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Comments: Please accept the attached comments on the draft assessments - thank you

January 10, 2025

Re: Tongass Land Management Plan Revision #64039 (submitted via
<https://cara.fs2c.usda.gov/Public/CommentInput?Project=64039>)

Please accept these comments on the TLMP draft revision assessments as part of the public record. We submit these comments as feedback on the assessment drafts, note several places where factual corrections are needed, additional datasources, and published studies (hyperlinked herein) need to be included in the final integrated TLMP revision assessment.

Wild Heritage has been involved on the Tongass since our seminal breeding and winter bird studies (DellaSala et al. 1996), repeated by the US Fish & Wildlife Service in 2012 (Matsuoka et al. 2012). At the time, those studies underscored the importance of Tongass old-growth for bird communities and how thinning and canopy gap creation in second growth was not having much of a beneficial effect on old-growth associated bird species. Tongass old growth importance and its unique global significance via relative intactness and carbon density estimates have been updated and highlighted throughout our comments.

Notably, DellaSala (2011) published the first global assessment of temperate and boreal rainforests of the world that placed the Tongass in a global context of conservation importance as "one of the world's last remaining relatively intact temperate rainforests" (emphasis added). While Tongass intactness is globally significant, Canada's Great Bear rainforest, the Valdivia temperate rainforests of Chile/Argentina, and the temperate and hemi-boreal rainforests of Southern Siberia and the Russian Far East need to be also referenced in context as these rainforests eclipse the Tongass in total forested area and relative intactness, particularly given the amount of high-grade logging of Tongass high-volume old growth prior to the Tongass Timber Reform Act (Albert and Schoen 2013), which especially targeted Prince of Wales Island. This correction of proper context needs to be acknowledged in the terrestrial assessment along with the impact of high-grade logging that degraded high carbon dense, biodiverse old growth replacing it with impoverished plantations. While the total "productive" old growth on the Tongass is still impressive (~5 million acres, 89% of historic, DellaSala et al. 2022), most of the high-volume old growth was eliminated decades ago and this should be acknowledged for historical content (Albert and Schoen 2013). Further, the Tongass also contains low volume ("unproductive") old growth such as muskegs that should not be discounted in terms of their conservation significance as intact areas of high ecological integrity. Shoen and Albert (2007) conducted a conservation assessment of priority areas in southeast Alaska that included most of the

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Tongass old growth and intact areas and this should be recognized in the terrestrial

assessment.

Recent studies on the Tongass, not cited in the carbon assessment section, need proper recognition along with climate related studies that are published and peer reviewed (DellaSala et al 2015, Vynne et al. 2021). The reference to Halofsky as an unpublished "draft" should be referred to only when available to the public. Importantly, when Halofsky is published it will be a General Technical Report not subject to independent peer review and thus these other published studies take on important regional significance and should have been included.

Draft Carbon Stocks Assessment Misses Several Important Studies and Does Not Provide an Appropriate Carbon Life Cycle Analysis of Logging Related Carbon Losses

The Tongass has globally important carbon stocks representing up to 20% of the total stock on the national forests (DellaSala et al. 2022) and more than the 10% acknowledged in the draft carbon assessment. While we appreciate mention of our prior publication, there is a lot more in our study that should be referenced. For instance, most (96%) of the Tongass carbon is tied up in old growth and roadless areas (DellaSala et al. 2022) with very little (4%) stock in second growth. The 10% carbon stock cited in the draft carbon assessment is only for the live tree biomass component (see Law et al. 2023 cited in the assessment) and does not include dead biomass or below-ground carbon stocks that were reported in DellaSala's percentages as noted in their figure herein.

That omission needs to be corrected in the draft assessment. Further, your FIA based carbon assessment is missing wilderness areas (35% of the Tongass which includes old growth). DellaSala et al (2022) included all Tongass LUDs and their figures should be better cited. We request you include these data and related information in the carbon assessment from DellaSala et al. (2022) as noted herein from their published study.

It cannot be overstated how important carbon stocks in old-growth forests and roadless areas are to the Tongass' globally important carbon sink properties. The stock change from logging that peaked in the 1980s has resulted in a great deal of atmospheric emissions that in no way are made up for by natural regeneration in young stands nor the minor amount of carbon tied up in much shorter-lived wood product pools. The harvested wood product pool pales in comparison to stocks retained for centuries in old-growth forests and they should never be compared to biogenic

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carbon in forests in a carbon assessment as harvest wood product pools come with a substantial cost to the climate because most of the carbon was released at some point post logging. Notably, on the Tongass, as much if not more than 50% of the biomass in an old-

growth forest is left on site as slash, stumps, and tree trunks as "fall down" (DellaSala et al. 2022). That is a serious omission in the draft carbon assessment that lacks a proper life cycle analysis (Hudiburg et al. 2019) that needs to include all sector emissions from forest floor carbon losses to transport and distribution of wood products as emissions.

Here, we summarize the logging simulation analysis from DellaSala et al. (2022) that should be referenced in the draft carbon assessment in terms of emissions already released by historic logging and what would be released under alternative scenarios (the Forest Service should conduct an updated analysis based on TLMP alternatives using a similar approach).

While the draft carbon assessment aptly notes that "harvest is the dominant disturbance," it is incorrect to assume this has had "minimal impacts to carbon density." This is an incorrect and highly subjective statement given that carbon density is highest in old-growth forests (DellaSala et al. 2022) and logging in these forests type converted them to low-carbon density second growth (~400,000 acres) at the expense of atmospheric emissions that you did not account for. While "on average, harvest affected 0.04 percent of the total forested area per year," this is the wrong scale of analysis. What's most important is how harvest targeted first and foremost the most carbon dense old-growth forests on the Tongass and then type converted them to diminished stocks that resulted in most of the carbon emitted.

Thus, in a nutshell, your carbon assessment is not based on best available science, needs to incorporate published studies that estimated stock reduction from

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logging (DellaSala et al. 2022), acknowledge how little is stored in wood product pools (Law et al. 2018, Hudiburg et al. 2019, Harmon 2019), and conduct a proper carbon life cycle analysis of the impacts of timber harvest (past, current, projected) on carbon stocks and how harvest targeted the most carbon dense forests on the Tongass. That is - the percentage of the land base logged on average is hiding the ball (trivializing) on how impactful logging has

been aimed at the most productive, carbon dense old-growth forests. Harvest wood product pools are nearly always overestimated by the Forest Service and timber industry (Harmon et al. 2019) as is the case in the draft carbon assessment.

Terrestrial Assessment and Species of Conservation Concern

Ecological Integrity Problems are Incorrectly Portrayed as Primarily a Natural Disturbance Problem - the draft terrestrial assessment - as well as other Forest Service assessments like the national old growth threat assessment - inappropriately blames natural disturbances for declines in ecological integrity even though there are clearcut differences between logging-related forest disturbances vs. natural disturbances that are often associated with high levels of ecological integrity (DellaSala et al. 2025). We request that you specify clearly how ecosystems respond differently to cumulative logging and road building (degradation) vs. natural disturbances like blowdown, wildfires, insects and disease that in most cases are beneficial ecologically (DellaSala et al. 2022, 2025).

Species of Conservation Concern Draft List Is Missing Important Taxa - Yellow cedar is aptly noted in the draft terrestrial assessment for climate-change induced losses related to declining snowpack regionally. However, yellow cedar should have been selected as a species of conservation concern (SCC) in the SCC assessment given its widely documented decline. In addition, DellaSala et al. (1996) recommended the inclusion of the Pacific Slope Flycatcher (using difference criteria at the time) because of its tight association with old-growth forests and its lower abundance in second growth. We also appreciate the attention to bryophytes, fungi, and lichens as potential SCC mainly because these taxa tend to be very sensitive to subtle changes in forest microclimates that can be induced by edge effects from logging and road building. This is especially importance given the Tongass has world-class levels of lichen richness, for instance (DellaSala 2011). Additionally, we request that you query published datasets on endemic subspecies known to be distributed - and perhaps even isolated - across the Tongass archipelago, especially in karst areas (e.g., Androski et al. 2024).

Transition to Young/Second Growth Needs to Speed Up and Eliminated all Old Growth Harvesting aside from micro-site removals for Indigenous Uses - we fully support the Southeast Alaska Sustainability Strategy emphasis on transitioning the Tongass out of old-growth logging as demonstrated in our published studies (DellaSala and Furnish 2020, pdf attached). Tongass second growth can meet the Tongass timber targets entirely without the need for even 5 mm bd ft of old growth annually (DellaSala and Furnish 2020). The Forest Service's own analysis supports this request to transition fully into second growth.

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Inadequate Climate Change Assessment - the draft terrestrial assessment refers to Halofsky et al. (draft) yet that is not provided to the public nor will it be subjected to independent peer review standards compared to the peer reviewed publications that were not cited and are available herein. There are several published reports and studies that need to be cited on the importance of the Tongass as potential climate refugia (DellaSala et al. 2015, 2022; Law et al. 2023, Vynne et al. 2023 - all hyperlinked above).

Conclusions (What's Needed in Revision)

The draft assessments overall need to be substantially improved based on the best available science pertaining to: (1) the Tongass' global significant ecosystem values by recognizing its global context compared to other temperate rainforest regions in DellaSala (2011); (2) its potential as climate refugia (DellaSala et al. 2015, Vynne et al. 2023, Law et al. 2023); (3) importance of Tongass old-growth forests and roadless areas for carbon and for climate refugia (DellaSala et al. 2022); (4) how historic logging targeted the most carbon dense forests (Albert and Schoen 2013); (5) the cumulative effects of logging and road building, including fragmentation of previously intact areas (DellaSala et al. 2022); emissions from logging and how little carbon is stored in wood product pools (Hudiburg et al. 2019, Harmon 2019, DellaSala et al. 2022); and (6) published climate projections of the region in relation to the Tongass' climate refugia properties (DellaSala et al. 2015, Vynne et al. 2023, Law et al. 2023). We request that you include a time series, spatially explicit analysis of old growth logging and road building by eco-provinces that also includes road densities and impacts of roads and fragmentation on species of conservation concern. That analysis would show how certain provinces like those on Prince of Wales Island have been targeted and cumulatively impacted. Additionally, while the draft assessment refers to the Tongass wildlife conservation strategy, that strategy does not protect enough old growth habitat (Smith and Flaherty 2023). Instead, published studies request protection of Tongass old-growth and roadless areas (DellaSala et al. 2022) because of their important refugia and carbon properties (Vynne et al. 2023, Law et al. 2023) and they should be fully protected as carbon reserves in forest-climate policy (Law et al. 2022). A Tongass conservation strategy is needed in TLMP revision that protects ALL old growth and roadless areas (preferred alternative) and further enables the transition out of old growth through prior analysis (DellaSala and Furnish 2020 - below) and the agency's own young growth analysis that shows the transition is feasible, while also allowing some young growth not needed in transition volume (DellaSala and Furnish 2020) to mature and further accrue carbon stocks degraded by past logging via proforestation (Moomaw et al. 2019).

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Can Young-Growth Forests Save the Tongass Rainforest in Southeast Alaska?

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Abstract

The Tongass National Forest in southeast Alaska is one of the last relatively intact temperate rainforests in the world. Due to public controversy over old-growth logging, the USDA Forest Service finalized a plan in 2016 to transition out of old-growth logging but not until 2032 as the agency claims it needs to log 17,000ha of old growth as "bridge timber" until

some

114,000ha of young growth regenerating from prior clearcut logging is readily available. Transitioning out of old growth

logging faster than proposed by the Forest Service would maintain fish, wildlife, and climate benefits along with timber

industry needs more aligned with the limits of what the Tongass rainforest can sustain. Recent young growth (mainly 55-year old precommercially thinned stands) inventories on the Tongass suggest that the Forest Service can begin a transition out of old-growth logging within 5 years and on a much smaller (50,000ha) and predominately young growth land base than the agency proposes in its transition plan, if certain conditions are met.

"The Tongass National Forest is a national treasure. Today, I am outlining a series of actions by USDA and the Forest Service that will protect the old-

growth forests of the Tongass while preserving forest jobs in southeast Alaska. I am asking the Forest Service to immediately begin planning for the

transition to harvesting second growth timber while reducing old-growth harvesting over time."

July 3, 2013 Press Release, USDA Secretary Tom Vilsack

Tongass as a World Class Temperate Rainforest

At 6.8 million hectares, the Tongass National Forest in southeast Alaska is the largest national forest in the United States and one of

the world's last relatively intact temperate rainforests (DellaSala, 2011). This national forest is hemmed in by glaciated Coast Mountains to the east and numerous near-shore islands to the west ranging from the Yakutat Forelands in the north to Prince of Wales

Island south (one of the largest islands in North America) (Fig. 1). Some 90% (>2 million ha) of forests on the Tongass is considered "productive" old growth, consisting of structurally

complex, multilayered forests with trees >150 years (Schoen and Orians, 2013, also see Fig. 1). Old-growth Sitka spruce (*Picea*

sitchensis) and western hemlock (*Tsuga heterophylla*) forests on the Tongass are global carbon sinks (Leighty et al., 2006) that

store atmospheric carbon for centuries primarily because the maritime climate limits fire occurrence. The region's relatively

intact watersheds provide ideal conditions (compared to the lower 48 states) for native species of salmonids (*Oncorhynchus*

spp.), a principal food source for grizzly bears (*Ursus arctos*), wolves (*Canis lupus ligoni*, unique subspecies), and bald eagles

(*Haliaeetus leucocephalus*).

In spite of its global significance, the Tongass is the only national forest in the nation that still clearcuts (clear-fells) old growth on

an industrial scale. Old-growth logging began in earnest in the 1950s with peak logging levels achieved in the 1960s-80s (Fig. 2). At

the time, "high-grading" of the largest trees was a common practice that concentrated logging in low-elevation systems and on

productive karst (limestone base) topography (Schoen and Orians, 2013).

The Tongass is now at a critical juncture regarding its status as a global carbon sink and relatively intact rainforest. Compared to

the Pacific Northwest, which overcut old growth decades ago resulting in a shutdown of federal lands logging due to litigation over

the imperiled Northern Spotted Owl (*Strix occidentalis caurina*), the Tongass currently has no endangered species. Therefore, there is

a unique opportunity to transition out of old-growth logging to avoid future controversial listings.

In 2016, the USDA Forest Service finalized an amendment to the Tongass land use plan to transition out of old-

growth logging if

certain conditions were met. The transition would provide a potential means to end decades of controversy where the choice were

limited to either protect some or clearcut much of the old growth (Fig. 3). A transition would present a third option that would

eventually rely mostly on limiting logging to young forests regenerating from prior clearcut logging.

218 Encyclopedia of the World's Biomes, Volume 3 <https://doi.org/10.1016/B978-0-12-409548-9.11685-9>

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Fig. 1 Tongass National Forest, southeast Alaska. Map provided by J. Leonard, Geos Institute. Dark green

shows forests exceptionally high carbon-

biomass important in climate regulation and climate refugia (DellaSala, 2011).

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(A)

30000

25000

20000

15000

10000

5000

0

Time Period and Current Young Growth Stand Age

(B)

8000

7000

6000

5000

4000

3000

2000

1000

0

Fig. 2 (A) Tongass National Forest old-growth forest logged from 1909 to 2015 and current (2018) age of logged young stands. (B) Timber

volume logged from 1908 to 2006 on the Tongass National Forest. Volume calculations (cubic meters) are based on green and rough sawn at 1 full

inch containing 2.4 cubic meters of usable material. Actual recovery of lumber is greater than estimated long log scale and therefore a conversion

factor of 6.25 was used to express the data in cubic meters. Data for both figures were extracted from available timber harvest records courtesy of A.

Brackley, USDA Forest Service, Pacific Northwest Research Station, Sitka, AK, United States.

To achieve it transition, the Forest Service specified that it would need to log another 17,000 ha of old growth during the next 16 years (presumably to 2032) before getting to 114,000 ha of young growth needed to sustain industry over a 100-year period at

a projected volume of 287.5 million cubic meters annually.

Setting a Transition Timeline: Young Growth Volume

Determining when to transition out of old growth centers on how much young growth is available now and into the future and the

commercial viability of young trees (i.e., can industry make a profit?). Only the volume necessary to meet a transition timeline is

estimated herein. More detailed timber volume estimates and a study of economic value of young growth trees are currently in

progress.

Adjusting Cumulative Mean Annual Increment (CMAI) of young growth stands on the Tongass must reach 95% of CMAI, generally

the time at which annual growth of trees begins to level off before a regeneration (clearcut) harvest is attempted (80-90 years,

pers. commun. A. Brackley). However, the Forest Service can relax this requirement if logging is deemed consistent with other

plan components of its land management plan, which, in this case, is a transition out of old-growth logging.

Shorter rotation

ages allow capture of timber volume in younger age stands. We argue that a rotation age of 55- years can be used to achieve transition

quickly, as this age class corresponds to the oldest young growth stands currently available on the Tongass (Fig.

2) and the average

quartile mean diameter-at-breast-height of 28cm, which is currently being exported on private lands in the region.

1909-45-73yr

1946-50-68yr

1951-55-63yr

1956-60-58yr

1961-65-53yr

1966-70-48yr

1971-75-43yr

1976-80-38yr

1981-85-33yr

1986-90-28yr

1991-95-23yr

1996-00-18yr

2001-05-13yr

2006-10-8yr

2010-15-3yr

1908

1913

1918

1923

1928

1933

1938

1943

1948

1953

1958

1963

1968

1973

1978

1983

1988

1993

1998

2003

Forest Logged (ha)

CUBIC METERS LOGGED X THOUSAND

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(A) (B)

(C)

Fig. 3 Three choices on the Tongass rainforest: (A) protect some of the old growth for ecological, cultural, and climate benefits; (B) log most of the accessible old growth and convert it to commercially producing plantations; and (C) transition into previously logged and now regenerated young growth (D. DellaSala). Note on the Tongass, regeneration following clearcut logging is via natural seed source. No planting is necessary.

Ecological and Operability Constraints on Young Growth LoggingdBased on Forest Service inventories, the Tongass has over

173,000ha of young growth of varying ages (mostly<50years; Fig. 2); 71% of this is within roaded and development land-use

designations andtechnically within the timber base (USDA Forest Service 2014). Notably, the Forest Service uses the mostcurrent

and complete data available on young growth, which provided a foundation for a faster transition

([http://databasin.org/maps/](http://databasin.org/maps/d4ee7a0d9662463289b17bf429f6a0ff/active)

[d4ee7a0d9662463289b17bf429f6a0ff/active](http://databasin.org/maps/d4ee7a0d9662463289b17bf429f6a0ff/active)).

For this estimate, we included young stands (55 years) within 240 m of operable roads that were either precommercially thinned

(PCT) or commercially thinned (CT), on slopes < 72% (based on prior Forest Service analysis), and not within ecologically sensitive

areas (Table 1). Precommercial thinning on the Tongass is designed to reduce competition among densely packed young trees

(speeding up growth rates) and usually occurs 15-30 years after stand initiation. A second entry via commercial thinning typically

occurs at 60 years with extraction of commercial product.

Young Growth Timber Volume ProjectionsdBased on the logging constraints proposed, sufficient young growth timber volume

would be readily available on the Tongass to meet transition requirements (287 million cubic meters annually) beginning as

soon as 2020 (Table 2). Obtaining young growth volume from these stands would reduce the timber land base by >60% of

the Forest Service's transition footprint. In sum,

50,000 ha of predominately young growth PCT and CT stands within the Ranger

Districts closest to milling operations could support a more rapid transition with reduced insert "environmental" conflicts.

Young Growth Economics: The Bottom Line

Determining the market potential of young growth on the Tongass is in early stages but initial results are promising (Fig. 4). For

instance, a commercial thinning project ("Dragon Point commercial thin") in 70-year old young growth offered by the Forest

Service yielded 28.1 million cubic meters with an appraised value of \$440,035. All four timber sale bids received by the agency

were above appraised value and one was 81% above appraisal ([http://sitkawild.org/2014/06/dargon-point-timber-sale-local-](http://sitkawild.org/2014/06/dargon-point-timber-sale-local-wood-local-benefits/)

[wood-local-benefits/](http://sitkawild.org/2014/06/dargon-point-timber-sale-local-wood-local-benefits/)). The private sector (mainly Sealaska Native Corporation) also exports Sitka spruce round logs from 50 to

70-year-old young growth in the region.

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Table 1 Ecological and operability constraints for a 55-

year old young growth timber base within ?ve Tongass Ranger Districts (Thorne Bay, Craig, Petersburg, Wrangell, Ketchikan) closet to timber mills

Importance

Ecological constraint

Karst topography Known to be highly productive and likely to become future old growth via restoration

(also the terrain tends to be unstable due to physical and chemical weathering of the bedrock geology

Wilderness, land-use II designations, national High ecological values, mostly old growth, mostly off-limits to logging (out of the

monuments, inventoried roadless areas timber base)

Beach fringe, riparian buffers Highly productive ecotones for salmon, bears, eagles, and other wildlife and where logging is restricted via forest plan standards and guidelines

Slopes >72% Unstable and erosive

Natural disturbances To allow for development of complex early seral forests and succession to old growth

Not in the suitable harvest base Already restricted due to environmental concerns

Operability constraint

5 Ranger districts with prior log sourcing Hauling distance

Precommercially thinned within 240 m of operable roads Already productive with road access

(as determined by the Forest Service)

Precommercially thinned with at least partial overlap with May have access problems given part of the stand lies outside the 240-m buffer

a 240-m road access buffer

Commercially thinned stands within 240 m of road access Additional young growth sites for volume estimates

Table 2 Timber volume scenarios within ?ve Tongass ranger districts (Craig, Wrangell, Ketchikan, Thorne Bay, Petersburg) projected over a six-

decade period using precommercially thinned (PCT) stands within 240 m of operable roads. Carryover volumes are based on harvest

levels remaining consistent for each of the scenarios with the carryover from prior periods being used to supplement the harvest bases such

that there are no rolling green outs

Annual cubic Annual carryover/de?cit cubic Additive annual carryover/de?cit cubic

Time period meters thousand meters thousand meters thousand

2015-19 142,512 4362

2020-24 524,968 290,594 290,593

2025-29 520,119 285,744 576,338

2030-34 475,569 241,194 817,531

2035-39 394,338 159,962 977,494

2040-44 299,850 65,475 1,042,969

2045-49 205,206 29,169 1,013,800

2050-54 42,881 191,494 822,306

2055-59 194 234,181 588,125

2060-64 0 234,375 353,750

2065-69 0 234,375 119,375

a

2070-74 142,512 91,862 27,521

2075-79 524,969 290,594 318,106

a

Re-harvest of 2015-19 units begins.

As an important next step to securing a rapid transition, an economic study is needed to determine the lumber grade of 55-year old

logs, in consultation with experts from the timber industry and Forest Service. Recently proposed on the Tongass, a wood pr

products

study would allow mill to sort young growth by "value-added" lumber and determine market response, securing the best possible information on young growth log and lumber recovery, young growth value-added grade recovery, and market response to young-growth wood products.

Climate Benefits of a Rapid Transition

Tongass rainforests not only store more carbon than any national forest in the United States, but also may function as a critically important climate refuge (i.e., first line of defense) given maritime influences that moderate more extreme climate events anticipated for interior Alaska and temperate regions further south (DellaSala et al., 2017). Relatively intact watersheds also provide refuge for old-growth dependent species (including many that are important to subsistence needs), while buffering salmon from cumulative effects of climate change and more extensive logging in the surroundings (especially on private lands) (Watson et al., 2013).

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Notably, prior estimates of carbon flux from logging scenarios on the Tongass indicate that only a no-logging scenario maintains carbon stores over time. Carbon also has future economic value in terms of avoided costs from global warming pollution and development of carbon-offset markets. For instance, if carbon were stored long-term in old-growth forests instead of being released to the atmosphere by logging, estimated annual economic value of stored carbon would be comparable to revenue generated from Tongass timbers alone should carbon markets mature (Leighty et al., 2006). Importantly, an Interagency Working Group on Social Cost of Carbon estimated that the cost of carbon from global warming effects would be \$27-221 per ton by 2050. Recent evidence suggests the costs may be much higher, including large demographic displacements of human settlements along coastlines (Pizer et al., 2014).

Soon after logging old growth, carbon is emitted to the atmosphere via decomposition of logging slash, fossil-fuel emissions from transport and wood processing (e.g., up to 50% of Tongass logs can be shipped overseas), and decay or combustion (within 40-50 years) of forest products in landfills. Planting or growing young trees or storing carbon in wood products does not make up for emissions released from a logged forest, especially one on short timber rotations (<100 years compared to old-growth forests that store carbon for centuries). Indeed, after an old forest is clearcut, the young forest remains a net CO₂ emitter for 5-50 years,

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depending on site productivity (see Harmon et al., 1990; Law and Harmon, 2011) (Fig. 5).

Globally, deforestation (8%-15%) and forest degradation (6%-13%) contribute more greenhouse gas pollution than the

world's entire transportation network (Estimates are conservative as they were mainly derived from the tropics where the majority

Fig. 4 (A) Young trees on a log deck awaiting processing. (B) Milled beams processed by local Alaskan mill (D.

DellaSala).

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Fig. 5 Logging on the Tongass National Forest contributes greenhouse gas emissions while depleting fish and wildlife habitat (D. DellaSala).

of forest losses occur boreal and temperate losses are not available at this time (Intergovernmental Panel on Climate Change,

2007; Houghton et al., 2012). Recognizing the importance of unlogged forests as carbon sinks, scientists have repeatedly called

for protecting carbon stored in primary forests as integral to stabilizing global climate change (Mackey et al., 2014), which is

why countries have committed to reducing emissions and protecting forest sinks (COP 21 climate agreements).

Tongass Climate Change Refuge: Uncertainties and Risks

Follow Up Research and Monitoring reliably estimating carbon flux under different transition scenarios requires comprehensive

carbon assessment tools. Without the benefit of such analysis, however, the Forest Service claims that logging old-growth forests

"could result in either a net loss or gain of carbon" (emphasis added) depending on logging practices used even though clearcut

logging (a substantial emissions source) is the method of choice on the Tongass (some young tree retentions and small

(<4ha) clearcuts are proposed in young forests within Old Growth Reserves and Beach buffers by the agency).

Follow up

work, ideally conducted by the Forest Service, in consultation with carbon scientists, is needed to determine logging emissions;

however, in prior simulations (as noted), only a no-logging alternative results in continued long-term carbon storage (Leighty

et al., 2006).

Climate Shift Happens effects of climate change on forest productivity represent significant and costly risks to the Tongass'

global status. As the climate warms, other vegetation types may replace carbon-dense conifer forests on the Tongass that

evolved during a cooler climate (DellaSala et al., 2017). For instance, during the Miocene millions of years ago, Alaska

was a much warmer place dominated by hardwood forests. As current climate change accelerates, it could lower carbon

storage potential of conifer forests as hardwoods gradually replaces conifers and some conifers die off (thereby emitting

CO₂ as is currently happening with an extensive die-off of Alaska yellow cedar *Cupressus nootkatensis*; Hennon et al.,

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2012). However, the maritime climate of the Tongass also might ameliorate some of climate-mediated impacts compared

to more extreme changes for interior Alaska and temperate rainforests to the south, but only if old-growth forests are intact

(DellaSala et al., 2017) (Fig. 6).

In sum, the Tongass is a global carbon sink; however, this sink may increasingly become an emissions source due to old-growth

logging (DellaSala, 2011). Choosing a climate responsible and rapid transition for the Tongass would better safeguard Alaska's

climate, comply with the COP21 Paris climate change agreements and the global pledge by governments and entities to end global

deforestation.

"We share the vision of slowing, halting, and reversing global forest loss while simultaneously enhancing food security for all. Reducing emissions

from deforestation and increasing forest restoration will be extremely important in limiting global warming to 2 C." United Nations Climate

Summit New York Declaration on Forests (agreed to by 157 governments, including the United States, indigenous groups, corporations, NGOs, and others).

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Fig. 6 Relatively intact forest landscape (potential climate refuge) within Mendenhall Glacier National Park near Juneau, Alaska (A. DellaSala).

Conclusions

The Tongass is one of the last places on Earth where primary forests (unlogged) are still relatively abundant but declining. This

critically important rainforest provides Alaskans with unparalleled economic (e.g., recreation and tourism economies greatly exceed

logging related jobs and revenue), ecological, and climate benefits (Schoen and Orians, 2013). Using Forest Service inventories,

a rapid transition could (1) begin in 2020 as 55-

year stands become increasingly available compared to the agency's 2032 transition

that relies mostly on old growth logging to get to a transition stage; (2) achieved on a much smaller land base (50,000 ha of young

growth vs. a mix of 114,000 ha of young growth and 17,000 ha of old growth); and (3) results in substantially less carbon emissions

along with ecological and cultural benefits sustained over time. Under a rapid transition, logging would occur within areas of rela-

tively low controversy, reducing litigation costs and uncertainty of timber supply to local mills. An economic assessment of young

growth is needed to fully assess viability of young trees.

The Tongass is the only national forest still clear cutting old growth on an industrial scale. Other national forests such as the

Siuslaw in Oregon are generating young growth timber volume as part of a 1990s-transition due to policy reforms enacted. The

time for the Tongass to make a transition is rapidly approaching if the Forest Service will act while there is still significant old growth

remaining to conserve and without the controversy of future endangered species listings and ongoing timber wars.

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