



Understanding Carbon in Our Rangelands of Eastern Oregon

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What I study?

Rangeland Carbon Fluxes



Image from LICOR



Precision Livestock Management

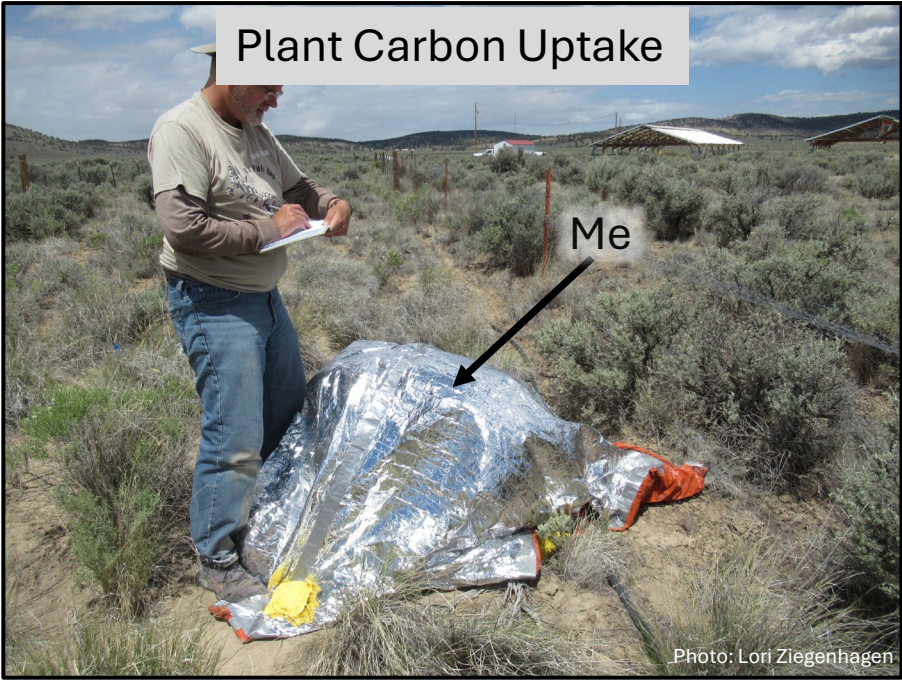


Land Use Land Cover Change



Rangeland Carbon Pools

Photo: Tori Fox



Plant Carbon Uptake

Photo: Lori Ziegenhagen

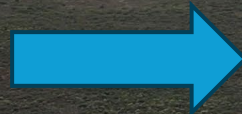
Eastern Oregon Rangelands



Some carbon terms to know

Carbon Sequestration

The process of capturing & storing atmospheric carbon dioxide (CO₂) in a carbon pool.



Carbon Pools

A reservoir of carbon, generally multiple pools in an ecosystem (soil, plants, air, water).



Carbon Security

How secure carbon pools are through time and from disturbances.

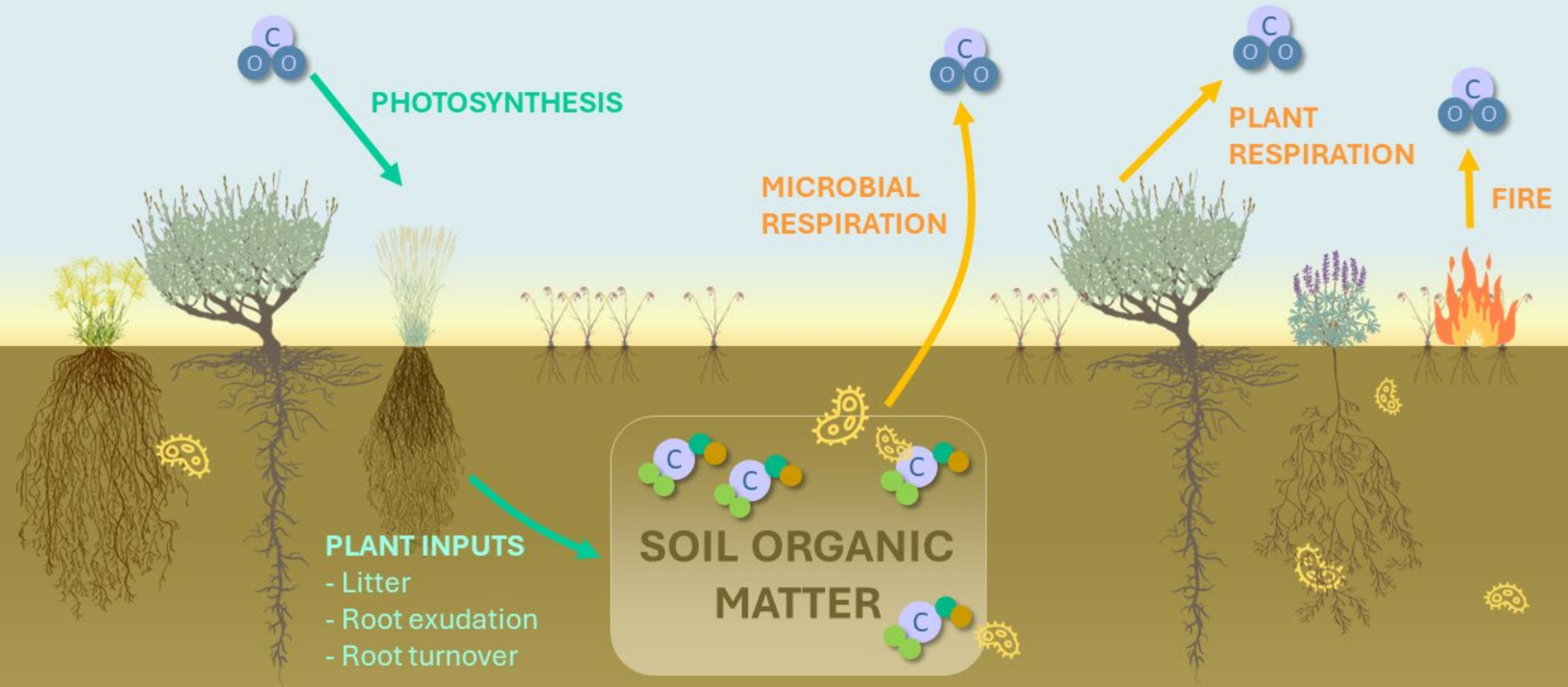
O'Connor et al. 2024

Carbon Fluxes

Amount of carbon exchanged between different carbon pools at a given point in time and area.

Carbon Stocks

The absolute quantity of carbon in a pool at a specific point in time and area.



LEGEND

	Carbon dioxide (CO ₂)		Soil carbon		Soil microbe
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Carbon Management in Rangelands

Managing carbon like row crops

- Increase carbon sequestration
- Increase carbon storage

Myopic focus on carbon outcomes
NOT on **ecological integrity**



Land Use Land Change

- We are losing 280,000 acres of forest each year. (Global Forest Watch 2024)
- We are losing 1.3 Million acres of sagebrush steppe each year! (Doherty et al. 2022)
- Why?
 - Fire
 - Drought
 - Invasive species
 - Woody plant expansion
 - Urban expansion
 - Cropland expansion
 - Gas and mineral extraction



Irrecoverable Carbon



Photo: Jason Williams

Land Management

- Annual grasses conversion reduces deeply stored soil organic carbon by <50%.
(Bagcliar et al. *In Review*; Maxwell et al. 2025)
- Perennial bunchgrass foliar cover correlates to increased soil organic carbon.
(Bagcliar et al. *In Review*)
- Treatment of junipers to increase sagebrush doesn't reduce soil organic carbon.
(Bagcliar et al. *In Review*)



Land Management

- Moderate intensity grazing resulted in greater particulate organic matter (POM) and mineral associated organic matter (MAOM) compared to light and heavy intensity grazing.

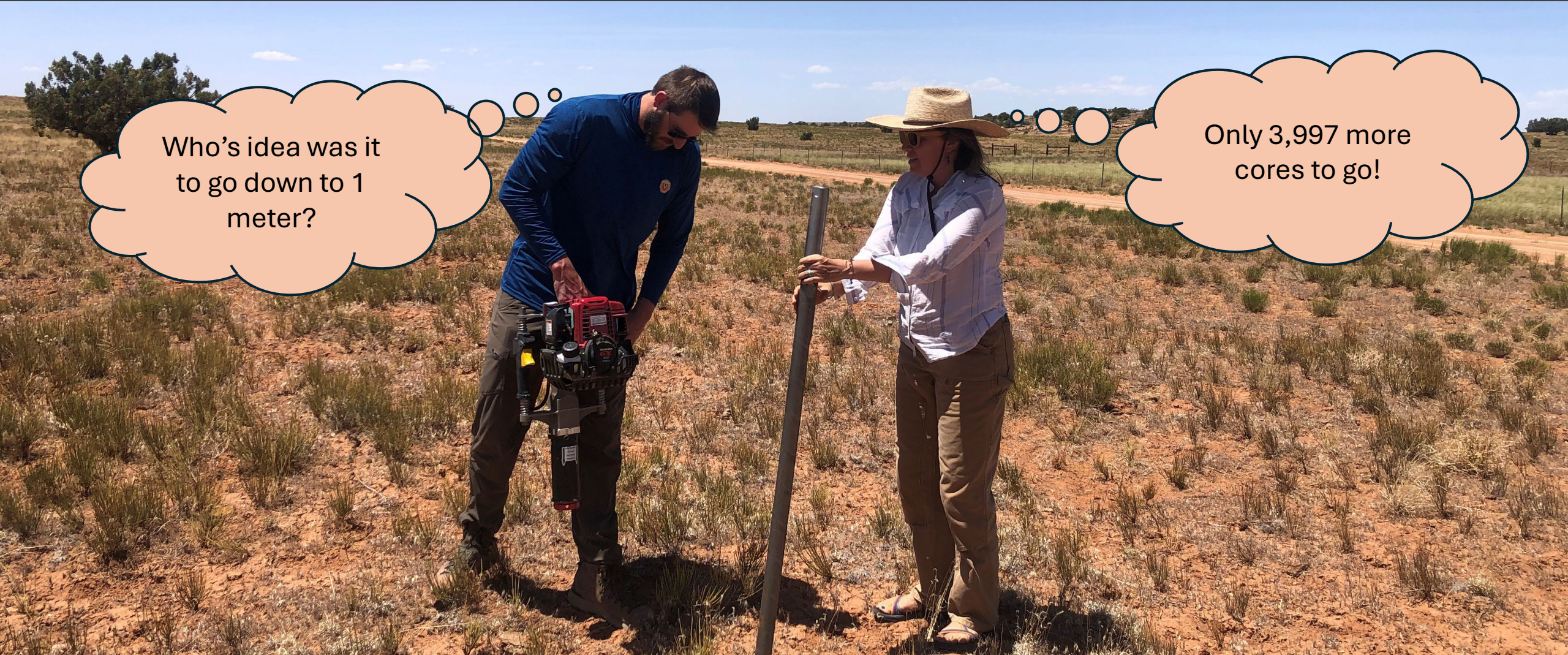
(Adkins 2025)

- Beneath perennial bunchgrasses and interspace had more MAOM when moderately or heavily grazed.

(Adkins 2025)



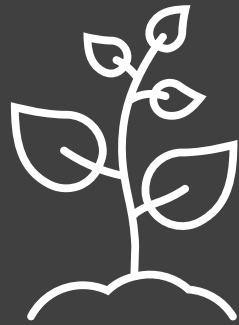
Managers can't manage for grams of carbon per sq. meter at management scales.



Who's idea was it to go down to 1 meter?

Only 3,997 more cores to go!

What can land managers manage and monitor at large scales?



Plant functional groups



Fire Probability

Carbon Security Management

1. Protect carbon security

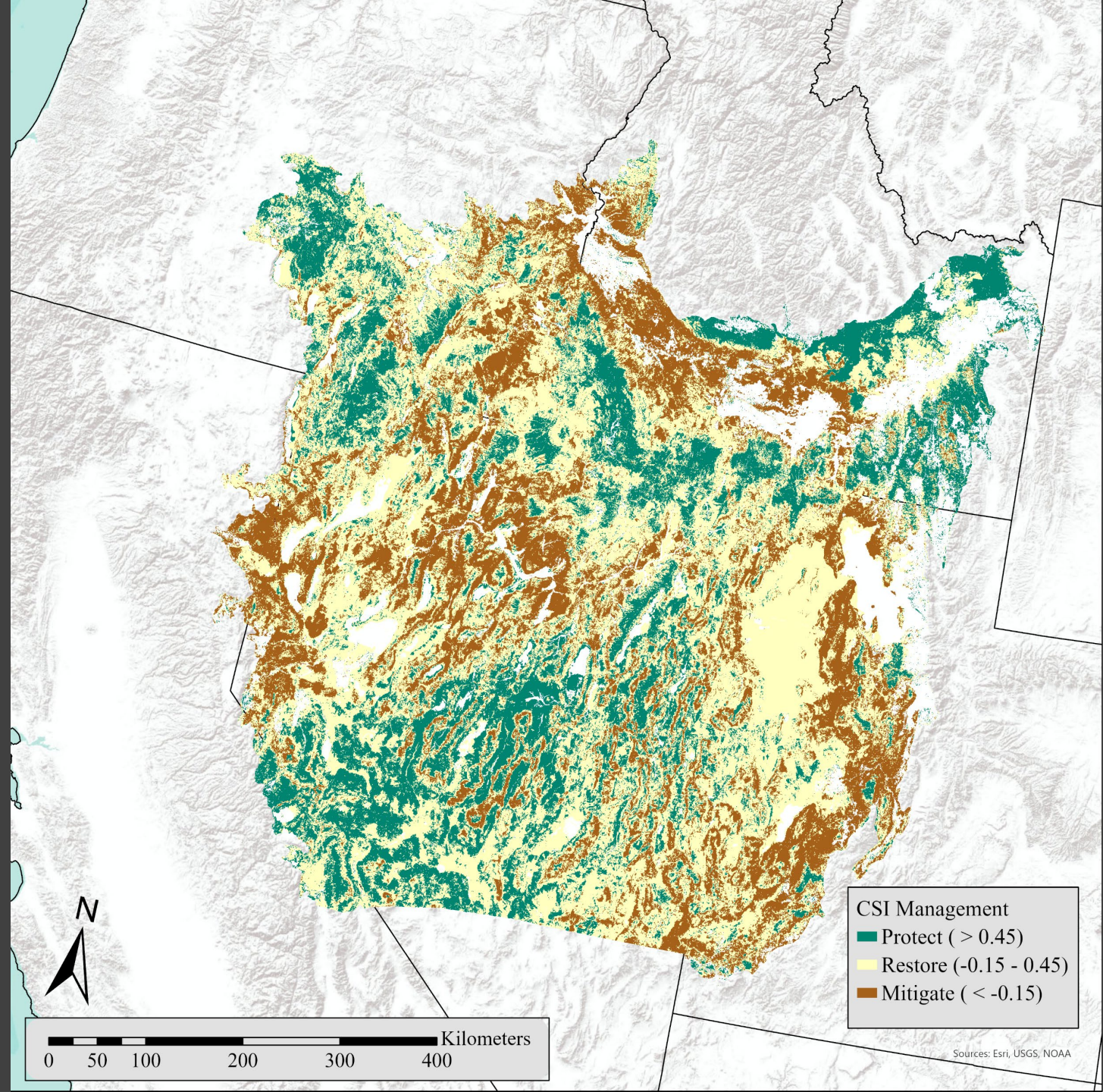
- Maintain what is present

2. Restore carbon security

- Prioritize areas for restoration
- Avoid further degradation

3. Mitigate loss in carbon security

- Try and reduce chances of further carbon loss



Secure the carbon we have, and prevent loss



We need to think about the system as a whole and not be focused on a single facet of that system when making management decisions.





Questions

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