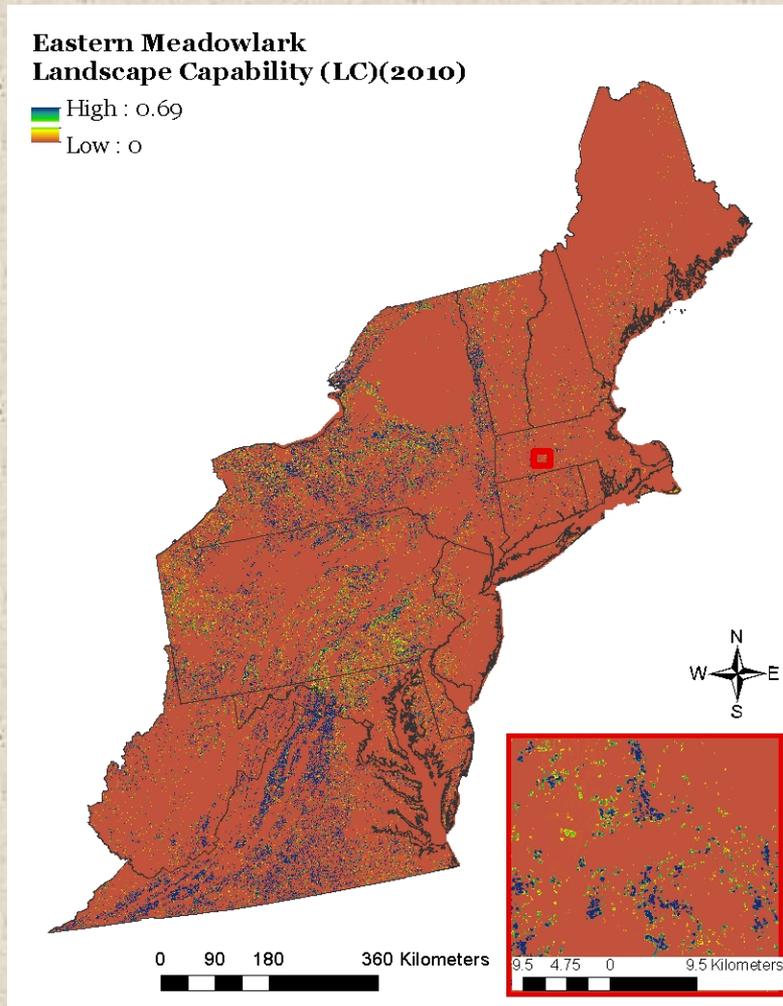


Landscape Capability

$$LC = HC \cdot CN$$



Current LC vs future LC



Landscape Change Assessment

Non-spatial indices

1. **Climate response...** percent change in LC due to climate change
2. **Habitat response...** percent change in LC due to vegetation disturbance
3. **Climate & habitat response...** percent change in LC due to both climate & vegetation disturbance

Species	Current (2010) Landscape Capability (LC)	Landscape Change Response (2080) (%)		
		Climate	Habitat	Climate & Habitat
Blackburnian warbler	1,808,392	-94.3	tbd	tbd
Eastern meadowlark	660,206	17.4	tbd	tbd

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 in LCD for prioritizing areas for species conservation accounting for potential future change

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

*Perhaps useful mainly in visualizing changes

Landscape Change Assessment

Spatial indices

1. **Persistence...** places with persistent high LC (current high LC and where climate and habitat conditions are expected to persist)
$$= (\text{current LC} + \text{future LC}) / 2$$

Subject to the influence of future stochastic vegetation disturbances (or lack of)

In progress

Landscape Change Assessment

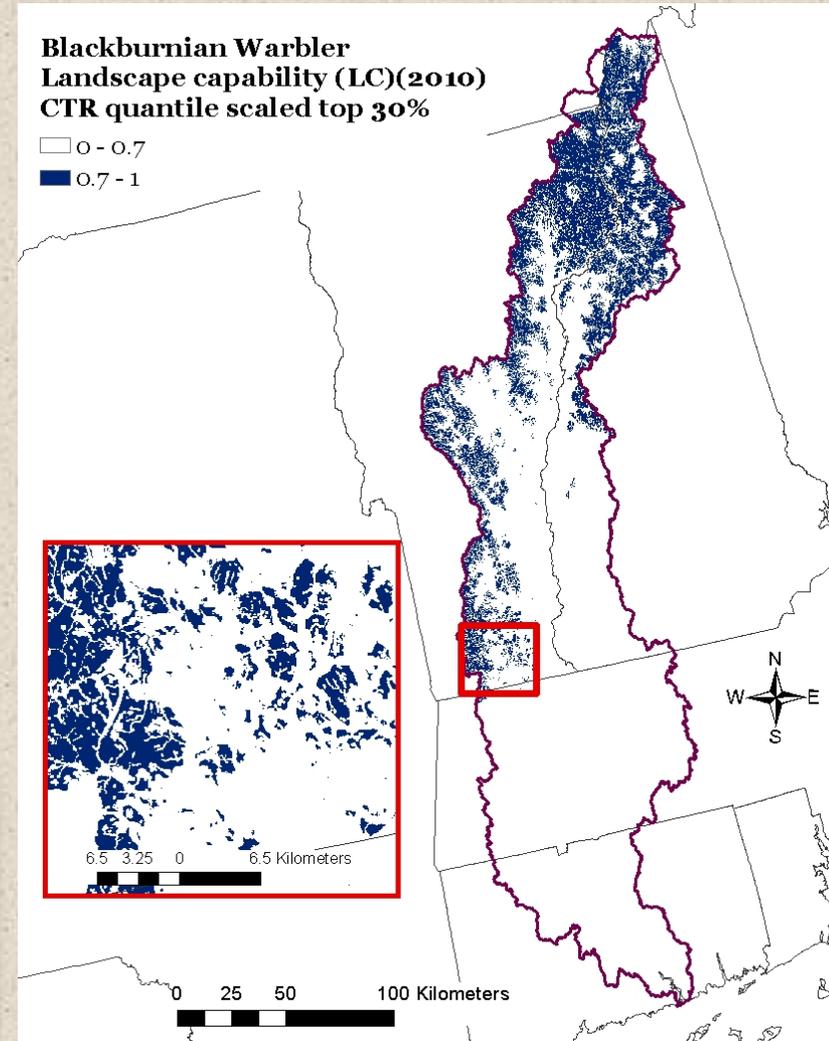
Spatial indices

2. Climate persistence...
places with high current
LC that are most likely
to maintain climate
suitability over time

$$= (\text{current LC} + \text{future LC.climate}^*) / 2$$

* Holds HC constant

Not subject to the influence
of future stochastic vegetation
disturbances (or lack of)



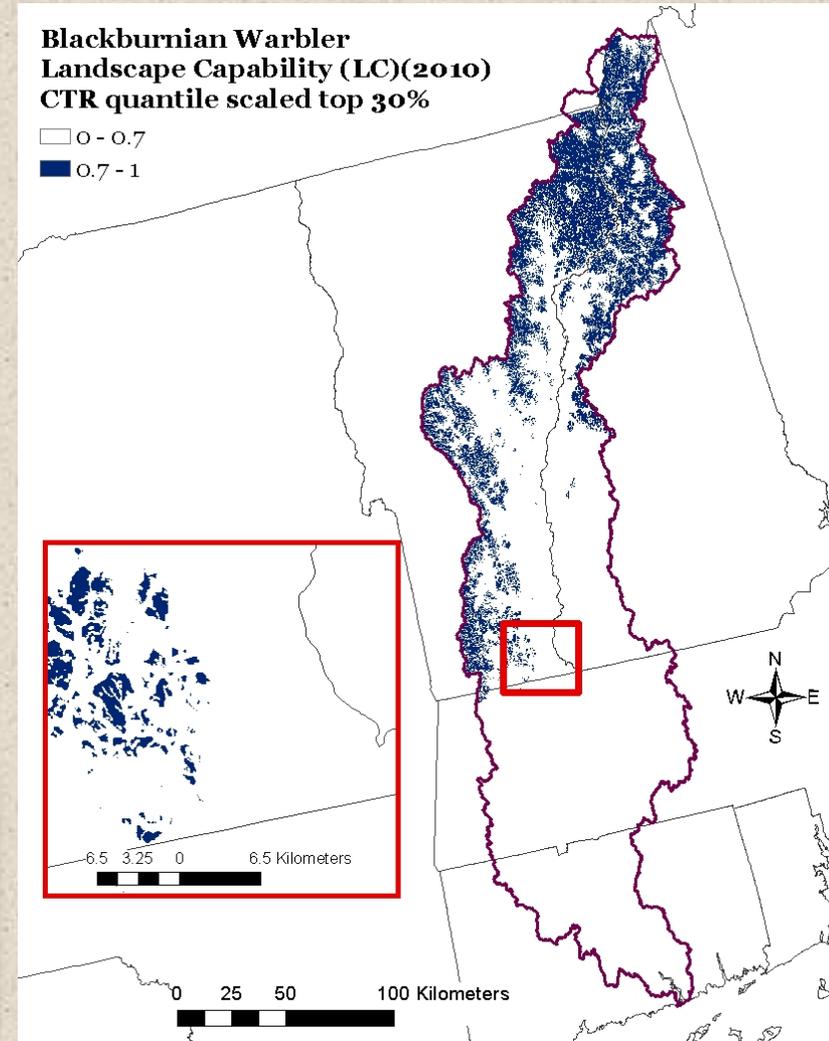
Landscape Change Assessment

Spatial indices

3. Climate vulnerability...
places with high current
HC that are most likely
going to be outside the
future CNE

= within zone of contraction,
(1 - current CN) · current HC · prev

Not subject to the influence
of future stochastic vegetation
disturbances (or lack of)



Landscape Change Assessment

Spatial indices

4. Climate expansion...

places with greatest
likelihood of occurrence
under a range shift
scenario

= within zone of expansion,
Future LC

Subject to the influence of
future stochastic vegetation
disturbances (or lack of)

In progress

Landscape Change Assessment

Spatial indices

5. Habitat persistence...

places with high current
LC that are most likely to
maintain habitat capability
over time

$$= (\text{current LC} + \text{future LC.habitat}^*) / 2$$

* Holds CN constant

Subject to the influence of
future stochastic vegetation
disturbances (or lack of)

In progress

Landscape Change Assessment

Spatial indices

6. Habitat vulnerability...

places with high current LC that are most likely to undergo future habitat loss or degradation

= (current LC – future LC.habitat*)**

· current LC

* Holds CN constant

** Positive deltas only

Subject to the influence of future stochastic vegetation disturbances (or lack of)

In progress

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

UMass Landscape Ecology Lab: Kevin McGarigal, Brad Compton, Ethan Plunkett, Bill DeLuca, Liz Willey and Joanna Grand.

Manager Feedback and Questionnaire

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 ties (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**

- **Personal contact:** mccgarigalk@eco.umass.edu
413-577-0655