PROTECTING THE TONGASS RAINFOREST, OLDER FORESTS, AND LARGE TREES NATIONWIDE FOR THE U.S. NATIONALLY DETERMINED CONTRIBUTION TO THE PARIS CLIMATE AGREEMENT

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photo: J. Schoen

Executive Summary: the 16.8 million-acre Tongass rainforest in southeast Alaska represents 12% of the entire North Pacific Coastal Temperate Rainforest Biome (from coastal Alaska to the California coast redwoods); collectively, the largest expanse of temperate rainforests on Earth. The Tongass also contains the most old-growth forest of any national forest with ~5 million acres remaining (29% of total area; 89% of historic). 9.2 million acres are roadless* (not all old growth), representing 16% of nationwide roadless total. Revised carbon accounting presented herein reinforces the world-class position of the Tongass as a carbon reservoir and climate sanctuary. In sum, the Tongass is the national carbon champ, storing the equivalent of 44% of the total ecosystem carbon for the entire national forest system. Historical Tongass logging peaked at over half-billion board feet in 1980 (enough to fill 30,000 log trucks), declining after expiration of two 50-year pulp contracts from 2000-2020. Projected logging from 2021-2032 will occur predominately within old-growth rainforests inside (Trump) or outside (Obama) roadless areas ramping up in 2033-2100 mainly in younger forests. Emissions from logging accumulate in the atmosphere at an estimated rate of 50,000 vehicle emissions equivalents annually, topping off at >9 million accumulated vehicle emissions by mid-century from a century of past and future estimated logging, which is grossly negligent of the global climate emergency. The social cost of carbon from logging emissions is estimated at $15 million annually beginning in 2033, which is >30 times the lowest timber value sold in 2020. The Tongass rainforest along with older forests and large trees

nationwide need to be included in the Biden administration's National Determined Contributions (*referring to the 2001 National Roadless Rule).

The Tongass is a National Carbon Champion - At 16.8 million acres, the Tongass National Forest in southeast Alaska is the nation's largest national forest and one of the world's last relatively intact temperate rainforests.[1] Its world-class salmon runs are the backbone of Indigenous, commercial fishery, and recreation-based economies. The Tongass is by far the nation's champion in storing carbon long-term[2] and presents a unique opportunity for the Biden administration to exercise its Nationally Determined Contribution (NDC) to the Paris climate agreement by including the Tongass, along with remaining older (mature and old-growth) forests and large trees nationwide, in the lead up to the COP26 UNFCCC meetings in Glasgow. The Tongass is especially noteworthy because it by far has more old growth than any national forest. Prudent climate strategy would be to protect its carbon dense older forests within and outside roadless areas while allowing younger forests time to sequester more carbon.[3] In general, roadless areas and older forests are more resilient to climate change than logged areas, and they provide a sanctuary for climate-sensitive species.[4] Unfortunately, the Tongass is the only national forest where clearcut logging of old-growth forests and costly road building is practiced on an industrial scale.

For years, the US Forest Service has claimed that emissions from logging cannot be properly tracked, are trivial compared to total US emissions, or are compensated by storing carbon in wood products and planting trees. Here, I summarize why this view is misinformed via key findings from a forthcoming manuscript on the value of the Tongass carbon reservoir and estimated emissions from over a century of logging. This summary is intended to document the contribution of the Tongass and all older forests and large trees as carbon reservoirs if protected in a *strategic natural carbon reserve network.*[5]

Global Importance of Tongass National Forest

- One of the world's last relatively intact temperate rainforests represents 12% of the entire Northern Pacific Coastal Temperate Rainforest biome (coastal Alaska to California), which, itself is 34% of the global temperate rainforest total.[1]
- ~89% of original old growth remains, by far more than any national forest; however, logging disproportionately removed the largest trees in the 1950s-80s.[6]

[1]DellaSala, D.A. 2011. Temperate and boreal rainforests of the world: ecology and conservation. Island Press: Washington, D.C.
[2]Leighty, W.W. et al. 2006. Effects of management on carbon sequestration in forest biomass in southeast Alaska. Ecosystems 9:1051-1065
[3]Moomaw, W.R. et al. 2019. Intact forests in the United States: proforestation mitigates climate change and serves the greatest good. Front. For. Glob. Change, 11 June 2019
[4]Watson, et al. 2013. Mapping vulnerability and conservation adaptation strategies under climate change. Nature Climate Change 3:989-994.
[5] DellaSala, D.A. et al. 2020. https://www.seattletimes.com/opinion/a-strategic-natural-carbon-reserve-to-fight-climate-change/
[6]Albert, D.M., and J.W. Schoen. 2013. Use of historical logging patterns to identify disproportionately logged ecosystems within temperate rainforests of southeastern Alaska. Conservation Biol. https://pubmed.ncbi.nlm.nih.gov/23866037/

- Prolific salmon runs, abundant populations of wildlife considered imperiled in the lower 48 states (e.g., brown bears, marbled murrelets).
- High levels of endemic subspecies (i.e., found nowhere else) across the archipelago.
- Extraordinary diversity of rainforest lichens.

Tongass Carbon and Logging Emissions:

- The Tongass is the national carbon champion representing **~44% of the total ecosystem carbon of the entire national forest system.**[7] Our estimate was based on published values (above ground, below ground, live and dead woody biomass carbon), including new spatial analysis of FIA datasets, and is consistent with other peer-reviewed studies.[8]
- ~5 million ac of "productive" old growth (29% of Tongass) remains, ~1 million acres are within roadless areas, another 497,871 acres is "suitable for logging" in areas designated for development (opened by the Trump plan).
- Logging hit a historic high in 1980 (~600,000 million board feet, ~30,000 logging trucks full), declined significantly after the pulp era contracts expired in 2000, and is poised to ramp up in 2033, levelling off at 103 million board ft annually (~5150 fully loaded logging trucks) through the century.
- Because there is no difference in the timber volume removed under the Tongass 2016 Land Use Plan Amendment (i.e., Obama transition plan) vs. the Trump roadless rule rollback, carbon emissions are the same. The main difference is where the old-growth will come from – under Trump, mostly roadless areas.
- Logging emissions remain in the atmosphere for decades and are expressed herein as vehicle emissions equivalents using both back-casting (1900s to 2020) and forecasting (based on forest plans 2021-2100) models[9] (manuscript underway).
- **Annual emissions peaked in 1980s at ~300,000 vehicle emissions equivalents (Figure 1).**
- **Future emissions are estimated at rate of 50,000 vehicle equivalents annually beginning in 2033.**
- **A century (1950-2050) of cumulative logging emissions is equivalent to >9 million vehicle emissions before tapering off by mid-century.**
- Highest timber value sold on the Tongass was **$21 million in the peak year, 1980**, lowest was **$469,591 in 2020**. By comparison, the social cost of carbon is estimated at **~$15 million annually as logging ramps back up in 2033-2100**.[10]

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[7] Total carbon pools for all national forests obtained from Congressional Research Service. 2020. U.S. forest carbon data: in brief. https://fas.org/sgp/crs/misc/R46313.pdf

[8] Leighty, W. et al. 2006. Effects of management on carbon sequestration in forest biomass in southeast Alaska. Ecosystems 9:1051-1065.

[9] Hoover, C., R. Birdsey, B. et al, 2014. Chapter 6: Quantifying Greenhouse Gas Sources and Sinks in Managed Forest Systems. In Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory. Technical Bulletin Number 1939, Office of the Chief Economist, US Department of Agriculture, Washington, DC. 606 pages.

[10] Based on mean value from global estimates of $54.7/tCo2 and Tongass logging levels 2033-2100. Wang, P., et al. 2019. Estimates of the social cost of carbon: a review based on meta analysis. J. Cleaner Production https://doi.org/10.1016/j.jclepro.2018.11.058

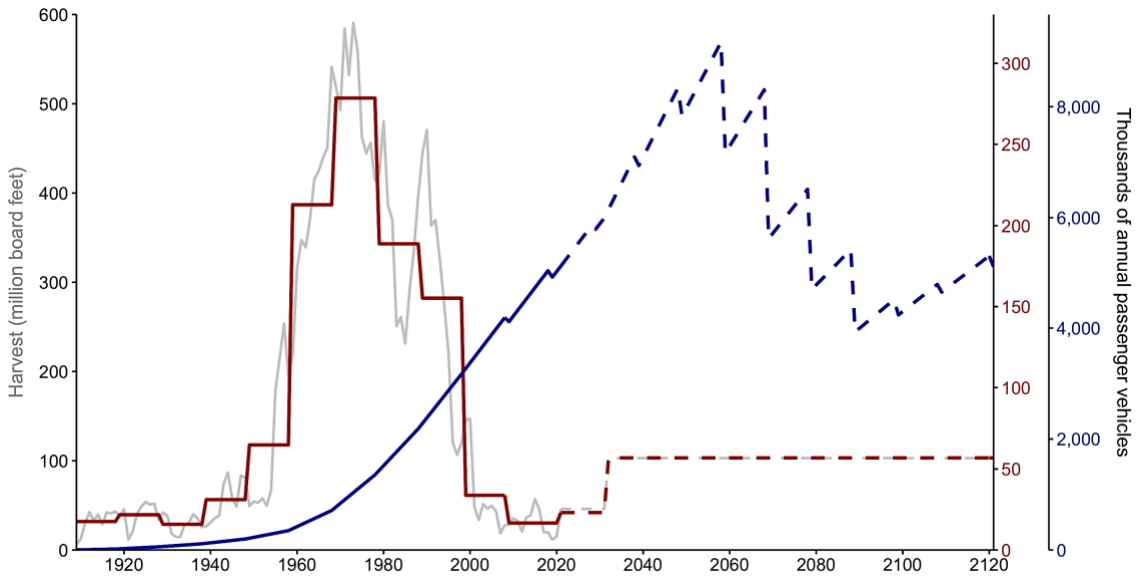

Figure 1. Logging emissions estimated by converting annual board feet sold (FY Tongass timber sale reports) to CO_2 emissions to vehicle emissions equivalents (preliminary). Z-axis reflects both the estimated accumulated (blue) and annual (red) vehicle emissions equivalents. Grey line is actual board ft data. End of pulp era 2000, Obama transition 2016, Trump/Obama logging plans 2021-2100.

Tongass as a Climate Sanctuary

Based on down-scaled climate modeling and recent observations,[11] southeast Alaska is experiencing climate impacts noted by the decline of Alaska yellow cedar, depleted salmon runs from unprecedented droughts, decreasing snow pack, and advancing glacial melt that will only worsen if emissions across all sectors are not drastically cut and forest sinks and reservoirs like the Tongass protected from logging and road building. However, the Tongass is likely to function as a climate sanctuary due to cooler maritime climate, high amounts of old growth and intact roadless areas, relative to interior Alaska and points further south (Figure 2). Carbon stocks are also more stable here given the cooler coastal climate.

[11]DellaSala, D.A. et al. 2015. Climate change may trigger broad shifts in North America's Pacific coastal rainforests. Online module – Earth Systems and Environmental Sciences – published by Science Direct

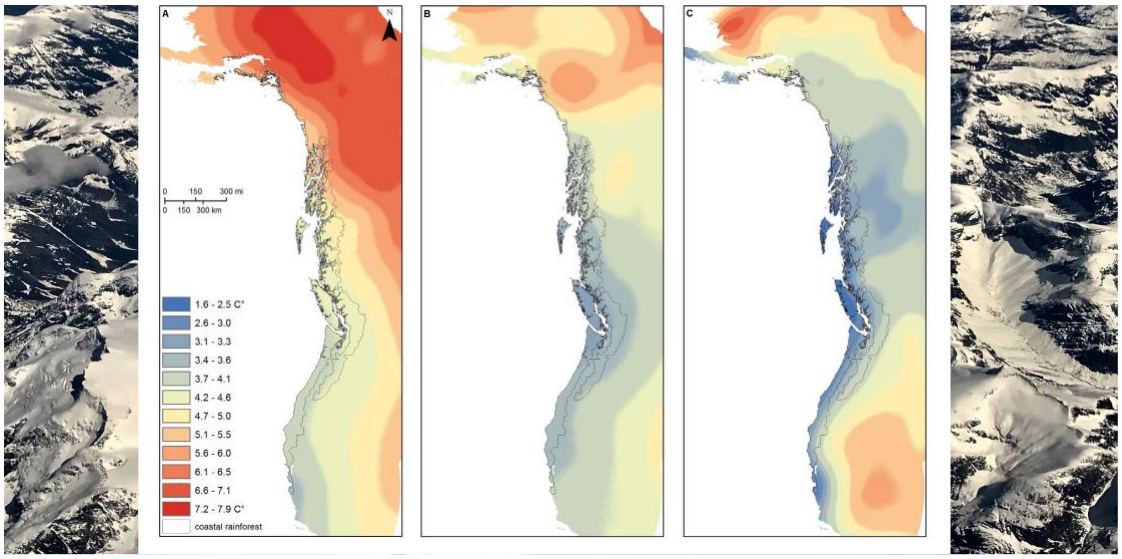

Figure 2. Three downscaled climate models for the North Pacific Coastal Temperate Rainforest biome.[3] Warmer colors = warmer temperatures.

Why Forests Matter in Climate Mitigation - as a forest matures, it continues to accrue carbon, functioning as a net carbon "sink" for decades if not centuries. Ongoing carbon accumulation and storage levels have been measured in forests >800 years old[12] with most of the carbon stored in the largest trees.[13] This is why protecting large trees as well as older forests is important not only on the Tongass but nationwide. In contrast, when an old-growth forest (or individual large trees) is cut down, about half of the forest carbon is released to the atmosphere within a decade or so.[14] Carbon is emitted by decomposition of logging slash, stumps, root wads, and soils; emissions are added from using fossil fuels in transport and manufacturing of products often shipped back and forth overseas. Wood products, at best, can be thought of as delayed emissions that in no way are made up for by planting trees. Globally, deforestation (8-15%) and forest degradation (6-13%) contribute more emissions than the entire transportation network,[15] which is one reason why countries have signed on to the Paris Climate Agreement (Box 1).

Box 1. Conference of the Parties (COP21) 21st session, Paris, December 12, 2015

1. "Recognizes the importance of adequate and predictable financial resources, including for results-based payments, as appropriate, for the implementation of policy approaches and positive incentives for *reducing emissions from deforestation and forest degradation*,

[12] Luyssaert, S. et al. 2008. Old-growth forests as global carbon sinks. Nature 455:213-215

[13] Stephenson, N., Das, A., Condit, R. *et al.* Rate of tree carbon accumulation increases continuously with tree size. *Nature* **507,** 90–93 (2014). https://doi.org/10.1038/nature12914. Lutz, J.A. 2018.Global importance of large-diameter trees. Global Ecol Biogeogr. 2018:1-16. Mildrexler, D.J. et. 2020. Large trees dominate carbon storage in forests east of the Cascade Crest in the United States Pacific Northwest. Frontiers in Forests and Global Change Nov 2020 Volume 3 Article 594274.

[14] Hudiburg, T.H. 2019. Meeting GHG reduction targets requires accounting for all forest sector emissions. Environ. Res. Lett 14 095005 https://iopscience.iop.org/article/10.1088/1748-9326/ab28bb/pdf

[15]Houghton, R. A., and A.A. Nassikas. 2018. Negative emissions from stopping deforestation and forest degradation, globally. Glob. Change Biol. 24: 350–359 doi: 10.1111/gcb.13876.

and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks; as well as alternative policy approaches, such as joint mitigation and adaptation approaches for the integral and sustainable management of forests…..

2. Article 5 1. Parties should take action to *conserve and enhance, as appropriate, sinks and reservoirs of greenhouse gases* as referred to in Article 4, paragraph 1 (d), of the Convention, *including forests*. 2. Parties are encouraged to take action to implement and support, including through results-based payments, the existing framework as set out in related guidance and decisions already agreed under the Convention for: policy approaches and positive incentives for activities relating to *reducing emissions from deforestation and forest degradatio*n, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries; and alternative policy approaches, such as joint mitigation and adaptation approaches for the integral and sustainable management of forests, while reaffirming the importance of incentivizing, as appropriate, non-carbon benefits associated with such approaches.

https://unfccc.int/sites/default/files/english_paris_agreement.pdf

USA Nationally Determined Contribution to the Paris Agreement

As the Biden administration formulates its NDC, it is vital that older forests and large trees across all federal forests take center stage in the protection of land carbon sinks and reservoirs, and in conjunction with USA emissions reductions. As noted, the Tongass is a *globally significant temperate rainforest* and *the national carbon and old growth champion*. However, it is not alone. Millions of acres of older (mature and old growth) forests and large trees need to be protected nationwide in *a strategic natural carbon reserve network*.[5] A comprehensive forest-climate policy needs to include prior logged but revegetated areas managed to recover carbon stocks by allowing younger forests time to reach their full carbon potential (a process called "proforestation"[16]). Currently, national forests sequester some 12% of the nation's annual emissions.[17] Additionally, to avoid climate disruptions and bolster the NDC, all older forests and large trees require protection. Protecting them comes with a "basket of ecosystem co-benefits" such as biodiversity conservation, air and water filtration, erosion control, hunting, fishing, recreation, and Indigenous livelihoods.[18] These benefits will only become more vital in a climate emergency, which is why scientists have called on governments to protect at least 30 percent of lands and waters by 2030 and 50% by mid-century.[19]

[16] Moomaw, W.R. et al. 2019. Intact forests in the United States: proforestation mitigates climate change and serves the greatest good. Front. For. Glob. Change, 11 June 2019 | https://doi.org/10.3389/ffgc.2019.00027

[17]Congressional Research Service. 2020. U.S. forest carbon data: in brief. https://fas.org/sgp/crs/misc/R46313.pdf

[18] Brandt, P, D.J. Abson, D.A. DellaSala et al. 2014. Multifunctionality and biodiversity: ecosystem services in temperate rainforests of the Pacific Northwest, USA. Biol. Cons. 169:362-371.

[19] Dinerstein, E. 2018. A global deal for nature: guiding principles, milestones, and targets. *Science Advances* 19 Apr 2019: Vol. 5, no. 4, eaaw2869 DOI: 10.1126/sciadv.aaw2869. Ripple, W. 2021. The

In closing, climate change is solvable if we do two things right away to avoid imminent climate catastrophes:[20] (1) drastically cut emissions across all sectors (including forestry) (i.e., keep fossil fuels in the ground); and (2) protect carbon reservoirs and sinks as nature-based climate solutions (i.e., keep carbon in forests and trees and out of the atmosphere). Other strategies like planting trees, afforestation, and reforestation can provide some benefits; however, by far the most cost-effective nature-based climate solution is to protect existing carbon stocks present at high levels in older forests and large trees nationwide.[21] Doing so, would provide the Biden administration a unique opportunity to assume global leadership on climate change solutions.

climate emergency: 2020 in review. Scientific Am https://www.scientificamerican.com/article/the-climate-emergency-2020-in-review/

[20] https://scientistswarning.forestry.oregonstate.edu/

[21]Law, B.E., et al. 2018. Land use strategies to mitigate climate change in carbon dense temperate forests. PNAS April 3, 2018 115 (14) 3663-3668; https://doi.org/10.1073/pnas.1720064115