

Assessing critical loads nationwide and in relationship to Native American tribal lands



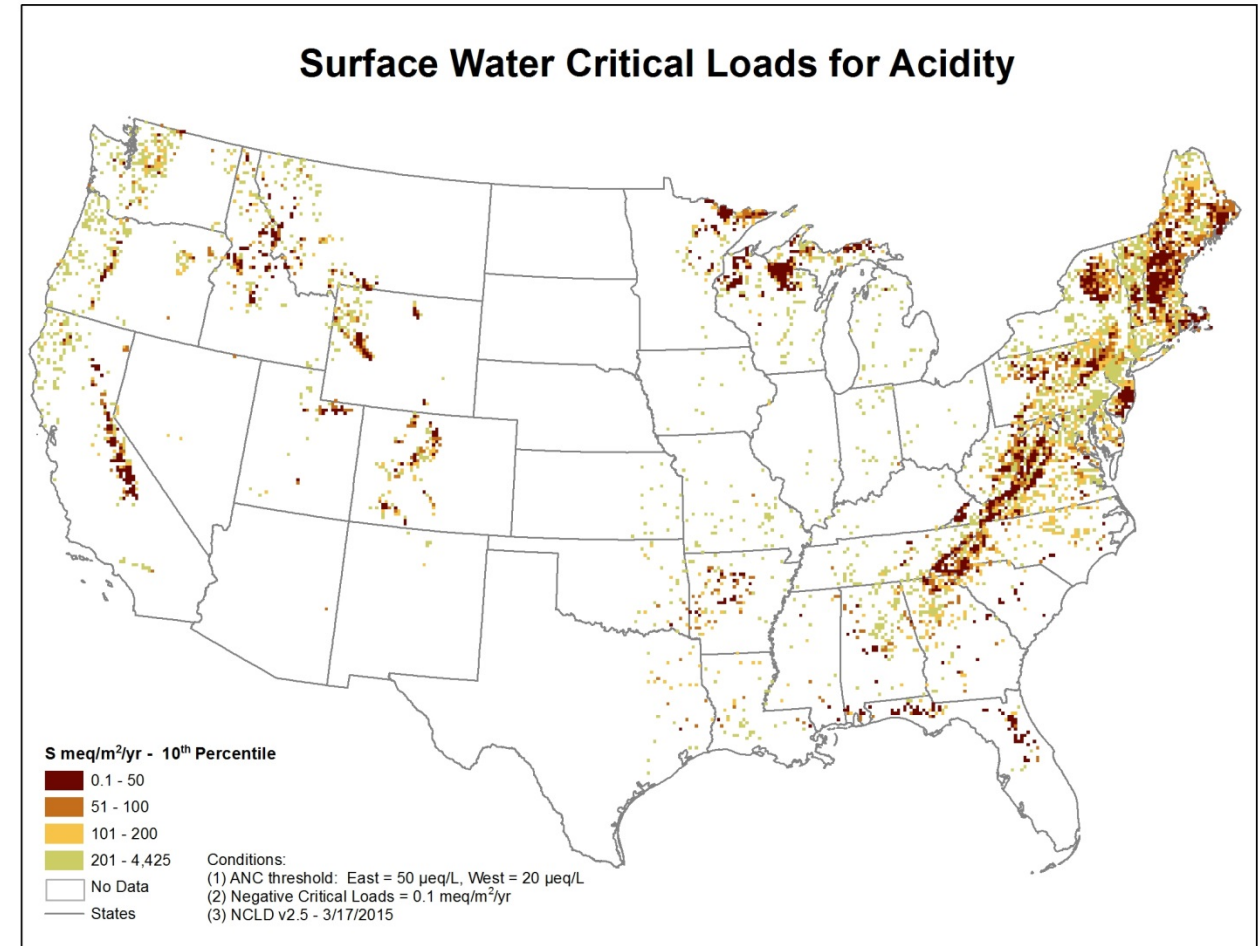
Jason Lynch and Clara Funk

**Environmental Protection Agency
Office of Atmospheric Programs**

**2016 NADP Scientific Symposium
November 3, 2016**

Introduction

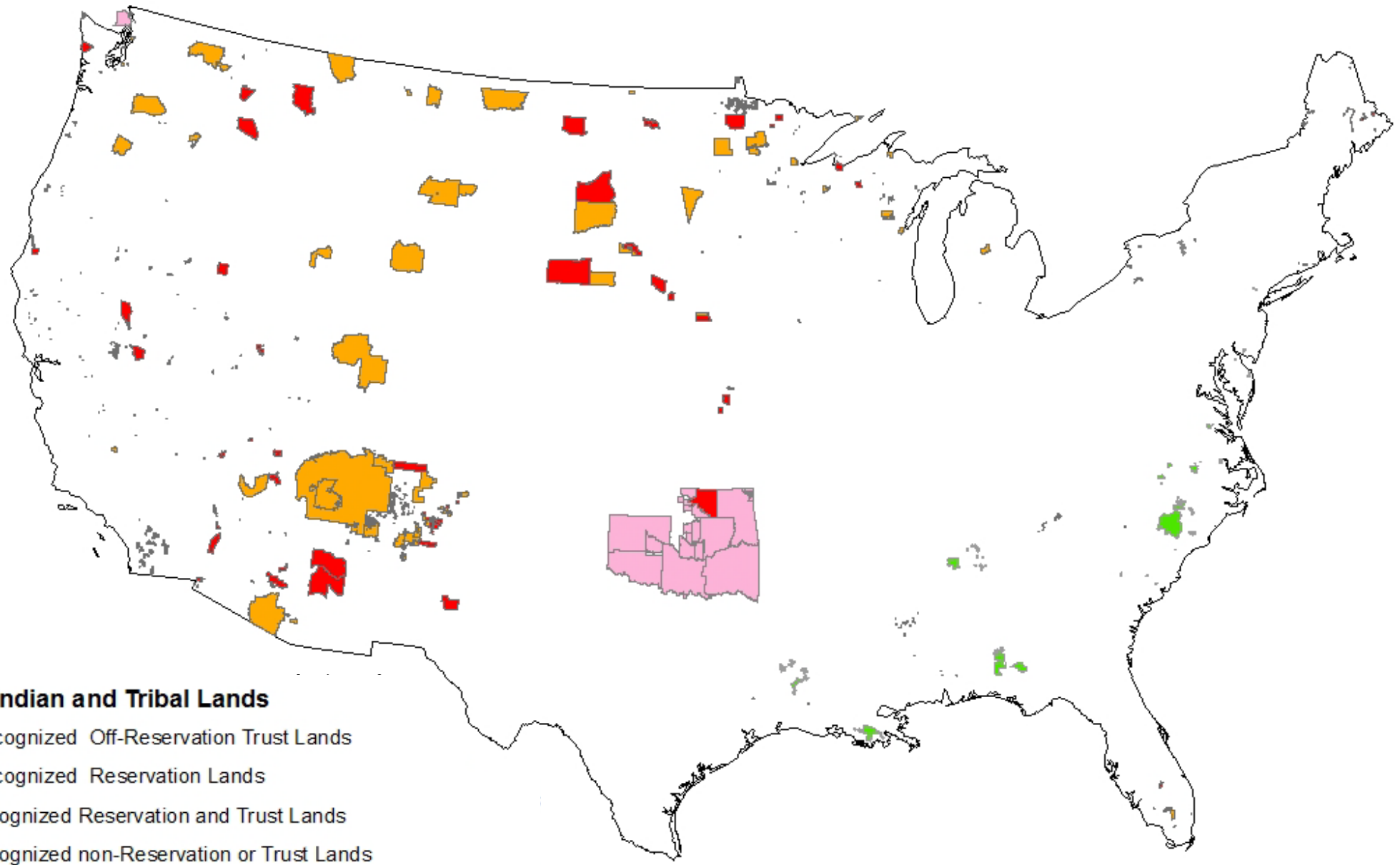
- **National Critical Load Database**
- **National vs. Regional to Local**
- **First Nations and Tribal Lands**



Objectives

- **Is to use critical load data from the National Critical Load Database (NCLD) to examine critical load exceedances both across the US and on Tribal lands**
- **To determine if differences exist among the different critical load endpoints for Tribal lands compared to U.S**
- **Initial Evaluation**



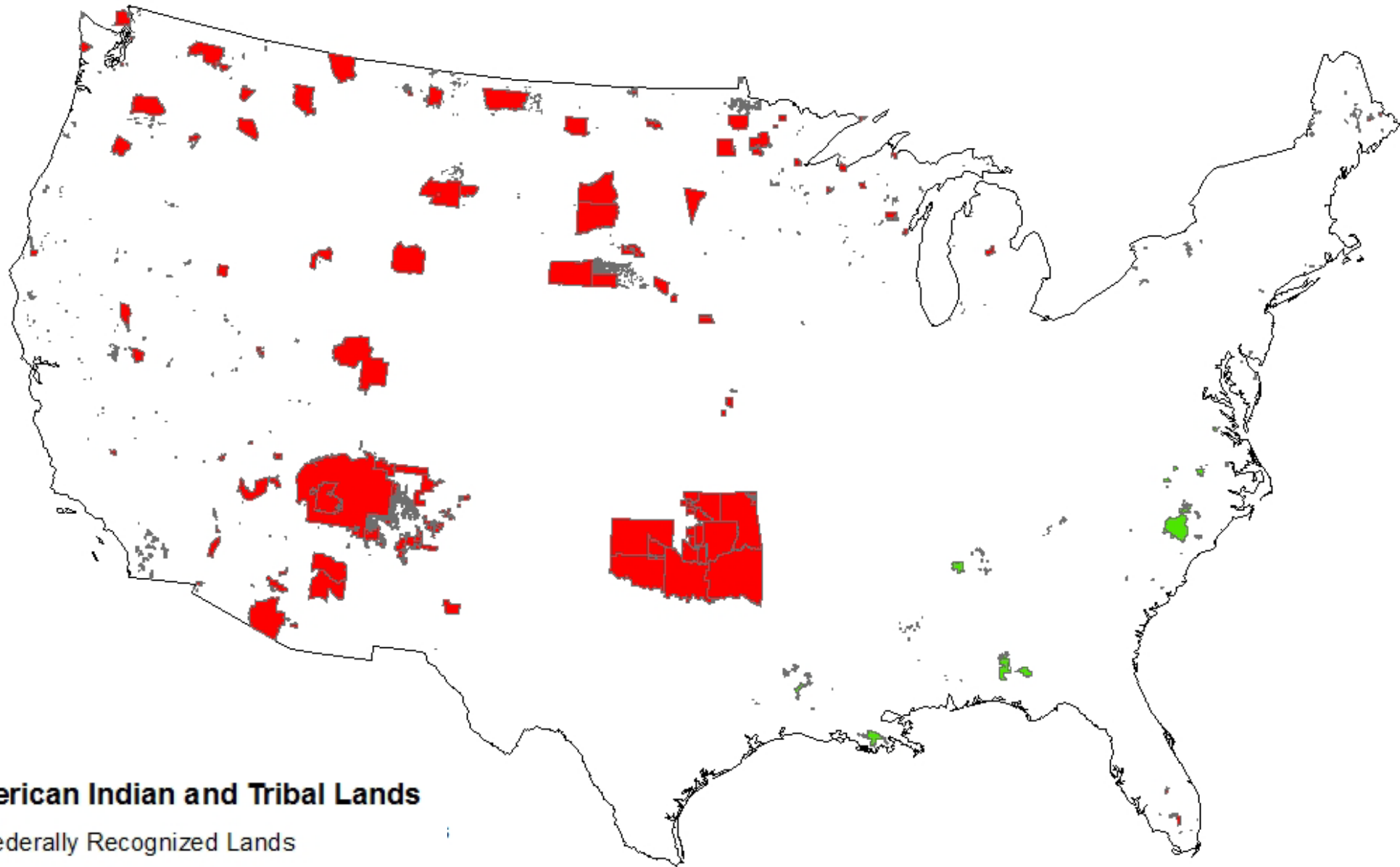


Legal American Indian and Tribal Lands

-  Federally Recognized Off-Reservation Trust Lands
-  Federally Recognized Reservation Lands
-  Federally Recognized Reservation and Trust Lands
-  Federally Recognized non-Reservation or Trust Lands
-  State Recognized Lands
-  State Recognized non-Reservation or Trust Lands

Source: U.S. Census Bureau





Legal American Indian and Tribal Lands

 All Federally Recognized Lands

 All State Recognized Lands

Source: U.S. Census Bureau

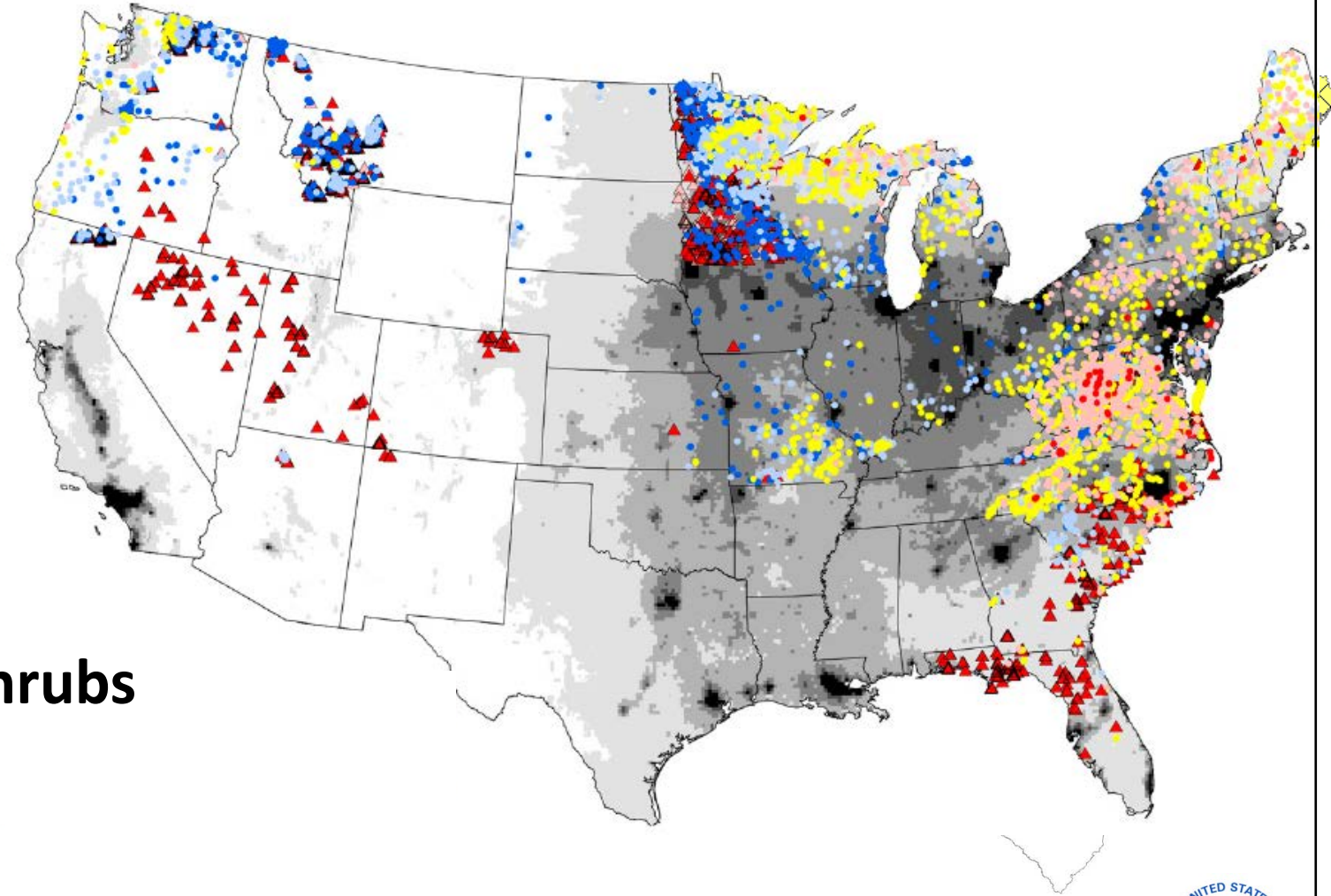


Critical Loads

- **The threshold of deposition below which specified harmful ecological effects do not occur (Porter et al. 2005)**
- **Potential Ecological Sensitivity and Vulnerability**
- It is **NOT** about protection of Human Health

Biological Receptors




- **Aquatic Acidification**
(McDonnell et al. & others)
- **Terrestrial Acidification**
(McNulty et al., Duarte et al., McDonnell & Sullivan, Phelan et al.)
- **Empirical for Nitrogen**
(Pardo et al., Simkin et al.)
 - **Forest**
 - **Herbaceous Plants and Shrubs**
 - **Mycorrhizal Fungi**
 - **Herb Diversity**



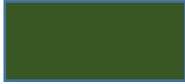



Analysis

- **Critical Load Exceedance = Deposition – Critical Load**

Acidification

-		Doesn't Exceed
		Could exceed +/- 10%
+		Exceeds

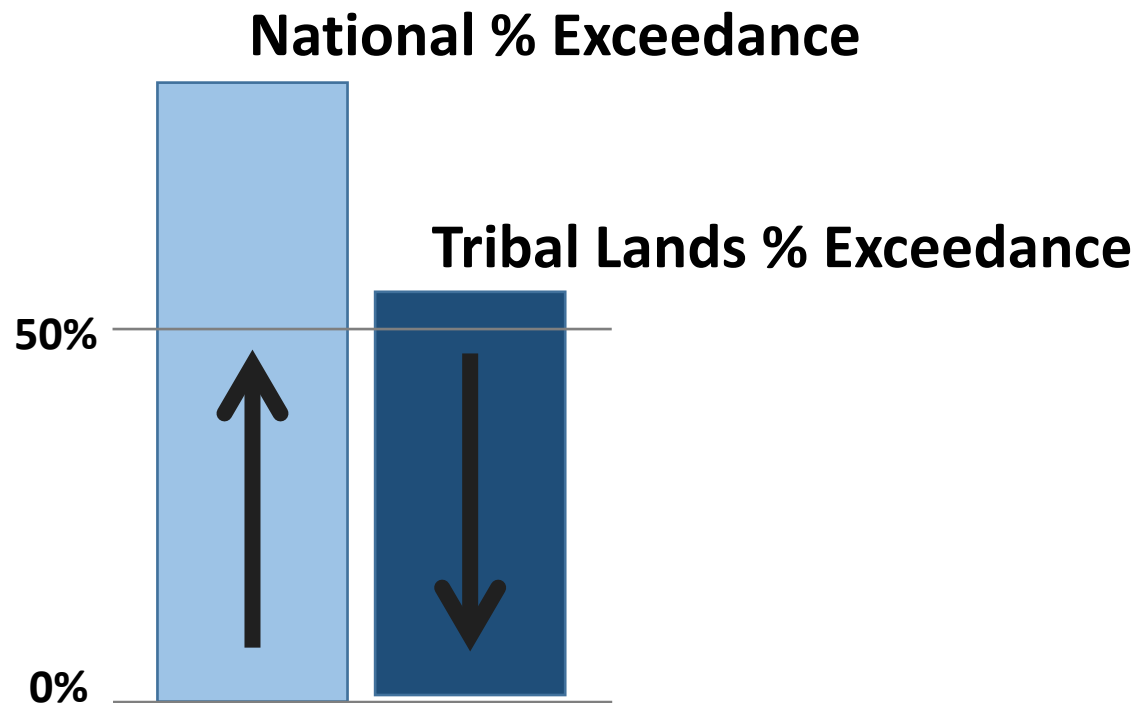
Empirical

	Doesn't Exceed
	Could exceed +/- 0.5 kg/ha
	Exceed min. Critical Load
	Exceed max. Critical Load

- **“Tdep” - Total S and N Deposition 2000-2002 & 2012-2014**
- **2011 National Land Cover Data**

Analysis Cont.

- National vs. Tribal Lands



Direction of Change

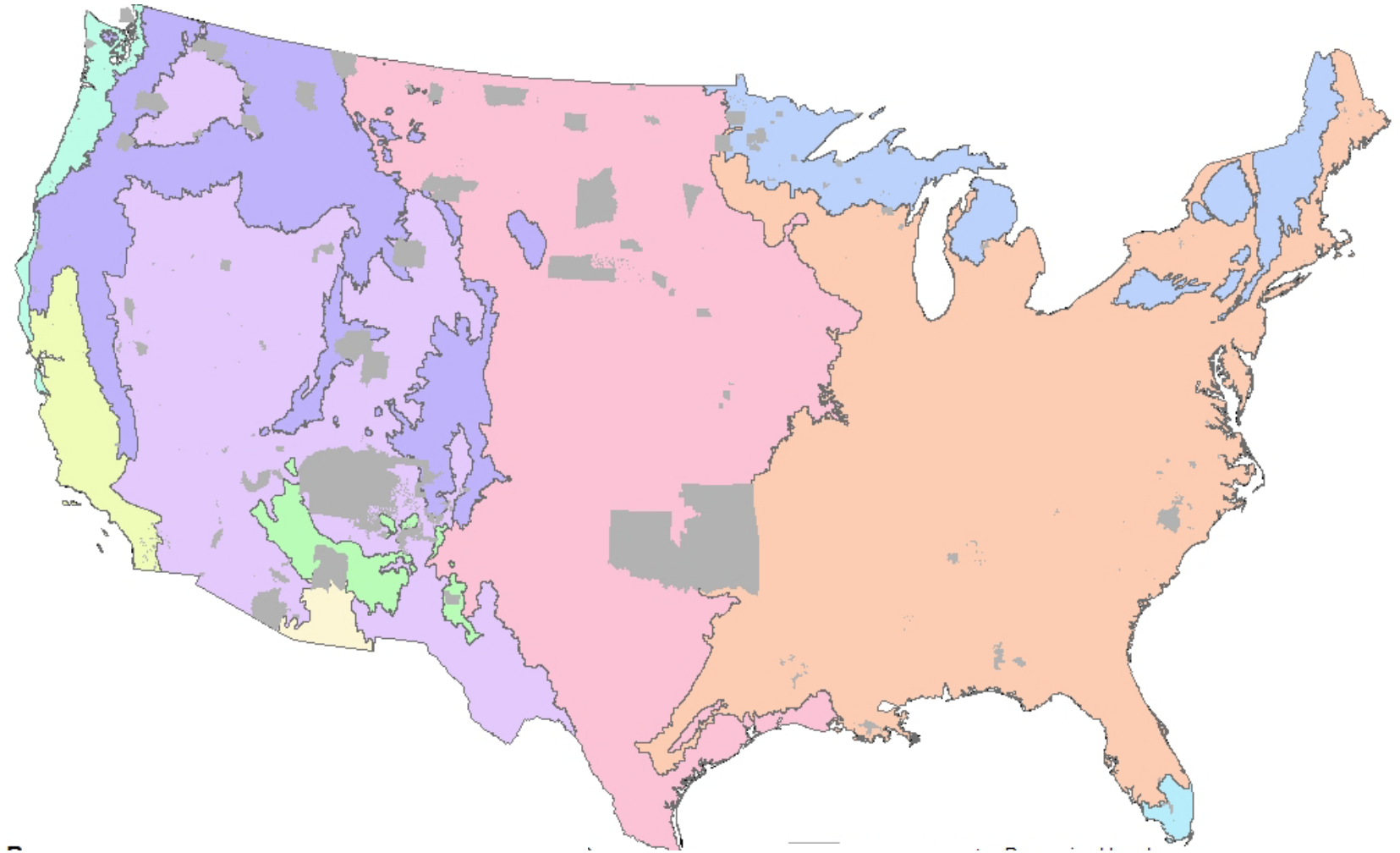


Increasing from 2000-03 to 2012-14



Decreasing from 2000-03 to 2012-14

EcoRegions



EcoRegion I

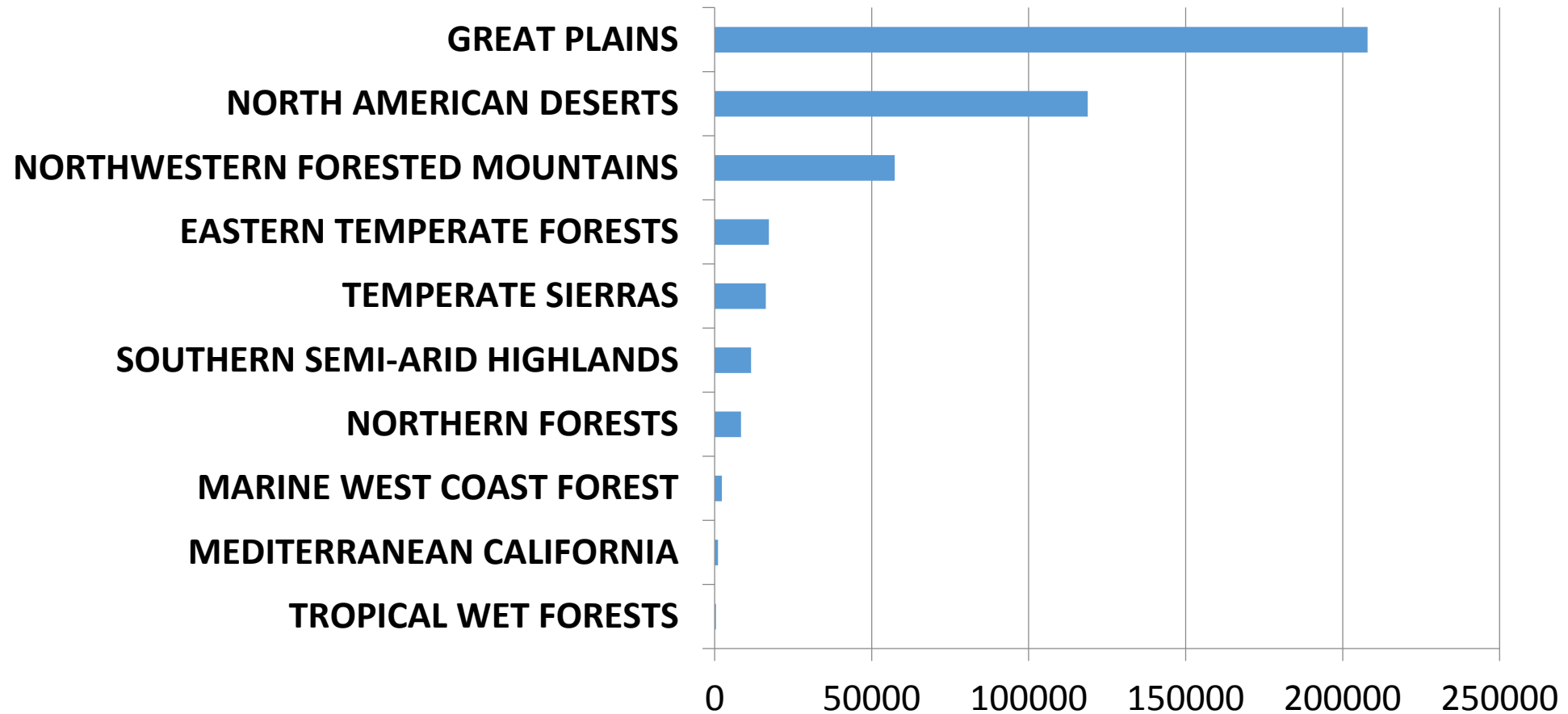
- | | |
|---------------------------|---------------------------------|
| EASTERN TEMPERATE FORESTS | NORTHERN FORESTS |
| GREAT PLAINS | NORTHWESTERN FORESTED MOUNTAINS |
| MARINE WEST COAST FOREST | SOUTHERN SEMIARID HIGHLANDS |
| MEDITERRANEAN CALIFORNIA | TEMPERATE SIERRAS |
| NORTH AMERICAN DESERTS | TROPICAL WET FORESTS |
| | WATER |

Federally & States Recognized Lands

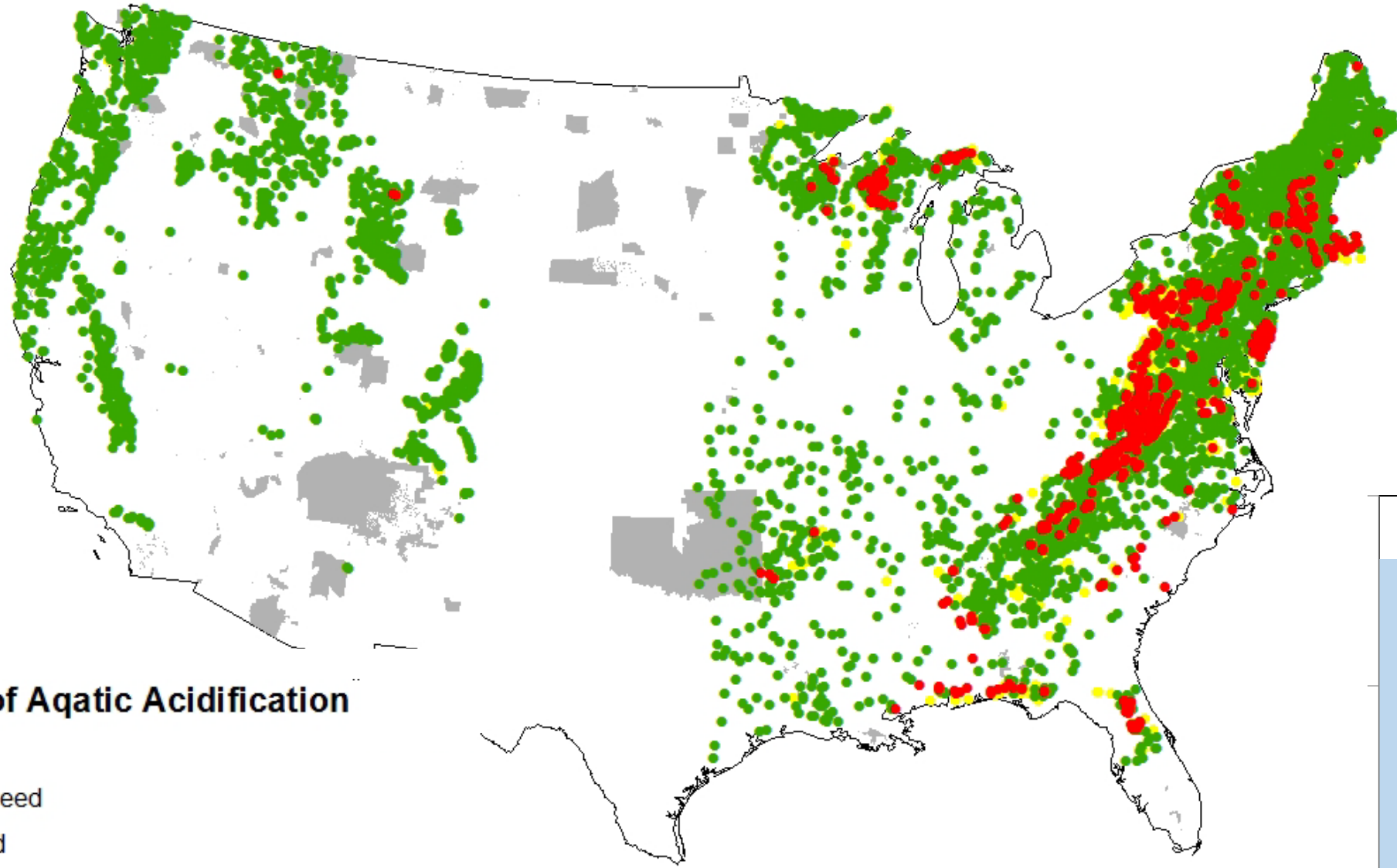


EcoRegions Cont.

Land Area (km²)



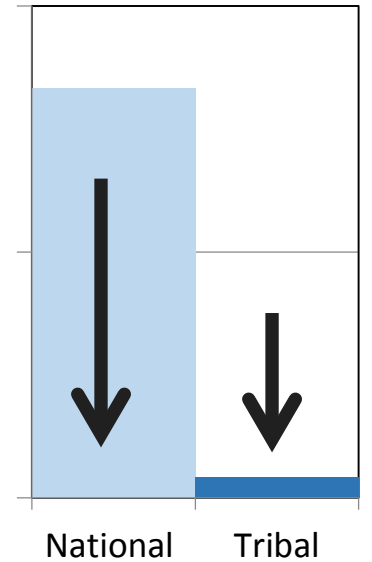
Aquatic Acidification



**Critical Load of Aquatic Acidification
meq/m²/yr**

- Does not Exceed
- Could Exceed
- Exceeds

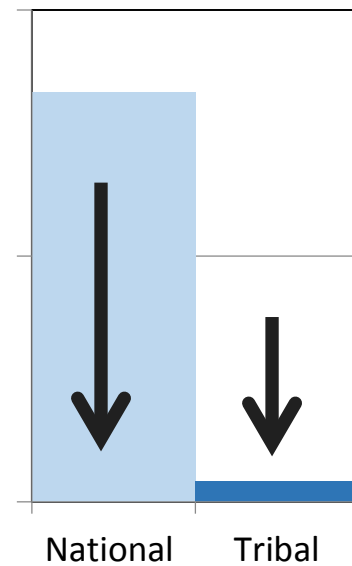
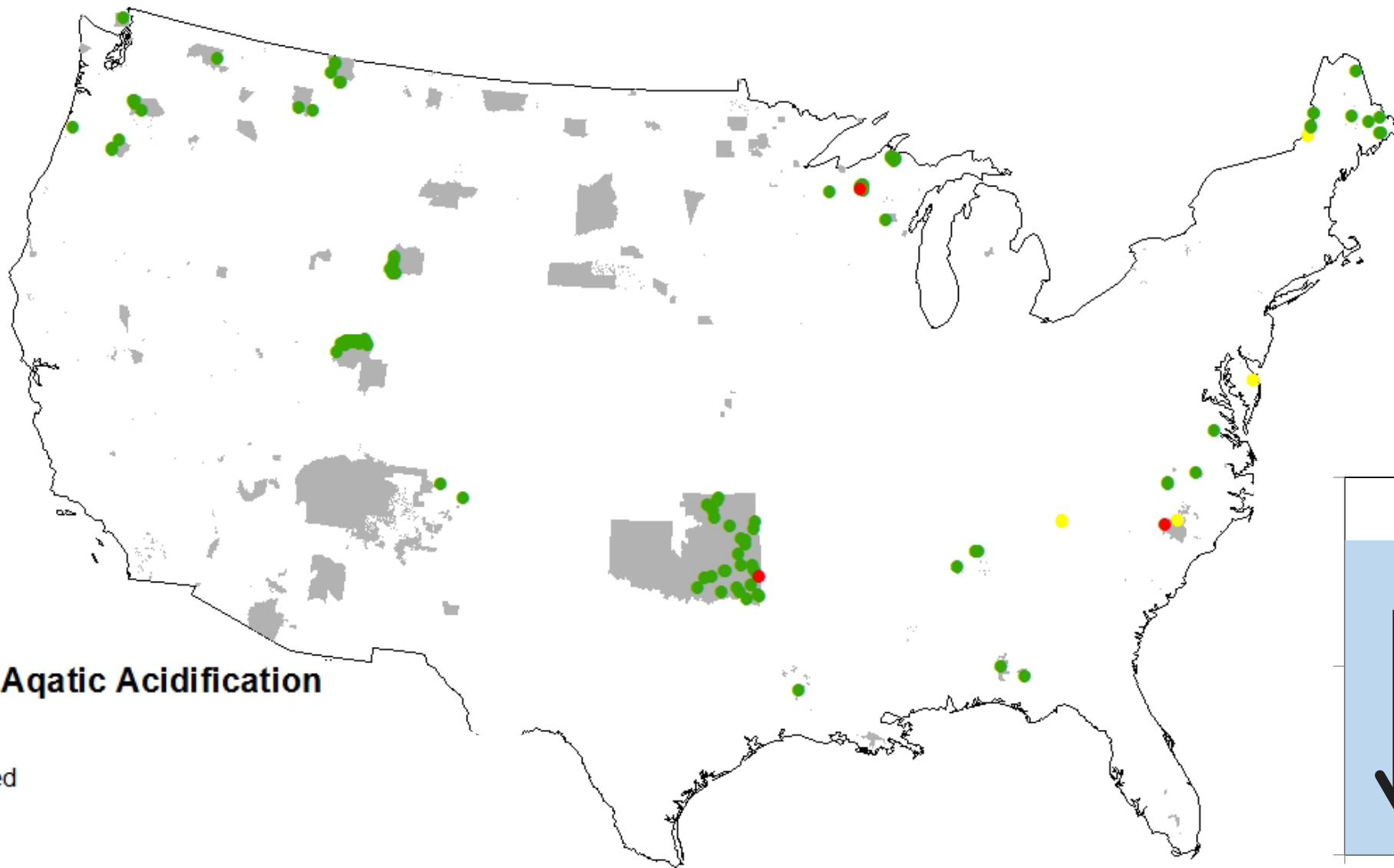
■ Federally & States Recognized Lands

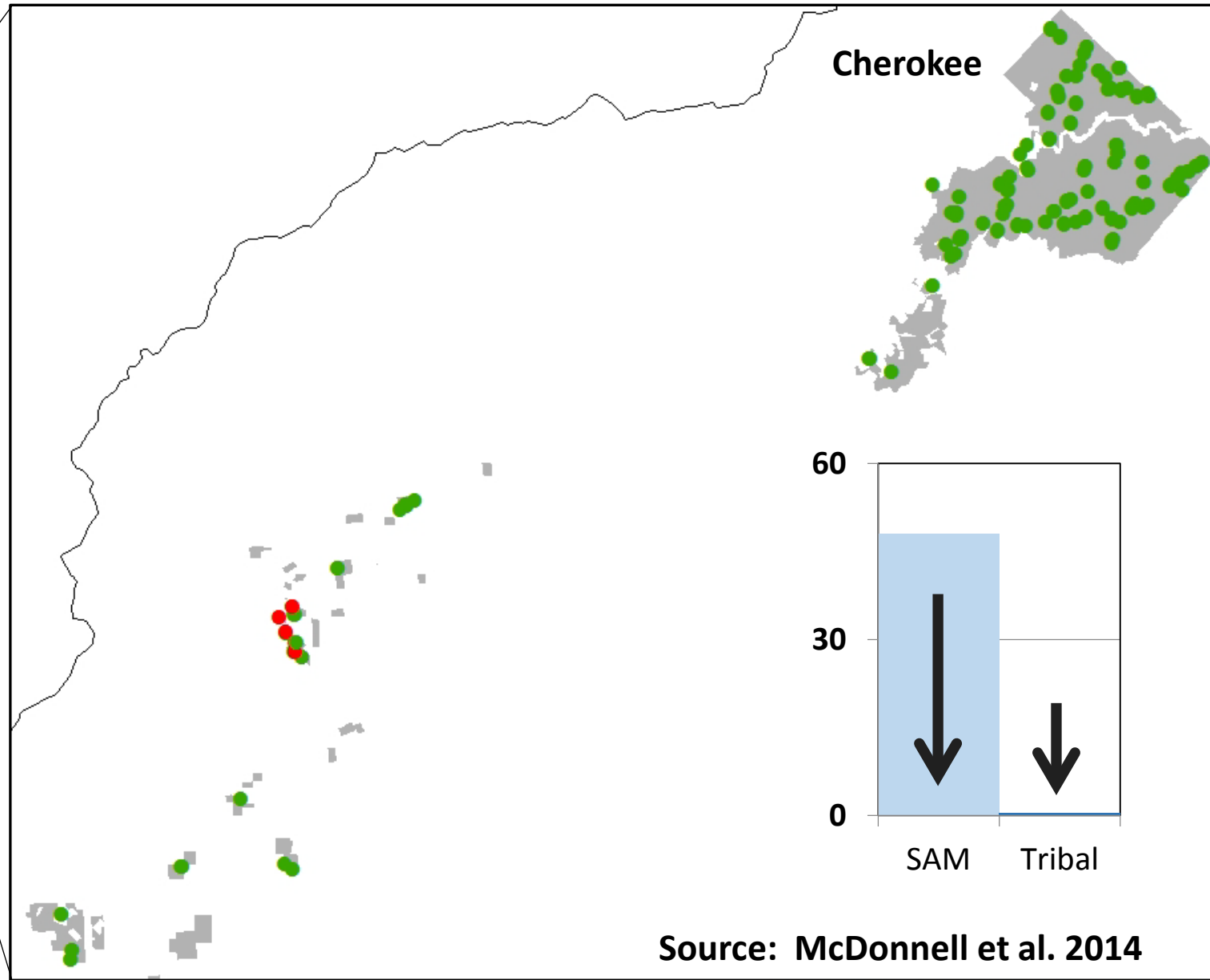
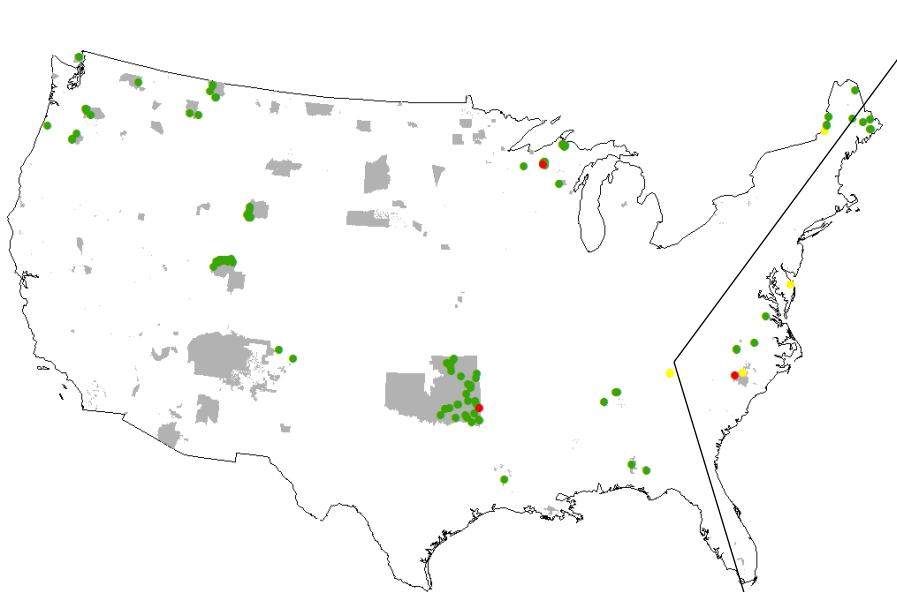


Critical Load of Aqatic Acidification meq/m²/yr

- Does not Exceed
- Could Exceed
- Exceeds

■ Federally & States Recognized Lands





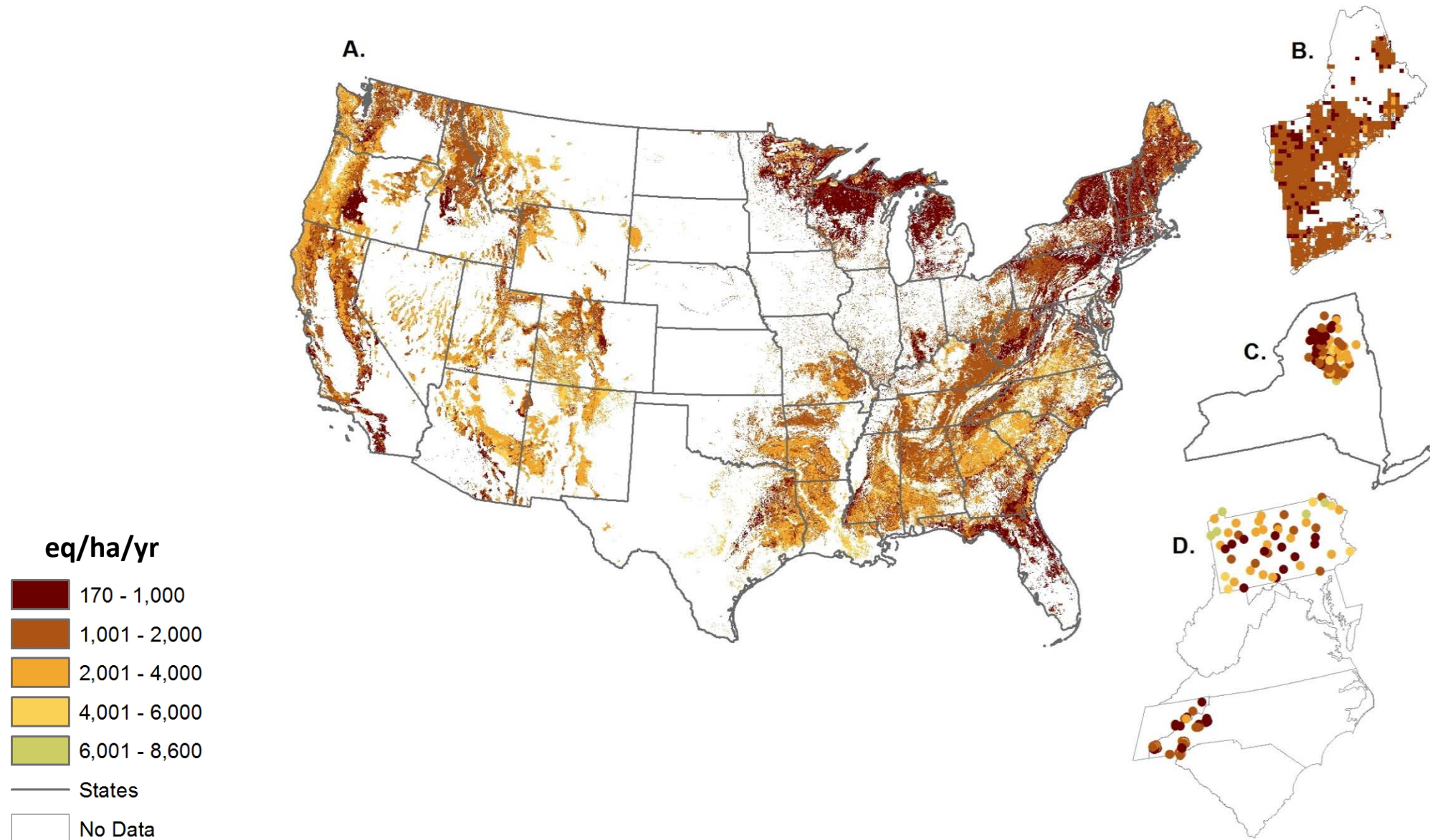
**Critical Load of Aquatic Acidification
meq/m²/yr**

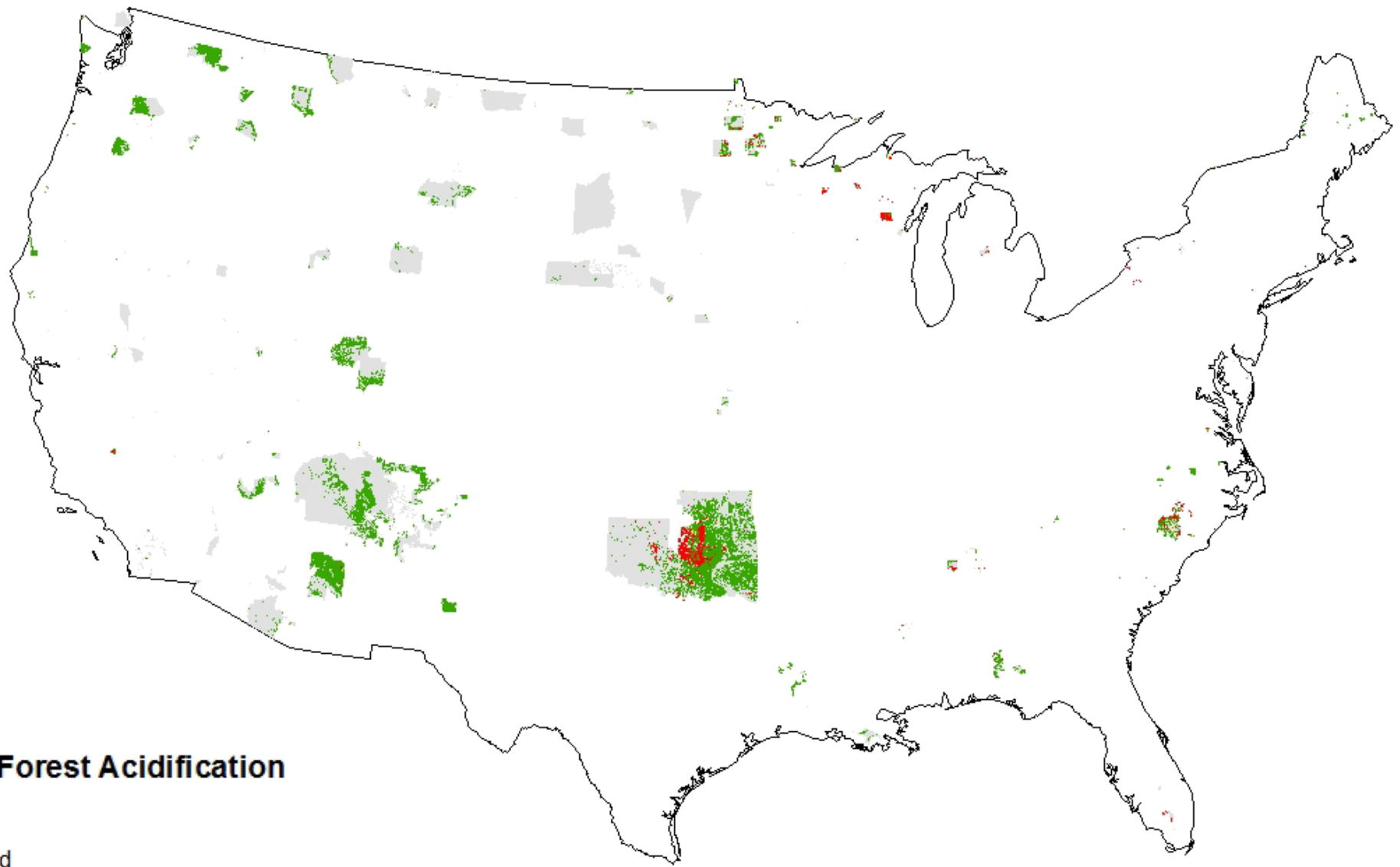
- Does not Exceed
- Could Exceed
- Exceeds

■ Federally & States Recognized Lands


Source: McDonnell et al. 2014


Forest Ecosystem Acidification







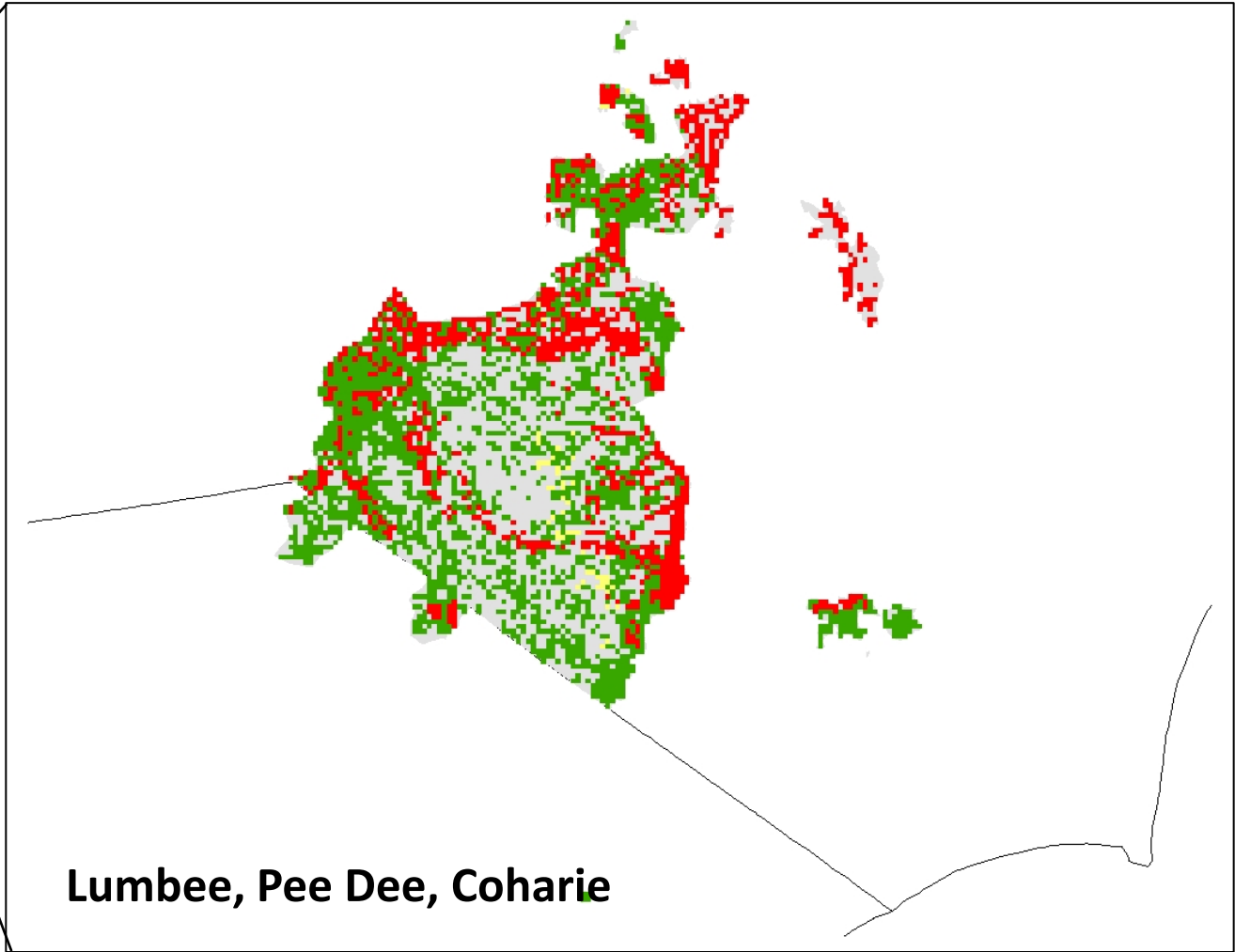
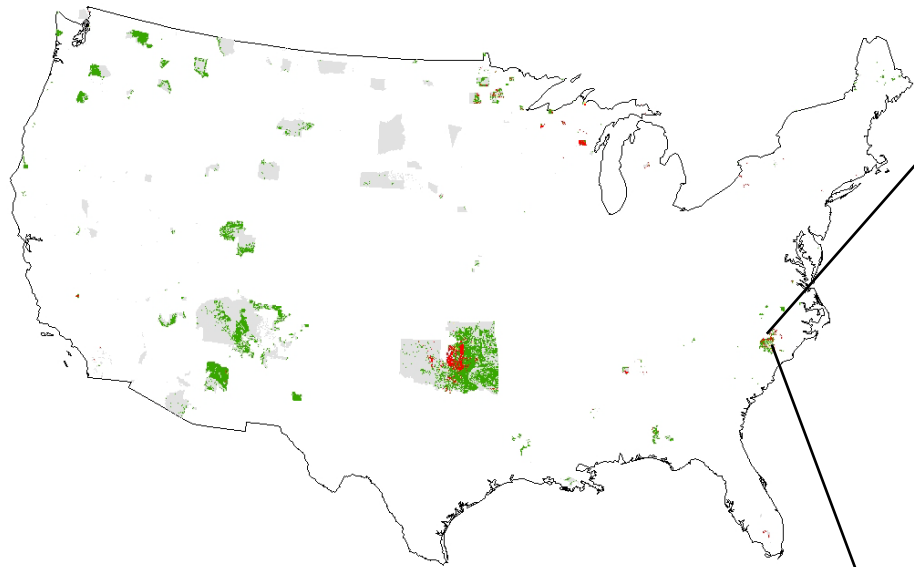
Critical Load for Forest Acidification
eq/ha/yr

 Does not Exceed


 Could Exceed


 Exceeds


 Federally & States Recognized Lands




**Critical Load for Forest Acidification
eq/ha/yr**

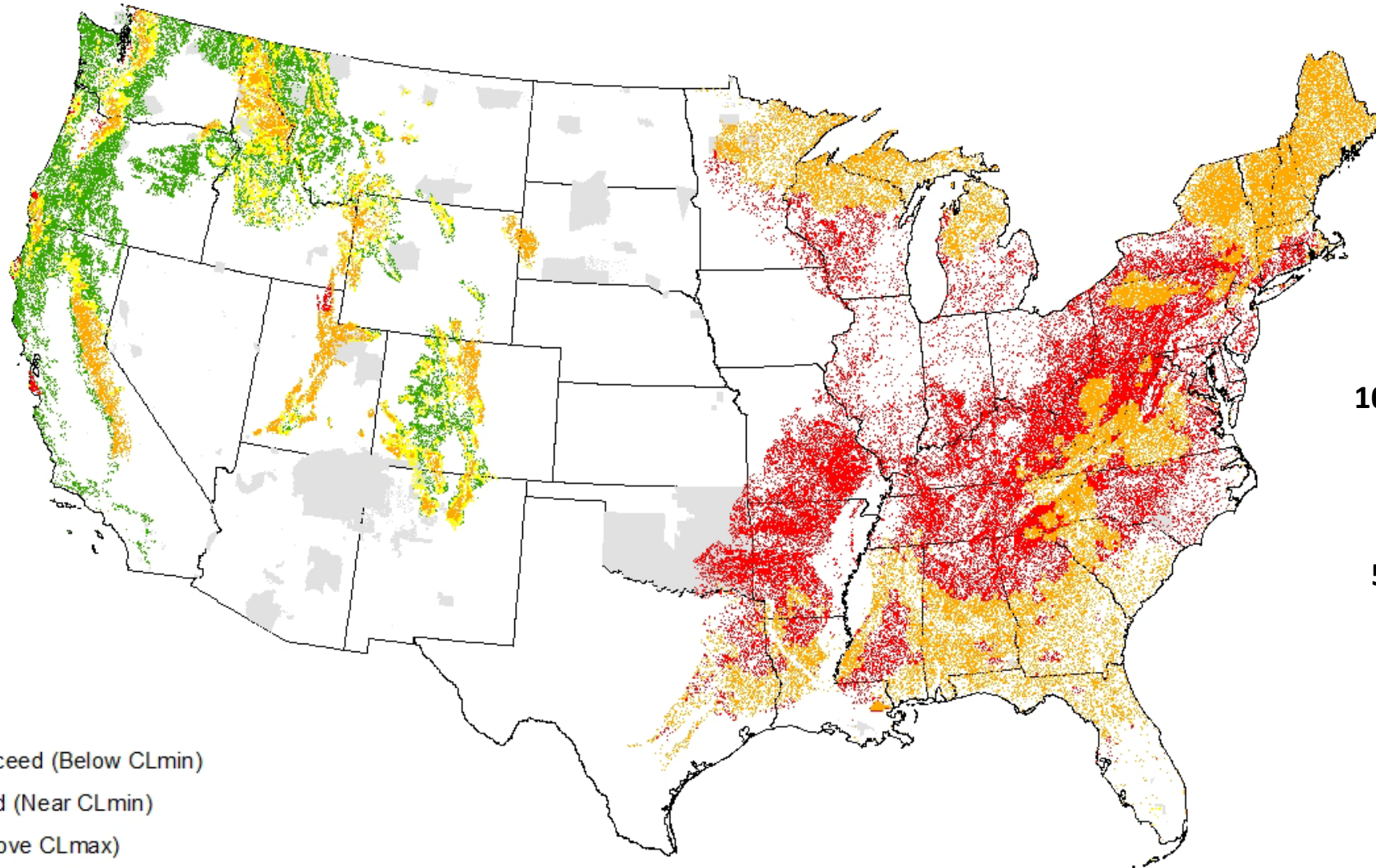
 Does not Exceed

 Could Exceed






 Exceeds

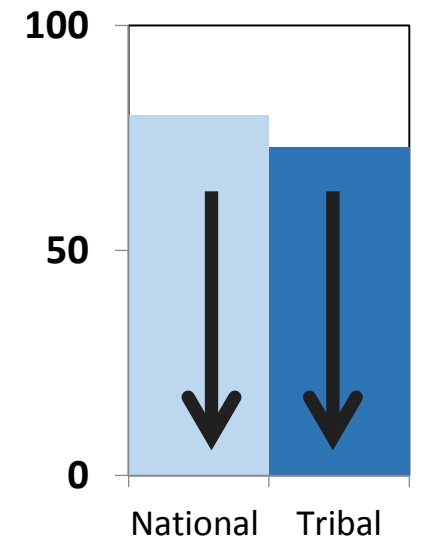
 Federally & States Recognized Lands

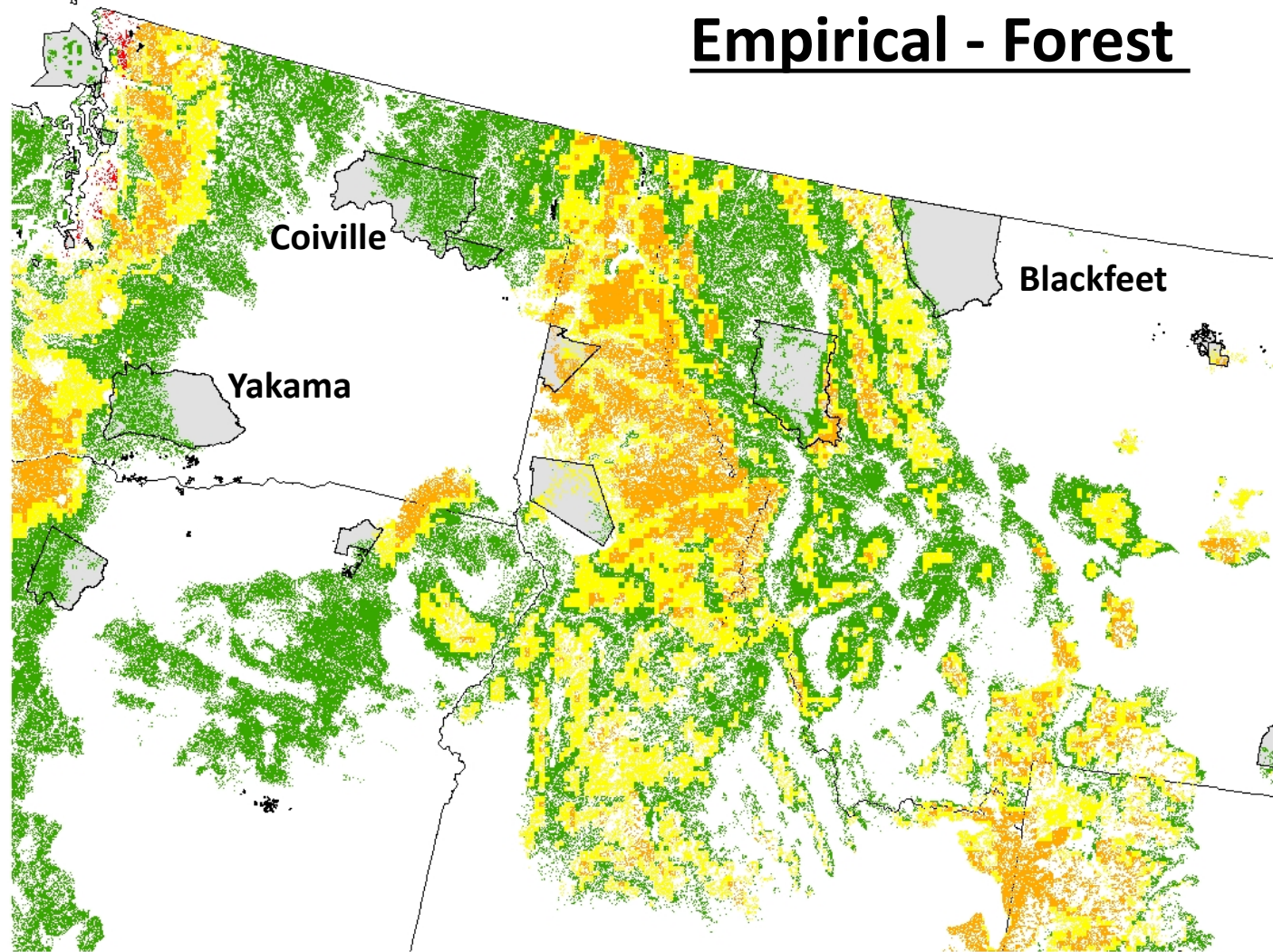
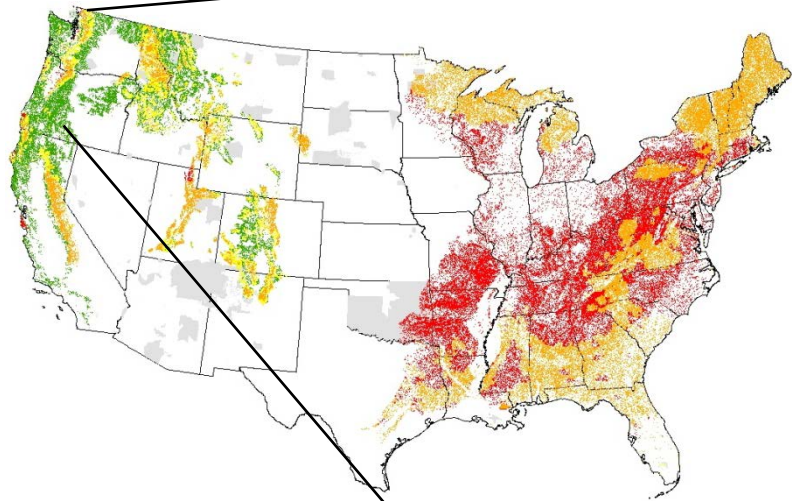
Empirical - Forest








N kg/ha/yr

-  Does Not Exceed (Below CLmin)
-  Could Exceed (Near CLmin)
-  Exceeds (Above CLmax)
-  Exceeds (Above CLmin)
-  Federally & States Recognized Lands

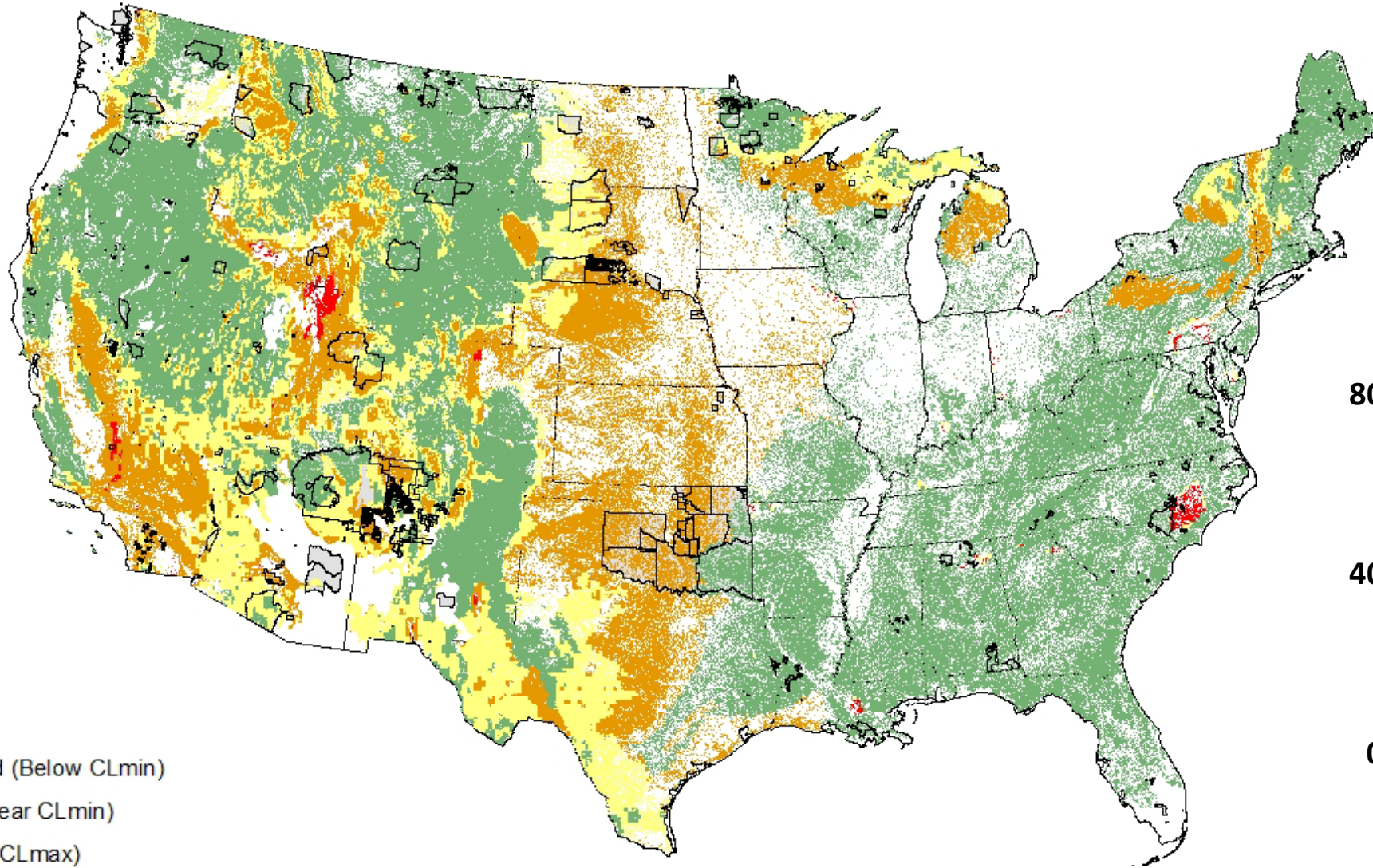




N kg/ha/yr

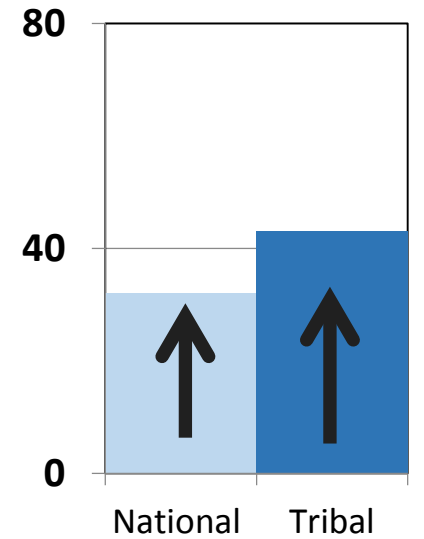
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Empirical – Herbaceous Plants and Shrubs

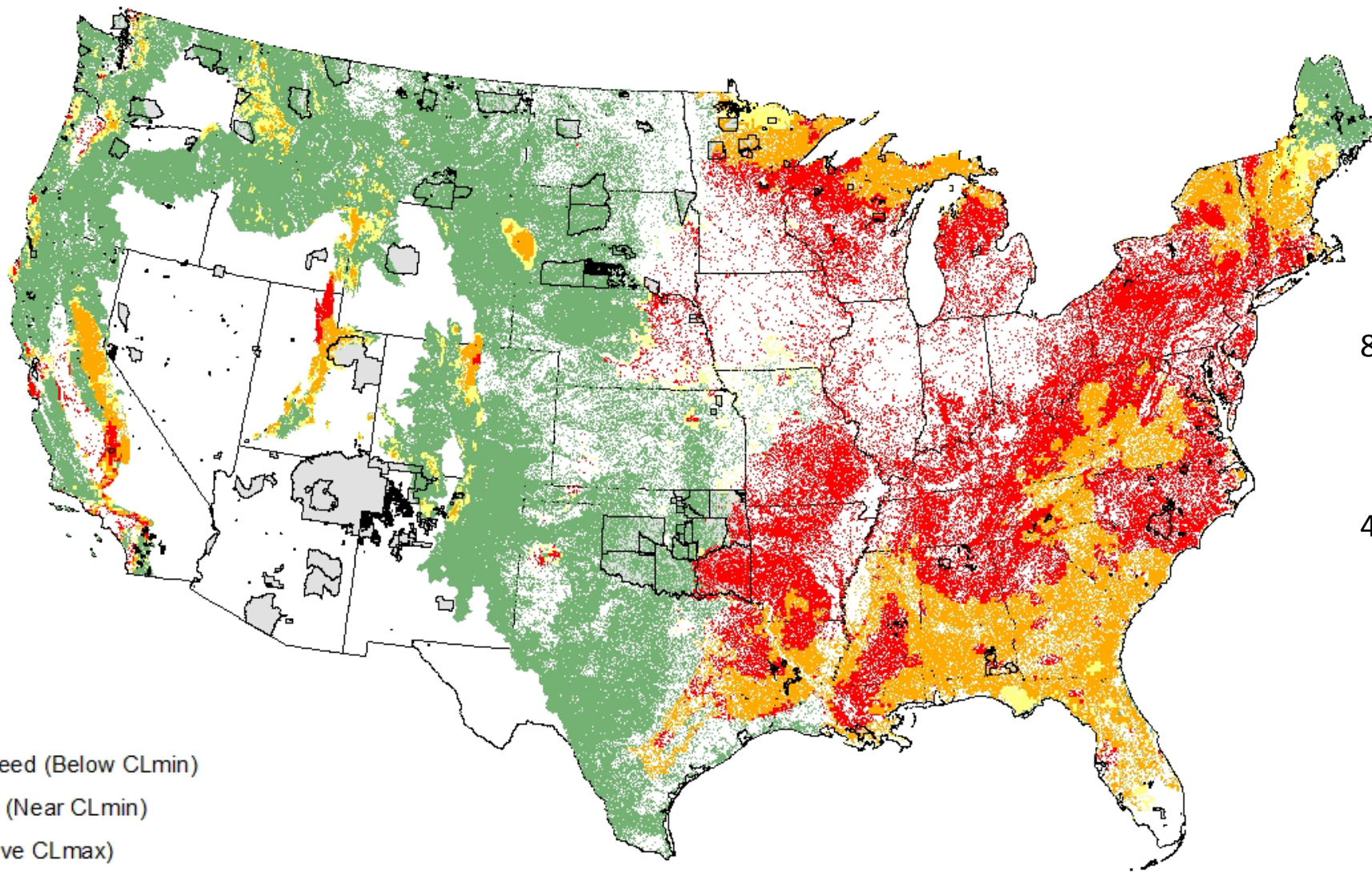


N kg/ha/yr

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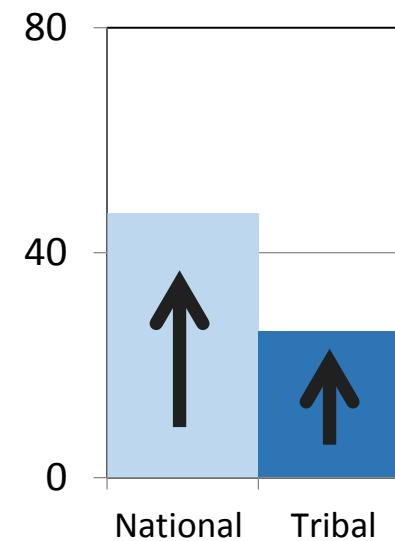


Empirical – Mycorrhizal Fungi



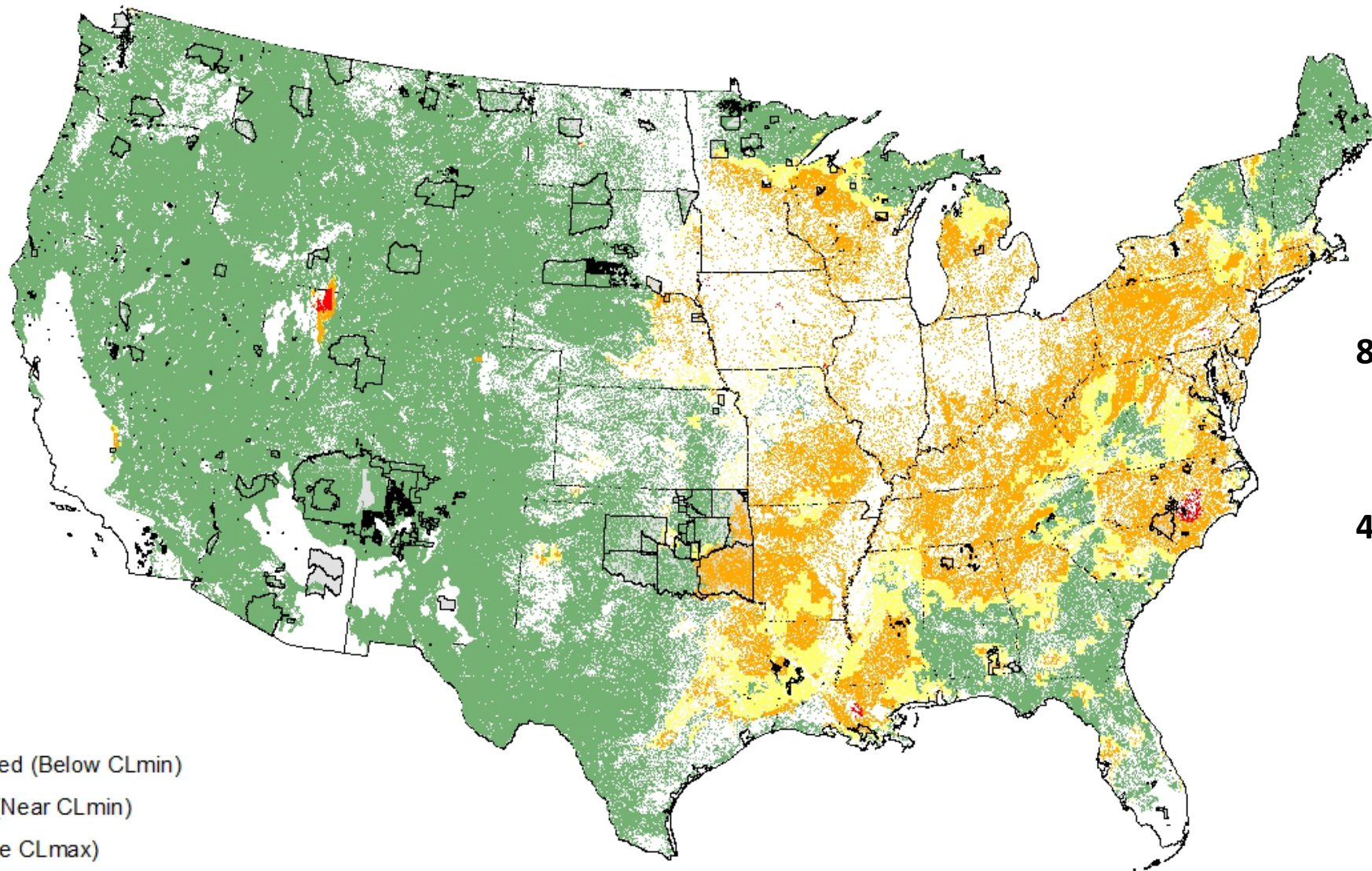
N kg/ha/yr

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


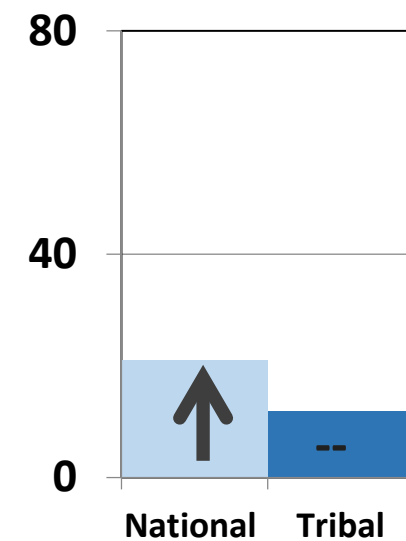
Empirical – Herb Diversity

Closed Canopy



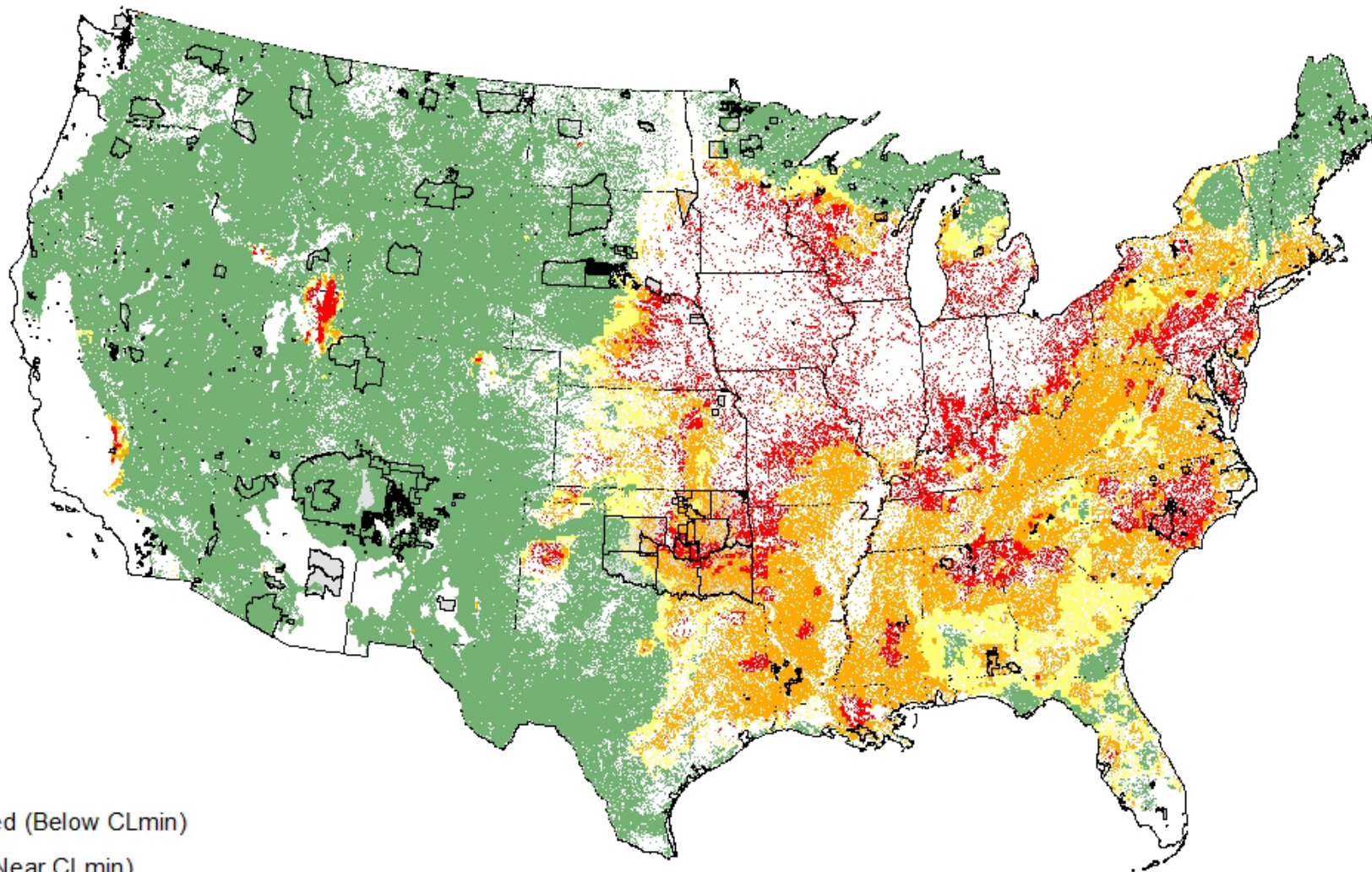
N kg/ha/yr

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


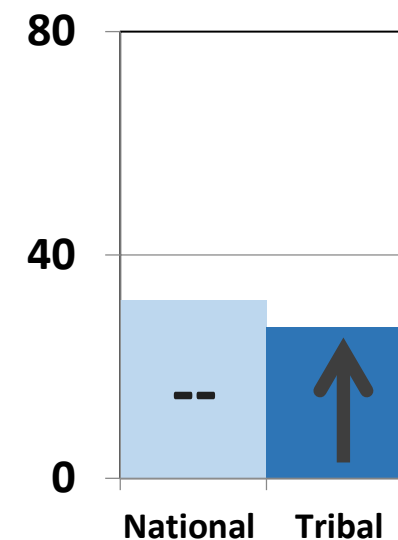
Empirical – Herb Diversity

Open Canopy



N kg/ha/yr

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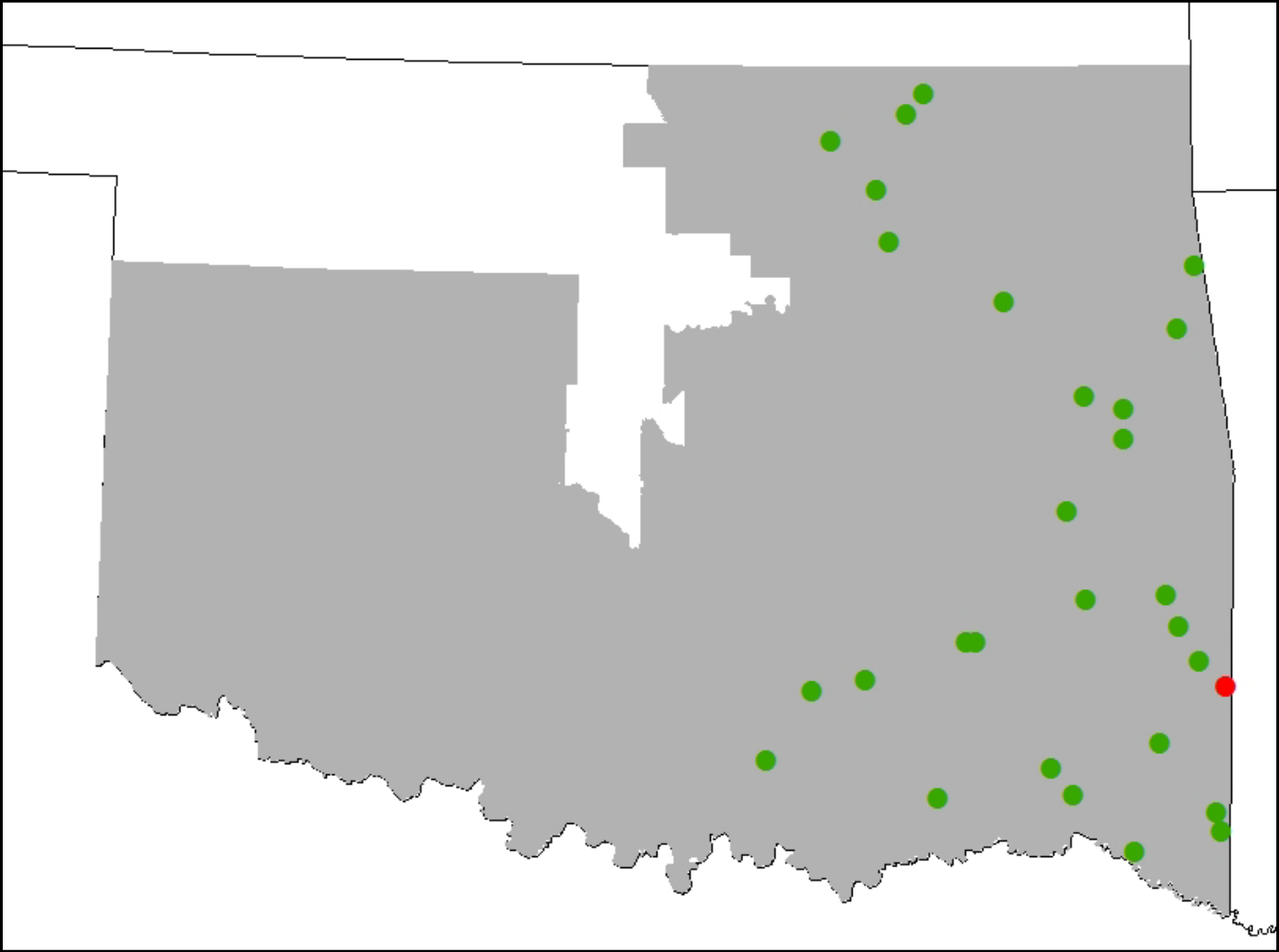
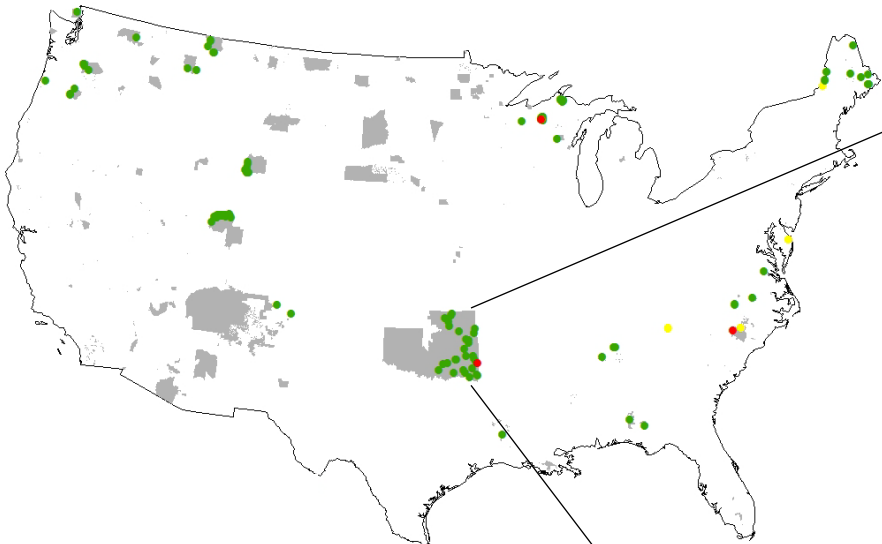
Summary

- **Aquatic and Forest Acidification** - there was limited data for aquatic acidification but indicated Tribal lands were not particularly sensitive
- **Forest, Mycorrhizal Fungi, Herb Diversity** - there was higher critical load exceedances Nationwide than for Tribal Lands
- **Herbaceous Plants and Shrub Plants** - there was higher critical load exceedances for Tribal Lands than Nationwide

Summary Cont.

- **Exceedance Direction:**
 - Aquatic & Forest Acidification and Forest – declining
 - Plant Diversity and Mycorrhizal - increasing
 - Open Canopy Herb Diversity – Tribal Lands had an increasing area of exceedance while the area nationwide was unchanged

Oklahoma Tribal Lands

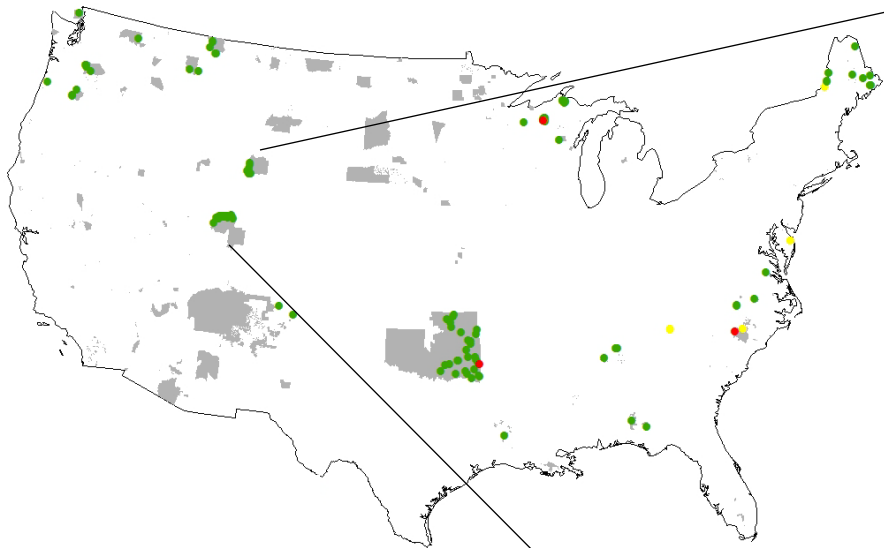


Critical Load of Aqatic Acidification meq/m2/yr

- Does not Exceed
- Could Exceed
- Exceeds

■ Federally & States Recognized Lands

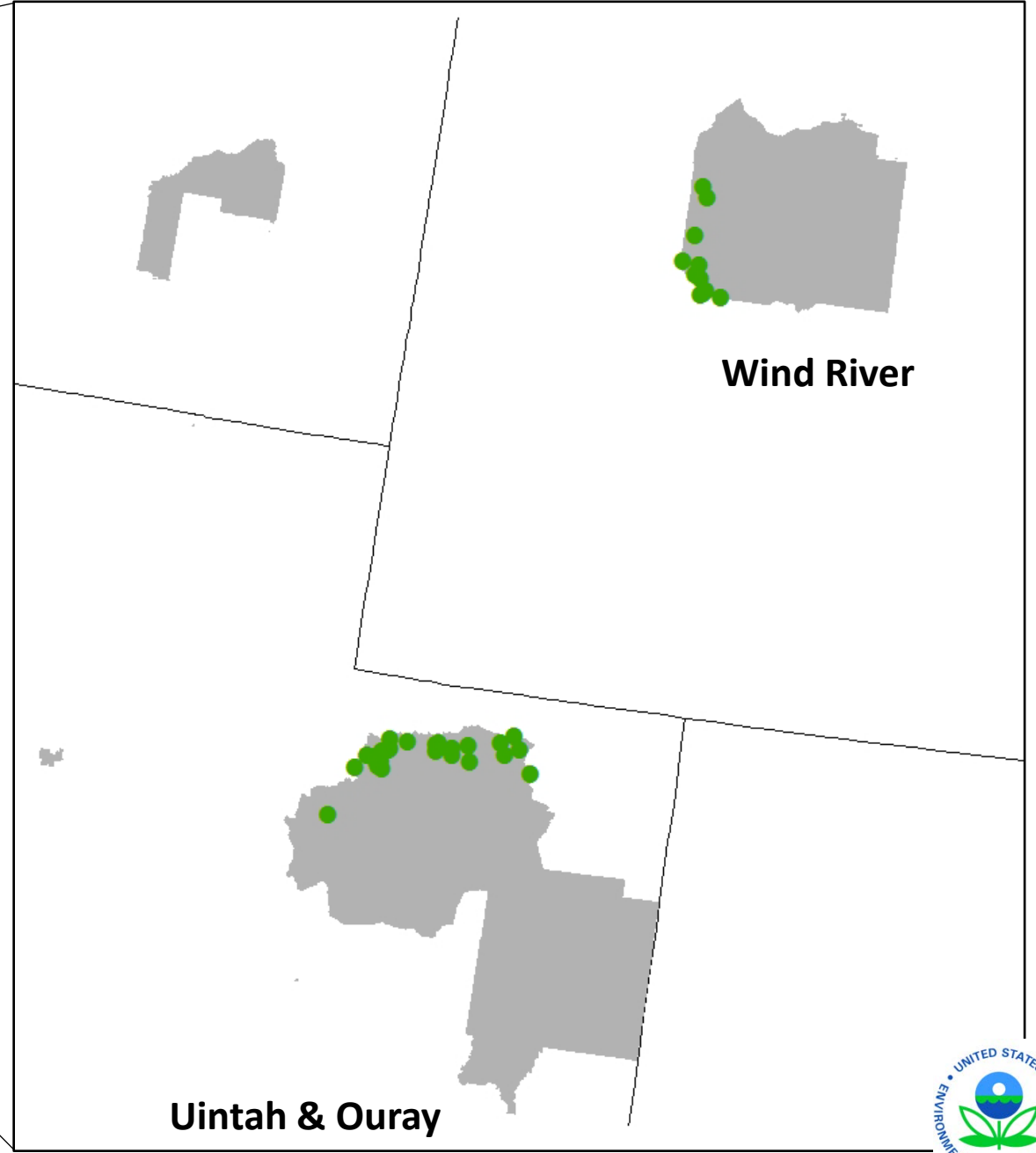


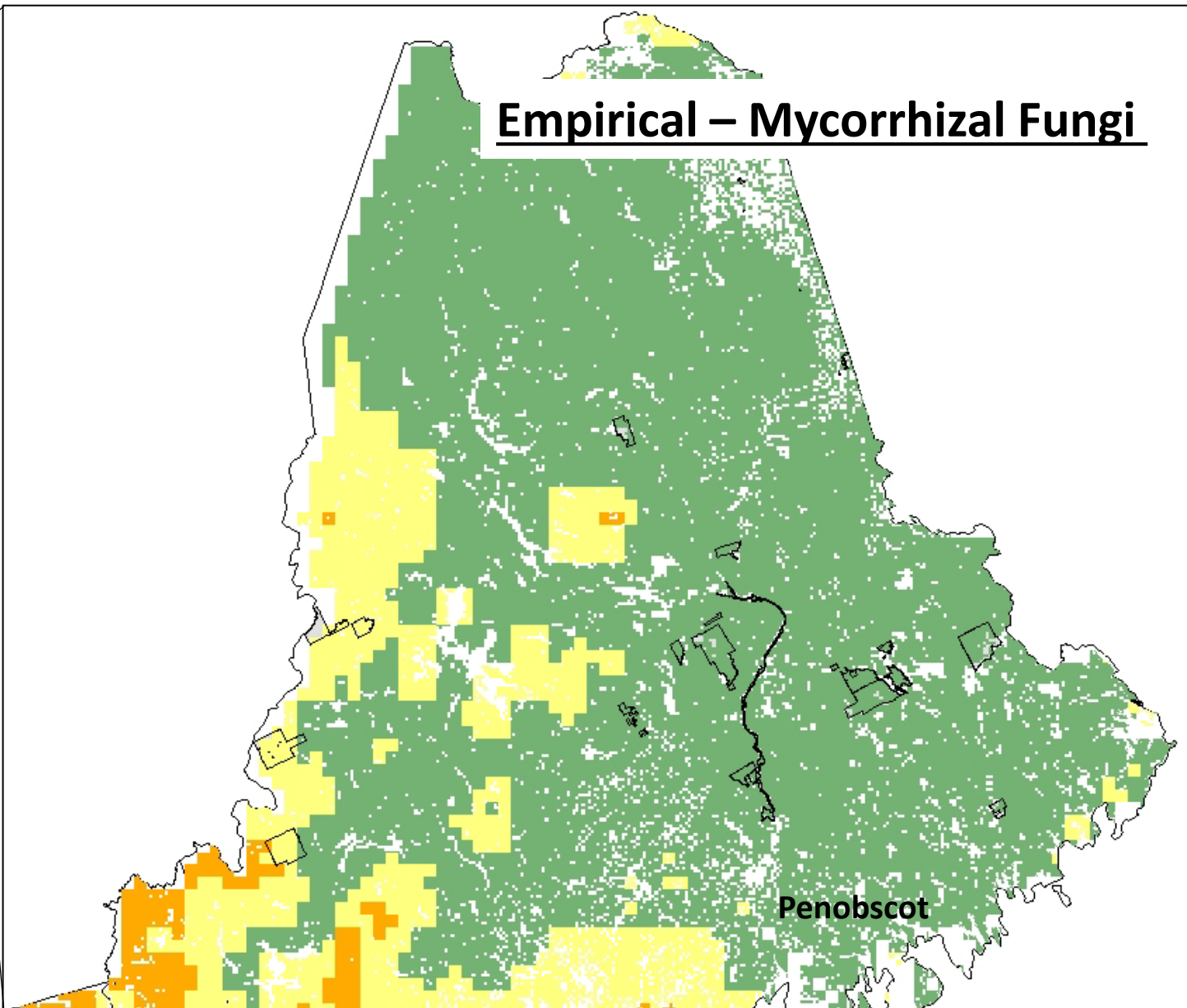
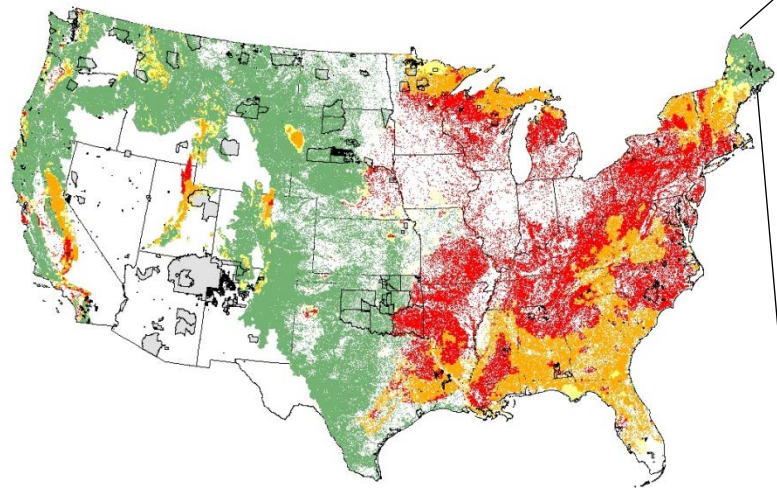


Critical Load of Aqatic Acidification meq/m2/yr

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
■ Federally & States Recognized Lands





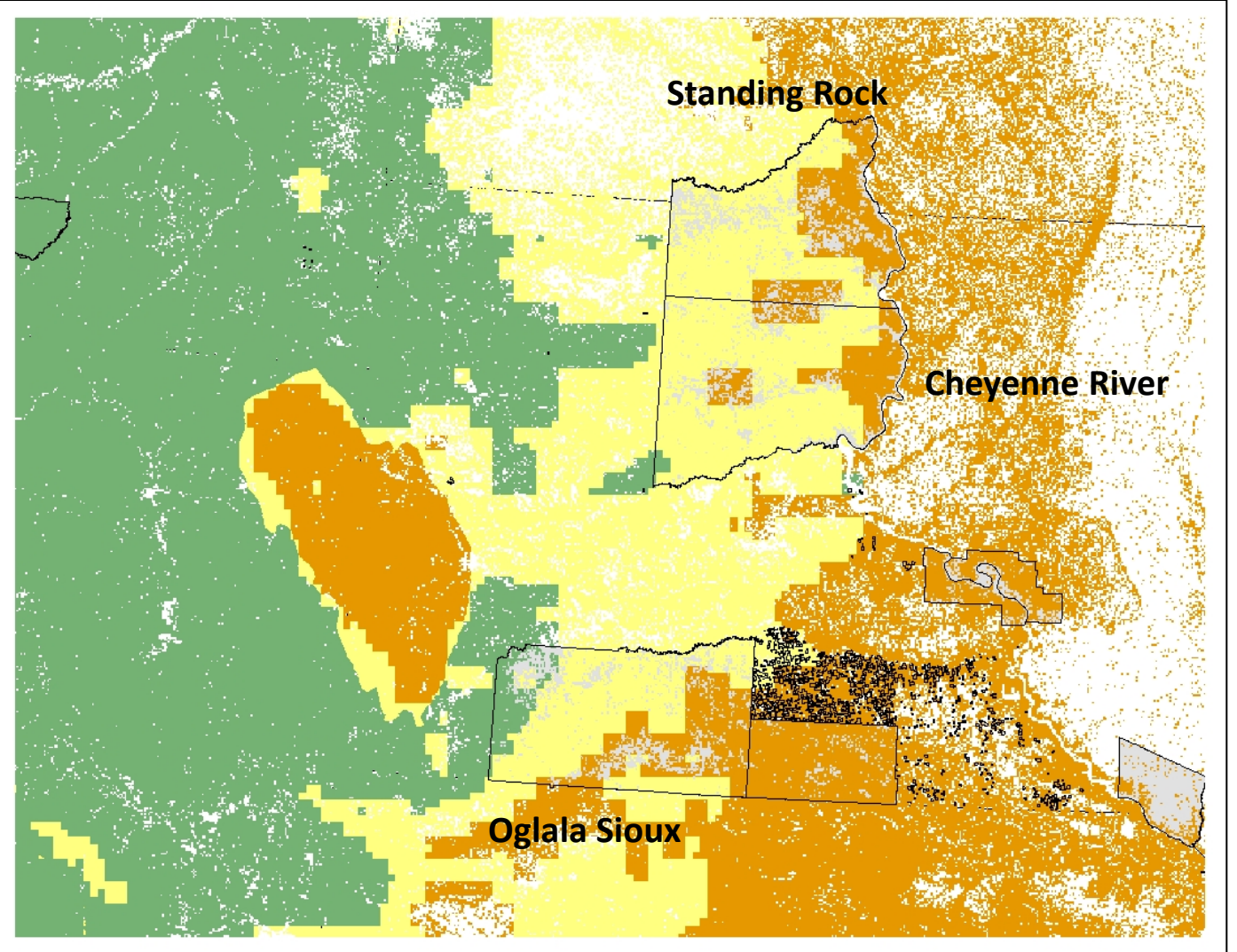
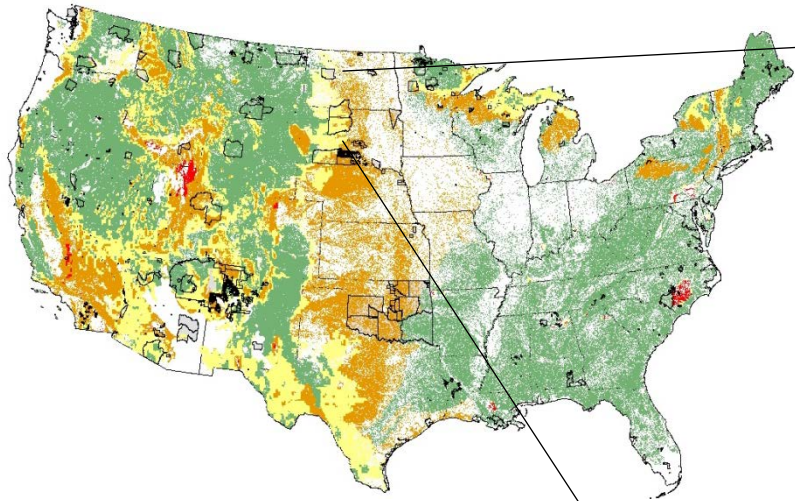
Empirical – Mycorrhizal Fungi

N kg/ha/yr






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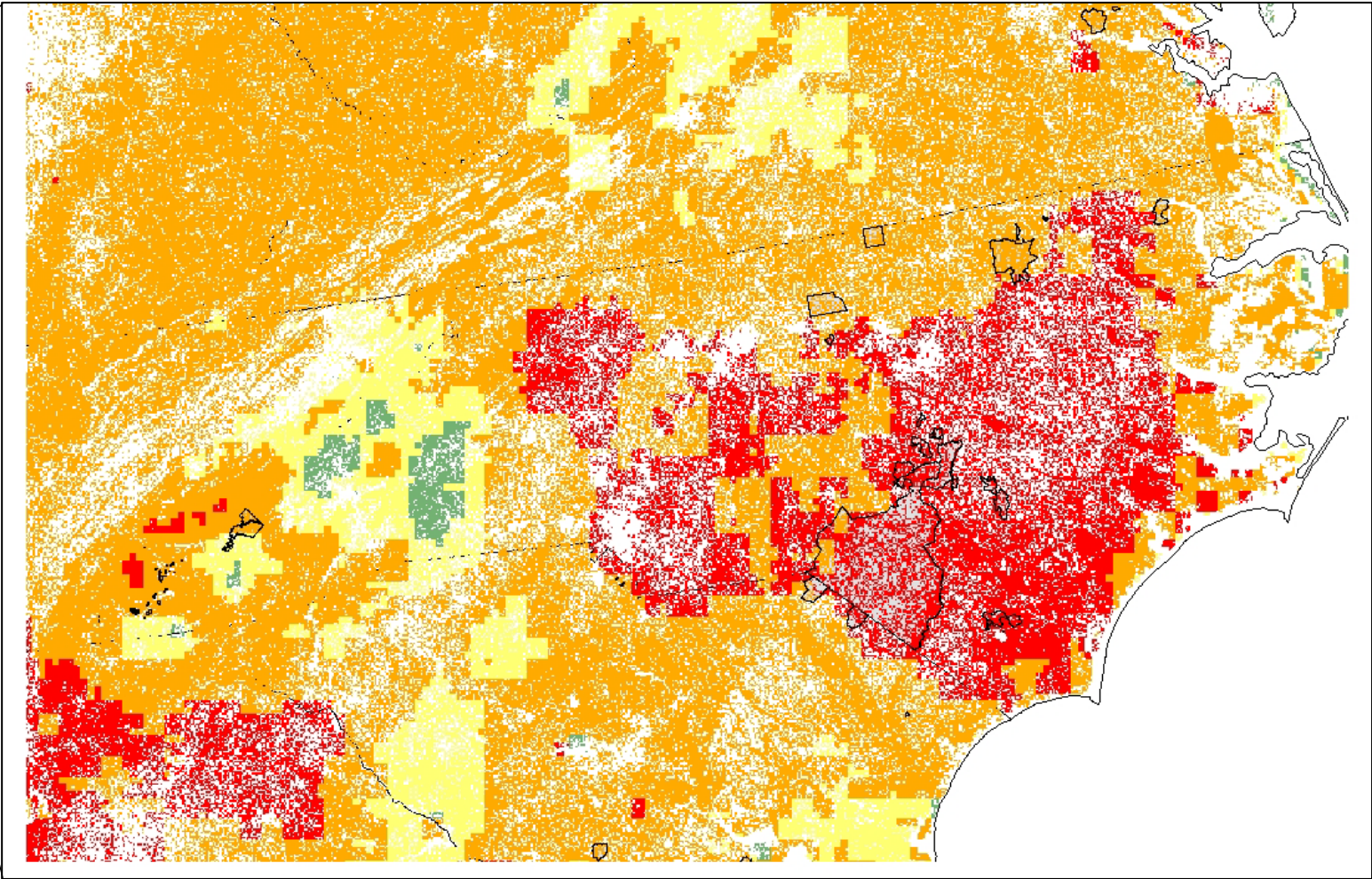
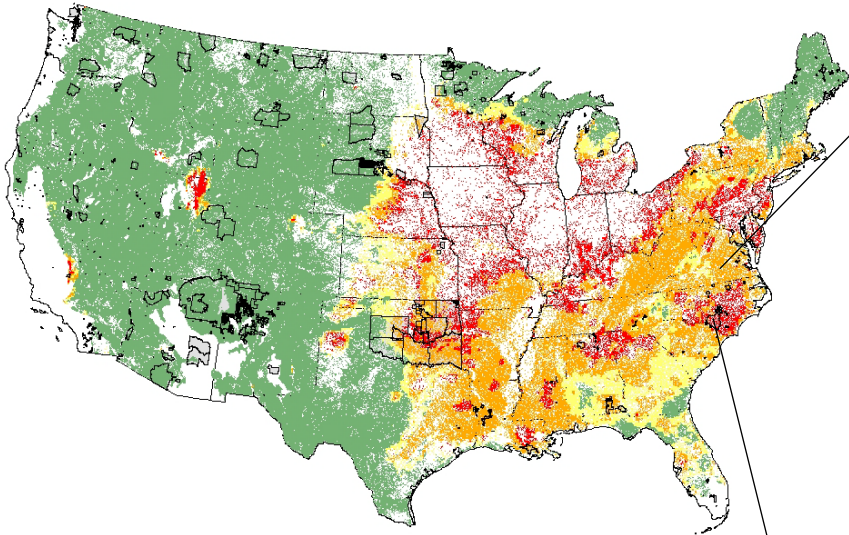
Empirical – Herbs and Shrubs








N kg/ha/yr

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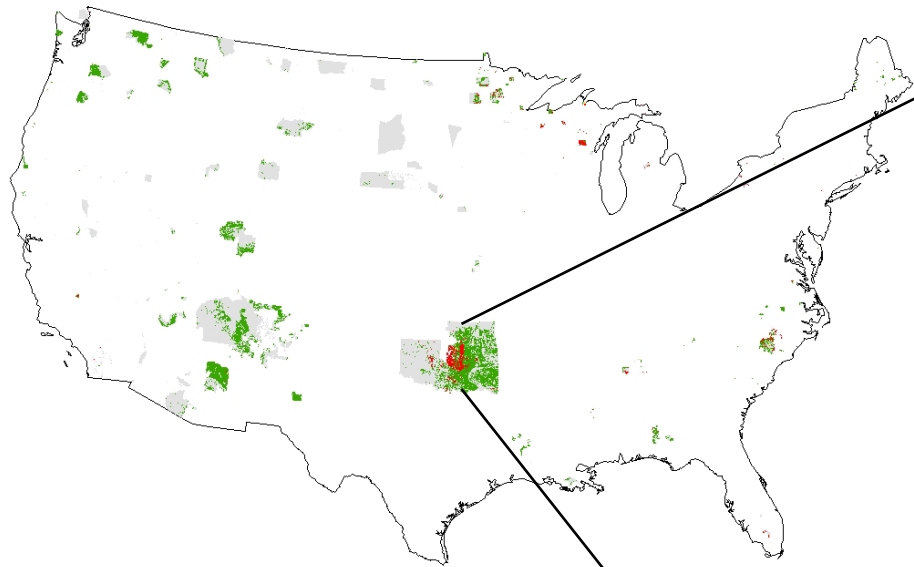
Empirical – Herb Diversity



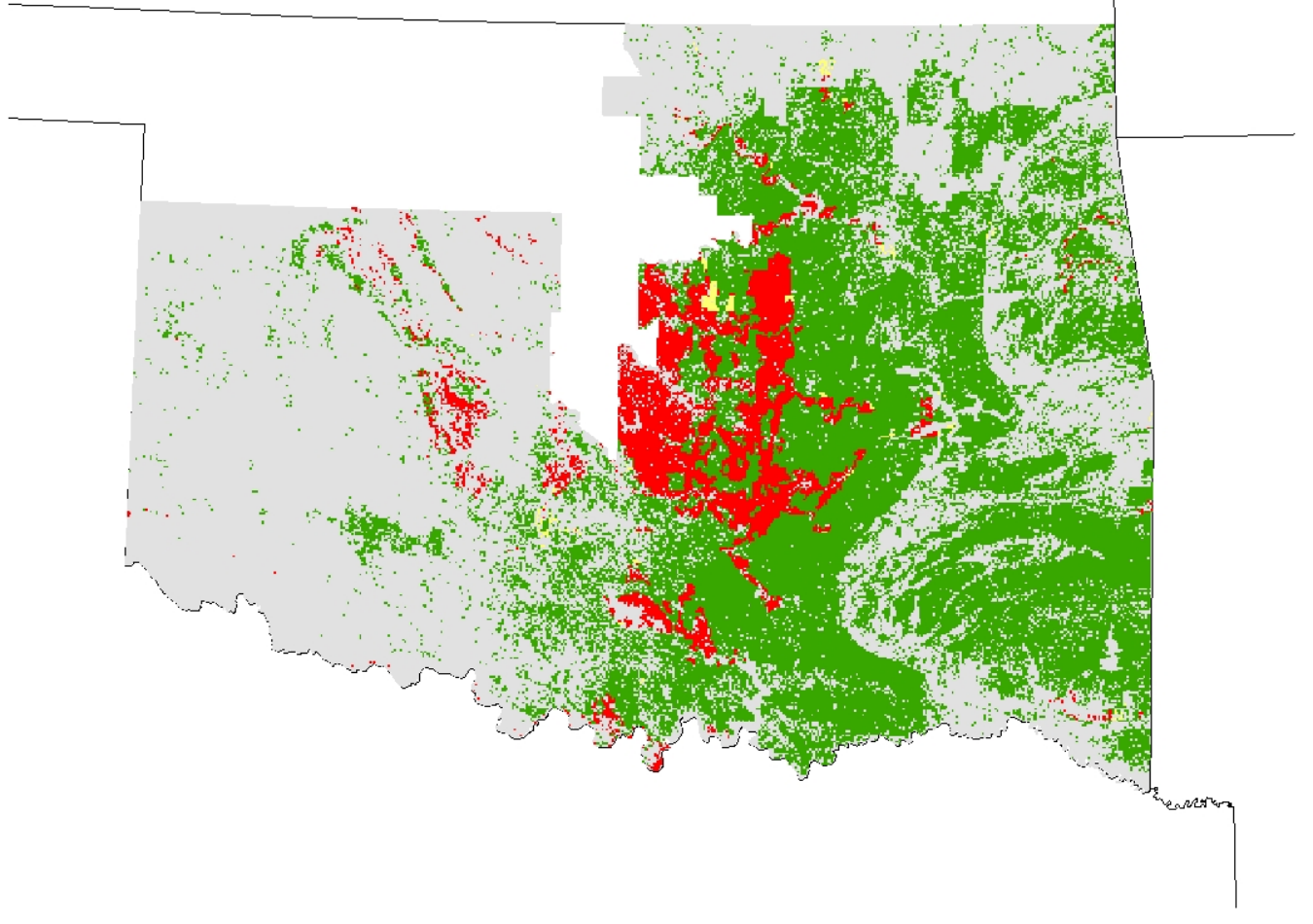
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






Oklahoma Tribal Lands




Critical Load for Forest Acidification eq/ha/yr

 Does not Exceed

 Could Exceed

 Exceeds

 Federally & States Recognized Lands