

# Geospatial analysis of tree species at risk from nitrogen deposition in the northeastern U.S.

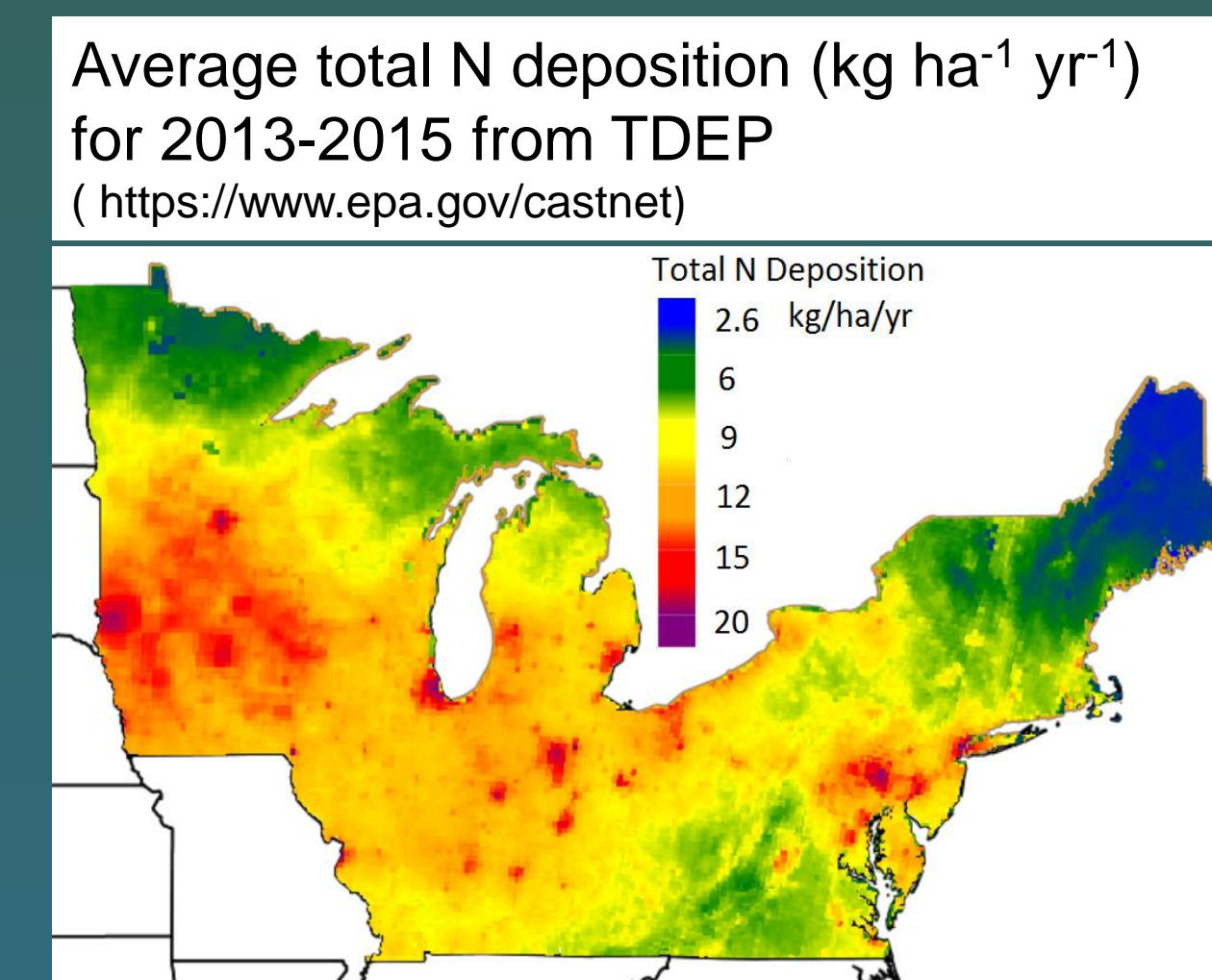
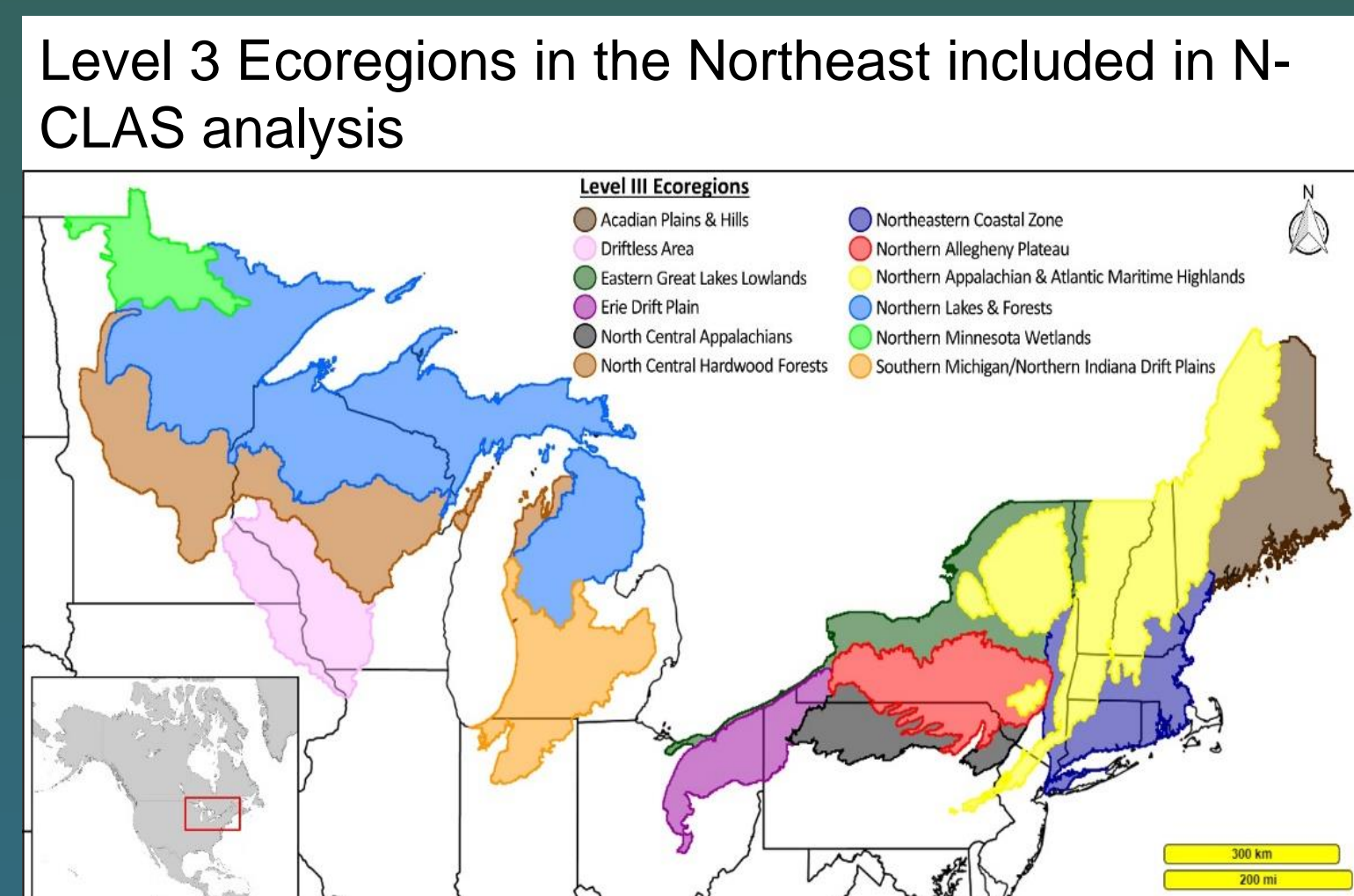
Molly Robin-Abbott<sup>a</sup>, Linda H. Pardo<sup>a</sup>, Jason A. Coombs<sup>b</sup>, Jennifer H. Pontius<sup>c</sup>, Anthony W. D'Amato<sup>c</sup>

<sup>a</sup> USDA Forest Service, Northern Research Station, Burlington VT 05405 <sup>b</sup> Department of Environmental Conservation/USDA Forest Service, Amherst MA 01003, <sup>c</sup> Rubenstein School of Environment and Natural Resources, University of Vermont, Burlington VT 05405

## Background information

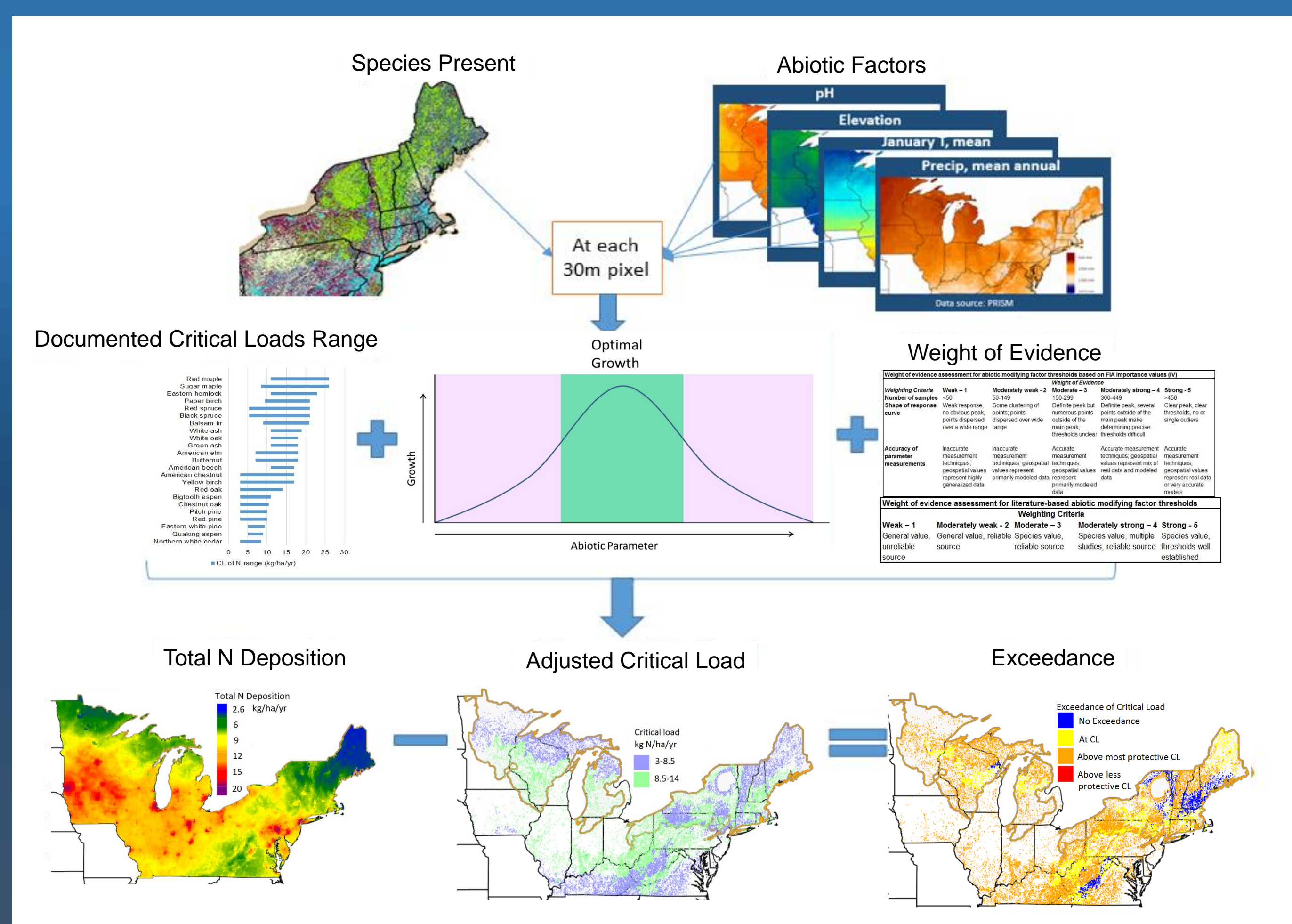
Spatial patterns of tree species at risk from N deposition were analyzed using **N-CLAS** (Nitrogen Critical Loads Assessment by Site), an online GIS tool. N-CLAS maps the critical load, target load, and exceedance of the critical load of N for 23 tree species of management concern in the northeastern United States.

**Critical load:** the level of deposition below which no harmful ecological effects occur.



## Methods

- N-CLAS uses geospatial data for topographic, climatic, and soil parameters (abiotic modifying factors) to predict whether growth in each 30 x 30 m pixel is likely to be optimal or suboptimal for each species.
- The combined effect of abiotic modifying factors on growth determines whether the N-CLAS adjusted critical load for a species will be in the bottom half or upper half of the species' reported critical load range (Robin-Abbott and Pardo, 2017).
- For every pixel across the landscape, N-CLAS calculates an adjusted critical load for individual species, an aggregate critical load for all species present, and exceedance of the critical load.

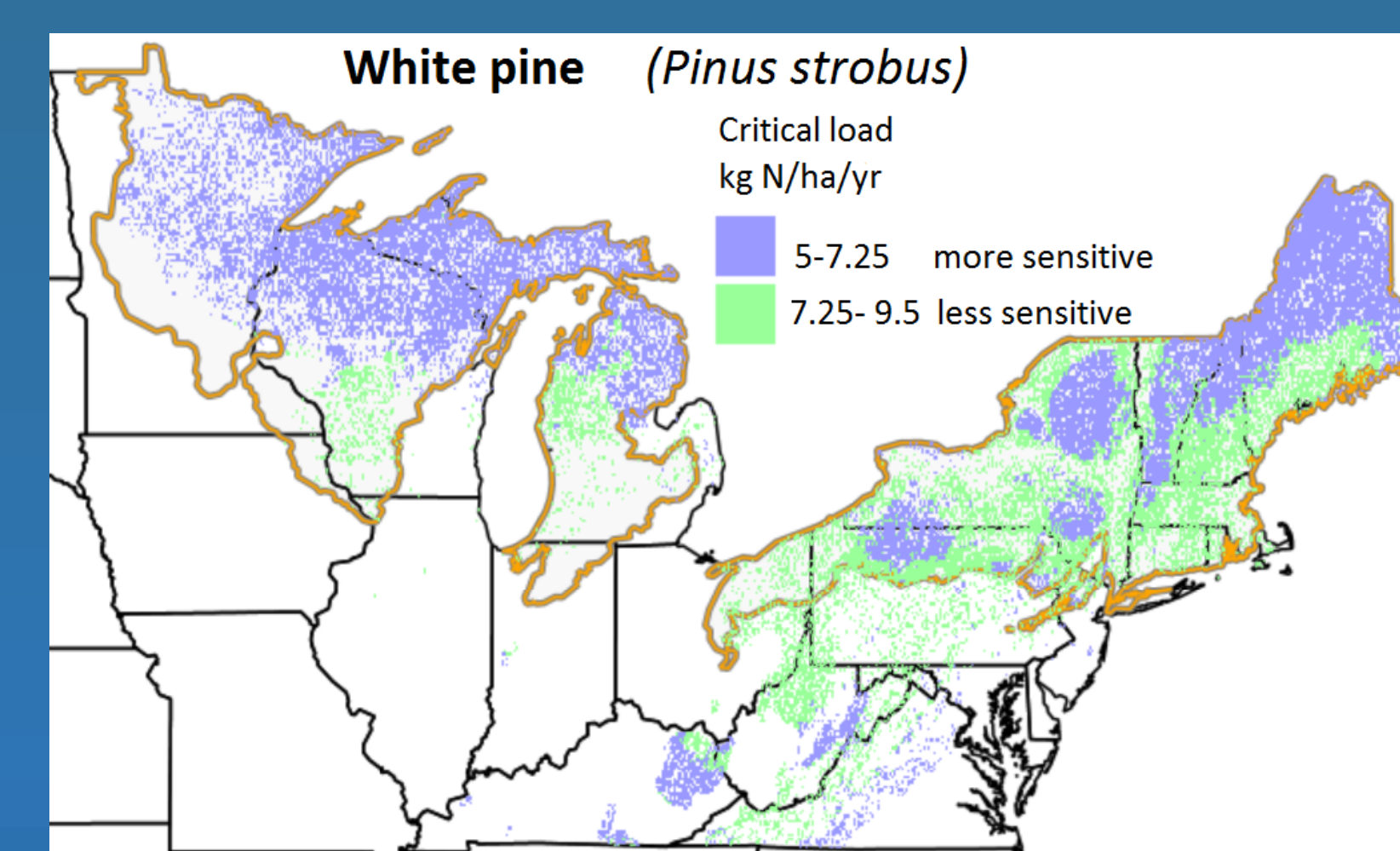
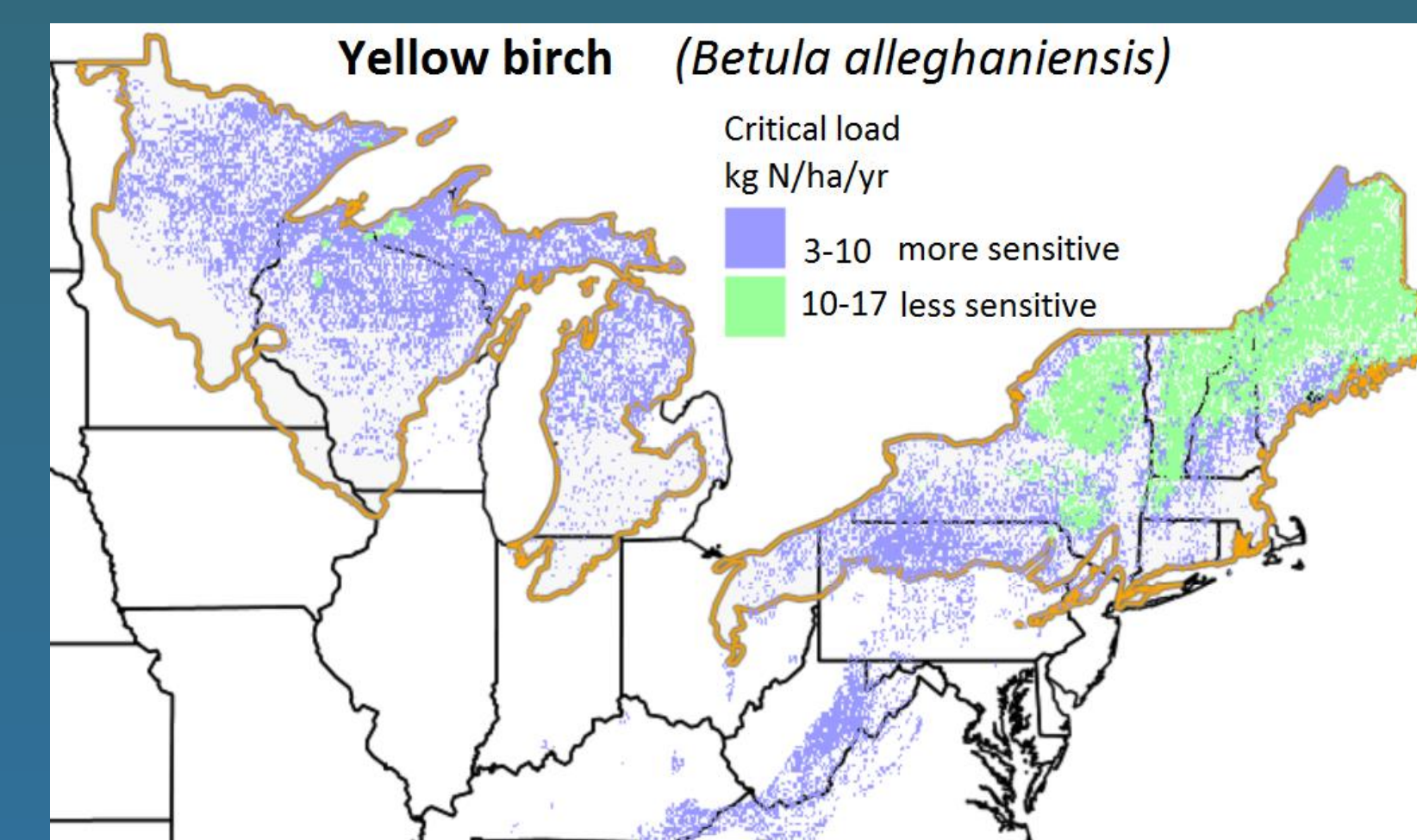
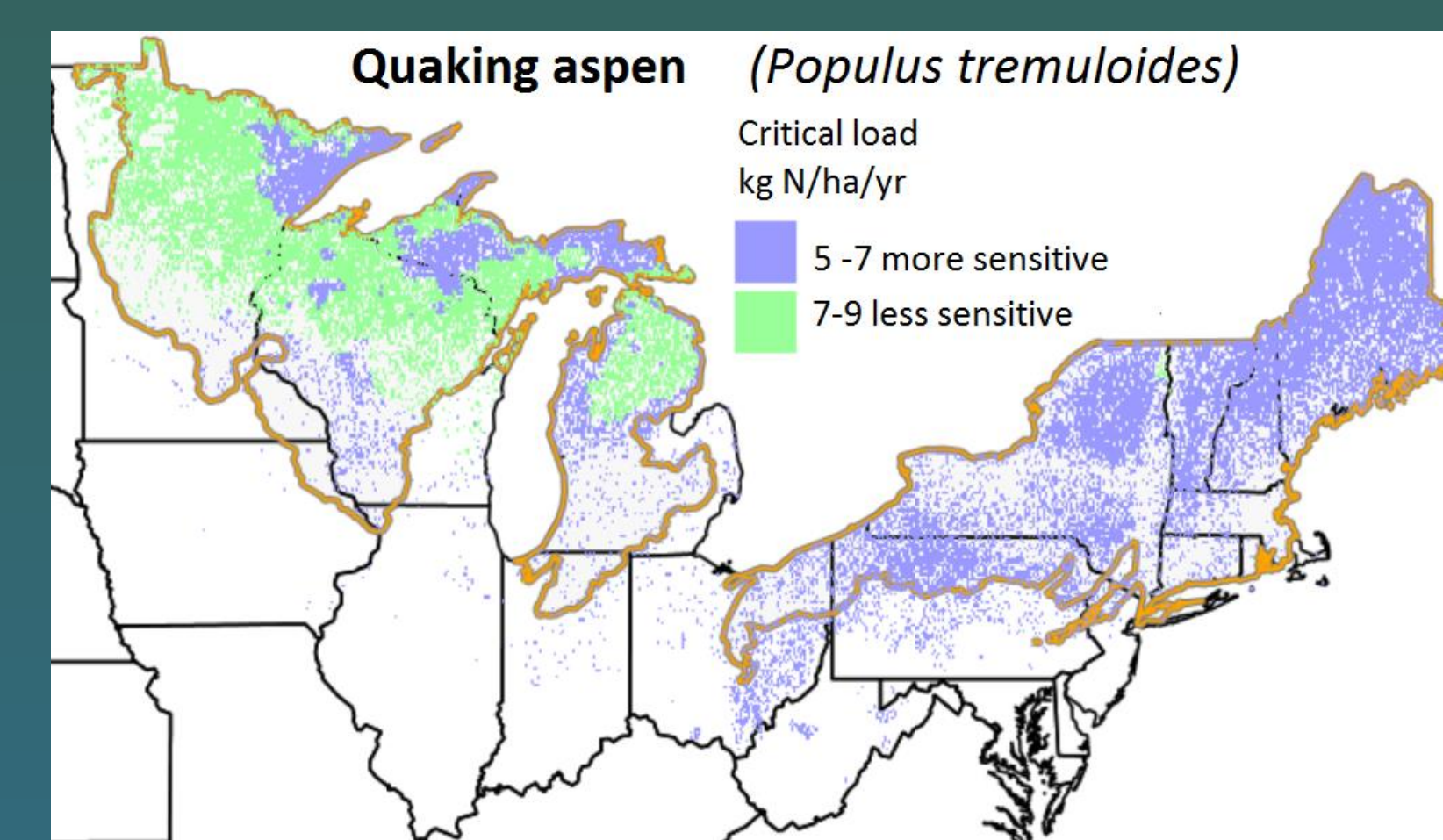


## Results

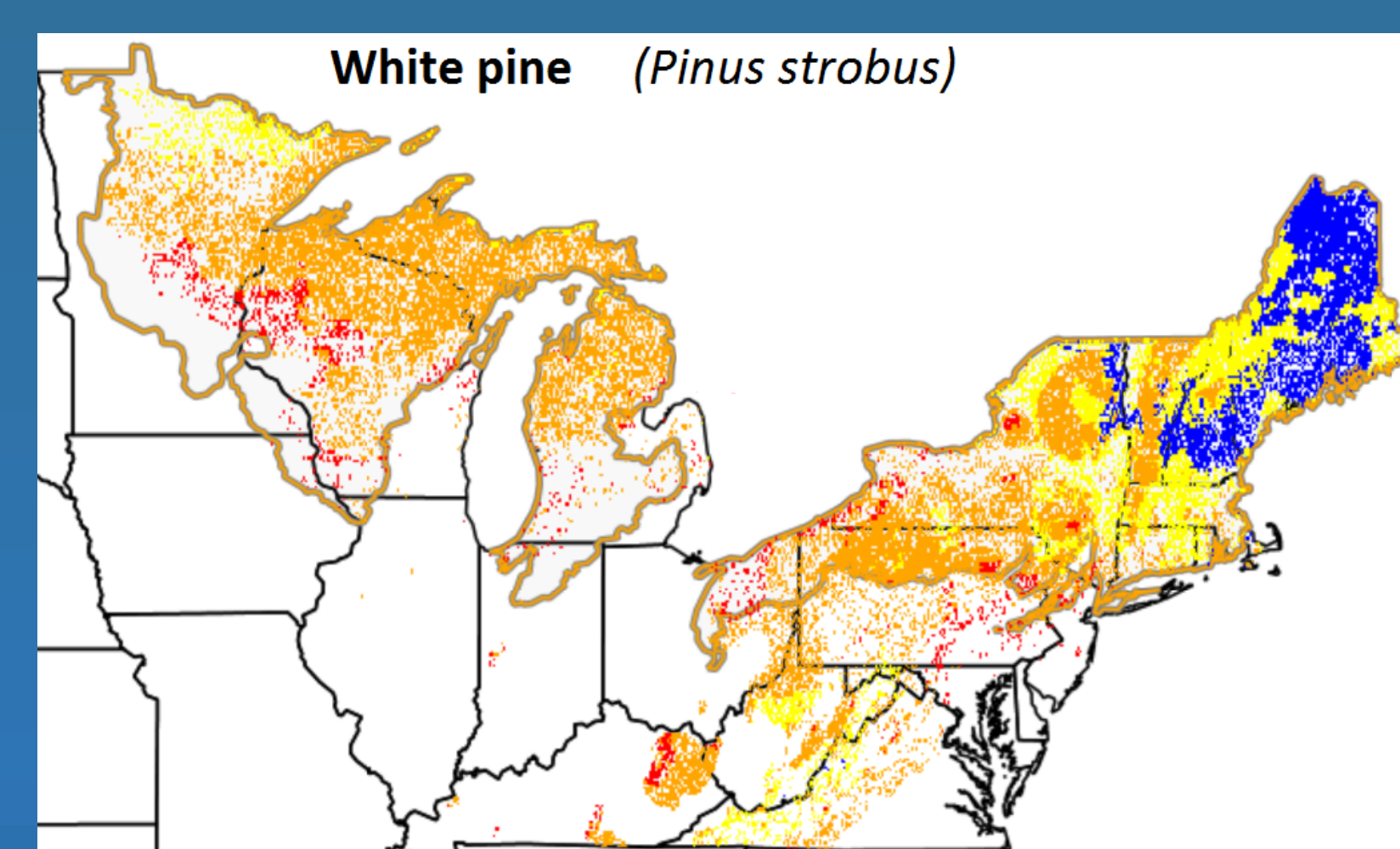
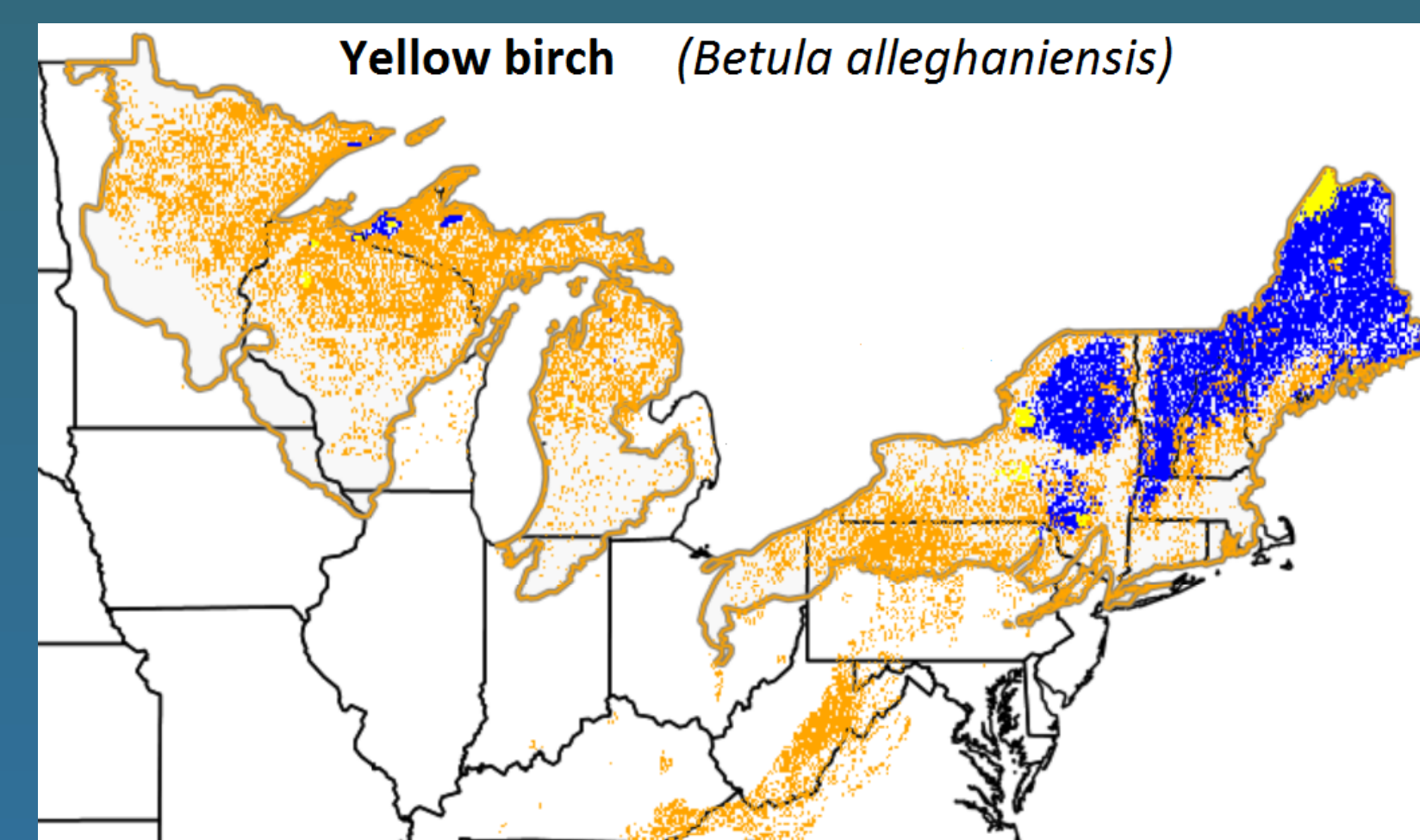
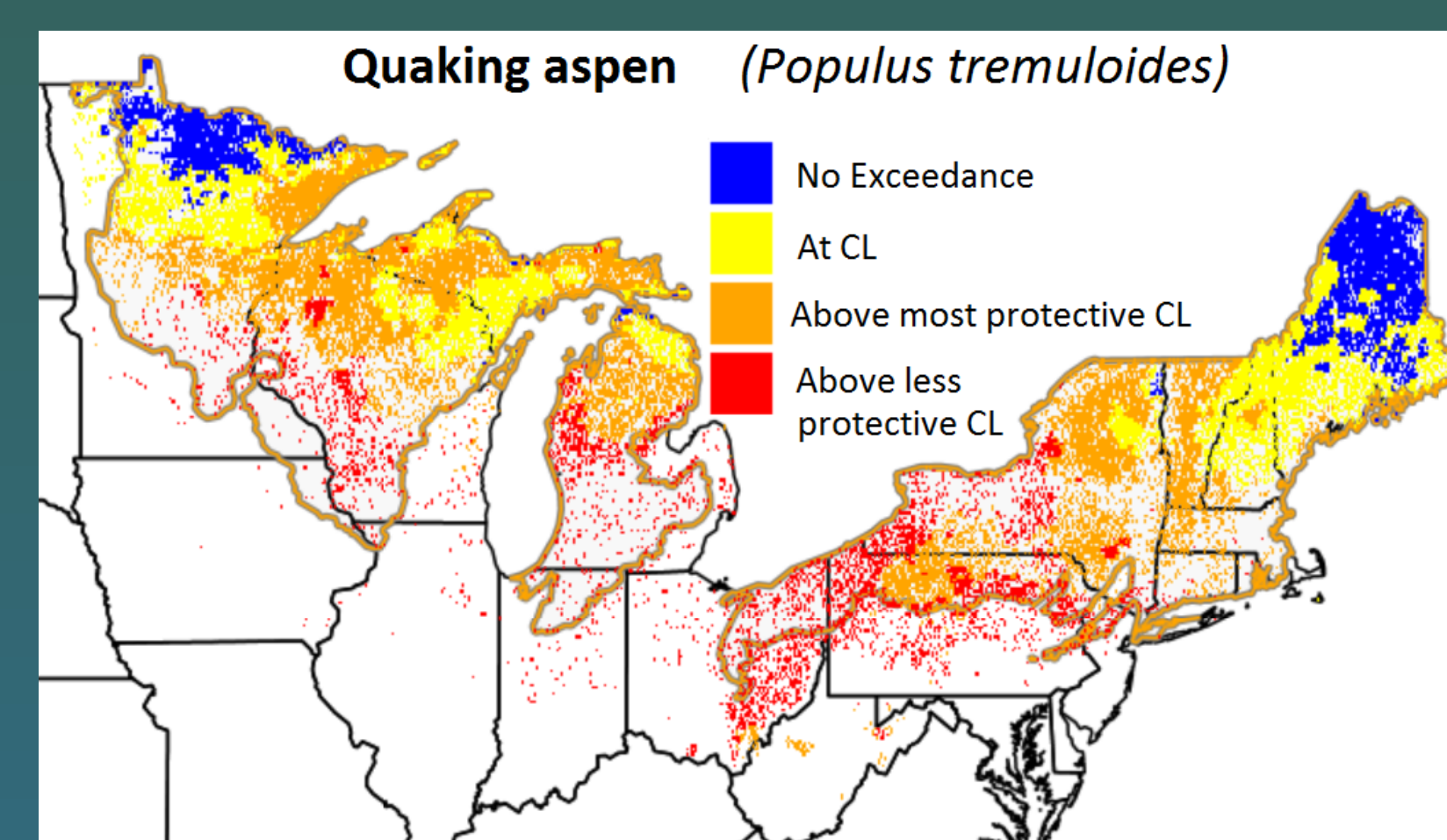
The species most at risk are yellow birch, eastern white pine, and quaking aspen.

- These species have low critical loads and the most area in exceedance across the study area.
- Other N sensitive species with large areas in exceedance include butternut, northern white cedar, American elm, bigtooth aspen, and northern red oak.
- Chestnut oak, pitch pine, and red pine have the highest percent of their range in exceedance.

### Critical Loads



### Exceedance of Critical Load



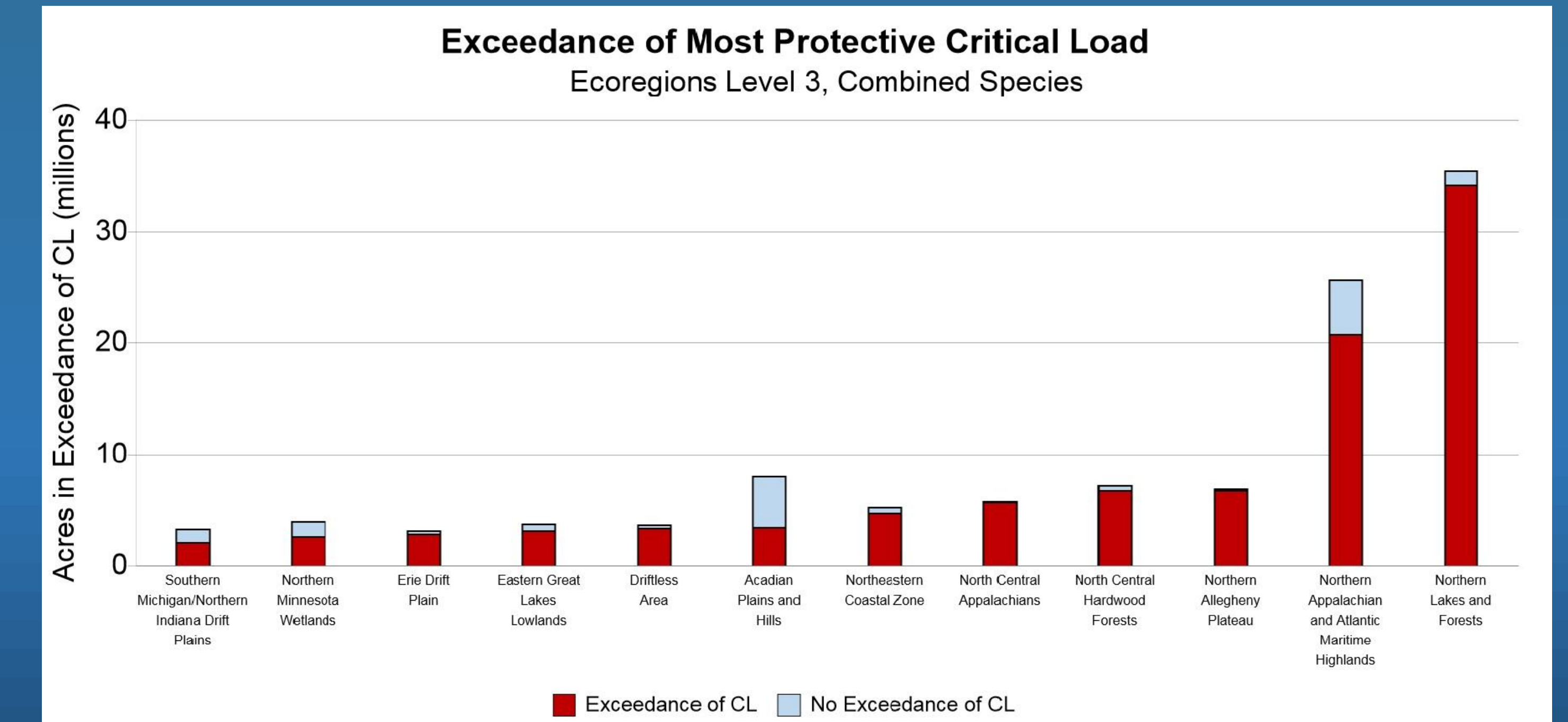
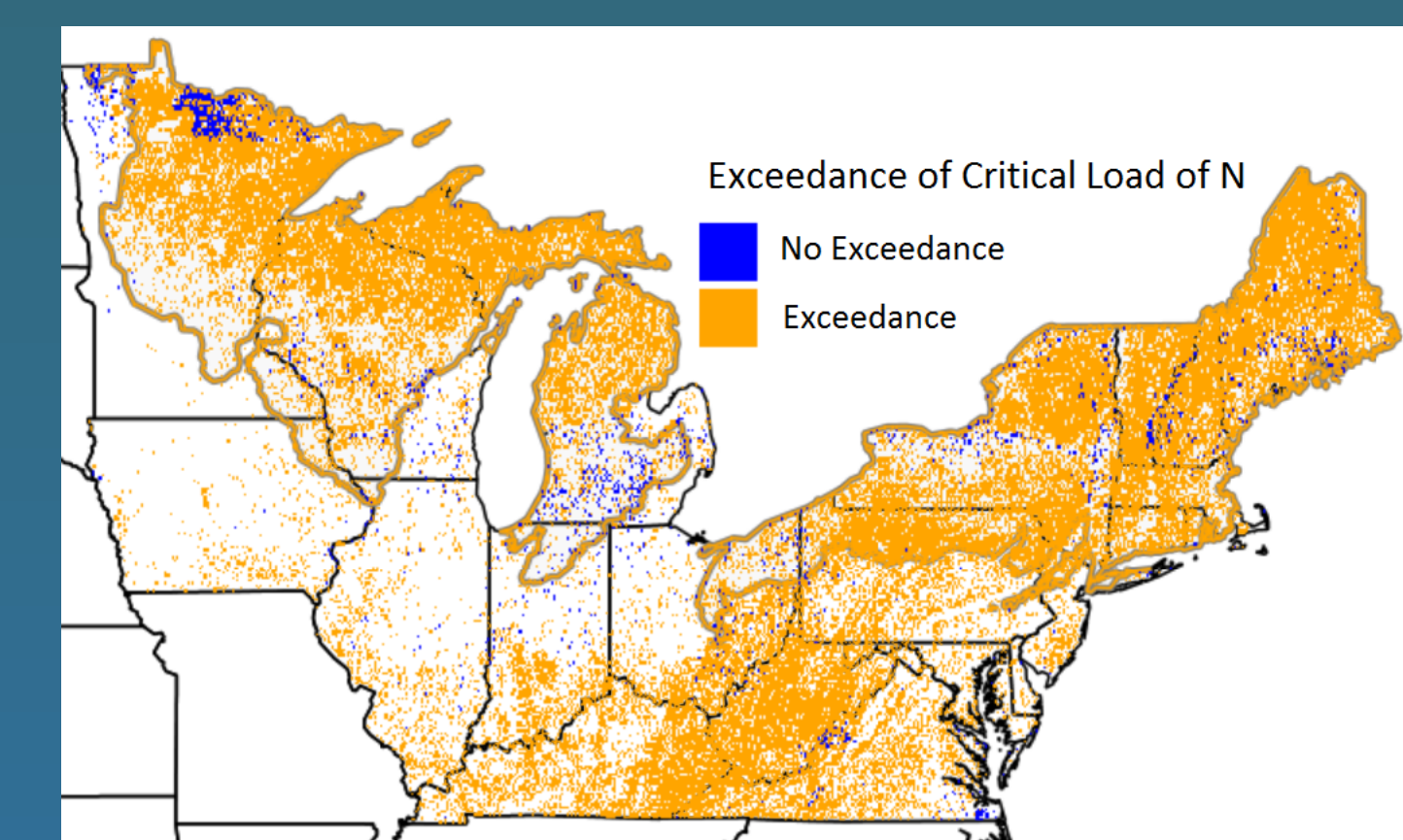
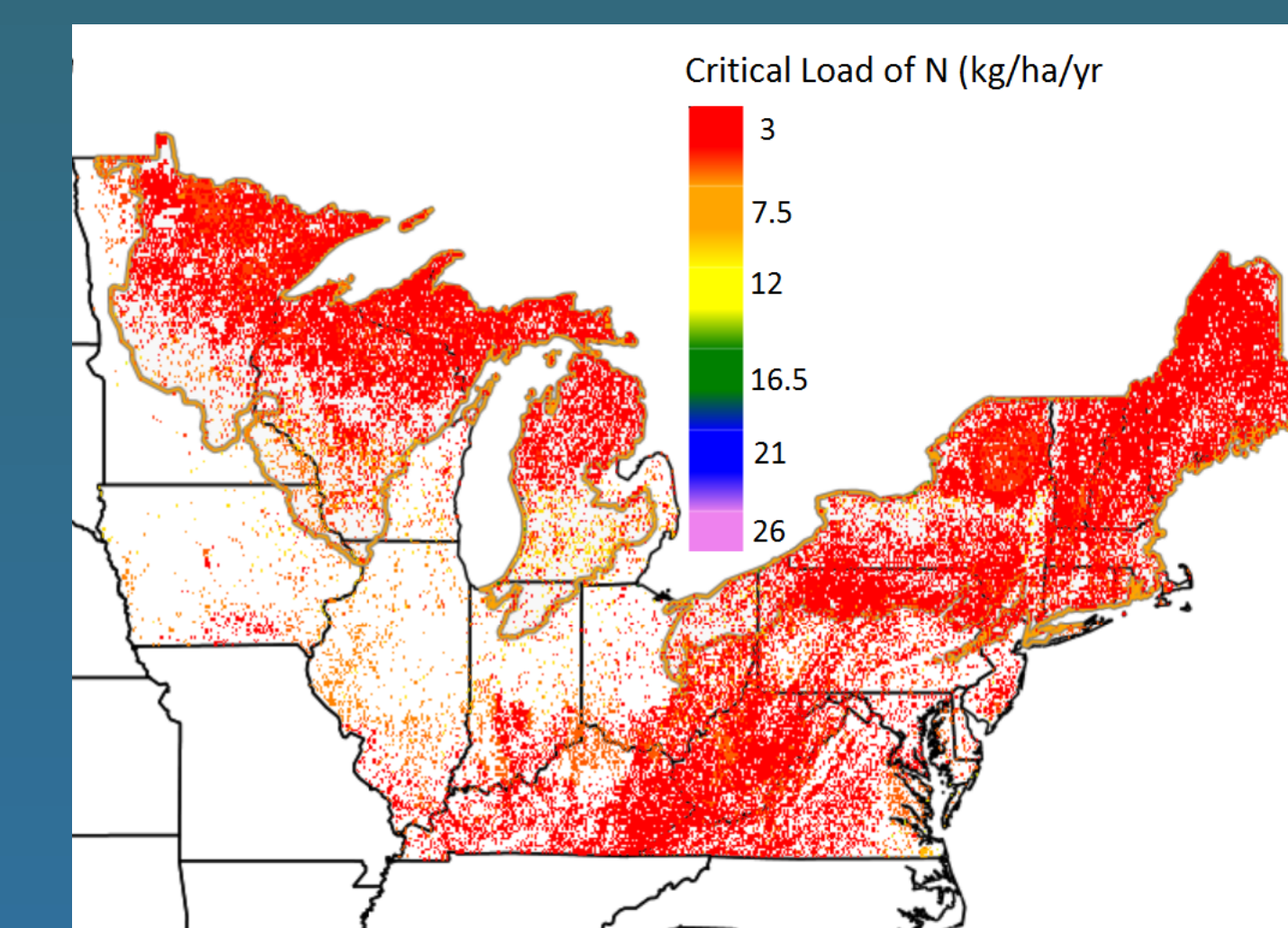
## Results

Eighty-six percent of forested area in the region (98M acres) is in exceedance of the most protective critical load.

- The magnitude of exceedance is highest (6-8 kg N ha<sup>-1</sup> yr<sup>-1</sup>) in southwestern parts of the study region where N deposition is higher.
- The magnitude of exceedance is lowest (1-2 kg N ha<sup>-1</sup> yr<sup>-1</sup>) in the northeastern and northwestern part of the study area where N deposition is lower.

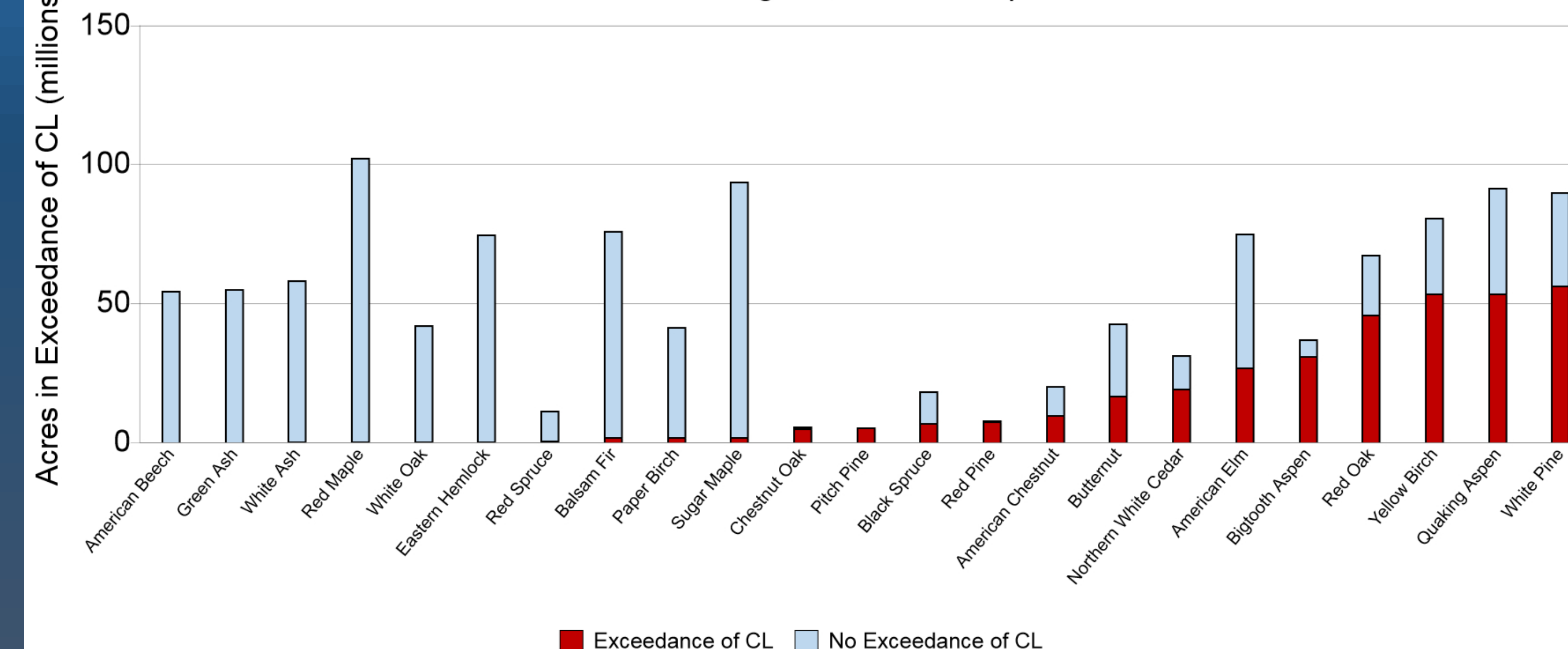
### Critical load and exceedance of the most protective critical load for combined species:

This critical load protects the most N sensitive species in each 30 x 30 m pixel.



### Exceedance of Most Protective Critical Load

All Ecoregions, Individual Species



**Exceedance of the most protective critical load:**  
The most protective critical load is the low end of the critical load range.

## Resources:

<http://ecosheds.org:3411/NCLAS/>



Pardo, L. H., Coombs, J. A., Robin-Abbott, M. J., Pontius, J. A., D'Amato, A. W. *In review*. Tree species at risk from nitrogen deposition in the northeastern United States: a geospatial analysis of effects of multiple stressors using exceedance of critical loads. *Forest Ecology and Management*.

Robin-Abbott, M. J., Pardo, L. H. 2017. How Climatic Conditions, Site, and Soil Characteristics Affect Tree Growth and Critical Loads of Nitrogen for Northeastern Tree Species. *Gen. Tech. Rep. NRS-172*. Newtown Square, PA, U.S. Department of Agriculture, Forest Service, Northern Research Station, USA.