Modeling to inform conservation of Cerulean Warblers

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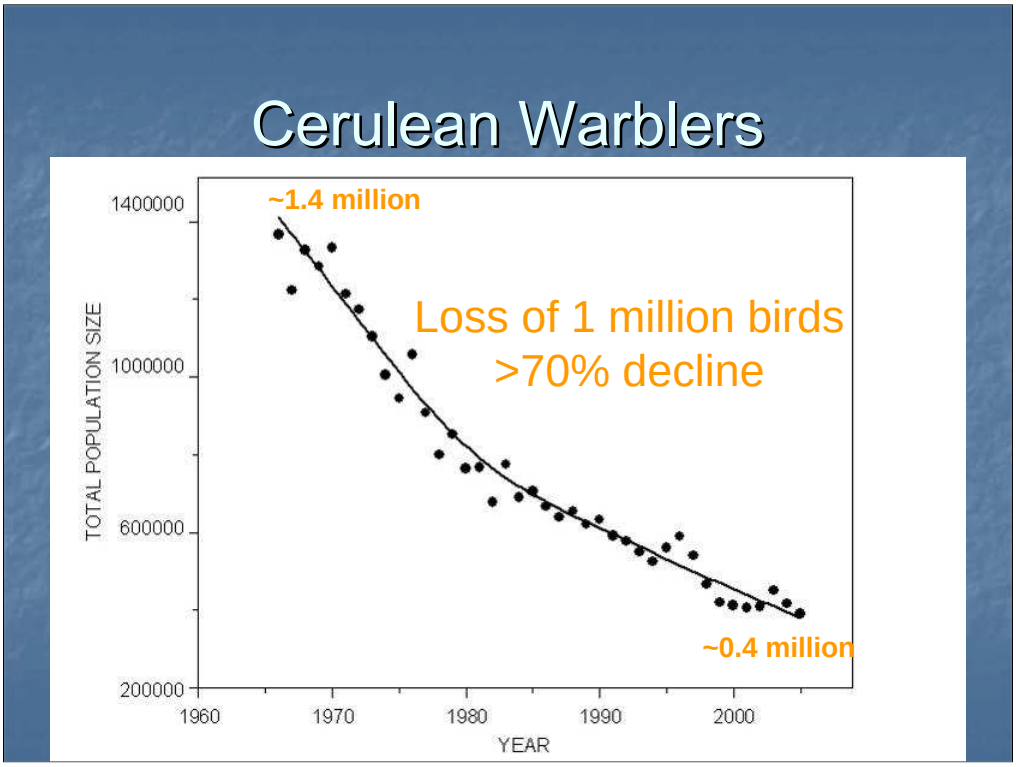
Cerulean Warblers

- Declined 4.3%/yr between 1966 and 2005 (Sauer et al. 2005)

- Considered for listing under Endangered Species Act



Combining the annual indices produced by John Sauer using a hierarchical count model with the continental estimate of abundance circa 1995, we can reconstruct a time series of population size. This time series suggests a loss of 1 million birds, or ~70% of the population, in the last 40 yrs.

Modeling

- Models simplify a complex world
- Simplification introduces error
- “All models are wrong, but some are useful”
  George Box

- Our objective: Present useful models for CERW
- Review of current efforts to understand patterns and processes organizing CERW abundance

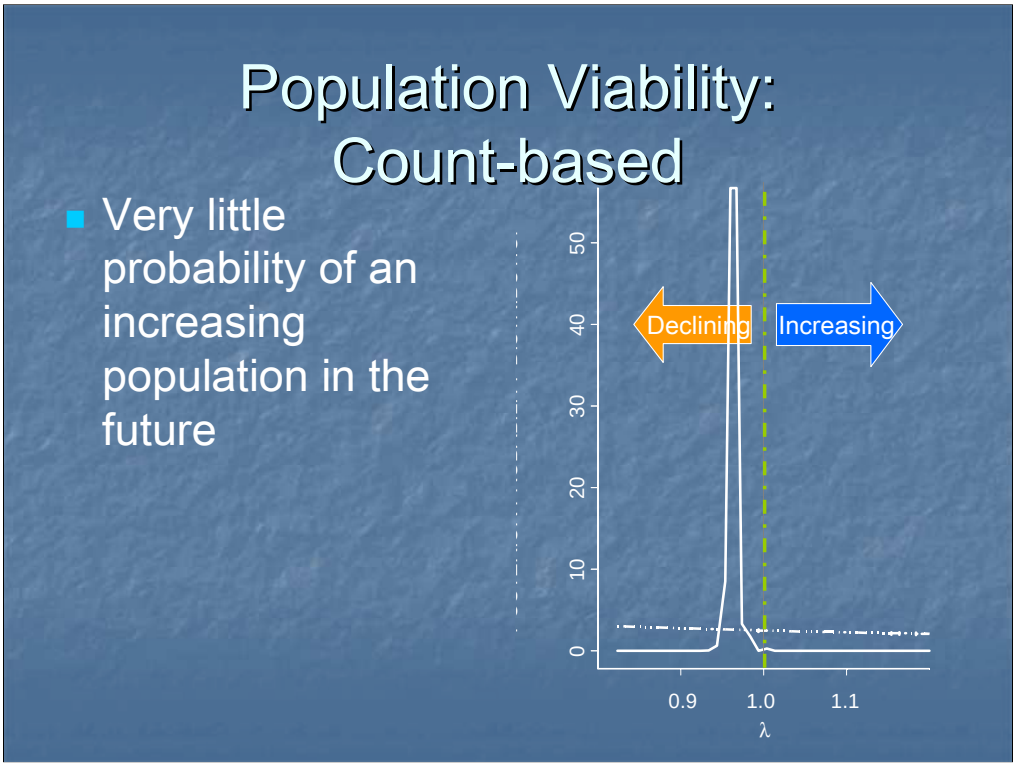
We can not describe all efforts currently on-going, nor can we describe any of the examples we do provide in any great detail.

Model Types

- Population Viability
- Patterns in Occurrence and Abundance

Population Viability: Count-based

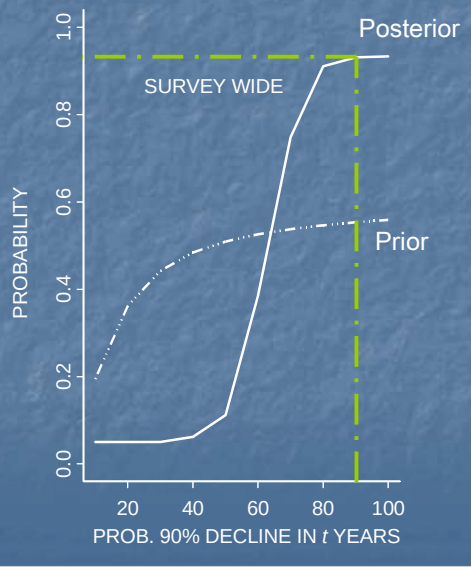
- Thogmartin, Cochrane, Sauer, Dettmers, and Woods
- Bayesian implementation of a Diffusion Approximation approach
- Breeding Bird Survey data (1966–2005)
- Predict Probabilities of and Time to Extinction



The mass of the posterior probability of the predicted lambdas lies to the left of the lambda = 1 line, indicating that there is very little probability associated with an increasing population in the future (IF current conditions persist).

Population Viability: Count-based

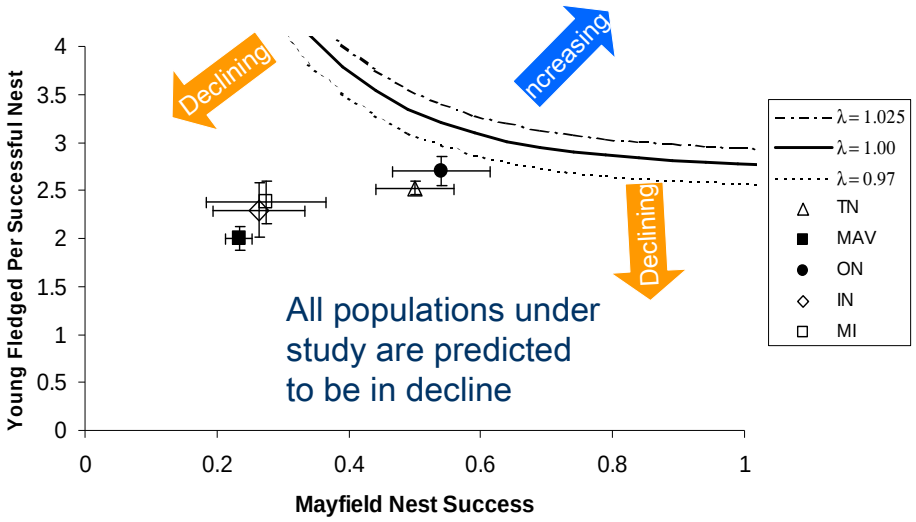
- >90% probability of a 90% decline within 100 years

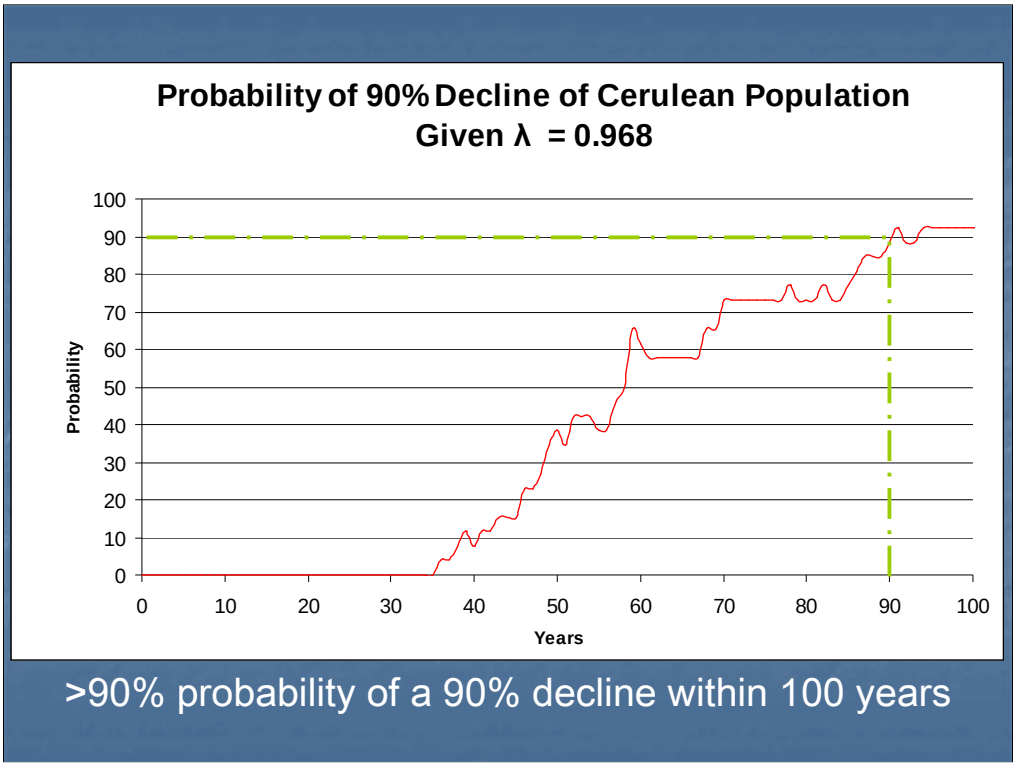


Population Viability: Demographic-based

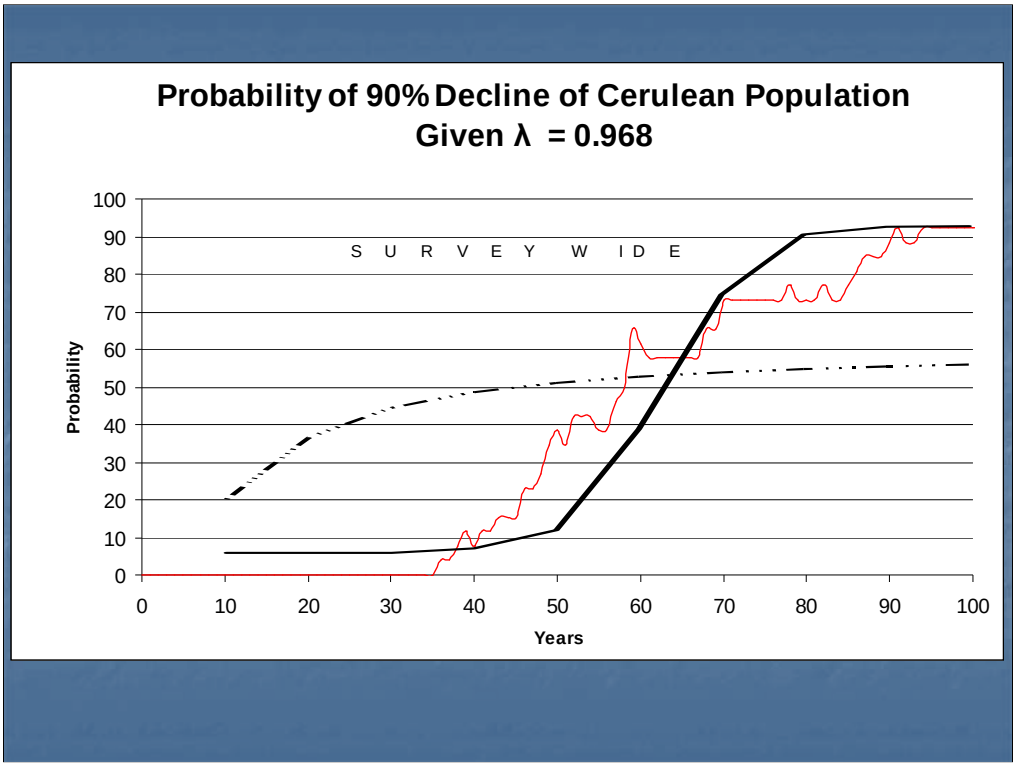
- Giocomo and Buehler
- Accounting-based Methods
- Demographic estimates from review of existing studies
- Predict Probabilities of and Time to Extinction
- Identify Demographic Associations to Extinction Risk

Demographic Analyses to Predict λ





>90% probability of a 90% decline within 100 years

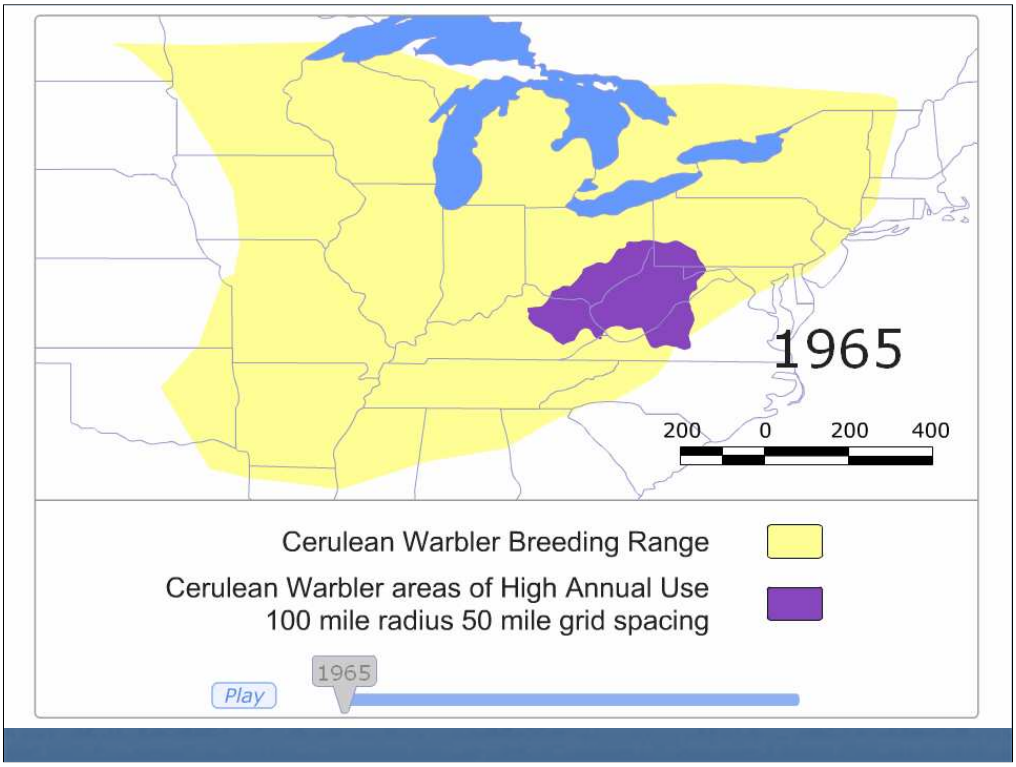


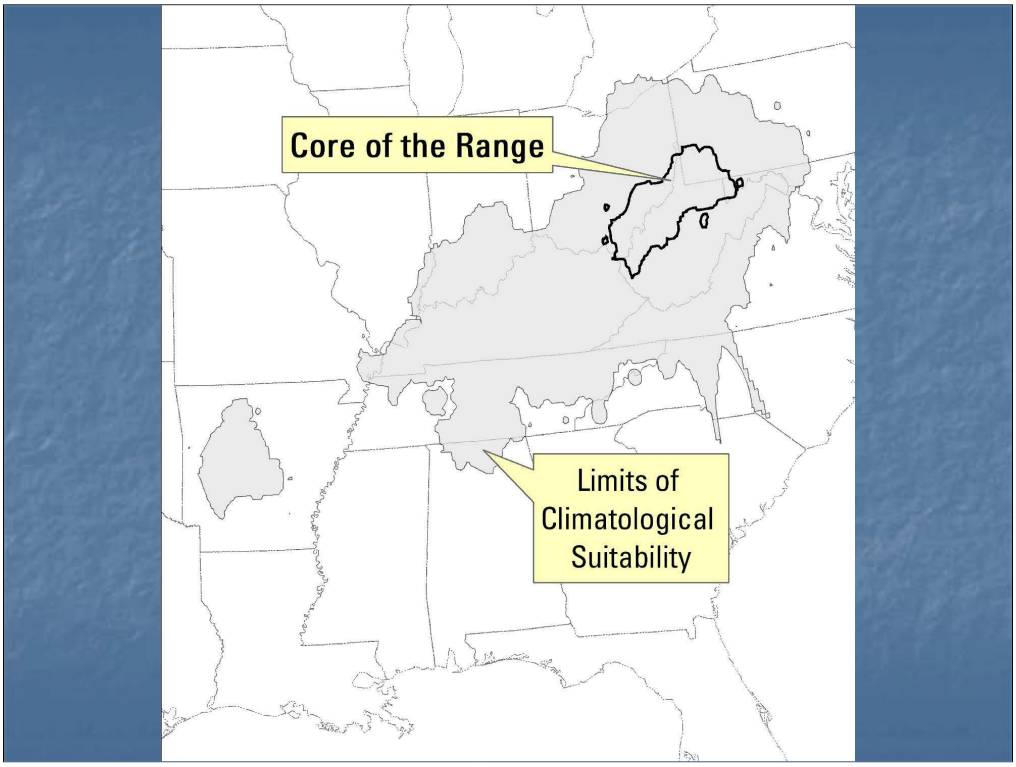
Overlay of the two approaches appears to suggest a similar result.

Patterns in Occurrence & Abundance: Climate

- Baldy, Ozdenerol, and Hamel
- Spatial filtering approach
- Breeding Bird Survey data (1966–2003)
- Identify ideal climate

- Animated annual patterns in the concentrated occurrences


1965
200 0 200 400
Cerulean Warbler Breeding Range
Cerulean Warbler areas of High Annual Use
100 mile radius 50 mile grid spacing
1965
Play


Core of the Range
Limits of Climatological Suitability

Patterns in Occurrence & Abundance: Regional

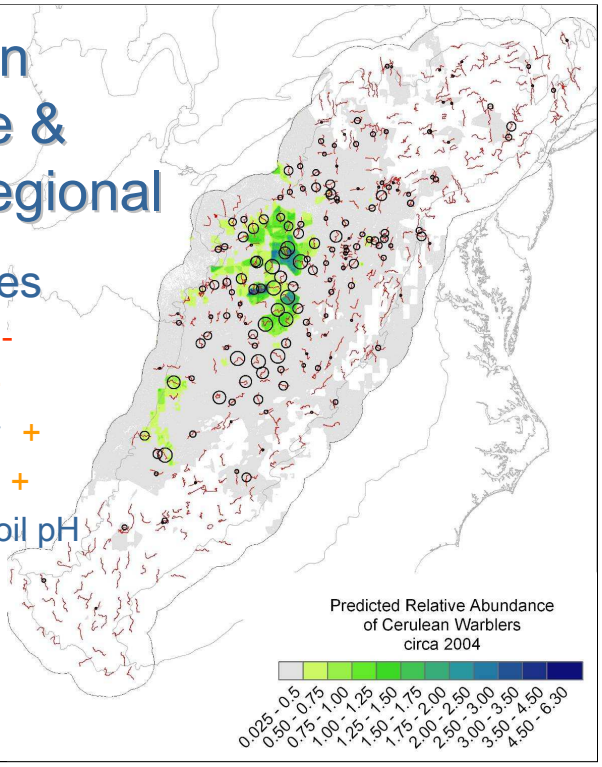
- Thogmartin, Sauer, & Knutson
- Hierarchical, spatial count model
- Breeding Bird Survey data (1981–2005)

- Identify landscape conditions in the core of the species range

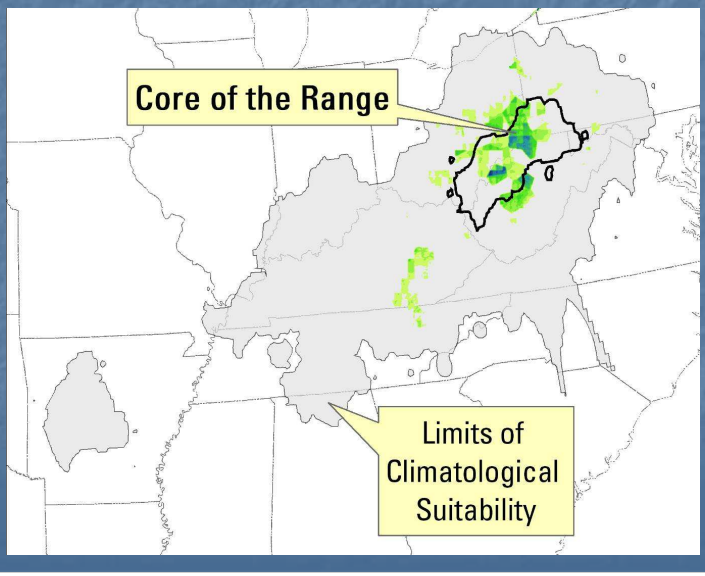
Patterns in Occurrence & Abundance: Regional

- Important variables
  - Mean **precipitation** -
  - **Forest** patch size +
  - **Forest** edge density +
  - **Forest** composition +
  - Acid deposition × Soil pH

Higher abundance in areas in which acid deposition is **buffered by basic soils**

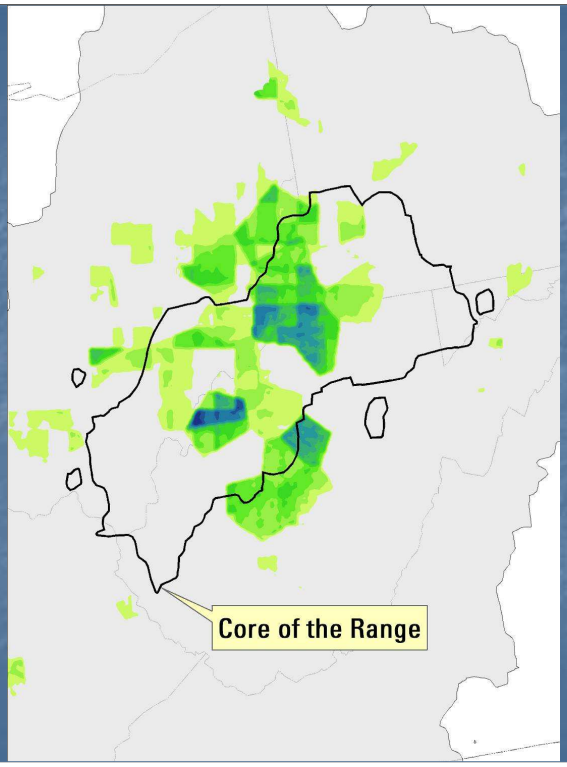


Intersection of Climate and Land Cover



Strong concordance in predictions of occurrence between model types

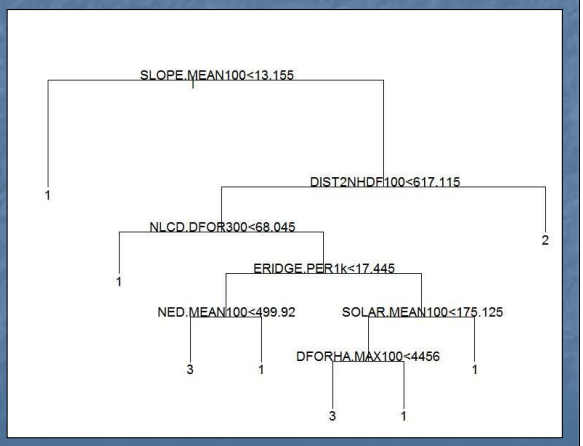
One connection is coincidence of precipitation in both models



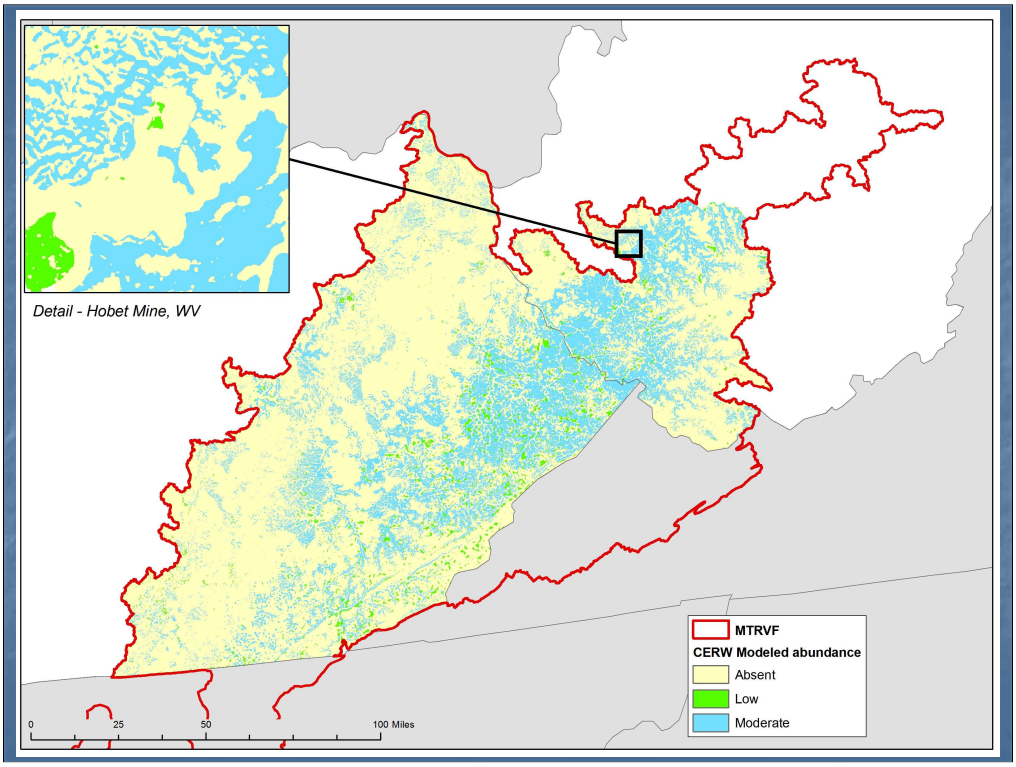
Finer-scaled Models of Habitat I

- Wood et al.
- Classification and regression trees

- Important variables
  - Slope
  - Dist. to forest stream
  - Deciduous forest
  - Upper slopes / ridges
  - Elevation



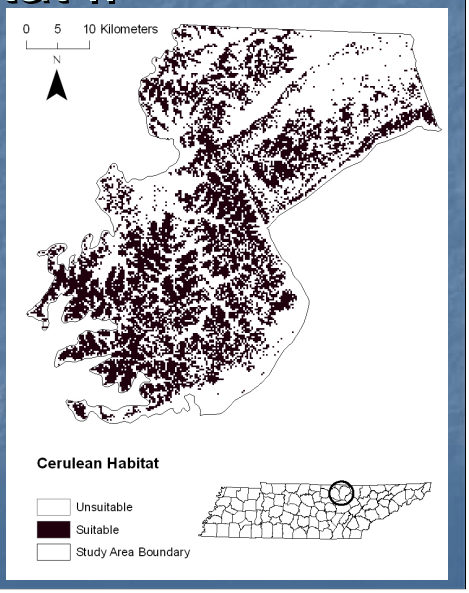
1 = absent, 2 = low abundance, 3 = high abundance


Detail - Hobet Mine, WV
MTRVF
CERW Modeled abundance
Absent
Low
Moderate
0
25
50
100 Miles

Finer-scaled Models of Habitat II

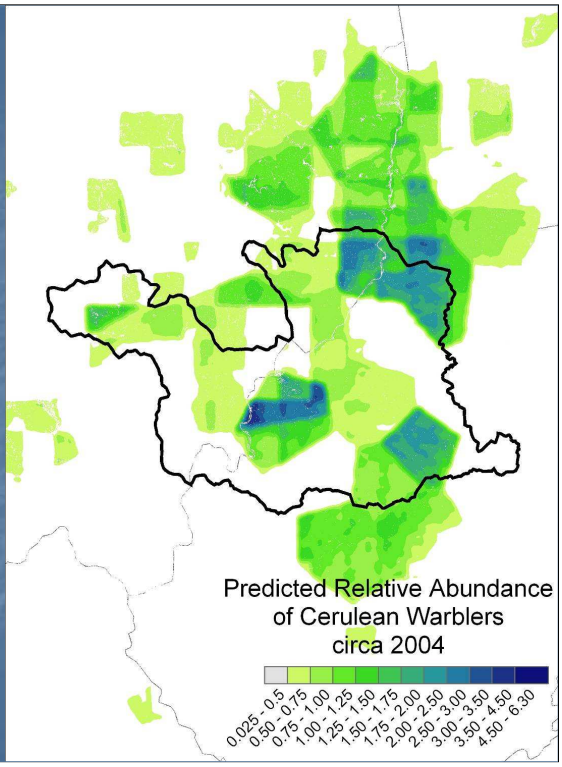
- Buehler, Welton, & Beachy
- Mahalanobis D’

Variable	CERW vs SA
Average **solar** exposure (d/yr)	<
Distance to nearest **stream** (m)	>
Elevation (m)	>
Relative **slope** position	>
Slope (º)	>
Mature Deciduous Forest	>



Modeled Threats

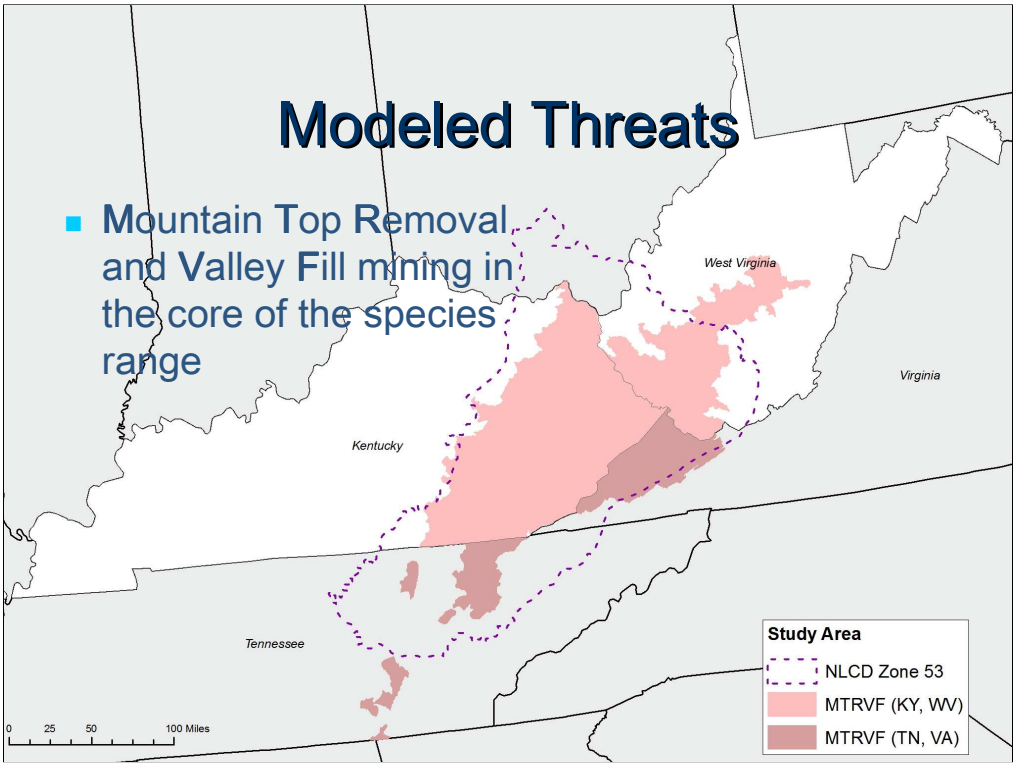
- Conversion of Forest to Urban Development
  (USFS' Forest on the Edge)
- Little Kanawha watershed possesses 24% of core population
  (almost 1/5 of global pop)

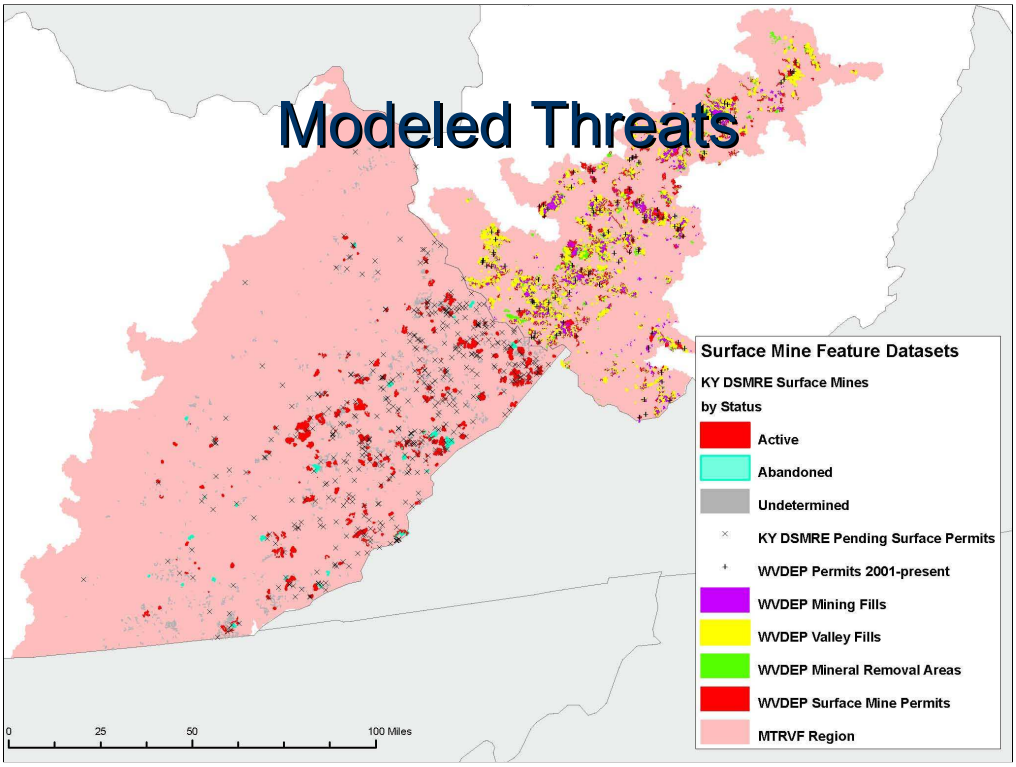


The Forest Service's Forest on the Edge program predicts watersheds at risk for conversion of forest to human land uses. The Little Kanawha is in the heart of the predicted peak of Cerulean Warbler abundance and it is also in the top 10 of the watersheds predicted for future forest conversion

Modeled Threats

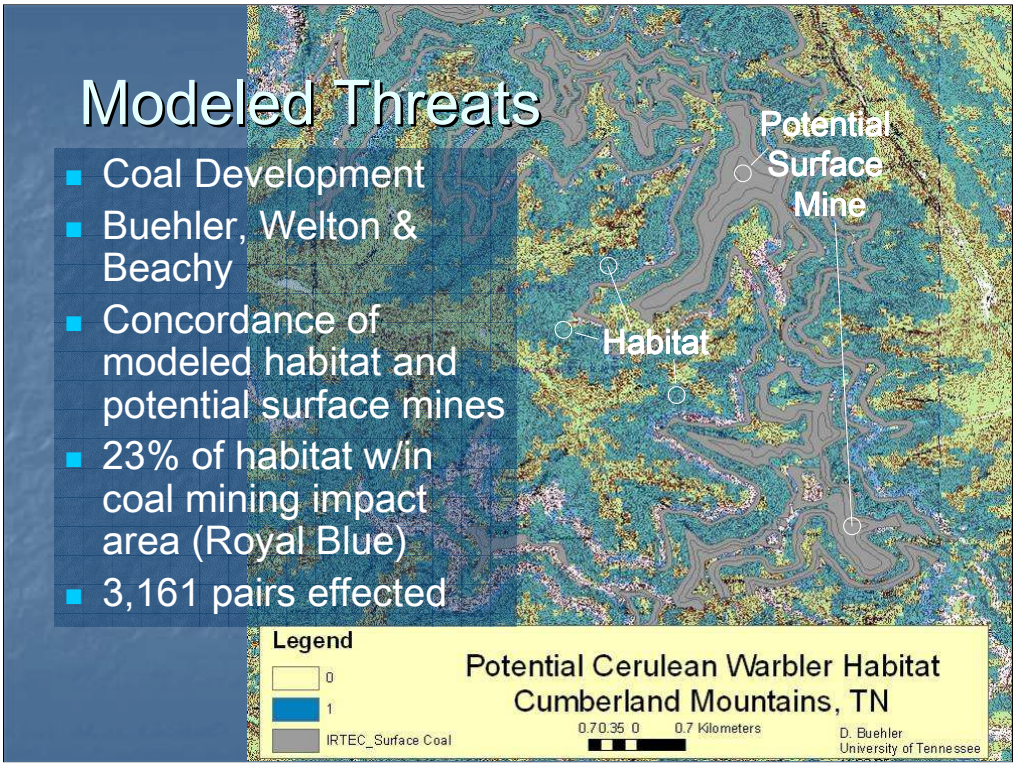
- Mountain Top Removal and Valley Fill mining in the core of the species range




Modeled Threats
Surface Mine Feature Datasets
KY DSMRE Surface Mines
by Status
Active
Abandoned
Undetermined
KY DSMRE Pending Surface Permits
WVDEP Permits 2001-present
WVDEP Mining Fills
WVDEP Valley Fills
WVDEP Mineral Removal Areas
WVDEP Surface Mine Permits
MTRVF Region
0
25
50
100 Miles

Modeled Threats

- Coal Development
- Buehler, Welton & Beachy
- Concordance of modeled habitat and potential surface mines
- 23% of habitat w/in coal mining impact area (Royal Blue)
- 3,161 pairs effected



Conclusions

- Modeling has provided better understanding of patterns in species occurrence and abundance
  - Concordance of models in the importance of forest composition, very similar results regarding topography
  - Similar results for viability of the species (90% loss within century)
- Modeling is being used to understand the threats to the species, and in devising means of mitigation