Natural Climate Solutions 4 Quantitative Approaches

Addressing Climate Mitigation through Carbon Sequestration

Compiled for OWEB 10/2020 by L Buckmaster

INTRO

- This brief video introduces the potential for climate mitigation through natural carbon sequestration "based on research by The Nature Conservancy and 15 other institutions [Griscom, et al, 2017], published in the *Proceedings of the National Academy of Sciences*."
- Certain activities from this study and others presented here for comparison were selected by Graves, et al. and tailored for Oregon's Natural and Working Lands.

TNC Global Communications. (10/13/17) "Natural Climate Solutions - Mitigation Potential" https://youtu.be/ZMaPfa_6WpE

GRISCOM, et al. (2017)

Griscom, et al. quantify **global** sequestration rates by activity, showing ROI and ecosystem co-benefits. The timeline runs through 2030.

This study was featured in The Nature Conservancy's 'Nature's Make or Break Potential for Climate Change' (10/ 2017) and in the introductory video presented here.

PgCO2e yr: Petagrams (aka Gigatons) of CO2 equivalents per year.

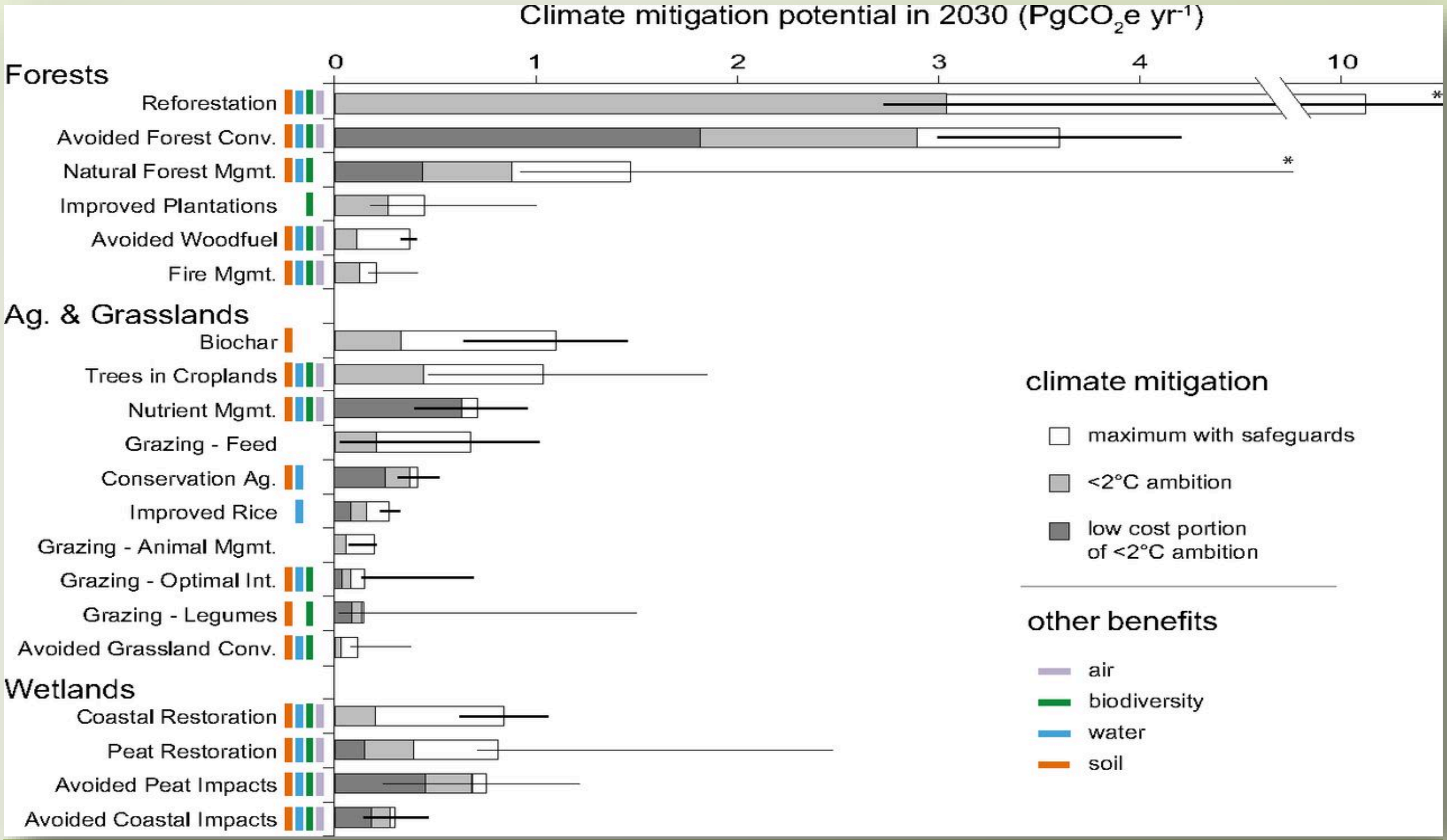


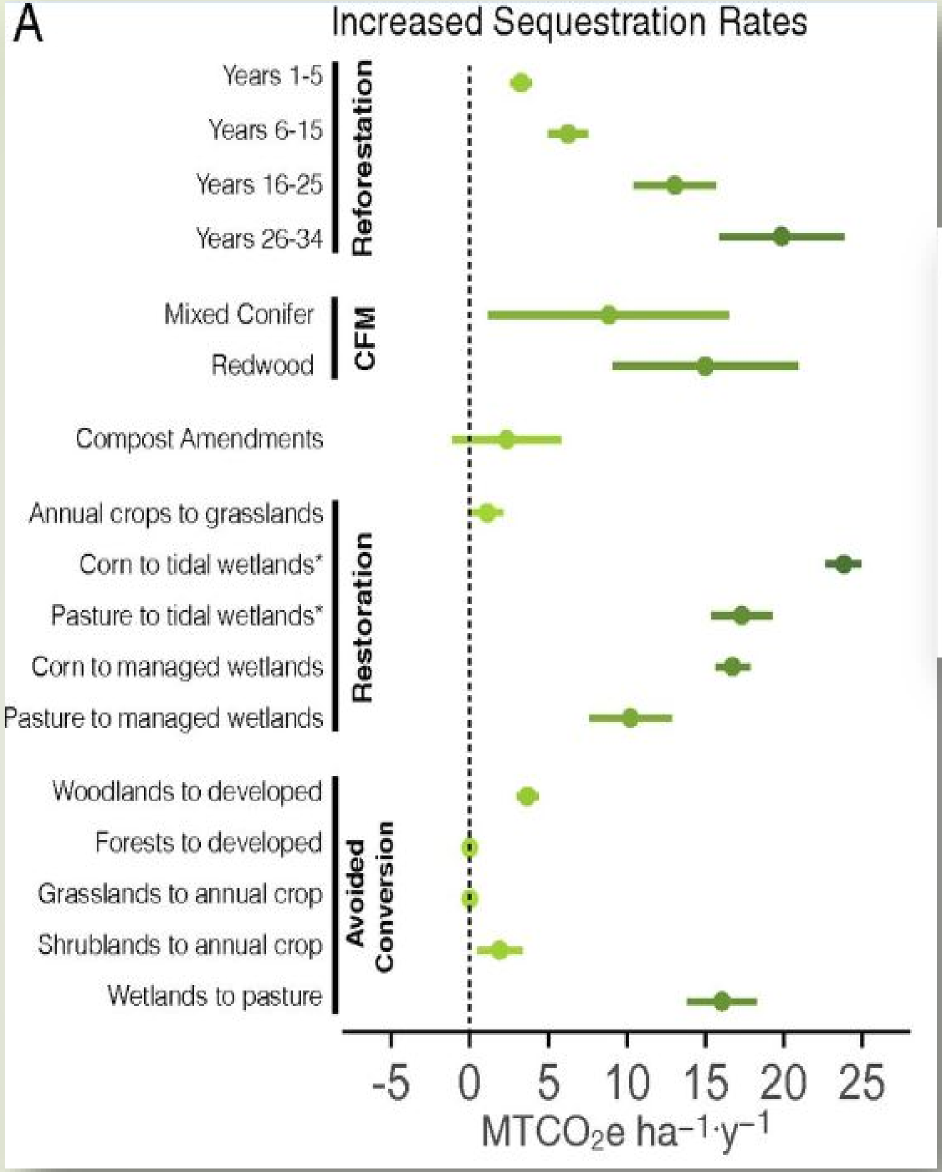
Fig. 1. Climate mitigation potential of 20 natural pathways. We estimate maximum climate mitigation potential with safeguards for reference year 2030. Light gray portions of bars represent cost-effective mitigation levels assuming a global ambition to hold warming to <2 °C (<100 USD MgCO2e−1 y−1). Dark gray portions of bars indicate low cost (<10 USD MgCO2e−1 y−1) portions of <2 °C levels. Wider error bars indicate empirical estimates of 95% confidence intervals, while narrower error bars indicate estimates derived from expert elicitation. Ecosystem service benefits linked with each pathway are indicated by colored bars for biodiversity, water (filtration and flood control), soil (enrichment), and air (filtration). Asterisks indicate truncated error bars. See SI Appendix, Tables S1, S2, S4, and S5 for detailed findings and sources.

Griscom, et al. (2017) Natural Climate Solutions. *Proceedings of the National Academy of Sciences* Oct 2017, 114 (44) 11645-11650; DOI: 10.1073/pnas.1710465114.
https://www.pnas.org/content/114/44/11645 (accessed 10/2020)

CAMERON, et al. (2017)

Cameron, et al. quantify sequestration rates by activities selected for use in **California**. By highlighting the range of confidence intervals (CI), the near-, mid-, & long-term rates of sequestration are easily noted. The 2050 timeline has a benchmark at 2030 to correlate with the state's GHG emissions reduction plan.

MTCO2e ha-1 y-1: Metric Tons of CO2 equivalents per hectare per year.
CFM: Changes to Forest Mgmt



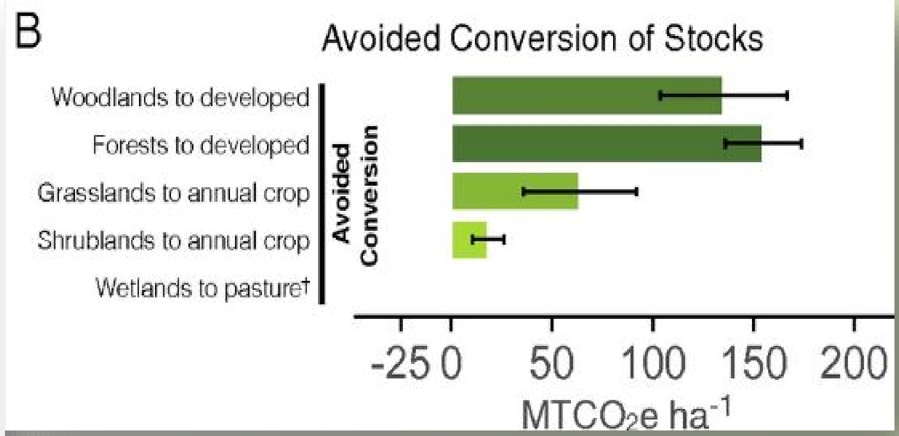
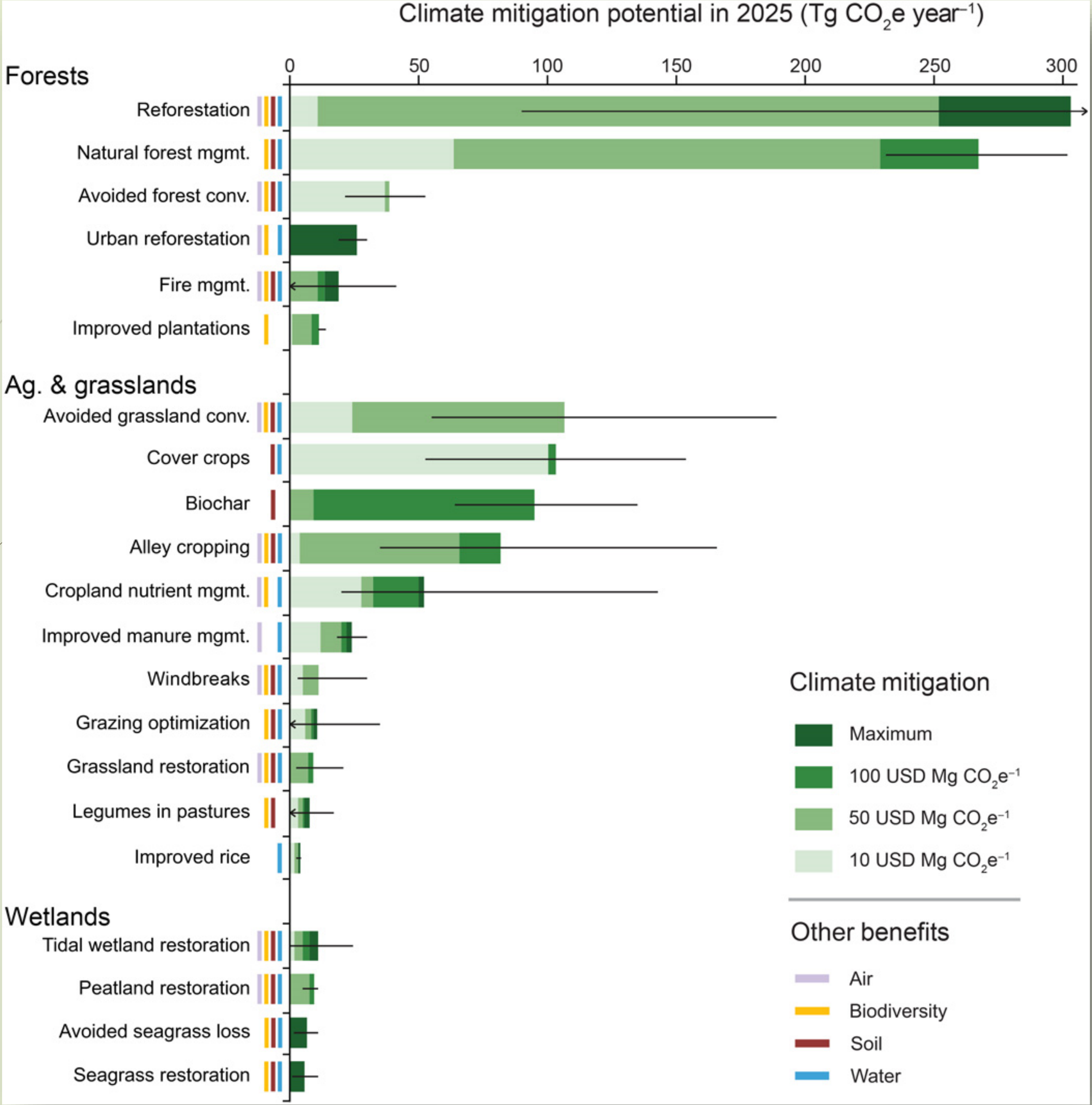


Fig. 1. Reductions used to parameterize the Monte Carlo simulations for (A) activities that increase sequestration of GHG and (B) activities that also have a reduction associated with the avoided conversion of their carbon stock. Reforestation is a single activity but has varying rates of sequestration based on forest age. Error bars represent the 90% confidence intervals. *The reduction rate of the tidal wetland activities may be overestimated because potential methane emissions after restoration are not included. †Estimate on one-time emissions from wetland to pasture conversion event unavailable. See Table S6 and SI Methods for a detailed description of all activities and the calculation of the associated reductions.

Cameron et al. (2017) Ecosystem management and land conservation can substantially contribute to California's climate mitigation goals. *Proceedings of the National Academy of Sciences* Nov 2017, 114 (48) 12833-12838; DOI: 10.1073/pnas.1707811114 https://www.pnas.org/content/114/48/12833 (accessed 10/2020)

FARGIONE, et al. (2018)



Fargione et al. quantify the sequestration potential of 21 activities through 2025, the target year for the **United States**' NDC (Nationally Determined Contribution) under the Paris Agreement. ROI by price-point and ecosystem co-benefits are included.

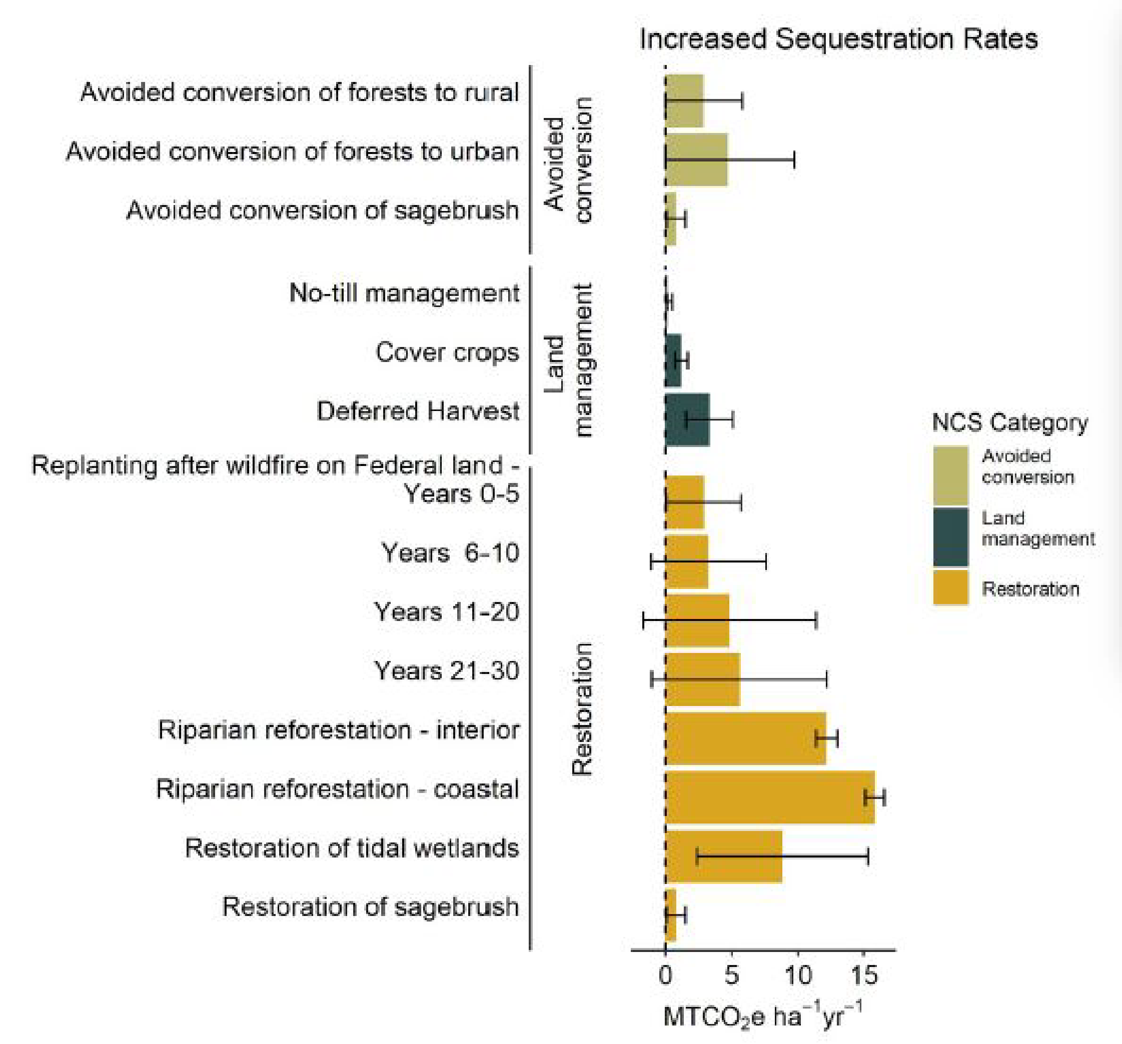
See Appendix:
US Carbon Mapper

TgCO2e year: Teragrams (equiv. to Million Metric Tons) of CO2 equivalents per year.

Fig. 1. Climate mitigation potential of 21 NCS in the United States. Black lines indicate the 95% CI or reported range (see table S1). Ecosystem service benefits linked with each NCS are indicated by colored bars for air (filtration), biodiversity (habitat protection or restoration), soil (enrichment), and water (filtration and flood control). See the Supplementary Materials for detailed findings and sources.

Fargione et al. (2018) Natural Climate Solutions for the United States. *Science Advances* 14 Nov 2018: Vol. 4, no. 11, eaat1869 DOI: 10.1126/sciadv.aat1869
https://advances.sciencemag.org/content/4/11/eaat1869 (accessed 10/2020)

GRAVES, et al. (2020)



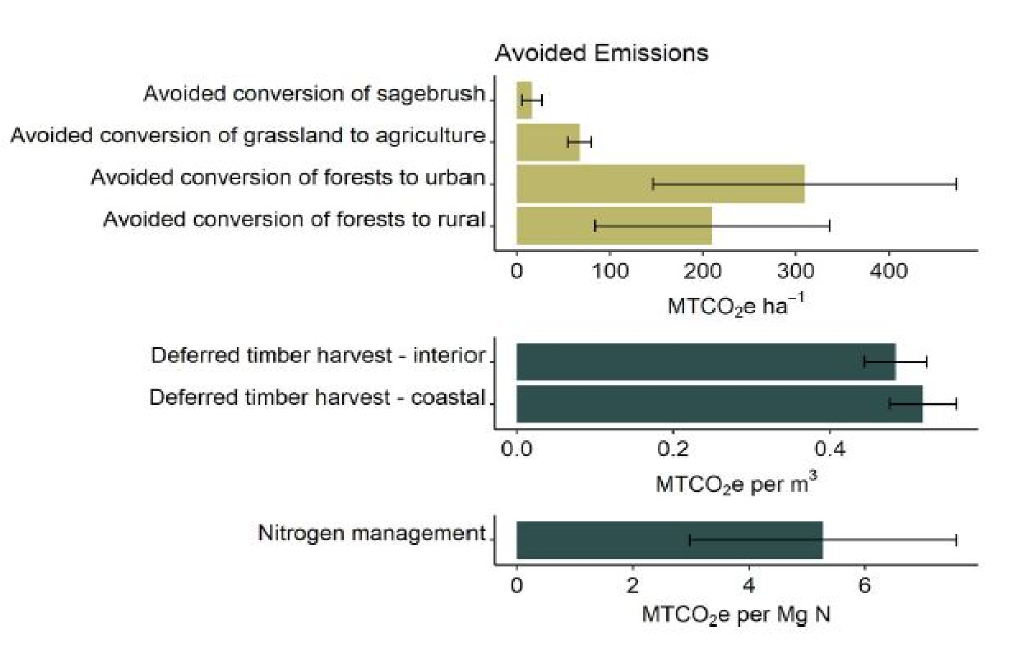


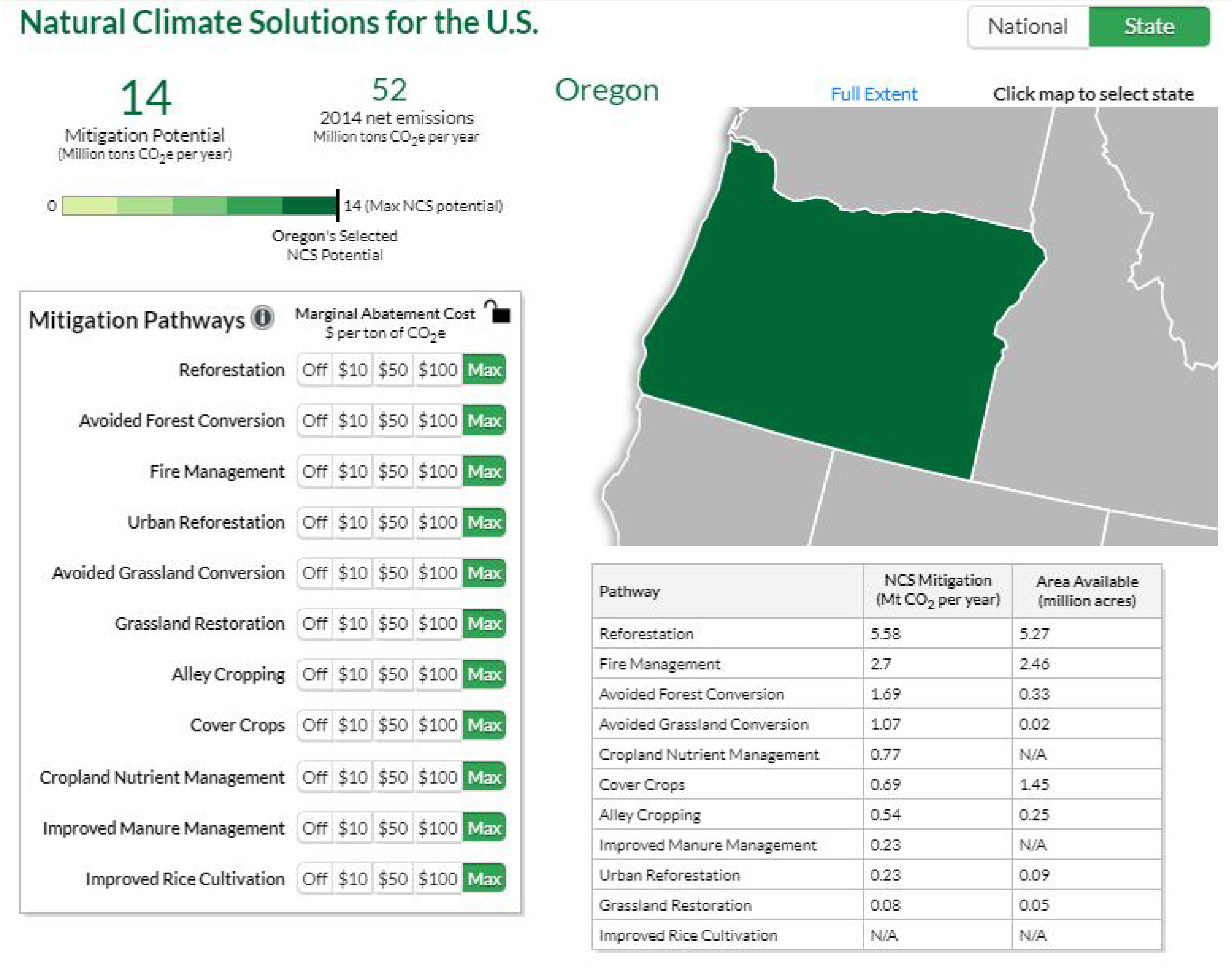
Fig 1. Values used to parameterize the Monte Carlo simulations for (A) increased sequestration and (B) avoided emissions. Some activities have varying rates of sequestration or avoided emissions depending on their location relative to the interior vs. coastal productivity gradient or based on forest age. Error bars represent the 90% confidence interval.

Graves, et al. select activities from the 3 previous studies for "their ability to directly achieve co-benefits for the conservation of biodiversity" and their application to **Oregon**'s Natural & Working Lands. A 2050 timeline is used to meet with parameters set forth in Governor Brown's EO 20-04.
Agroforestry activities are not measured (other than those which are part of riparian reforestation). Compost amendments, biochar, & urban reforestation are also not included as they do not meet either the criteria or scope of this study.
The authors note that after timber harvest deferment, "riparian reforestation provides the second largest mitigation potential by 2050 under moderate and ambitious implementation and has the highest carbon sequestration per unit area."

Graves, et al. (2020) Potential greenhouse gas reductions from Natural Climate Solutions in Oregon, USA. *PLOS ONE* 15(4): e0230424.
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0230424 (accessed 10/20)

Appendix: U.S. CARBON MAPPER

APPENDIX:
US Carbon Mapper



Pathway	NCS Mitigation (Mt CO_2 per year)	Area Available (million acres)
Reforestation	5.58	5.27
Fire Management	2.7	2.46
Avoided Forest Conversion	1.69	0.33
Avoided Grassland Conversion	1.07	0.02
Cropland Nutrient Management	0.77	N/A
Cover Crops	0.69	1.45
Alley Cropping	0.54	0.25
Improved Manure Management	0.23	N/A
Urban Reforestation	0.23	0.09
Grassland Restoration	0.08	0.05
Improved Rice Cultivation	N/A	N/A

The U.S. Carbon Mapper is an interactive tool that provides a breakdown of 11 mitigation pathways at both national and state levels. Information can be filtered by state showing pathways, acres available for each, and NCS CO2 mitigation per year. This data can be further tailored according to various levels of abatement costs* per ton of CO2e.

← The (non-interactive) image here presents data for Oregon using costs for maximum abatement potential.

- *More detailed information about the mapper can be found in the **US State Mapper FAQ.** (Abatement costs are covered in item #9.)*

The state carbon mapper is not intended to replace more detailed analysis tailored for policy makers at the state level.

The U.S. Carbon Mapper selects only 11 of the 21 mitigation pathways researched by Fargione, et al. (2018) due to data limitations. While all 21 pathways have significant potential, the 11 included in the mapper represent 60% of the U.S.'s natural climate solution potential. The underlying study:

Fargione et al. (2018) Natural Climate Solutions for the United States. *Science Advances* 14 Nov 2018: Vol. 4, no. 11, eaat1869 DOI: 10.1126/sciadv.aat1869 https://advances.sciencemag.org/content/4/11/eaat1869 (accessed 10/2020)