



REGENERATION ISSUES IN NORTHEASTERN FORESTS

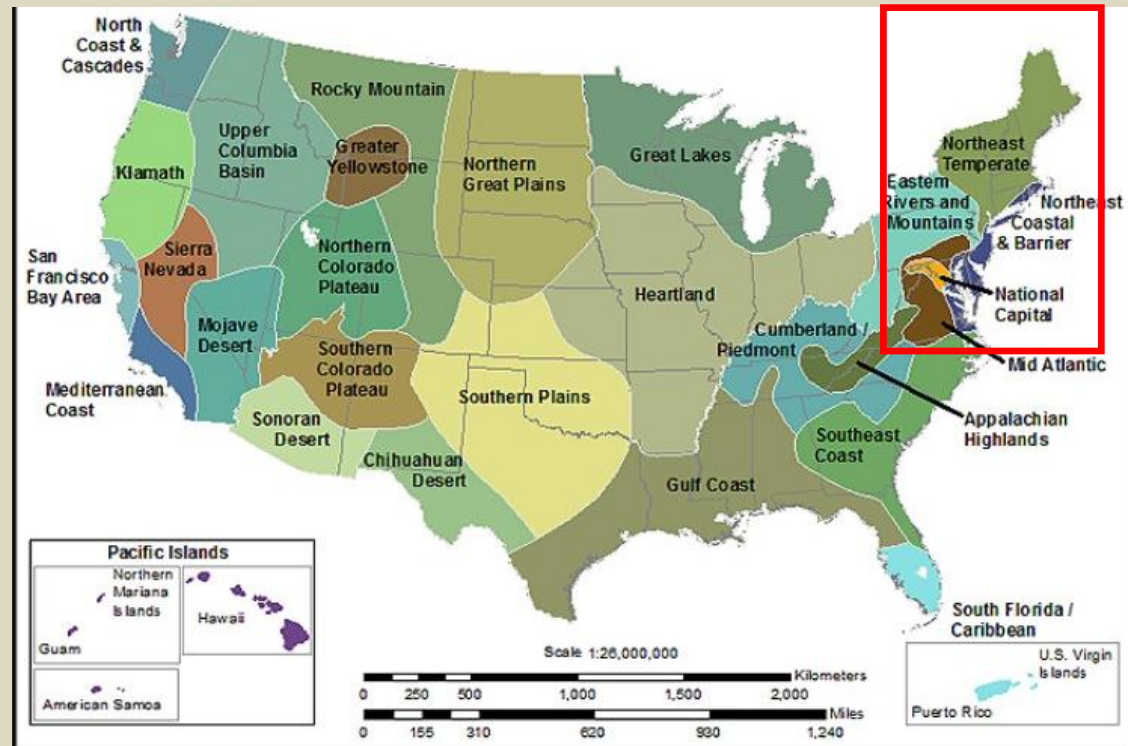
Kate Miller, Quantitative Ecologist





Inventory and Monitoring Program Overview

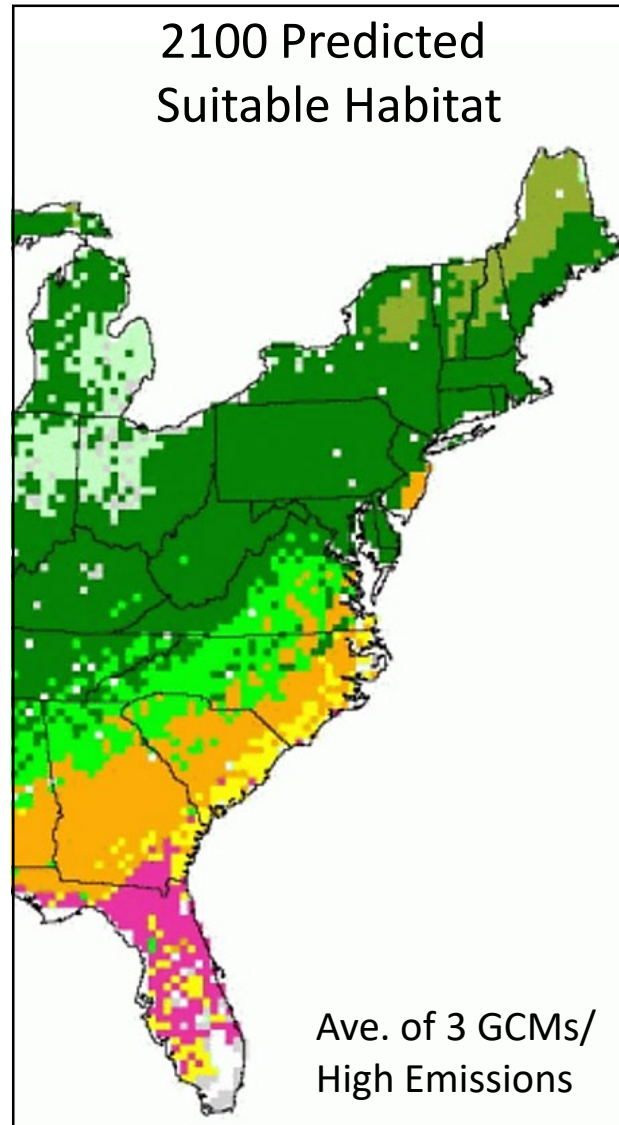
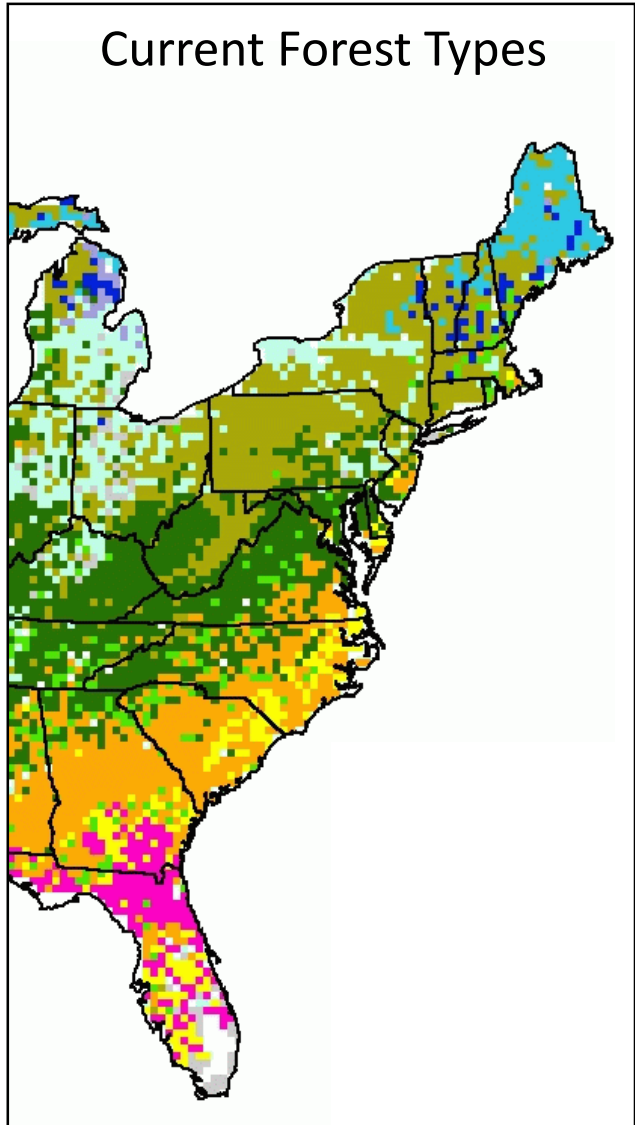
- 32 Networks containing 270 park units
 - 12 Baseline Inventories
 - Vital Signs Monitoring





CC Tree Atlas: Current Forest Types

Predicted Changes in Suitable Habitat in 2100



Ave. of 3 GCMs/
High Emissions

- Spruce/Fir
- Pine: White/Red/Jack
- Maple/Beech/Birch
- Elm/Ash/Cottonwood
- Oak/Hickory
- Oak/Pine
- Loblolly/Shortleaf Pine
- Oak/Gum/Cypress
- Longleaf/Slash Pine
- No Data



Details on Tree Migration

- Migration was main tree response to past climate change
- Tree migration depends on:
 - Seed dispersal ability
 - Life history traits
 - Habitat connectivity/landscape configuration
 - Regeneration





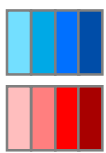
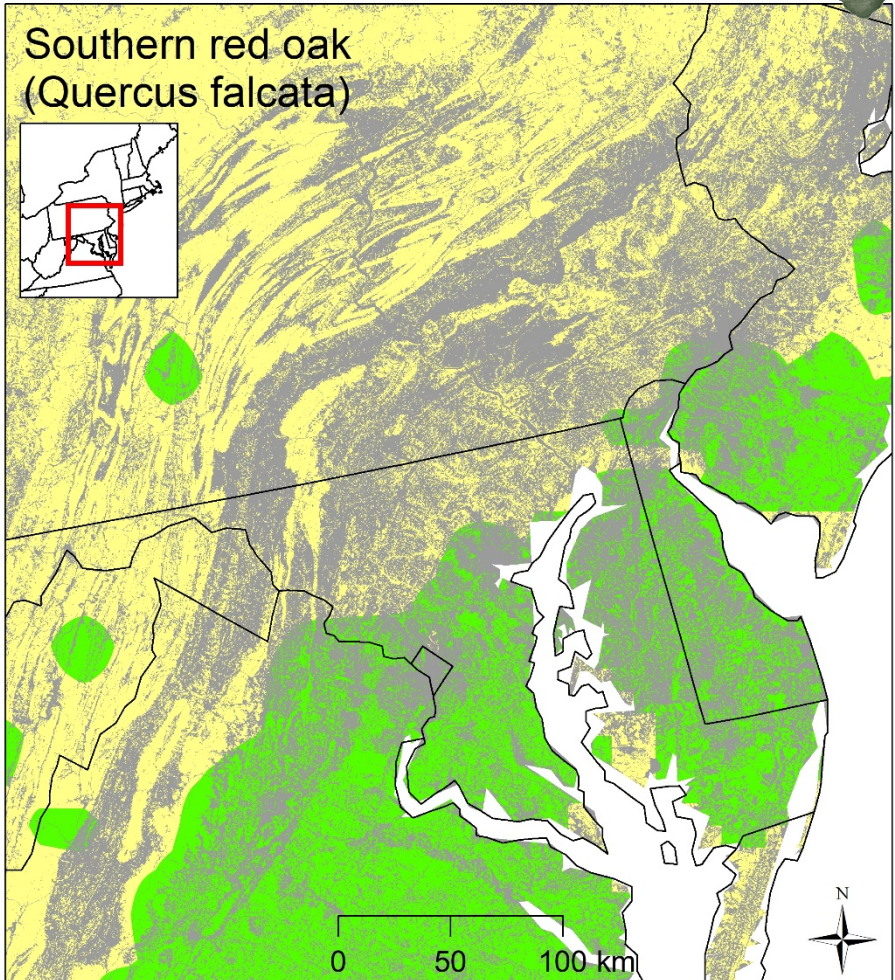
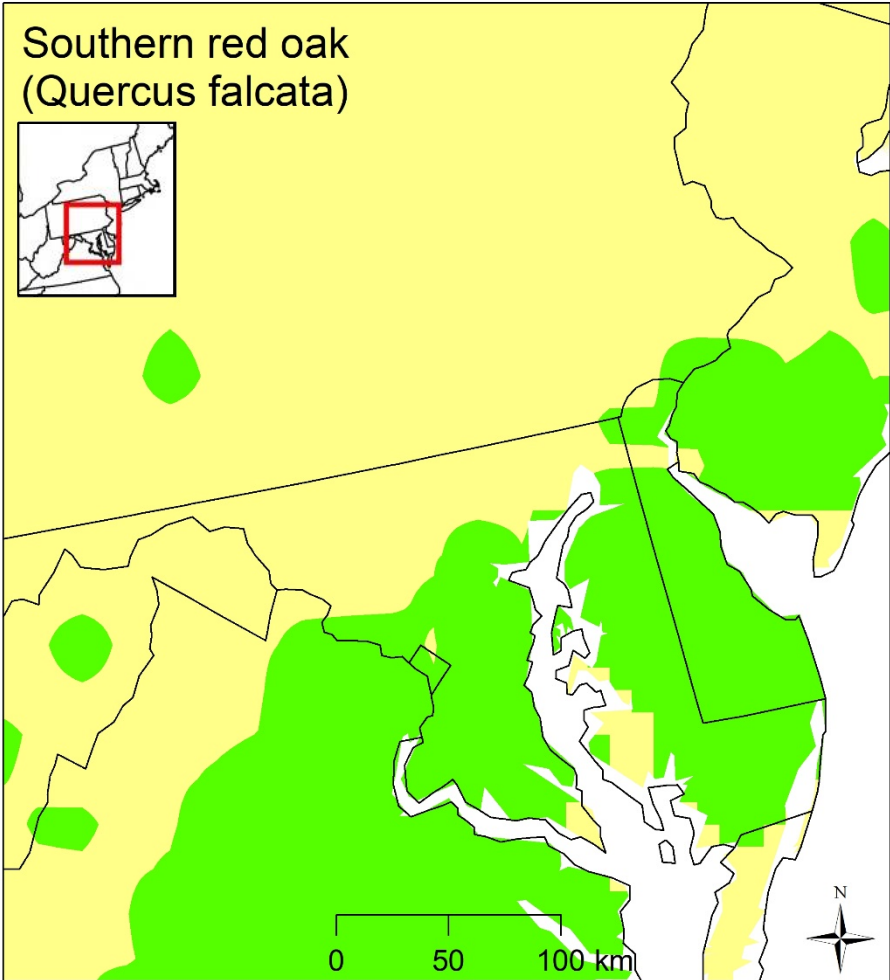
Tree Dispersal Simulations

- Simulate 100 years of dispersal for 15 eastern tree species to:
 - Assess species-specific dispersal
 - Determine influence of non-forest land use
 - Identify major dispersal barriers
 - Compare dispersal rates with rates of habitat shift



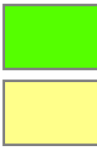


Dispersal Simulation Results: Time = 0



Dispersal in 25 year intervals

Null Dispersal in 25



Current Habitat

Future Suitable Habitat

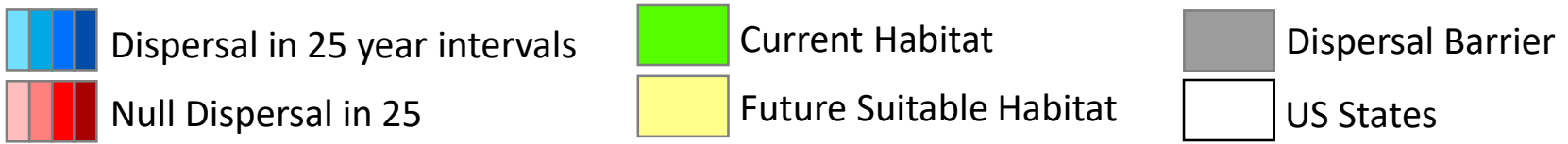
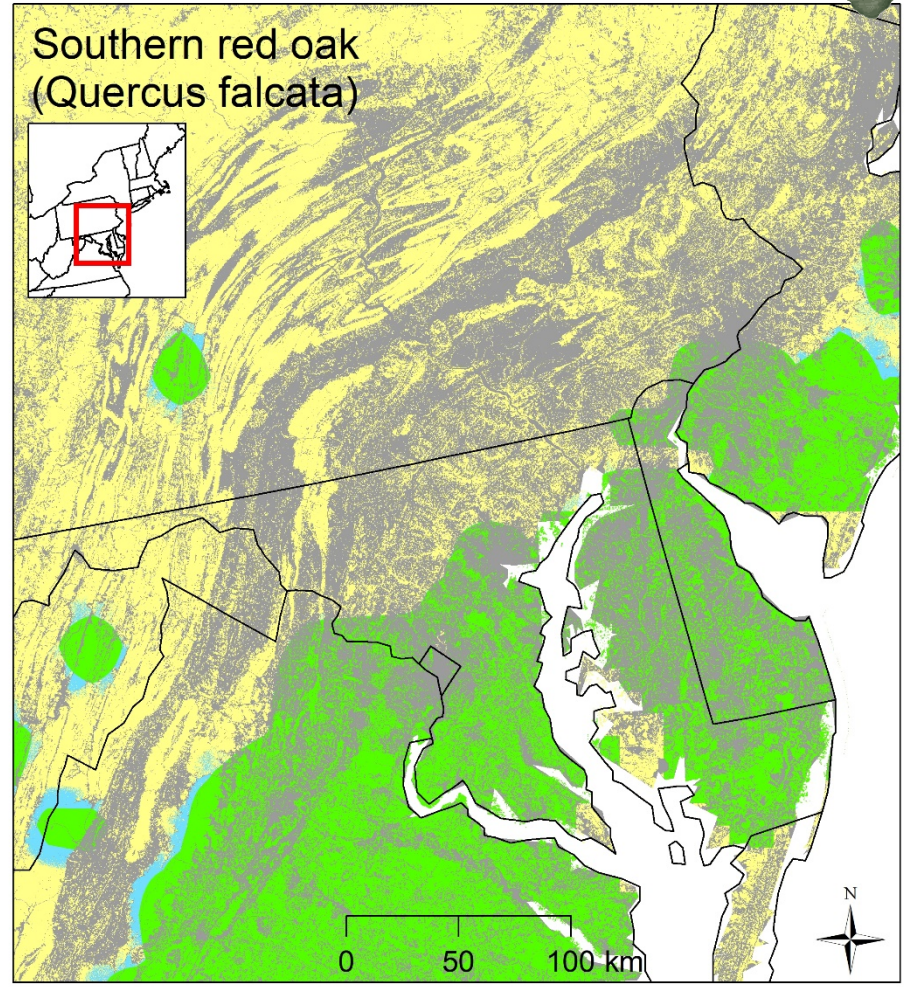
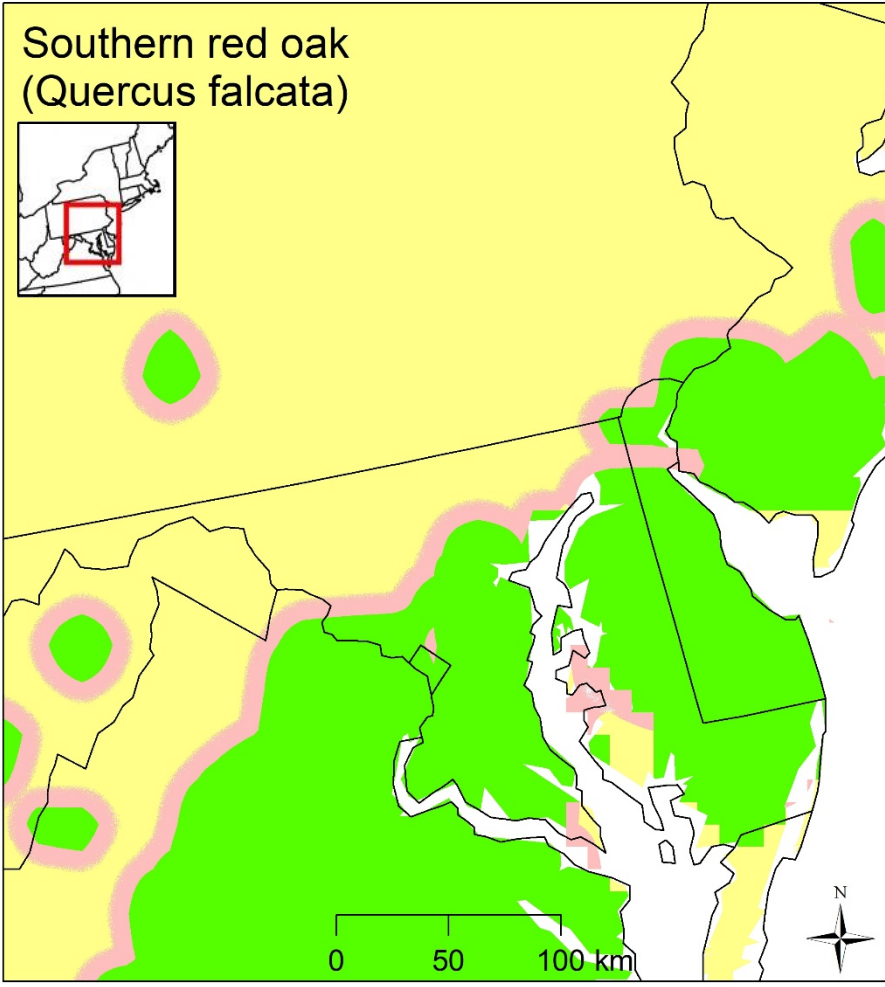


Dispersal Barrier

US States

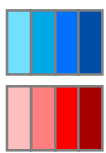
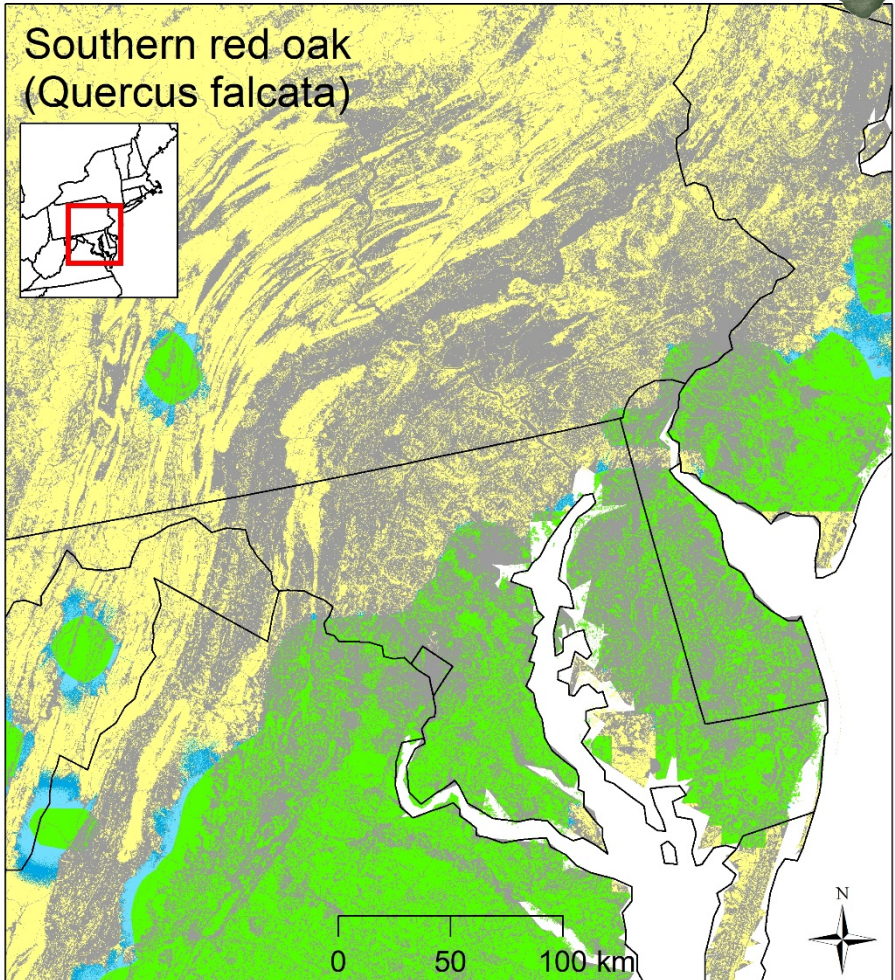
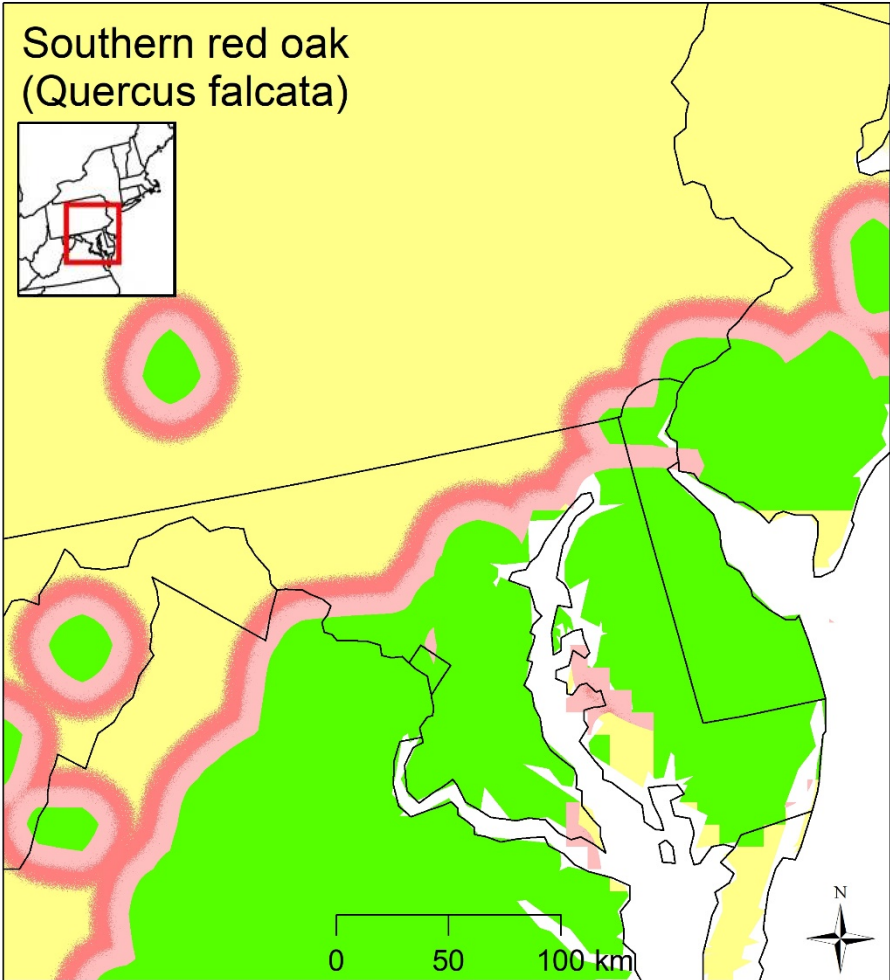


Dispersal Simulation Results: Time = 25 years





Dispersal Simulation Results: Time = 50 years



Dispersal in 25 year intervals

Null Dispersal in 25



Current Habitat



Future Suitable Habitat



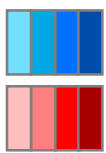
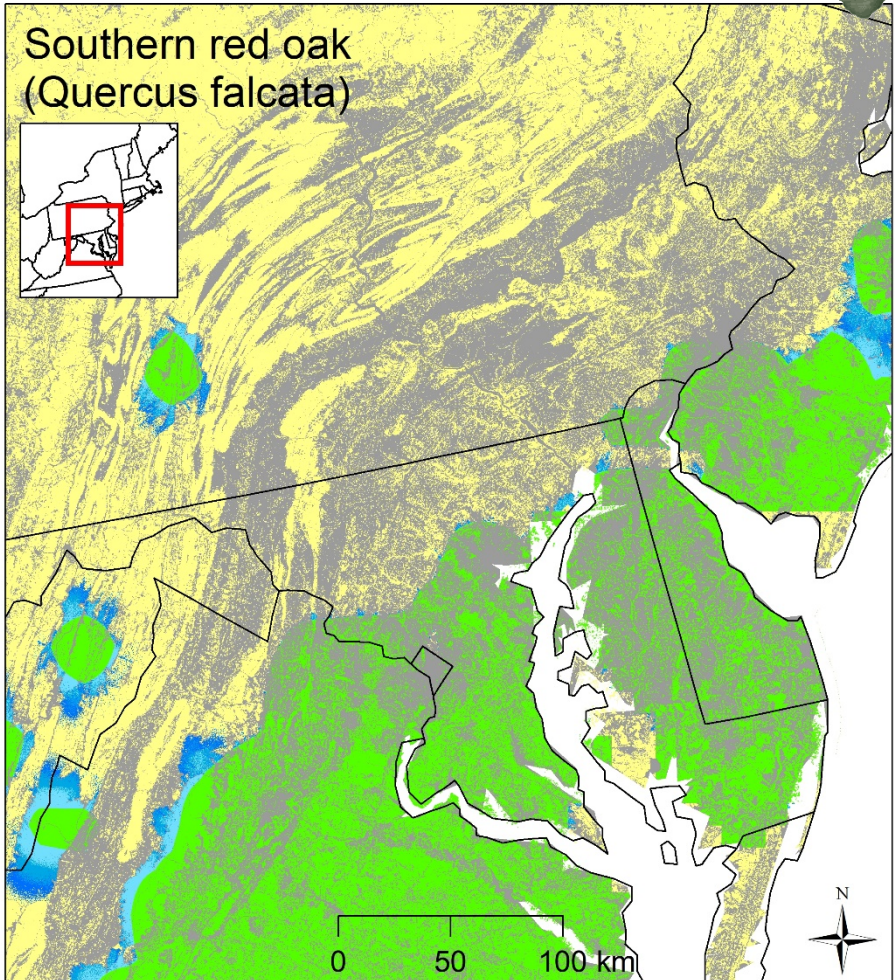
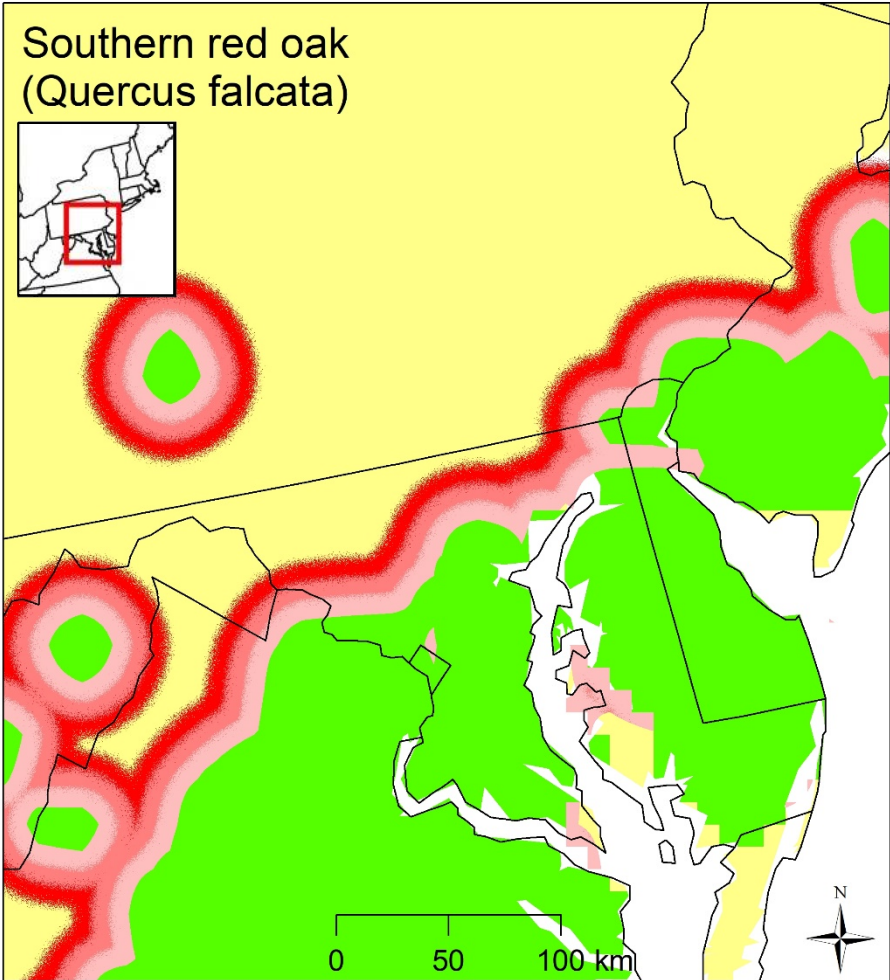
Dispersal Barrier



US States



Dispersal Simulation Results: Time = 75 years



Dispersal in 25 year intervals

Null Dispersal in 25



Current Habitat



Future Suitable Habitat



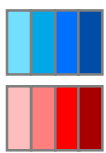
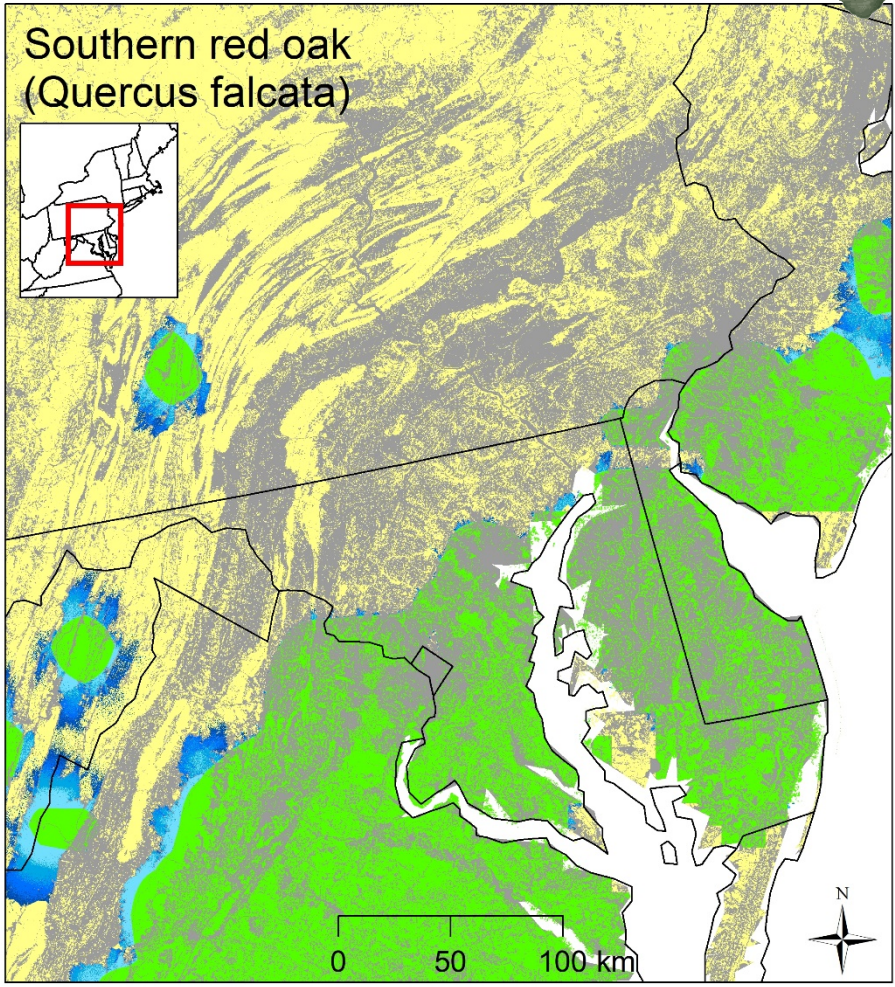
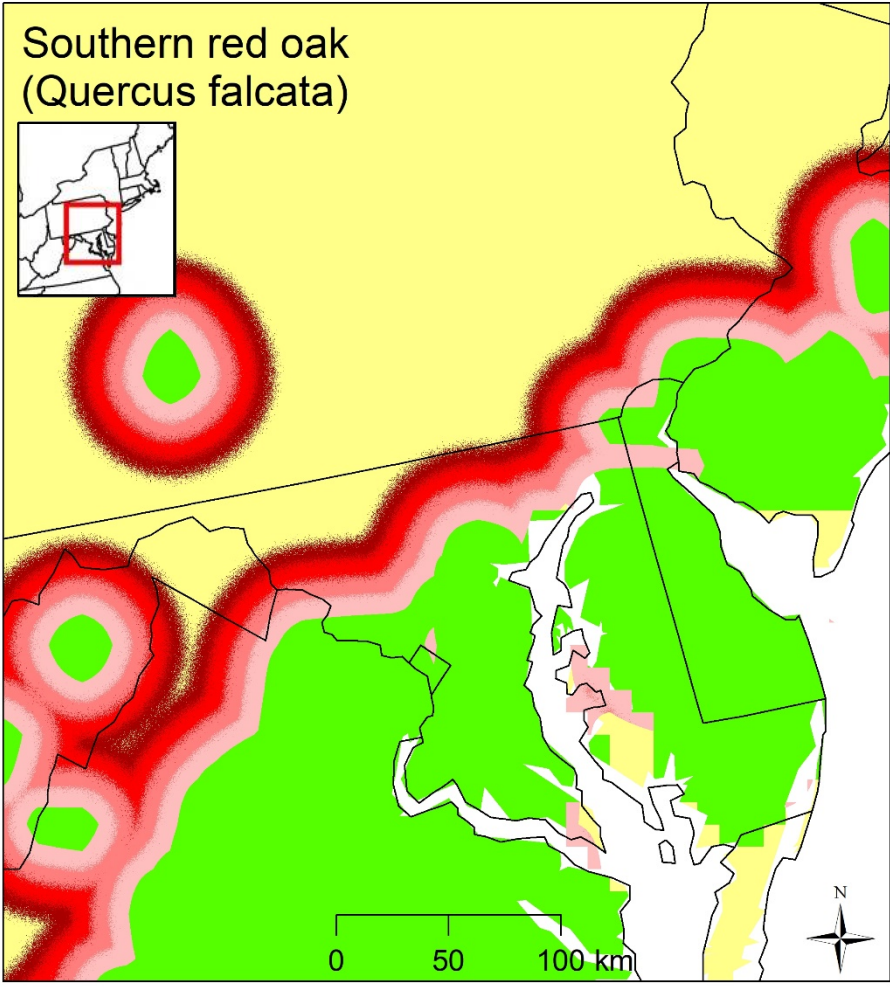
Dispersal Barrier



US States



Dispersal Simulation Results: Time = 100 years



Dispersal in 25 year intervals

Null Dispersal in 25



Current Habitat



Future Suitable Habitat



Dispersal Barrier



US States



Dispersal Simulation Summary

- Species dispersal rates were slower than species habitat shifts even in the null models at 50 km LDD
- Oak species had the slowest dispersal rates and the fastest species habitat shifts
- No species filled majority of the predicted newly suitable habitat by 2100
- Major dispersal barriers: DC to central NJ, and central NY



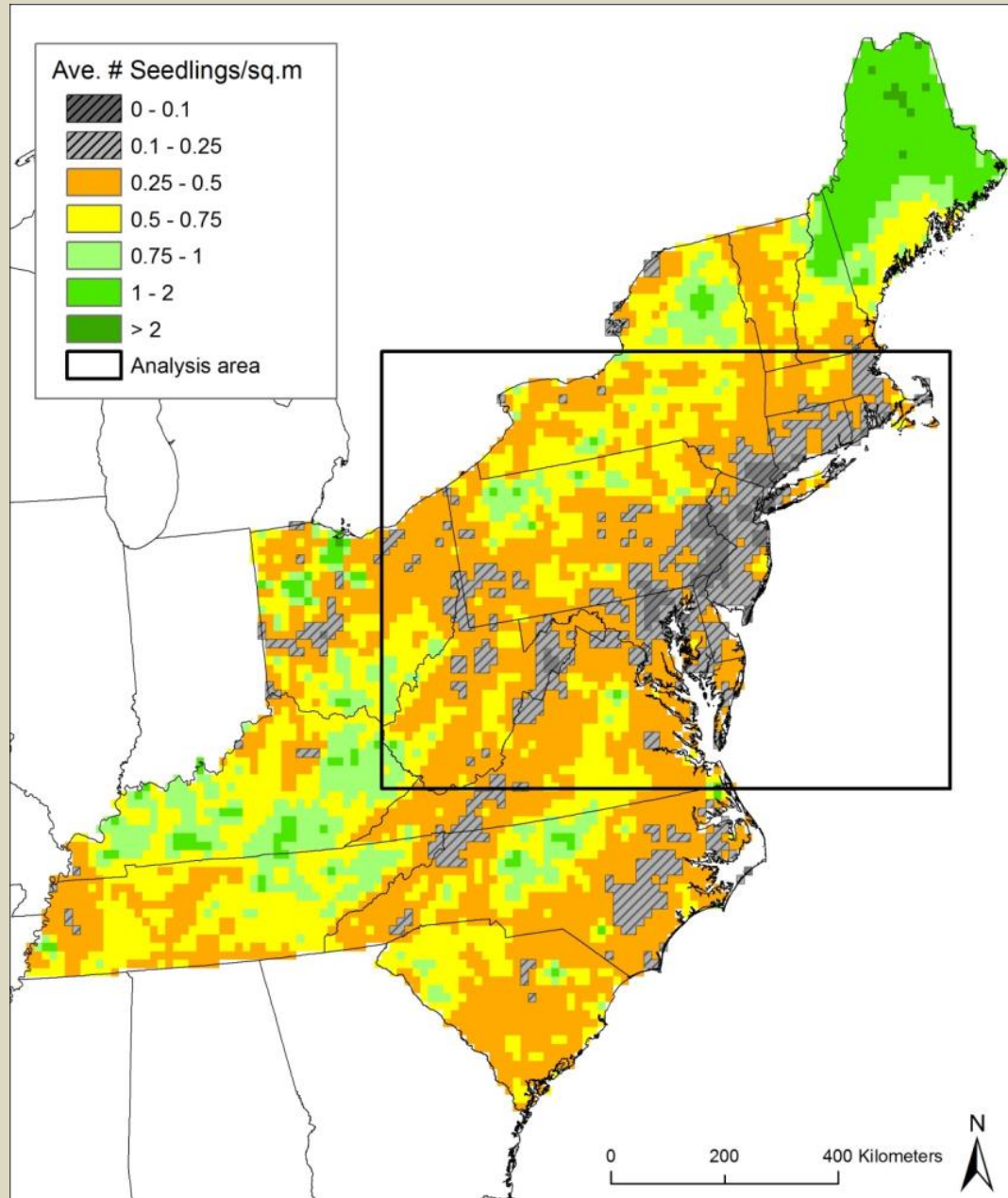
Regional Regeneration Study



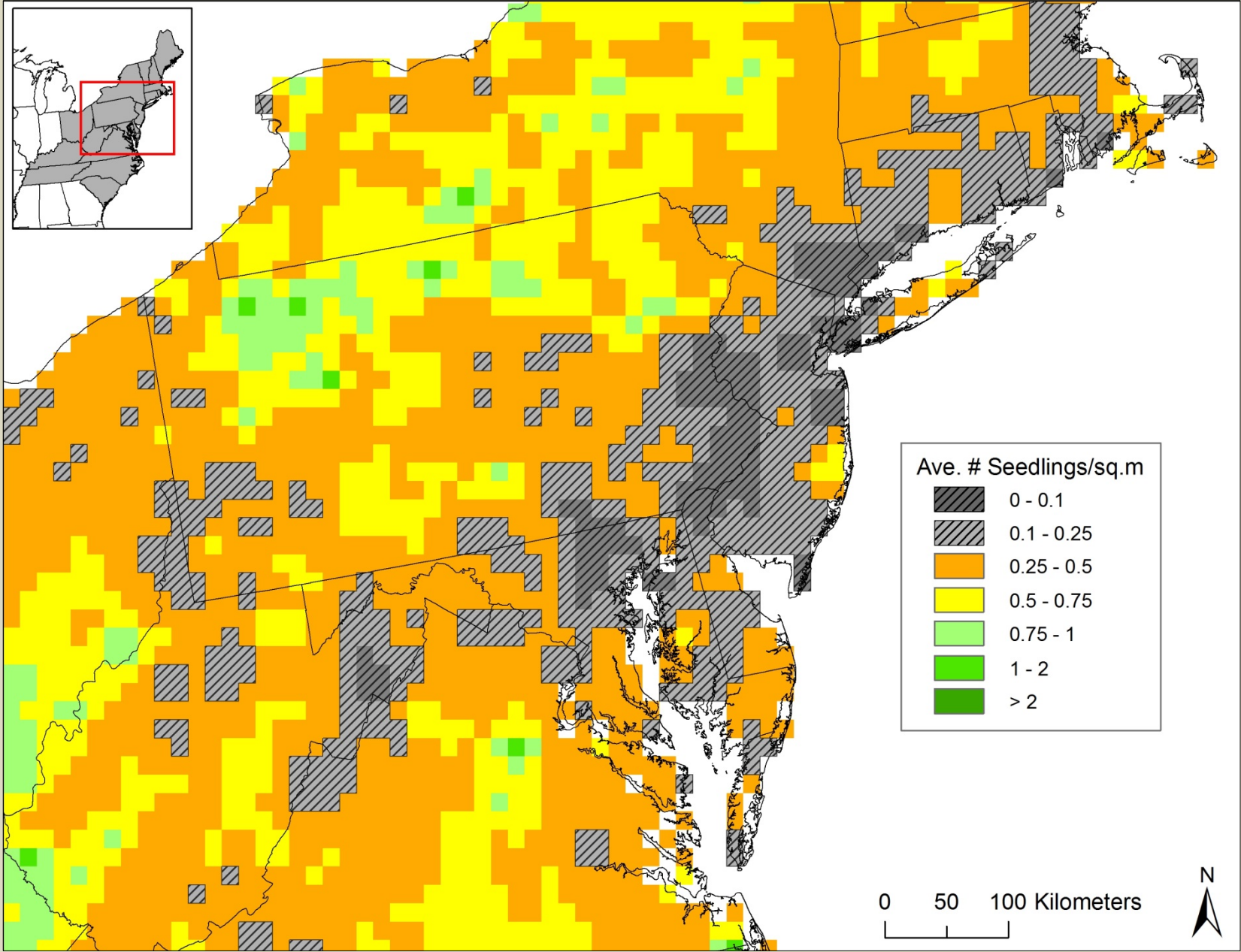
- Quantify **Regeneration Debt** in Eastern forests
 - Seedling and sapling abundance
 - Mismatch between regeneration and canopy species
- Relate results to anthropogenic stressors and metrics of climate change



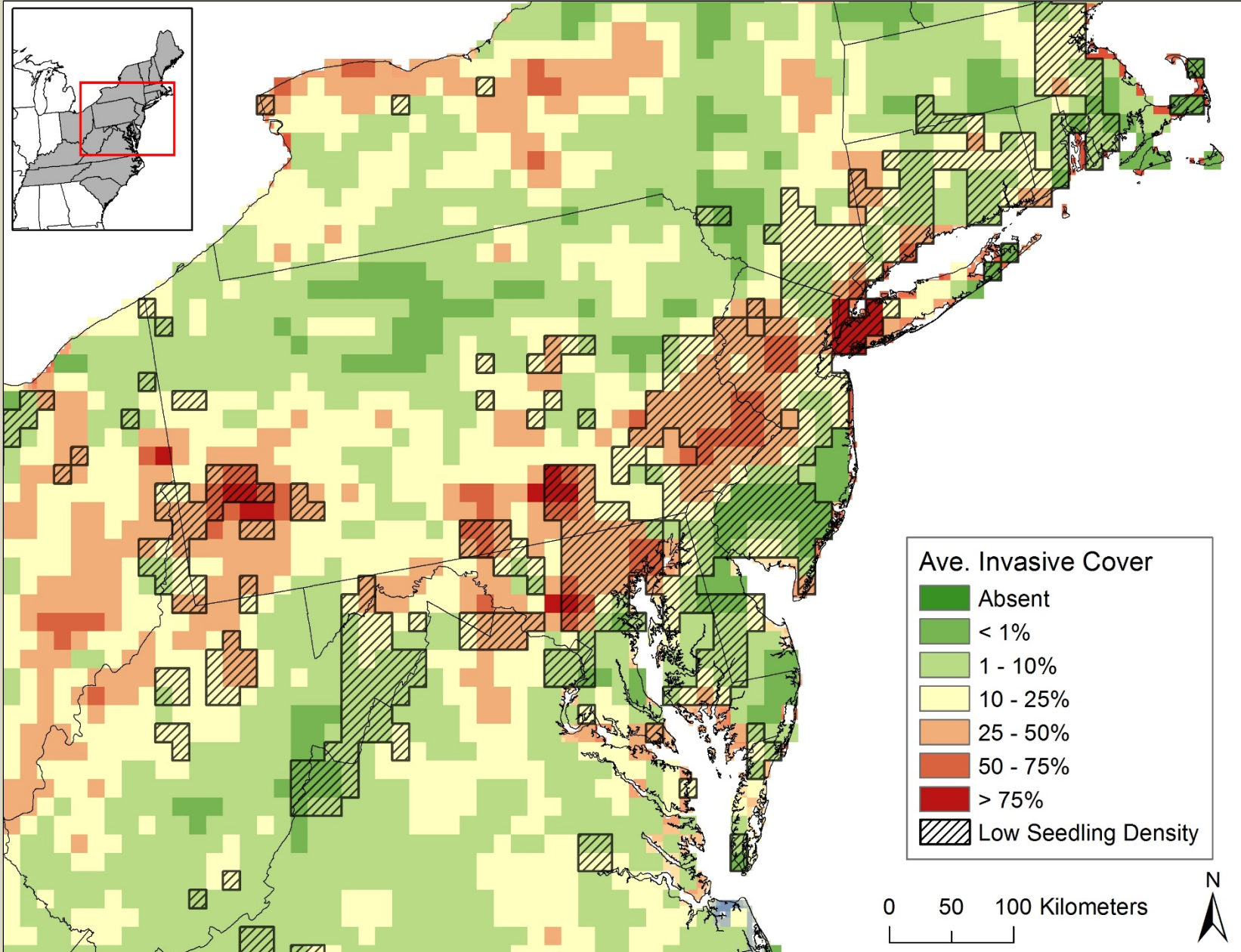
Regional Seedling Density



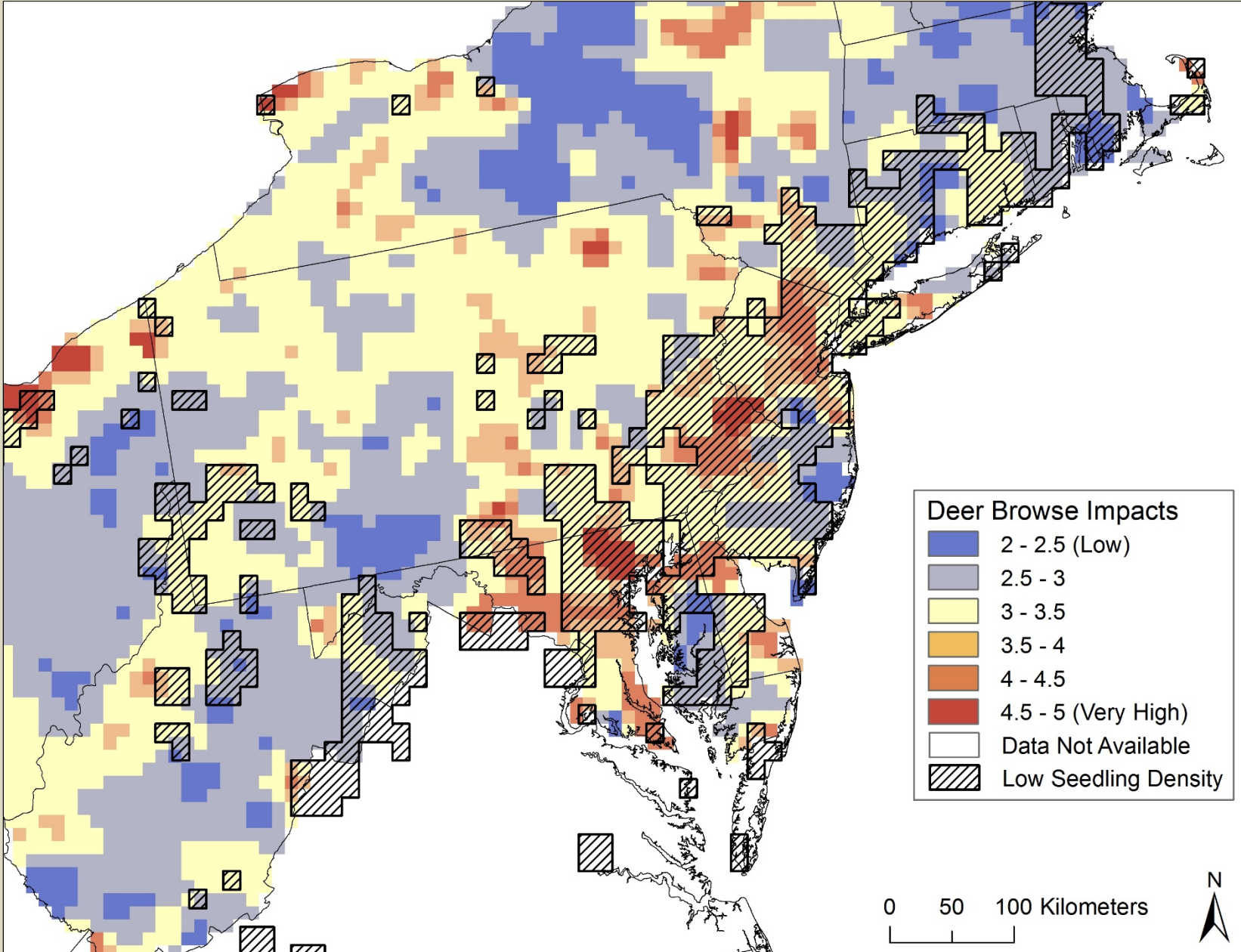
Regional Seedling Density



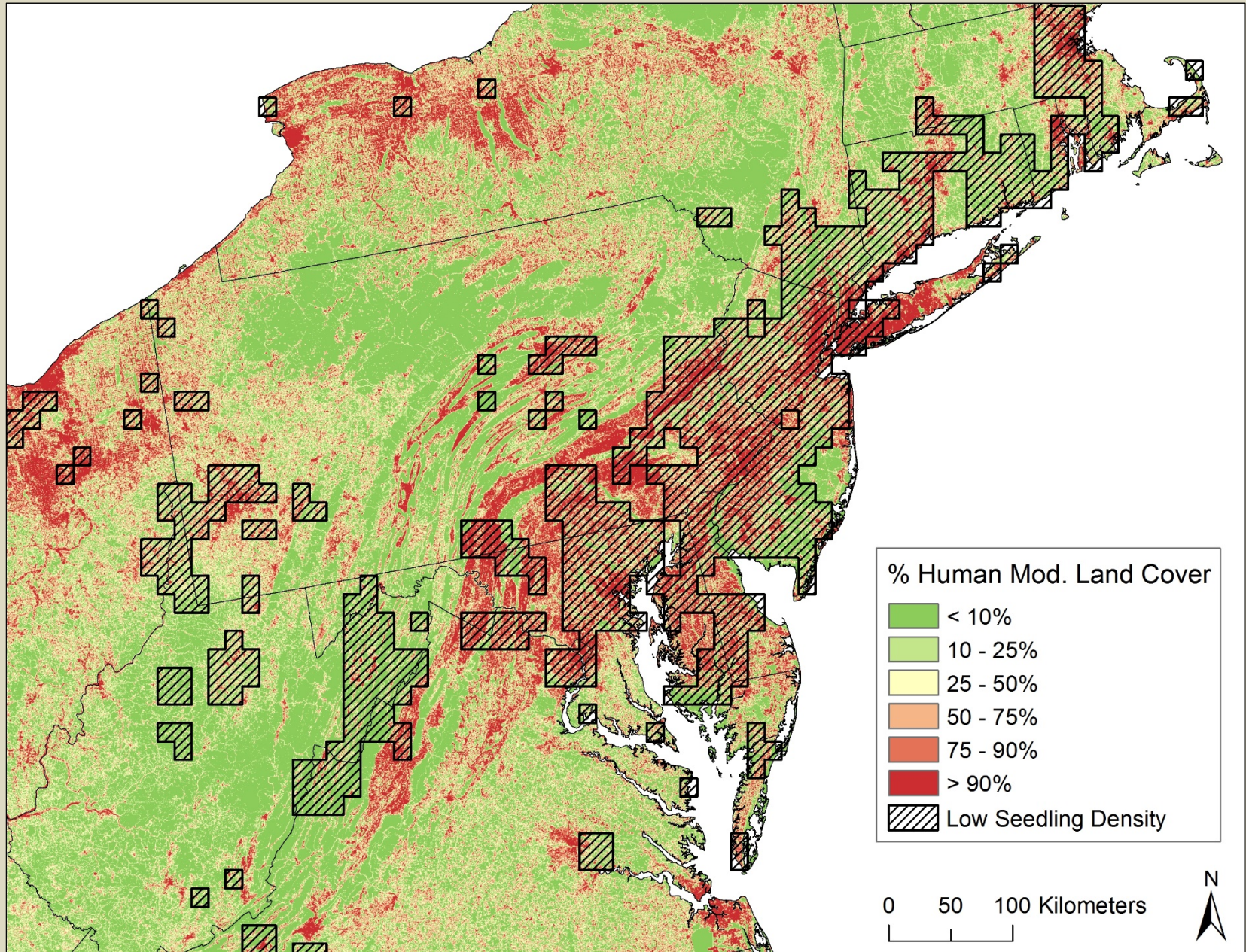
Invasive Plant Cover



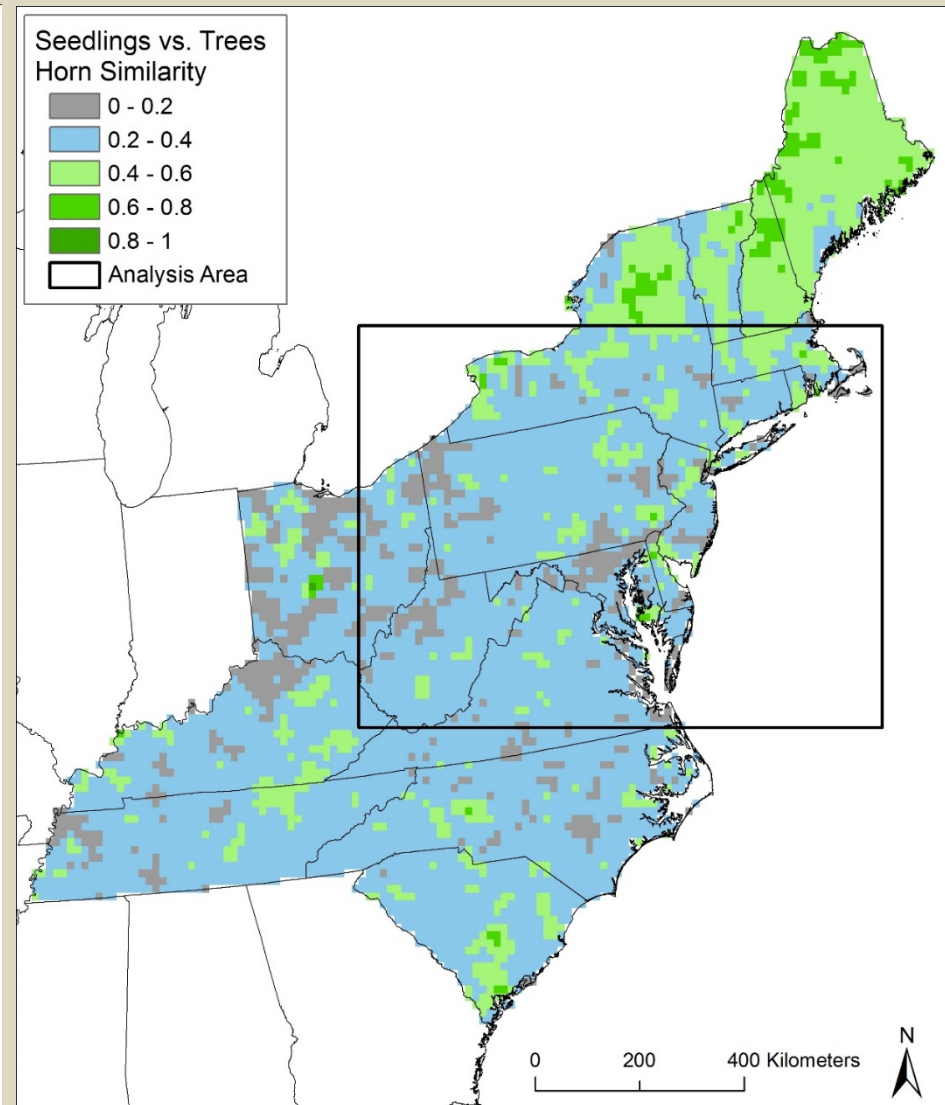
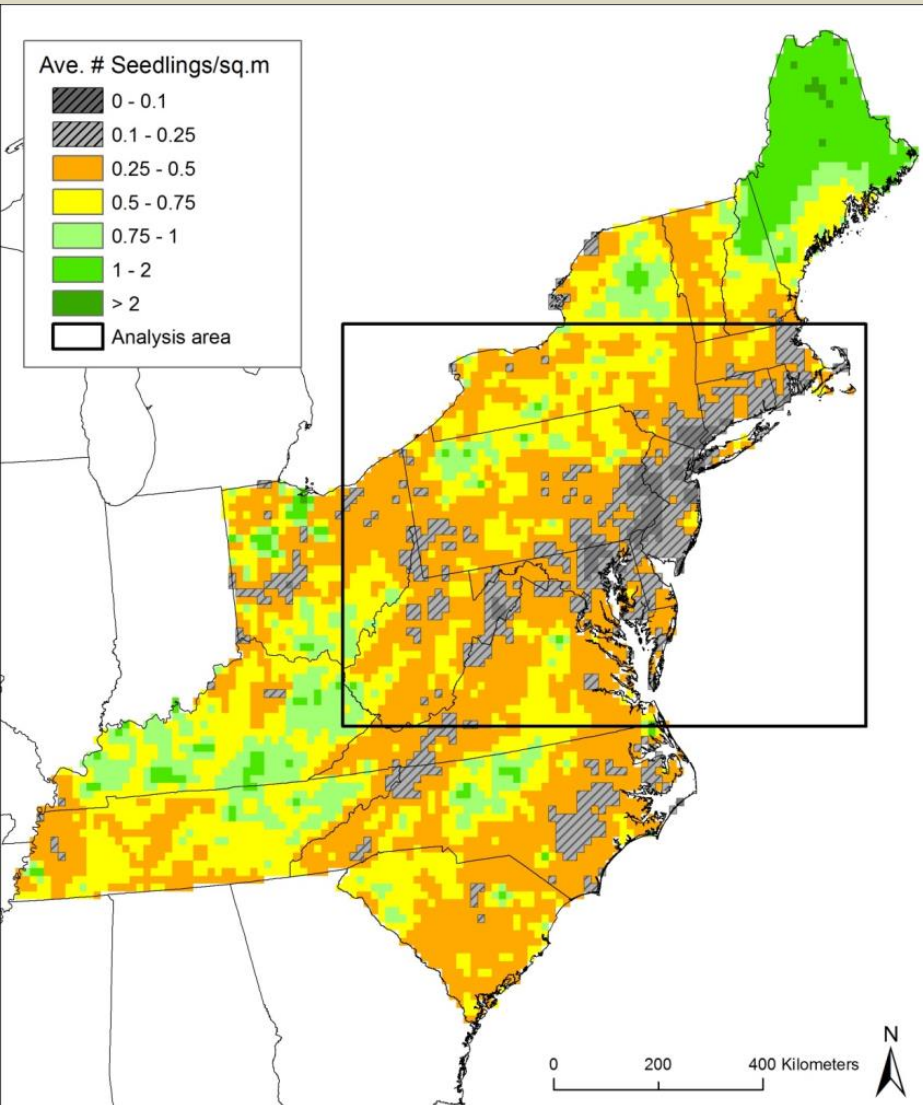
Deer Browse Impacts



% Human Modified Land Cover



Seedling Abundance vs. Similarity with Canopy





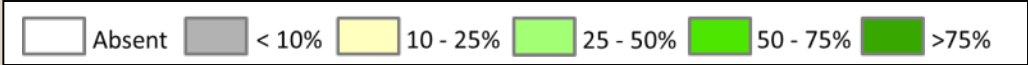
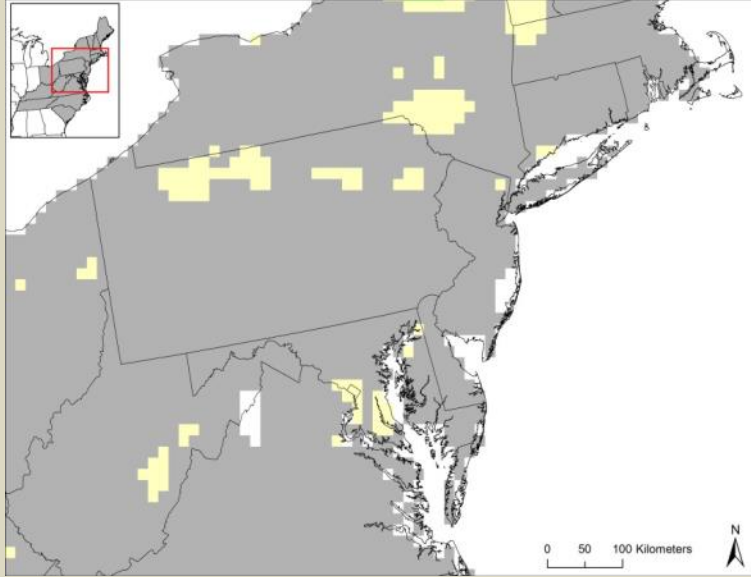
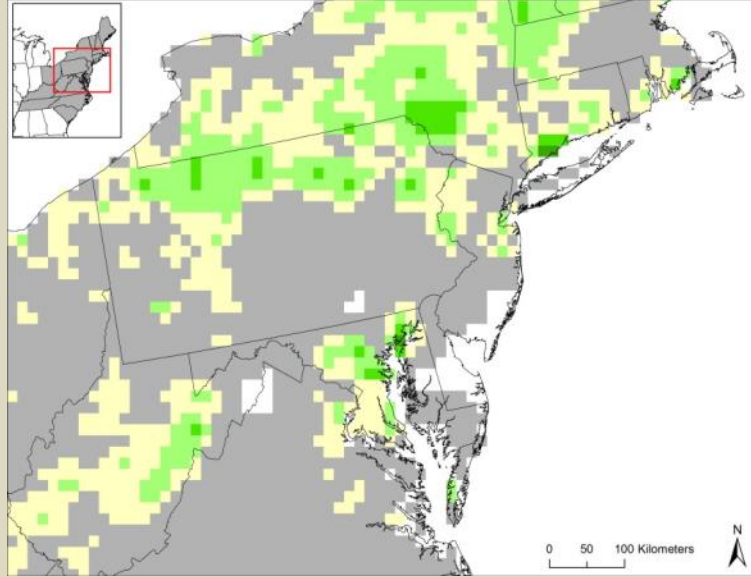
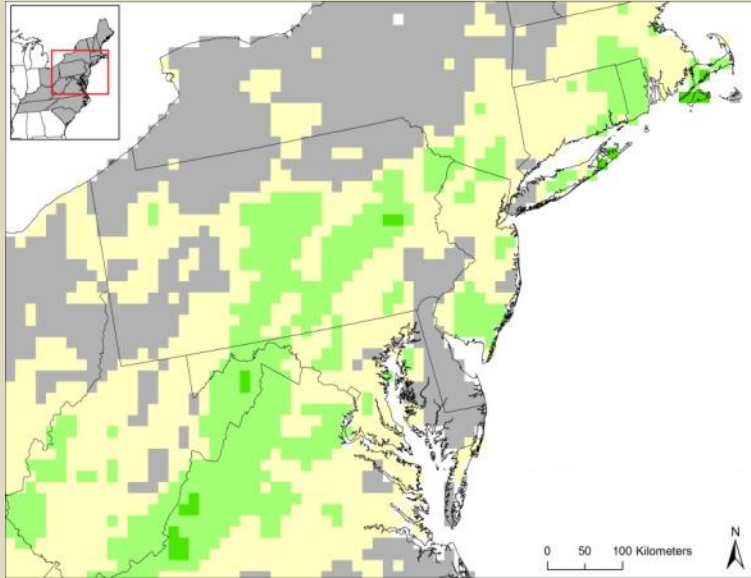
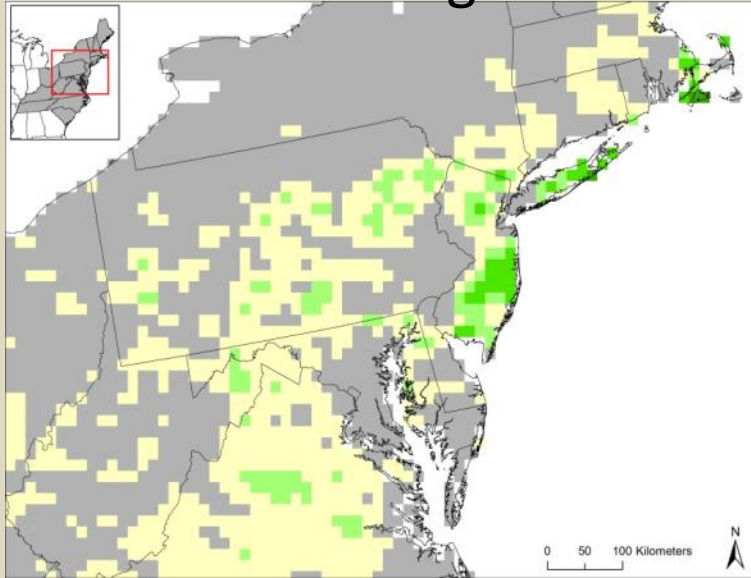
Relative Abundance

Seedlings

Trees

Oak

Beech



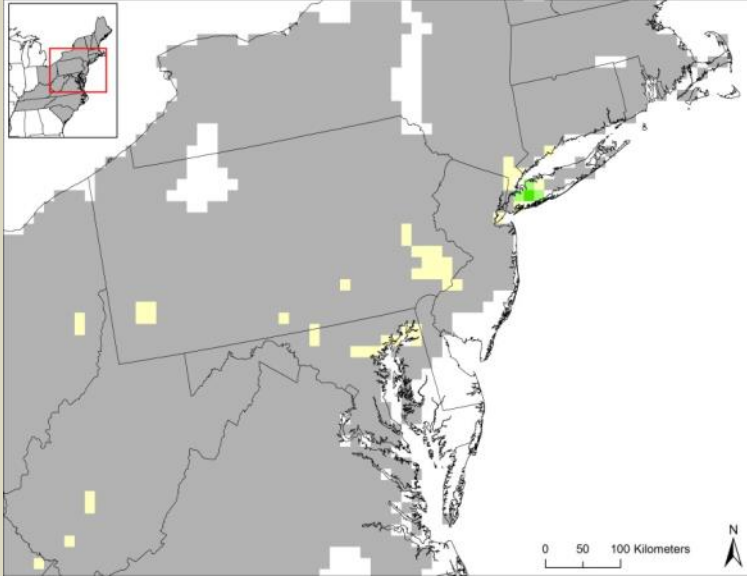
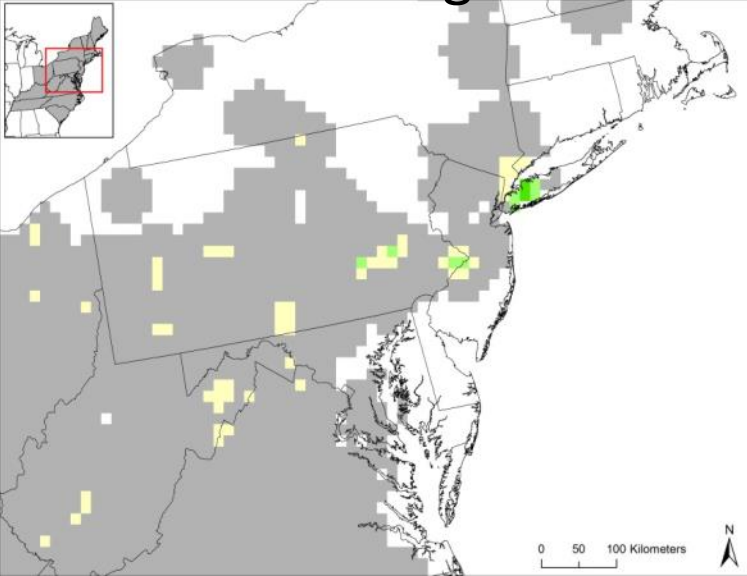


Relative Abundance

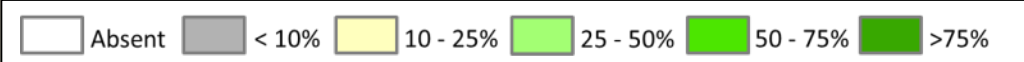
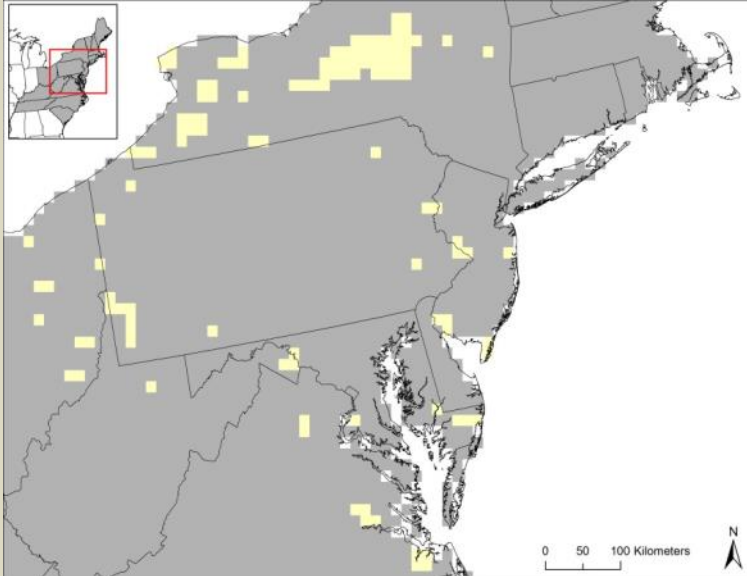
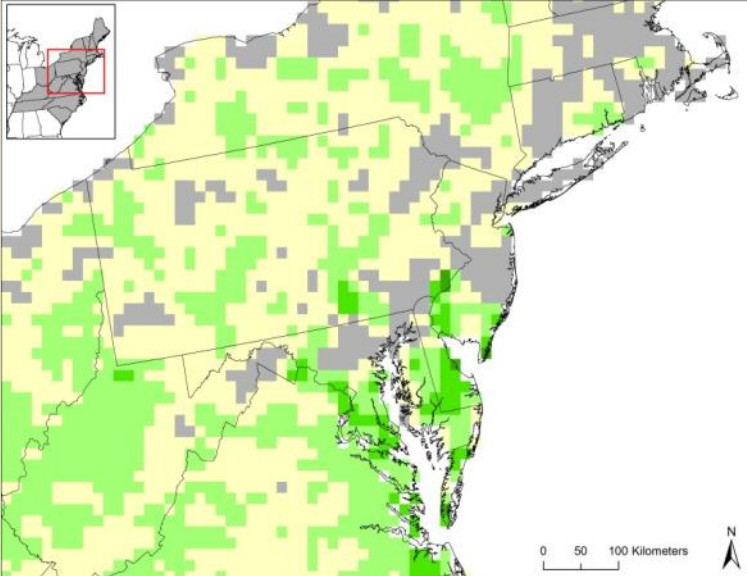
Seedlings

Trees

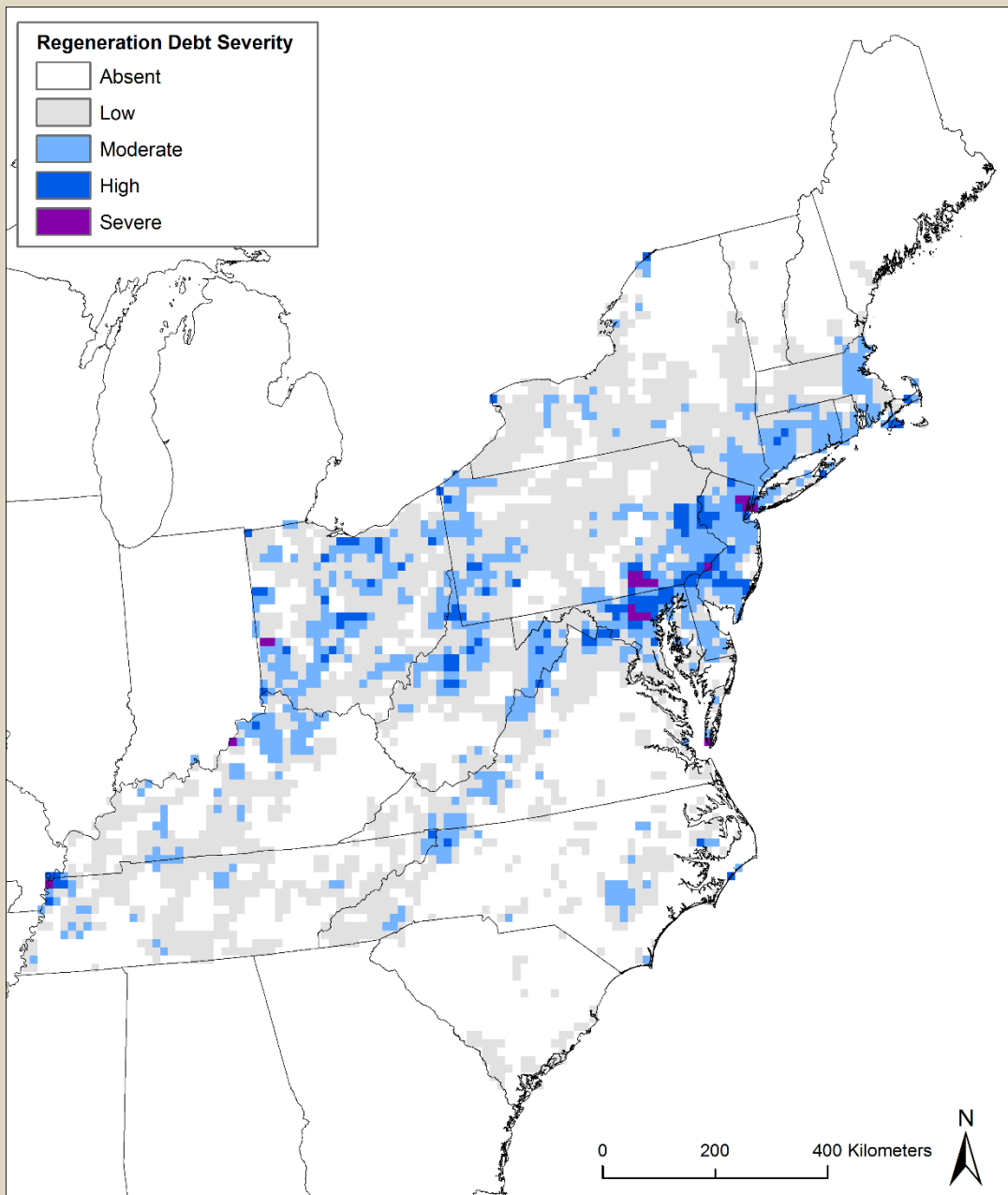
Invasive



Low Canopy



Regeneration Debt Quantified



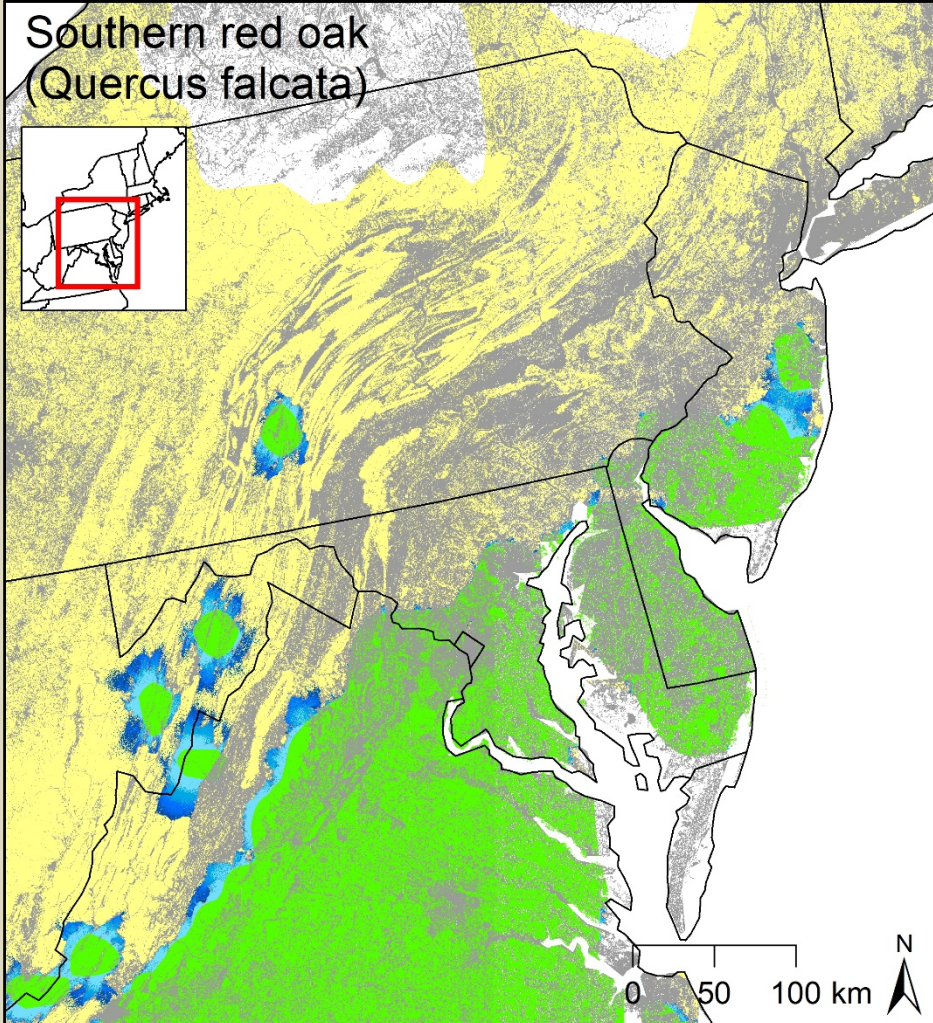
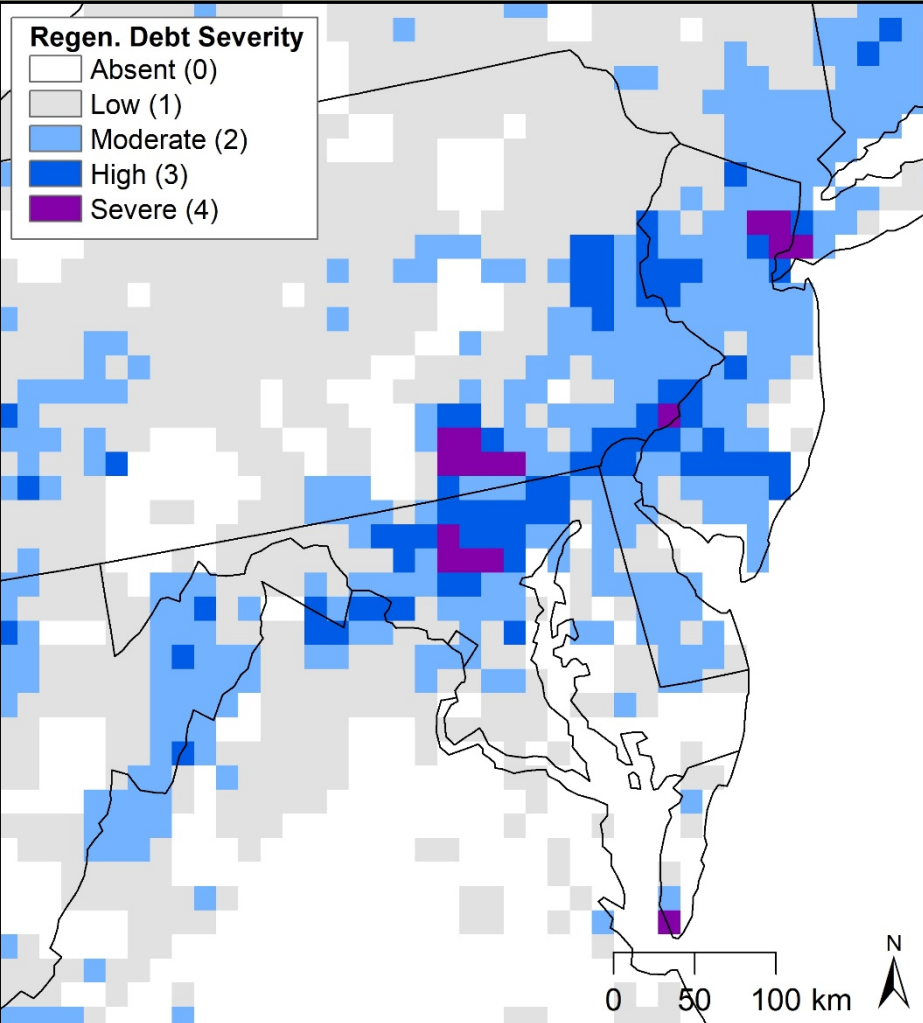
Regeneration Debt Summary



- Severe regeneration debt in mid-Atlantic forests, particularly in oak/hickory forests
- Anthropogenic stressors predicted debt better than climate change metrics
- Involves many of the species predicted to gain suitable habitat in the Northeast

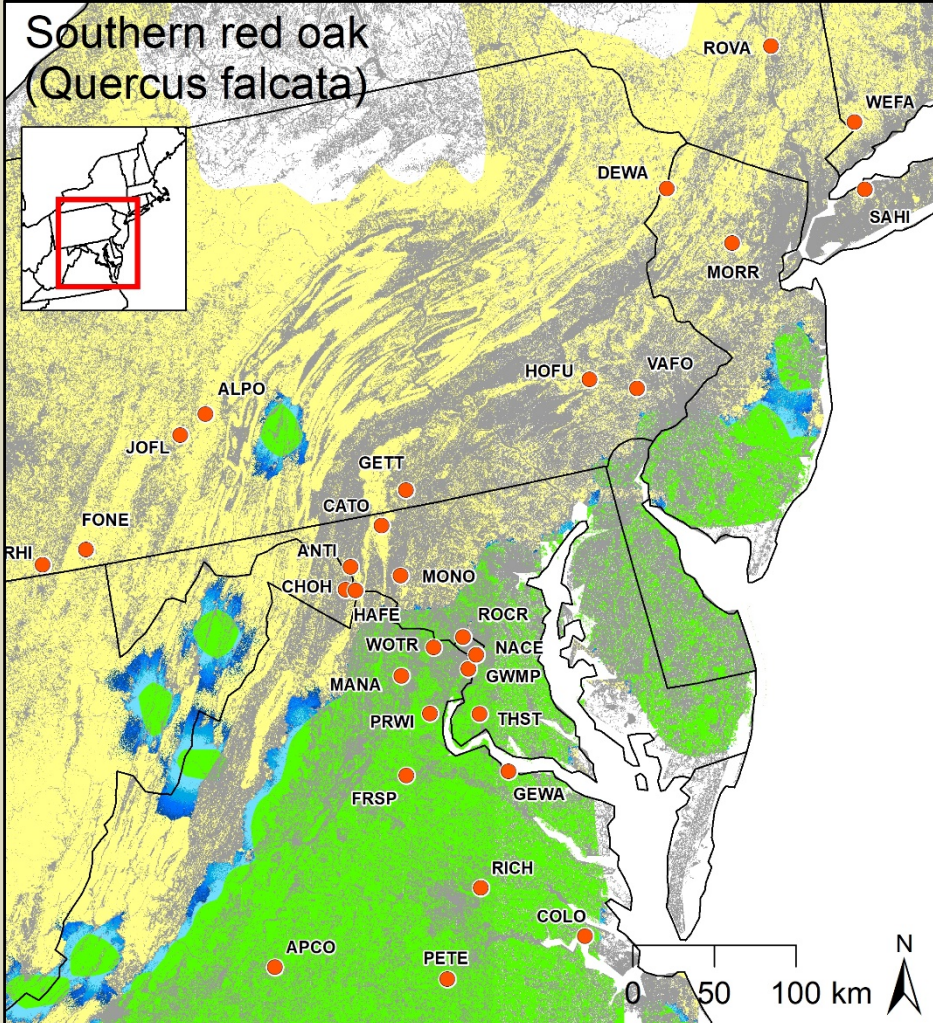
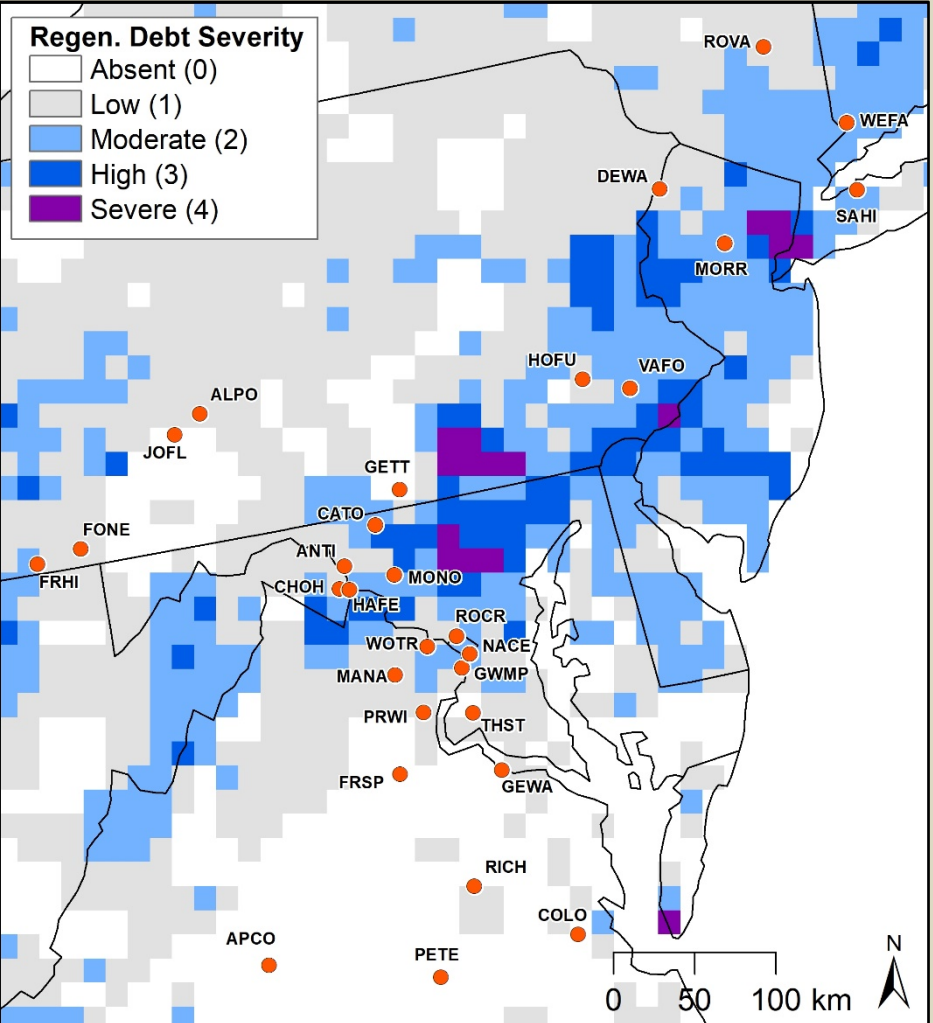


Overlapping migration barriers





Overlapping migration barriers

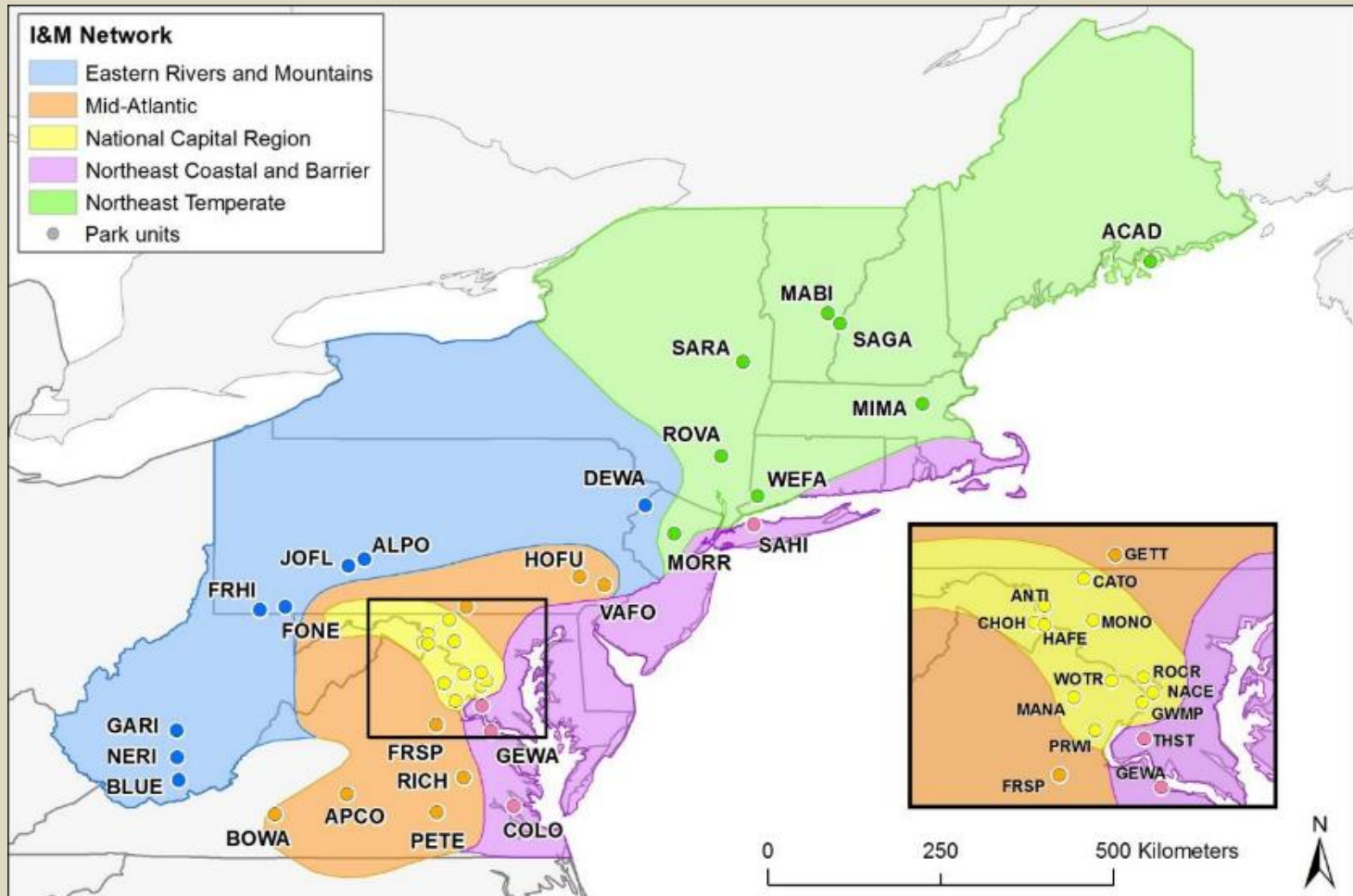




Regional trends in national parks

Invasive trend analysis

- 5 networks
- 39 parks
- 1,470 forest plots
- 3 cycles over 12 years



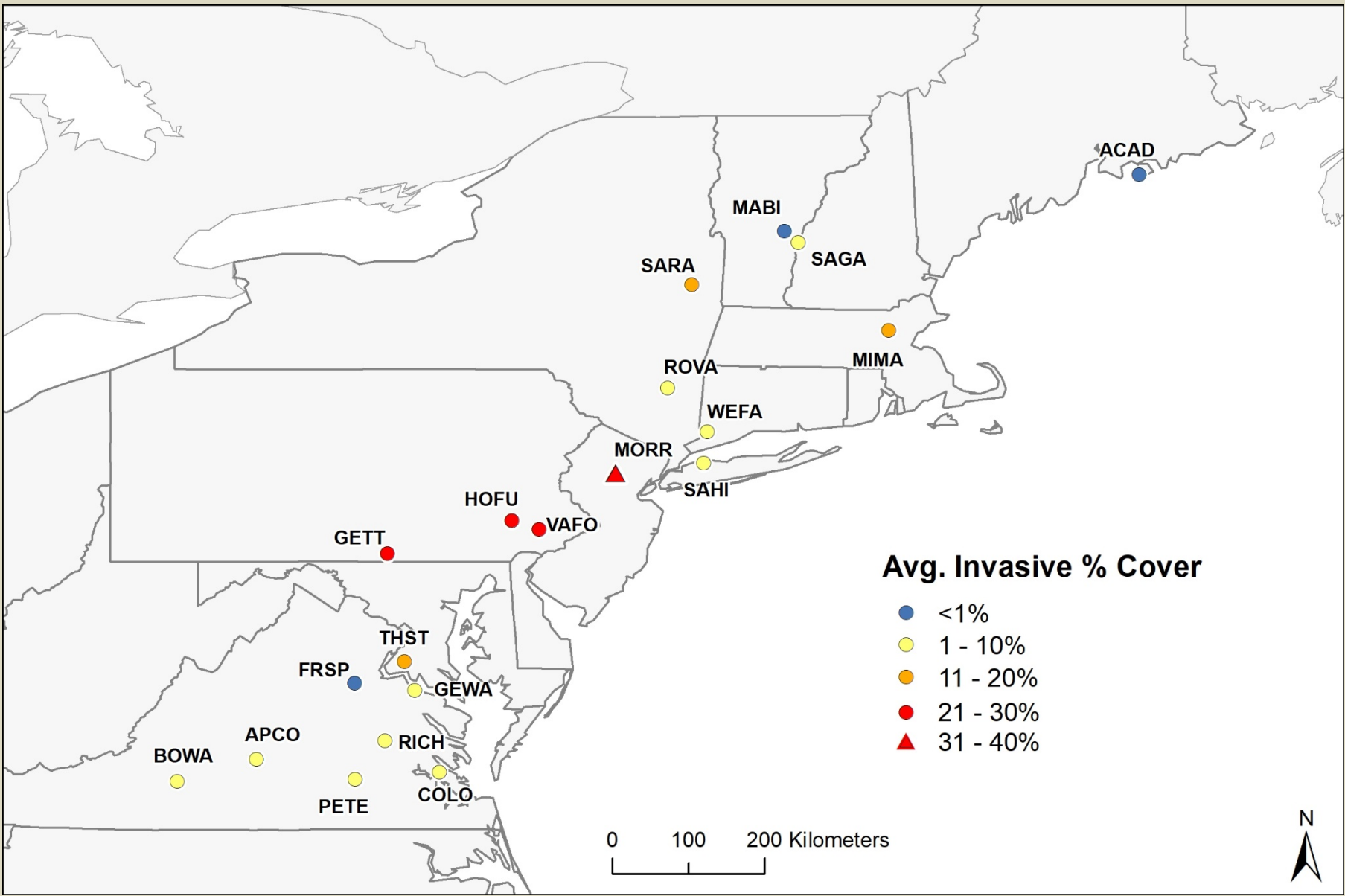
Invasive Trend Summary



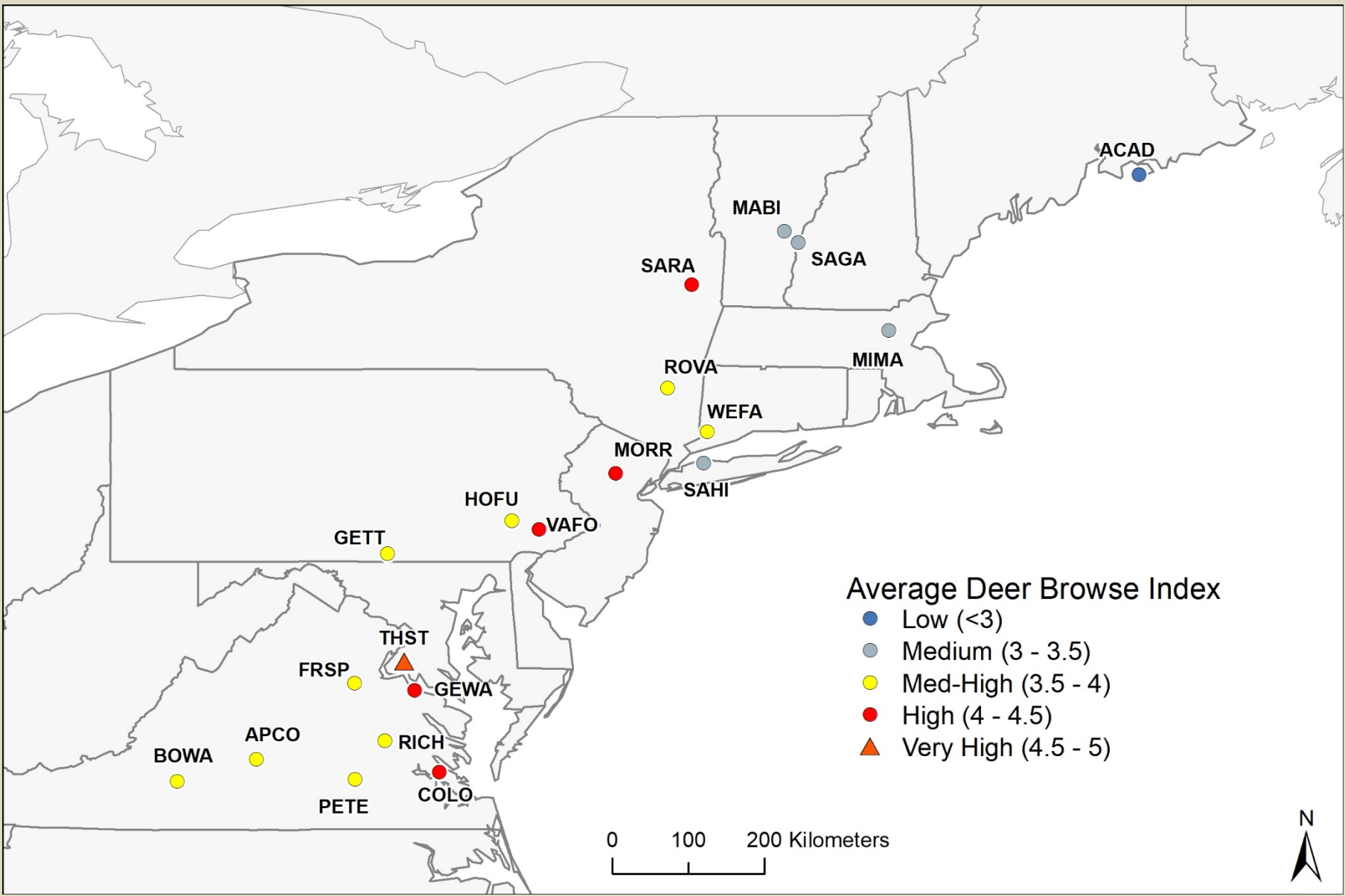
- Invasive species are widespread and consistently increasing in abundance across eastern parks
 - 35/39 parks had invasives in at least half of their plots
 - 30 parks had at least one significant increase
 - Only 2 parks showed overall declines
 - Worst invaders: exotic shrubs and Japanese stiltgrass (*Microstegium vimineum*)



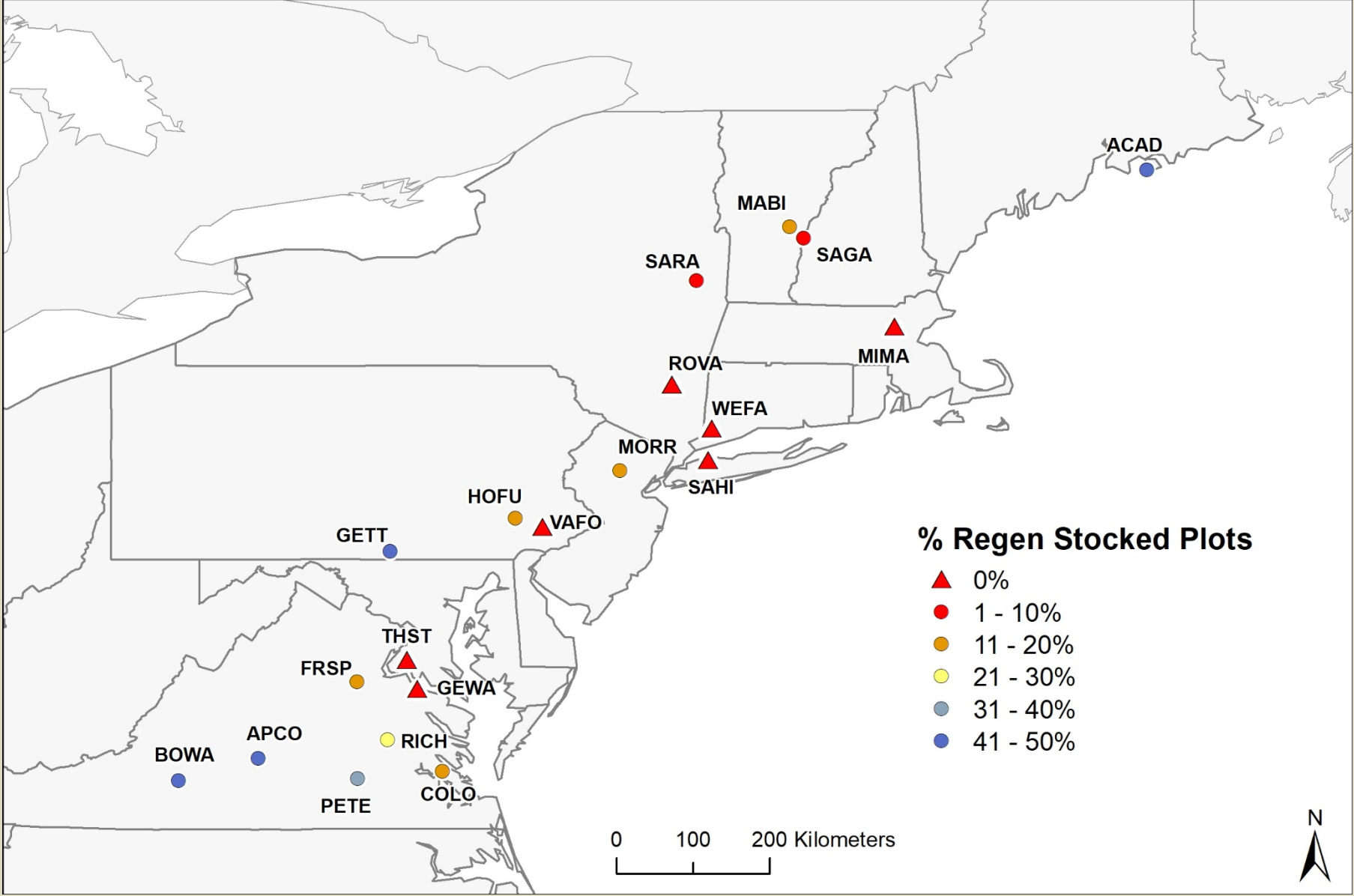
Invasive Plant Abundance



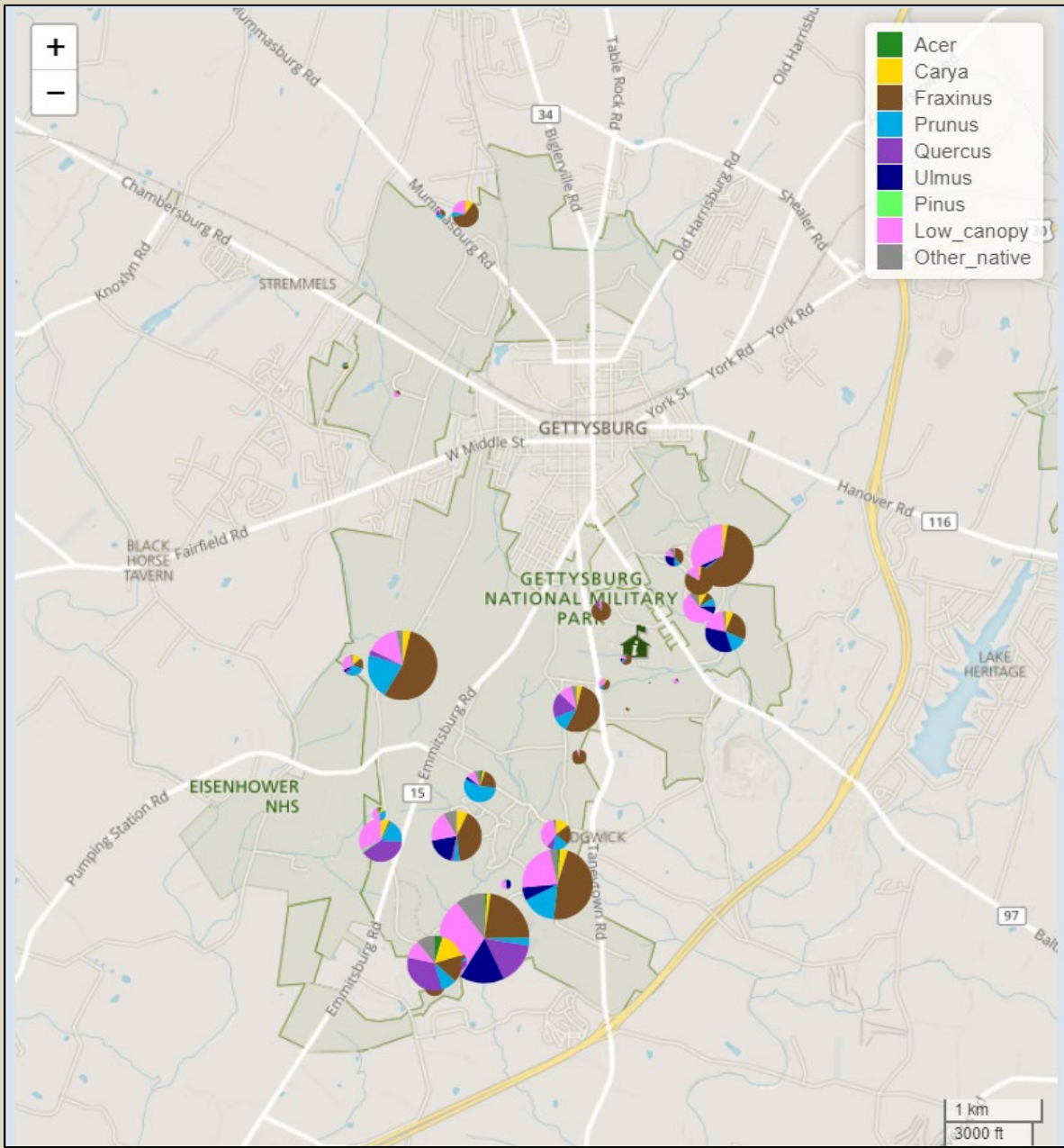
Index of Deer Browse Impacts



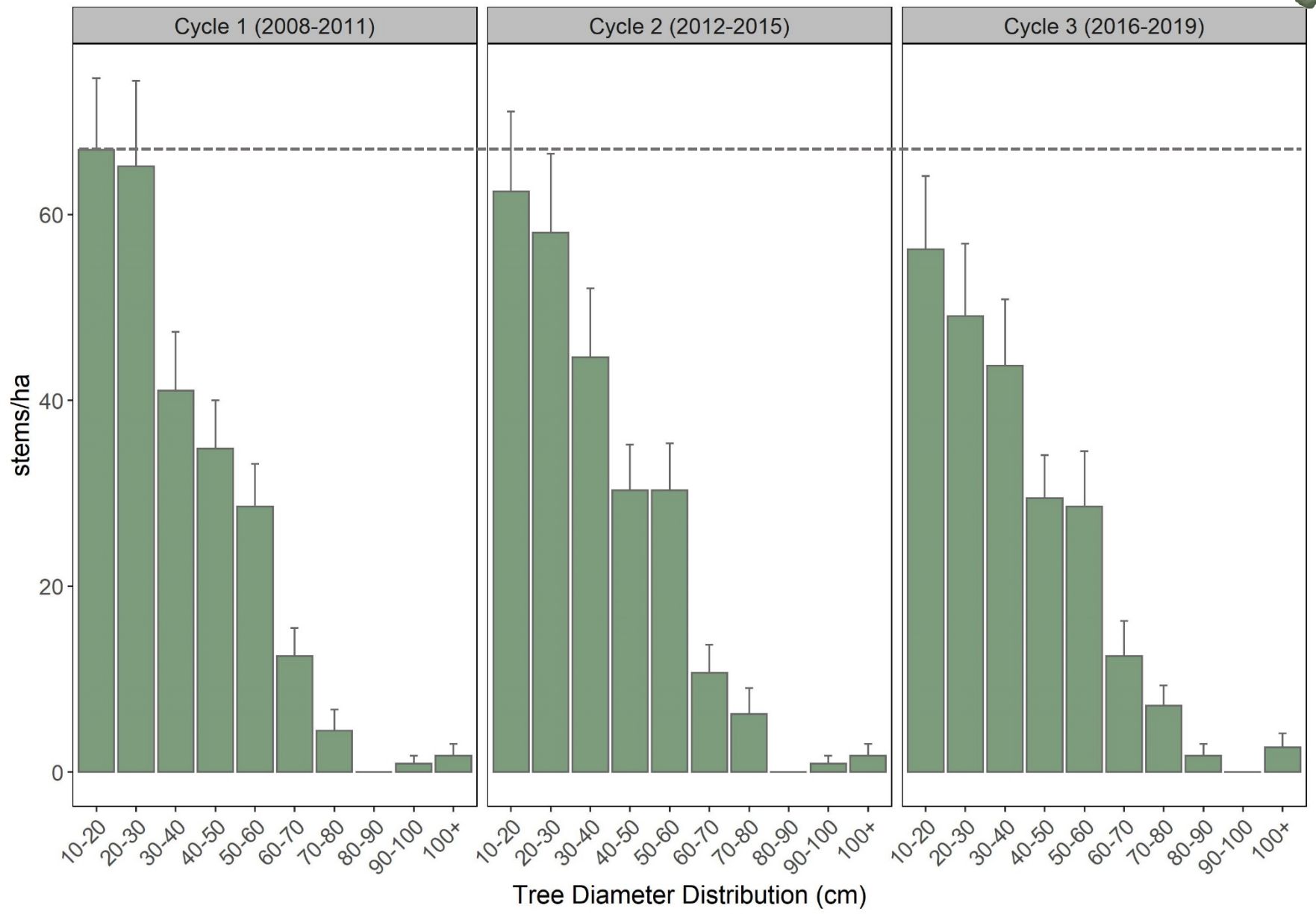
Regeneration Stocking Index



Regeneration Composition in GETT, PA



Tree Diameter Distribution: MORR, NJ



Exotic Shrub Thicket in MORR, NJ





Summary of Regeneration Concerns

- Invasive species and overabundant deer are impacting forest regeneration in parks and throughout the region
- Many species predicted to gain suitable habitat in the northeast have regeneration debts in their current range
- Spatial overlap of regeneration debt and dispersal barriers will likely impact tree migration



Management Recommendations



- Reduce non-climate stressors impacting regeneration
 - Overabundant deer
 - Invasive plants
- Range expansion and assisted migration beyond dispersal and regeneration barriers



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Research Gate Project: [Forest Monitoring in National Park Units of the Eastern USA](#)



National Park Service
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