Version	Description	Changed By	Date
1.0	First draft	S. Schwenk	7/18/11
	Note: this model was developed jointly with Bill DeLuca		
2.0	Revised draft based on review comments	S. Schwenk	9/19/11
2.1	Representative species background added	S. Schwenk	12/07/11
2.2	Model assessment and climate niche model added	W. DeLuca	7/7/12
2.3	Minor editorial changes for consistency	K. McGarigal	7/18/12

1 Index

2 Background

2.1 Blackpoll Warbler as a Representative Species

Blackpoll Warbler was selected as a representative species at a workshop for the northern New England and New York region of the North Atlantic LCC (NALCC) in May 2011. It was considered to be representative of a cluster of five coniferous ecological systems: Acadian Low-Elevation Spruce-Fir Forest and Flats, Acadian Sub-boreal Spruce Barrens, Acadian-Appalachian Montane Spruce-Fir Forest, Boreal Jack Pine-Black Spruce Forest, and Boreal-Laurential Conifer Acidic Swamp. The other two species selected from this cluster were American (pine) marten and White-throated Sparrow. Other candidate representative species considered at the workshop for this cluster included Bay-breasted Warbler, Bicknell's Thrush, Black-backed Woodpecker, Boreal Chickadee, Boreal Owl, Brown Creeper, Cape May Warbler, Gray Jay, lynx, Northern Saw-whet Owl, Olive-sided Flycatcher, Palm Warbler, Pine Grosbeak, Purple Finch, Spruce Grouse, and Yellow-bellied Flycatcher. Blackpoll Warbler is absent or very rare as a breeder in the southern New England-New York and Mid-Atlantic regions of the NALCC (see Section 2.4) and was not considered as a representative species for those regions.

2.2 Key Resources and Habitat Needs

I. This model is limited to habitat needs during the breeding season (late May to early August). At least some Blackpoll Warblers undertake "mesoscale" movements (e.g., 1 to 16 km) away from their home range prior to migration; habitat usage during this time period appears generally similar to breeding habitat (Mitchell et al. 2010a, b) and we did not model these needs separately. The species is found in a wide variety of habitats during migration, including thickets, woodlands, and forests (Hunt and Eliason 1999). Peak migration occurs during May and September in the region of the North Atlantic LCC (henceforth "North Atlantic"). As in the case of postbreeding habitat, we did not model migration habitat, which we do not expect to be an important limiting factor within the North Atlantic. During the northern hemisphere winter, Blackpoll Warblers reside in South America.

Breeding season (Hunt and Eliason 1999 except where otherwise noted)

a) Diet and foraging locations. Feeds on arthropods. Forages primarily on the inner limbs of conifer trees in mid-levels of the canopy; also forages on deciduous and dead trees (Morse 1979).
b) Breeding (nest) sites. Most nests are built in conifers; in the North Atlantic, most nests have been found in live balsam fir trees (W. DeLuca and K. McFarland, unpublished data).

c) Cover. In the U.S. portion of the North Atlantic, occurs primarily in high elevation spruce-fir forests, with abundance declining in the increasingly mixed forests of lower elevations (Able and Noon 1976, Sabo 1980). It is one of the few birds found in the stunted balsam fir forests that constitute the last forest type below treeline. It does not appear highly sensitive to disturbance, and in fact may prefer disturbed forests except during the earliest stages of succession (Whitaker and Montevecchi 1997, Imbeau et al. 1999, Leonard et al. 2008, Dalley et al. 2009)

d) Spatial requirements. Breeding territories in the U.S. portion of the North Atlantic (White Mountains of NH) range from 0.4 to 0.8 ha. Like most territorial forest songbirds, territories are likely to be embedded within a larger home range if habitat is available; home range size has been estimated to be approximately 1.5 times territory size and movements are affected by landscape characteristics in a radius >1 km around territory centers (Leonard et al. 2008).

2.3 Conceptual Model of Habitat

Key resources and habitat needs are illustrated in **Figure 1**, along with factors that are major determinants of the availability and quality of these resources. Important considerations from the conceptual model include the following:

- Within the North Atlantic, montane spruce-fir forests provide food, nesting locations, and cover. Suitability decreases as the deciduous component of the canopy increases or when conifers are very large and mature.
- Climate, soils, and topography combine to determine the location and affect the suitability of conifer forests. Typically, within montane spruce-fir forests, these factors combine such that habitat suitability increases with increasing elevation
- Disturbance history influences the structure, composition, and extent of forests at specific locations over time and therefore affects habitat quality. Wind and ice are the primary drivers of forest disturbance within North Atlantic montane coniferous forests. Temporary disturbances, including those due harvesting of forests, may enhance habitat suitability once trees advance past the sapling stage. Permanent replacement of forests by mountain-top development would reduce habitat availability.
- Suitability is affected by the availability of sufficient spatial extent of forests to constitute a breeding territory and is also expected to be affected by the extent of forest within the larger landscape in which a territory is embedded.

2.4 Distribution in States of the North Atlantic LCC

State	Distribution	Source
Maine	In 1978-1983 Atlas, evidence for breeding in 53/543 blocks; primarily in higher mountains, also 6 blocks along NE coast	Adamus (1987)
New H.	Abundant in spruce-fir forests above 750 m from White Mts. Northward	Richards (1994)

Vermont	Generally restricted to high elevation boreal forests; found at lower elevations in north where spruce-fir forests occur	Kibbe (1985)
Mass.	In 2007-2011 Atlas, confirmed breeding only on Mt. Greylock; evidence for breeding in 3 other areas, one coastal	On-line Atlas results
Rhode I.	Not known to breed in the state	On-line Atlas results
Conn.	Not known to breed in the state	On-line Atlas results
New York	Primarily above 1,000 m in Adirondacks and Catskills	McFarland and Rimmer (2008)
New Jersey	Not known to breed in the state	Boyle (2011)
Penn.	First confirmed breeding in state in 1994 in a montane spruce swamp; in 2004-2008 Atlas, evidence for breeding in 3 blocks	Gross (1994); on-line Atlas results
Delaware	Not known to breed in the state	On-line Atlas results
Maryland	Not known to breed in the state	On-line Atlas results
Virginia	Not known to breed in the state	On-line Atlas results

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3 Habitat Capability Model

3.1 Summary

The Blackpoll Warbler model involves assessment of three components of local resource availability for breeding: the presence of ecological systems used for breeding (primarily coniferous forests), the conifer composition and structural characteristics of those forests, and availability of the forests within a broader landscape. The quantity and suitability of these resources in the neighbourhood of each focal cell are then evaluated to compute a single value of home range capability. Given home range capability, the number of home ranges expected to be supported by the landscape can be estimated (landscape capability). The structure of the model is summarized in **Fig. 2** and described in more detail in sections 3-5 of this document.

3.2 Local Resource Availability

Local resource capability for Blackpoll Warbler is comprised of three local resource indices, as follows.

LRB1: Ecological System for Breeding – Categorical index; assign weights (0 to 1) to each ecological system.

Input data – Modified Ecological Systems
Mean July Temperature

We consider four ecological systems to be potentially suitable for breeding (**Table 1**). Of these systems, montane spruce-fir-hardwoods (ecological system code 201.566) is the primary system used by Blackpoll Warbler and all occurrences are assigned the maximum weight of 1. Based on findings that Blackpoll Warbler rarely breeds at low elevations in the NALCC region (e.g., Sabo 1980), we consider the other three systems most likely to be suitable when they occur in close geographical proximity to and experience similar climatic regimes to montane spruce-fir forests. We therefore assigned the three systems a weight of 1 where they were likely to co-occur with montane spruce-fir forests and a weight of 0 otherwise. We defined the montane spruce-fir zone to be the area where the historical mean temperature in July has ranged from 13.0 to 17.6 °C. This range is based on findings of Cogbill and White (1991) that the spruce-fir zone in the Appalachians is well-defined by a mean July temperature range of 13 to 17 °C and our analysis that the chosen interval would encompass 95% of montane spruce-fir-hardwood system occurrences in the White Mountain National Forest, NH.

We assigned a weight of 0 to all other ecological systems. Although Blackpoll Warbler may breed in low numbers in other ecological systems, we believe occurrence is too limited to merit assigning breeding value for modeling purposes. We considered including Boreal-Laurentian Bog-Saco Heath (103.581) but determined this system was insufficiently forested to constitute high quality breeding habitat. Northern Appalachian-Acadian Conifer-Hardwood Acidic Swamp (201.574) has some characteristics that reflect Blackpoll Warbler habitat needs (namely occurrence of red spruce and balsam fir) but this system does not appear to be sufficiently coniferous to consistently constitute breeding habitat. Finally, the Nature Conservancy has defined another system that could constitute breeding habitat, Boreal-Laurentian Conifer Acid Swamp (103.724), but this system was not mapped in the Modified Ecological Systems dataset.

Primary uncertainties: Breeding habitat of Blackpoll Warbler appears to be well-characterized by a few ecological systems defined by The Nature Conservancy, particularly montane spruce-fir-hardwoods. Compared to most species, uncertainty about ecological systems associations is low. Occurrence in boreal forested wetlands may not be adequately reflected in the model, however.

LRB2: Coniferous Composition and Forest Structure– Continuous logistic function of an index of forest composition and structure

Input data – Mean July Temperature

Montane spruce-fir forests encompass a broad elevational range (<700 to >1400 m) and the structure and composition of this system varies substantially across the gradient (Cogbill and White 1991). At lower elevations, the system typically is a mixed forest dominated by yellow birch, paper birch, and red spruce. At higher elevations, coniferous composition increases substantially, red spruce is replaced by balsam fir, and trees are increasingly stunted. Habitat quality for Blackpoll Warbler reflects this gradient. Abundance is reported to be greatest and territory size smallest in the dense, highly coniferous forests typical of the higher elevation portion of the gradient, indicating superior habitat quality there (Able and Noon 1976, Sabo 1980). Therefore, this index is intended to reflect the gradient in habitat quality that is associated with forest composition and structure.

The index (**Fig. 3**) is a decreasing logistic function of mean July temperature, which is an indicator of the gradient in forest structure and conifer composition. Mean July temperature is closely related to elevation, but the association varies with latitude; equivalent temperatures occur at higher elevations in more southerly regions. The shape of the function corresponds to the association between July temperature and Blackpoll Warbler abundance along 10 transects in the White Mountains of New Hampshire repeated for two years (Bill DeLuca, unpublished data*)* as well as other, less quantitative analyses (Sabo 1980, Richards 1994). In an analysis of montane spruce-fir system occurrences in White Mountain National Forest, we found that the temperature dataset was much more closely associated with elevation than the imputed biomass dataset provided by the U.S. Forest Service, which is an alternative indicator of forest structure. Note that because we expect that changes in forest structure and composition will change much more slowly than temperature, the index (based on historical average temperature) does not change in future time steps within Habit@. However, effects of climate change on species are considered in a separate component of the NALCC Designing Sustainable Landscapes project (see NALCC_documentation_species).

Primary uncertainties: the functional relationship is based on empirical data and as a general matter should be a reliable indicator of patterns of habitat capability. However, the index does not reflect fine-scale heterogeneity in forest structure and composition that influences habitat capability at a local scale. Reliable measures of forest structure and composition at a fine scale (e.g., 30 m resolution) are not currently available on a region-wide basis.

LRB3: Quantity of Breeding Habitat within the Landscape – Increasing logistic function of the quantity of forests that are suitable for breeding within the landscape (1 km radius).

Input data – Modified Ecological Systems

This index (**Fig. 4**) is intended reflect increasing suitability of habitat as the quantity of forest in the landscape surrounding a home range increases. Numerous temperate and boreal forest songbirds are known to regularly use forest that surrounds the relatively small territory that they actively defend (Whitaker and Warkentin 2010). In the case of Blackpoll Warbler, Taylor and Krawchuk (2005) reported a positive association between occurrence of this species and proportion of woodland (not including clearcuts) within 150 m but a unimodal association at a 1.25 km scale (i.e., peak occurrence at intermediate proportions of woodland). Leonard et al. (2008) also reported that space use and movements by Blackpoll Warblers are influenced by landscape characteristics at a 1.25 km scale. Note that both of these Blackpoll Warbler studies were conducted in a naturally patchy area of

Newfoundland that included numerous bogs and ponds. Based on these studies, we expect that landscapes with small, isolated patches of breeding habitat are likely to be less suitable than landscapes with more extensive breeding habitat, but that the landscape need not consist entirely of spruce-fir forests for a home range to be of high suitability.

The model proceeded in two steps. In the first step, the quantity of breeding habitat (as identified by LRB1) within 1 km of focal cells was calculated, with decreasing weight applied to more distant habitat. We refer to the result of this step as the "intensity" of breeding habitat. We used a 1 km radius rather than the 1.25 distance used in Newfoundland because we expect territories and movement distances to be smaller in the North Atlantic. In the second step, we applied an increasing logistic function to intensity (**Fig. 4**). When this function was applied, maximum suitability of 1 was approached once the intensity of breeding habitat in the surrounding landscape approached approximately 0.5.

Primary uncertainties: although we believe the general relationship we applied is supported by ecological theory, findings from other songbird species, and a study of Blackpoll Warbler in Newfoundland, we are not aware of any studies in the U.S. portion of the North Atlantic that have examined relationship between forest availability and occurrence or suitability of habitat. The greatest uncertainty likely is whether suitability of small and isolated habitat patches is adequately characterized.

Calculation of LRA

LRA is computed as the product of LRB1, LRB2, and LRB3, which results in all cells receiving a value between 0 and 1. Because ecological systems that are not suitable for breeding are assigned a value of 0 by LRB1, their LRA value likewise equals 0. For the four ecological systems potentially suitable for breeding, the product of LRB2 and LRB3 act to reduce the value of LRB1 (which equals 1).

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4 Home Range Capability

Home range capability for the breeding season is comprised of a single index, as follows:

HRC: For each focal cell with LRA>0, build a resistant kernel scaled to breeding territory size, with resistance weights (costs) for land cover types based on expected tolerance of Blackpoll Warbler for the land cover type within its home range.

Input data – Modified Ecological Systems and LRA

Based on reported territory sizes of 0.4 to 0.8 ha in the White Mountains of New Hampshire (Hunt and Eliason 1999), we used 0.8 ha as the breeding territory scale. Developed land types, ponds, and lakes were considered absolute home range barriers. All other ecological systems were assigned the lowest possible resistance. Given the size of territories, however, even small patches of ecological systems that are non-habitat constitute barriers for home ranges as assessed by HRC.

Primary uncertainties: uncertainty specific to this metric is considered low relative to other indices.

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5 Results

5.1 Location of Ecological Systems Suitable for Breeding

Figure 5 depicts the location of ecological systems classified as potentially suitable for breeding by Blackpoll Warbler based on current conditions (time step = year 0 = approx. 2000), as well as other major land cover categories such as developed land. Montane spruce-fir-hardwoods forests, the most suitable ecological system for breeding, are confined to the high peaks of the Adirondacks of New York, Green Mountains of Vermont, White Mountains of New Hampshire and Maine, and other Maine mountains. (The Catskills of New York, which also contain this ecological system, are outside of the North Atlantic LCC area.) Note that much of the spruce flat, high conifer variant of northern hardwoods, and low elevation spruce-fir forests mapped in this figure are not classified as suitable after complete application of LRB1.

5.2 Examples of Model Results

We illustrate the results of application of the model to the Kennebec Watershed in Maine. **Figure 6** depicts an ecological system map of the entire watershed and an inset approximately 25 km by 20 km that includes Sugarloaf, Crocker, and Saddleback Mountains and Mt. Abraham. These peaks are among the highest in Maine after Mt. Katahdin. **Figure 7** depicts model results for the inset region. Given the small territory size, results for LRA and HRC are very similar, with HRC resulting in slight reductions in suitability along edges of breeding habitat. Final results (HRC) area also presented for a portion of the inset using a three-dimensional projection in **Figure 8**. Finally, HRC results for the entire Kennebec Watershed are depicted in **Figure 9**.

The model predicts that breeding habitat within the Kennebec Watershed is confined to the high elevation peaks of the north. In addition to the region illustrated in the inset of **Figure 6**, areas of highest predicted suitability include Bigelow, White Cap, Kibby, Coburn, Lily Bay, Baker, and Little Spruce Mountains.

For detailed spatial results of the current time step see on the project website:

Kennebec River watershed:
- Kenbec_species_2010.zip

Middle Connecticut River watershed:
- Conn_species_2010.zip

Pocomoke-Nanticoke River watershed:
- Pocnan_species_2010.zip

For detailed spatial results for 2030 and 2080 see:

Kennebec River watershed:
- Kenbec_species_2030.zip
- Kenbec_species_2080.zip

Middle Connecticut River watershed:
- Conn_species_2030.zip
- Conn_species_2080.zip

Pocomoke-Nanticoke River watershed:
- Pocnan_species_2030.zip
- Pocnan_species_2080.zip

For non-spatial results summarized in tables and graphs see:

Kennebec River watershed:
- Kenbec_tables.zip

Middle Connecticut River watershed:
- Conn_tables.zip

Pocomoke-Nanticoke River watershed:
- Pocnan_tables.zip

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6 Model Assessment

Because montane spruce-fir forests were not adequately sampled in eBird, we supplemented eBird with data from Mountain Birdwatch collected from 2000 to 2010. Mountain Birdwatch is a montane bird monitoring program throughout the Northeast run by the Vermont Center for Ecostudies. eBird data had one presence and 58 absences while MBW had 62 presences and eight absences. Aside from data supplementation, assessment methods followed those described in the species documentation. The Blackpoll Habit@ model associates higher habitat capability with locations of known Blackpoll presences compared to locations where Blackpolls were not detected (**Figs. 10** and **11**). See species documentation for a detailed description of this process http://jamba.provost.ads.umass.edu/web/lcc/NALCC_documentation_species.pdf

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7 Climate Niche Envelope Model

7.1 Model Building

A detailed description of the methods used to define the climate niche envelope (CNE) model can be found here NALCC_documentation_species.pdf. Briefly, we used logistic regression to build species' CNE models from downscaled climate data and independent species' occurrence data from eBird for the period 1985-2010 and Mountain Birdwatch from 200 - 2010. All possible combinations of predictor variables were considered and the final model was selected between models that minimized false positive rates at model sensitivities of 95%, 97.5%, and 99%. The distribution of the CNE for each sensitivity level was compared to Blackpoll Warbler's geographic distribution and the sensitivity level that best approximated its range, was selected.

Detailed results of the climate niche envelop model for Blackpoll Warbler can be found at the locations outlined in Section 5.2 of this document. The logistic regression model that was ultimately selected had a delta false positive value of 0.00 and a total false positive error rate of 0.01 with model sensitivity at 95%, $D^2 = 0.83$. The cutpoint that minimized the false positive rate was 0.293. The model selected with a specified sensitivity of 95% best approximated the species current geographic distribution compared to models that minimized false positive rates with model sensitivities at 97.5% or 99%. See **Table 2** for climate variables and parameter estimates that were included in the final model. The Monte Carlo randomization tests confirmed that the observed false positive rate was significantly different from that under the null distribution (**Fig. 12**).

7.2 Model Validation

The Monte Carlo randomization tests confirmed that the observed false positive rate was significantly different from that under the null distribution (**Fig. 14**). Therefore, we conclude that the Blackpoll Warbler CNE model is a relatively accurate representation of the spatial distribution of suitable climate conditions for Blackpoll Warbler throughout its range in the Humid Temperate Domain.

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9 Appendix A – Tables and Figures

Table 1. Ecological systems considered to be potential breeding habitat. Systems 201.562, 201.564, and 201.566 were assigned a weight of 1 when they occurred in the montane spruce-fir zone and a weight of 0 otherwise. All other systems were assigned a weight of 0.

Ecological System Code	Ecological System
201.562	Acadian Sub-boreal Spruce Flat
201.564	Laurentian-Acadian Northern Hardwood Forest (high conifer variant)
201.565	Acadian Low Elevation Spruce-Fir-Hardwood Forest
201.566	Acadian-Appalachian Montane Spruce-Fir-Hardwood Forest

Table 2. Parameter estimates for variables included in the final logistic regression model for Blackpoll Warbler's climate niche envelop model. Blackpoll Warbler presence/absence data were obtained from eBird and Mountain Birdwatch. The selected model minimized the false positive rate with a model sensitivity at 95% and best approximated Blackpoll's geographic distribution.

Variable	Estimate
β	-3.269e+00
GDD	-1.333e-02
May-Sept precip.^{2}	-3.189e-08*
Avg. annual precip.	1.414e-03*

*$P \leq 0.05$

Figure 1. Conceptual model of Blackpoll Warbler habitat requirements.

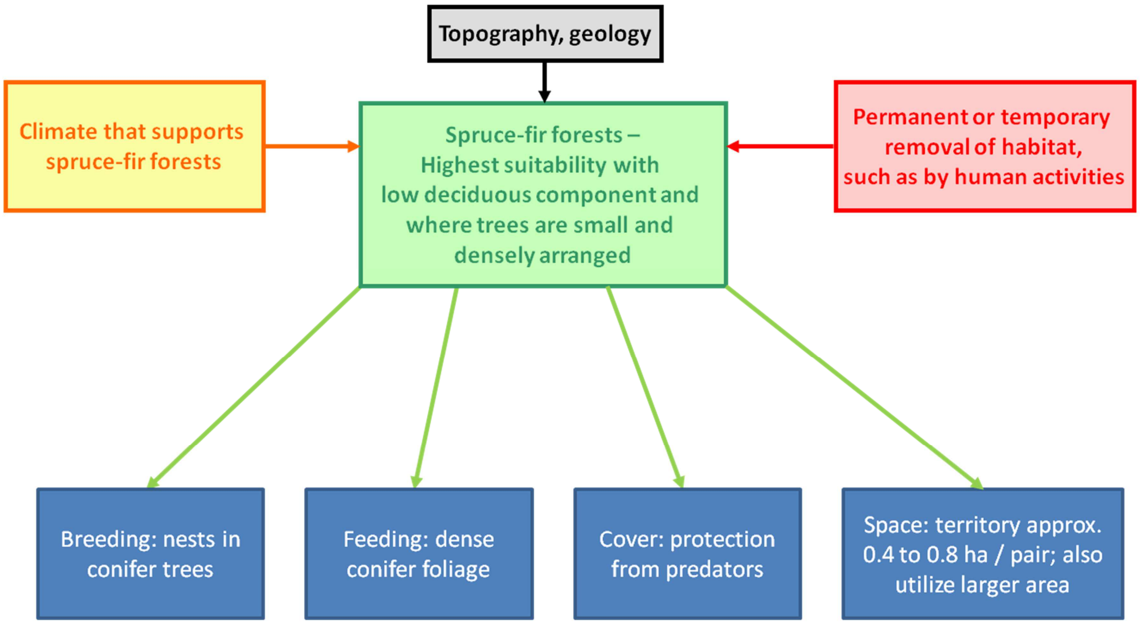


Figure 2. Summary of the steps in computing overall Blackpoll Warbler home range capability (HRC) and landscape capability (LC).

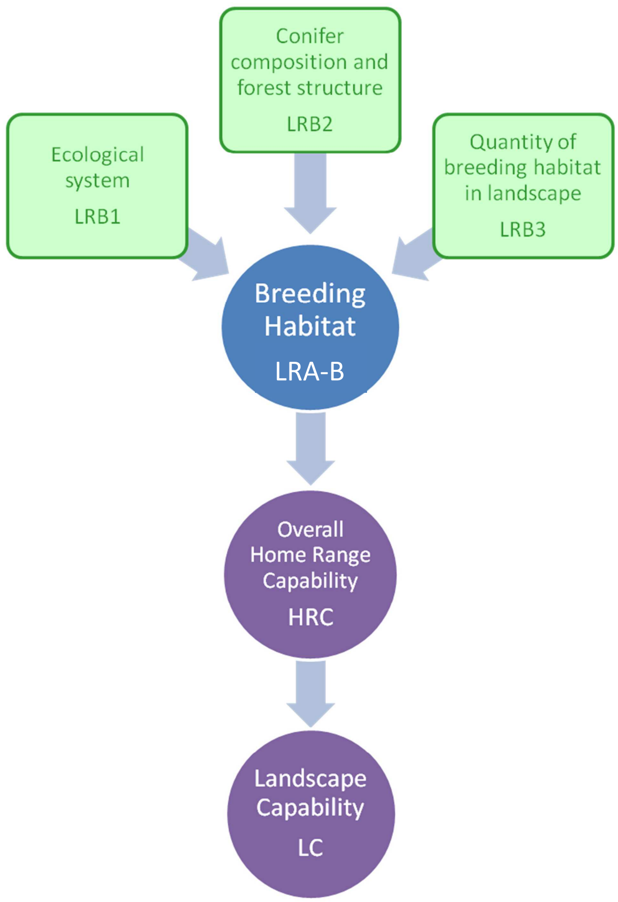


Figure 3. Suitability of Blackpoll Warbler habitat as a function of mean July temperature, and indicator of conifer composition and forest structure. For reference, an axis is included that indicates the elevations that equate to these temperatures in the White Mountains of New Hampshire.

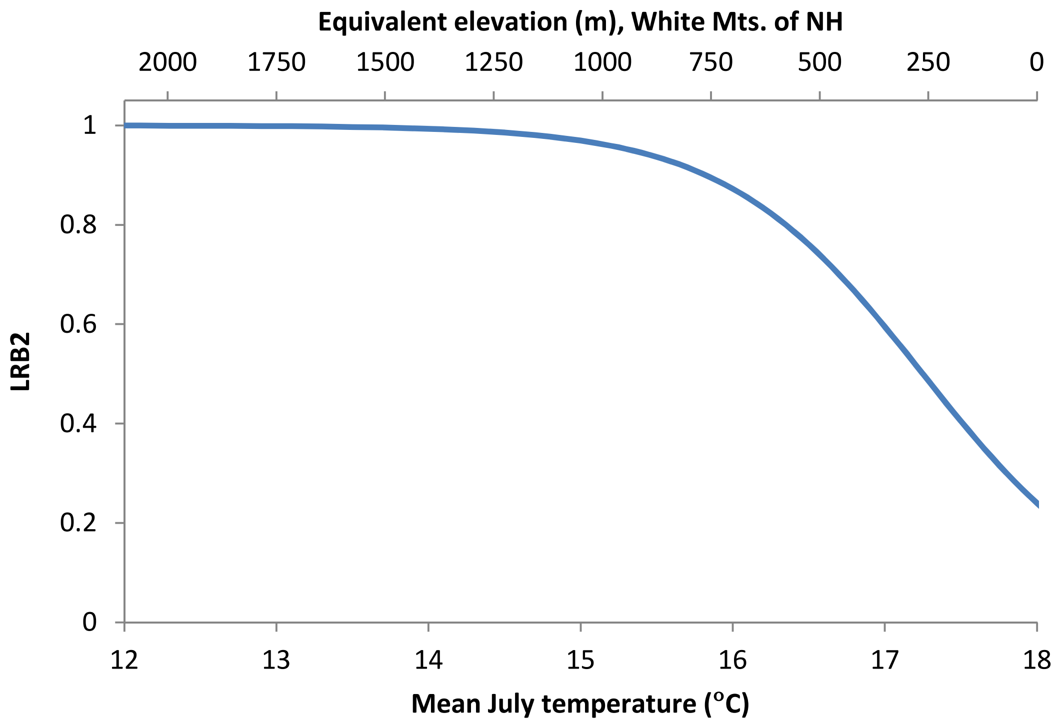


Figure 4. Suitability of local Blackpoll Warbler habitat as a function of the (distance-weighed) availability of forests suitable for breeding within 1 km.

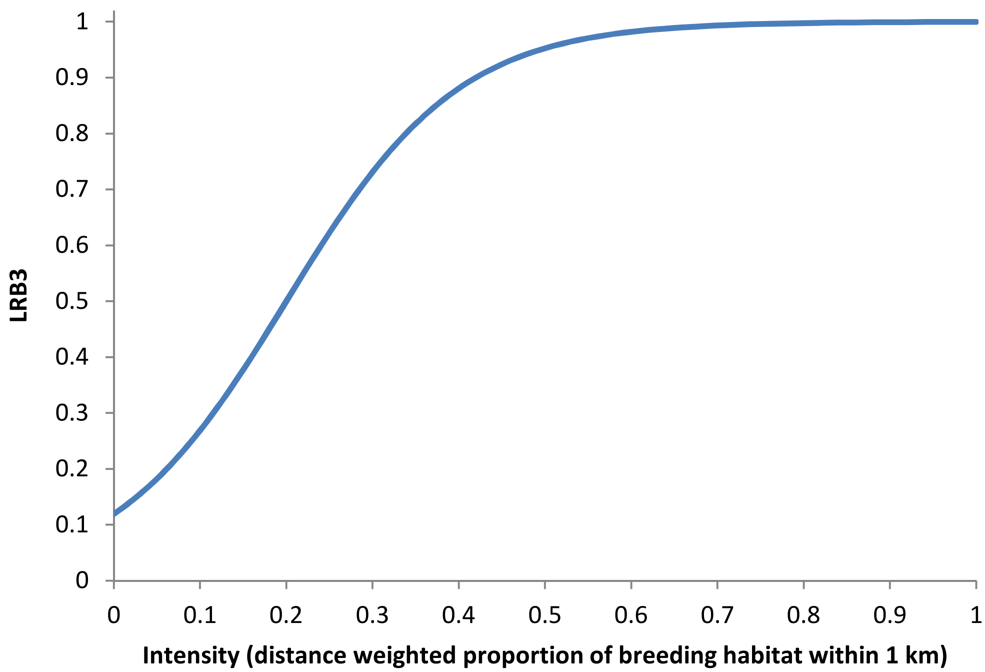


Figure 5. Patterns of occurrence of ecological systems in the North Atlantic LCC identified as potentially suitable for breeding by Blackpoll Warbler; water, developed land, and agriculture are also illustrated.

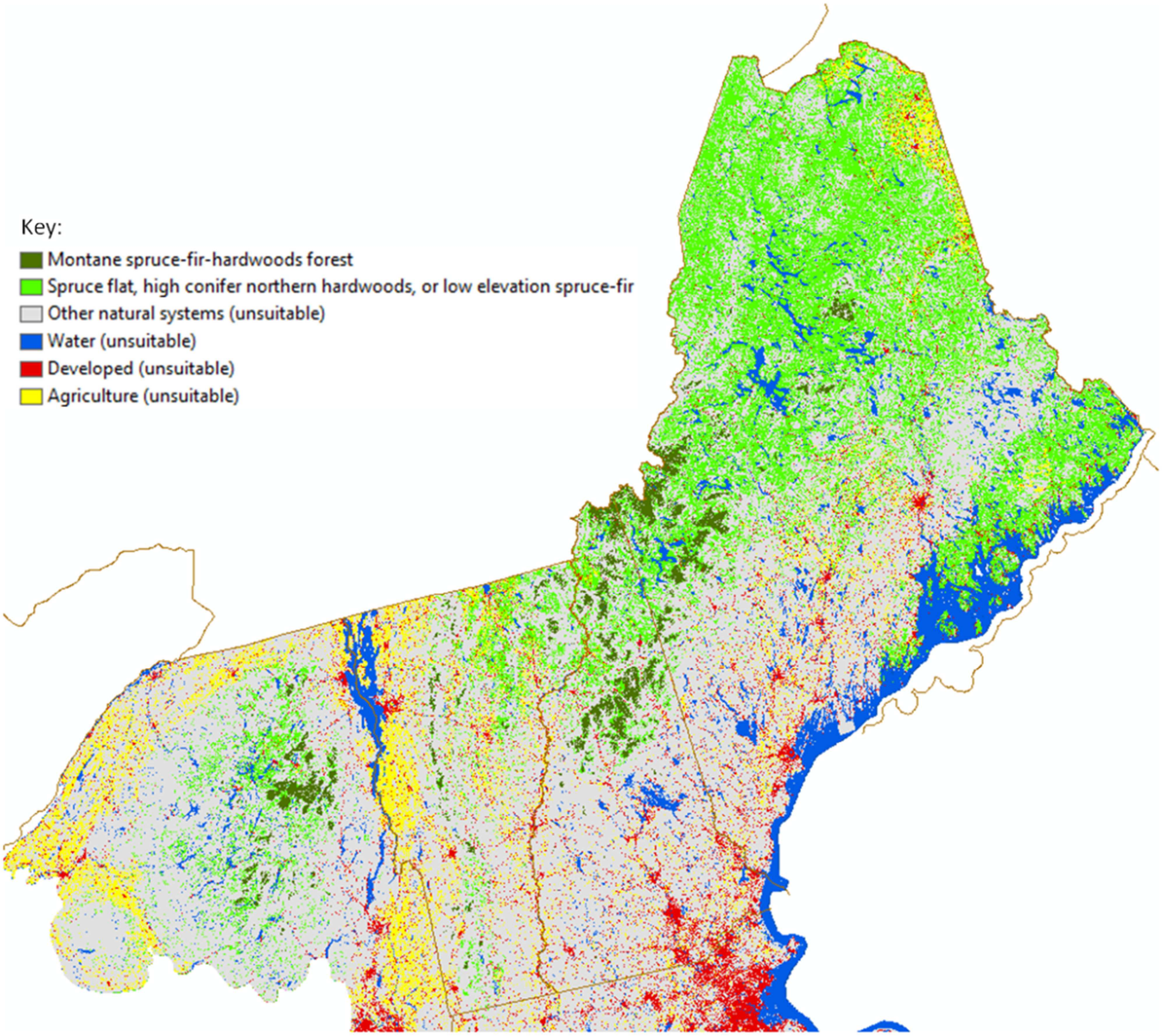


Figure 7. Examples of model results for an area in the Kennebec River watershed, with resource values increasing from yellows to greens to darkest blue: a) LRB1 (ecological systems suitable for breeding, b) LRB2 (coniferous composition and forest structure), c) LRB3 (quantity of breeding habitat in landscape), d) LRC (combined breeding local resources) , e) HRC (home range capability, breeding) with suitability key.

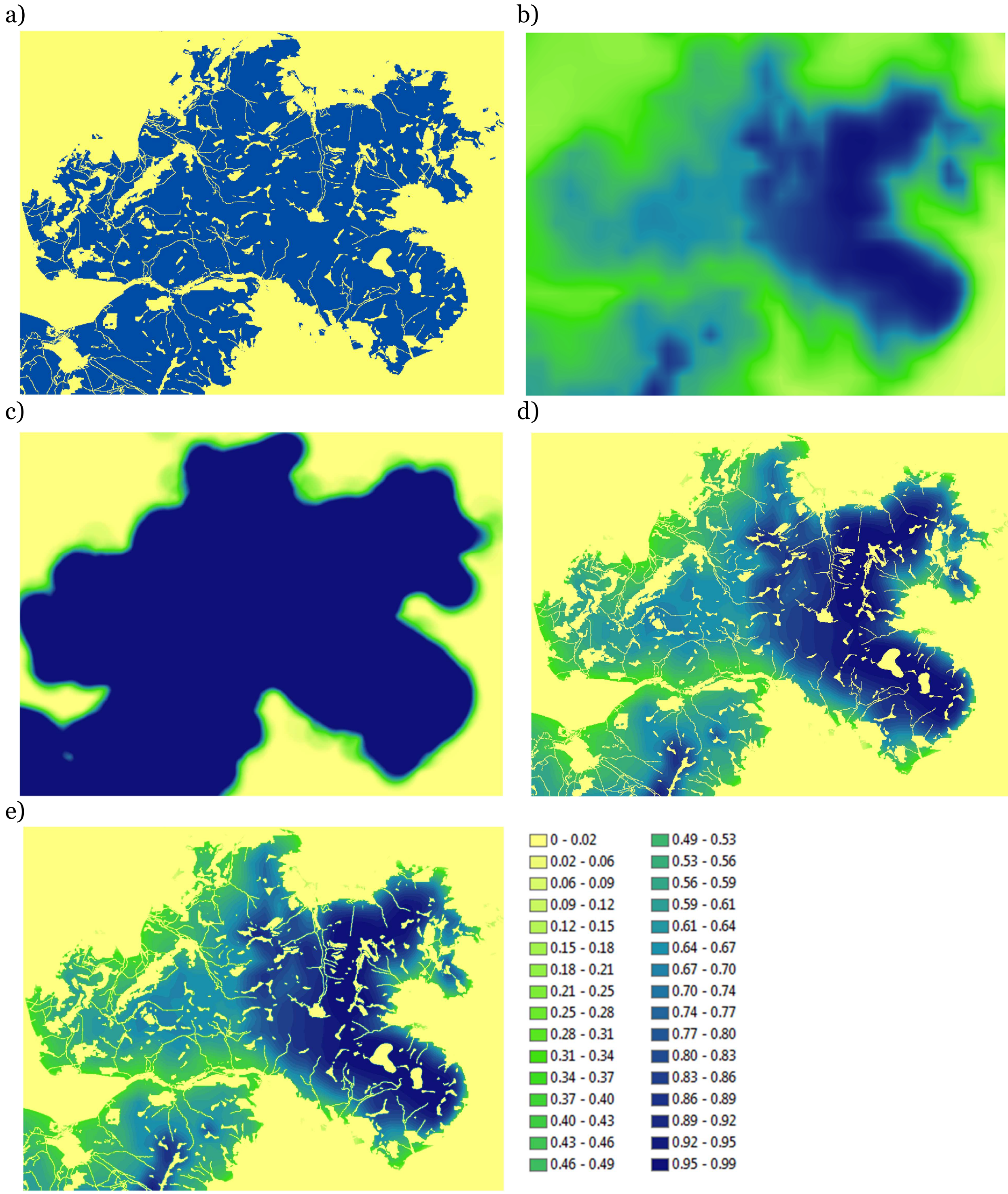


Figure 8. Example of home range capability (HRC) projected on image of Crocker Mt. and adjacent peaks in the Kennebec watershed of Maine. Suitability corresponds to that of Figure 7(e).

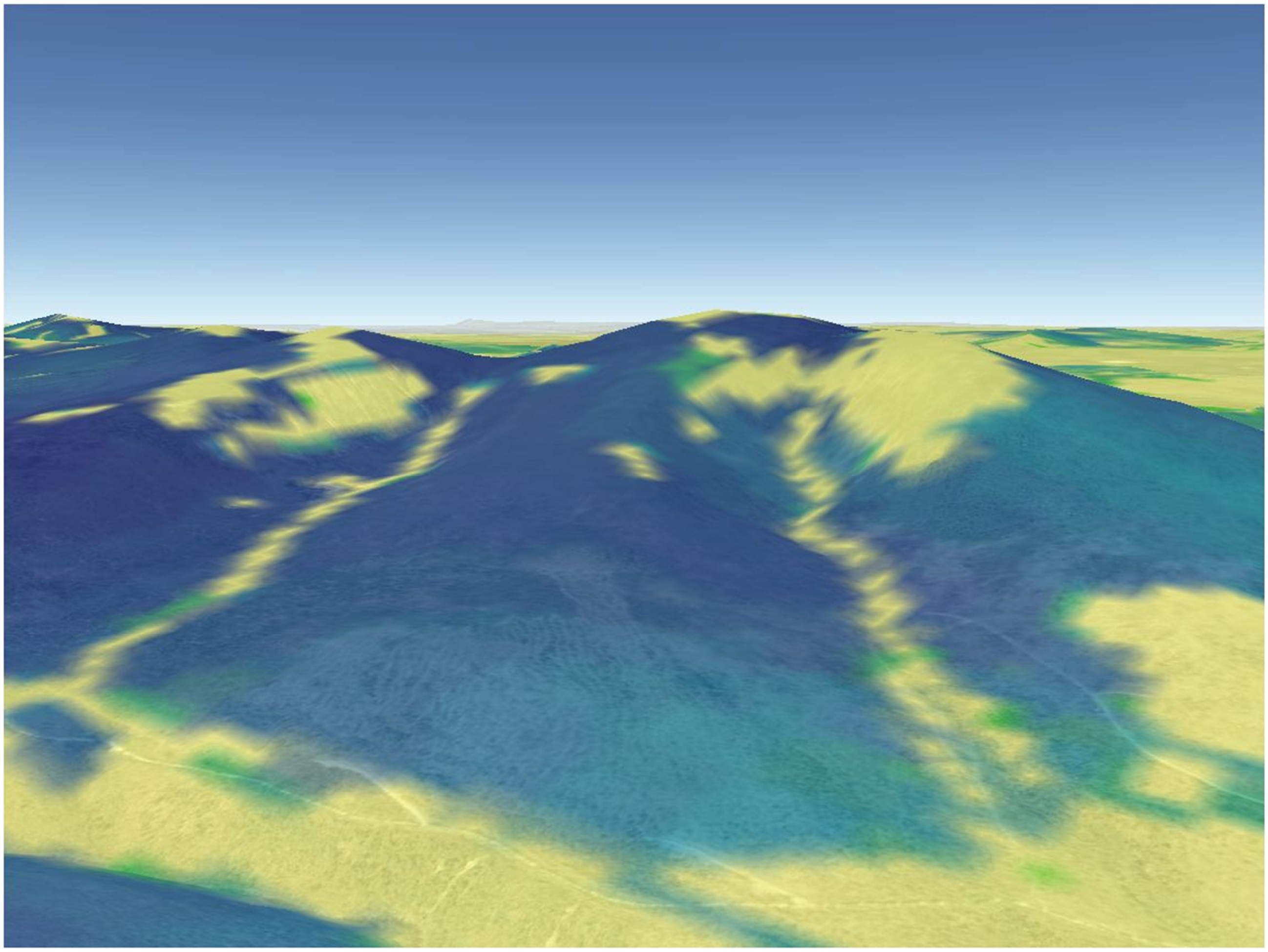


Figure 9. Blackpoll Warbler home range capability (HRC) in the entire Kennebec watershed (plus 10 km buffer) of Maine in 2010. Suitability corresponds to that of Figure 7(e).

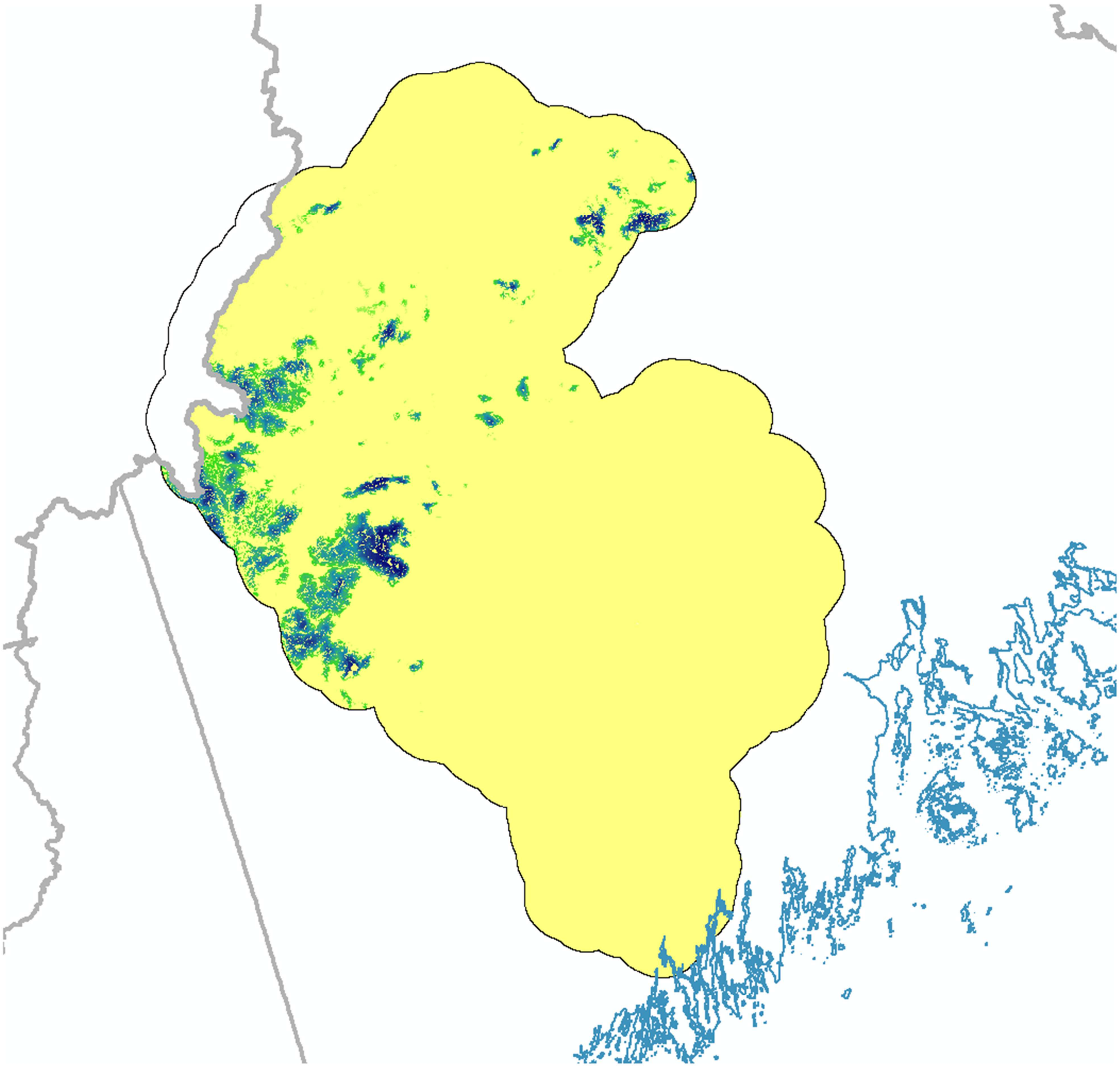


Figure 10. Statistical assessment of HABIT@ model performance for Blackpoll Warbler in the Kennebec River study areas. Solid lines are kernel density estimates of the maximum Home Range Capability (HRC) index within 100, 200, 400, and 800 m of the survey location for sites where Blackpolls were present (green, n=63) and absent (red, n=68). Dashed lines are the mean of the maximum HRC values and solid black lines are the 95% confidence intervals on the mean. A *p*-value is reported for the model with the greatest Kappa and is based on a Monte Carlo randomization test (Figure 11); delta Kappa's (difference between observed Kappa and the Maximum Kappa) are reported for the other three scales. Kappa values are based on logistic regression models that also contain two detection covariates (Julian date, time of day) to account for detection probabilities and an offset term (survey hours) to account for varying survey effort. Presence and assumed absence data are from eBird and Mountain Birdwatch.

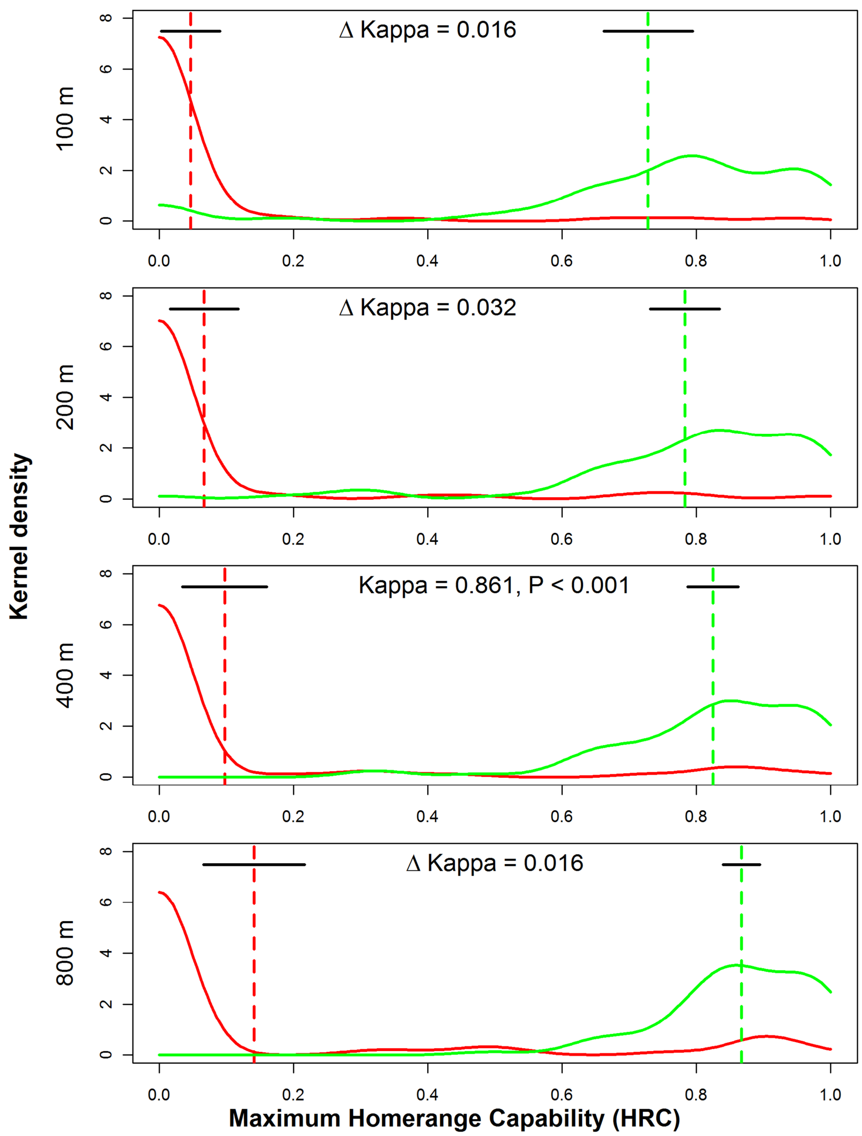


Figure 11. Monte Carlo randomization test (1,000 replications) of the observed Kappa for the logistic regression model predicting species' presence from Habit@-derived maximum HRC values at a spatial extent that maximized Kappa (400 m); shown here Blackpoll Warbler. The null distribution of Kappa is given by the frequency distribution, while the observed Kappa (0.86) is shown as a vertical dashed line. The *p*-value (0.001) is computed as the proportion of the null distribution greater than or equal to the observed Kappa.

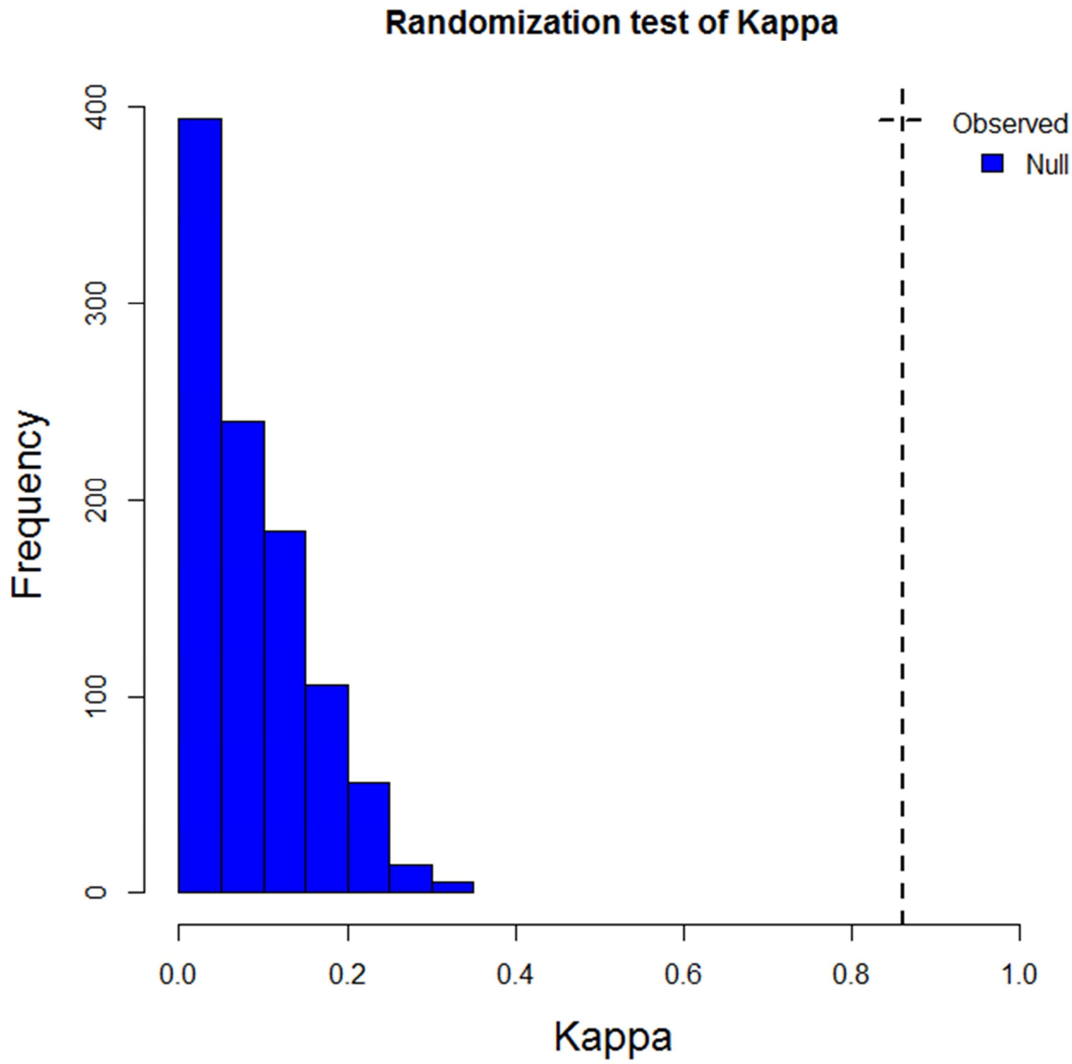
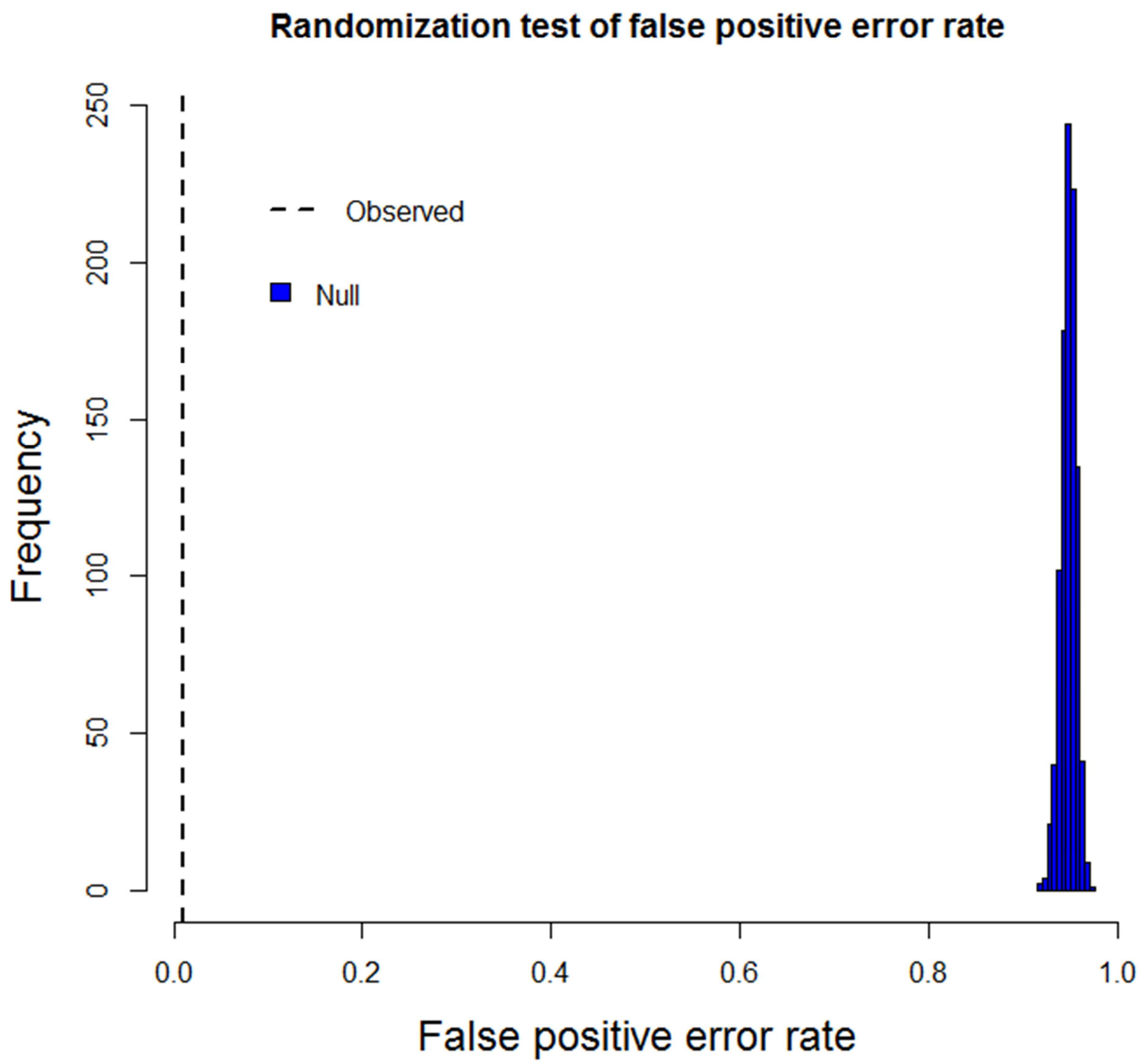


Figure 12. Monte Carlo randomization test (1,000 replications) of the observed false positive rate for the logistic regression model predicting Blackpoll Warbler presence from climate variables. The null distribution of the false positive rate is given by the frequency distribution, while the observed false positive rate (0.01) is shown as a vertical dashed line. The *p*-value (0.01) is computed as the proportion of the null distribution greater than or equal to the observed false positive rate.



10 Appendix B – File Names and Brief Descriptions

Parameter files:
X:\LCC\Parameters\habitat

Parameter files include:

- habit@.par - used by Anthill (cluster software) to run Habit@
- blpw.txt - contains the specific Habit@ functions
- forests_566.txt - classifies montane spruce-fir-hardwoods forests as 1, everything else as 0
- forests_other.txt - Used in lrb1; classifies 562, 5642, 5650 as 1 (oth. conif. systems), everything else as 0
- blpwmask.txt - creates a mask of suitable habitats used in obtaining HRC
- blpw_cost.txt - defines ecological resistance for the ES map used in obtaining HRC
- blpw_hr.txt - defines homeranges for running resistance kernels

Resulting grids created by Habit@ are located here:
X:\LCC\GISdata\DataFinal\species

Grids include (See blpw.txt for interpretation):

- lrb1
- lrb1a
- lrb1b
- lrb1c
- lrb1d
- lrb2
- lrb3
- lrb3a
- lrc
- july_temp
- hrc

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