

High-elevation spruce-fir forest at risk from climate change, N.C.

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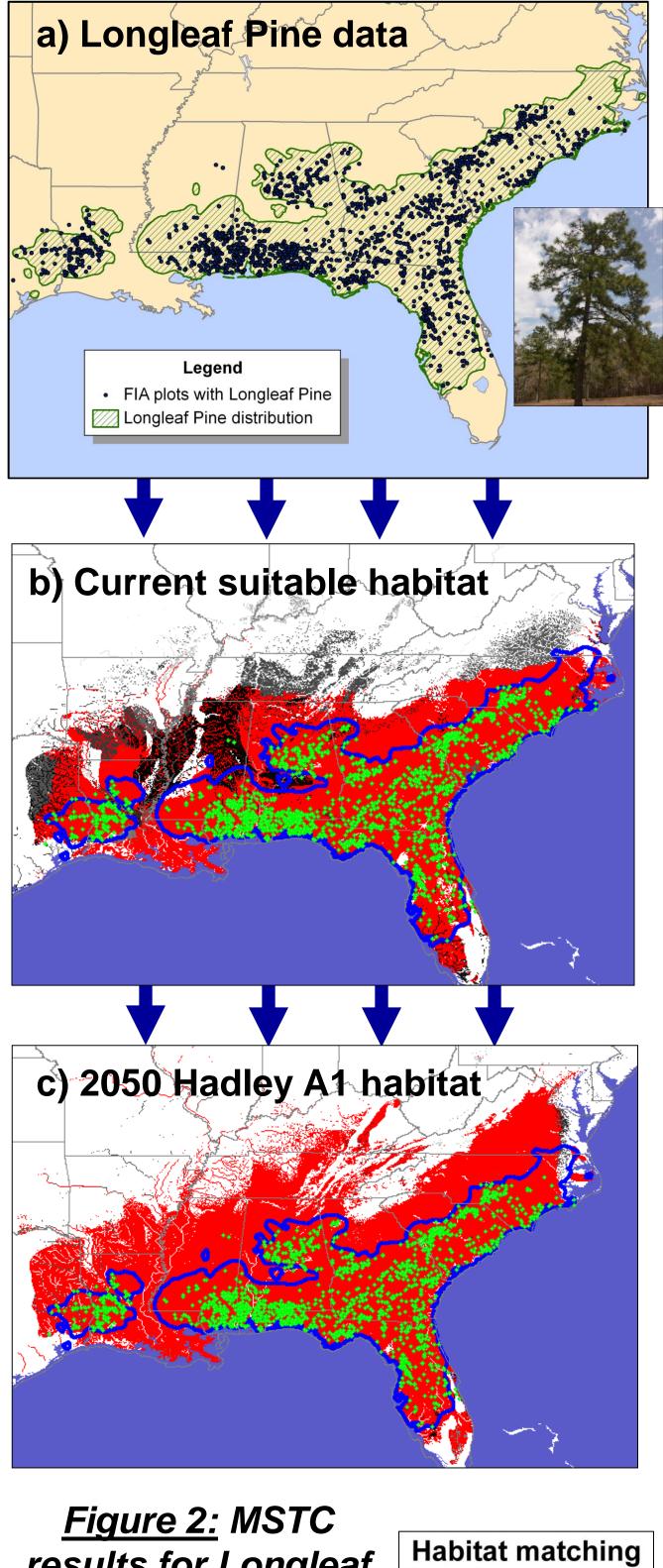
Introduction

Imate change is expected to result in extensive ecological, social and economic effects for U.S. forests (Malmsheimer et al. 2008). To survive, many tree species will be forced to adapt to new conditions or shift their ranges to more favorable environments. Both could have negative genetic consequences (Inset 1).

In 2008, the Forest Health Monitoring (FHM) Working Group called for a baseline assessment of the risk of climate change to the genetic integrity of North American tree species.

Objective 1

Forecast the location and quality of habitat for 200 North American forest tree species



results for Longleaf Identical Pine: a) FIA data, b) Most similar current habitat prediction, c) 2050 Least similar Little's range map Hadley A1 high Sample location emissions prediction

Products needed: Maps of future suitable habitat based on existing species occurrence data and pertinent environmental variables

- High-resolution and global
- Incorporate soils, temperature, precipitation, topography, growing season

Species data: Forest Inventory and Analysis (Figure 1a) or Global Biodiversity Information Facility (rare spp.)

Map generation method: Multivariate Spatio-Temporal Clustering (MSTC) (Hargrove and Hoffman 2005)

- Classifies each 4-km² pixel into one of 30,000 unique "ecoregions" using 16 environmental variables
- For each species, creates map of current potentially suitable habitat based on existing occurrence data (Figure 1b)
- Tracks current habitat regions into future regions in 2050 and 2100 (under Hadley and PCM) models, high and low emissions) (Figure 1c)

Assessing Forest Tree Risk of Genetic Degradation from Climate Change (SO-EM-09-01)

Kevin M. Potter¹, William W. Hargrove², Frank H. Koch¹

Inset 1: Genetics and climate change: Why should we care?

Genetic variation = potential adaptability to changing environment

Degradation may increase susceptibility to stressors such as pests, pathogens, climate (Inset Figure 1)

Potential genetic impacts of tree responses to climate change:

Adaptation: strong selection could reduce genetic variation

Range shift: founder effects, loss of trailing edge populations

Population extirpation: loss of unique genes or gene combinations

Inset Figure 1: Negative impacts of climate change may result in loss of genetic variation, decreasing the ability of populations to adapt to change.

Objective 2

Identify existing populations most at risk from climate change, based on distance to future suitable habitat

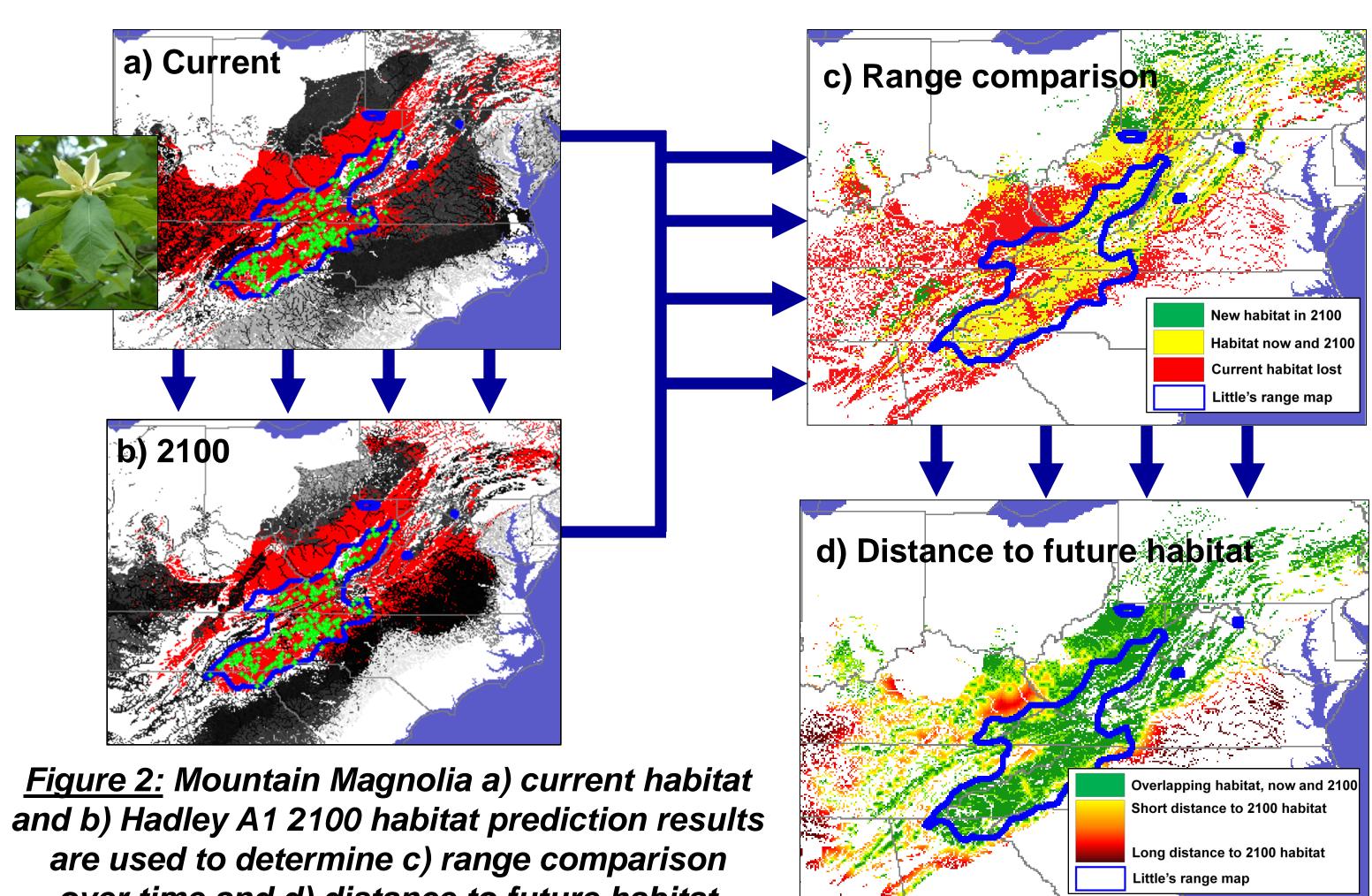
Products needed: Maps of areas potentially at risk from changes in suitable habitat (Figure 2)

Identify possible corridors between current and future habitat

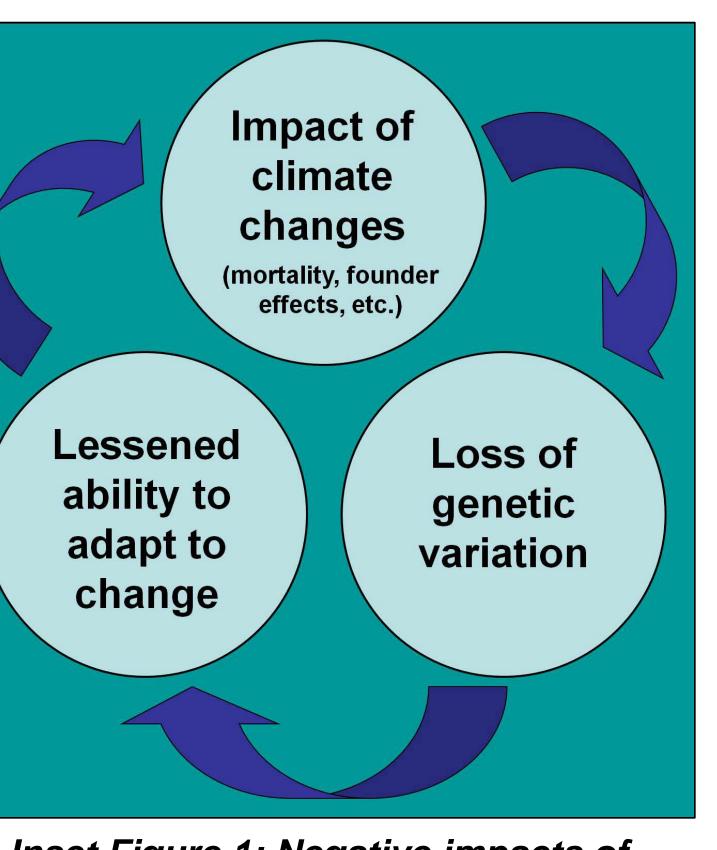
Areas of overlapping habitat

Minimum Required Movement (MRM) distance between current and future suitable habitat

Find potential "lifeboat" areas preserving multiple species from broad regions



over time and d) distance to future habitat



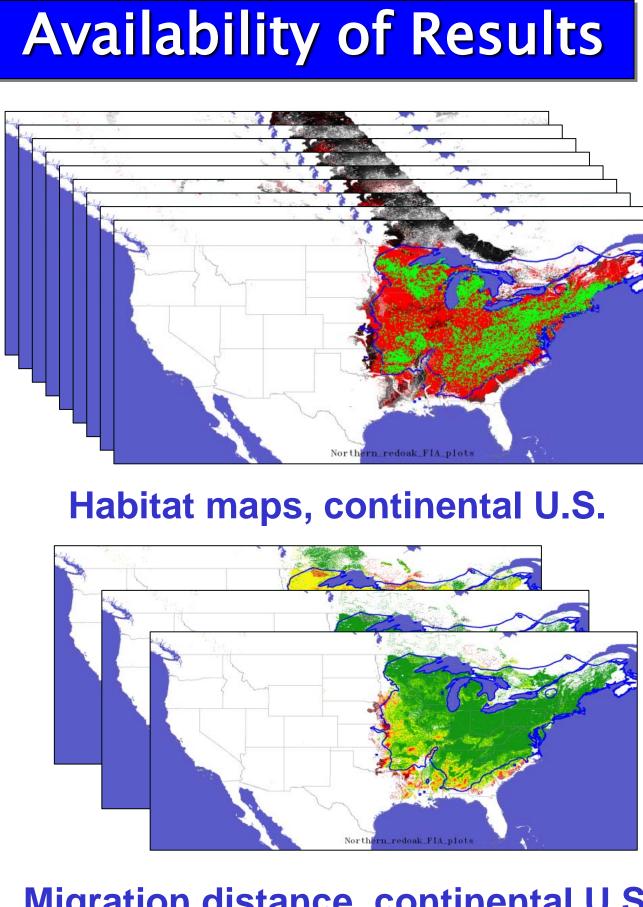
Incorporate movement barriers

Objective 3

Products needed: Spatially explicit assessments of which populations are most at risk

Synthesize map results with existing knowledge about species biology, population genetics and extrinsic factors (Figure 4)

Incorporate expert opinion from geneticists, ecologists and other species specialists within a **Bayesian Belief Network** framework



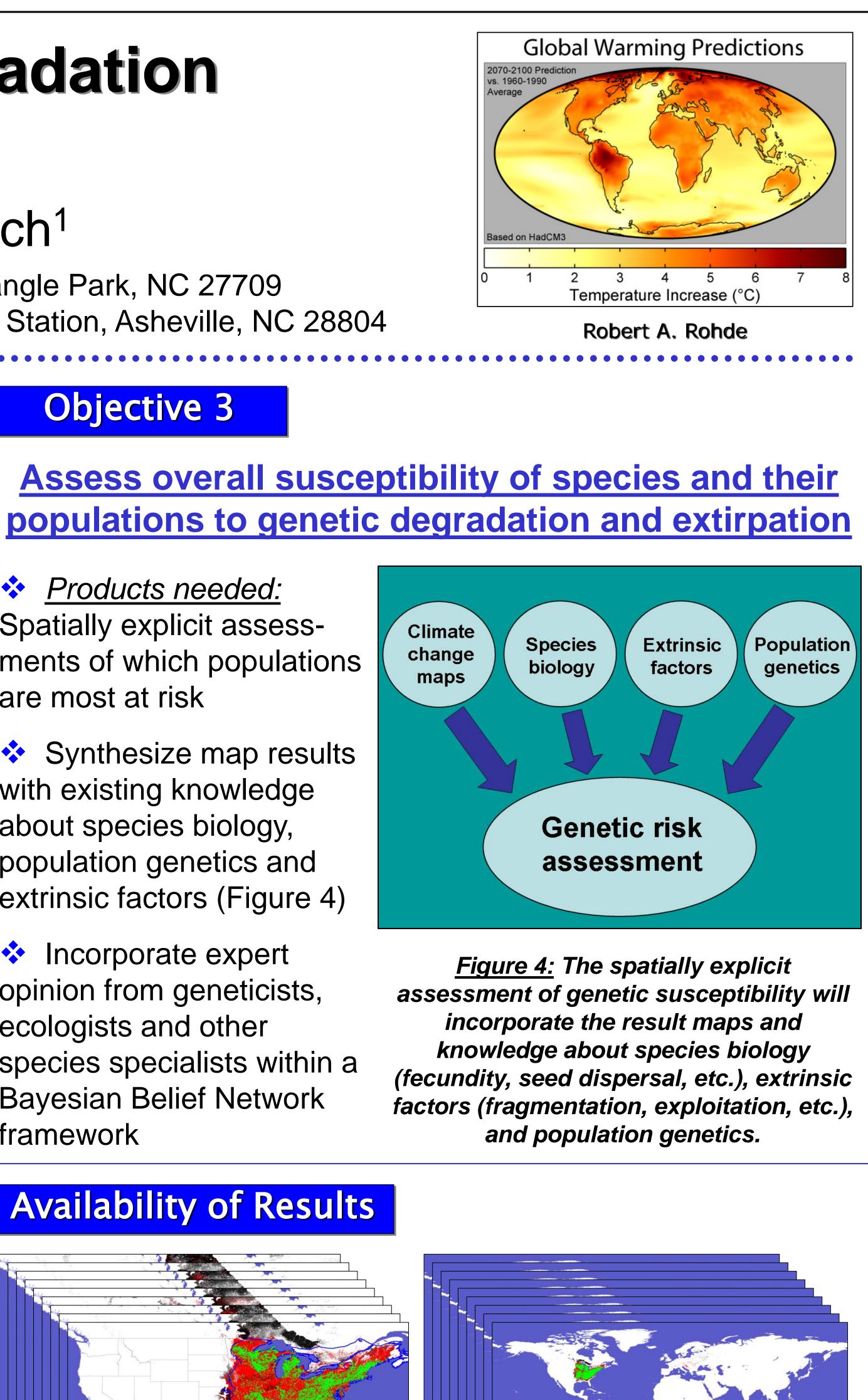
Migration distance, continental U.S. <u>Figure 4:</u> This project will generate at least 24 predictive maps for each of the ~200 species included in the analyses. These will be made available online.

References

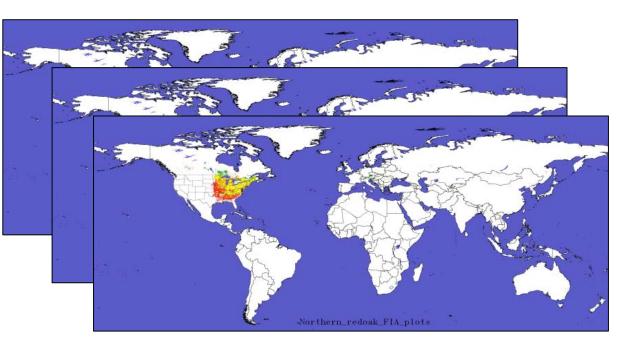
Hargrove, W.W.; Hoffman, F.M. 2005. Potential of multivariate quantitative methods for delineation and visualization o ecoregions. Environmental Management. 34(Suppl. 1):S39-S60. Malmsheimer, R.W., et al. 2008. Forest Management solutions for mitigating climate change in the United States. Journal of Forestry. 106(3):115-173.



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Migration distance, global