History of Critical Loads in North America

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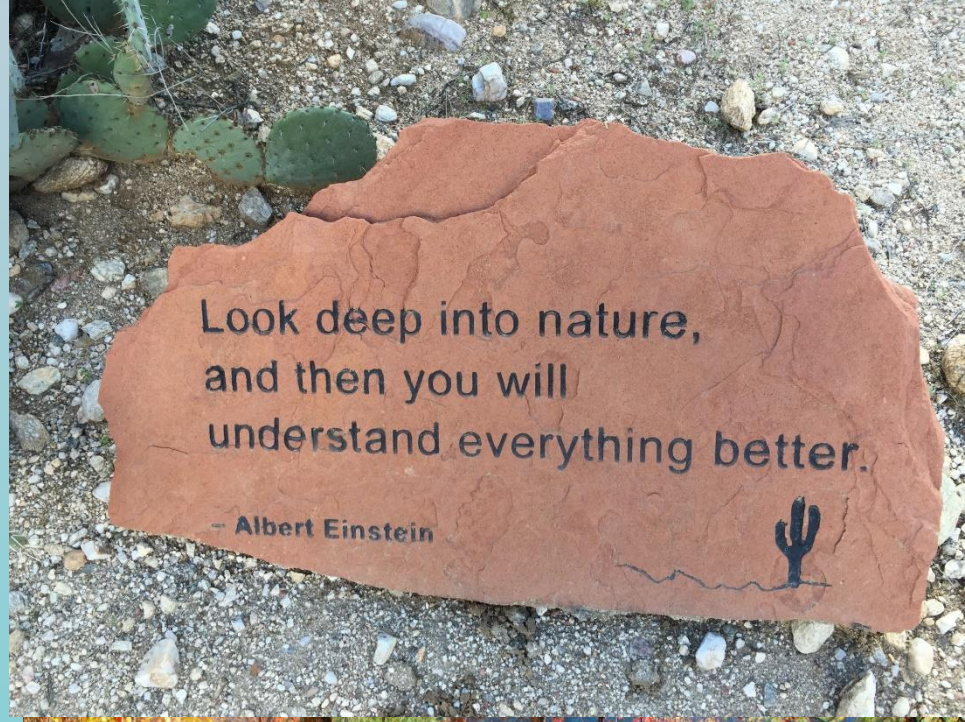


Critical Loads:
How much deposition is “too much” for ecosystems?

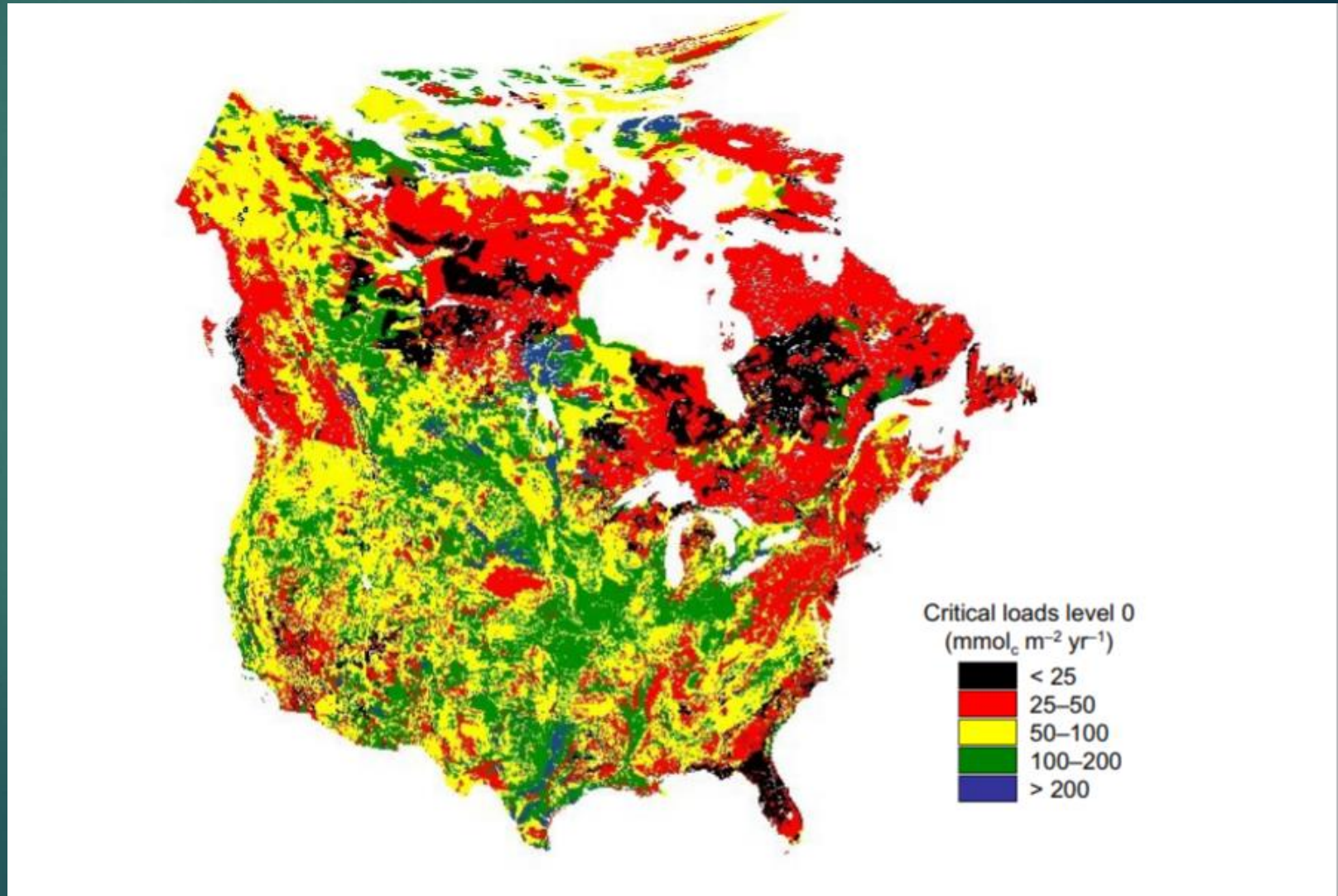
Critical Loads Scavenger Hunt

Which Pollutants?	N, S, O3, Hg?
What mechanisms?	Acidification? Eutrophication?
What is most sensitive to air pollution?	Plants? Waters? Soils? Fish?
What causes an ecosystem to be sensitive?	Elevation? Species? Chemistry?
How to estimate critical load values?	Modeling? Field Experiments?
How to Scale deposition and effects?	Extrapolation of site data?
How to characterize Uncertainties?	Science or policy answers?
How to link emissions to effects?	Air Regulatory Questions?
Why should people care?	Ecosystem Services

N. American Critical Loads Story:1990s:

- Fed Agencies wanted to know “how much is too much” air pollution
- Scientists wanted to study how, why and where air pollution alters ecosystems
- Europeans had already been leading the way with national data sets linked to CL maps and emissions reductions strategies
- Canadians had been developing surface water acidification data bases

Critical Loads of Surface water acidity for North America (Aherne, et al, 2005)



North American Critical Loads Story 2000s:

Agency Workshops:

- FS Research [CL monitoring sites (ozone and lakes)]
- NPS-ARD [CL as tool for park protection]
- EPA-CAMD [CL as science policy interface]

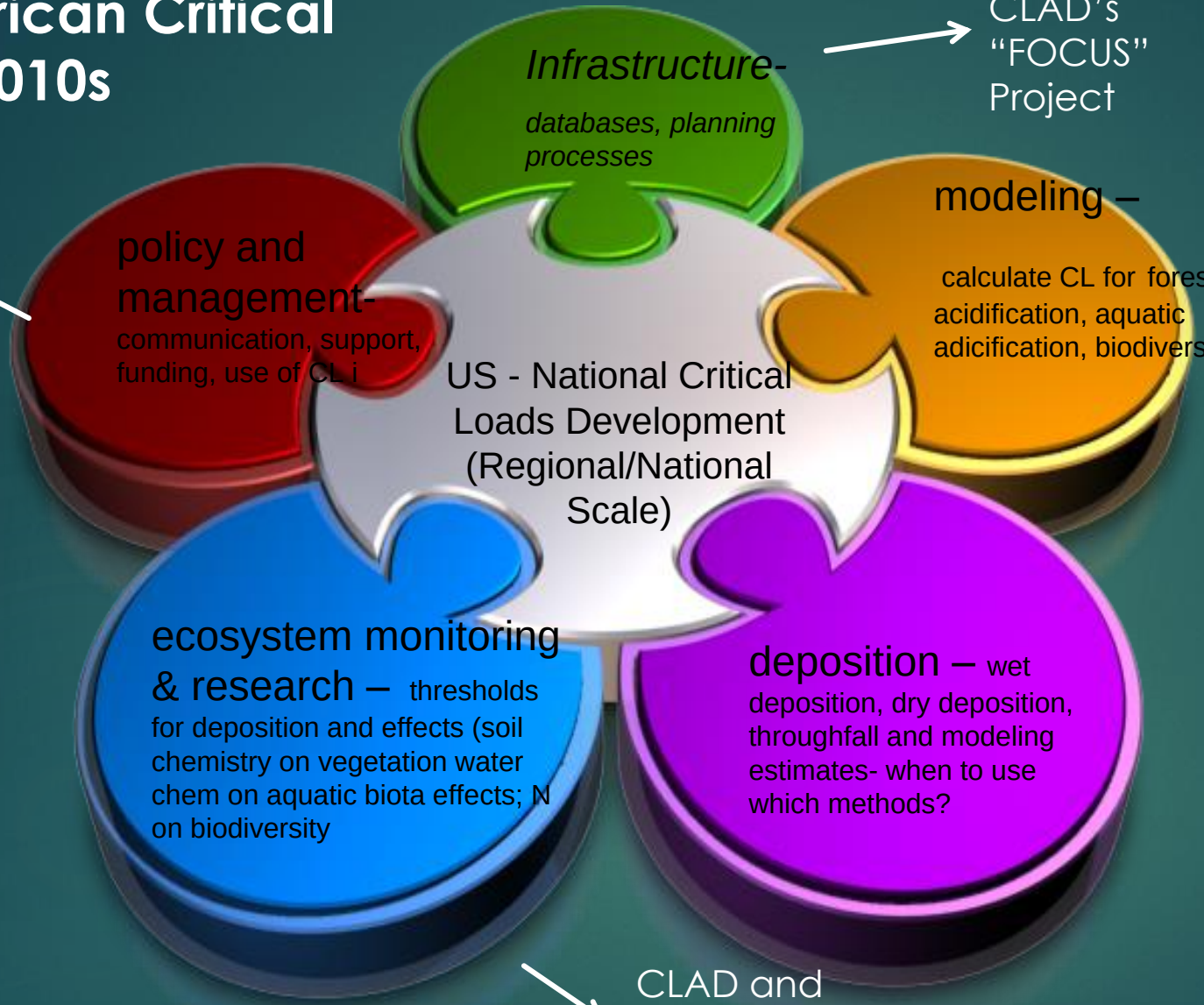
Work together? Where? How?

NADP!!!

2006- NADP granted CLAD "Ad Hoc" subcommittee status

(Some little known facts are…..)

N. American Critical Loads 2010s



CLAD's "FOCUS" Project

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CLAD

NADP's new Total Deposition Science Committee

CLAD and cooperator support of Univ. & Federal Agency research projects

1. FOCUS Critical Loads Phase I “mock practice submittal”

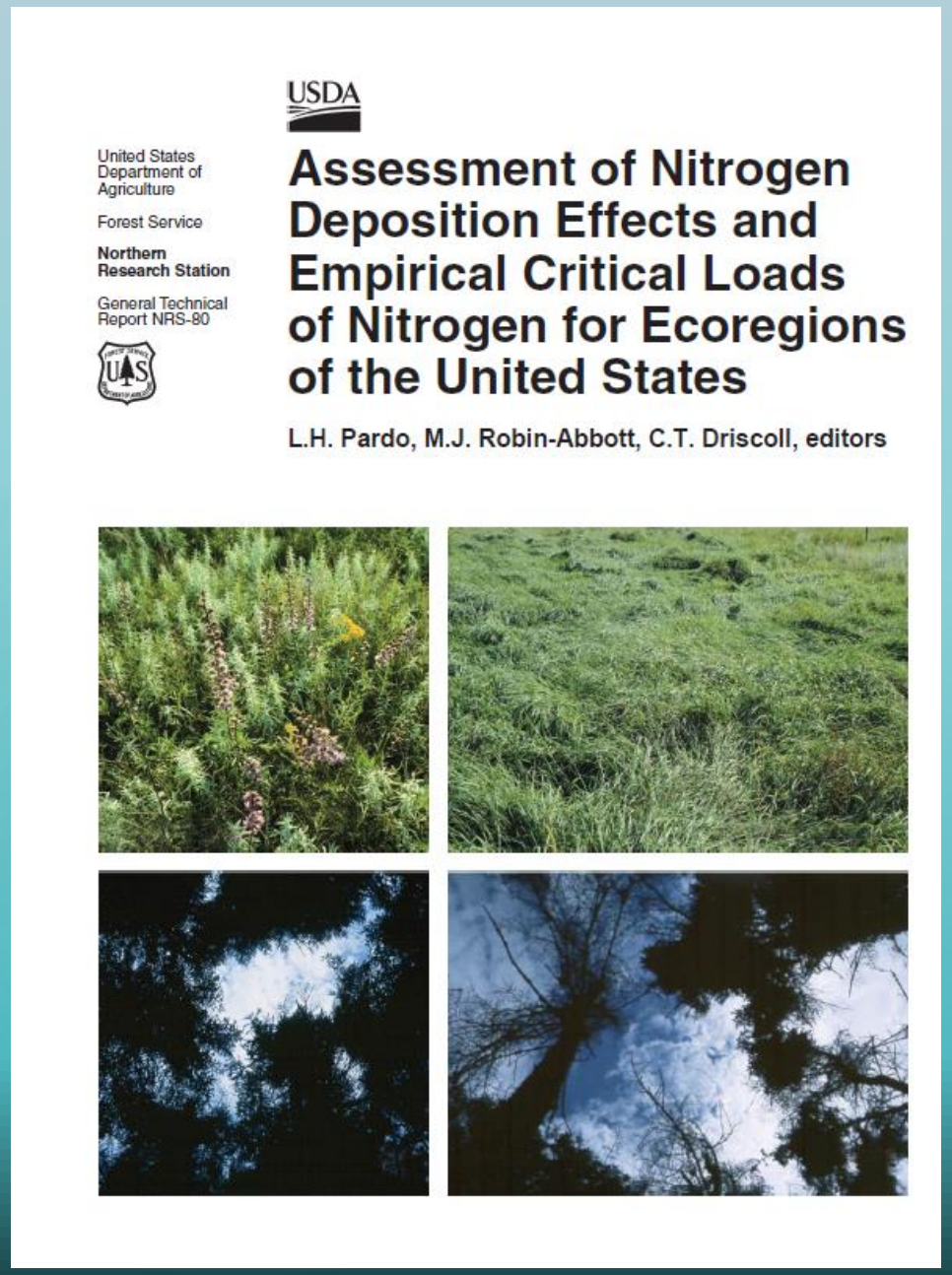
UNECE-CCE “Call for Critical Loads Data”

- CL Data/maps submitted by “countries” (not individuals) to CCE
- A new “call for data” only occurs every 2-3 years
- CCE “Call” for Empirical and Calculated CL Anticipated for fall 2010
- CL data/maps would be due from countries to CCE in March 2011
- US does not have a “focal center” sanctioned by the US State Dept.

So……

FOCUS Pilot Study to:

- Do a “mock” submittal of US CL data to CCE for the call
- Ask US scientists doing CL work to submit data via FOCUS/CLAD
- Help US scientists develop consistent protocols for submitting CL maps/data
- Serve as “point of contact” for US “mock” submission of CL data
- Identify conflicts in data, gaps in info, issues


USDA
United States Department of Agriculture
Forest Service
Northern Research Station
General Technical Report NRS-80
Assessment of Nitrogen Deposition Effects and Empirical Critical Loads of Nitrogen for Ecoregions of the United States
L.H. Pardo, M.J. Robin-Abbott, C.T. Driscoll, editors

Moving on to the "hard" stuff:

- Characterizing Uncertainty (extent, magnitude, reliability, weight of evidence)
- Scaling CL (site A → Region → site B)
- Forest response to tree species response
- Single species response to food chain impacts
- Biodiversity implications in the future

Final Ecosystem Goods and Services

"components of nature, directly enjoyed, consumed, or used to yield human well-being" ***(Boyd & Banzhaf 2007)***

Make linkages:

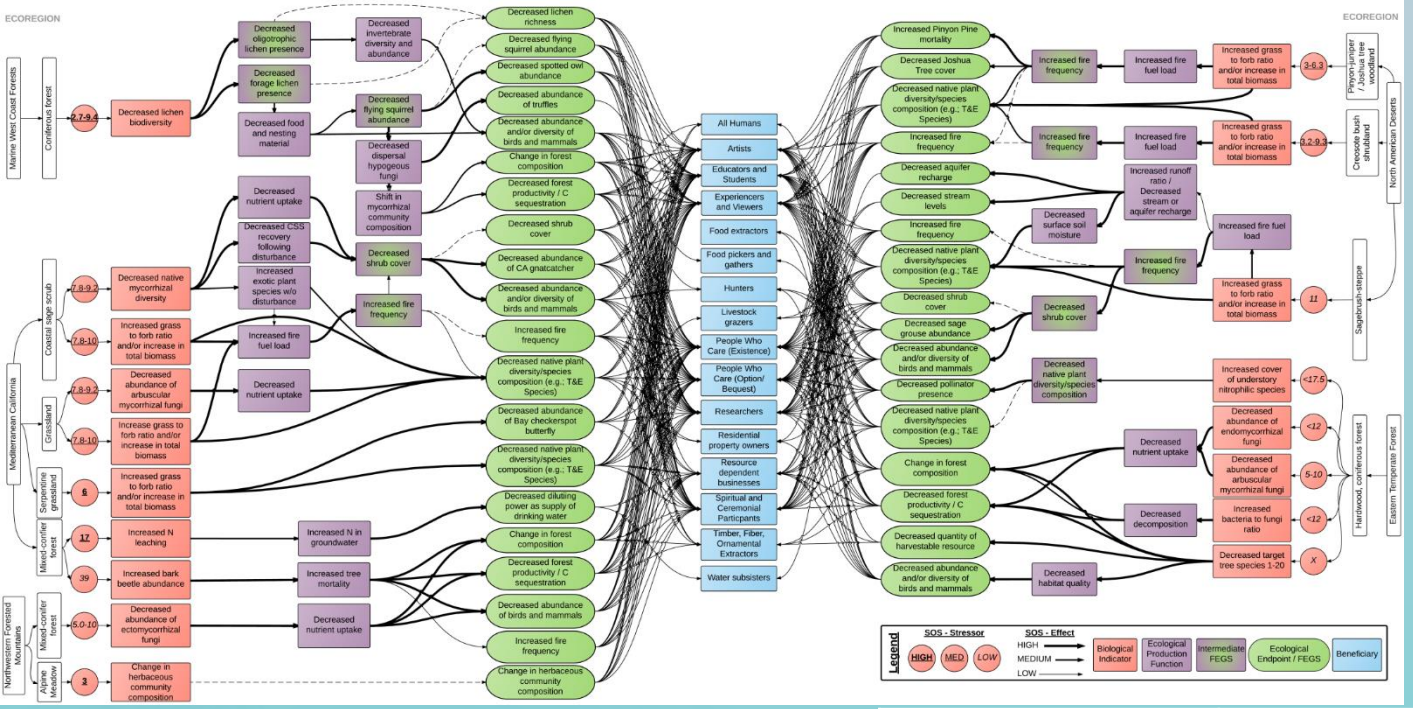
(1) Impact of air pollution to ecosystems (based on critical loads)

(2) Loss of benefit (many simultaneously) to humans

(3) Description of loss (of what by whom)

(4) Level of certainty

(5) Good stories



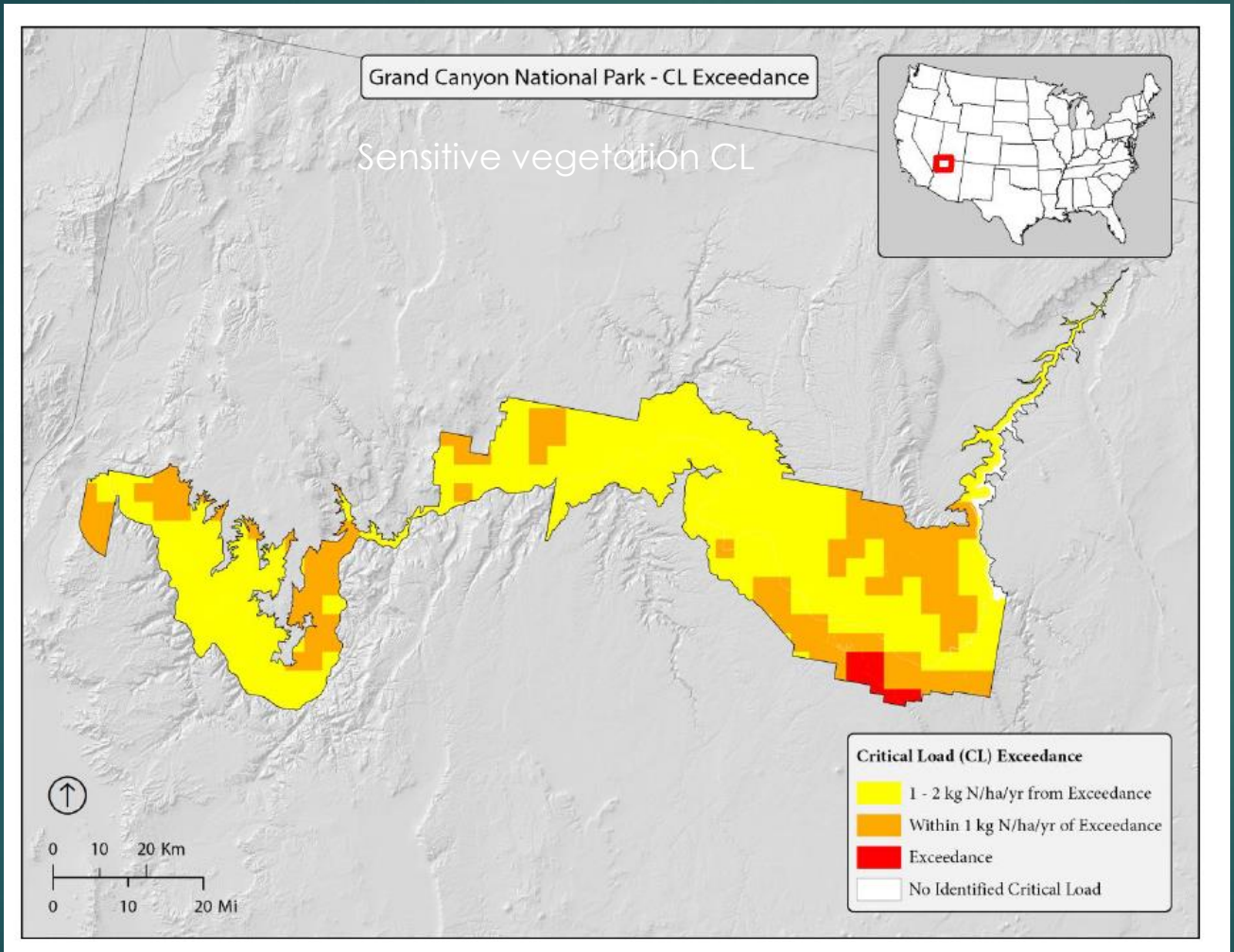
Over 1000 links between **Critical Loads exceedance** and change in an **ecosystem service**

	Change in biological indicators	Ecological endpoints	Beneficiary groups	Ecological Production Functions	Chains
Aquatic acidification	9	10	15	25	208
Aquatic eutrophication	6	13	18	13	127
Terrestrial acidification	8	11	10	68	160
Terrestrial eutrophication	21	43	16	77	582

Policy /Mgt uses of Critical Loads Science

- **State of Colorado -**Rocky Mountain NP Nitrogen Deposition Reduction Plan
- **State of NY-** Adirondack CLs related to ecosystem services
- **EPA** -NOx/SOx secondary standards process
- **BLM –**Oil and Gas analyses
- **National Park Service –** park planning & management actions; CAA restoration
- **USFS –** CL incorporated into FS "Inventory and monitoring strategic plan" and "watershed condition assessment rankings" and Forest Plans
- **Great Smoky Mountains NP –** CL to set stream/fish restoration targets

Park Restoration Activities



CL exceedance maps within parks can be used to:

- **Identify areas for invasive grass monitoring**
- **Determine where restoration activities likely to succeed**
- **Understand areas of higher fire risk**

CL Mapper Tool