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6 Nov 2024

TO: Blue Mountains Forest Plan Revision Team, and Pacific Planning Service Group

VIA: https://cara.fs2c.usda.gov/Public//CommentInput?Project=64157

Subject: Blue Mountains Forest Plan [ldquo]Need for Change[rdquo] [mdash] comments

Please accept the following comments from Oregon Wild concerning the draft Preliminary Need for Change related to the Blue Mountains Forest Plan Revision, https://usfs-public.app.box.com/v/PinyonPublic/folder/208417236164. Oregon Wild represents 20,000 members and supporters who share our mission to protect and restore Oregon[rsquo]s wildlands, wildlife, and water as an enduring legacy. Our goal is to protect areas that remain intact while striving to restore areas that have been degraded.

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Key Needs for Change
From our perspective the key needs for change include:

* The need to provide abundant, well-connected, high-quality habitat to recover ESA-listed species, prevent the listing of additional species, and maintain viable populations of all others.
* The need to store carbon to reduce the worst effects of global climate change and ocean acidification.
* The need to reintroduce fire during moderate weather conditions to reduce fuels and prevent uncharacteristic fire when weather conditions are extreme.
* There is a need to limit livestock grazing to protect streams, springs, wetlands, meadows, other ecosystems, and associated fish, wildlife, and ecosystem services.
* The need to make room for natural processes to do their ecological work.
* The need to reduce roads density to prepare watersheds for the amplified hydrologic cycle caused by GHG emissions and global climate change.
* The need to conserve intact forests and watersheds that support social, economic, and environmental sustainability, not just for local communities, but also for regional and national interests.
* The need to conserve ecosystem elements that are rare and underrepresented compared to the natural range of variability, including:

* roadless areas,
* mature and old-growth forests,
* large snag habitat,
* carbon storage in large fire resistant trees,
* ungrazed ecosystems,
* functioning watersheds and aquatic systems,
* weed free vegetation communities, etc.

Interior Columbia Basin Ecosystem Management Project
The sources of information for this planning process should include the entire administrative record and scientific record for the Interior Columbia Basin Ecosystem Management Project. The agencies invested millions of dollars and many years developing important information that was intended to lead to improved, ecosystem-based forest plans.

ICBEMP was initiated in part because of a petition from NRDC and others contending that logging of eastside National Forests was failing to maintain viable populations of native species. This [ldquo]need for change[rdquo] remains highly relevant, and should be a focus of restoration efforts in the Blue Mountains. Logging and road construction continues to degrade ecosystems, and the legacy of past mismanagement is still with us. The Forest Service cannot assume that they have figured out how to mitigate the adverse trade-offs from logging and road construction, because the evidence says otherwise. Soil and water are still degraded by heavy equipment and roads. Weeds are still proliferating. Logging still removes valuable habitat trees that can never be used by fish & wildlife. Logging still results in net carbon emissions that exacerbate the global climate crisis. There is a compelling need to find ways of restoring forest that have fewer trade-offs. The agency needs to de-emphasize logging as a restoration tool, and focus on non-commercial thinning and prescribed fire, which achieve as good or better results with far fewer adverse trade-offs.

An example of such information is the ICBEMP analysis of wildlife sources and sinks, and the finding of Korol et

al (2002) that estimated that even if the Forest Service applies enlightened forest management on federal lands in the Interior Columbia Basin for the next 100 years, we will still reach only 75% of the historic large snag abundance, and most of the increase in large snags will occur in roadless and wilderness areas. Jerome J. Korol, Miles A. Hemstrom, Wendel J. Hann, and Rebecca A. Gravenmier. 2002. Snags and Down Wood in the Interior Columbia Basin Ecosystem Management Project. PNW-GTR-181.
http://www.fs.fed.us/psw/publications/documents/gtr-181/049_Korol.pdf. Now is the time to bring that information into the planning process. We incorporate ALL that information by reference. See
https://www.fs.usda.gov/r6/icbemp/ and related government sources, e.g.,
https://www.fs.usda.gov/r6/icbemp/html/science.shtml.
2012 NFMA regs on Carbon and Climate
The Blue Mountains Forest Plan Revision should implement the requirements of the 2012 NFMA planning regulations that recognize carbon storage and climate regulation as an "ecosystem service" provided by forests.

The rules say:

The plan must include plan components, including standards or guidelines, to guide the plan area[rsquo]s contribution to social and economic sustainability, taking into account: ... (4) Ecosystem services; ...

36 CFR [sect] 219.19- The definition of [ldquo]ecosystem services[rdquo] includes [ldquo]long term storage of carbon[rdquo].

[sect] 219.5 the planning framework is intended to allow the FS to adapt to changing conditions, including climate change.

[sect] 219.6 During plan revision, FS must prepare an assessment using [ldquo]existing information[rdquo] including: [ldquo]system drivers[rdquo] such as climate change; a [ldquo]baseline assessment of carbon stocks;[rdquo] an assessment of the [ldquo]benefits people obtain[rdquo] from ecosystem services, e.g. carbon storage.

The 2012 regs are focused on planning for sustainability, including plan components that guide provision of ecosystem services such as carbon storage.

[ldquo]Sustainability - The plan must provide for social, economic, and ecological sustainability within Forest Service authority and consistent with the inherent capability of the plan area, as follows: (a) Ecological sustainability. (1) Ecosystem Integrity. The plan must include plan components, including standards or guidelines, to maintain or restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds in the plan area, including plan components to maintain or restore structure, function, composition, and connectivity, taking into account: [hellip] (iv) System drivers, including [hellip] stressors, such as [hellip] climate change; and the ability of terrestrial and aquatic ecosystems on the plan area to adapt to change. [hellip] (b) Social and economic sustainability. The plan must include plan components, including standards or guidelines, to guide the plan area[rsquo]s contribution to social and economic sustainability, taking into account: [hellip] (4) ecosystem services [carbon storage] [hellip][rdquo]

36 CFR [sect] 219.8.

[sect] 219.10 Ecosystem services seem to be added to the list of multiple uses. And plans must [ldquo]consider[rdquo] and [ldquo]provide for[rdquo] ecosystem services through [ldquo]integrated resource management[rdquo] and must consider [ldquo]system drivers[rdquo] including [ldquo]stressors[rdquo] such as climate change.

FS Handbook 1909.12- 12.42 [ndash] Assessing the Plan Area Influences on Carbon Stocks - The Interdisciplinary Team should identify influences on carbon stocks. Influences on the carbon or carbon-bearing compounds of the carbon pool may include disease, insects, growth, management, timber harvest, vegetation, and wildfire. Consider using information assessed according to section 12.3 of this Handbook, regarding system drivers and stressors. If information is available, the assessment may include the potential change over time (flux) of carbon stocks within those pools.
[ldquo]Inflexible management[rdquo] to you is [ldquo]environmental safeguards[rdquo] for us.
The Preliminary Need for Change (p 3) says [ldquo]the 1990 forest plans as amended need to change to address inflexible management direction that limit innovative, new, science-based approaches.[rdquo] The document however fails to provide any clear examples and evidence of these so-called inflexible requirements and how they impede science-based management. In fact, the Forest Service has plenty of discretion to implement new science.

Others view the clear and unambiguous requirements such as retention of all large trees (per the Eastside Screens) and protection of stream buffers (per PACFISH/INFISH) as wise limits on agency discretion that provide guardrails that help the agency avoid conflicts of interest and avoid making mistakes that threaten their social license to manage public forests. There is no compelling science to show that these requirements are not needed, or that the Forest Service is unable meet its goals related to fuels reduction, species composition, and stress reduction by focusing on removal of small trees and areas outside riparian buffers.

Contrary to the Forest Service insistent that logging is necessary to address species composition, there is evidence that natural mortality processes are self-correcting the species composition, and getting the job done better than logging because natural processes kills the trees that are least fit to survive, and natural processes create and retain snags, and dead wood habitat. In 2022, forest scientists reported a [ldquo]Firmageddon[rdquo] event, where true firs such as white fir and grand fir and noble fir were dying across large areas of eastern Oregon, apparently from drought stress. See Nathan Gilles 2022. Massive die-off hits fir trees across Pacific Northwest | Columbia Insight (AP) Updated: Nov 27, 2022. https://www.mailtribune.com/top-stories/2022/11/27/massive-die-off-hits-fir-trees-across-pacific-northwest/.

Contrary to the Forest Service insistent that logging is necessary to address fire hazard caused by native grand fir/white fir, there is evidence indicating that Grand fir may be more fire resistant than assumed in the NEPA analysis supporting the recent Trump Screens Amendment. "The grand fir forest type had severity values at the same level of forest types dominated by fire-resister species despite grand fir was classified as a fire-avoider species. [hellip] In many ponderosa pine forests maintained historically by a high frequency, low-severity fire regime, the transition towards denser forests dominated by Douglas-fir and grand fir would explain why ponderosa pine and Douglas-fir still compose a significant proportion of basal area in the grand fir forest type, and many maintain large, old, fire-resistant ponderosa pine trees (Johnston et al. 2021; Merschel et al. 2021). Therefore, the particular structure and composition of these [ldquo]recent[rdquo] grand fir forests (e.g., Merschel et al. 2014), with an important presence of large-diameter trees of fire-resistant species, may provide latent fire resistance (Larson et al. 2013)." Jose V. Moris, Matthew J. Reilly, Zhiqiang Yang, Warren B. Cohen, Renzo Motta, Davide Ascoli 2022. Using a trait-based approach to asses fire resistance in forest landscapes of the Inland Northwest, USA. Landsc Ecol (2022) 37:2149[ndash]2164. energyhttps://doi.org/10.1007/s10980-022-01478-w, https://www.fs.usda.gov/rm/pubs_journals/2022/rmrs_2022_moris_j001.pdf.

The Preliminary Need for Change (p 4) says [ldquo][hellip] conflicts and inconsistencies between management direction for various resources [hellip] created confusion and interfered with reaching forest plan desired

conditions and objectives. [hellip] Integrated, flexible, and adaptable plan components must be developed considering local knowledge, federal and state agencies, county governments, public input, a changing climate, and best available scientific information to maintain and restore ecological integrity and sustain local economies.[rdquo] This sounds like environmental requirements got in the way of timber targets, so the Forest Service wants more flexibility to produce logs. This is not appropriate. If conservation got in the way of timber production, then it shows that timber production is out of line with important public values such as clean water, biodiversity conservation, climate stability, recreation, quality of life, etc.
Economics: Not Just Logging, Not just Local
The Preliminary Need for Change (p 4) seems to place a high emphasis on economic outputs for local economies, which we interpret as timber production, but this planning process must recognize the significant economic value of intact forests. And the planning process must recognize that these are NATIONAL Forests that should be managed in the national interest, not just a resource for exploitation to benefit local timber interests.

As noted in our comments on the Assessment Reports:

The Assessment must give fair consideration to the social and economic benefits of conservation AND the often uncounted costs of resource extraction.

Even back in 1971, Oregon was looking forward. OSU Extension summarized the role of federal lands in Oregon[rsquo]s future economy:

Because of the heavy reliance on our natural resources as our industrial base in Oregon, we depend heavily on the export of our natural resource materials, such as forest products and livestock. In the future, however, the overall relative importance of these basic resources is expected to fall as demonstrated by the recent decrease in allowable cut in Oregon's O & C lands. Any significant increase in our national economy attributable to federal lands is expected to originate with recreation and wildlife enhancement. Resource-based recreation is expected to increase 40 times by the year 2,000. In Oregon, at the present time, visitors from other states bring in more than $250 million annually. By 1978 this figure is expected to reach $388 million.

OSU Cooperative Extension. 1971. The Public Land Law Commission Report and It[rsquo]s Importance to Oregon. Special Report 328. http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/4390/SR%20no.%20328_ocr.pdf. These economic trends noted 50+ years ago remain strong today. Federal lands must be carefully protected to ensure that the economic benefits associated with Oregon[rsquo]s quality of life are conserved.

The economic benefits of conservation vastly exceed the economic costs of conservation. The Campaign for Nature conducted a thorough analysis of the economic trade-offs of a proposed policy to conserve 30% of the earth[rsquo]s surface.

The report[rsquo]s main [shy]finding is that protecting at least 30% of the world[rsquo]s land and ocean provides greater benefi[shy]ts than the status quo, both in terms of fi[shy]nancial outcomes and non-monetary measures like ecosystem services.

The fi[shy]nancial and economic benefi[shy]ts of 30% protection exceed the costs by a factor of at least 5:1.

This is a conservative estimate because the report did not quantify all ecosystem services bene[shy]fits.

Protected areas boost the global economy and deliver key non-monetary bene[shy]fits:

30% protection leads to increased economic output (compared to the status quo, across all the sectors analyzed in the report) averaging $250 billion annually (the report estimates a range of $64-454 billion, as the costs and bene[shy]fits will vary depending on which areas are protected) and generates additional non-monetized economic benefi[shy]ts from ecosystem services averaging $350 billion annually (the report estimates a range of $170-534 billion) by 2050.

The nature conservation sector is a net contributor to the global economy, not a drain. The economic growth of the nature sector, primarily driven by growth in nature-based tourism, outweighs the economic impacts of expanded protection on agriculture, timber and [shy]fisheries. In fact, after recovery from the COVID-19 pandemic, the nature sector is projected to grow 4-6% per year compared to less than 1% for agriculture, timber and fi[shy]sheries.

The non-monetary economic bene[shy]fits of 30% protection, which are typically considered [ldquo]public goods[rdquo] and currently outside the market economy, include ecosystem services such as climate change mitigation, flood protection, clean water provision and soil conservation. While studies have estimated the total global value of nature[rsquo]s ecosystem services to be up to $125 trillion per year, this new report only calculates the value of a subset of ecosystem services provided by forests and mangroves, the two ecosystems for which there is the most reliable data on a global scale.

Campaign for Nature 2020. Highlights and policy implications of new economic report: [ldquo]Protecting 30% of the planet for nature: costs, benefi[shy]ts and economic implications[rdquo]

https://static1.squarespace.com/static/5c77fa240b77bd5a7ff401e5/t/5f05c366f5edb16b875b3964/1594213260537/Waldron+Report-Highlights.pdfciting Waldron, Anthony et al 2020. Protecting 30% of the planet for nature: costs, benefits and economic implications Working paper analysing the economic implications of the proposed 30% target for areal protection in the draft post-2020 Global Biodiversity Framework. https://www.conservation.cam.ac.uk/files/waldron_report_30_by_30_publish.pdf.

https://www.campaignfornature.org/protecting-30-of-the-planet-for-nature-economic-analysis. Dr. Andrew Balmford, Professor of Conservation Science, University of Cambridge said of this report: [ldquo]This work is extraordinary, in scope, but particularly in its novel multi-sectoral reach. As a result it sheds critically important light on the apparent trade-offs between expanding nature conservation and mainstream economic activity [mdash] and shows that ambitious new proposals for safeguarding wild species and places are likely to enhance human prosperity too.[rdquo]

The proposition that natural resources are a source of wealth is disproven by the evidence that [ldquo]Remoteness, as measured by urban influence code, has a negative effect on every measure of economic development indicator. It reduces income, employment, housing prices and total developed areas.[rdquo] If natural resources were a source of wealth remoteness would enhance wealth but the evidence shows that it does just the opposite. Note however, that the negative effects of remoteness can be mitigated in part through natural amenities that attract people who are willing to trade lower wages for higher quality of life. These are important considerations in the analysis of community welfare related to federal land management. JunJie Wu, Munisamy Gopinath. 2005. How Do Location Decisions of Firms and Households Affect Economic Development in Rural America? Selected Paper prepared for presentation at the American Agricultural Economic Association Annual Meeting, Providence, Rhode Island, July 24-27, 2005. http://ageconsearch.umn.edu/bitstream/19229/1/sp05wu02.pdf. http://web.archive.org/web/20090115192759/http://oregonstate.edu/dept/ncs/newsarch/2008/Aug08/remotecommunities.html

Forests are more valuable, and better serve to stabilize communities, when they are protected from logging than when they are logged. Well-conserved forests provide numerous valuable ecosystem services, such as water purification, climate stability, flood control, slope stability, nutrient cycling, habitat for fish & wildlife, recovery of imperiled species, recreation, scenic views, and quality of life. Conserved forests contribute to our quality of life which is one of the most valuable economic development assets we have. Quality of life provided by forests and watersheds represent a [ldquo]second paycheck[rdquo] enjoyed by everyone who lives and visits the northwest. Logging cuts our second paycheck and makes us all poorer. Congrove, Niemi, Fifield. 2000. Seeing the Forest for Their Green: Economic Benefits of Forest Protection, Recreation and Restoration. ECONorthwest 2000. Prepared for the Sierra Club.

http://www.econw.com/media/ap_files/FR2-Seeing-Forests-For-Green_ECONorthwest.pdf. See also, Niemi, E. 2017. Memo to Oregon Board of Forestry on Oregon's Forest Economy - Importance Of Unlogged Forests. July 25, 2017. http://www.oregon.gov/ODF/Board/Documents/BOF/20170725/BOFMIN_20170725_ATTCH_02.pdf. This memo describes a compelling analytic framework for describing market and non-market values from consumptive and non-consumptive ecosystem services provided by forests. This analytic framework should be used in the Assessment.

There is significant new information indicating that the timber industry is inherently volatile, therefore providing timber from federal lands likely causes community instability rather than community stability as often assumed. BLM[rsquo]s 2015 Western Oregon Plan Revision DEIS (p 472) said:

Over the long-term (1969-2007), timber-based industries nationally exhibited low or negative growth rates with high volatility compared with the United States economy as a whole, indicating that these industries tend to be inherently volatile. Increases in timber industry activity in the planning area could bring additional exposure to greater economic instability.

http://www.blm.gov/or/plans/rmpswesternoregon/deis.php BLM[rsquo]s DEIS acknowledges that the timber industry is far more volatile than other industries so boosting timber jobs does not necessarily translate to community stability. This new information requires a fundamental shift in thinking about the value of federal lands for timber production versus provision of public benefits that do contribute to community stability, such as: clean water, carbon storage and stabilizes the climate, biodiversity, diverse recreation opportunities, scenic values, etc.

Lehner, J. 2012. Historical Look at Oregon[rsquo]s Wood Product Industry. http://oregoneconomicanalysis.com/2012/01/23/historical-look-at-oregons-wood-product-industry/.

Timber industry volatility would have its greatest adverse effect in local communities that have the lowest levels of economic diversity, the greatest dependence on commodity production, and would therefore see the greatest fluctuations in jobs and income. The gain and loss of jobs caused by timber industry volatility would cause a variety of social problems related to job insecurity, depression, substance abuse, health care insecurity, domestic abuse, etc. which would in turn cause an increase in the demand for social services that are not adequately funded. If the Forest Service and BLM would emphasize development of less volatile economic sectors through provision of amenities instead of commodities, the social problems described above would be diminished and the demand for social services would be reduced.

All things being equal, a more diversified economy is a more stable economy. Oregon will always have a timber industry based on non-federal forest lands. The highest and best use of public forest lands, in terms of community stability, is to conserve the resources on those lands to provide a stable flow of ecosystem services such as clean water, carbon storage and recreation opportunities, that will help diversify the economy, and mitigate the economic instability caused by logging on non-federal lands.

The agency should do more to diversify local economies, rather than deepen and perpetuate timber dependency. The National Research Council found that timber dependency is associated with a variety of social problems, including: unemployment, poverty, crime, infant mortality, lower educational attainment, lower access to healthcare, etc.

The majority of the relationships between increasing timber dependency as measured by the proportion of timber-related jobs and social and economic well-being indicated that well-being went up as timber dependency went down. In most cases, timber dependency seemed to hurt rather than help communities.

National Research Council, Committee on Environmental Issues in Pacific Northwest Forest Management. 2000. Environmental Issues in Pacific Northwest Forest Management. National Academies Press. https://www.nap.edu/read/4983/chapter/1.

The agency should not focus the economic analysis exclusively on local communities. Well-conserved natural landscapes provide important economic values to urban residents as well. Urban residents obtain drinking water, benefit from carbon storage, and importantly, they travel to remote areas to recreate and enjoy natural landscapes.

Rapid growth in the Pacific Northwest over the 1980s and 1990s has been difficult to explain in the context of traditional economic models of regional growth. The input-output framework used by many economic development organizations predicted that reductions in logging due to environmental policy would have permanent negative effects on the economies of the affected areas. Instead, the region experienced strong economic growth over this time period. It has been suggested that this economic growth might have resulted in part because of the protection of natural resources in the area, rather than in spite of it.

This possibility is consistent with a fairly extensive empirical literature showing that variations in region-specific amenities can account for persistent differences in real wages across regions. The presence of an amenity valued by workers generates negative compensating wage differentials, as a higher supply of workers drives down wages in that area. At the same time, the presence of an amenity increases demand for housing in the region, which generates positive rent differentials. Such amenities can generate sizeable effects on wages.

[hellip]The empirical literature to date has considered only amenities that are in the same location (usually the county or the metropolitan statistical area) as the household. The argument tested here is that environmental amenities at some distance from but accessible to urban areas may have a value to consumers that can lead to negative compensating wage differentials. These wage differentials, in turn, serve as production amenities, attracting industrial and commercial activity and generating economic growth.

[hellip]Our results suggest that natural resource amenities outside the metropolitan area do generate compensating wage differentials, as workers are willing to accept lower wages to live in accessible proximity to [ldquo]nice[rdquo] places. This implies that [ldquo]nice[rdquo] places provide a positive externality to those communities that find them accessible. It will therefore generally be very difficult to assure optimal provision of the amenity, either through market or nonmarket means. It is difficult enough to organize local jurisdictions to produce amenities efficiently within their own borders. Here the problem is much more complicated, as the relevant amenities will generally be produced in jurisdictions that are distinct from those in which the affected employers and employees transact their business. The effects that we estimate are quantitatively important, suggesting that these externalities should be taken into account in the making of environmental and natural resource policy.

Schmidt, L. and P. N. Courant (2006). "Sometimes Close is Good Enough: The Value of Nearby Environmental Amenities." Journal of Regional Science 46(5): 931-951. https://ideas.repec.org/p/wil/wileco/2003-07.html. It should be noted that the economic benefits of conservation that accrue to urban areas spill-over to also benefit rural areas. These benefits include direct local tax revenue, income generated from visitors, public services that are funded from state tax revenues, and rural areas[rsquo] access to specialized urban services. Cortright, Joseph. 2011. Who Pays, Who Benefits? An Analysis of Taxes and Expenditures in Oregon. In Michael Hibbard, Ethan Seltzer, Bruce Weber, Beth Emshoff (eds) Toward One Oregon. https://muse.jhu.edu/book/2135.

([ldquo]It seems apparent that the availability of public services in much of nonmetropolitan Oregon hinges vitally on the economic health of the Portland metropolitan area.[rdquo]) Castle, Emery N., JunJie Wu, and Bruce Weber. 2011. Place Orientation and Rural-Urban Interdependence. Applied Economic Perspectives and Policy. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1009.3704&rep=rep1&type=pdf. ([ldquo]Overall, there is a substantial net flow of resources from the metropolitan area to the remainder of Oregon [about $500 million per year for schools alone]. Those whose primary interest is in rural development need to learn about the role of cities.[rdquo]). Martin, Sheila. 2011.Critical Linkages: Strengthening Clusters in Urban and Rural Oregon. In Michael Hibbard, Ethan Seltzer, Bruce Weber, Beth Emshoff (eds) Toward One Oregon. https://muse.jhu.edu/book/2135. ([ldquo][U]rban and rural Oregonians are also linked by the state[rsquo]s revenue-sharing system that is used to equalize the services available for the citizens of its state, especially for education and health care. This linkage is critical, because it means that economic vitality in one part of the state provides benefits to citizens in other parts. In effect, we all benefit from economic success in one part of the state because state tax revenues are shared statewide.[rdquo])

Biodiversity is the diversity of life. We will find that the economics of biodiversity is the economics of the entire biosphere. So, when developing the subject, we will keep in mind that we are embedded in Nature. The Review shows (Chapter 4*) that although the difference in conception is analytically slight, it has profound implications for what we can legitimately expect of the human enterprise. The former viewpoint encourages the thought that human ingenuity, when it is directed at advancing the common good, can raise global output indefinitely without affecting the biosphere so adversely that it is tipped into a state far-removed from where it has been since long before human societies began to form; the latter is an expression of the thought that because the biosphere is bounded, the global economy is bounded.

[hellip]

The Review demonstrates that in order to judge whether the path of economic development we choose to follow is sustainable, nations need to adopt a system of economic accounts that records an inclusive measure of their wealth. The qualifier [lsquo]inclusive[rsquo] says that wealth includes Nature as an asset. The contemporary practice of using Gross Domestic Product (GDP) to judge economic performance is based on a faulty application of economics. GDP is a flow (so many market dollars of output per year), in contrast to inclusive wealth, which is a stock (it is the social worth of the economy[rsquo]s entire portfolio of assets). Relatedly, GDP does not include the depreciation of assets, for example the degradation of the natural environment (we should remember that [lsquo]G[rsquo] in GDP stands for gross output of final goods and services, not output net of depreciation of assets). As a measure of economic activity, GDP is indispensable in short-run macroeconomic analysis and management, but it is wholly unsuitable for appraising investment projects and identifying sustainable development. Nor was GDP intended by economists who fashioned it to be used for those two purposes. An economy could record a high rate of growth of GDP by depreciating its assets, but one would not know that from national statistics. The chapters that follow show that in recent decades eroding natural capital has been precisely the means the world economy has deployed for enjoying what is routinely celebrated as [lsquo]economic growth[rsquo]. The founding father of economics asked after The Wealth of Nations, not the GDP of nations. The idea of wealth that is developed in the Review is, not surprisingly, a lot richer than the one Adam Smith was able to fashion, but his identification of assets as the objects of interest was exactly right.

[hellip]

Dasgupta, P. (2021), The Economics of Biodiversity: The Dasgupta Review. (London: HM Treasury). https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/962785/The_Economics_of_Biodiversity_The_Dasgupta_Review_Full_Report.pdf.

Harmonize Climate Change Mitigation and Adaptation

The Preliminary Need for Change (p 4) says [ldquo]The 2012 Planning Rule requires that plan revision consider system drivers including dominant ecological process, disturbance regimes, and stressors such as natural succession, wildland fire, invasive species, and climate change.[rdquo] The document cites [ldquo]Climate change vulnerability and adaptation in the Blue Mountains[rdquo] (2017) which recommends [ldquo]density management through forest thinning.[rdquo]

The Forest Service fails to recognize the equally important role of forests in storing carbon, and the fact that logging to address climate stress will emit greenhouse gases and exacerbate global climate change. This highlights the critically important need to harmonize the competing goals of climate change adaptation and climate change mitigation (carbon storage).

The Forest Service seems to think that logging is required to reduce forest density and address increased stress from climate change, but this logging will emit greenhouse gases to the atmosphere and which will exacerbate global climate change (and ironically increase the climate stress imposed on the forest). These are very significant effects that require careful analysis in the EIS and consideration of mitigating alternatives. The agency can mitigate the effects of logging-related GHG emissions by retaining more trees, thinning less aggressively, forgoing logging in some areas, etc.

NEPA mandates that an agency [ldquo]shall to the fullest extent possible: use the NEPA process to identify and assess the reasonable alternatives to proposed actions that will avoid or minimize adverse effects of these action upon the quality of the human environment.[rdquo] 40 C.F.R. [sect] 1500.2(e). NEPA also requires the agency to [ldquo]study, develop, and describe appropriate alternatives to the recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources as provided by section 102(2)(E) of the Act [NEPA].[rdquo]40 C.F.R. [sect] 1501.2 (c). All reasonable alternatives must receive a [ldquo]rigorous exploration and objective evaluation ..., particularly those that might enhance environmental quality or avoid some or all of the adverse environmental effects.[rdquo] Id. [sect] 1500.8(a)(4).

The agency need to rethink its focus on climate adaptation/resilience actions (such as density reduction with commercial log removal) that will actually increase carbon emissions and exacerbate global climate change and reduce climate resilience, not just in the treated stands but around the world. The agencies instead need to design preferred alternaitves that meaningfully harmonize climate change adaptation and climate change mitigation, such as non-commercial thinning + prescribed fire, increased riparian protection, conservation of mature, old-growth and unroaded areas, road system rescaling and storm-proofing.

The agency should develop alternatives that harmonize potentially competing objectives of climate change mitigation, and climate change adaptation. Climate change mitigation involves keeping carbon in the forest and avoiding GHG emissions to the atmosphere from logging. Climate change adaptation may involve a variety of actions that range from reducing stand density to reduce water stress in a warming world to providing habitat redundancy and connectivity, and maintaining cool/moist habitat refugia for wildlife that thrive in dense forests.

The Biden Administration has adopted a policy to both mitigate AND prepare for global climate change.

[ldquo]It is, therefore, the policy of [the Biden] Administration to listen to the science; to improve public health and protect our environment; to ensure access to clean air and water; [hellip] to reduce greenhouse gas emissions; to bolster resilience to the impacts of climate change; [hellip] To that end, this order directs all executive departments and agencies (agencies) to immediately review and, as appropriate and consistent with applicable law, take action to address the promulgation of Federal regulations and other actions during the last 4 years that conflict with these important national objectives, and to immediately commence work to confront the climate

crisis.[rdquo]

Executive Order on Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis. JANUARY 20, 2021 https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/20/executive-order-protecting-public-health-and-environment-and-restoring-science-to-tackle-climate-crisis/. This requires careful balancing of sometimes competing objectives, such as retaining trees to store carbon, and thinning to reduce climate stresses. The best harmony among these objectives is to retain medium and large trees that store the most carbon and provide the greatest ecosystem services, while thinning small trees removal of which will reduce climate stresses on the larger trees while emitting less carbon.

President Obama established a clear policy mandate to avoid, minimize, and rectify impacts of federal land use:

Section 1. Policy. It shall be the policy of the Departments of Defense, the Interior, and Agriculture; the Environmental Protection Agency; and the National Oceanic and Atmospheric Administration; and all bureaus or agencies within them (agencies); to avoid and then minimize harmful effects to land, water, wildlife, and other ecological resources (natural resources) caused by land- or water-disturbing activities, and to ensure that any remaining harmful effects are effectively addressed, consistent with existing mission and legal authorities. Agencies shall each adopt a clear and consistent approach for avoidance and minimization of, and compensatory mitigation for, the impacts of their activities and the projects they approve.

[hellip] Sec 2. Definitions [hellip] (f) "Mitigation" means avoiding, minimizing, rectifying, reducing over time, and compensating for impacts on natural resources. As a practical matter, all of these actions are captured in the terms avoidance, minimization, and compensation. These three actions are generally applied sequentially, and therefore compensatory measures should normally not be considered until after all appropriate and practicable avoidance and minimization measures have been considered.

[hellip]

Sec. 3. Establishing Federal Principles for Mitigation. [hellip] (b) Agencies' mitigation policies should establish a net benefit goal or, at a minimum, a no net loss goal for natural resources the agency manages that are important, scarce, or sensitive, or wherever doing so is consistent with agency mission and established natural resource objectives. When a resource's value is determined to be irreplaceable, the preferred means of achieving either of these goals is through avoidance, consistent with applicable legal authorities. Agencies should explicitly consider the extent to which the beneficial environmental outcomes that will be achieved are demonstrably new and would not have occurred in the absence of mitigation (i.e. additionality) when determining whether those measures adequately address impacts to natural resources.

Presidential Memorandum: Mitigating Impacts on Natural Resources from Development and Encouraging Related Private Investment. Nov 3, 2015. https://www.whitehouse.gov/the-press-office/2015/11/03/mitigating-impacts-natural-resources-development-and-encouraging-related In the context of climate change this means that greenhouse gas emissions should be avoided and that the climate forcing effects of any emissions that do occur must be mitigated.

Stein et al (2014) make the distinction between climate change mitigation and adaptation and the potential conflict between the two.

Climate change adaptation is the discipline that focuses on addressing these impacts. In contrast, climate change mitigation addresses the underlying causes of climate change, through a focus on reductions in greenhouse gas concentrations in the atmosphere. Confronting the climate crisis requires that we both address the underlying causes of climate change and simultaneously prepare for and adapt to current and future impacts. Accordingly, adaptation and mitigation must be viewed as essential complements, rather than as alternative approaches. Because greenhouse gas emissions and concentrations will dictate the type and magnitude of impacts to which we will need to adapt, the ability to successfully accomplish adaptation over the long term will be linked to the success of climate mitigation efforts (Warren et al. 2013).

[hellip]

Climate-smart conservation strategies must also take climate mitigation considerations into account. Although adaptation is about addressing the impacts of rapid climate change, adaptation actions should not aggravate the underlying problem of global warming. Indeed, minimizing the carbon footprint of adaptation actions can help society avoid the [ldquo]worst-case[rdquo] scenarios for climate change, which would make successful adaptation in human and natural systems difficult, if not impossible, to achieve. Ideally, adaptation efforts should contribute to meeting climate mitigation goals both by minimizing or reducing the greenhouse gas emissions from project operations, including from any construction and ongoing maintenance, as well as by managing natural systems in ways that sustain or enhance their ability to cycle, sequester, and store carbon.

[hellip]

Some of the most obvious synergies between adaptation and mitigation are those aimed at enhancing carbon stocks in natural forests, [hellip] Strategies for increasing the capture and storage of forest carbon include: avoiding deforestation; afforestation (i.e., establishment of trees in areas have not been forests or where forests have not been present for some time); decreasing forest harvest; and increasing forest growth (McKinley et al. 2011). Managing natural systems to provide carbon benefits must be carefully balanced, however, with other conservation and adaptation goals. [hellip] Recent research, however, indicates that old trees [ldquo]do not act simply as senescent carbon reservoirs[rdquo] but actively fix larger amounts of carbon than smaller trees (Stephensen et al. 2014). This recognition highlights the important role that biodiversity-rich old-growth forests can play in sequestering carbon.

[hellip]

It is not always obvious, however, when conservation and climate mitigation efforts might be in alignment or in conflict. [hellip] Although there are clear synergies between adaptation and mitigation focused activities, managers will also need to carefully consider any trade-offs.

Stein, B.A., P. Glick, N. Edelson, and A. Staudt (eds.). 2014. Climate-Smart Conservation: Putting Adaptation Principles into Practice. National Wildlife Federation, Washington, D.C. https://www.nwf.org/~/media/PDFs/Global-Warming/2014/Climate-Smart-Conservation-Final_06-06-2014.pdf.

Sometimes climate change mitigation and adaptation are in complete harmony, such as protecting riparian forests that both store carbon and buffer streams from hydrological extremes caused by climate change. See Justice et al. 2017. Can stream and riparian restoration offset climate change impacts to salmon populations? Journal of Environmental Management 188 (2017) 212e227 https://www.critfc.org/wp-content/uploads/2017/01/JournalPost_Justice_etal2017.pdf. However, there are also times when efforts directed at climate change adaptation conflict with climate change mitigation goals. For instance, some people argue that we should reduce the density of federal forests so they are more resilient to soil-water stress caused by global warming. However, forest density reduction will accelerate the transfer of carbon from the forest to the atmosphere where it will contribute to global climate change.

Logging and the entire wood products supply chain causes significant emissions of CO2, this makes fire worse in several ways. It not only warms the atmosphere and extends the fire season, CO2 is also a [ldquo]floating fertilizer[rdquo] that stimulates the growth of hazardous fuels. When the agency says they are logging to make the forest more resilient to climate change, they must address these countervailing risks, and consider alternatives that better harmonize climate change resilience/adaptation and climate change mitigation (emissions avoidance). Allen, R. J., Gomez, J., Horowitz, L. W., & Shevliakova, E. (2024). Enhanced future vegetation growth with elevated carbon dioxide concentrations could increase fire activity. Communications Earth & Environment, 5(1), 1-15. https://doi.org/10.1038/s43247-024-01228-7. ([ldquo][hellip] the spatial pattern of the NPP response is quite similar to the corresponding spatial pattern of the fFire response (Fig. 2)-not only for 1% per year CO2 and 1% per year CO2-bgc, but interestingly also for 1% per year CO2-rad. This is also the case for other vegetation parameters, including leaf area index (LAI; Supplementary Figs. 10[ndash]11 and Supplementary Note 4). This implies that the increase in fFire is largely due to the increase in biomass production (i.e., more fuel to burn) and likewise for decreases. The corresponding correlations (between the NPP and fFire responses) across grid boxes yield significant positive MMM correlations at 0.34, 0.26 and 0.17 for 1% per year CO2, 1% per year CO2-bgc, and 1% per year CO2-rad, respectively. [rdquo]).

Federal agencies must strive to harmonize climate change mitigation (carbon storage or avoided emissions) and climate change adaptation (making ecosystems more resilient to climate change). For example, if the agency uses climate change adaptation as a rationale for forest thinning, they must not only fully disclose the increased GHG emissions caused by their proposal, they must also consider alternatives that harmonize these competing goals, such as by thinning very lightly and retaining all of the medium and large trees that store most of the carbon.

The Forest Service recognizes the need to optimize, rather than maximize, objectives on the National Forests.

Climate adaptation

Actions that provide adaptation benefits through reduced risk of unintended climate impacts can provide carbon benefits through avoided carbon emissions. Some disturbances or forest health issues may also decrease carbon uptake through plant growth. While not all adaptation actions provide carbon benefits, there are many actions that address risks to ecosystem health that sustain or improve the capacity of systems to sequester carbon.

Carbon optimization

While national forests and grasslands can play an important role in climate change mitigation through land management, balancing the numerous environmental benefits provided by healthy ecosystems is paramount to achieving our mission. Carbon stewardship aims to optimize carbon benefits on the landscape in a way that recognizes the importance of achieving other management objectives. Maximizing ecosystem carbon stocks can create undesirable tradeoffs with other environmental benefits, and in some landscapes may result in lower carbon benefits where carbon stability is compromised. Maximizing carbon is therefore not necessary, and is often counter to, achieving effective carbon stewardship.

USDA Forest Service 2024. Sustainability and Climate website. https://www.fs.usda.gov/managing-land/sustainability-and-climate/carbon. The NEPA anlysis needs to reflect these nuances by harmonizing competing objectives. For instance, climate adaptation can be advanced in various ways, some of whcich emit more carbon (such as commercial logging), while others emit less carbon (such as non-commercial thinning and prescribed fire). The NEPA analysis should consider and weigh alternatives that highlight and resolve these trade-offs.

There may be climate benefits from thinning but there will also be climate trade-offs in the form of carbon emissions, unless thinning is done very early in stand development. Schaedel et al (2017) said --

Thinning in second growth forests is often suggested as a climate change adaptation strategy (Bradford and D[rsquo]Amato, 2012; Churchill et al., 2013), because thinning can be used to promote the development of complex stand structures resilient to disturbances and drought. However, these climate change adaptation outcomes attainable with thinning generally require a tradeoff with climate change mitigation objectives: most studies have shown decreased forest C storage in thinned stands (Bradford and D[rsquo]Amato, 2012).

...

We found that: (1) fifty-four years after PCT total aboveground C is similar across treatments, due primarily to the increase in mean tree C of trees grown at lower stand densities; (2) deadwood legacies from the pre-disturbance forest still play an important role in long-term C storage 62 years after current stand initiation, accounting for approximately 20[ndash]25% of aboveground C stores; and (3) given enough time since early thinning, there is no trade-off between managing stands to promote individual tree growth and development of understory vegetation, and maximizing stand level accumulation of aboveground C over the long term. We infer that early PCT can be used to simultaneously achieve climate change mitigation and adaptation objectives, provided treatments are implemented early in stand development before canopy closure and the onset of intense intertree competition.

Michael S. Schaedel, Andrew J. Larson, David L.R. Affleck, R. Travis Belote, John M. Goodburn, Deborah S. Page-Dumroese. 2017. Early forest thinning changes aboveground carbon distribution among pools, but not total amount. Forest Ecology and Management 389 (2017) 187[ndash]198. https://www.fs.fed.us/rm/pubs_journals/2017/rmrs_2017_schaedel_m001.pdf. There are actually conflicting results on pre-commercial thinning ...

... precommercial thinning (PCT) when the thinned trees have no commercial value, show inconsistent results. Some PCT studies of this type found that decreasing stand density decreased total forest C stores (Skovsgaard et al., 2006; Jim[eacute]nez et al., 2011), while others noted that the increased growth rate of trees grown at lower densities can maintain or increase live tree C (Hoover and Stout, 2007; Dwyer et al., 2010), especially in the case of longer-term responses to thinning (Horner et al., 2010). Short-term studies of PCT effects on aboveground C have shown consistent decreases in aboveground C (Campbell et al., 2009; De las Heras et al., 2013; Jim[eacute]nez et al., 2011; Dwyer et al., 2010), indicating that low densities of small trees do not fully occupy the site (Turner et al., 2016). Given these conflicting results, it is still unclear whether PCT is compatible with the climate change mitigation goal of forest C storage (Jim[eacute]nez et al., 2011).

This is important because, even if thinning provides climate benefits in future decades, short-term carbon emissions conflict with climate policy priorities. The next few decades are critical to achieving goals related to decarbonizing our economy. Delayed climate benefits should be strongly discounted because we should have decarbonized our economy by then, so future effects are not nearly as important as near-term effects. If thinning causes a short-term pulse of GHG emissions, that[rsquo]s a problem.

The Oregon Global Warming Commission[rsquo]s Roadmap to 2020 (https://www.keeporegoncool.org/roadmap-to-2020/) guides the state[rsquo]s efforts to meet its legislatively mandated GHG emissions reduction goals, including broad objectives for increasing carbon storage in Oregon forests.

The Roadmap also set out general strategies for dry forests east of the Cascade Mountains versus moist west of the Cascades. Based on improved understanding of the carbon storage capacity of the state[rsquo]s forests, the 2017 Global Warming Commission Report explained that, [ldquo]The Roadmap sees [lsquo]Eastside forests . . . managed primarily for ecosystem restoration, safety and climate adaptation with a minimum of incurred carbon (loss). West-side forests (are) managed . . . to increase carbon storage . . . private forestlands (are) managed primarily for production of timber and wood products . . . [rsquo] with carbon stores remaining stable or increasing[rdquo].

Fain, S.J.; Kittler, B.; Chowyuk, A. Managing Moist Forests of the Pacific Northwest United States for Climate

Positive Outcomes. Forests 2018; 9(10):618. https://www.mdpi.com/1999-4907/9/10/618. Following this strategy will require the agencies to retain all medium and large trees that store carbon and that do not pose a substantial fire hazard.

The Forest Service[rsquo]s 2022 Climate Adaptation Strategy says that harmonizing climate change mitigation and climate change adaption is [ldquo]complex problem[rdquo] that requires [ldquo]frank discussions.[rdquo] This indicates a need for an EIS that carefully weighs and balances trade-offs:

Many forests with old-growth characteristics have a combination of higher carbon density and biodiversity that contributes to both carbon storage and climate resilience. They are often viewed as ideal candidates for increased conservation efforts, [hellip] Even so, as climate continues to deviate from historical norms, many of these forests are expected to be at increasing risk from acute and chronic disturbances such as drought, wildfires, and insect and disease outbreaks. As a result, climate-amplified disturbances like these have become the primary threat to old-growth stands on national forests. In response, Executive Order 14072 Strengthening the Nation[rsquo]s Forests, Communities, and Local Economies emphasizes the climate-informed stewardship of mature and old-growth forests on Federal lands, as part of a science-based approach to maintain valued characteristics and reduce wildfire risk. There is no single [ldquo]right answer[rdquo] in addressing the complex problem, but the spirit and practice of shared stewardship can help us generate the frank discussions necessary to consider values and risks as we find the best paths forward.

[hellip]

Unfortunately, many forests are increasingly vulnerable to climate-amplified impacts and stressors. If a forest is vulnerable, so is its carbon. Thoughtful carbon stewardship does not seek to maximize carbon at the expense of forest health but rather to optimize carbon within the context of ecosystem integrity and climate adaptation. Some forests, such as those at risk for high severity wildfire, might require hazardous fuels treatments and other forest health interventions that reduce carbon storage in the short term [hellip]

USDA FOREST SERVICE CLIMATE ADAPTATION PLAN. FS-1196 | July 2022. https://www.usda.gov/sites/default/files/documents/4_NRE_FS_ClimateAdaptationPlan_2022.pdf. Any effort to optimize requires weighing the competing values. The NEPA analysis must document this process. The last sentence suggests that carbon emissions from fuel reduction are justified, but it can also be said that forgoing fuel reduction is justified in order to retain carbon and avoid GHG emissions. The Strategy offers no tools to resolve these competing views. Weighing these issues is an appropriate subject for a hard look under NEPA.

The agencies often claim that density reduction treatments are expected to increase the resiliency of treated stands to the projected effects of climate change. But this small increase in resiliency comes at a tremendous cost. The NEPA analysis needs to disclose and consider the fact that logging will result in greenhouse gas emissions that make climate change worse. Think about that trade-off. Logging might make a small area more resilient to climate change while making climate conditions (and ocean acidification) worse for ecosystems all over the rest of the world. This significant trade-off needs to be carefully evaluated in the NEPA document.

There is evidence that tree mortality is controlled more by low humidity than soil water availability, so thinning to increase soil water availability and drought resilience won[rsquo]t do much good. Karla M. Jarecke, Linnia R. Hawkins, Kevin D. Bladon, Steven M. Wondzell 2023. Carbon uptake by Douglas-fir is more sensitive to increased temperature and vapor pressure deficit than reduced rainfall in the western Cascade Mountains, Oregon, USA. Agricultural and Forest Meteorology, Volume 329, 15 February 2023, 109267. https://www.sciencedirect.com/science/article/abs/pii/S0168192322004543. This undercuts the idea that logging is useful to increase forest resilience and adaptation to climate change. Such logging just emits a lot of carbon and exacerbates climate change without actually increasing forests resilience. This is a highly unfavorable trade-off.

Even well-intentioned logging also has impacts that make ecosystems less resilient to climate change. For instance, (i) roads and soil degradation make watershed less resilient to the expected effects of the amplified hydrologic cycle; (ii) reduction of complex forest structure and dense forest conditions makes certain species populations less resilient to climate change, including species associated with relatively dense forests and species associated with snags and dead wood. These species are already stressed by the cumulative effects of non-federal land management and fragmentation caused by past and ongoing management on federal lands; (iii) Also, [ldquo]High overstory density can be resilient[rdquo] when ladder fuel are absent and there is a gap between surface and canopy fuels. Terrie Jain (2009) Logic Paths for Approaching Restoration: A Scientist[rsquo]s Perspective, from Workshop: Restoring Westside Dry Forests - Planning and Analysis for Restoring Westside Cascade Dry Forest Ecosystems: A focus on Systems Dominated by Douglas-fir, Ponderosa Pine, Incense Cedar, and so on. May 28, 2009. http://ecoshare.info/projects/central-cascade- adaptive-management-partnership/workshops/restoring-westside- dry-forests/. New information indicates that El Ninos will likely become stronger even if we are able to limited warming to 1.5 degrees C. Guojian Wang, et al. 2016. Continued increase of extreme El Ni[ntilde]o frequency long after 1.5[thinsp][deg]C warming stabilization. Nature Climate Change (2017). doi:10.1038/nclimate3351. https://www.nature.com/nclimate/journal/vaop/ncurrent/full/nclimate3351.html. A bet-hedging strategy should retain trees of all sizes and stands of various densities. [ldquo]Removal of most small trees to reduce wildfire risk may compromise the bet-hedging resilience, provided by small trees and diverse tree sizes and species, against a broad array of unpredictable future disturbances.[rdquo] William L. Baker and Mark A. Williams. 2015. Bet-hedging dry-forest resilience to climate-change threats in the western USA based on historical forest structure. Front. Ecol. Evol., 13 January 2015 | doi: 10.3389/fevo.2014.00088. http://journal.frontiersin.org/Journal/10.3389/fevo.2014.00088/full.

Forests are already highly adaptable to climate change. There is evidence that a wide variety of different forest types are capturing and storing more carbon from the current CO_2 enriched atmosphere. Davis, E.C., Sohngen, B. & Lewis, D.J. The effect of carbon fertilization on naturally regenerated and planted US forests. Nat Commun 13, 5490 (2022). https://doi.org/10.1038/s41467-022-33196-x. The temperate forest environment is and has always been highly dynamic. Forest species evolved over long periods that include significant changes in climate. The large and complex genomes of forest species may include the memory of which genes to turn on or off to increase survival during climate stress. Forest disturbance can take many forms and almost always creates new opportunities for better-adapted species to establish and thrive. Mortality from any cause thins the forest, reducing total demand for light, water, and nutrients, and increasing availability of those resources to surviving trees. Several mechanisms can trigger forest vegetation to adjust stomatal opening and use water more efficiently, e.g., due to CO_2 enrichment of the atmosphere (Law, B.E., Waring, R.H. 2015. Review and synthesis - Carbon implications of current and future effects of drought, fire and management on Pacific Northwest forests. Forest Ecology and Management 355 (2015) 4[ndash]14. http://people.forestry.oregonstate.edu/richard-waring/sites/people.forestry.oregonstate.edu.richard-waring/files/publications/Law%20and%20Waring%202015.pdf), and due to chemical signaling of drought conditions. Xu, B., Long, Y., Feng, X. et al. GABA signaling modulates stomatal opening to enhance plant water use efficiency and drought resilience. Nat Commun 12, 1952 (2021). https://doi.org/10.1038/s41467-021-21694-3; https://www.nature.com/articles/s41467-021-21694-3.pdf. For all these reasons, it is wise to focus on climate mitigation by conserving forests and allowing them to store more carbon. Climate adaptation will take care of itself. Forests are self-organizing systems that adapt to changing conditions without the need for logging.

Also, wildfire is mostly climate driven, not fuel driven, and the actual effects of fuel reduction on the spatial extent of wildfires is highly variable and fairly modest. [ldquo]Analysis of simulation results from the 14 wildfires indicates that fuels treatments reduced the average size of any given wildfire by an estimated 7.2%, with amount of change correlated with the proportion of the landscape treated (Spearman[rsquo]s correlation p=0.692, n=14; P=0.008).[rdquo] M. A. Cochrane, C. J. Moran, M. C. Wimberly, A. D. Baer, M. A. Finney, K. L. Beckendorf, J. Eidenshink, and Z. Zhu. 2012. Estimation of wildfire size and risk changes due to fuels treatments. International

Journal of Wildland Fire. http://dx.doi.org/10.1071/WF11079. http://www.publish.csiro.au/?act=view_file&file_id=WF11079.pdf. This raises a serious question whether the modest increase in resilience really justifies the adverse effects of landscape fuel treatments on climate, wildlife, soil, water, etc.

When all these trade-offs are considered, we feel that climate change mitigation should receive emphasis over climate adaptation on federal land management (especially when adaptation efforts come with significant trade-offs). When climate change mitigation and adaptation may be in conflict, the agency needs to focus on reducing GHG emissions (or maintaining carbon stores). These mitigation actions are more important because (i) mitigation is shown to be more challenging (institutionally) and it is perennially under-achieved, (ii) mitigation has global benefits, and (iii) mitigation ultimately reduces the need for adaptation. An emphasis on mitigation is in accord with international law, e.g. the European Convention on Human Rights:

The court emphasises that the [State[rsquo]s duty of care] first and foremost should concern mitigation measures, as adaptation measures will only allow the State to protect its citizens from the consequences of climate change to a limited level. If the current greenhouse gas emissions continue in the same manner, global warming will take such a form that the costs of adaptation will become disproportionately high. Adaptation measures will therefore not be sufficient to protect citizens against the aforementioned consequences in the long term. The only effective remedy against hazardous climate change is to reduce the emission of greenhouse gases.

Urgenda Foundation v. The State of the Netherlands. Hague Court of Appeal. October 9, 2018. https://uitspraken.rechtspraak.nl/inziendocument?id=ECLI:NL:RBDHA:2015:7196

[ldquo]According to a recently published analysis, increasing carbon storage could lead to more favorable conditions for northern spotted owls, pileated woodpeckers, olive-sided flycatchers, Pacific marten and red tree voles. These species may benefit from management policies that favor less intensive logging and longer periods between tree harvests.[rdquo] Nick Houtman 2016. Storing more carbon in western Cascades forests could benefit some wildlife species, not others. Phys.org News. November 17, 2016. http://phys.org/news/2016-11-carbon-western-cascades-forests-benefit.html, http://onlinelibrary.wiley.com/doi/10.1002/eap.1358/abstract

Stenzel et al (2021) highlighted the complex nature of the trade-offs between climate adaptation (density reduction/drought tolerance) and climate mitigation (maintaining carbon storage/reducing carbon emissions) in the context of thinning.

Carbon balance tradeoffs between reduced biomass density and increased forest resilience to disturbance are uncertain in large part due to the uncertainty of future natural disturbances occurring in treated areas. Our simulated mass mortality scenarios indicated that 2050 thinning emissions approximately equaled the 2050 emissions from stand mortality events greater than 75% and occurring after 2035. In these experiments, the gradual decomposition of large pools of killed biomass remaining on site highlighted that the emissions consequences of near-term natural disturbances will in part be realized beyond current GHG reduction timelines (e.g., 2035 or 2050, IPCC, 2018). Thus, when managing for forest carbon storage, the timing and magnitude of potential carbon gains or losses, which may be offset in time from disturbance events, must be considered. In our simulations, the near-parity in carbon emissions from thinning and high natural disturbance late in the simulation period occurred at the stand level. However, at the landscape level, the encounter rates between treatments and disturbance are typically low (J. L. Campbell et al., 2012). Greater areas of forest must therefore be treated than will encounter a disturbance, in turn increasing any carbon cost to benefit ratio estimated at the stand scale. Due to the infeasibility of landscape level treatment experiments, landscape level predictions of disturbance impacts are generally simulated with earth systems models (Buotte, Levis, et al., 2020), which remain limited in their ability to represent stochastic disturbance such as wildfire

Stenzel, J. E., Berardi, D. B., Walsh, E. S., & Hudiburg, T. W. (2021). Restoration thinning in a drought-prone Idaho forest creates a persistent carbon deficit. Journal of Geophysical Research: Biogeosciences, 126, e2020JG005815. https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2020JG005815. The agency needs to take a hard look at these trade-offs and develop alternatives that harmonize divergent climate goals in light of the evidence for (and against) benefits on both sides of the adaptation/mitigation ledger.

CARBON AS ONE OF MANY MANAGEMENT OBJECTIVES

Management objectives dictate the decisions land managers make. These objectives vary widely based on the landowner as well as the conditions of the ecosystem in question, and objectives may include any number of desired ecosystem benefits: water protection, wood production, wildlife, specific recreational opportunities, aesthetics, privacy, and more. Greenhouse gas mitigation is thus part of a wider array of management aims for forests and grasslands. Managers may choose to incorporate greenhouse gas mitigation as a management objective for a number of reasons, including increasing forest productivity or deriving benefits from participating in carbon markets. However, focusing solely on carbon could lead to non-optimal management decisions, and, in some situations, managing for carbon benefits may be at odds with other goals.

The tradeoffs inherent in balancing multiple management goals necessitate the recognition that it may not be possible to meet all goals, including those for carbon, in a single stand or at a single point in time (Ryan et al. 2010). Consideration of the effects of management actions on carbon require thinking broadly across large spatial scales and long timeframes to determine the true effects on atmospheric greenhouse gases (Harmon 2001).

Janowiak, M.; Connelly, W.J.; Dante-Wood, K.; Domke, G.M.; Giardina, C.; Kayler, Z.; Marcinkowski, K.; Ontl, T.; Rodriguez-Franco, C.; Swanston, C.; Woodall, C.W.; Buford, M. 2017. Considering Forest and Grassland Carbon in Land Management. Gen. Tech. Rep. WO-95. Washington, D.C.: United States Department of Agriculture, Forest Service. 68 p. https://www.fs.usda.gov/research/publications/gtr/gtr_wo95.pdf.
[ldquo]Restore Ecosystem Integrity and Reduce Wildfire Risks[rdquo]
We are compelled to share key passages from our 5-28-2024 comments on the Assessment Reports which address the draft Preliminary Need for Change related to [ldquo]Restore Ecosystem Integrity and Reduce Wildfire Risks[rdquo] among others.

In general, the planning process must remain cognizant of the Forest Service[rsquo]s track record of being vastly over-confident in both its ability to control fire, and its ability to avoid significant adverse tradeoffs from aggressive management of our public forests. This is probably closely related to the Forest Service[rsquo]s propensity to use commercial logging (plus road building) as the primary tool to achieve virtually all its goals. One of the most insidious problems with commercial logging is the inherent conflicts of interest. The Forest Service needs to remove medium and large trees to make the timber sale profitable even when doing so undermines the very goals they are seeking to accomplish, whether that is fuel reduction, habitat, and/or climate change adaptation/mitigation.

The planning process should emphasize use of effective tools other than commercial logging whenever possible.
Make Way for Global Climate Change
Climate change is a major focus of our comments because it presents significant challenges for our forests, watersheds, ecosystems, and management approaches. While the climate crisis is very real, and demands management adjustments, the Forest Service may be over-reacting by using heavy handed approaches, and forgetting that these ecosystems have experienced climate change before, and have the capacity for self-organizing and self-correcting. We will of course see changes to our forests that make us uncomfortable, but we think it wise to remain humble and allow natural processes to do their work and avoid the cumulative impacts of widespread logging and roads, plus unavoidable climate driven disturbance events.

Forests provide a variety of ecosystem services that will be increasingly important as the climate changes.

[F]orest, water and energy interactions provide the foundations for carbon storage, for cooling terrestrial surfaces and for distributing water resources. Forests and trees must be recognized as prime regulators within the water, energy and carbon cycles. [hellip]

[F]orests play important roles in producing and regulating the world[rsquo]s temperatures and fresh water flows. [hellip] By evapotranspiring, trees recharge atmospheric moisture, contributing to rainfall locally and in distant locations. Cooling is explicitly embedded in the capacity of trees to capture and redistribute the sun[rsquo]s energy (Pokorn[yacute] et al., 2010). Further, trees[rsquo] microbial flora and biogenic volatile organic compounds can directly promote rainfall. Trees enhance soil infiltration and, under suitable conditions, improve groundwater recharge. Precipitation filtered through forested catchments delivers purified ground and surface water (Calder, 2005; Neary et al., 2009). [hellip]

Forests play a large role in regulating fluxes of atmospheric moisture and rainfall patterns over land. Earth[rsquo]s land and ocean surfaces release water vapor to the atmosphere. On continental surfaces, this process is aided by forests and other vegetation through evapotranspiration (ET) [ndash] evaporation from soil and plant surfaces and transpiration of water by plants. The resulting atmospheric moisture is circulated by winds across the Earth[rsquo]s continents and oceans. The upwind and cross-continental production and transport of atmospheric moisture [mdash] [ldquo]precipitation recycling[rdquo] [mdash] can, in the appropriate circumstances, promote and intensify the redistribution of water across terrestrial surfaces.

On average, at least 40% of rainfall over land originates from ET. [hellip]

Trees and forests contribute to the intensification of rainfall through the biological particles they release into the atmosphere, which include fungal spores, pollen, bacterial cells and biological debris. Atmospheric moisture condenses when air becomes sufficiently saturated with water and much more readily when suitable surfaces, provided by aerosol particles (condensation nuclei), are present (Morris et al., 2014; Sheil, 2014). Some volatile organic compounds, 90% of which are also biological in origin, become oxidized and sticky in sunlight and attach to any (mainly biological) particles, thereby growing to sizes that enhance

condensation [hellip]

Forests influence local and global temperatures and the flow of heat. At the local scale, forests can remain much cooler during daytime due to shade and the role of evaporation and transpiration in reducing sensible heat [hellip] Additional regional and global cooling derives from the fact that, through emissions of reactive organic compounds (Spracklen et al., 2008), forests can increase low-level cloud cover and raise reflectivity [albedo]. [hellip]

Using the sun[rsquo]s energy, individual trees can transpire hundreds of liters of water per day. This represents a cooling power equivalent to 70 kWh for every 100 L of water transpired (enough to power two average household central air-conditioning units per day). With deeper roots, trees can maintain their cooling function even during long-lasting heatwaves [hellip]

Forests may be particularly important for the so-called [ldquo]water towers[rdquo] of larger regions (see e.g. Viviroli and Weingartner, 2004). High altitude forests have a special ability to intercept fog and cloud droplets. Condensation on plant surfaces, including on dense, epiphytic lichen and moss communities, provides additional moisture for tree growth, ET, infiltration, groundwater recharge, and, ultimately, runoff [hellip]

Tree root architecture is also highly important for the hydraulic redistribution of water in soils, facilitating both upward and downward flows and thereby improving dry-season transpiration and photosynthesis while simultaneously transporting rainwater downward to levels where it cannot easily be evaporated (Neumann and Cardon, 2012; Prieto et al., 2012). Intermediate tree densities on degraded lands may in fact maximize groundwater recharge (Ilstedt et al., 2016). [hellip]

Biodiversity enhances many ecosystem functions like water uptake, tree growth and pest resistance (Sullivan and O[rsquo]Keeffe, 2011; Vaughn, 2010). The perverse effects of current land management strategies require closer scrutiny. For example, the practice of plantation forestry can negatively impact species richness and related ecosystem services (Ordonez et al., 2014; Verheyen et al., 2015).

Mixed species forests may lead to healthier, more productive forests, more resilient ecosystems and more reliable water related services, and often appear to perform better than monocultures regarding drought resistance and tree growth (Ordonez et al., 2014; Paquette and Messier, 2011; Pretzsch et al., 2014 Pretzsch et al., 2014). Through variation in rooting depth, strength and pattern, different species may aid each other through water uptake, water infiltration and erosion control (Reubens et al., 2007). [hellip]

The climate-regulating functions of forests [ndash] atmospheric moisture production, rainfall and temperature control at local and regional scale [ndash] should be recognized as their principal contribution, with carbon storage, timber and non-timber forest products as co-benefits (Locatelli et al., 2015). [hellip]

The multiple water and climate-related services provided by forests [ndash] precipitation recycling, cooling, water purification, infiltration and groundwater recharge, [hellip] represent powerful adaptation opportunities that can significantly reduce human vulnerability and simultaneously, through their carbon storage functions, provide mitigation (Pramova et al., 2012b). [hellip]

Given sufficient scientific evidence on forest, water and energy interactions, decision-making must recognize that water and climate-related ecosystem services benefit and impact people well beyond the local or catchment scale, often far from where actual decisions on tree planting or removal are made. Tradeoffs, for example between local restoration costs and downstream or downwind benefits, must also be taken into account [hellip]

Findings on forest and water interactions have important implications for environmental accounting. In addition to representing a potential loss for downstream water users, we likewise see ET as a potential gain for downwind users. Thus, the accounting and definition of plant water use as [ldquo]consumption[rdquo] is problematic and requires careful consideration (Launiainen et al., 2014; Maes et al., 2009). [hellip]

The effects of forests on water and climate at local, regional and continental scales provide a powerful adaptation tool that, if wielded successfully, also has globally-relevant climate change mitigation potential.

David Ellison et al 2017. Trees, forests and water: Cool insights for a hot world. Global Environmental Change 43 (2017) 51[ndash]61. http://ac.els-cdn.com/S0959378017300134/1-s2.0-S0959378017300134-main.pdf?_tid=38eca4a8-081a-11e7-9f6d-00000aab0f02&acdnat=1489429617_9efb667c50b0b4b3a3a03214472ba08d

Another study showed that as the climate warms forests, especially natural forests, become an increasingly important refuge for North American mammals, and that thinning dense forests may impair the forests function as climate refugia. Tourani et al 2023. Maximum temperatures determine the habitat affiliations of North American mammals. PNAS December 4, 2023. 120 (50) e2304411120 https://doi.org/10.1073/pnas.23044111, https://www.pnas.org/doi/pdf/10.1073/pnas.2304411120. ([ldquo]When temperatures spike (or plummet), many species can behaviorally thermoregulate by seeking thermally buffered microclimates (20). The presence of suitable microclimates can therefore drive species[rsquo] distributions (21), allowing species to persist in areas that would otherwise regularly exceed their thermal tolerances. Critically, anthropogenic land-uses are often much more structurally homogeneous than natural areas, resulting in reduced thermal buffering capacity and fewer potential climate refugia (20, 22[ndash]24). [hellip] [W]e found that mammals switch their habitat affiliations to become more associated with forests and more sensitive to human modification in warmer regions. [hellip] [C]losed forest canopies can thermally buffer the understory, thereby guarding against regional climate extremes (44). In contrast, many anthropogenic habitats lack closed canopies and thus also lack the local thermal buffering capacity needed to provide organisms with climate refugia (20, 22[ndash]24). [hellip] Our findings reaffirm that high temperatures may prevent species from exploiting habitats that they might otherwise occupy (64). [hellip] Our work suggests these climate extremes may further constrain species distributions and compromise efforts to conserve biodiversity in human-dominated landscapes.[rdquo]).

Ecosystem Integrity Through Natural Processes. Work with Nature, Not Against It

Natural processes act over varying scales of space and time to create and maintain biodiverse and productive ecosystems. The Assessment and the revised plans should strive to harmonize with these natural processes rather than interfere with them. It[rsquo]s time to do real ecosystem management.

Ecosystem integrity must be defined to include natural mortality as a desired part of the ecosystem and (not just another excuse to log the forest to save it from fire, insects, density dependent mortality, etc). The Assessment must recognize that these natural processes are solutions, not problems. The draft wildlife Assessment says [ldquo]Wildfire still plays an important ecological role in maintaining and restoring ecosystem functions, vegetation conditions, and reducing hazardous fuels.[rdquo] But this is not very well reflected in most of the management we see (e.g., aggressive logging to control fire) and we fear that it will not well reflected in this plan revision process.

These natural processes include photosynthesis, succession, and competitive mortality, non-competitive mortality, various forms of disturbance (fire of varying severity, wind, drought, floods, tree fall events, insects, disease, snow/ice, landslides, etc), organism establishment/ growth/mortality, species range expansion/contraction, predator/prey relations, herbivory, symbiosis/mutualism/parasitism, etc. Each of these process provides ecosystem services. As an example, some of the ecosystem services provided by tree mortality include: creating canopy gaps that make resources available to new tree cohorts, and other diverse species; recruitment of dead wood that serves many purposes from soil building to habitat; reallocation of resources such as light, water, and nutrients; thinning that reduces competitive stress;

The Forest Management and Timber Assessment says [ldquo]excess forest growth is [hellip] susceptible to competition-related mortality, insect and disease outbreaks, and wildfires.[rdquo] This is based on an outdated agricultural model of forestry that tries to control mortality, instead of seeing these natural mortality processes as solutions to the problems created by past management, especially logging, dense replanting, and fire suppression. The Assessment and the Planning process must recognize that natural processes taken together represent a self-organizing system that generates desired conditions. These forests have gone through climate change before, and are doing so again now. The Forest Service must give these processes wide berth to help the forest adapt to global climate change. This means being tolerant of some disturbance events that might make people uncomfortable.

The Assessment needs to recognize that mortality from logging is often greater than expected mortality from natural processes. And mortality from logging is not better than mortality from natural processes. In fact, it[rsquo]s arguably much worse, because mortality from natural processes does not require roads and heavy equipment and it recruits snags and dead wood that are essential to wildlife and other biophysical functions.

Berner, Law et al 2017. Tree mortality from fires, bark beetles, and timber harvest during a hot and dry decade in the western United States (2003[ndash]2012). Environ. Res. Lett. 12 065005. http://iopscience.iop.org/article/10.1088/1748-9326/aa6f94/meta (In the western continental United States[hellip] [ldquo]Harvest accounted for the largest percentage of MORTH+B+F (~50%), followed by beetles (~32%), and fires (~18%). Tree mortality from harvest was concentrated in Washington and Oregon, where harvest accounted for ~80% of MORTH+B+F in each state. Tree mortality from beetles occurred widely at low levels across the region,[hellip][rdquo]).

The Assessment should disclose the stand-scale mortality from logging versus natural processes, and should explain the relative ecological costs and benefits or mortality from natural events like drought, beetles fire versus mortality from logging. Why is the Forest Service so accepting of logging mortality and so intolerant of natural mortality. Humane Society v. Locke, 9th Circ, 2010.

https://web.archive.org/web/20101130013757/http://www.ca9.uscourts.gov/opinions/view_subpage.php?pk_id=0000010986.

From an ecological standpoint, it is much better for a tree to die of natural causes and stay in the forest to serve diverse biophysical functions, rather than be cut and sent from the ecosystem on the back of a log truck. Retaining unlogged forests allows natural processes (such as disturbance and succession) to flourish. This typically results in higher-quality combination of habitat features with fewer trade-offs. For instance, allowing trees to grow unharvested, results in natural tree mortality which not only frees up resources (light, moisture, nutrients, growing space) for residual trees to be grow larger, but also creates valuable snags and down wood habitat, and opens small canopy gaps that stimulate understory development and new tree cohorts. The benefits of allowing natural succession to occur in older stands is summarized by Eugene BLM:

As dominant trees continue to grow, they would gain late-successional habitat features like large diameters, deeply fissured bark, deep crowns, large branches, broken tops, and cavities. As individual dominant trees die, they would become large snags or down wood. As large trees or snags fall, they would knock over other trees and branches, creating growing space. This growing space would release understory conifers and hardwoods, allowing them to grow into dominant trees, and stimulate growth of shrubs and herbaceous vegetation. The overall effect of these successional processes would create a mosaic of tree ages, species composition, and late-successional habitat features in the stands. Additionally, patches of overstory trees would continue to suffer mortality from sporadic processes such as root rot or other disturbance such as windthrow. This would create larger areas of growing space for surviving overstory trees, hardwoods, conifer regeneration, shrubs, and herbs to occupy. Therefore, habitat in the project area would primarily develop late-successional characteristics, with patches of early- or mid-successional habitat throughout.

McKenzie Landscape EA, No. DOI-BLM- OR060-2013-0005-EA. https://eplanning.blm.gov/epl-front-office/projects/nepa/69610/91093/109561/2016_11_23_McKenzie_Landscape_EA__and_Preliminary_FONSI.pdf

The agency[rsquo]s need to take a hard look at the comparative risk of mortality from logging versus natural processes is analogous to the 9th Circuit's decision in Humane Society vs Locke (9th Circ. November 23, 2010) which halted the killing of sea lions below Bonneville Dam because "NMFS has not adequately explained its finding that sea lion predation is having a significant negative impact on salmonid decline or recovery in light of its positive environmental assessments of harvest plans having greater mortality impacts. The absence of an explanation is particularly concerning with respect to the 2005 fishery environmental assessment. In that assessment, NMFS found that a plan providing for fisheries to take between 5.5 and 17 percent of listed salmonids annually, depending on run size, would be expected to result in [ldquo]minimal adverse effects on Listed Salmonid [populations] in the Columbia River Basin,[rdquo] and that the [ldquo][c]umulative impacts from NMFS[rsquo]s Proposed Action would be minor if at all measurable.[rdquo] Those findings are in apparent conflict with NMFS[rsquo]s finding in this case that sea lions responsible for less or comparable salmonid mortality have a [ldquo]significant negative impact[rdquo] on the decline or recovery of these same populations, yet the agency has not offered a rationale to explain the disparate findings.... NMFS cannot avoid its duty to confront these inconsistencies by blinding itself to them."

http://www.ca9.uscourts.gov/datastore/opinions/2010/11/23/08-36038.pdf.

The FS must embrace a probabilistic framework of analysis that recognizes our limited control of nature, the significant adverse trade-offs of commercial logging plus roads, the limited effectiveness of commercial logging[1], and the fact that the combined effects of commercial logging, plus natural disturbances, will likely result in net negative outcomes relative to natural process augmented by cautious application of non-commercial thinning and prescribed fire.

Faison et al (2023) say that natural processes are more likely to develop complexity and resilience-

North America's temperate forests evolved continuously in response to natural disturbances and changes in climate over the past 65 million years (Askins, 2014). Only in the past 10[ndash]15,000 years did humans arrive and manage forests with fire and tree removal for subsistence and safety near their settlements (Roos, 2020; Roos et al., 2021), and only in the past two centuries did humans manage forests intensively (including the suppression of natural disturbances like fire) for industry and other values at the regional scale (Williams, 1992).

[hellip]

Forest health and resilience are important tenets of adaptation. Yet definitions of forest health focus on the ability of forests to provide direct resources and services to people (Millar & Stephenson, 2015), rather than the ability of ecosystems to persist and adapt per se in the face of changing disturbances. Hence, forest adaptation projects are portrayed as necessary for protecting forest ecosystems from climate change, when these initiatives are often more about resisting and directing change to promote a particular set of natural resource values and objectives, including economic gain.

[hellip]

Here we argue that a resist and direct approach to managing forests (e.g., mechanical thinning, prescribed burns, species selection, pre- and post-disturbance salvage/planting, and other fire suppression tactics) is appropriate in some forests intended for resource production, experiments, and human safety in the [ldquo]wildland[ndash]urban interface.[rdquo] However, accepting the capacity of natural systems to adapt and be self-sustaining with natural stewardship is a critical and cost-effective approach in other forest contexts.

[hellip]

Although improved resilience and protection of biodiversity are goals of proposed adaptation management, active management may, in some cases, have little effect on future stand resistance (Morris et al., 2022), is often unnecessary for natural forest resilience (e.g., Cansler et al., 2022; Hart et al., 2015) and biodiversity (Thom & Seidl, 2016; Viljur et al., 2022), and is generally counterproductive to carbon storage, structural complexity, tree diversity, and resistance to invasive species. (Donato et al., 2013; Miller et al., 2018; Patton et al., 2022; Schwilk et al., 2009; Young et al., 2017; Table 1). Moreover, conservation evidence for the effectiveness of management interventions is often lacking or has mixed results (Sutherland et al., 2021), resources for interventions are limited, and management incurs substantial financial and other costs to society (Houtman et al., 2013). Depending on local considerations, and based on multiple values, natural or near natural forest stewardship is an effective approach to developing and sustaining forest complexity, diversity, and functionality and traditional/aesthetic values (Franklin et al. 2002; Miller et al., 2016; Miller et al., 2018; Sze et al., 2022; Waller & Reo, 2018). It is also an insurance policy as we face an uncertain future.

[hellip]

From an ecological perspective, it is questionable whether it is even desirable or necessary to reduce the frequency and intensity of fire and other disturbances away from human settlements and forests managed for sustained wood production (e.g., Bradley et al., 2016; Kulakowski, 2016). Even moderate to severe natural disturbances promote structural heterogeneity, create biological legacies and unique habitats, and can increase biodiversity (Carbone et al., 2019; Klaus et al., 2010; Santoro & D'Amato, 2019; Shive et al., 2013; Swanson et al., 2011). And while mechanical thinning may mimic some of the habitat benefits of low to moderate severity fires, it does not emulate the important habitat characteristics of high severity fires (Stephens et al., 2012).

[hellip]

A common rationale for forest adaptation management is preventing future tree mortality, species compositional shifts, and carbon loss from natural disturbances. In some cases, thinning has been shown to reduce subsequent tree death from insects and drought compared to untreated areas, thereby promoting stand resistance and maintaining an existing species composition, while procuring sound timber (Hood et al., 2016; Knapp et al., 2021). However, in other cases prescribed burn treatments increased subsequent tree mortality (Knapp et al., 2021; Stark et al., 2013; Youngblood et al., 2009), and thinning and burn treatments generally promote the spread of invasive plants relative to controls (Schwilk et al., 2009; Willms et al., 2017). Additionally, loss of tree basal area and carbon storage from thinning and prescribed burning is often equal to or considerably greater than tree mortality and carbon loss from the disturbances themselves (Campbell et al., 2012; Hood et al., 2016; Knapp et al., 2021; Powers et al., 2010; Yocom-Kent et al., 2015). As a result, treated stands are not objectively more resistant or resilient to tree mortality or carbon loss[mdash]and in many cases are less so[mdash]if losses from the management itself are taken into account. Not surprisingly, natural forests in strictly protected areas store greater amounts of carbon, on average, than managed and unprotected areas (Collins & Mitchard, 2017; Moomaw et al., 2019).

[hellip]

[M]ost forests still regenerate without interventions, even after severe natural disturbances (Donato et al., 2016; Pielou, 1991; Santoro & D'Amato, 2019; Shive et al., 2013). In fact, natural regeneration often exceeds active restoration efforts (Cook-Patton et al., 2020; Donato et al., 2006), provides greater genetic diversity than planted seedlings (Swanson et al., 2011), and greater stand-level carbon storage in coarse woody debris (Donato et al., 2013).

[hellip]

Perceived regeneration failures from severe fire, intensive ungulate browsing, or seed source limitations may, in many cases, be patchy or delayed tree regeneration that has other benefits when seedling densities, growth rates, and particular tree species are not primary concerns. As one example, low density regeneration reduces the severity of reburns, facilitating forest recovery (Cansler et al., 2022; Harvey et al., 2016). Heterogeneity of natural regeneration also avoids structural uniformity that occurs with planting and can extend the duration of early successional patches and gaps, there by accelerating the development of spatial and structural complexity (Donato et al., 2012; Reed et al., 2022; Swanson et al., 2011).

[hellip]

[A]ccepting change with natural stewardship and exposure to natural disturbances and processes generally increases structural complexity, carbon storage, and tree species and other diversity. These accruing benefits, in turn, make forests more resistant and resilient to many future natural challenges and provide mitigation against climate change. Given the limited resources for actively managing forests, the mixed evidence of management promoting young trees and reducing fire and other risks, and little evidence that we can actively resist or direct change in unknown future conditions better than nature can, protecting more forests with natural stewardship is a cost effective way to harness the inherent adaptation and mitigation powers in forests and ensure that they are at their most functional to regulate planetary processes.

Faison, E. K., Masino, S. A., & Moomaw, W. R. (2023). The importance of natural forest stewardship in adaptation planning in the United States. Conservation Science and Practice, e12935. https://doi.org/10.1111/csp2.12935. https://conbio.onlinelibrary.wiley.com/doi/pdf/10.1111/csp2.12935.

We are concerned that the assessment is based on a false sense of control over nature when in reality fuel reduction has a low probability of encountering fire and has a modest/marginal effect on fire behavior, and wildfires continue to burn with a characteristic mix of low, moderate, and severe effects. The purpose and need for this plan amendment should be adjusted accordingly and the agency should consider alternatives that are based on working with, instead of against, natural processes.

Oregon forests are fire-dependent. Even with increasing acres burned by wildfire in recent years, there is still a severe deficit of fire in all severity classes, including severe fire, a deficit which grows yearly. In eastern Oregon and Washington,

Contemporary years average well under historical rates for virtually all severity classes across dry and moist (but not cold) forests. Annualized fire deficits relative to historical rates are especially conspicuous for low-severity area in dry forests (on average missing 127,000[ndash]161,000 ha[sdot]yr[minus]1 regionally) and moderate-severity area in both dry (missing 34,000[ndash]44,000 ha[sdot]yr[minus]1) and moist (missing 9000[ndash]12,000 ha[sdot]yr[minus]1) forests. Ten-year moving averages in burn area are increasing in recent years, but remain below historical levels. Trends are similar across states and major land ownerships. [hellip] As such, beneficial fire years may be those not with less, but rather more, area burned [ndash] with characteristic severity and patch distributions, minimal clearly-negative impacts (e.g. loss of life and property), and contribution to restoration/maintenance objectives.

[hellip]

Three key takeaways emerge: 1) historically, for all the forest types of the inland Pacific Northwest to have burned at published frequencies, a significant fraction of the land base [ndash] hundreds of thousands of hectares [ndash] would have burned each year, albeit with substantial year to year variation; 2) the contemporary era (1985[ndash]2020) has been much less fiery than the historical era [ndash] by nearly an order of magnitude when comparing averages of annual area burned; and 3) these burned-area rates demonstrate that successful forest restoration and maintenance will likely require both increasing active treatment rates and incorporating managed wildfire.

[hellip] Without significantly greater use of managed wildfire, in combination with major increases in prescribed fire or other treatments, it will be challenging to achieve wildfire risk reduction and landscape climate adaptation goals in a meaningful timeframe (North et al., 2012, North et al., 2021, Ager et al., 2022).

[hellip] A broader assessment of fire impacts could place fire seasons in a more meaningful context. Rather than a narrative centered simply on absolute area burned, a broader evaluation would consider both the impacts and the [lsquo]work[rsquo] accomplished by wildfires. The [lsquo]work[rsquo] of wildfire can be thought of as the degree to which stand- and landscape-scale fire effects are consistent with science-based objectives for ecosystem resilience or planned forest restoration/maintenance treatments. In essence, the question shifts from [ldquo]how many hectares burned?[rdquo] to [ldquo]how many hectares burned that produced desired versus deleterious outcomes [ndash] ecologically and socially?[rdquo] (See WA DNR, 2022a, WA DNR, 2022b).

Daniel C. Donato, Joshua S. Halofsky, Derek J. Churchill, Ryan D. Haugo, C. Alina Cansler, Annie Smith, Brian J. Harvey, 2023. Does large area burned mean a bad fire year? Comparing contemporary wildfire years to historical fire regimes informs the restoration task in fire-dependent forests, Forest Ecology and Management, Volume 546, 2023, 121372, ISSN 0378-1127, https://doi.org/10.1016/j.foreco.2023.121372. https://www.sciencedirect.com/science/article/pii/S0378112723006060. The authors recommend greater use of fire as a management tool.

After the extreme 2020 wildfires in Oregon[rsquo]s western Cascades, Bev Law testified before Congress saying:

The takeaway from the 2020 fires in Oregon is that we will always have available fuel in the forests that can burn. Grasslands and shrublands can burn too. We are not going to be able to cut our way to less fire, nor are we going to be able to suppress all fire. We need to be prepared for the large fire events by hardening our homes and protecting our communities. We may need to improve forest management, and that discussion needs to include how we manage industrial forestlands so they do not pose increased risks to communities.

[hellip]

Increasing the use of prescribed fires and managing wildland fires may promote resilience to more frequent fire (Schoennagel et al. 2017).[rdquo] However, the scope and scale of this work is very expensive, and thinning vast landscapes has not been shown to have a high-probability of success in encountering fire or altering fire behavior. In Oregon, we have millions of acres of dry forests, and just addressing a portion of this landscape will costs billions of dollars. Because of the short period of treatment effectiveness (10-20 yr), the treatments will need to be repeated into the future. It is important for policymakers to know that there are ecological and carbon costs from landscape scale thinning, and that it is not an effective tool to ensure community safety. Rather, as Dr. Jack Cohen has demonstrating, working from the home outward is the best approach to ensuring fire safe communities.

[hellip]

It is highly unlikely that attempt to manage the flammability of vast landscapes by cutting will be effective or achievable over time. See responses to (#5a, 16c). State and federal agencies need to support individuals and communities to be fire wise, create and maintain defensible space and protect critical infrastructure. Home hardening works. Emergency planning and early warning systems are the

most effective ways to save lives and livelihoods in extreme fire weather.

Law, B. 2021. Response to Questions for the Record, attached to STATEMENT OF DR. BEVERLY LAW, PROFESSOR EMERITUS, OREGON STATE UNIVERSITY, BEFORE THE UNITED STATES HOUSE OF REPRESENTATIVES, SUBCOMMITTEE ON NATIONAL PARKS, FORESTS AND PUBLIC LANDS, APRIL 29, 2021, CONCERNING [ldquo]WILDFIRE IN A WARMING WORLD: OPPORTUNITIES TO IMPROVE COMMUNITY COLLABORATION, CLIMATE RESILIENCE, AND WORKFORCE CAPACITY[rdquo] https://naturalresources.house.gov/imo/media/doc/Law,%20Beverly%20-%20Testimony%20-%20NPFPL%20Ov%20Hrg%2004.29.21.pdf (link to Statement, without Response to Questions).

The agencies are moving across the landscape often using commercial logging as a tool to aggressively manage fuels and reducing stand density which causes significant cumulative impacts on soil, water, wildlife habitat, carbon storage, and other values. These public resources are now exposed to the unprecedented compound effects of both logging and fire. The agency thinks it has found great alignment between its desire for timber production, risk reduction, and other restoration goals, but this view is just too convenient. It requires constant validation and reassessment. The view that everything aligns may be hiding significant trade-offs and causing the agency to overlook other viable options, such as decreasing reliance on logging and increasing reliance on fire as tools to achieve more optimal forest management outcomes. The accumulation of evidence does not support logging for fuel reduction as a sound strategy to manage fuel and fire.

* Most fires are climate-driven, rather than fuel-driven. The warming climate is likely to make this effect even more pronounced. Schoennagel et al 2017. Adapt to more wildfire in western North American forests as climate changes. PNAS 2017; published ahead of print April 17, 2017. www.pnas.org/cgi/doi/10.1073/pnas.1617464114; https://headwaterseconomics.org/wp-content/uploads/Adapt_To_More_Wildfire.pdf; Odion, D.C. et al 2014. Examining Historical and Current Mixed-Severity Fire Regimes in Ponderosa Pine and Mixed-Conifer Forests of Western North America. PLOS One. February 2014 | Volume 9 | Issue 2 http://www.californiachaparral.org/images/Odion_et_al_Historical_Current_Fire_Regimes_mixed_conifer_2014.pdf; See also, Alisa Keyser and Anthony Westerling, 2017. Climate drives inter-annual variability in probability of high severity fire occurrence in the western United States, Environmental Research Letters. Accepted Manuscript online 4 April 2017 https://doi.org/10.1088/1748-9326/aa6b10.
* Our forests are still suffering from a deficit of fire, including high severity fire. Any trend toward more severe fires in the west is very recent and driven by climate change, not fuels. Many institutions (timber industry, counties, land management agencies, some academics) have been advocating for aggressive fuel reduction for years, based on a counterfactual assertion that recent fires are uncharacteristic and driven by excessive fuels. Neither of these is well-supported by evidence (except for some very recent fire seasons driven to extremes by global climate change).
* Schwind, B. (compiler). 2008. MTBS: Monitoring Trends in Burn Severity: Report on the PNW & PSW Fires [mdash] 1984 to 2005. https://web.archive.org/web/20130214220819/http://www.mtbs.gov/reports/MTBS_pnw-psw_final.pdf ([ldquo]MTBS data does not support the assumption that wildfires [in the PNW] are burning more severely in recent years. ... The majority of area burned falls within the unburned to low severity range, with relatively low annual variation in these severity classes. The high and moderate severity classes show higher relative variation between years, suggesting that these classes may be most influenced by variation in climate, weather, and seasonal fuel conditions.[rdquo])
* Vaillant & Reinhardt 2017. An Evaluation of the Forest Service Hazardous Fuels Treatment Program[mdash]Are We Treating Enough to Promote Resiliency or Reduce Hazard? J. For. 115(4):300 [ndash]308. July 2017. https://doi.org/10.5849/jof.16-067. https://www.fs.fed.us/pnw/pubs/journals/pnw_2017_vaillant001.pdf (Nationwide, only 11% of fires burn uncharacteristically.)
* Law, B.E., Waring, R.H. 2015. Review and synthesis - Carbon implications of current and future effects of drought, fire and management on Pacific Northwest forests. Forest Ecology and Management 355 (2015) 4[ndash]14. http://people.forestry.oregonstate.edu/richard-waring/sites/people.forestry.oregonstate.edu.richard-waring/files/publications/Law%20and%20Waring%202015.pdf (This study reported no significant trend in area burned, number of fires, or fire severity for the state of Oregon.)
* Ray Davis et al 2015. RMP Revisions for Western Oregon BLM DEIS. Appendix D [ndash] Modeling Wildfires and Fire Severity. http://www.blm.gov/or/plans/rmpswesternoregon/files/draft/RMP_EIS_Volume3_appd.pdf. ([ldquo][hellip] examined the MTBS data for any obvious temporal trends in wildfire severity [within the range of the spotted owl], but did not detect a strong signal (Figure D-6). Over the course of 25 years, there appears to be a slight increase in the percentage of area burned by low and moderate severity wildfire, and a slight decrease in the percent of area burned in high severity wildfire, although these trends are not statistically significant. [hellip][rdquo])
* Alisa Keyser and Anthony Westerling, 2017. Climate drives inter-annual variability in probability of high severity fire occurrence in the western United States, Environmental Research Letters. Accepted Manuscript online 4 April 2017 https://doi.org/10.1088/1748-9326/aa6b10. ([ldquo]We tested trends for WUS [western United States], each state, and each month. We found no significant trend in WUS high severity fire occurrence over 1984-2014, except for Colorado (table S1). While some studies have shown increasing fire season length, we saw no significant increase in high severity fire occurrence by month, May through October (figure S1). We found no correlation between fraction of high severity fire and total fire size, meaning increasing large fires does not necessarily increase fractional high severity fire area.[rdquo])
* Brendan P. Murphy, Larissa L. Yocom, Patrick Belmont. 2018. Beyond the 1984 perspective: narrow focus on

modern wildfire trends underestimates future risks to water security. Earth's Future, 2018; DOI: 10.1029/2018EF001006 https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/2018EF001006 ([ldquo]Compiling several datasets, we illustrate a comprehensive history of western wildfire, demonstrate that the majority of western settlement occurred during an artificially and anomalously low period of wildfire in the 20th century, ... A crucial first step toward realigning public perspectives will require scientists and journalists to present recent increases in wildfire area within the context and scale of longerterm trends. ... A review of Science, Nature, and PNAS reveals that 77% of wildfire-related articles published about the western U.S. since 2000 (n=52) only address fire trends from the past few decades. In many of these studies, as well as in principal wildfire databases (Eidenshink et al., 2007; NIFC, 2017), ca. 1984 is frequently the first year presented, because this marks the beginning of consistent, satellite-derived records (Short, 2015). Wildfire area has rapidly increased since 1984, as ecosystems realize their potential to burn in an era of lengthening fire seasons and warming temperatures (Abatzoglou & Williams, 2016). However, this [ldquo]1984 perspective[rdquo] of wildfire is problematic. First and foremost, the 1980s represent the end of an anomalously low period for wildfire during the mid-20th century, and western U.S. landscapes remain well below historical wildfire activity (Barrett, et al., 1997; Leenhouts, 1998; Stephens et al., 2007; Littell et al., 2009; Swetnam et al., 2016). ... Historical reconstructions of annual area burned demonstrate that wildfire area in the pre-settlement western U.S. was many times greater than the supposed [lsquo]record highs[rsquo] of today (Barrett, et al., 1997; Leenhouts, 1998; Stephens et al., 2007) (Fig. 1A&C). Borne out by hundreds of fire-history studies, research consistently shows that dry western forests frequently burned by wildfire over the past few centuries (Falk et al., 2010). Although wildfire activity naturally oscillates over millennial timescales (Marlon et al., 2012), area burned across the West began to rapidly decline in the late 19th century with the introduction of railroads and livestock (Swetnam et al., 2016). This was especially true in dry forest ecosystems, where livestock ate the fine fuel necessary to carry widespread surface fires. By the mid-20th century (ca. 1950s to mid-1980s), the area burning annually across all western ecosystems had plummeted from 7-18 Mha to less than 0.5 Mha due to fire suppression activities (Leenhouts, 1998; Littell et al., 2009) (Figure 1A). This West-wide decline in area burned is corroborated by subregional records (Figure 1C) and is consistent with the 20th century [ldquo]fire deficit[rdquo] observed in fire scar and charcoal influx records Marlon et al., 2012). ... The annual area burned, as well as burn severity, are projected to continue increasing across the western U.S. through the 21st century due to climate change and, in some ecosystems, excess fuel loading from fire suppression (Brown et al., 2004; Westerling et al., 2011; Hawbaker & Zhu, 2012; Abatzoglou & Williams, 2016; Abatzoglou et al., 2017).[rdquo])
* Baker, W. L. 2015. Are high-severity fires burning at much higher rates recently than historically in dry-forest landscapes of the Western USA? PLoS ONE 10(9): e0136147;
* Collins, B.M. et al. 2009. Interactions among wildland fires in a long-established Sierra Nevada natural fire area. Ecosystems 12:114[ndash]128;
* Dillon, J.K. et al. 2011, Both topography and climate affected forest and woodland burn severity in two regions of the western US, 1984 to 2006. Ecosphere 2: Article 130;
* Hanson, C. T. and D.C. Odion, 2014. [ldquo]Is fire severity increasing in the Sierra Nevada, California, USA? International Journal of Wildland Fire 23: 1[ndash]8;
* Hanson, C.T. and D.C. Odion, 2015. Sierra Nevada fire severity conclusions are robust to further analysis: a reply to Safford et al. International Journal of Wildland Fire 24: 294-295;
* Keyser, A. and A.L. Westerling 2017. Climate drives inter-annual variability in probability of high severity fire occurrence in the western United States. Environmental Research Letters 12 065003;
* Miller, J.D. et al. 2012. Trends and causes of severity, size, and number of fires in northwestern California, USA. Ecological Applications 22: 184-203;
* Odion, D.C. et al. 2014. Examining historical and current mixed-severity fire regimes in Ponderosa pine and mixed-conifer forests of western North America. PLoS ONE 9(2): e87852;
* Picotte et al. 2016. 1984-2010 Trends in fire burn severity and area for the coterminous US. International Journal of Wildland Fire 25: 413-420;
* Schwind, B. 2008. Monitoring trends in burn severity: report on the Pacific Northwest and Pacific Southwest fires (1984 to 2005). US Geological Survey.

* There is a relatively low probability that fuel treatments will interact with wildfire before fuels regrow and render the fuel reduction effort ineffective. Tania Schoennagel highlights the problem of removing fuels from a vast forest landscape that has a low annual probability of burning by saying that forest fuel reduction [ldquo]is like trying to scoop water out of the ocean to make it less wet.[rdquo] [ldquo]A recent study conducted by researchers at the University of Montana found that only about 7 percent of fuel-reduction treatment areas in the entire United States were subsequently hit by wildfires since 1999. [hellip] If someone had the magical ability to predict, within the past decade, that a major fire was going to strike that particular portion of the 240,000-acre Scapegoat Wilderness, then thinning and logging theoretically could have helped. But it doesn[rsquo]t work that way, and fires are sparked in random places by lightning and humans, and they are pushed by erratic winds and weather. [hellip] According to Tania Schoennagel, a forest landscape ecologist and fire researcher at the University of Colorado, [hellip] [lsquo]it[rsquo]s little bit of a crapshoot probability game whether the treatment you put in is going to encounter wildfire in the 10 to 15 years it remains effective in reducing fire severity. Simply because forests in the West are so vast, the chance of burning in a place we[rsquo]ve pre-treated is so low. It[rsquo]s not a very effective lever. We don[rsquo]t know where fires are going to happen.[rsquo][rdquo] David Erickson (2017). Experts: More logging and thinning to battle wildfires might just burn taxpayer dollars. CREDIT: MISSOULIAN.COM. Oct 1, 2017. http://www.america.easybranches.com/montana/Experts--More-logging-and-thinning-to-battle-wildfires-might-just-burn-taxpayer-dollars-152776 citing Kevin Barnett, Sean A. Parks, Carol Miller, and Helen T. Naughton. 2016. Beyond Fuel Treatment Effectiveness: Characterizing Interactions between Fire and Treatments in the US. Forests [open access] 2016, 7, 237; doi:10.3390/f7100237. http://www.mdpi.com/1999-4907/7/10/237. See also, William L. Baker, Jonathan J. Rhodes. 2008. Fire Probability, Fuel Treatment Effectiveness and Ecological Tradeoffs in Western U.S. Public Forests. pp.1-7 (7). The Open Forest Science Journal, Volume 1. 2008. http://api.ning.com/files/1kp0vDW*F1cqOeO4-GdXE1AHOATghmIAN2x9qLpH3aA_/FireandFuelTreatments.pdf; [ldquo]According to a recent analysis, annually less than one percent of U.S. Forest Service fuel reduction treatments in forested areas subsequently burned, on average. From 2000 to 2015, almost 17 million acres of federal land were treated for fuels reduction, equating to approximately four percent of U.S. Forest Service and Bureau of Land Management lands. During the same time period, more than 93 million acres burned. The odds of putting fuel treatments in the wrong place are extremely high.[rdquo] Pohl, Kelly 2019. [ldquo]For communities, land use planning is more effective than logging on federal lands to reduce future wildfire disasters.[rdquo] https://headwaterseconomics.org/wildfire/solutions/land-use-planning-is-more-effective/. Also, [ldquo]In real landscapes treatments are static, restricted to a small portion of the landscape and against a background of stochastic fire and dynamic vegetation, thus the likelihood of fire encountering a treatment during the period treatments remain effective is small. ... Allocating priorities to treat based on merchantable timber (THIN), vegetation departure (VDEP), area suitable for prescribed fire and restoration wildfire (FIRE) and conditional flame length (CFL) had similar or lower success odds than random allocation ... [S]uccess odds declined sharply as desired success levels increased suggesting that fuel management goals need to be tempered to consider the stochastic nature of wildfire.[rdquo] Barros, Ana M. G.; Ager, A. A.; Day, M. A.; Palaiologou, P. 2019. Improving long-term fuel treatment effectiveness in the National Forest System through quantitative prioritization. Forest Ecology and Management. 433: 514-527. https://www.fs.fed.us/rm/pubs_journals/2019/rmrs_2019_barros_a001.pdf.
* The effects of fuel reduction are modest. Even extensive fuel reduction reduces the extent of wildfire by less than 10 percent. See M. A. Cochrane, C. J. Moran, M. C. Wimberly, A. D. Baer, M. A. Finney, K. L. Beckendorf, J. Eidenshink, and Z. Zhu. 2012. Estimation of wildfire size and risk changes due to fuels treatments. International Journal of Wildland Fire. http://dx.doi.org/10.1071/WF11079. http://www.publish.csiro.au/?act=view_file&file_id=WF11079.pdf. Andrew Larson, a forest ecologist from the University of Montana said

"Even after you go and thin a forest, when it's dry like it is now, it's still going to carry a fire, it's still going to generate smoke. So, in terms of day to day life, the experience we have during the fire season, we need to not get our hopes up," Larson says. "You can anticipate more smoke. Even if we were to double, triple, increase the amount of area logged or thinned by a factor of ten or 20, we're still going have smoke, we're not going to stop the fires. We may change how they burn, and that's an important outcome, it's something that a lot of my research is directed at. But we need to make sure people don't get their hopes up and expect something that the forestry profession, that managers in the Forest Service, the Department of Interior, can't deliver on."

ERIC WHITNEY 2017. Forest Ecologist Comments On Senator Daines' Fire Call. Montana Public Radio. Sept 14, 2017. http://mtpr.org/post/forest-ecologist-comments-senator-daines-fire-call. Also, Hurteau et al (2019) found that [ldquo]fuel availability and flammability only reduced the cumulative area burned in the Sierra by about 7.5 percent over the course of the century ... because vegetation re-growth happens with sufficient speed that the fuel limitation effects from fire are short-lived.[rdquo] Matthew D. Hurteau, Shuang Liang, A. LeRoy Westerling & Christine Wiedinmyer 2019. Vegetation-fire feedback reduces projected area burned under climate change. Scientific Reports, volume 9, Article number: 2838 (2019), https://www.nature.com/articles/s41598-019-39284-1; https://doi.org/10.1038/s41598-019-39284-1; https://news.ucmerced.edu/news/2019/scientists-simulate-forest-fire-dynamics-understand-area-burn-future-wildfires

* Commercial logging will often make fire hazard worse, not better. Reducing the forest canopy will make the stand hotter, drier, and windier, produce more activity fuels, and stimulate the growth of ladder fuels. Professor Char Miller said [ldquo][hellip] decades of data show that intense logging creates more destructive fires than the ones that burn through roadless areas, parkland and wilderness.[rdquo] Char Miller. 2017. Op-Ed: What the Trump administration doesn't understand about wildfires. LA Times. Oct 1, 2017. http://www.latimes.com/opinion/op-ed/la-oe-miller-zinke-fire-memo-20171001-story.html. See also, Jain, Theresa B.; Battaglia, Mike A.; Han, Han-Sup; Graham, Russell T.; Keyes, Christopher R.; Fried, Jeremy S.; Sandquist, Jonathan E. 2012. A comprehensive guide to fuel management practices for dry mixed conifer forests in the northwestern United States. USDA Forest Service Gen. Tech. Rep. RMRS-GTR-292. 2012 http://www.firescience.gov/projects/09-2-01-16/project/09-2-01-16_09-2-01-16_rmrs_gtr292web.pdf. A meta-analysis of the effects of partial cutting showed that understory growth was stimulated in all cases. D. Zhou, S. Q. Zhao, S. Liu, and J. Oeding. 2013. A meta-analysis on the impacts of partial cutting on forest structure and carbon storage. Biogeosciences, 10, 3691[ndash]3703, 2013. https://www.biogeosciences.net/10/3691/2013/bg-10-3691-2013.pdf. ([ldquo]Understory C was stimulated significantly by partial cutting in all of the studies. This stimulation can be mostly attributed to an increase in the availability of light, water, and nutrients to the understory because of tree removal (Aussenac, 2000; Kleintjes et al., 2004; Deal, 2007)[rdquo]) Removing commercial sized logs as part of fuel reduction degrades habitat while doing little to modify fire behavior. If conducted at large scales, the effects of commercial logging for fuel reduction will be socially and ecologically unacceptable. Lehmkuhl, John; Gaines, William; Peterson, Dave W.; Bailey, John; Youngblood, Andrew, tech. eds. 2015. Silviculture and monitoring guidelines for integrating restoration of dry mixed-conifer forest and spotted owl habitat management in the eastern Cascade Range. Gen. Tech. Rep. PNW-GTR-915. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 158 p. ?http://www.fs.fed.us/pnw/pubs/pnw_gtr915.pdf. ([ldquo]Tradeoffs between fire resistance and NSO habitat quality are real.Our results demonstrate that balancing the goals of increasing fire resilience while maintaining habitat function, especially nesting and roosting, for the NSO in the same individual stand is a difficult, if not an impossible, task. Even lighter thinning treatments typically reduce canopy cover below 40 percent. The reality is that nesting and roosting NSO habitat is by definition very susceptible to high-severity fire; owl habitat value and fire risk are in direct conflict on any given acre. [hellip][rdquo]). Montana Public Radio reported on Senator Daines statement that [ldquo][rsquo]radical environmentalists[rsquo] would try to stop efforts to remove dead trees from Montana forests. [Ecologist Andrew Larson said] "That's an attitude that I'm always kind of disappointed to encounter," Larson said, "because a healthy forest has dead trees and dead wood. The snags [mdash] standing dead trees [mdash] and dead logs are some of the most important habitat features for biodiversity. You can't have an intact, healthy wildlife community without dead wood in your forest." ERIC WHITNEY 2017. Forest Ecologist Comments On Senator Daines' Fire Call. Montana Public Radio. Sept 14, 2017. http://mtpr.org/post/forest-ecologist-comments-senator-daines-fire-call;
* Retaining mature forest canopy is more fire resilient than most logged sites. Canopy removal via thinning not only makes the forest hotter, drier, and windier, it also stimulates the growth of shrubs and create the very

conditions that favor more severe crown damage during fire. This challenges the very popular notion that dense forests are a fire hazard. A meta-analysis of the effects of partial cutting showed that understory growth was stimulated in all cases. D. Zhou, S. Q. Zhao, S. Liu, and J. Oeding. 2013. A meta-analysis on the impacts of partial cutting on forest structure and carbon storage. Biogeosciences, 10, 3691[ndash]3703, 2013. https://www.biogeosciences.net/10/3691/2013/bg-10-3691-2013.pdf. ([ldquo]Understory C was stimulated significantly by partial cutting in all of the studies. This stimulation can be mostly attributed to an increase in the availability of light, water, and nutrients to the understory because of tree removal (Aussenac, 2000; Kleintjes et al., 2004; Deal, 2007)[rdquo]). [ldquo]Thinning is most effective when it removes understory trees, because larger overstory trees are more resistant to heat injury (Agee and Skinner 2005). In addition, shade and competition from larger trees slows the recruitment of younger trees in the understory.[rdquo] Keeley, J.E.; Aplet, G.H.; Christensen, N.L.; Conard, S.C.; Johnson, E.A.; Omi, P.N.; Peterson, D.L.; Swetnam, T.W. 2009. Ecological foundations for fire management in North American forest and shrubland ecosystems. Gen. Tech. Rep. PNW-GTR-779. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 92 p. http://www.fs.fed.us/pnw/pubs/pnw_gtr779.pdf. Zald & Dunn (2018) looked at fire severity in a mixed ownership landscape and found that stand age was inversely related to fire severity suggesting that older forests are more resistant and resilient to fire and that time-since-fire has the opposite of the assumed effect on fire hazard. [ldquo][hellip]we found daily fire weather was the most important predictor of fire severity, followed by stand age and ownership, followed by topographic features. Estimates of pre-fire forest biomass were not an important predictor of fire severity. Adjusting for all other predictor variables in a general least squares model incorporating spatial autocorrelation, mean predicted RdNBR was higher on private industrial forests (RdNBR 521.85 [plusmn] 18.67 [mean [plusmn] SE]) vs. BLM forests (398.87 [plusmn] 18.23) with a much greater proportion of older forests. Our findings suggest intensive plantation forestry characterized by young forests and spatially homogenized fuels, rather than pre-fire biomass, were significant drivers of wildfire severity. This has implications for perceptions of wildfire risk, shared fire management responsibilities, and developing fire resilience for multiple objectives in multi-owner landscapes.[rdquo] Harold S. J. Zald, Christopher J. Dunn. 2018. Severe fire weather and intensive forest management increase fire severity in a multi-ownership landscape. Ecological Applications. Online Version of Record before inclusion in an issue. 26 April 2018. https://doi.org/10.1002/eap.1710. Also, https://phys.org/news/2018-04-high-wildfire-severity-young-plantation.html.

An example of thick brush that can grow after thinning.

* Only a small fraction of needed density reduction can support an economically viable timber sale. See Rainville, Robert; White, Rachel; Barbour, Jamie, tech. eds. 2008. Assessment of timber availability from forest restoration within the Blue Mountains of Oregon. Gen. Tech. Rep. PNW-GTR-752. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 65 p. http://www.fs.fed.us/pnw/pubs/pnw_gtr752.pdf ([ldquo]Hoping to boost their economies and also restore these forests, local leaders are interested in the economic value of timber that might be available from thinning treatments on these lands. [hellip] [W]e found that on lands where active forestry is allowable, thinning of most densely stocked stands would not be economically viable. [hellip] In the 46 percent of the three Blue Mountains national forests that is forested, thinning with timber removal is an unlikely treatment method. This does not mean that other vegetative management options (prescribed fire, wildland fire use, or thinning without commercial timber removal) could not be used to reduce fire hazard, but it is doubtful that these areas would produce much commercial timber. [hellip] Commercial thinning would only be possible where the value of the timber harvested exceeds the cost of the harvesting, hauling, road maintenance, and contractual requirements (i.e., a positive net revenue exists). Because most simulated thinnings harvested low volumes of small trees, commercial removal was possible on only 39,900 ([plusmn] 4,600) acres, or less than 10 percent of the densely stocked acres (table 4-8). [hellip] [hellip] even when considered under the most favorable of assumptions, most densely stocked stands would not be treatable without significant investments.[rdquo])

* The agencies are failing to treat the areas of highest hazard and choosing instead to treat areas that produce profitable timber sales. Vaillant & Reinhardt 2017. An Evaluation of the Forest Service Hazardous Fuels Treatment Program[mdash]Are We Treating Enough to Promote Resiliency or Reduce Hazard? J. For. 115(4):300 [ndash]308. July 2017. https://doi.org/10.5849/jof.16-067. https://www.fs.fed.us/pnw/pubs/journals/pnw_2017_vaillant001.pdf. ([ldquo][W]e evaluated the [nationwide] extent of fuel treatments and wildfire occurrence within lands managed by the National Forest System (NFS) between 2008 and 2012 [hellip] The very high hazard class had the lowest treatment percentage and the highest incidence of uncharacteristically high-severity wildfire out of all the hazard classes. [hellip] Areas of very low hazard often are favored for treatment because they are less complex to plan and implement, are more economical to treat, [hellip] [T]reatments may be placed where they can accomplish multiple objectives, including production of wood products. This may result in selection of locations that are less important for hazard mitigation.[rdquo])
* Building codes and land use planning are more effective than logging to reduce community wildfire hazard. Pohl, Kelly 2019. [ldquo]For communities, land use planning is more effective than logging on federal lands to reduce future wildfire disasters.[rdquo] https://headwaterseconomics.org/wildfire/solutions/land-use-planning-is-more-effective/. ([ldquo][W]e have the knowledge and tools to reduce risk posed by homes in wildfire-prone areas. ... [T]here are many land use planning tools available that can mean the difference between home survival and loss.[rdquo]). The fire threat to communities is caused by, and may be best addressed by, land use practices, not forest fuels. Forest fuels policy needs to recognize that structures themselves represent hazardous fuels that can carry fire from structure-to-structure, or from structure-to-forest. There are already too many homes in the wildland urban interface, and more are being built every day. Radeloff, Helmers, Kramer et al 2017. Rapid growth of the US wildland-urban interface raises wildfire risk. Proceedings of the National Academy of Sciences. Mar 2018, 2017. https://www.pnas.org/cgi/doi/10.1073/pnas.1718850115. ([ldquo]Abstract: [hellip] Here we report that the WUI in the United States grew rapidly from 1990 to 2010 in terms of both number of new houses (from 30.8 to 43.4 million; 41% growth) and land area (from 581,000 to 770,000 km2; 33% growth), making it the fastest-growing land use type in the conterminous United States. The vast majority of new WUI areas were the result of new housing (97%), not related to an increase in wildland vegetation. Within the perimeter of recent wildfires (1990[ndash]2015), there were 286,000 houses in 2010, compared with 177,000 in 1990. Furthermore, WUI growth often results in more wildfire ignitions, putting more lives and houses at risk. Wildfire problems will not abate if recent housing growth trends continue.[rdquo]). This also shows that people are quite willing to tolerate fire hazard in order to enjoy the quality of life associated with living near the forest.
* Unlogged areas provide many benefits such as wildlife cover, snag & wood recruitment, carbon storage, soil/watershed quality, microclimate buffering, etc. Forests are naturally adaptive and natural processes will accomplish many of the benefits attributed to thinning. [ldquo]Counter to many regional studies, our results indicated that treated and long-unaltered, untreated areas may be moving in a similar direction. Treated and untreated areas experienced declines in tree density, increases in the size of the average individual, and losses of surface fuels in most size classes. The number of large trees increased in untreated areas, but decreased in treated areas. Our results suggested that untreated areas may be naturally recovering from the large disturbances associated with resource extraction and development in the late 1800s, and that natural recovery processes, including self thinning, are taking hold. ... In a study of forest restoration need across eastern Washington and Oregon, over 25% of required restoration could be achieved through transition to later stages of forest stand development through successional processes as western landscapes recover from widespread historic degradation (Haugo et al., 2015).[rdquo] Zachmann, L. J., D. W. Shaw, and B. G. Dickson. 2018. Prescribed fire and natural recovery produce similar long-term patterns of change in forest structure in the Lake Tahoe basin, California. Forest Ecology and Management 409:276[ndash]287. http://www.csp-inc.org/wp-content/uploads/2017/11/Zachmann_et_al_2017.pdf
* Wildfire effects are more ecologically beneficial than logging. The 2017 Fuels Report for the 130,000 acre East Hills Project on this Fremont-Winema NF admits that wildfires are expected to have beneficial effects even under the no action alternative - [ldquo]Overall expected value of fire effects is moderately beneficial. This assumes that fires burn throughout the range of conditions [ndash] actual current practice is to suppress fires that are most likely to be beneficial.[rdquo] https://www.fs.usda.gov/nfs/11558/www/nepa/101283_FSPLT3_4264365.pdf. This

would indicate a need to modify fire suppression practices and work with fire when weather conditions are favorable.

Considering all of this, forest managers need to recognize that they cannot log their way out of the fuel predicament they are in. Forest managers will eventually come to realize that the vast majority of the ecological work will be accomplished by wild and prescribed fire.

Oregon Wild supports the objective of preparing the forest for wildfire, but this does not mean that extensive commercial logging is required. Preparing for fire can often be done best by doing non-commercial pre-treatment followed by prescribed fire at the appropriate time, when the weather and fuels are relatively cool and moist. Fire is preferable because it has a lighter ecological footprint on soil, water, and large wood habitat.

Schoennagel et al (2017) make a compelling case for a new approach to managing fire and fuel with a greater emphasis on using wild and prescribed fire instead of mechanical fuel reduction.

Key aspects of an adaptive resilience approach are (i) recognizing that fuels reduction cannot alter regional wildfire trends; (ii) targeting fuels reduction to increase adaptation by some ecosystems and residential communities to more frequent fire; (iii) actively managing more wild and prescribed fires with a range of severities; and (iv) incentivizing and planning residential development to withstand inevitable wildfire. [hellip] Managing ecosystems, people, and wildfire in a changing climate is a complex but critical challenge that requires effective and innovative policy strategies. Our key message is that wildfire policy and management require a new paradigm that hinges on the critical need to adapt to inevitably more fire in the West in the coming decades. [hellip] Three primary factors have produced gradual but significant change across western North American landscapes in recent decades: the warming and drying climate, the build-up of fuels, and the expansion of the wildland[ndash]urban interface. [hellip] Increasing the use of prescribed fires and managing rather than aggressively suppressing wildland fires can promote adaptive resilience as the climate continues to warm. [hellip] Strategic planning for more managed and uncontrolled wild fires on the landscape today may help decrease the proportion of large and severe wildfires in the coming decades and may enhance adaptive resilience to changing climate. Prescribed fires, ignited under cooler and moister conditions than are typical of most wildfires, can reduce fuels and minimize the risk of uncontrolled forest wildfire near communities. In contrast to wildfires, prescribed fire risks are relatively low, and more than 99% of prescribed fires are held within planned perimeters successfully. [hellip] We need to develop a new fire culture. Despite these and various legal and operational challenges, the benefits of prescribed fire and managed wildfires to ecosystems and communities are high. Promoting more wildfire away from people and prescribed fires near people and the WUI are important steps toward augmenting the adaptive resilience of ecosystems and society to increasing wildfire. [hellip] [T]he effectiveness of this [fuel reduction] approach at broad scales is limited. Mechanical fuels treatments on US federal lands over the last 15 y (2001[ndash]2015) totaled almost 7 million ha (Forests and Rangelands, https://www.forestsandrangelands.gov/), but the annual area burned has continued to set records. Regionally, the area treated has little relationship to trends in the area burned, which is influenced primarily by patterns of drought and warming. Forested areas considerably exceed the area treated, so it is relatively rare that treatments encounter wildfire. [hellip] [R]oughly 1% of US Forest Service forest treatments experience wildfire each year, on average. The effectiveness of forest treatments lasts about 10[ndash]20 y, suggesting that most treatments have little influence on wildfire. [hellip] [T]he prospects for forest fuels treatments to promote adaptive resilience to wildfire at broad scales, by regionally reducing trends in area burned or burn severity, are fairly limited. [hellip] Home loss to wildfire is a local event, dependent on structural fuels (e.g., building material) and nearby vegetative fuels. Therefore, fuels management for home and community protection will be most effective closest to homes, which usually are on private land in the WUI where ignition probabilities are likely to be high. [hellip] The majority of home building on fire-prone lands occurs in large part because incentives are misaligned, where risks are taken by homeowners and communities but others bear much of the cost if things go wrong. Therefore, getting incentives right is essential, with negative financial consequences for land-management decisions that increase risk and positive financial rewards for decisions that reduce risk. [hellip]

Schoennagel et al 2017. Adapt to more wildfire in western North American forests as climate changes. PNAS 2017; published ahead of print April 17, 2017. www.pnas.org/cgi/doi/10.1073/pnas.1617464114; https://headwaterseconomics.org/wp-content/uploads/Adapt_To_More_Wildfire.pdf. Others seem to agree that fire is the preferred tool for management of fire-dependent forests that are suffering from fire exclusion and climate stress. MP North, RA York, BM Collins, MD Hurteau, GM Jones, EE Knapp, L Kobziar, H McCann, MD Meyer, SL Stephens, RE Tompkins, CL Tubbesing. 2021. Pyrosilviculture Needed for Landscape Resilience of Dry Western United States Forests, Journal of Forestry; https://doi.org/10.1093/jofore/fvab026 ([ldquo]A management paradigm shift in fire use is needed to restore western forest landscape resilience. We propose a [ldquo]pyrosilviculture[rdquo] approach with the goals of directly increasing prescribed fire and managed wildfire and modifying thinning treatments to optimize more managed fire.[rdquo]) We would caution adoption of this paper[rsquo]s recommendation of using [ldquo]revenue thinning[rdquo] to pay for prescribed fire treatments, as large-scale commercial logging will have unacceptable trade-offs such as wildlife habitat, snag habitat, water quality, and carbon storage.

As explained in greater detail in the wildlife section of or comments, snags and dead wood serve valuable ecosystem services yet are in short supply due to a long history of management that is adverse to snag recruitment. The Assessment needs to better explain the critical values provided by snags and dead wood, the shortage of them, and the cause of the shortage. The plan revision needs to fix this problem by reducing logging and retaining more trees and letting natural processes act upon those trees to create desired conditions. Wisdom et al (2008) found that snag abundance in the Pacific northwest forests is inversely related to past harvest and proximity to roads. Wisdom, M.J., and Bate, L.J. 2008. Snag density varies with intensity of timber harvest and human access. For. Ecol. Manage. 255: 2085[ndash]2093. doi:10.1016/j.foreco.2007.12.027. http://www.fs.fed.us/pnw/pubs/journals/pnw_2008_wisdom001.pdf ([ldquo]Our highest snag density [hellip] occurred in unharvested stands that had no adjacent roads. [hellip] Stands with no history of timber harvest had 3 times the density of snags as stands selectively harvested, and 19 times the density as stands having undergone complete harvest. Stands not adjacent to roads had almost 3 times the density of snags as stands adjacent to roads.[rdquo])

Low-impact restoration activities, including but not limited to prescribed fire, mowing, non-commercial thinning, and weed removal may be appropriate to augment natural processes. Commercial logging prescriptions are typically designed to exert significant control over fire behavior and tree mortality, and similar prescriptions have been and are being applied across quite a large area of our federal forests. By limiting treatments to low-impact, non-commercial activities in undeveloped areas we are still treating them, and still getting benefits in terms of fire and "forest heath," but we are relaxing our control just a bit and letting natural processes play a bigger role in that subset of the landscape.
Mature and Old-Growth
Large and old trees are rare compared to the historic range of variability and they provide a wide range of ecosystem services related to carbon/climate, fish & wildlife habitat, hydrological function, fire resistance/resilience, recreation and scenic values, etc. The Assessment needs to explain the value of conserving large and old trees, and the adverse effects of removing large and old trees.

On April 22, 2022 President Biden issued an executive order declaring a policy to conserve mature and old-growth forests on federal land and to manage forests to retain and enhance carbon storage. The agencies should immediately implement these policies.

Sec. 1. Policy.

Strengthening America[rsquo]s forests, which are home to cherished expanses of mature and old-growth forests on Federal lands, is critical to the health, prosperity, and resilience of our communities [hellip]. Forests provide clean air and water, sustain the plant and animal life fundamental to combating the global climate and biodiversity crises, and hold special importance to Tribal Nations. [hellip] Conserving old-growth and mature forests on Federal lands [hellip] is critical to protecting these and other ecosystem services provided by those forests. [hellip] We can and must take action to conserve, restore, reforest, and manage our magnificent forests [hellip] It is the policy of my Administration, [hellip] to [hellip] conserve America[rsquo]s mature and old-growth forests on Federal lands [hellip]

[hellip]

Sec. 2. Restoring and Conserving the Nation[rsquo]s Forests, Including Mature and Old-Growth Forests.

My Administration will manage forests on Federal lands, which include many mature and old-growth forests, to promote their continued health and resilience; retain and enhance carbon storage; conserve biodiversity [hellip]

Biden, J. 2022. Executive Order #14072 on Strengthening the Nation[rsquo]s Forests, Communities, and Local Economies. APRIL 22, 2022. PRESIDENTIAL ACTIONS https://www.whitehouse.gov/briefing-room/presidential-actions/2022/04/22/executive-order-on-strengthening-the-nations-forests-communities-and-local-economies/ (emphasis added). The official policy of the federal government is to conserve mature and old-growth forests on federal land and that policy should be implemented here and now.

Additional commitments were made public on December 19, 2023, announcing efforts to amend all Forest Plans across the country. Any revised Blue Mountains Forest Plans should treat existing protections as a floor rather than a ceiling, and include iron-clad protections for mature and old growth forests.

It is often said that forests are not static, which is very true. Old-growth forests don[rsquo]t last forever. They can succumb to natural mortality as well as logging. In fact, the climate change impacts assessment says, [ldquo]future forests may be dominated by younger age classes and smaller trees.[rdquo] Old forests are already in short supply, that is why it is critical to maintain mature forests as a replacement pool for the old growth cohort. See Doug Heiken 2009. The Case for Protecting Both Old Growth and Mature Forests. Version 1.8 April 2009. https://www.dropbox.com/s/4s0825a7t6fq7zu/Mature%20Forests%2C%20Heiken%2C%20v%201.8.pdf?dl=0.

The Forest Service likes to say that species composition is shifting to shade-tolerant trees grand fire/white fir that (they assert) are less resilient. The Forest Service should show more humility. These shifting patterns are a result of the conditions we have created for them. Who are we to question which native species are desired and not desired? Grand fir appear to be a fairly successful species in our forests modified by logging and fire suppression. Is that going to change?

The Forest Service also needs to give these trees their due. The Forest Service commonly overstates the fire sensitivity of these species. There is new information indicating that Grand fir may be more fire resistant than assumed in the NEPA analysis supporting the Screens Amendment. "The grand fir forest type had severity values at the same level of forest types dominated by fire-resister species despite grand fir was classified as a fire-avoider species. [hellip] In many ponderosa pine forests maintained historically by a high frequency, low-severity fire regime, the transition towards denser forests dominated by Douglas-fir and grand fir would explain why ponderosa pine and Douglas-fir still compose a significant proportion of basal area in the grand fir forest type, and many maintain large, old, fire-resistant ponderosa pine trees (Johnston et al. 2021; Merschel et al. 2021). Therefore, the particular structure and composition of these [ldquo]recent[rdquo] grand fir forests (e.g., Merschel et al. 2014), with an important presence of large-diameter trees of fire-resistant species, may provide latent fire resistance (Larson et al. 2013)." Jose V. Moris, Matthew J. Reilly, Zhiqiang Yang, Warren B. Cohen, Renzo Motta, Davide Ascoli 2022. Using a trait-based approach to asses fire resistance in forest landscapes of the Inland Northwest, USA. Landsc Ecol (2022) 37:2149[ndash]2164. energyhttps://doi.org/10.1007/s10980-022-

01478-w, https://www.fs.usda.gov/rm/pubs_journals/2022/rmrs_2022_moris_j001.pdf.

As shown in the table below from the 2020 Amendment to the Eastside Screens, there is still a shortage of large trees across the eastside landscape.

Significantly, large white fir contribute positively to biodiversity associated with large trees and large snags, climate mitigation and adaptation, and fire resistance/resilience. The problem of large white fir co-mingling and adversely competing with large pine is overstated, and does not justify sweeping exemptions to the well-supported standards requiring protection of all large trees in eastside National Forests.

Where large trees appear to be abundant, they are helping to compensate for large areas lacking large trees. The agency is not helping when they propose to remove large trees when they exceed the historic average, because large trees populations exhibited a range of conditions often exceeding the average.

Furthermore, where large trees appear to be in competition and at risk of mortality, they are just furthering the natural processes that help tree populations develop adaptive traits such as when less fit individuals die and allow more fit individuals to survive and reproduce, thus increasing population resilience to drought. Mortality also helps recruit valuable large snags and dead wood. It is unavoidable that logging large trees has net negative ecological effects and cannot be justified on ecological grounds. The agency must consider all the trade-offs carefully.

Hessburg et al 2015 recommend: [ldquo]To improve the longevity of larger early seral trees, restorative activities would include thinning and removing neighboring shade-tolerant trees to reduce competition for water and nutrients, and removing nearby surface and ladder fuels to reduce fire intensities that would threaten their long-term survival.[rdquo] Paul F. Hessburg . Derek J. Churchill . Andrew J. Larson . Ryan D. Haugo . Carol Miller. Thomas A. Spies . Malcolm P. North . Nicholas A. Povak . R. Travis Belote . Peter H. Singleton. William L. Gaines . Robert E. Keane . Gregory H. Aplet . Scott L. Stephens . Penelope Morgan, Peter A. Bisson . Bruce E. Rieman . R. Brion Salter . Gordon H. Reeves. 2015. Restoring fire-prone Inland Pacific landscapes: seven core principles. Landscape Ecology, May 2015. DOI 10.1007/s10980-015-0218-0
http://link.springer.com/content/pdf/10.1007%2Fs10980-015-0218-0.pdf.

However, the Forest Service is over-stating the [ldquo]problem[rdquo] of large Ponderosa pine co-mingling with large white fir. Mildrexler et al (2023) looked at the FIA data and found [ndash]

Large ponderosa pine co-mingle with large grand fir about 14% of the time (259 plots), leaving 86% of plots with large ponderosa pine without large grand fir (1616 plots). Similarly, large western larch co-mingle with large grand fir about 56% of the time. Large ponderosa pine and grand fir are found together on only 8% of all plots in the region, while large larch and grand fir are found together on only 4% of all plots in the region. In other words, large ponderosa pine are by far the most common tree species found in these six National Forests and infrequently co-mingle with large grand fir at the FIA plot scale, whereas large western larch are far less common and co-mingle with large grand fir about half the time, which is expected since these species occupy similar environmental settings [hellip]

David J. Mildrexler, Logan T. Berner, Beverly E. Law, Richard A. Birdsey, William R. Moomaw 2023. Protect large trees for climate mitigation, biodiversity, and forest resilience. Conservation Science and Practice. 2023;e12944. https://doi.org/10.1111/csp2.12944. This paper also notes that large trees are more resilient to drought stress than small trees, and [ldquo]a trait-based approach to assess fire resistance found that the grand fir forest type had the second highest fire resistance score, and one of the lowest fire severity values among forest types of the Inland Northwest USA (Moris et al., 2022).[rdquo] Citing Moris, J. V., Reilly, M. J., Yang, Z., Cohen, W. B., Motta, R., & Ascoli, D. (2022). Using a trait-based approach to asses fire resistance in forest landscapes of the inland northwest, USA. Landscape Ecology, 37, 2149[ndash]2164.

https://doi.org/10.1007/s10980-022-01478-w.

[ldquo]Older forests are an important part of the [lsquo]evolutionary anvil[rsquo] upon which biodiversity is hammered out by natural selection. If we drive species to extinction through our artificial, often unwitting human-imposed selection processes, we will be harming the biological potential of the land far more than by the removal of individual species. We will be striking a devastating blow to the wellspring of our biological and social future.[rdquo] NCSSF 2008. Beyond Old Growth Older Forests in a Changing World - A synthesis of findings from five regional workshops. National Commission on Science for Sustainable Forestry. http://cms.oregon.gov/ODF/BOARD/docs/FFAC_020108_Beyond_Old_Growth_John_Gordon.pdf; https://andrewsforest.oregonstate.edu/sites/default/files/lter/pubs/pdf/pub4524.pdf.

We wish to reiterate some key points made by the Eastside Forests Coalition.

* In the face of the ongoing climate crisis, the revised Blue Mountains Forest Plans should at a minimum [ndash] reinstate the original Eastside Screens[rsquo] protections for large trees[mdash]which store a disproportionately large amount of above ground carbon[mdash]both inside and outside late old structure forests.
* Mature and old growth forests and large trees must be protected to support wildlife dependent upon large living trees and snags, closed canopies, and mature and old forest abundance.
* Protecting mature and old growth forests and large trees also offers protections to cold clean water and aquatic habitat, as the complex ecosystem structure created by these forests helps filter rainwater and provides necessary shading in riparian areas, among other benefits.

The Assessment should reflect the fact that old trees appear to be more resilient to heat stress than younger trees. Parks, Bradley 11-22-2021. Oregon trees cooked during summer heat waves. https://www.opb.org/article/2021/11/22/oregon-trees-cooked-by-summer-heat-waves/. ([during the 2021 Oregon heat wave] [ldquo]Younger trees also fared worse than older ones. [ldquo]There is going to be an impact, I think, going forward, if this young generation had lots and lots of mortality, which we think it did,[rdquo] [Christopher] Still said. [ldquo]The older trees, they[rsquo]re going to be more resilient,[rdquo]).

Old trees are [ldquo]life history lottery winners[rdquo] and exhibit unique characteristics that are lost when old trees are logged.

Human cultures around the world have revered ancient trees as powerful spiritual beings, connecting Earth and Heaven, as sources of wisdom, fertility, balance and longevity1. These myths and legends are often embodied by a particularly old and venerated individual tree of exceptional presence, distinguishable from the many other large trees in the forest. These ancient trees are seen as belonging to a separate and special class of being that transcends the normal plane of existence, binding the tree to a deep knowledge and awareness of history, change and persistence. With increasing knowledge about the role old trees play in ecosystems, biologists are also beginning to attach special importance to individual ancient trees in populations2,3.

The ecological importance of old trees in forested ecosystems has been extensively documented, particularly as small natural features that provide a wide range of services4[ndash]6. And yet, our understanding of tree age structure in forested ecosystems remains poor7. Fundamentally, the lifespan of even an average tree greatly exceeds the duration of any current ecological project, so true demographic studies of trees have never been carried out, except on a cross-sectional, not longitudinal, basis. [hellip] [W]e highlight several exceptional population-level demographic properties that emerge from these models and discuss their evolutionary implications, particularly given long-term environmental cycles. First, a small proportion of individuals win the life-history [lsquo]lottery[rsquo] and obtain exceptional ages, far more than ten times greater than the median age in the population (Fig. 1a). These ancient trees are observed in natural populations and are possible because of the lack of programmed senescence enabled by the woody plant growth form3 and the low mortality rates observed in many old-growth forests globally13[ndash]16. We argue that, despite the rarity of these individuals, they play a significant role maintaining diversity in the population and bridging across unusual and infrequent environmental conditions. Second, a larger proportion of individuals reach significant ages many times greater than the median age. These old individuals contribute substantially to the stabilization of population diversity to intermediate environmental change.

[hellip]

The ancient trees, particularly the oldest, display the greatest degree of responsiveness to changing model conditions. Some individuals obtain truly astonishing ages in relation to the mean age of the population, which, as noted above, is already substantially greater than the median population age and even the median oldest individual across replicates (Fig. 3; see full range of variation in Supplementary Fig. 3). Even in the smallest populations, individuals achieve ages that are significantly more than the mean maximum age, and the frequency and magnitude of these outliers increase with declining mortality (Fig. 3). Essentially, a life-history [lsquo]lottery winner[rsquo] can emerge at any timepoint. The maximum age obtained by these lottery winners is substantially greater than even forest climax age, indicating that, even after population age structure has stabilized, the ancient trees continue to become more unusual and idiosyncratic for many more centuries. Unfortunately, the ancient age group that emerges from a stochastic death process, and thus their impact on evolutionary dynamics, can only be found in old-growth forests. Anthropogenic forest conversion resets the clock on this long emergent process.

[hellip]

[B]ecause each ancient tree can differ in age from other ancient trees by decades and even centuries, every individual represents a unique set of environmental conditions that existed when they established.

These ancient trees can be a very valuable resource for the population, if temporal scales of environmental variation extend beyond the age of even old trees, thus bridging between extreme and infrequent environmental conditions that the population might not survive without the ancient trees.

[hellip] Given that selective environments change through a complex cyclical process of several underlying patterns, extreme environmental conditions can return over time periods of decades or hundreds of years (Fig. 4a). The greater longevity of ancient trees increasingly bridges the temporal gap between the return of these environmental extremes (Fig. 4b[ndash]e). If individuals that establish during those extreme periods are more fit for these conditions, they can produce offspring that are likely to have advantageous alleles that facilitate establishment during those extreme conditions. As fecundity is generally maintained in ancient trees26, their contribution to regeneration during these extreme but rare climatic conditions can be disproportionate. Overall, despite the rarity of the ancient individuals, each ancient individual is connected to a unique historical circumstance (Fig. 4). They create a rich and deep genetic diversity within the community that can bridge the gaps between rare and extraordinary environmental conditions. In particular, given predictions of global climate change, the baseline itself of cyclical environmental change is shifting and the amplitude of change is increasing, driving conditions towards more and more extreme values, further accentuating the importance of these ancient reservoirs of valuable adaptive capacity at the outer margins of genetic diversity.

[hellip] Several mechanisms have evolved in individual trees to enable extreme longevity and deal with negative effects of ageing (Fig. 5). In general, they can be grouped into two non-mutually exclusive categories: senescence avoidance and ageing tolerance. [hellip]

Stress tolerance is indeed a mechanism of ageing tolerance, since it serves to delay death as trees age. In ancient trees, the ability to maintain pluripotent meristems is key for resistance (growth memory), resilience and stability of populations32,33. While shoot apical meristems lead directly to vegetative and reproductive growth, axillary meristems are particularly important for plant branching and regeneration after damage34. Ancient trees possess huge vegetative plasticity, even through epicormic shoots in consequence of severe disturbances3. [hellip] The cambial meristem continually renews the vascular system of the tree, responding to local conditions, both temporally and spatially, essentially creating a record of change and resilience in the tree wood. Meristematic tissues, both pluripotent and constantly renewing themselves, enable the tree to essentially be potentially immortal28, 29.

[hellip] Estimates that old-growth forest can be achieved in 150 years (ref. 46) neglects the impact of ancient trees. These ancient trees are indicators of the degree of development in old-growth processes47. Old and ancient trees are unique proxies for reconstructing past climate and environment48. Such old trees have survived multiple decadal (Atlantic Multidecadal Oscillation and Pacific Decadal Oscillation generally lasting between 30 and 70 years) and even longer contrasting climatic phases (Medieval Warm Period, Little Ice Age, global warming).

[hellip]Finally, ancient trees represent a major reservoir for deep genetic

diversity that can bridge long temporal gaps between extreme environmental conditions. While these ancient individuals are rare in the population, their existence can have profound impacts on population evolutionary dynamics, [hellip]

[hellip] For all of these reasons, old-growth forests with their unique stock of ancient trees are becoming increasingly important to protect. Losing these trees is like species extinction, in that an irreplaceable genetic resource is being lost. Ecologically, ancient trees are known to be unique biodiversity hubs56 that provide key or unique ecosystem functions unparalleled by managed forests. They contribute disproportionately to the forest rate of carbon sequestration, as this rate continuously increases with tree size57. But these ancient trees, perhaps most critically, are an irreplaceable evolutionary resource for the tree species themselves. The loss of these ancient trees can greatly reduce the evolutionary potential of the species. Preserving and restoring ancient trees everywhere in the world, from the heart of old-growth forests to tiny fragments in managed forest or along roadsides, is an urgent goal for a sustainable future. We strongly advocate research focused on these ancient trees and their contribution to the future adaptive capacity of our global forests.

Charles H. Cannon, Gianluca Piovesan, and Sergi Munn[eacute]-Bosch 2022. Old and ancient trees are life history lottery winners and vital evolutionary resources for long-term adaptive capacity. Nature Plants 8, pages136[ndash]145 (2022). https://doi.org/10.1038/s41477-021-01088-5.

See also, Lindenmayer, D. B., Laurance, W. F., Franklin, J. F., Likens, G. E., Banks, S. C., Blanchard, W., Gibbons, P., Ikin, K., Blair, D., McBurney, L., Manning, A. D. and Stein, J. A.R. (2013), New policies for old trees: averting a global crisis in a keystone ecological structure. Conservation Letters. doi: 10.1111/conl.12013. (Abstract: [ldquo]Large old trees are critical organisms and ecological structures in forests ... They play many essential ecological roles ranging from the storage of large amounts of carbon to the provision of key habitats for wildlife. Some of these roles cannot be replaced by other structures. Large old trees are disproportionately vulnerable to loss in many ecosystems worldwide as a result of accelerated rates of mortality, impaired recruitment, or both[hellip]. we argue that new policies and practices are urgently needed to conserve existing large old trees and restore ecologically effective and viable populations of such trees by managing trees and forests on much longer time scales than is currently practiced, and by protecting places where they are most likely to develop.[rdquo])

George Monbiot (2021) extolled the virtues of old trees and slow ecology:

Healthy ecosystems depend to a great extent on old and gnarly places, that might take centuries to develop, and are rich in what ecologists call [ldquo]spatial heterogeneity[rdquo]: complex natural architecture. They need, for example, giant trees, whose knotty entrails are split and rotten; great reefs of coral or oysters or honeycomb worms; braiding, meandering rivers full of snags and beaver dams; undisturbed soils reamed by roots and holes. The loss of these ancient habitats is one of the factors driving the global shift from large, slow-growing creatures to the small, short-lived species able to survive our onslaughts. Slow ecology would protect and create our future ancient habitats.

[hellip]there[rsquo]s no substitute for an ancient tree, or an ancient anything else. Big old trees are the [ldquo]keystone structures[rdquo] of forests, on which many other species depend. The very trees that foresters have tended to weed out [ndash] forked, twisted, lightning-struck, rotten, dead [ndash] are those that harbour the most life. For example, a single species of bracket fungus, which grows on rotten branches (dryad[rsquo]s saddle), harbours 246 species of beetle.

Bats shelter in splits in the trunk. Forks hold tiny pools of water or pockets of soil. Jagged wounds where limbs have sheared, burrs and excrescences, scrapes from which resin bubbles, ivy, vines, lichens and mosses, tangles of twigs and derelict nests, peeling bark and fire scars are all crucial wildlife habitats. But the most important features of ancient trees [ndash] and many other habitats [ndash] are holes.

Between 10% and 40% of the world[rsquo]s forest birds and mammals need holes in trees in which to nest or roost. Many other animals [ndash] amphibians, reptiles, invertebrates [ndash] depend on them. But these species suffer from a void of voids, an absence of absences.

Holes take many forms: hollow trunks or branches, galleries mined by insects, cavities dug by woodpeckers. Woodpeckers are keystone species, whose tunneling makes homes for other nesting birds and mammals. They appear to spread fungal spores on their beaks in the same way that bees spread pollen, and this helps create the soft wood into which they can drill. The trees they need are big, old and rotten.

But almost everywhere, trees like this are disappearing. [hellip]

Our tidy-minded forestry and our habit of treating trees as interchangeable are devastating to wildlife. [ldquo]Replacing[rdquo] an old tree is no more meaningful than replacing an old master. [hellip]

So what would a slow ecology movement look like? As Henry David Thoreau said, we are rich in proportion to the number of things we can afford to let alone. To the greatest extent possible, we should allow our complex natural architectures to recover. [hellip]

Wherever possible, we should allow the trees killed by ash dieback and other diseases to remain standing. If one good thing arises from these plagues, it could be an increase in the amount of standing and fallen dead wood, both of which are crucial habitats. [ldquo]Salvage logging[rdquo] [ndash] removing dead or dying trees [ndash] is one of the most damaging human activities. Perhaps it also means a general preservation order for all trees, living or dead, greater than 100 years old: you would need express permission to fell one. It would mean a new and deeper respect for the entanglements of nature.

We need to create today the knurled and wizened ecosystems that only our grandchildren will see. Restoring the living world means restoring complexity, and complexity takes ages to develop. So it[rsquo]s time we began.

George Monbiot 2021. The gift we should give to the living world? Time, and lots of it. The Guardian, 8-8-2021. https://www.theguardian.com/commentisfree/2021/aug/08/living-world-time-saplings-oak-slow-ecology-habitats.

Bell et al (2021) conducted a study of trends in forest area supporting large trees and snags in Oregon and Washington using GNN [gradient nearest neighbor] tools and said -

The presence of large live trees and standing dead trees, or snags, is a defining characteristic of old-growth forest ecosystems in western North America (Franklin et al. 1981, 2002, Kaufmann et al. 2007, Lindenmayer et al. 2012, Reilly and Spies 2015). They provide structural elements supporting high quality habitat for many wildlife species (Hunter and Bond 2001). Since the mid-20th century, anthropogenic stressors, such as timber harvesting, land conversion, and wildfire, have greatly reduced the extent of old-growth forests in Oregon and Washington (Bolsinger and Waddell 1993). Many wildlife species in this region rely entirely or in part on the availability of large live and dead trees [hellip]

Succession and management also affect snag densities, with a greater frequency in older, unmanaged stands or for several years following moderate or high severity wildfire. Recent (i.e., following the Northwest Forest Plan [1994] and Eastside Screens [1995]) management of federal forests in Oregon and Washington have emphasized promotion of late succession and old-forest attributes, including large snags (e.g.; Davis et al. 2015). Other management goals can conflict with the aim to increase snag densities, such as thinning to accelerate old forest conditions in moister forests (northwestern OR, western WA), and fuel reduction treatments in drier forests (southwestern OR, eastern OR and WA).

[hellip] As the diameter threshold for large live trees and snags increased, the frequency of reference plots with no such trees increased and the maximum densities decreased, reflecting increasing scarcity of large live trees and snags.

[hellip] [as of 2011] current forest area [in Oregon and Washington] supporting large live trees and snags was less than historical reference conditions (Fig. 4, Table 3). The differences between historical and current forest area supporting large live trees or snags were generally greater for forests in the western portion of the study area (WLCH_OCA, WLCH_WCA, WLCH_OCO, WLCH_OCO, MMC, and SWOMC) compared to eastern WHTs [wildlife habitat types] (EMB_ECB, EMC_NCR, LP, and PPDF). [hellip] Federal lands had a greater percentage of forest area supporting large live trees and snags compared to nonfederal lands.

[hellip] Federal lands showed increases (95% confidence intervals greater than zero) for all classes except forest with live trees [ge] 100 cm (only 68% confidence intervals greater than zero). In contrast, chnage [sic] on non-federal lands were not different from zero [hellip] Thus, federal forestlands during recent decades account for much of the regional trends in forest area supporting large live trees and snags. [hellip]

While we observed increases in areas supporting large live trees and snags during recent decades (Fig. 6), these changes in area were relatively small (Fig. 5) and are therefore unlikely to offset past losses for the region as a whole. We observed increases in area with large live trees and snags on federal lands, but not on nonfederal lands, indicating that those federal lands drive most of the regional changes. The reduction of forest area supporting high densities of large live trees and snags since historical times and the lack of substantial increases during recent decades on all lands highlights major challenges to maintaining quality habitat for some wildlife species. Large, continuous tracts of suitable old-growth forest habitat are already restricted by historical land-use history and further endangered by emerging issues, like climate change and wildfire (Davis et al. 2015, 2016, Phalan et al. 2019).

[hellip]

Conclusions

In part, the maintenance of forest biodiversity depends on the retention of existing and restoration of late-successional and older forest habitat for wildlife species to within natural or desired ranges. Our results indicate that the forests of Oregon and Washington have lost a substantial proportion of forests supporting large live trees and snags compared to reference conditions and that recruitment of these structural elements of wildlife habitat at regional scales is a slow process. [hellip] Large quantities and diversities of dead wood structures are needed to maintain biodiversity in forest ecosystems (Sandstr[ouml]m et al. 2019). Given that most forests supporting large live trees and snags are federally managed, these federal lands will be central to the conservation and management of large live trees and snags in the Pacific Northwest.

David M. Bell et al 2021. Quantifying regional trends in large live tree and snag availability in support of forest management. Forest Ecology and Management 479 (2021). https://pdf.sciencedirectassets.com/271259/1-s2.0-S0378112720X0020X/1-s2.0-S0378112720313232/am.pdf.

A recent study supports the retention of slow growing old trees because they are relatively more resilient. The study found that slower-growing older trees tend to channel their energy into structural support and defense compounds to [ldquo]maximize durability while minimizing [hellip] damage[rdquo]. Black, Colbert, & Pederson. 2008. Relationship between radial growth rates and lifespan within North American tree species. Ecoscience 15(3), 349-357 (2008). http://fate.nmfs.noaa.gov/documents/Publications/Black_et_al_2008_Ecoscience.pdf. Tobias Z[uuml]st, Bindu Joseph, Kentaro K. Shimizu, Daniel J. Kliebenstein and Lindsay A. Turnbull, Using knockout mutants to reveal the growth costs of defensive traits, in: Proceedings of the Royal Society B, 2011, Jan. 26, doi:10.1098/rspb.2010.2475. See also, University of Montana. June 18, 2019. Cell structure linked to longevity of slow-growing Ponderosa Pines. https://www.sciencedaily.com/releases/2019/06/190618174358.htm ([ldquo]Slow-growing ponderosa pines may have a better chance of surviving longer than fast-growing ones, especially as climate change increases the frequency and intensity of drought, according to new research from the University of Montana. ... [A] key difference between fast and slow growers resides in a microscopic valve-like structure between the cells that transport water in the wood, called the pit membrane. The unique shape of this valve in slow-growing trees provides greater safety against drought, but it slows down water transport, limiting growth rate.[rdquo]) citing Beth Roskilly, Eric Keeling, Sharon Hood, Arnaud Giuggiola, Anna Sala. Conflicting functional effects of xylem pit structure relate to the growth-longevity trade-off in a conifer species. Proceedings of the National Academy of Sciences, 2019; 201900734 DOI: 10.1073/pnas.1900734116. See also, University of Montana. June 18, 2019. Cell structure linked to longevity of slow-growing Ponderosa Pines. https://www.sciencedaily.com/releases/2019/06/190618174358.htm ([ldquo]Slow-growing ponderosa pines may have a better chance of surviving longer than fast-growing ones, especially as climate change increases the frequency and intensity of drought, according to new research from the University of Montana. ... [A] key difference between fast and slow growers resides in a microscopic valve-like structure between the cells that transport water in the wood, called the pit membrane. The unique shape of this valve in slow-growing trees provides greater safety against drought, but it slows down water transport, limiting growth rate.[rdquo]). citing Beth Roskilly, Eric Keeling, Sharon Hood, Arnaud Giuggiola, Anna Sala. Conflicting functional effects of xylem pit structure relate to the growth-longevity trade-off in a conifer species. Proceedings of the National Academy of Sciences, 2019; 201900734 DOI: 10.1073/pnas.1900734116.

De la Mata et al (2017) studied the variable survival of Ponderosa pine during a mountain pine beetle (MPB) outbreak and found that slow growing trees had an advantage -

Growth rates have fitness consequences and selection is expected (23). Indeed, we found significant genetic responses to selection on growth rates, but importantly, these responses changed in direction and strength over time (Fig. 2A). Fast growth was positively selected before the outbreak, but negatively selected during the outbreak, clearly showing that intense herbivory shifted selection patterns. Fast growth in trees under competitive environments is critical for light acquisition and resource capture, and slow growth is selected against and underrepresented at mature stages (27). Consistently, selection for fast growth was strongest during early seedling establishment when density-dependent mortality in trees typically occurs (38) and when the proportion of seeds that attain maturity is usually very small (6). The MPB outbreak, however, caused significant selection differentials in the opposite direction (positive selection for slow-growing phenotypes), which triggered a negative genetic response after the outbreak (Fig. 2A). Our results are consistent with studies showing that fast early growth within tree species correlates with decreased longevity (29) and increased herbivory at maturity (30), and provide strong empirical evidence of the conflicting effects of growth rates on fitness during ontogeny.

[hellip]

Our results also have important management implications. Tree improvement programs supply seed resources for managed tree plantations, and for restoration purposes after natural and human-caused disturbances (e.g., fire, severe drought, and reclamation). These programs have traditionally focused on selection on growth-related traits (52), although efforts to breed for tree resistance against insects and pathogens are currently in place (53). Our results indicate that the traditional focus on fast-growth by tree breeding programs may reduce survival under intense, unpredictable stress (54).

Raul de la Mata, Sharon Hood, and Anna Sala 2017. Insect outbreak shifts the direction of selection from fast to slow growth rates in the long-lived conifer Pinus ponderosa. PNAS. www.pnas.org/cgi/doi/10.1073/pnas.1700032114.

In order to conserve forest values that have been severely degraded over many decades of forest mismanagement on the eastside, the Forest Service must protect all available large AND old trees, especially those that are naturally fire tolerant such as Ponderosa pine, larch, sugar pine, white pine, lodgepole pine, and Douglas fir. Large trees also contribute to the canopy that helps retain moisture and shade and thereby reduces fuel desiccation and fire danger. Large trees also perform hydraulic lift whereby deep roots of large trees bring water up from deep soil horizons and during the night and make it available to plant communities with shallower root systems.

Old growth is defined by ICBEMP as:

1. Large trees for species and site.
2. Wide variation in tree sizes and spacing.
3. Accumulations of large-size dead standing and fallen trees that are high relative to earlier stages.
4. Decadence in the form of broken or deformed tops or bole and root decay.
5. Multiple canopy layers.
6. Canopy gaps and understory patchiness.

USDA/USDI. ICBEMP SDEIS. Appendix 17a [ndash] Definitions of Old Forest. https://web.archive.org/web/20161221104651/http://www.icbemp.gov/pdfs/sdeis/volume2/appendix17a.pdf. The Assessment should be inclusive in describing the character of old growth. It should not be predominantly [ldquo]park-like[rdquo] stands devoid of snags and understory. It should be much more complex.

Instead of striving for park-like single strata forests, the agency should consider working toward complex forests. Such an approach would retain all existing large and old trees, retain untreated patches at many scales, manipulate basal area as guided by PAGs, and generally tolerate more diversity in the stand. Norm Johnson and Jerry Franklin worked on a restoration plan for the Klamath Tribes former reservation which defined [ldquo]complex forests[rdquo] [mdash]

The Interforest Report defines structurally complex forests as follows: [ldquo]These are forests which retain much of the pre-management forest structure, including: 1) a large-diameter tree component (including ponderosa pine when appropriate to the site); 2) a spatially-complex pattern of stand structural units (e.g., large tree groves and open areas of dense regeneration); 3) coarse wood habitats (snags and logs); 4) a well-developed understory communities of herbs and shrubs; and 5) moderate tree stocking levels (Interforest Report 2000, p. 21).[rdquo] The goal of restoration of healthy, diverse, structurally complex forest ecosystems[rdquo] calls for the return of ponderosa pine and mixed-conifer forests of the Reservation to this structurally complex condition across the landscape.

A complex ponderosa pine forest is illustrated in Figure 1 (from the Interforest Report). Individual patches can be relatively simple, i.e., all trees of similar size, but the mosaic of different sizes and ages creates the complexity. Thus, the structural complexity is achieved through a fine-scale mosaic of relatively simple patches along with scattered large trees, snags, and down logs.

Figure 1. Canopy profile (150m x 20m) that shows the structural cross-section of a ponderosa pine forest at Bluejay Springs, Klamath Reservation Forest. Source: Interforest Report (2000). http://web.archive.org/web/20040202102340/http://klamathtribes.org/forestplan.htm [See page 49 of the report for pictures of a [ldquo]superlative[rdquo] ponderosa pine stand that needs only maintenance, not restoration.]
Timber (and the Required Roads)
Timber should be a by-product of ecological integrity. Logging for the purpose of creating timber is not sustainable given the cumulative effects of past management, private land management, and the demands of the climate crisis (in terms of both carbon storage and resilience to change).

The Assessment of timber should also address the effects of roads which are often required for no other reason than to access timber, and roads have serious adverse effects. Problems with roads/culverts include:

* Soil disturbance, erosion, compaction, loss of forest productivity
* Pollution: sedimentation, thermal loading
* Hydrologic modification: flow interception, accelerated run-off, peak flows
* Impaired floodplain function
* Barrier to movement of wood and spawning gravel
* Habitat removal
* Reduced recruitment of snags and down wood habitat
* Fragmentation: wildlife dispersal barrier
* Human disturbance, weed vector, hunting pressure, loss of snags, litter, marbled murrelet nest predation, human fire ignition, etc.
* Reduced carbon storage in adjacent and nearby forests

Science tells us that

[hellip] no truly [ldquo]safe[rdquo] threshold road density exists, but rather negative impacts begin to accrue and be expressed with incursion of the very first road segment; and 2) highly significant impacts (e.g., threat of extirpation of sensitive species) are already apparent at road densities on the order of 0.6 km/km2 (1.0 mi/mi[sup2]) or less.

Carnefix, G. and C.A. Frissell. [ldquo]Aquatic and Other Environmental Impacts of Roads: The Case for Road Density as Indicator of Human Disturbance and Road-Density Reduction as Restoration Target; A Concise Review.[rdquo] Pacific Rivers Council Science Publication (2009) 09-001. Pacific Rivers Council, Portland, OR and Polson, MT. http://pacificrivers.org/science-research/resources-publications/road-density-as-indicator

Especially in light of climate change and its interactions with the transportation system, the assessment should review and consider the information and recommendations made in the scientific literature.

The following literature review summarizes the most recent thinking related to the

environmental impacts of forest roads and motorized routes and ways to address them. The literature review is divided into three sections that address the environmental effects of transportation infrastructure on forests, climate change and infrastructure, and creating sustainable forest transportation systems.

I. Impacts of Transportation Infrastructure and Access to the Ecological Integrity of Terrestrial and Aquatic

Ecosystems and Watersheds

II. Climate Change and Transportation Infrastructure Including the Value of Roadless Areas for Climate Change Adaptation

III. Sustainable Transportation Management in National Forests as Part of Ecological Restoration

...

As climate change impacts grow more profound, forest managers must consider the impacts on the transportation system as well as from the transportation system. In terms of the former, changes in precipitation and hydrologic patterns will strain infrastructure at times to the breaking point resulting in damage to streams, fish habitat, and water quality as well as threats to public safety. In terms of the latter, the fragmenting effect of roads on habitat will impede the movement of species which is a fundamental element of adaptation.

...

Transportation infrastructure and carbon sequestration

The topic of the relationship of road restoration and carbon has only recently been explored. There is the potential for large amounts of carbon (C) to be sequestered by reclaiming roads. When roads are decompacted during reclamation, vegetation and soils can develop more rapidly and sequester large amounts of carbon. A recent study estimated total soil C storage increased 6 fold to 6.5 x 107g C/km (to 25 cm depth) in the northwestern US compared to untreated abandoned roads (Lloyd et al. 2013). Another recent study concluded that reclaiming 425 km of logging roads over the last 30 years in Redwood National Park in Northern California resulted in net carbon savings of 49,000 Mg carbon to date (Madej et al. 2013, Table 5).

The Wilderness Society. 2014. Transportation Infrastructure and Access on National Forests and Grasslands - A Literature Review. May 2014. https://www.fs.usda.gov/nfs/11558/www/nepa/96158_FSPLT3_3989888.pdf, https://www.sierraforestlegacy.org/Resources/Conservation/ProjectsPlans/ForestPlanRevisions/SFL%20et%20al.%20FPR%20comments%20part%205%20of%205.pdf.

Road networks are also associated with reduced carbon storage in adjacent and nearby forests. Hu, X., Zhang, L., Ye, L., Lin, Y. & Qiu, R. Locating spatial variation in the association between road network and forest biomass carbon accumulation. Ecol. Indic. 73, 214[ndash]223 (2017). https://www.sciencedirect.com/science/article/abs/pii/S1470160X16305738.

Science indicates that the erosion from roads is far worse than that from severe fire.

Colombaroli, D. and D.G. Gavin. 2010. Highly episodic fire and erosion regime over the past 2000 years in the Siskiyou Mountains, Oregon. Proceedings of the National Academy of Sciences of the United States of America 107: 18909-18914. http://www.pnas.org/content/early/2010/10/13/1007692107.full.pdf. This should be part of the Assessment weighing the relative risks from fire vs the effects of logging and roads.

The ICBEMP analysis found that roads have a disproportionate impacts on aquatic and terrestrial systems.

A good example of combined departures [from historic range of variability] is roads on BLM- and FS-administered lands. Road surface area in itself only accounts for 2 percent of the BLM- and FS-administered lands. However, because of the linear pattern across the contour and connected effects on aquatic and terrestrial systems the affected area is approximately 65 percent. [hellip] Road density was found to be indirectly correlated with: (1) the distribution and spread of exotic plants, (2) many forest composition and structural changes, (3) efficacy of fire suppression activities, and (4) the probability of fire occurrence due to human caused ignitions. In forest systems, roads were associated with timber-management practices and thus correlated with the transition of shade-intolerant to shade-tolerant species, the loss of late-seral structures, reduced densities of large trees and snags, and increased fuel loadings. In rangeland systems, roads appear to function as vectors for dispersing exotic species. Regardless of the biophysical setting, roads appear to increase the efficacy of fire-suppression activities. [hellip] Subbasins having the highest forest integrity values were largely unroaded [hellip] Conversely, subbasins [hellip] that had been intensively roaded, typically had the lowest forest integrity [hellip]

[hellip]

Major decreases in pool habitat have been caused by two factors: the loss of riparian vegetation, and road and highway construction accompanying human

activities (such as timber harvest, grazing, and farming). Most notably, pool frequency (large pools and all pools) is inversely correlated with road density and management intensity. [hellip] The amount of fine sediment (sediment less than

6 mm) on channel beds is another important aspect of habitat quality that apparently is influenced by management. The results of our analysis indicate

road density significantly affects surface fines and corroborates the link between forest management practices and channel sediment characteristics. [hellip] [T]he proportion [of strong salmonid populations] declines with road density. [hellip]

Roads and Associated Activity

Roads contribute to the disruption of hydrologic function and increase sediment delivery to streams. Roads also provide access, and the activities that accompany access magnify their negative effects on aquatic habitats. Activities associated with roads include fishing, recreation, timber harvest, livestock grazing, and agriculture. Roads also provide avenues for stocking non-native fishes. Unfortunately, we do not have adequate broad-scale information on many of these attendant effects to accurately identify their component contributions. Thus we are forced to use roads as a catch-all indicator of human disturbance.

The discussion of the relationship of roads to fishes often centers around three themes: 1) the belief that road-building practices have improved enough in the last decade that we should not worry about their effects on aquatic systems; 2) the legacy of past road building is so vast and road maintenance budgets so low that the problems will be with us for a long time; and 3) the belief that there is not a strong correlation between road density and fish habitat and population.

From an intensive review of the literature, we conclude that increases in sedimentation are unavoidable even using the most cautious reading methods. Roads combined with wildfires accentuate the risk from sedimentation. The amount of sediment or hydrologic alteration from roads that streams can tolerate before there is a negative response is not well known. It is not fully known which causes greater risk to aquatic systems: building roads to reduce fire risk or realizing the potential risk of fire. More research is needed in this area.

The ability of the Forest Service and Bureau of Land Management to conduct road maintenance has been sharply reduced because of declining budgets. This is resulting in progressive degradation of road drainage structures and a potential increase in erosion. Most problems are with older roads that are located in sensitive terrain and roads that have been essentially abandoned, but are not adequately configured for long-term drainage. Given the magnitude of the area of federal forests with moderate to high road densities, the job of road maintenance will be expensive. Most road networks have not been inventoried to determine influence on riparian or aquatic resource goals and objectives.

We conducted two analyses examining the correlation of roads to habitat and fish population status. Each of these analyses support the general conclusion that increasing road density correlates with declining aquatic habitat conditions and aquatic integrity. Our results clearly show that increasing road densities (combined with the activities associated with roads) and their attendant effects are associated with declines in the status of four nonanadromous salmonid species. Those species are less likely to use moderate to highly roaded areas for spawning and rearing, and if found are less likely to be at strong population levels. There is a consistent and unmistakable pattern based on empirical analysis of thousands of combinations of known species status and subwatershed conditions. The analysis is limited primarily to forested lands managed by the Forest Service and Bureau of Land Management.

[hellip]

Designated wilderness and potentially unroaded areas are important anchors for [salmonid] strongholds throughout the Basin. More than 8 million hectares (27%) of Forest Service and BLM lands in the Basin contain strongholds (40% of Forest Service and 4% of BLM). These stronghold subwatersheds contain large areas of unroaded land (about 4.7 million hectares), averaging 58 percent of the area of an individual subwatershed.

Quigley, Thomas M.; Arbelbide, Sylvia J., tech. eds. 1997. An assessment of ecosystem components in the interior Columbia basin and portions of the Klamath and Great Basins: volume 1. Gen. Tech. Rep. PNW-GTR-405. Portland, OR.
http://www.fs.fed.us/pnw/publications/pnw_gtr405/pnw_gtr405_06.pdfhttp://www.fs.fed.us/pnw/publications/pnw_gtr405/pnw_gtr405_07.pdf. We would be kidding ourselves to think that [ldquo]modern road practices[rdquo] avoid these problems, because the described effects seem to be mostly inherent and unavoidable outcomes of roads.

EPA describes the impacts of roads as follows:

Stormwater discharges from logging roads, especially improperly constructed or maintained roads, may introduce significant amounts of sediment and other pollutants into surface waters and, consequently, cause a variety of water quality impacts. [hellip] [S]ilviculture sources contributed to impairment of 19,444 miles of rivers and streams [nationwide]. [hellip] forest roads can degrade aquatic ecosystems by increasing levels of fine sediment input to streams and by altering natural streamflow patterns. Forest road runoff from improperly designed or maintained forest roads can detrimentally affect stream health and aquatic habitat by increasing sediment delivery and stream turbidity. This can adversely affect the survival of dozens of sensitive aquatic biota (salmon, trout, other native fishes, amphibians and macroinvertebrates) where these species are located. Increased fine sediment deposition in streams and altered streamflows and channel morphology can result in increased adult and juvenile salmonid mortality where present (e.g., in the Northwest and parts of the East), a decrease in aquatic amphibian and invertebrate abundance or diversity, and decreased habitat complexity.

The physical impacts of forest roads on streams, rivers, downstream water bodies and watershed integrity have been well documented but vary depending on site-specific factors. Improperly designed or maintained forest roads can affect watershed integrity through three primary mechanisms: they can intercept, concentrate, and divert water (Williams, 1999).

EPA 2012. Notice of Intent To Revise Stormwater Regulations [hellip] Federal Register. May 23, 2012.
http://www.gpo.gov/fdsys/pkg/FR-2012-05-23/pdf/2012-12524.pdf.

The Assessment says that timber suitability will be addressed later in the planning process. Why not now? The assessment phase seems like a good time. To help ensure that timber production is sustainable, the

Assessment should describe ecosystem character, provision of ecosystem services, diversity of species, carbon storage, etc in areas that have been logged versus those that have been unlogged. The Suitability Analysis should exclude timber production where logging has (or is likely to) degrade conditions.

The Forest Management and Timber Assessment finds [ldquo]High levels of net growth combined with low levels of harvest removals, non-commercial thinning, and forest fuels reduction increases the risk of high severity disturbance long-term to timber resource as well as ecosystem health.[rdquo] This is misleading in several ways. Forest growth actually makes forests more resilient to fire and benefits forest health in a variety of ways, such as:

* Not all fuels are created equal. Some might tend to increase fire hazard, while others actually tend to reduce fire hazard;
* When trees grow it raises tree height and canopy height, so the fine fuels are held above the ground where most fires occur;
* Dense canopy also cause self-pruning that raises canopy base height
* Increasing bark thickness adds fire resistance;
* Increasing canopy density helps maintain a cool, moist microclimate that is less conducive to fire,
* Dense canopy reduces wind speed under the canopy which reduces fire rate of spread;
* Dense canopy helps suppress the growth of surface and ladder fuels and reduces the cost of fuel maintenance;
* Dense forest creates beneficial habitat for a variety of species that prefer dense forests or forests with more dead wood
* Competitive mortality thins the forest for free without roads and with greater carbon retention;
* Competitive mortality creates snag habitat that is in short supply;

Retaining and recruiting abundant dead wood is a natural process of critical important that is adversely affected by logging. The Assessment should describe this effect and it[rsquo]s implications on the forests of the Blue Mountains.

The presence of coarse woody debris is critical for biodiversity conservation. [hellip] In general, post-fire forest ecosystems include the presence of large numbers of snags and downed woody debris. This dead material provides important habitat elements for many species of plants and animals, while also storing a great deal of carbon (MacDonald 1993; Fleming and Freedman 1998; Freedman et al. 1996). Clearcut harvesting of natural forests results in the removal of most of the aboveground woody biomass from the site because trees are the commodity being harvested. [hellip] Because clearcut harvesting concentrates on the removal of biomass, it fails to produce large-dimension snags and coarse-woody debris in intensively managed forests, [hellip] Although both harvesting and wildfire kills trees, only fire leaves them as dead standing biomass. [hellip] The fire-killed snags and woody debris cast partial shade, which ameliorates the surface microclimate and may enhance the survival of pine seedlings (Fraser and Farrar 1953; Cayford and McRae 1983; Carleton and MacLellan 1994). [hellip] Some studies have suggested that the cover and richness of the understorey vegetation of a natural forest may never fully recover from clearcutting. [hellip] Wildfires reduce the presence of some hosts that assist the spread of pests and pathogens while clearcutting may promote them. [hellip] [E]xclusion of fire from such ecosystems, along with forestry practices that leaves young infected trees in the residual stand, leads to increased abundance of this parasite. In contrast, fire eliminates Dwarf mistletoe. [hellip] Numerous studies have determined the potential removals of nutrients with conventional and whole-tree clearcuts [hellip] The data show that clearcutting removes large amounts of biomass and nutrients from the site, and that these are equivalent to a substantial fraction of the site capita of these materials. [hellip] During a wildfire, biomass capital of the stand is lost by combustion, as is that of nitrogen through the oxidation of organic compounds and the release of gaseous NO and NH_3. In intense wildfires these losses of biomass and nitrogen can be comparable in magnitude to what would be removed by the clearcutting of comparable stands. Unlike wildfire, however, clearcutting also removes large amounts of phosphorus, potassium, calcium, and magnesium contained in the tree biomass; these materials are mostly conserved in situ during a wildfire. [hellip] Clearcut harvesting with heavy equipment can cause severe soil compaction along skidding lanes and it can also disrupt soil profiles by churning [hellip]

Permanent roads are not generally associated with wildfire management or suppression (although temporary access routes may be constructed while fighting some wildfires). An extensive road network is, however, necessary for timber harvesting and subsequent stand management. Roads affect biodiversity in many ways. Roads directly remove natural habitat, alter drainage and stream dynamics, cause erosion, introduce edge effects, fragment contiguous ecosystems, alter species movements, and act as corridors for the introduction of non-native species [hellip]. Road density is a useful indicator of ecological threat [hellip] [I]t is erroneous to assume that forest harvesting plays the same ecological role as wildfire.

D.J. McRae, L.C. Duchesne, B. Freedman, T.J. Lynham, and S. Woodley, 2001. Comparisons between wildfire and forest harvesting and their implications in forest management. Environ. Rev. 9. 223-260 (2001); DOI: 10.1139/er-9-4-223.

Foresters like to think that regen logging mimics natural processes like fire, but this is far from the case, because logging removes so much more biomass than fire. Fire leaves abundant legacies that offer some late successional habitat value, even in the young stands that dominate in the decades after fire. This is not the case with regen logging which removes much more biomass and disproportionally removes the large legacy components. This causes a much more abrupt spatial and temporal transition/ fragmentation between young and old forests. Logging also causes much more significant soil disturbance, especially compaction and displacement, from roads, landings, skidding and yarding logs, and unusually hot slash fires. This spreads weeds, harms the below-ground ecosystem, degrades site productivity, and causes erosion. Regen combined with replanting and roads also causes very atypical hydrologic disruption, including artificial peak flows immediately after the first several storms following logging, and artificial low flows during summer for several decades following establishment of dense tree plantations.

[ldquo]Key attributes[rdquo] of high quality early seral habitat include [ldquo]exceptionally high quantities of large dead wood,[rdquo] a condition that is not provided by commercial timber harvest that exports the vast majority of wood from the site. [ldquo][P]rompt reforestation and few legacies is unlikely to approximate the role of naturally generated early-seral conditions[rdquo] M.E. Swanson Mark E. Swanson, Nichole M. Studevant, John L. Campbell, Daniel C. Donato. 2014. Biological associates of early-seral pre-forest in the Pacific Northwest. Forest Ecology and Management 324 (2014) 160[ndash]171. http://www.sierraforestlegacy.org/Resources/Conservation/Biodiversity/BD-Swanson-etal-EarlySeral2014.pdf.

Although many existing silvicultural systems have been designed to mimic stand-scale natural disturbances, McRae et al. (2001) and Palik et al. (2002) remind us that natural disturbances are inherently different from those of silviculture. One difference, of course, relates to the amount of carbon removed from the site when harvesting a forest. Removals tend to be much greater with harvesting than for fire, for example. Fire tends to create a complex mosaic of forest types and ages on the landscape. Forest harvesting, as commonly practiced, tends to simplify forest composition and structure.

Crow, T.R. and A.J. Perera. 2004. Emulating natural landscape disturbance in forest management [ndash] an introduction. Landscape Ecology 19: 231-233. http://www.firescience.gov/projects/01-1-3-43/project/01-1-3-43_01_1_3_43_Deliverable_02.pdf

The assessment should disclose that timber production requires roads, which have serious adverse effects on soil, water, and wildlife.

In terms of sedimentation, it is the forest roads that may have the most signi?cant impact because of the constant source of sediment they can provide over the life time of the road network. When all attributes are considered it appears that [clearcutting] does not emulate wild?re and may have a more detrimental impact on headwater systems in both the short and long-term. [hellip] Overall, the results suggest that harvesting does not emulate wild?re, particularly [clearcutting]. [hellip] It is important for forest managers to consider the complex affects that harvest treatments can have on headwater systems if they are going to successfully practice ecosystem management and achieve sustainable forest management. It is also important for managers to understand that there are many other attributes to be considered. In particular, the ability of harvest treatments to emulate wild?re in regards to peak ?ows, organic matter inputs, large woody debris recruitment, channel morphology, and stream biota response. Due to the inability to statistically analyse these attributes they were not incorporated into the scope of this paper.

Nitschke C.R. 2005. Does forest harvesting emulate ?re disturbance? A comparison of effects on selected attributes in coniferous-dominated headwater systems. Forest Ecology and Management 214 (2005) 305[ndash]319.
http://www.sierraforestlegacy.org/Resources/Conservation/FireForestEcology/FireScienceResearch/FuelsManagement/FM-Nitschke05.pdf

The production of timber must mitigate for adverse effects to wildlife.

From a wildlife perspective, stand-replacing fires and timber harvesting both represent major disturbances which significantly alter habitats [hellip] Despite their similarities, fire and logging differ in several of the habitat conditions they procure for wildlife. Wildfires, especially when severe, generate large amounts of standing (eventually downed) dead trees including large ones which represent an important habitat and food source for many wildlife species (Drapeau et al. 2002; Pedlar et al. 2002). [hellip] [T]he spatial variability of fire severity creates various amounts of green or mixed-severity stands over the burned landscape (e.g., Kafka, Gauthier, and Bergeron 2001; Smyth et al. 2005), which represent important refuge sites for some wildlife species (Norton and Hannon 1997; Tittler and Hannon 2000; Lance and Phinney 2001; Tittler, Hannon, and Norton 2001). Contrarily, clearcut harvesting removes most of the large live trees, leaves few standing deadwood, and retains variable amounts of non-commercial trees and understory vegetation. [hellip] All studies directly comparing bird assemblages in burned and harvested stands reported an important divergence in bird assemblages, especially for the first years following disturbance (Hutto 1995; Schulte and Niemi 1998; Hobson and Schieck 1999; Imbeau, Savard, and Gagnon 1999; Schieck and Hobson 2000; Morissette et al. 2002; Simon, Schwab, and Otto 2002). One of the most striking differences lies in the abundance of the snag-associated guild in post-fire stands. [hellip] [H]igh snag densities are clearly missing in harvested stands (Schulte and Niemi 1998; Pedlar et al. 2002; Simon, Schwab, and Otto 2002). Concordantly, Imbeau, Savard, and Gagnon (1999) found no resident and cavity-nesting species in recent clearcuts, where little retention (green or dead trees) has been left on site. Similarly, Hobson and Schieck (1999) found very distinct assemblages between burned and harvested forests, a difference that was partly explained by the dominance of several snag-associated species. These major differences in the abundance of snag-associated species are of particular importance considering that several of these have been identified as the most sensitive to the long-term effects of forestry (Imbeau, M[ouml]nkk[ouml]nen, and Desrochers 2001). [hellip] The magnitude of the initial divergence and eventual convergence in bird communities between fire and harvesting may greatly depend on the level of residual vegetation (Schieck and Hobson 2000). Schieck and Hobson (2000) found that bird assemblages from larger patches within disturbed stands supported more species from older forests than smaller ones. In contrast, bird communities from smaller patches (within cut blocks vs. burned stands) mainly reflected the surrounding post-disturbance communities, therefore showing the same initial divergence in bird assemblages between post-fire and post-harvest stands reported by Hobson and Schieck (1999). Nonetheless, over time these small patch communities also became more similar to those inhabiting mature fire origin forests and hence converged as succession proceeded (although some differences still persisted up to 60 years after disturbance). [hellip] Early after disturbance, most stand-level attributes differ between harvesting and wildfire. Structurally, young post-fire stands are characterized by more snags and less downed woody debris than young post-harvest stands. [hellip] Biodiversity elements significantly differ between burned and logged sites. Early after disturbance, significant differences in understory vascular and non-vascular community composition are commonly reported. Faunal assemblages, be they mammals, invertebrates, or birds, all seem to respond differently initially to harvesting- and wildfire-induced disturbances. [hellip] At the stand scale, while most forest attributes are different early after disturbance between burned and logged stands, the majority of these converge a few decades after fire. A few exceptions are to be noted, though. [hellip] [W]hile faunal communities do become less different as time passes, late in succession some species present in burned stands are either significantly less abundant or absent in similarly aged logged stands. [hellip] Post-fire salvage logging affects ecological processes, biological legacies, and the abundance of species commonly encountered only after fire. Removal of fire-killed trees can affect tree regeneration, understory composition, the abundance and distribution of dead wood, wildlife habitat, and soil properties. [hellip] At the landscape scale, the most important difference between fire and harvesting regimes is the distribution of stand age classes. The proportion of stands older than the rotation period (usually 100 yrs) tends toward zero under a fully regulated harvesting regime, while it is around 37% under a fire regime of similar rotation period. This results in a significant loss of over-mature forests in managed landscapes, potentially affecting organisms that are often associated with such stands.

NCASI. 2006. Similarities and differences between harvesting- and wildfire-induced disturbances in fire-mediated Canadian landscapes. Technical Bulletin No. 924. Research Triangle Park, N.C.: National Council for Air and Stream Improvement, Inc. http://landscape.zoology.wisc.edu/People/Simard/NCASI924.pdf

Salvage logging is particularly adverse impacts on species diversity and ecosystem services. There has been a lot of new science on the adverse effects of salvage logging since the last forest plan was adopted. Natural forest recovery without salvage logging creates numerous desired effects, including complex early seral forest which provides diverse food for diverse wildlife, retention of old growth legacy structures which help old growth species persist in the burned landscape, carbon retention, etc. The Assessment should highlight the benefits of natural recovery after disturbance, and the adverse effects of salvage logging.

Carbon Storage/Emissions

The Assessment should address carbon Stocks, Influences on those stocks, Ecosystem Services of carbon storage (e.g., climate stability), and the Influence of the Plan Area on Social, Cultural, and Economic Conditions in the Broader Landscape. The Assessment of Air quality also needs to be addressed as a climate issue. Every ton of carbon emitted contributes to a [ldquo]load exceedance[rdquo] of the global airshed.

The carbon stocks assessment finds [ldquo]Increasing the resilience of national forests and grasslands to disturbances is important in maintaining or improving their carbon stability over the long term.[rdquo] This reveals that the Forest Service has created a new goal for forest carbon that is actually contrary to the paramount need for forest carbon storage and reduced logging related emissions. The fact is thatstabilizing forest carbon is not a climate solution.

"Stabilizing" forest carbon is becoming a buzzword and a new goal for forest management, but it is NOT a climate solution. In order to address the global climate crisis, we need to reduce atmospheric carbon at the global scale, not stabilize forest carbon at the local scale. This is because Earth[rsquo]s atmosphere is well-mixed. It does not matter if forest carbon booms and busts at the scale of stands or even landscapes. What matters is the total amount of carbon in the atmosphere, which is the net result of both carbon emissions in some locations, and carbon uptake in the rest of the living landscape that is still growing. From a climate perspective, it might make more sense to let forests grow and accumulate carbon in vegetation and soils (let forest carbon boom), even if it is not considered "sustainable" over the long term because it will eventually burn (the carbon might go bust), because every day/week/month/year that carbon stays in forests and soils is a day/week/month/year with less solar forcing.

The goal of stabilizing carbon is especially suspect when the proposed activities required to stabilize carbon themselves emit carbon. The first problem is that emissions come first and alleged carbon benefits from avoided disturbance are delayed. This time lag conflicts with the urgent need to avoid emissions and store carbon in the near term.

The second problem is that the carbon emissions from efforts to stabilize carbon very likely exceed the carbon [ldquo]savings[rdquo] from those stabilizing actions. This is because it is impossible to predict where or when natural destabilizing events such as wildfire might occur. Only a small fraction of deliberate actions taken to stabilize forest carbon will actually interact with natural disturbance events and provide carbon benefits. Most individual efforts to stabilize carbon will cause carbon emissions without any offsetting carbon benefits, so collectively, efforts to stabilize carbon will emit more carbon than just letting forest carbon accumulate, and eventually boom and bust.

Some forests may be storing more carbon than the carbon carrying capacity projected under climate change. Such forests are providing a great climate service to humanity (as well as great benefits to threatened & endangered species that rely on such forests), especially in the short-term, while the global need to reduce GHG emissions is most urgent. There are significant trade-offs related to any proposal to artificially remove medium and large trees from carbon-rich forests in order to help them match their projected carbon carrying capacity. We must carefully consider the cumulative effects of doing so across large areas, because it would cause tremendous additional and unneeded GHG emissions.

Logging proponents often claim that logging will increase carbon storage in the forest by limiting carbon emissions caused by natural processes such as fire and insect-induced mortality. This is simply counter-factual. In most cases, managing forests in an effort to control natural processes that release carbon will only make things worse by releasing MORE carbon. This is mostly because no one can predict where fire or insects will occur, so the treatments must be applied to broad landscapes, yet the probability of fire or insects at any given location remains low, and only a small fraction of the treated areas will actually experience fire or insects. As a result, many acres will be treated "unnecessarily" and therefore the cumulative carbon emissions from logging to control fire and insects (plus the carbon emissions from fire and insects that occur in spite of control efforts) are greater than emissions from fire and insects alone. A careful analysis shows that logging to control fire and expecting to increase carbon storage is analogous to rolling a die and expecting to roll a six every time.

This is an example of the [ldquo]base rate fallacy[rdquo] or [ldquo]neglecting priors[rdquo] from Bayesian statistics. The probability of a forest NOT burning are far greater than the probability of a forest burning. Attempts to address a problem that is unlikely to occur, such as by thinning a forest that is unlikely to burn, runs a high risk that unintended negatives effects will overwhelm beneficial effects.
https://en.wikipedia.org/wiki/Base_rate_fallacy

[T]here is no guarantee that thinning across vast landscapes will stabilize carbon stores. Rather the best available scientific study has shown that thinning reduces carbon stores more than fire itself and reduces carbon stores whether or not fire burns that particular forest.

Law, B. 2021. Response to Questions for the Record, attached to Statement Of Dr. Beverly Law, Professor Emeritus, Oregon State University, Before The United States House Of Representatives, Subcommittee On National Parks, Forests And Public Lands, April 29, 2021, Concerning [ldquo]Wildfire In A Warming World: Opportunities To Improve Community Collaboration, Climate Resilience, And Workforce Capacity[rdquo]
https://naturalresources.house.gov/imo/media/doc/Law,%20Beverly%20-%20Testimony%20-%20NPFPL%20Ov%20Hrg%2004.29.21.pdf (link to Statement, without Response to Questions).

The 2018 US Forest Service Northwest Forest Plan Science Synthesis concluded that fuel reduction is unlikely to be an effective climate mitigation strategy.

Some studies from other regions in the Western United States (i.e., the Southwest and Sierra Nevada) suggest that thinning and fuel reduction can mitigate carbon loss from fire. Fuel reduction may reduce losses of carbon at stand levels compared with the consequences of high-severity wildfire burning in stands with high fuel loads (Finkral and Evans 2008; Hurteau and North 2009; Hurteau et al. 2008, 2011, 2016; North and Hurteau 2011; North et al. 2009, Stephens et al. 2009). However, because the probability of treated areas burning is generally low (Barnett et al. 2016), and most biomass is not consumed by fire, slight differences in losses resulting from combustion in fire compared with losses from fuel reduction are unlikely to make fuel reduction a viable mitigation strategy (Ager et al. 2010, Campbell et al. 2012, Kline et al. 2016, Mitchell et al. 2009, Restaino and Peterson 2013, Spies et al. 2017).

USDA 2018. Synthesis of Science to Inform Land Management Within the Northwest Forest Plan Area. General Technical Report. PNW-GTR-966 Vol. 1. June 2018. https://www.fs.fed.us/pnw/pubs/pnw_gtr966_vol1.pdf.

Law & Harmon (2011) conducted a literature review and concluded [hellip]

Thinning forests to reduce potential carbon losses due to wildfire is in direct conflict with carbon sequestration goals, and, if implemented, would result in a net emission of CO_2 to the atmosphere because the amount of carbon removed to change fire behavior is often far larger than that saved by changing fire behavior, and more area has to be harvested than will ultimately burn over the period of effectiveness of the thinning treatment.

Law, B. & M.E. Harmon 2011. Forest sector carbon management, measurement and verification, and discussion of policy related to mitigation and adaptation of forests to climate change. Carbon Management 2011 2(1).
https://content.sierraclub.org/ourwildamerica/sites/content.sierraclub.org.ourwildamerica/files/documents/Law%20and%20Harmon%202011.pdf.

Bartowitz et al (2022) found

[hellip] [S]ome recent policies have proposed diameter increases in fuel reduction strategies. While the primary goal is fire risk reduction, these policies have been interpreted as strategies that can be used to save trees from being killed by fire, thus preventing carbon emissions and feedbacks to climate warming. This interpretation has already resulted in cutting down trees that likely would have survived fire, resulting in forest carbon losses that are greater than if a wildfire had occurred. [hellip] [H]arvest of mature trees releases a higher density of carbon emissions (e.g., per unit area) relative to wildfire (150[ndash]800%) because harvest causes a higher rate of tree mortality than wildfire. Our results show that increasing harvest of mature trees to save them from fire increases emissions rather than preventing them. [hellip] On public lands, management aimed at less-intensive fuels reduction (such as removal of [ldquo]ladder[rdquo] fuels, i.e., shrubs and small-diameter trees) will help to balance reducing catastrophic fire and leave live mature trees on the landscape to continue carbon uptake.

[hellip]

Many new policy discussions on fire and forest management are being based upon the misconception that harvest will protect forests from mortality and carbon loss (Executive Order, 2018; Zinke, 2018; Infrastructure Investment and Jobs Act, 2021; Newhouse, 2021), and decrease fire risk (Forest Climate Action Team, 2018; Figure 1) despite substantial uncertainty over long-term impacts to forest climate resilience (i.e., forest treatments may decrease forest resilience in the era of climate change). Our results and the majority of full-carbon accounting studies conclude that any type of harvest (logging or commercial thinning) decreases forest carbon storage (Law et al., 2013), and this research shows harvest emits more carbon per unit area than fire at all scales [hellip]

[hellip] Locations with high-harvest rates and carbon dense forests, such as the Pacific Northwest United States, see higher carbon losses from harvest than fire compared to areas in the Southwest United States with low harvest rates and carbon sparse forests (e.g., Oregon versus Arizona). Forest management needs to be specific to forest type and region; old-growth and wet forests in the Northwest are best left preserved while dry, fire-prone forests or areas in the Wildland Urban Interface benefit from fire risk-reduction strategies like small-diameter thinning and prescribed fires (Law et al., 2018; Case et al., 2021). Inclusion of specific diameter limits in policy for

public lands could help prevent large-diameter tree removal and subsequent unintended consequences.

[hellip] The most effective forest management strategy to protect forest carbon stocks on public lands is to preserve forests through decreased harvest and thinning, lengthened harvest rotations, increased proportion of long-term wood products, reduced harvest and mill waste, and working toward afforestation and reforestation (Hudiburg et al., 2013; Law et al., 2018; Buotte et al., 2020; Figure 1).

Bartowitz KJ, Walsh ES, Stenzel JE, Kolden CA and Hudiburg TW (2022) Forest Carbon

Emission Sources Are Not Equal: Putting Fire, Harvest, and Fossil Fuel Emissions in Context. Front. For. Glob. Change 5:867112. doi: 10.3389/ffgc.2022.867112.
https://www.frontiersin.org/articles/10.3389/ffgc.2022.867112/full

Campbell and Agar (2013) conducted a sensitivity analysis and found robust results indicating that fuel reduction does not increase forest carbon storage.

[hellip] we attempt to remove some of the confusion surrounding this subject by performing a sensitivity analysis wherein long-term, landscape-wide carbon stocks are simulated under a wide range of treatment efficacy, treatment lifespan, fire impacts, forest recovery rates, forest decay rates, and the longevity of wood products. Our results indicate a surprising insensitivity of long-term carbon stocks to both management and biological variables. After 80 years, [hellip] a 1600% change in either treatment application rate or efficacy in arresting fire spread resulted in only a 10% change in total system carbon. This insensitivity of long-term carbon stocks is due in part by the infrequency of treatment/wildfire interaction and in part by the controls imposed by maximum forest biomass. None of the fuel treatment simulation scenarios resulted in increased system carbon.

Campbell, J, Agar, A (2013) Forest wildfire, fuel reduction treatments, and landscape carbon stocks: A sensitivity analysis. Journal of Environmental Management 121 (2013) 124-132
http://fes.forestry.oregonstate.edu/sites/fes.forestry.oregonstate.edu/files/PDFs/Campbell_2013_JEM.pdf.

Before attributing carbon benefits to fuel reduction logging please consider the conclusions of:

* John L Campbell, Mark E Harmon, and Stephen R Mitchell. 2011. Can fuel-reduction treatments really increase forest carbon storage in the western US by reducing future fire emissions? Front Ecol Environ 2011; doi:10.1890/110057 http://forestpolicypub.com/wp-content/uploads/2011/12/campbell-2011.pdf. (Results suggest that the protection of one unit of C from wildfire combustion comes at the cost of removing three units of C in fuel treatments.)
* Mitchell, Harmon, O[rsquo]Connell. 2009. Forest fuel reduction alters fire severity and long-term carbon storage in three Pacific Northwest ecosystems. Ecological Applications. 19(3), 2009, pp. 643[ndash]655. http://www.fs.fed.us/pnw/pubs/journals/pnw_2009_mitchell001.pdf. ([ldquo][hellip]reducing the fraction by which C is lost in a wildfire requires the removal of a much greater amount of C, since most of the C stored in forest biomass (stem wood, branches, coarse woody debris) remains unconsumed even by high-severity wildfires. For this reason, all of the fuel reduction treatments simulated for the west Cascades and Coast Range ecosystems as well as most of the treatments simulated for the east Cascades resulted in a reduced mean stand C storage[hellip]. We suggest that forest management plans aimed solely at ameliorating increases in atmospheric CO2 should forego fuel reduction treatments [hellip][rdquo])
* Reinhardt, Elizabeth, and Lisa Holsinger 2010. Effects of fuel treatments on carbon-disturbance relationships in forests of the northern Rocky Mountains. Forest Ecology and Management 259 (2010) 1427[ndash]1435. http://www.fs.fed.us/rm/pubs_other/rmrs_2010_reinhardt_e002.pdf ([ldquo]Although wildfire emissions were reduced by fuel treatment, the fuel treatments themselves produced [carbon] emissions, and the untreated stands stored more carbon than the treated stands even after wildfire. [hellip] Our results show generally long recovery times [hellip][rdquo])

* Law, B. & M.E. Harmon 2011. Forest sector carbon management, measurement and verification, and discussion of policy related to mitigation and adaptation of forests to climate change. Carbon Management 2011 2(1). https://content.sierraclub.org/ourwildamerica/sites/content.sierraclub.org.ourwildamerica/files/documents/Law%20and%20Harmon%202011.pdf ([ldquo]Thinning forests to reduce potential carbon losses due to wildfire is in direct conflict with carbon sequestration goals, and, if implemented, would result in a net emission of CO2 to the atmosphere because the amount of carbon removed to change fire behavior is often far larger than that saved by changing fire behavior, and more area has to be harvested than will ultimately burn over the period of effectiveness of the thinning treatment.[rdquo])
* Restaino, Joseph C.; Peterson, David L. 2013. Wildfire and fuel treatment effects on forest carbon dynamics in the western United States. Forest Ecology and Management 303:46-60. http://www.fs.fed.us/pnw/pubs/journals/pnw_2013_restiano001.pdf ([ldquo][hellip] C costs associated with fuel treatments have can exceed the magnitude of C reduction in wildfire emissions, because a large percentage of biomass stored in forests (i.e., stem wood, branches, coarse woody debris) remains unconsumed, even in high-severity fires (Campbell et al., 2007; Mitchell et al., 2009). [hellip] Wildfire occurrence in a given area is uncertain and may never interact with treated stands with reduced fire hazard, ostensibly negating expected C benefits from fuel treatments. Burn probabilities in treated stands in southern Oregon are less than 2%, so the probability that a treated stand encounters wildfire and creates C benefits is low (Ager et al., 2010).)[rdquo]
* Goslee, K., Pearson, T., Grimland, S., Petrova, S., Walls, J., Brown, S., 2010. Final Report on WESTCARB Fuels Management Pilot Activities in Lake County, Oregon. California Energy Commission, PIER. DOE Contract No.: DE-FC26-05NT42593. http://uc-ciee.org/downloads/Fuels_Management_LakeCo.pdf; AND Pearson, T.R.H., Goslee, K., Brown, S., 2010. Emissions and Potential Emission Reductions from Hazardous Fuel Treatments in the WESTCARB Region. California Energy Commission, PIER. CEC-500-2014-046. http://www.energy.ca.gov/2014publications/CEC-500-2014-046/CEC-500-2014-046-AP.pdf. (Summarized by Restaino & Peterson (2013) as follows: [ldquo]Pearson et al. (2010) and Goslee et al. (2010) developed methodologies to evaluate C dynamics associated with fuel treatment projects in low to mid-elevation forest in northern California and Oregon. The authors, with consultation from teams of scientists, quantify C storage and release within the context of a six-point conceptual framework: annual fire risk, treatment emissions, fire emissions, forest growth and re-growth, re-treatment, and the shadow effect (i.e., treatment effect outside the treated area). Results indicate that the mean annual probability of wildfire for the study region is less than 0.76%/year, and treatments reduce C stocks by an average of 19%. Where timber is removed, 30% of extracted biomass is stored in long-lasting wood products. Wildfire emissions in treated stands, quantified with the Fuel Characteristic Classification System, are reduced by 6% relative to untreated stands. Growth estimates for a 60-year simulation horizon, derived from FVS, indicate that in the absence of wildfire, untreated stands sequester 17% more C than treated stands. However, in simulations that include wildfire, treated stands sequester 63% more C than untreated stands. The shadow effect is unlikely to be large enough to affect net GHG emissions. In summary, initial reductions in C stocks (e.g., thinning), combined with low annual probability of wildfire, preclude C benefits associated with fuel treatments, even if harvest residues are used for biomass energy.[rdquo])
* Chiono, Lindsay 2011. Balancing the Carbon Costs and Benefits of Fuels Management. Research Synthesis for Resource Managers. Joint Fire Science Program Knowledge Exchange. http://static1.squarespace.com/static/545a90ede4b026480c02c5c7/t/5527ebd9e4b0f620d0cb5b58/1428679641640/CFSC_Chiono_Carbon_and_Fuel_Mngmt.pdf ([ldquo][T]he net carbon impact of fuel treatments is further complicated by the probabilistic nature of wildfire occurrence and the impermanence of post-treatment stand conditions [hellip] [T]reatment activities produce an immediate carbon emission while future wildfire emissions are uncertain [hellip] Depending on the intensity of treatment, the quantity of carbon removed may be substantial enough to negate gains from avoided wildfire emissions. [hellip] cumulative emissions from fuels reduction activities repeated in order to maintain low hazard conditions over time can overwhelm avoided wildfire emissions, resulting in a net carbon loss.[rdquo])
* Dina Fine Maron 2010. FORESTS: Researchers find carbon offsets aren't justified for removing understory (E&E Report 08/19/2010, reporting on the WESTCARB Project) https://pacificforest.org/pft-in-the-media-2010-climatewire-8-19-10.html. ([ldquo][rsquo]The take-home message is we could not find a greenhouse gas

benefit from treating forests to reduce the risk of fire,[rsquo] said John Kadyszewski, the principal investigator for the terrestrial sequestration projects of the West Coast Regional Carbon Sequestration Partnership. WESTCARB, ... Since there is a relatively low risk of fire at any one site, large areas need to be treated -- which release their own emissions in the treatment process. The researchers have concluded that the expected emissions from treatments to reduce fire risk exceed the projected emissions benefits of treatment for individual projects.[rdquo])

* Rachel A. Loehman, Elizabeth Reinhardt, Karin L. Riley 2014. Wildland fire emissions, carbon, and climate: Seeing the forest and the trees [ndash] A cross-scale assessment of wildfire and carbon dynamics in fire-prone, forested ecosystems. Forest Ecology and Management 317 (2014) 9[ndash]19. http://www.fs.fed.us/rm/pubs_other/rmrs_2014_loehman_r001.pdf ([ldquo][hellip] management of carbon in fire-prone and fire-adapted forests is more complex than simply minimizing wildfire carbon emissions and maximizing stored carbon in individual stands. The stochastic and variable nature of fires, the relatively fine scale over which fuels treatments are implemented, and potentially high carbon costs to implement them suggest that fuel treatments are not an effective method for protecting carbon stocks at a stand level (Reinhardt et al., 2008; Reinhardt and Holsinger, 2010).[rdquo])
* Jim Cathcart, Alan A. Ager, Andrew McMahan, Mark Finney, and Brian Watt 2009. Carbon Benefits from Fuel Treatments. USDA Forest Service Proceedings RMRS-P-61. 2010.
* Chiono, L. A., D. L. Fry, B. M. Collins, A. H. Chatfield, and S. L. Stephens. 2017. Landscape-scale fuel treatment and wildfire impacts on carbon stocks and fire hazard in California spotted owl habitat. Ecosphere 8(1):e01648. 10.1002/ecs2.1648. http://onlinelibrary.wiley.com/doi/10.1002/ecs2.1648/full ([ldquo]We used a probabilistic framework of wildfire occurrence to (1) estimate the potential for fuel treatments to reduce fire risk and hazard across the landscape and within protected California spotted owl (Strix occidentalis occidentalis) habitat and (2) evaluate the consequences of treatments with respect to terrestrial C stocks and burning emissions. Silvicultural and prescribed fire treatments were simulated on 20% of a northern Sierra Nevada landscape in three treatment scenarios [hellip] [A]ll treatment scenarios resulted in higher C emissions than the no-treatment scenarios.[rdquo])
* Stenzel, J. E., Berardi, D. B., Walsh, E. S., & Hudiburg, T. W. (2021). Restoration thinning in a drought-prone Idaho forest creates a persistent carbon deficit. Journal of Geophysical Research: Biogeosciences, 126, e2020JG005815. https://doi.org/10.1029/2020JG005815 ([ldquo]Forest thinning in a young ponderosa pine plantation resulted in observed and modeled decreases in ecosystem and forest sector carbon storage over unmanaged control plots through the year 2050. Despite increased tree-level production and water use in a location characterized by growing season drought stress, this study affirms inherent site tradeoffs between individual tree vigor and stand carbon storage over time. We estimate that thinned plot carbon stocks will return to prethinned levels by 2035 (Figure 6), but forest sector carbon parity (Mitchell et al., 2012) with untreated plots will not occur by 2050 and therefore represents a relative carbon source to the atmosphere in the absence of disturbance. [hellip][A] carbon deficit relative to control remained due to the removal of [sim]40% of live ecosystem carbon as well as the subsequent release of [sim]60% of removed biomass by 2050. Despite the continued storage of a portion of removed biomass in long-lived wood products, large immediate and short-term emissions were associated with slash combustion, on-site decomposition, and short-term product chain emissions (i.e., waste and paper), and do not represent avoided emissions through 2050. A multidecadal ecosystem biomass (i.e., carbon) deficit following moderate and heavy partial harvest is supported by most analyses of mid to long-term thinning structural impacts (James et al., 2018; Zhou et al., 2013), [hellip][rdquo]).
* Harmon, M.E.; Hanson, C.T.; DellaSala, D.A. Combustion of Aboveground Wood from Live Trees in Megafires, CA, USA. Forests 2022, 13, 391. https://doi.org/10.3390/f13030391; https://www.mdpi.com/1999-4907/13/3/391/pdf ([ldquo]Biomass combustion is a major biogeochemical process, but uncertain in magnitude. We examined multiple levels of organization (twigs, branches, trees, stands, and landscapes) in large, severe forest fires [hellip] [C]ombustion rates are very low overall at the stand (0.1%[ndash]3.2%) and landscape level (0.6%[ndash]1.8%), because large trees with low combustion rates comprise the majority of biomass, and high severity fire patches are less than half of the area burned. Our findings of low live wood combustion rates have important implications for policies related to wildfire emissions and forest management.[rdquo]).
* John W Coulston et al 2023. Near-term investments in forest management support long-term carbon

sequestration capacity in forests of the United States, PNAS Nexus (2023). DOI: 10.1093/pnasnexus/pgad345 (pdf). ([ldquo]Fuel treatments are designed to temporarily reduce carbon from forests through thinning, prescribed fire, or other mechanical means, and under a fuel high-treatment (FHT) scenario [10-50% of basal area removed] (Fig. 1D), 288 MMT of aboveground carbon will be removed from western forests by 2032 (Fig. 2B). Under a fuel low-treatment (FLT) scenario [10-25% of basal area removed] (Fig. 1D), 194 MMT of carbon will be removed (Fig. 2B). The fuel-treatment scenarios have two additional short-term (2022[ndash]2032) effects: (i) lost sequestration potential from live tree removal and (ii) decreased wildfire carbon emissions (Fig. 2B). [hellip] Results for the fuel-treatment scenarios suggest a negative mitigation potential in the near-term largely due to the removal of live trees. In the longer term, projections suggest a positive, but small, mitigation potential largely due to increased growth of thinned stands and reduced fire mortality. Under the FHT scenario, in 2032, projections suggest a [minus]31 MMT yr[minus]1 mitigation potential, indicating that forests would have less net annual carbon accumulation with the fuel treatments. Conversely, by 2050, the FHT fuel treatments may lead to a +6 MMT yr[minus]1 mitigation potential (about 4.5% of current flux). These results highlight that carbon accumulation through net forest growth is unlikely to offset carbon removal and loss of sequestration potential from fuel treatments in the near term. In the longer term, the treatments may lead to small increases in annual accumulation rates due to avoided wildfire emissions and improved growth in thinned forests. However, the projected cumulative 2022[ndash]2050 carbon sequestered under the FLT and FHT scenarios is 200 and 310 MMT less, respectively, than the baseline (Fig. 2D), indicating a reduced capacity of US forests to offset emissions from other sectors over the projection period.[rdquo])

Roadless/Wilderness

Unroaded/unmanaged areas represent significant key ecosystem characteristics and are an important element of the natural range of variability that require special attention in the assessment. As required by the NFMA planning rules, the assessment must address wilderness potential, but it must also go beyond that to inventory ecologically significant unroaded areas smaller than 5,000 acres, and assess the wide range of ecosystem services provided by such areas. Best science indicates that unroaded areas 1,000 acres and larger are ecologically significant and there are compelling rationales supporting their protection.

The Designated Areas Report identifies the problem of crowding in wilderness. One way to address that is to recommend more wilderness! It[rsquo]s not rocket science. We are concerned that the Forest Service has been downplaying the wilderness inventory in recent public meetings. The Forest Service should also refrain from suggesting that there has been a lot of negative public reaction to wilderness when the agency has not completed its public review processes (barely started in in fact.) And finally, we must emphasize that these are NATIONAL forests, and the Forest Service must represent the interests of the entire nation, not just the noisy locals who often fail to operate in good faith from a factual basis.

It is important for the assessment to recognize and disclose impacts to wilderness values AS WELL AS other unique values provided disproportionately by large unroaded/unmanaged areas. The analysis of effects to wilderness values must not be blurred with effects on other roadless values, and the analysis of effects on roadless values must not be blurred with effects on the degraded values provide on previously managed areas.

Wilderness is just one among many reasons to protect unroaded areas. The FS needs to recognize that unroaded areas provide disproportionate public values such as clean water, biodiversity, carbon storage, resilience to climate change, recreation, and scenery. Watson et al (2018) [ndash]

[hellip] summarize published evidence that intact forests support an exceptional confluence of globally significant environmental values relative to forests that have experienced those damaging human actions. We show that intact forests are indispensable not only for addressing rapid anthropogenic climate change, but also for confronting the planet[rsquo]s biodiversity crisis, providing critical ecosystem services and supporting the maintenance of human health. We then show that the relative value of intact forests is likely to become magnified as already-degraded forests experience further intensified pressures (including anthropogenic climate change).

[hellip] [I]ntact forest protection can typically secure very high environmental values with often relatively low implementation and opportunity costs, which serves to reinforce the need for their direct inclusion in global environmental accords. [hellip]

[hellip] The increasing significance of intact forests

The differences in important environmental and social values of intact forests relative to degraded forests are likely to become magnified in the future due to two negative processes in degraded areas: progressive anthropogenic damage and reduced resilience to environmental change.

[hellip]

Retaining the integrity of intact forest ecosystems should be a central component of proactive global and national environmental strategies, alongside current efforts aimed at halting deforestation and promoting reforestation.

[hellip] An essential first step towards greater success is achieving widespread recognition that rapid loss of forest intactness represents a major threat to sustainable development and human well-being. Policymakers need to understand the challenge that the loss of forest intactness represents for achieving strategic goals outlined in key multilateral environmental agreements, including the Convention of Biological Diversity, the UNFCCC and the UN Sustainable Development Goals139,143, and this recognition needs to be translated into meaningful changes on the ground.

A fundamental constraint to progress is the fact that international definitions of forests have not differentiated among types of forest and, in most policy settings, they treat all forests, regardless of their condition, as equivalent1,144. As such, international policy processes seldom acknowledge the special qualities and benefits that flow from intact ecosystems as compared with those that are

degraded.

[hellip] There is evidence that the designation of [lsquo]roadless areas[rsquo] in the USA, for example, has led to an effective expansion in the degree of ecoregional representation under protection and increases in the number of areas big enough to provide refugia for species needing large tracts relatively undisturbed by people.

[hellip]

Conclusion

There are still significant tracts of forest that are free from the damaging impacts of large-scale human activities. These intact forests typically provide more environmental and social values than forests that have been degraded by human activities. [hellip] The practical tools required to address this challenge are generally well understood and include well-located and managed protected areas, indigenous territories that exemplify sound stewardship regulatory controls and responsible behaviour by logging, mining, and agricultural companies and consumers, and targeted restoration. Currently these tools are insufficiently applied, and inadequately supported by governance, policy and financial arrangements designed to incentivize conservation. Losing the remaining intact forests would exacerbate climate change effects through huge carbon emissions and the decline of a crucial, under-appreciated carbon sink. It would also result in the extinction of many species, harm communities worldwide by disrupting regional weather and hydrology, and devastate the cultures of many indigenous communities. Increased awareness of the scale and urgency of this problem is a necessary pre-condition for more effective conservation efforts across a wide range of spatial scales.

Watson, Evans, Venter et al 2018. The exceptional value of intact forest ecosystems. Nature Ecology &

Evolution (2018) https://www.nature.com/articles/s41559-018-0490-x

Oregon Wild has conducted a citizen inventory of unroaded areas 1,000 acres and larger. Oregon Wild conducted such an inventory as follows:

Oregon Wild[rsquo]s Citizen Roadless Inventory is shown on interactive statewide map available at http://www.oregonwild.org/explore-oregon/oregon-wild-map-gallery by following the link for [ldquo]All Potential Forest Wilderness.[rdquo] We generally define these areas as those that meet the criteria for inventoried roadless areas set forth by the USFS but based on new science showing the significant ecological values of unroaded areas >1,000 acres, we applied the criteria to federal land areas over 1,000 acres. They are generally in fairly good shape with no substantial/obvious logging, development, or roads.

These areas have wilderness qualities and may qualify for Wilderness protection. There are many other significant values that make these areas worthy of special attention including (but not limited to) their value as places where natural processes can do the ecological work and as a control to experiments (intentional and otherwise) being done across a landscape dominated by human activities including commercial logging, mining, grazing, road building, and other development.

The Forest Service defines unroaded areas as any area without the presence of classified roads, and of a size and configuration sufficient to protect the inherent characteristics associated with its roadless condition. http://web.archive.org/web/20010729111100/http://roadless.fs.fed.us/documents/feis/glossary.shtml. While we refer to Forest Service guidelines in identifying these areas, FS inventories such as RARE II are not the final word. In addition to errors made during the inventory, there are a number of exclusionary biases in defining potential wilderness area's and the roadless inventory. Furthermore, science has evolved since that time to recognize significant ecological value in areas than 5,000 acres.

To identify these areas, Oregon Wild started with a GIS query. Using the most current data layers available for existing roads, we identified all polygons >1,000 acres bounded by those roads. Using GIS layers, we excluded non-federal lands, clearcuts, and heavy thins. We then used aerial images to further refine boundaries based on obvious developments, roads, quarries, and other logging areas not previously identified. We then recruited volunteers to [ldquo]adopt[rdquo] candidate unroaded areas and ground-truth them to the extent possible by adding and subtracting areas based on ground reconnaissance. While not every area has been ground-truthed, we update the inventory as we receive information from individuals and agencies during project planning and at other times. Our inventory of unroaded areas is a work-in-progress with a fairly high level of accuracy.

The GIS files showing the results of our inventory are attached (or sent under separate cover, if the agency comment portal does not accept kmz files). Please consider our input in the Forest Service inventory of both potential wilderness, AND other unroaded areas.

Large intact expanses of unfragmented habitat were once quite common but are now rare. Species evolved in the context of the large habitat patches that result from the natural disturbance regime. As just one important example, big game need large patches of security cover which is best provided by large unroaded areas. New science confirms that roads and logging tend to be contagious on the landscape (managed areas beget more management until little remains unmanaged), so to conserve the habitat values associated with wild places we have to prevent the first intrusions. The purpose and need for this plan amendment should include protecting and restoring large unroaded areas consistent with the natural range of variability. This goal is just as important as goals related to tree density or species composition that the agency too often relies on to justify logging and road building.

Secretary of Agriculture Tom Vilsack recognizes the value of National Forest roadless areas: [ldquo]Roadless areas preserve essential watersheds and help ensure an abundant supply of clean drinking water. These large areas of undisturbed forests provide diverse habitats for sensitive and endangered wildlife. In addition, roadless areas provide other critical ecological services, such as carbon storage, and operate as effective barriers to invasive species, while also providing social values such as scenic landscapes and a host of recreational opportunities. Let me assure you that USDA and the Forest Service will move forward to conserve and protect these lands and meet all legal obligations.[rdquo] March 11, 2009 letter to Oregon Governor Ted Kulongoski.

The Assessment should discuss whether management actions have push the landscape toward or away from the natural range of variability for large-scale habitat patches. Landscape analysis based on historic disturbance patterns suggests that historically the majority of old forest occurred in large patches. See Wimberly, M. 2002. Spatial simulation of historical landscape patterns in coastal forests of the Pacific Northwest. Can. J. For. Res. 32:13-16-1328 (2002) http://andrewsforest.oregonstate.edu/pubs/pdf/pub2859.pdf (72% of the total mature forest in the Oregon Coast Range was concentrated in patches >1,000 ha). These large patches of older forests that native fish and wildlife species evolved with are now severely underrepresented on the forest landscape and must be protected and restored.

In considering the natural range of variability for unroaded/unmanaged areas, the FS should conduct an analysis like the Northwest Forest Plan LSOG Effectiveness Monitoring Plan which says that [ldquo]perhaps 80 percent or more [of the historic late-successional old-growth forest] would probably have occurred as relatively large (greater than 1,000 acres) areas of connected forest.[rdquo] Miles Hemstrom, Thomas Spies, Craig Palmer, Ross Kiester, John Teply, Phil McDonald, and Ralph Warbington; Late-Successional and Old-Growth Forest Effectiveness Monitoring Plan for the Northwest Forest Plan, USFS General Technical Report PNW-GTR-438; December 1998; http://www.fs.fed.us/pnw/pubs/gtr_438.pdf. Currently, these 1,000 acre and larger patches are rare on the landscape.

Also, consider the conclusions and recommendations of the interagency Road Density Analysis Task Team:

Unroaded and low road density areas potentially represent areas in which the aquatic ecosystems are still operating with minimal human disturbances. Areas like these that provide for high quality habitat and stable fish populations are important refugia and a cornerstone of most species conservation strategies.

[hellip]

Even well engineered roads act as conduits for sediment (Filipek 1993). Lee et al. (1997), also note that although improvements in road construction and logging methods can reduce sediment delivery to streams, sedimentation increases are unavoidable even when using the most cautious logging and construction methods.

As stated in the Biological Opinion for bull trout (USFWS 1998), there is no positive contribution from roads to physical or biological characteristics of watersheds. Under present conditions, roads represent one of the most pervasive impacts of management activity to native aquatic communities and listed fish species.

[hellip]

RDAT Recommendation (4): The Regional Executives provide direction to the field units that allow for road construction in undesignated low road density areas only after completion of the mid/fine scale analysis of these areas.

Regional Executive Decision: While we agree that avoiding road construction in low road density areas with high to very high fish values may be desirable, we also recognize that providing direction precluding such development could conflict in some instances with our legal obligations under laws such as the Alaska National Interest Lands Conservation Act (ANILCA) and the 1872 Mining Laws. Rather than totally precluding such development, the BLM State Directors and Regional Foresters, through this transmittal letter, direct field units as follows:

A. Avoid new road construction in low road density areas to the extent practical, consistent with existing authorities and LRMPs, but keep in mind that in some cases the need to remove hazardous fuels may be paramount for long term watershed restoration,

B. Decisions to allow new road construction in low road density areas should not be made without an assessment of environmental effects, including any changes to the value of the low road density area as a current or potential stronghold for listed aquatic species. This assessment and/or analysis should also consider the amount of acreage within the watershed already in Wilderness and inventoried roadless areas, and

C. Where new road development in low road density areas cannot be avoided, road location and design should minimize effects to aquatic resources and incorporate practical mitigation measures, including closure or decommissioning of the road if the need for the road is temporary.

Land Management Recommendations Related to The Value of Low Road Density Areas In the Conservation of Listed Salmon, Steelhead, and Bull Trout: A Commitment made as part of the Biological Opinions For Chinook Salmon and Steelhead (Snake River and upper Columbia River) and Bull Trout (Columbia and Klamath Rivers-areas not covered by the Northwest Forest Plan); Final Report; January 30, 2002; Prepared by the: Road Density Analysis Task Team.

http://web.archive.org/web/20021123151942/http://www.blm.gov/nhp/efoia/or/FY2002/IB/ib-or-2002-134.htm.

The Forest Service should follow its internal guidance (effective 1/30/2015) for [ldquo]broad and inclusive[rdquo] identification of potential wilderness, and public involvement in that process. The FS Planning Handbook says:

The primary function of the inventory step is to efficiently, effectively, and transparently identify all lands in the plan area that may have wilderness characteristics as defined in the Wilderness Act.

The inventory is intended to be reasonably broad and inclusive, based on the inventory criteria set out in this section and additional information provided to the Responsible Official through the required opportunities for public and government participation (sec. 70.61 of this Handbook). The intent is to identify lands that may be suitable, so that they can be evaluated and to allow for public input and feedback [hellip]

[hellip]

Include in the inventory areas that contain the following road improvement attributes if the areas also meet the other inventory criteria[hellip]

1. Areas that contain forest roads maintained to level 1;
2. Areas with any routes that are decommissioned, unauthorized or temporary, or forest roads that are identified for decommissioning in a previous decision document, or identified as likely unneeded in a travel management plan [hellip]

[hellip]

f. Areas with historical wagon routes, historical mining routes, or other settlement era transportation features considered part of the historical and cultural landscape of the area.

[hellip]

[The following developments should also be included in the inventory]

2. Vegetation treatments that are not substantially noticeable.

3. Timber harvest areas where logging and prior road construction are not substantially noticeable.

4. Permanently installed vertical structures, such as electronic installations that support television, radio, telephone, or cellular communications, provided their impacts, as well as their maintenance and access needs, are minimal.

5. Areas of mining activity where impacts are not substantially noticeable.

[hellip]

10. Lands adjacent to development or activities that impact opportunities for solitude. The fact that nonwilderness activities or uses can be seen or heard from within any portion of the area, must not, of itself, preclude inclusion in the inventory. It is appropriate to extend boundaries to the edges of development for purposes of inclusion in the inventory.

[hellip]

The Responsible Official shall ensure that the Interdisciplinary Team documents the evaluation [hellip] The intent is to ensure that the process for inventory and evaluation is transparent and accessible to the public for input and feedback.

[hellip]

Evaluate the degree to which the area has outstanding opportunities for solitude or for a primitive and unconfined type of recreation. The word [ldquo]or[rdquo] means that an area only has to possess one or the other. The area does not have to possess outstanding opportunities for both elements, nor does it need to have outstanding opportunities on every acre.

2012 Planning Rule Directives. FSH 1909.12- Chapter 70 [ndash] Wilderness.
http://www.fs.usda.gov/detail/planningrule/home/?cid=stelprd3828310

The International Union for Conservation of Nature (2020) recognizes [ldquo]While primary forests of all extents have conservation value, areas of greater extent warrant particular attention where they persist, as they support more biodiversity, contain larger carbon stocks, provide more ecosystem services, encompass larger-scaled natural processes, and are more resilient to external stresses. The significance of large areas of primary forests has been highlighted by the global mapping of Intact Forest Landscapes (IFL) greater than 500 km2 in extent. While suitable for many purposes, other thresholds may be more suitable at regional and national levels that reflect local ecological factors.[rdquo] IUCN Policy Statement on Primary Forests,
https://www.iucn.org/sites/dev/files/content/documents/iucn_pf-ifl_policy_2020_approved_version.pdf.

An international group of scientists has identified a diverse array of important values provided by roadless areas, including:

ROADLESS AREAS - biodiversity conservation

* Preservation of native biodiversity

* Barrier against invasive species
* Preservation of genetic resources
* Maintenance of ecosystem connectivity and integrity
* Ensure habitat for viability of populations
* Provide migration corridors and stopovers

ROADLESS AREAS - ecosystem services

* Water regulation and supply
* Erosion control
* Air quality
* Climate regulation
* Disease control (e.g. Lyme disease)
* Pollination of crops
* High resilience to pest outbreak
* Recreation
* Education and scientific value

ROADLESS AREAS - climate change

* High resilience and buffering capacity
* Protection against catastrophic events (e.g. fires, landslides, floods)
* Carbon sequestration and decrease of greenhouse gases effects
* Support species adaptation

2016 Roadless Initiative / Centre for Economics and Ecosystem Management, http://www.roadless.online/roadless-areas/ And conserving roadless areas is an efficient and economical way to meet many of these goals. PRESS RELEASE, Hyderabad, India, 18 October 2012, Protecting Roadless Areas: Meeting the Nagoya targets in a cost efficient and effective way http://www.roadless.online/wp-content/download/docs/Press%20Release%20Protecting%20Roadless%20Areas%20COP11%20CBD.pdf. Impacts to these values should be carefully evaluated before logging, road building, or using heavy equipment in roadless areas.

World Wildlife Fund and the Conservation Biology Institute summarized the important attributes of small roadless areas (1,000-5,000 acres).

Small roadless areas share many of attributes in common with larger ones, including:

[bull] Essential habitat for species key to the recovery of forests following disturbance such as herbaceous plants, lichens, and mycorrhizal fungi

[bull] Habitat refugia for threatened species and those with restricted distributions (endemics)

[bull] Aquatic strongholds for salmonids

[bull] Undisturbed habitats for mollusks and amphibians

[bull] Remaining pockets of old-growth forests

[bull] Overwintering habitat for resident birds and ungulates

[bull] Dispersal [ldquo]stepping stones[rdquo] for wildlife movement across fragmented landscapes

DellaSala, Dominick and James Strittholt. 2002. Scientific Basis For Roadless Area Conservation. World Wildlife Fund. Ashland, OR; Conservation Biology Institute. (June 2002 - Updated October 2003) https://d2k78bk4kdhbpr.cloudfront.net/media/reports/files/Scientific_Basis_For_Roadless_Area_Conservation.pdf .

Scientific recognition of the importance of [ldquo]small[rdquo] roadless areas in the Columbia Basin goes back at to 1994 when several scientific societies submitted a report to Congress and the President recommending conservation of roadless areas larger than 1,000 acres. This report is described by the Interior Columbia Ecosystem Management Project as a [ldquo]Major Stud[y] of Eastside Ecosystems and Management.[rdquo]

Because roads crisscross so many forested areas on the Eastside, existing roadless regions have enormous ecological value. [hellip] Although roads were intended as innocuous corridors to ease the movement of humans and commodities across the landscape, they harm the water, soils, plants, and animals in those landscapes. [p 6]

[hellip]

4. Do not construct new roads or log within existing (1) roadless regions larger than 1000 acres or (2) roadless regions smaller than 1000 acres that are biologically significant.

Roadless regions constitute the least-human-disturbed forest and stream systems, the last reservoirs of ecological diversity, and the primary benchmarks for restoring ecological health and integrity. Roads fragment habitat; alter the hydrological properties of watersheds; discharge excessive sediment to streams; increase human access and thus disturbance to forest animals; and influence the dispersal of plants and animals, especially exotic species, across the landscape. Because many forested areas in eastern Oregon and Washington are heavily dissected by roads, the ecological value of existing roadless regions is especially high. [pp 8, 202]

[hellip]

Our analysis defined a roadless region as any region where all points within an LS/OG stand were at least 100 meters from a road or trail.

[hellip]

What remains of ponderosa pine and Douglas fir LS/OG is the least protected today. In the four national forests within the Blue Mountains, 48% of the land base above 6000 feet lies in wilderness areas, whereas only 10% of the land below 6000 feet, where ponderosa pine occurs, receives such protection [hellip] [p 110]

[hellip] Fifth, roads, whose impact on aquatic and terrestrial resources is well documented, are widely distributed in eastside forests. Road densities in western Colville, Winema, and Ochoco National Forests average 2.5, 3.5, and 3.7 miles per square mile, respectively. Densities reach 8.8 and 11.9 miles per square mile in some watersheds. In the national forests of Oregon's Blue Mountains (Table 5.2), less than 10% of roadless regions on slopes steeper than 60% are now protected, less than 15% on slopes of 30-60%. Moreover, roadless regions, like LS/OG patches, are extensively fragmented. In northern Ochoco National Forest, nearly one-third (38,882 acres) of 128,140 acres of roadless region consists of patches smaller than 1000 acres. (RARE II surveys underestimated total roadless area in this region [45,700 acres] because they considered only areas larger than 5000 acres.) [p 110]

[hellip]

CONCLUSIONS

Watersheds outside wilderness and roadless regions in eastern Oregon and Washington are highly degraded. Without an intensive restoration effort on federal and private lands, many native aquatic stocks and species risk extinction. [p 160]

[hellip]

Because the distribution of many native fishes in Oregon's national forests has receded into steep headwater areas, USPS has a vital role in protecting the few remaining watershed refugia and preventing further damage to already degraded habitats downstream. Critical to securing eastside [aquatic diversity areas] ADAs as aquatic refugia are the remaining roadless regions, sources of large wood from LS/OG forests, and the integrity of riparian corridors on national forestlands. [p 168]

[hellip]

7. High road densities harm many forms of wildlife.

The ecological integrity of existing LS/OG patches and other roadless regions can only be maintained if these sites are not disturbed by the construction of roads. Roadless regions serve as critical refuges for terrestrial wildlife sensitive to human disturbance. Road densities in LS/OG patches that already have roads should be reduced to less than 1 mi/mi2. Achieving this goal is vital to rehabilitation of eastside fisheries and terrestrial resources. [p 197]

Henjum, M.G., J.R. Karr, D.L. Bottom, D.A. Perry, J.C. Bednarz, S.G. Wright, S.A. Beckwitt and E. Beckwitt. 1994. Interim Protection for Late-Successional Forests, Fisheries, and Watersheds: National Forests East of the Cascade Crest, Oregon and Washington. A Report to the Congress and President of the United States. Eastside Forests Scientific Society Panel.

A few years late, 136 scientists wrote to President Clinton, saying:

There is a growing consensus among academic and agency scientists that existing roadless areas[ndash]irrespective of size[ndash]contribute substantially to maintaining biodiversity and ecological integrity on the national forests. The Eastside Forests Scientific Societies Panel, including representatives from the American Fisheries Society, American Ornithologists[rsquo] Union, Ecological Society of America, Society for Conservation Biology, and The Wildlife Society, recommended a prohibition on the construction of new roads and logging within existing (1) roadless regions larger than 1,000 acres, and (2) roadless regions smaller than 1,000 acres that are biologically significant[hellip]. Other scientists have also recommended protection of all roadless areas greater than 1,000 acres, at least until landscapes degraded by past management have recovered[hellip]. As you have acknowledged, a national policy prohibiting road building and other forms of development in roadless areas represents a major step towards balancing sustainable forest management with conserving environmental values on federal lands. In our view, a scientifically based policy for roadless areas on public lands should, at a minimum, protect from development all roadless areas larger than 1,000 acres and those smaller areas that have special ecological significance because of their contributions to regional landscapes.

Letter to President Clinton from 136 scientists (Dec. 10, 1997).

https://drive.google.com/file/d/0B4L_-RD-MJwrRzhFcm5QcFR0MHM/view?usp=sharing&resourcekey=0-2-sbGMN3bOUBQGGMDBQM1Q

Kun et al (2020) highlight the importance of unmanaged forests as carbon sinks.

The most effective means for keeping carbon out of the atmosphere to meet climate goals is to protect primary forests (Mackey et al. 2020) and continue growing secondary forests to accumulate additional carbon (proforestation) (Moomaw et al. 2019) while reducing emissions from all sources including bioenergy. [hellip] The importance of primary (unlogged) forests lies in the magnitude and longevity of their carbon stock. In order to reverse the decreasing forest carbon stocks in Europe (EEA, 2019), the largest forest carbon stores must be protected and additional forests must be allowed to continue accumulating carbon (proforestation).

Kun, Z., DellaSala, D., Keith, H., Kormos, C., Mercer, B., Moomaw, W.R. and Wiezik, M. (2020), Recognising the importance of unmanaged forests to mitigate climate change. GCB Bioenergy. Accepted Author Manuscript. doi:10.1111/gcbb.12714 https://onlinelibrary.wiley.com/doi/pdfdirect/10.1111/gcbb.12714. See also, William R. Moomaw, Susan A. Masino, and Edward K. Faison. 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; https://www.frontiersin.org/articles/10.3389/ffgc.2019.00027/full.

Scientists recognize tremendous co-benefits from conserving large blocks of unmanaged forests, such as climate mitigation and biodiversity conservation.

Based on the species[ndash]area relationship, regarded as one of ecology[rsquo]s few universal laws, protection of [too] little habitat will condemn thousands of species to extinction if habitat outside them is converted, degraded or lost. It is this logic that underpins calls for [lsquo]Nature Needs Half[rsquo] [26], together with an understanding that ecosystem processes and services of the scale needed to sustain the well-being of life on Earth require large wildlife populations and huge expanses of intact and restored habitat. ... Climate change adds a new dimension to the question of how much protected area coverage is needed to assure conservation of wild nature. Climate change is already reducing wildlife population sizes and forcing range shifts as conditions alter [28,29]. Protected areas counter such stresses by building up populations, and connectivity of populations and habitats is emerging as a key property in securing species persistence and resilience to rapid change [5]. Hence networked protected areas, especially where embedded within well-managed land or seascapes, provide crucial stepping stones to accommodate range shifts and, where no further movements are possible, refuges of last resort [5]. Analyses suggest that adequate levels of population viability and connectivity can be achieved only with marine protected area coverages of 30% or more [27]. ... [G]iven that many ecosystems are already degraded, ensuring continued provision of ecosystem services requires not only the precautionary protection of currently intact habitats, but also large-scale habitat restoration.

Providing greater space for recovery of intact, vibrant nature is not altruistic conservation, but is, we argue, an indispensable act of self- preservation, producing a cascade of benefits that will help maintain the habitability of the biosphere as the climate changes, thereby securing the well-being of generations to come.

Roberts CM, O[rsquo]Leary BC, Hawkins JP. 2020 Climate change mitigation and nature conservation both require higher protected area targets. Phil. Trans. R. Soc. B 375: 20190121. http://dx.doi.org/10.1098/rstb.2019.0121. See also, Soto-Navarro C et al. 2020 Mapping co-benefits for carbon storage and biodiversity to inform conservation policy and action. Phil. Trans. R. Soc. B 375: 20190128. http://dx.doi.org/10.1098/rstb.2019.0128 showing the congruence of high carbon value and high biodiversity value in PNW forests.

Law et al (2022) make a strong case that conservation of intact forests advances the twin goals of protecting the climate and biodiversity, and that broad-scale thinning to reduce fire severity conflicts with climate and biodiversity goals.

[ldquo]While primary forests of all extents have conservation value, areas of greater extent warrant particular

attention where they persist, as they support more biodiversity, contain larger carbon stocks, provide more ecosystem services, encompass larger-scaled natural processes, and are more resilient to external stresses. The significance of large areas of primary forests has been highlighted by the global mapping of Intact Forest Landscapes (IFL) greater than 500 km2 in extent. While suitable for many purposes, other thresholds may be more suitable at regional and national levels that reflect local ecological factors.[rdquo] (IUCN Policy Statement on Primary Forests, https://www.iucn.org/sites/dev/files/content/documents/iucn_pf-ifl_policy_2020_approved_version.pdf, accessed on 22 April 2020).

[hellip]

Instead of regularly harvesting on all of the 70% of U.S. forest land designated as [ldquo]timberlands[rdquo] by the U.S. Forest Service, setting aside sufficient areas as Strategic Reserves would significantly increase the amount of carbon accumulated between now, 2050 and 2100, and reestablish greater ecosystem integrity, helping to slow climate change and restore biodiversity. The 2022 IPCC AR6 report stated that [ldquo]Recent analyses, drawing on a range of lines of evidence, suggest that maintaining the resilience of biodiversity and ecosystem services at a global scale depends on effective and equitable conservation of approximately 30% to 50% of Earth[rsquo]s land, freshwater and ocean areas, including currently near-natural ecosystems (high confidence).[rdquo] Continuing commercial timber harvest on a portion of the remaining public lands and tens of millions of hectares of private lands would continue to adequately supply a sustainable forestry sector.

Preserving and protecting mature and old forests would not only increase carbon stocks and growing carbon accumulation, they would slow and potentially reverse accelerating species loss and ecosystem deterioration, and provide greater resilience to increasingly severe weather events such as intense precipitation and flooding.

[hellip]

Many of the existing forest management practices allegedly protect forests and homes from wildfire and are having severe adverse effects on forest ecosystem integrity and resilience, and are worsening climate change and diminishing biodiversity.

[hellip]

To summarize, harvest-related emissions from thinning are much higher than potential reduction in fire emissions. In west coast states, overall harvest-related emissions were about 5 times fire emissions [hellip]

Law, Beverly E., William R. Moomaw, Tara W. Hudiburg, William H. Schlesinger, John D. Sterman, and George M. Woodwell. 2022. Creating Strategic Reserves to Protect Forest Carbon and Reduce Biodiversity Losses in the United States. Land Vol. 11, no. 5: 721. https://doi.org/10.3390/land11050721, https://www.mdpi.com/2073-445X/11/5/721/htm.

Law et al (2022) describe a strategic reserve approach to protect water, biodiversity, and carbon in Oregon[rsquo]s forests. Existing unroaded areas could make a significant contribution to such an approach.

Our study demonstrated that Oregon has high carbon density forests that also have high biodiversity and connectivity for species movement. When these characteristics were prioritized within each ecoregion, it identified sufficient forestland to meet both the 30% protection by 2030 and 50% by 2050 targets that are important nationally and internationally. [hellip] the climate resilience rank highlights large areas within the ecoregions with larger landscape features that are important for resilience (Figure 2D), such as the topography of mountain ranges in southwest Oregon, the Coast Range, Cascades, and Blue Mountains in the northeast. [hellip] Meeting the forest preservation targets would substantially increase protection of tree carbon stocks, animal and tree species[rsquo] habitat, and surface drinking water source areas. [hellip] Meeting these forest preservation targets would substantially increase forest habitat protection for threatened and endangered (T&E) species and other species of interest [hellip] Mitigation strategies need to explicitly protect existing oldgrowth forests, and allow mature secondary forests to regrow to their carbon capacity. For climate mitigation using natural climate solutions, effectiveness is based on the time that a unit of biomass carbon is resident in a forest ecosystem stock and thus kept out of the atmosphere (K[ouml]rner, 2017; Mackey et al., 2020). [hellip] We also found that limiting harvest to half of current levels on public lands and doubling harvest cycles to 80 years on private lands was three times more effective as a land use strategy than replanting and reforestation after cutting within current forest boundaries in Oregon (Law et al., 2018). [hellip] There is concern that protecting areas that are vulnerable to increased drought and fire will be ineffective, however, species diversity, and threatened and endangered species still need habitat, refugia and connectivity with other protected areas. Wildfires tend to be patchy, and a majority of trees survive low to mixed-severity fires (Halofsky et al., 2011) that can be critical habitat, and burned forests still retain the vast majority of their carbon (Hudiburg et al., 2009; Law et al., 2018). [hellip] Older forests in Oregon[rsquo]s watersheds exhibit greater water retention and improved late summer stream flows compared to managed plantations (Segura et al., 2020). Intact forests also tend to harbor more large and old trees, bolstering carbon stores and biodiversity services that large trees provide (Lutz et al., 2018; Plumtre et al., 2021). [hellip] The most important action Oregon can take to mitigate climate change, reduce biodiversity losses, and protect watersheds for drinking water is to set aside existing forests.

Law BE, Berner LT, Mildrexler DJ, Bloemers RO and Ripple WJ (2022) Strategic reserves in Oregon[rsquo]s forests for biodiversity, water, and carbon to mitigate and adapt to climate change. Front. For. Glob. Change 5:1028401. doi: 10.3389/ffgc.2022.1028401. https://www.frontiersin.org/articles/10.3389/ffgc.2022.1028401/pdf.

The importance of conserving unroaded areas is highlighted by the finding that forest fragmentation in the U.S. continues to increase. Riitters et al (2012) compared the decline in total forest area to the decline in interior forest conditions from 2001 to 2006 at 5 spatial scales and found that interior forest is declining faster than total forest at all spatial scales, with greater losses in the largest spatial scales.

Riitters, K.H. & Wickham, J.D. (2012) Decline of forest interior conditions in the conterminous United States. Sci. Rep. 2, 653; DOI:10.1038/srep00653.
https://www.srs.fs.fed.us/pubs/ja/2012/ja_2012_riitters_002.pdf.

The Blue Mountains planning assessment should include an inventory of unroaded areas and their ecosystem characteristics, an analysis showing whether unroaded areas are shrinking or growing toward the natural range of variability, and an assessment of fragmentation trends.

Each substantive issue discussed in these comments should be (i) incorporated into the purpose and need for the project, (ii) used to develop NEPA alternatives that balance tradeoffs in different ways, (iii) carefully analyzed and documented as part of the effects analysis, and (iv) considered for mitigation.

Note: If any of these web links in this document are dead, they may be resurrected using the Wayback Machine at Archive.org. http://wayback.archive.org/web/

Sincerely,

Doug Heiken (he/him)

[1] Logging results in only modest changes in the intensity and spatial extent of disturbance, and in many cases can result in effects counter to the intended effects, e.g. increase hazardous fuels and fire effects.