OREGON WILD

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FROM: Doug Heiken | Oregon Wild | PO Box 11648 | Eugene OR 97440 | dh@oregonwild.org
TO: PNW Regional Forester, USDA Forest Service
VIA: https://cara.fs2c.usda.gov/Public//CommentInput?Project=64745

Subject: Northwest Forest Plan Amendment — scoping comments

Please accept the following scoping comments from Oregon Wild concerning the Northwest Forest Plan Amendment, https://www.fs.usda.gov/project/?project=64745, https://www.fs.usda.gov/goto/r6/nwfp, https://usfs-public.app.box.com/v/PinyonPublic/folder/223939482015. Oregon Wild represents 20,000 members and supporters who share our mission to protect and restore Oregon'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. This can be accomplished by moving over-represented ecosystem elements (such as logged and roaded areas) toward characteristics that are currently under-represented (such as roadless areas and complex forests with a rich legacy of large trees and large wood).

Contents

Preliminary Proposed Action
The NOI provides only a bare skeleton of a *preliminary description* of a proposed action, which makes informed public comment more difficult. This proposal involves amending the NWFP to:

- Improve fire resistance and resilience by clarifying direction for employing prescribed fire, managed fire use associated with natural ignitions, cultural burning, and active management.
- Strengthen the capacity of NWFP ecosystems to adapt to the ongoing effects of climate change and to mitigate impacts of climate change.
- Improve sustainability of mature and old growth ecosystems by providing plan direction to maintain and expand mature and old growth forest conditions and reduce loss risk across all land use allocations. … [I]t would clarify management intent within land use allocations, including matrix and adaptive management areas.
- Add plan direction incorporating Indigenous Knowledge into planning and plan implementation, including future project design, to identify and support tribal goals, achieve forest management goals and meet the agency's trust responsibilities.
- Support the long-term sustainability of communities located near National Forest System lands and those that are culturally and economically connected to forest resources.

The vagueness of the proposed action denies us, and the public, information needed to focus our scoping comments. Our comments are therefore longer and more detailed than ideal, because we have to prepare for a wide range of possible directions these amendments might take. This is a waste of time and resources, and it's avoidable, if the Forest Service would just provide a clear description of what the proposed amendments.

Introduction
We are concerned that the Forest Service is using a rushed and abbreviated planning process to reach predetermined outcomes that have not been revealed to the public yet. The proposal described in the Federal Register Notice of Intent is dangerously vague. What is clear is that the agency seeks to give pro-logging managers more discretion to cut trees, especially mature trees and trees in reserves.

In our experience, the Forest Service consistently overestimates the benefits of logging and underestimates the adverse trade-offs of logging. The agency has a tendency to lock onto some alleged social or ecological benefit they can achieve through logging without weighing the adverse trade-offs. This is not sound decision-making. The Forest Service needs to de-emphasize commercial logging and use a more diverse set of tools to meet its management objectives.

It is imperative that the NEPA analysis ask and answer the right questions. As an example, during the January 17, 2024, virtual open house, Ray Davis displayed slides showing slight declining trend in spotted owl habitat, mostly due to increasing wildfires. This plan amendment purports to arrest that decline with logging to save the spotted owls' habitat from fire. This is easier said than done. The problem is that meaningful change in wildfire effects requires fuel modification on a landscape scale, and those fuel treatments, if conducted in suitable spotted owl habitat, will degrade spotted owl habitat as much or more than wildfire. The location and timing of wildfire remains highly unpredictable, so most of these fuel treatments will not interact with wildfire during the brief period before fuels regrow, and therefore will not provide any benefits in terms of modified fire behavior. This simple mathematical truth must be incorporated into the NEPA analysis.

Recent science shows that the spotted owl's population decline is accelerating rapidly. *See* Franklin *et al.*, Range-wide declines of northern spotted owl populations in the Pacific Northwest: A meta-analysis. *Biological Conservation* 259 (2021), available at https://www.fs.usda.gov/pnw/pubs/journals/pnw 2021 franklin001.pdf. Maintaining suitable habitat in the near-term is absolutely essential to prevent local or regional extirpations of the species. The question that the NEPA analysis must answer is whether the spotted owl (and other late successional wildlife) are threatened more by wildfire alone, or by the combined effects of fuel reduction logging, plus wildfire. Due to the unpredictability of wildfire and the ephemeral benefits of fuel reduction, the answer is that *fuel reduction logging of mature forest to save it from wildfire will not result in net benefits to the spotted owl or other late successional species*. Fuel reduction must be focused outside mature and old-growth habitat. This brings into question several elements of the *need for change* identified in the Notice of Intent.

NFMA Planning Requirements

Applicable NFMA planning regulations that are likely to be directly related to the proposed amendments include:

(1) 36 CFR 219.8(a)(1), ecosystem integrity;
(2) 36 CFR 219.8(b), Social and economic sustainability;
(3) 36 CFR 219.9(a), ecosystem plan components;
(4) 36 CRF 219.10 (a)(5), Habitat conditions, subject to the requirements of § 219.9, for wildlife, fish, and plants commonly enjoyed and used by the public; for hunting, fishing, trapping, gathering, observing, subsistence, and other activities (in collaboration with federally recognized Tribes, Alaska Native Corporations, other Federal agencies, and State and local governments);
(5) 36 CFR 219.10 (a)(8), System drivers, including dominant ecological processes, disturbance regimes, and stressors, such as natural succession, wildland fire, invasive species, and climate change; and the ability of the terrestrial and aquatic ecosystems on the plan area to adapt to change (§ 219.8);
(6) 36 CFR 219.10 (b)(1)(iii), Management of areas of tribal importance; and
(7) 36 CFR 219.11(c), Timber harvest for purposes other than timber production.

Notably absent from this list is 36 CFR 219.9(b), Additional, species-specific plan components. This provision is triggered when ecosystem plan components will not suffice to provide the ecological conditions necessary to recover ESA-listed species or maintain viable populations of species of conservation concern. In light of the indications in the Notice of Intent that the Forest Service intends to allow more logging and other management in reserve areas, we strongly urge the agency to develop species-specific plan components to ensure the recovery of spotted owls, marbled murrelets, and other listed species, as well as develop such components for potential species of conservation concern (species not listed under the ESA but for which viability concerns exists). *See* 36 CFR 219.9(b) and (c); *see also* 36 CFR 219.13(b)(6).

Species of conservation concern need to be addressed in a plan amendment when species will be adversely affected by a proposed amendment. In this case, proposals such as increasing active management in reserves, lifting the limitation for logging stands over 80 years old in LSRs, or eliminating Survey and Manage requirements would definitely trigger those requirements. Keep in mind that Brandt et al (2014) looked at the connection between biodiversity and ecosystem services in PNW forests and concluded "The concepts of ecosystem services and biodiversity are not only linked, they act in concert. Based on our analysis, an integrative approach of ecosystem management that incorporates both ecosystem services and biodiversity is indeed beneficial in providing goods and services to society while maintaining biodiversity. … We mapped nine actual and potential ecosystem services, grouped into provision, supporting, regulating and cultural ecosystem service categories, as well as species richness of four taxonomic groups (mammals, birds, trees, and amphibians). … We found significant positive linkages between ecosystem service diversity and species richness of all considered taxa. The provision of the majority of ecosystem services was higher in areas of high taxon diversity, indicating both positive relationships and slight trade-offs in maximizing single ecosystem services." Patric Brandt, David J. Abson, Dominick A. DellaSala, Robert Feller, Henrik von Wehrden 2014. Multifunctionality and biodiversity: Ecosystem services in temperate rainforests of the Pacific Northwest, USA. Biological Conservation 169 (2014) 362–371. https://www.researchgate.net/publication/259495573_Multifunctionality_and_biodiversity_Ecosystem_services_in_temperate_rainforests_of_the_Pacific_Northwest_USA

The NFMA planning regulations instruct the Forest Service to manage for carbon storage as an ecosystem service. The plan amendment must conduct a quantitative analysis of carbon storage, and how it is affected by management. The EIS must address the social cost of carbon dioxide emissions, per Biden 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/.

The Need for Change is Not Well Supported.
The NOI fails to provide a compelling explanation of how the existing Northwest Forest Plan prevents the agency from meeting its goals. What exactly does the Forest Service want to do that the Northwest Forest Plan prevents them from doing? The agency's failure to answer this question is what raises our suspicions. The Forest Service has a long track record of favoring logging at the expense of other goals, and we have yet to see if this plan amendment is any different.

The need for change needs to be carefully harmonized and aligned with the original goals of the Northwest Forest Plan. The mandates of the Northwest Forest Plan remain necessary to protect and restore a functional interconnected mature and old-growth ecosystem, and just as importantly the plan does not pose a barrier to active necessary to meet agency goals. The Northwest Forest Plan allows active management within every land allocation—even in reserves—but also wisely includes standards to help ensure that logging is both necessary and effective in meeting goals for the reserves. These requirements need to be faithfully implemented, not weakened.

The plan has remained in place for this long because it was built to last. The damage done by past forest mismanagement was so severe that the plan was designed to guide a 100- to 200-year forest recovery period. The plan's reserves were designed to be redundant and durable in the face of natural disturbance like wildfire. The Northwest Forest Plan was adopted almost 30 years ago to solve a crisis caused by decades of over-logging and overconfidence in managers' ability to understand and manipulate complex ecosystems that support old-growth conditions, biodiversity, clean water, and quality of life. The plan has been a tremendous success in reducing the rate of habitat loss, restoring watersheds, and reversing the flow of carbon from the forest to the atmosphere.

Several significant new developments set forth in these comments indicate a need to increase emphasis on conservation and restoration of more mature & old-growth forests, and reduced emphasis on Matrix objectives such as timber production from logging of mature & old-growth forests. Unfortunately, the Forest Service has been on notice for years yet has not taken steps to account for new information and has failed to adjust Matrix objectives accordingly.

We urge the Forest Service planning team to carefully consider several new developments over the last 29 years that should inform any effort to update the Northwest Forest Plan. Most of these issues bring into question the need for and desirability of logging for timber volume in the matrix, and indicate the need for increased conservation, and greater use of management tools other than logging.

Retain the Core Components of the Northwest Forest Plan.
The main motivations for adopting the Northwest Forest Plan have not changed. The spotted owl is still threatened, though is now warranted for uplisting to endangered. 85 Fed. Reg. 81,144, 81,146 (Dec. 15, 2020). The marbled murrelet is still threatened, although now considered endangered by the State of Oregon. Pacific salmon remain threatened. Several additional species have been petitioned or listed under the ESA since the Northwest Forest Plan was adopted, including the several salmon DPSs, North Coast DPS of red tree vole, marten, fisher, etc. Hundreds of not thousands of miles of streams still have impaired water quality.

The Forest Service should "stay the course" with the Northwest Forest Plan recognizing that we are merely 29 years into a plan that will take 100-200 years to correct the errors of the past caused by unsustainable liquidation and fragmentation of mature & old-growth forests.

To continue the process of forest recovery envisioned by the Northwest Forest Plan, the core components of the Plan must be retained, and enhanced where necessary. These include:

- **Maintain the Northwest Forest Plan as an ecosystem-based plan**, not just for listed species, but for conservation and restoration of natural ecological landscapes supporting biodiversity in all its dimensions. This includes an overall biodiversity strategy that contributes to recovery of ESA-listed species, maintains viability of wildlife populations, avoids the need for additional listings, and mitigates for more intensive management of non-federal lands.
- **Maintain the robust combination of course and fine filters for biodiversity conservation.** There may have been a time when a coarse filter approach might have been sufficient to preserve biodiversity, but continued implementation of fine filters is necessary because too much late-successional habitat was lost and fragmented before the reserve system was established.
- **Protect a robust network of Late Successional Reserves, with clear and enforceable limits on logging**. The reserve network needs to remain well-distributed and spatially connected to facilitate dispersal of spotted owls and other wildlife, and must remain redundant to accommodate natural disturbance regimes. LSRs should be managed to conserve both terrestrial and aquatic ecosystems. Fire risk reduction should be allowed only when it meets the standards in the 1994 ROD, including focusing on young stands and a required showing that intervention is clearly needed and will be clearly beneficial. If reserves boundaries are changed, existing design principles must be preserved, i.e., reserve spacing must facilitate juvenile owl dispersal, and each LSR must be connected to two or more adjacent reserves. The reserve system may need to be expanded for two reasons. First, because barred owls occupy and defend extensive areas of suitable owl habitat that is no longer available for spotted owls, so more and larger reserves may be necessary to increase the chances of coexistence and avoid competitive exclusion. Second, increasing the area of Late Successional Reserves will help advance both climate change mitigation (maintain and increase carbon storage, and reduce carbon emissions from logging) and climate change resilience (cool/moist refugia, greater redundancy attenuates the uncertainty related to climate change).

- **Retain the Aquatic Conservation Strategy** including a well-protected network of key watersheds and riparian reserves, with clear and enforceable limits on logging to protect both aquatic and terrestrial biodiversity and ecological structures, functions, and processes. The ACS must include an explicit restoration component. The riparian reserve boundaries should not be adjusted except by the procedures specified in the Aquatic Conservation Strategy, that includes consideration of all the values protected by riparian reserves. Standards should retain the prohibition on activities that would retard or prevent attainment of aquatic objectives and ensure a natural rate of hydrologic and ecological recovery. Protecting riparian reserves is especially important in light of global climate change, which is expected to increase stream temperatures and reduce fish habitat quality and quantity. Protection of riparian reserves can potentially off-set future increases in water temperature related to global climate change. The existing prohibition on logging in riparian reserves needs to be better enforced. The Forest Service is not doing a good job of accounting for the long-lasting reduction of wood recruitment caused by logging in riparian reserves.
- **Re-establish a robust Survey and Manage program** that recognizes a legacy of management-induced fragmentation and the importance of mitigation for reserves that are not yet functioning as intended. Logging and other management needs to be limited to mitigate for effects to low mobility species that are less able to disperse in a fragmented landscape. Continued pre-disturbance surveys should "look before you log" mature & old-growth habitat, and protect known sites. The existing *high-priority site* process must be reformed so that it does not become the exception that swallows the rule.
- Standards and guidelines that **avoid, minimize, and mitigate** the effects of management;
- Provision of a **balanced set of ecosystem services**, including clean water, biodiversity, climate stability, recreation, quality of life, and products.
- A planning process that is **inclusive, cooperative, fair and respects Tribal Treaty Rights and interests**.
- **A natural disturbance/fire policy that is science-based, ecosystem-centered, and tolerant of characteristic natural processes**, recognizing they are "essential for the development and maintenance of late-successional and old-growth forest ecosystems." (1994 NWFP ROD, p B-2).

The core purposes of the plan were about conserving biodiversity, and these purposes must be faithfully preserved.

Clear Guardrails Keep the Agency on Track.

Clear management standards and mechanisms for accountability have been part of the success of the Northwest Forest Plan. No compelling justification exists for weakening management standards and increasing management discretion. Clear standards help avoid conflict and controversy by telling managers where the guardrails are, and by tempering agency incentives that often bias managers toward commercial extraction.

Recognize the Northwest Forest Plan as an Interconnected Whole.
The NEPA analysis must recognize the interconnected nature of any land management scheme, especially an ecosystem plan like the Northwest Forest Plan. For instance, conservation of riparian reserves and key watersheds enhances conservation of terrestrial wildlife, conservation of Late Successional Reserves enhances conservation of riparian and aquatic habitat, increasing efforts to control fire and reduce fuels will *unavoidably* reduce habitat (implicating the reserve system), increase carbon emissions (exacerbating climate change), increase watershed disturbance (implicating the Aquatic Conservation Strategy). The agency must disclose and consider the effects of proposed changes on the plan as a whole and all it's parts.

Protect Mature & Old-Growth Forest
There is no longer a social license to log mature & old-growth forests. This is reflected in the fact that on April 22, 2022, President Biden issued an executive order declaring a policy to conserve mature & 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'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 …. 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. … Conserving old-growth and mature forests on Federal lands … is critical to protecting these and other ecosystem services provided by those forests. … We can and must take action to conserve, restore, reforest, and manage our magnificent forests … <u>It is the policy of my Administration, … to … conserve America's mature and old-growth forests on Federal lands …</u>
> …
> Sec. 2. Restoring and Conserving the Nation's Forests, Including Mature and Old-Growth Forests.
> <u>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 …</u>

Biden, J. 2022. Executive Order on Strengthening the Nation'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 E.O. also calls for an inventory of mature & old-growth on federal land, an analysis of threats to mature & old-growth forests, and development of policies to address those threats. The agencies do not need to wait for these steps. The official policy of the federal government is to conserve mature & old-growth forests on federal land and that policy should be implemented here and now.

To implement this EO, the Forest Service has embarked on a concurrent NEPA process to amend all land management plans for units of the National Forest System to include consistent direction to conserve and steward existing and recruit future old-growth forest conditions. https://www.fs.usda.gov/project/?project=65356. The Forest Service needs to make sure that this Northwest Forest Plan amendment process and decision is harmonized with the national mature and old-growth plan amendment.

Consistent with the evidence in the Northwest Forest Plan NEPA record and the best available science, the Forest Service should conserve mature forests (≥80 years old) and old growth forests (≥120 years old). The NEPA analysis should also review and consider all the compelling reasons for conserving a broad spectrum of mature and old-growth forests set forth in Heiken, D. 2009. "The Case for Protecting Mature & Old-Growth Forests" https://www.dropbox.com/s/4s0825a7t6fq7zu/Mature%20Forests%2C%20Heiken%2C%20v%201.8.pdf?dl=0.

"Older forests are an important part of the 'evolutionary anvil' 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." 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.

Forests Outside the Range of the Northern Spotted Owl

We question the need and desirability of including forests outside the range of the spotted owl in this amendment. This includes the eastern portions of the Deschutes and Fremont-Winema National Forests. A few of the key considerations include:

- These forests need to have reserves established, a task which should have followed the Interior Columbia Basin (ICBEMP) analysis, but which was never completed.
- These forests should retain the diameter limits in the Eastside Screens. This extension of the Northwest Forest Plan will create a lot of controversy and loss of public trust if this is a back-door way to eliminate protection for large trees. This cannot be emphasized enough. There is no valid basis for eliminating protection for large trees. If this amendment will allow removal of large trees in forests currently covered by the Eastside Screens, the NEPA analysis must fully disclose the impacts of that decision on carbon storage, climate change, biodiversity, and the cultural value of large trees. We incorporate by reference our scoping comments and comments on the Large Tree Amendment EA

and preserve all legal claims related to the issues raised in our NEPA comments. https://cara.fs2c.usda.gov/Public//ReadingRoom?Project=58050.

- The list of survey and manage species may need to be expanded to include species that live in forests outside the range of the spotted owl.
- Will these forests follow the Aquatic Conservation Strategy or PACFISH/INFISH?
- These forests may need extra mitigation for biodiversity that may be adversely affected by active management, because these forests are generally drier and have a low density of riparian reserves, which means that it may be more difficult to maintain habitat connectivity across the matrix.
- Extending the land allocations and standards & guidelines of the Northwest Forest Plan to forests outside the range of the spotted owl cannot be done as part of a plan amendment. This likely triggers a plan revision.

Spotted Owls and Barred Owls, Co-Existence Requires More Habitat
The threatened spotted owl faces a significant new threat in the form of the barred owl which has recently invaded the range of the spotted owl, prefers similar habitat, and uses many of the same food sources. Hundreds of thousands of acres of suitable owl habitat that were assumed in the Northwest Forest Plan to be available for spotted owl nesting, roosting, and foraging are now occupied and defended by territorial barred owls to the exclusion of spotted owls. There is an urgent need to protect additional suitable owl habitat (and reduce the loss of existing habitat) in order to increase the likelihood that threatened spotted owls can coexist with newly invading barred owls instead of facing competitive exclusion. More habitat increases the chances that the two owls can co-exist. More discretion and more logging reduce the changes for co-existence and increase the chances for competitive exclusion/extirpation.

It is settled science that when two territorial species are competing for the same habitat, the chances of coexistence are enhanced when there is more habitat, and the chances of competitive exclusions are enhanced when there is less habitat. So, the spotted owl needs more suitable habitat to increase the chances of coexistence with the barred owl. There is evidence that the two owls are most tolerant of each other where late successional habitat is of the highest quality. An aggressive program of thinning and fuel reduction will reduce habitat available for co-existence, and may create a landscape more suitable for barred owls than spotted owls. USFWS' proposed large-scale removal of barred owls does not in any way reduce the need for owl habitat conservation and restoration.

FWS has recommended protection of a subset of high quality owl habitat, but whether this subset of habitat is enough to ensure species recovery has never been tested and validated. The habitat modeling done as part of the spotted owl recovery planning process assume that the barred owl population would remain constant, but it is more realistic to expect that the barred owl population will continue to increase for some time. We are a long way from an effective rangewide barred owl control program, and if the program ever gets fully implemented, failure to maintain the program in perpetuity will likely lead to a rapidly resurgent population of barred owls. There are too many preconditions that undercut FWS' modeling assumptions and the effectiveness of relying on a subset of suitable habitat. Spotted owls would be safer if all suitable habitat were protected.

The FS is using Recovery Action 32 to mitigate for the barred owl, but the best science indicates the need to conserve a much more inclusive extent of suitable habitat.

> Our results and those of others referenced above consistently identify loss of habitat and Barred Owls as important stressors on populations of Northern Spotted Owls. In view of the continued decline of Spotted Owls in most study areas, **it would be wise to preserve as much high quality habitat in late-successional forests for Spotted Owls as possible**, distributed over as large an area as possible. This recommendation is comparable to one of the recovery goals in the final recovery plan for the Northern Spotted Owl (USDI Fish and Wildlife Service 2008), but **we believe that a more inclusive definition of high-quality habitat is needed** than the rather vague definition provided in the 2008 recovery plan. Much of the habitat occupied by Northern Spotted Owls and their prey does not fit the classical definition of "old-growth" as defined by Franklin and Spies (1991), and a narrow definition of habitat based on the Franklin and Spies criteria would exclude many areas currently occupied by Northern Spotted Owls. [p 77]...

Eric D. Forsman, Robert G. Anthony, Katie M. Dugger, et al. 2011. Population Demography of Northern Spotted Owls. University of California Press. No. 40 in Studies In Avian Biology by the Cooper Ornithological Society. https://www.ucpress.edu/book/9780520270084/population-demography-of-northern-spotted-owls, pdf

To help spotted owls and barred owl co-exist, the Forest Service should consider enlarging the reserve system. This is clearly supported by the best available science. A telemetry study showed that in fragmented landscapes barred owls have a survival advantage relative to spotted owls, but that survival advantage diminishes in landscapes with a higher proportion of older forest. In other words, conservation of mature and old-growth forest should be favored because spotted owls are able to compete nearly equally with barred owls in landscapes with a high proportion of old forest.

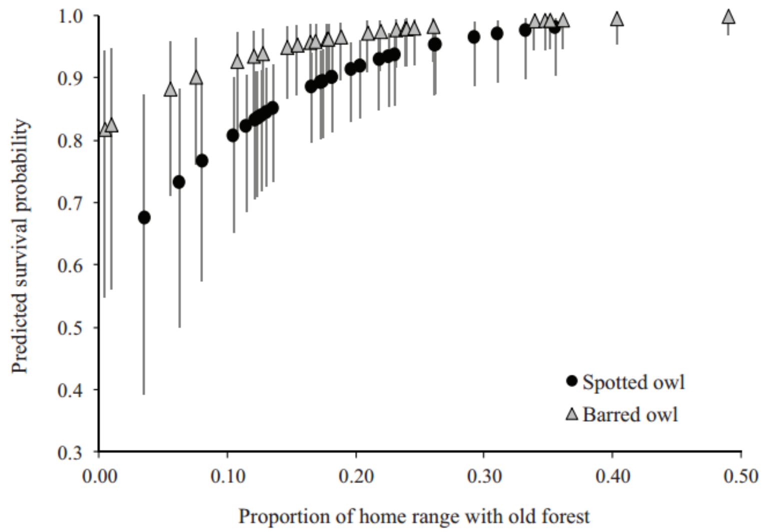


Figure 13. Predicted relationship between mean proportion of old conifer forest within the home range and seasonal (6-month) survival probabilities of radio-marked northern spotted owls ($n = 29$) and barred owls ($n = 28$) in western Oregon, USA, 2007–2009. We calculated point estimates with 95% confidence intervals at observed mean values for each individual under the best-supported model of survival, which included the additive effects of species and proportion of old conifer forest within the home range.

Wiens, J.D., Anthony, R.G., and E.D. Forsman. 2014: Competitive Interactions and Resource Partitioning Between Northern Spotted Owls and Barred Owls in Western Oregon. Wildlife Monographs 185:1–50; 2014; DOI: 10.1002/wmon.1009. https://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/48214/AnthonyRobertFisheriesWildlifeCompetitiveInteractions.pdf

A well-known axiom of the species-area relationship from island biogeography holds that as habitat area increases, the number of cohabiting species also increases, and conversely, as the area of suitable habitat declines, the risk of competitive exclusion increases. See especially, Part III - Competition in a Spatial World *in* Tilman, D. and P. Karieva, Eds. 1997. Spatial Ecology: The Role of Space in Population Dynamics and Interspecific Interactions. Monographs in Population Biology, Princeton University Press. 368 pp.

> "The major causes of population and species extinction worldwide are habitat loss and interactions among species. … The most robust generalization that we can make about population extinction is that small populations face a particularly high risk of extinction. … [E]mpirical support for the extinction-proneness of small populations has been found practically wherever this issue has been examined. … The loss of habitat reduced population size …. Larger habitat patches have larger expected population sizes than smaller patches. Therefore, other things being equal, we could expect large habitat patches to have populations with a lower risk of extinction than populations in small

> patches. … More generally, the relationship between patch size and extinction risk provides a key rule of thumb for conservation: other things being equal it is better to conserve a large than a small patch of habitat or to preserve as much of a particular patch as possible. … [T]here are likely to be many complementary reasons why large patches have populations with low risk of extinction. ”

Oscar E. Gaggiotti and Ilkka Hanski. 2004. Chapter 14 - Mechanisms of Population Extinction. *In* Ecology, Genetics, and Evolution of Metapopulations. Elsevier. 2004. http://web.archive.org/web/20070612211945/http://www.eeb.cornell.edu/sdv2/Readings/Gaggiotti&Hanski.pdf

The effects of habitat availability on competing species was explored by expert wildlife population modelers who found —

> The territorial occupancy model developed by Lande (1987), extended here to include two competing species, represents a useful tool for evaluating how equilibrium breeding numbers could be affected by changes in habitat availability, demographic parameters, dispersal behavior and interspecific competition … Its application shows that **increases in the exclusive suitable habitat of each species is the best option to maintain viable populations of territorial competitors** in a same area, given that it reduces competition for territories. Increases in habitat overlap by reducing the exclusive habitat available for one species strongly affected the outcome of competition, resulting in extinction of the species for which exclusive habitat had been eliminated.

Martina Carrete, Jose´ A. Sa´nchez-Zapata, Jose´ F. Calvo and Russell Lande. Demography and habitat availability in territorial occupancy of two competing species. OIKOS 108: 125-136, 2005 http://www.ebd.csic.es/carnivoros/personal/carrete/martina/recursos/13.%20carrete%20et%20al%20%282005%29%20oikos%20108-125.pdf.

From these ecological foundations, one can see that the barred owl, by invading, occupying suitable habitat and excluding spotted owls, has reduced the effective size of the reserves that were established in 1994, and thereby reduces the potential population of spotted owls. Extinction risk is increased by this loss of habitat and smaller population. If we provide more suitable habitat, the population potential increases, and the risk of extinction decreases. The most rational way to respond is to protect remaining suitable habitat, expand and restore the reserve system to provide more suitable habitat to increase the likelihood that the two owl species can co-exist.[1]

This view is corroborated by owl biologist David Wiens who was interviewed on the Lehrer NewsHour. He said: “The more habitat you protect, the more you're going to alleviate the competitive pressure between the species. Rather than reducing it and increasing the competitive

[1] Put another way, when threatened with extinction, “the best defense is a strong offense” that is, species are more likely to persist if they have a large, well-distributed population size and if we minimize all manageable threats. Dunham, Jason. 2008. Bull trout habitat requirements and factors most at risk from climate change. http://www.fs.fed.us/rm/boise/AWAE/projects/bull_trout/bt_Dunham.html

pressure between these two species, we need to provide as much habitat as possible for them." DAVID WIENS. NewsHour interview. "Biologists Struggle to Save the Spotted Owl." December 18, 2007. http://www.pbs.org/newshour/bb/science/july-dec07/owl_12-18.html. Robert Anthony agrees, "If you start cutting habitat for either bird, you just increase competitive pressure." Welch, Craig. 2009. The Spotted Owl's New Nemesis. Smithsonian Magazine. January 2009. http://www.smithsonianmag.com/science-nature/The-Spotted-Owls-New-Nemesis.html?c=y&page=2 And in the same article Eric Forsman added "You could shoot barred owls until you're blue in the face," he said. "But unless you're willing to do it forever, it's just not going to work."

Manage for High Quality Spotted Owl Dispersal Habitat

The Northwest Forest Plan amendment should account for new information on the importance of high quality dispersal habitat for the spotted owl by managing for high quality dispersal habitat, which is closer to suitable nesting, roosting, foraging habitat rather than the outdated "50-11-40" policy. Management activities, such as fuel reduction, that degrades habitat to meet the bare minimum criteria for either dispersal, foraging, nesting etc., must still be accurately accounted for in the NEPA process. Managing down to minimum thresholds does NOT "maintain" habitat.

The matrix was intended to support spotted owl dispersal, and it was assumed that 40% canopy closure of trees 11" dbh would be enough, but new information indicates that spotted owl dispersal habitat should be managed for "at least 80%" canopy cover. Sovern et al (2015) found that

> "**Roost Site Selection**. In contrast to the assumption that stands with relatively open canopies provide suitable dispersal habitat for spotted owls, our results suggest that dispersing juveniles selected stands for roosting that had relatively high canopy closure (x = 66 ± 2%). … Two hypotheses could explain why dispersing owls selected closed-canopy stands. First, several researchers (Barrows 1981, Forsman et al. 1984, Weathers et al. 2001) have shown that temperature and precipitation appear to influence selection for roost trees and attributes within a roost tree, such as perch height and percent overhead cover. … Second, juvenile northern spotted owls may have selected for closed-canopy forest because their preferred prey were most abundant … **Landscape Scale Selection**. … [O]ur mean estimate of canopy closure from plots at roosts (66%), which was likely an underestimate of canopy cover, was considerably higher than the minimum values recommended by Thomas et al. (1990) [i.e. 50-11-40]. … **Management Implications**. … Based on our study, we recommend that managers should pursue a strategy that exceeds the canopy cover guidelines recommended by Thomas et al. (1990) when managing dispersal habitat for spotted owls. Based on our estimate of mean canopy closure (66%), and our estimate of mean canopy cover from overlaying a dot grid on the same areas (approx. 14% larger), we recommend that the target for canopy cover in stands managed for dispersing spotted owls should be at least 80%."

Stan G. Sovern, Eric D. Forsman, Katie M. Dugger, Margaret Taylor. 2015. Roosting Habitat Use and Selection By Northern Spotted Owls During Natal Dispersal. The Journal of Wildlife Management 79(2):254–262; 2015; DOI: 10.1002/jwmg.834. https://osu-wams-blogs-uploads.s3.amazonaws.com/blogs.dir/2742/files/2016/09/Sovern-et-al.-2015.pdf.

Another owl dispersal concern is that in 2016 Oregon BLM adopted new RMPs that cut riparian reserves in half. Wide riparian reserves established by the Northwest Forest Plan were supposed to serve multiple purposes, including as spotted owl dispersal habitat, but the smaller riparian corridors do not fulfill that function, so the matrix needs to be modified to better meet spotted owl dispersal needs.

Mitigate for Reduced Conservation on BLM Lands That Were Part of the Northwest Forest Plan

The success of the entire Northwest Forest Plan is premised on the existence of the network of reserves that span the landscape from BLM to Forest Service lands. It was this unified approach that underscored the eventual judicial approval of the Northwest Forest Plan. *See Seattle Audubon Soc'y v. Lyons*, 871 F. Supp. 1291, 1300 (W.D. Wash. 1994). Notably, in upholding the Northwest Forest Plan, Judge Dwyer said that "any more logging sales than the plan contemplates would probably violate [NFMA]. Whether the plan and its implementation will remain legal will depend on future events and conditions." *Id.*

BLM in 2016 revised its RMPs in western Oregon to significantly modify large block reserves, shrink riparian reserves, and eliminate numerous standards and mitigations for logging both inside and outside reserves. Increased logging on BLM lands is causing further loss of suitable habitat and will have long-term consequences. Although the BLM plans purported to expand LSRs on Western Oregon BLM lands, BLM weakened protection for reserves and the agency has authorized extensive heavy commercial thinning within LSRs that will render habitat unsuitable for spotted owls for decades. *See, e.g., KS Wild v. BLM*, No. 1:23-cv-519-CL, ECF No. 21 (Nov. 21, 2023), Plaintiffs' Opening Brief, pp. 7, 16, 37, & 39 (attached).

In addition, another of the biggest problems with the RMP Revisions relates to reduced protection for streams that were intended to benefit spotted owl demography and dispersal. New information now indicates that complex riparian forests are one of the places that spotted owls and barred owls are more tolerant of each other so conservation of these areas is more important than ever. See Wiens, D.J. 2012. Dietary Overlap between Northern Spotted Owls and Barred Owls in Western Oregon, *workshop* What's for Dinner: Spotted Owl Prey 2012 http://ecoshare.info/projects/central-cascade-adaptive-management-partnership/workshops/spotted-owl/; http://ecoshare.info/wp-content/uploads/2012/08/Barred-compared-to-spotted-Owl-diets.ppt.

The NEPA analysis must consider the fact that reserves on BLM lands are no longer protected as part of the interagency reserve strategy, and therefore additional mitigations must be adopted on Forest Service lands to retain options for the conservation of the Threatened spotted owl, marbled murrelet, and Coho salmon. The spotted owl cumulative effects analysis in the 1994 SEIS is no longer valid and must be reconsidered at the regional scale.

In light of the above, and with increased logging now occurring on Western Oregon BLM lands, both in the Harvest Land Base *and* reserves, "events and conditions" have changed considerably since Judge Dwyer found the Northwest Forest Plan lawful. Any increased logging authorized on National Forest System lands through the proposed amendment risks further running afoul of Judge Dwyer's warning and the Forest Service's statutory obligations.

Carbon Storage and Climate Resilience – Two Goals That Must Be Harmonized

The proposal fails to acknowledge that the Northwest Forest Plan covers one of the most significant living carbon reservoirs on the planet, and that logging will emit far more carbon than it saves. Any attempt to address climate change must carefully harmonize the competing needs for increasing forest carbon storage to mitigate climate change, and the need for forest management to help ecosystems adapt to climate change. There can be no doubt that the agency's over-reliance on timber sales as the dominant forest management tool results in significant net carbon emissions, even when the goal is to reduce wildfire effects. Ecosystems can be made more resilient to climate change by retaining climate refugia such as the cool, moist conditions found in mature and old-growth stands and riparian reserves, careful use of non-commercial thinning and reintroducing fire.

The spotted owl region has shifted from a carbon source to a carbon sink due to reduced logging brought on by the Northwest Forest Plan.

> Here we use a combination of remote sensing and ecosystem modeling to examine the trends in NEP and net ecosystem carbon balance (NECB) in this region over the 1985–2007 period, with particular attention to land ownership since management now differs widely between public and private forestland. In the late 1980s, forestland in both ownership classes was subject to high rates of harvesting, and consequently the land was a carbon source (i.e. had a negative NECB). After the policy driven reduction in the harvest level, public forestland became a large carbon sink driven in part by increasing NEP whereas private forestland was close to carbon neutral. In the 2003–2007 period, the trend towards carbon accumulation on public lands continued despite a moderate increase in the extent of wildfire.

Turner, D.P., Ritts, W.D., Yang, Z., Kennedy, R.E., Cohen, W.B., Duane, M.V., Thornton, P.E., Law, B.E., 2011. Decadal trends in net ecosystem production and net ecosystem carbon balance for a regional socioecological system. For. Ecol. Manage. 262, 1318–1325. http://www.fsl.orst.edu/rna/Documents/publications/Decadal%20trends%20in%20net%20ecosystem%20production%20and%20net%20ecosystem%20carbon%20balance%20for%20a%20regional%20socioecological%20system.pdf. See also, Olga N. Krankina, Mark E. Harmon, Frank Schnekenburger, Carlos A. Sierra, Carbon balance on federal forest lands of Western Oregon and Washington: The impact of the Northwest Forest Plan, Forest Ecology and Management, Volume 286, 2012, Pages 171-182, ISSN 0378-1127, https://doi.org/10.1016/j.foreco.2012.08.028.

> Recent findings suggest that forests on Forest Service lands in Oregon and Washington currently store about 63 percent of their potential maximum carbon (Gray et al. 2016). ... In forests west of the Cascades where fire is less frequent, decreasing harvesting, increasing rotation age, and maintaining and increasing the extent of late-successional and old-growth forests are strategies to increase carbon storage toward theoretical maximum limits (Creutzburg et al. 2016, 2017; Hudiburg et al. 2009). Maintaining and increasing the area of dense old-growth forests with high biomass also has the potential to mitigate temperature changes in topographically complex mountainous environments (Frey et al. 2016).

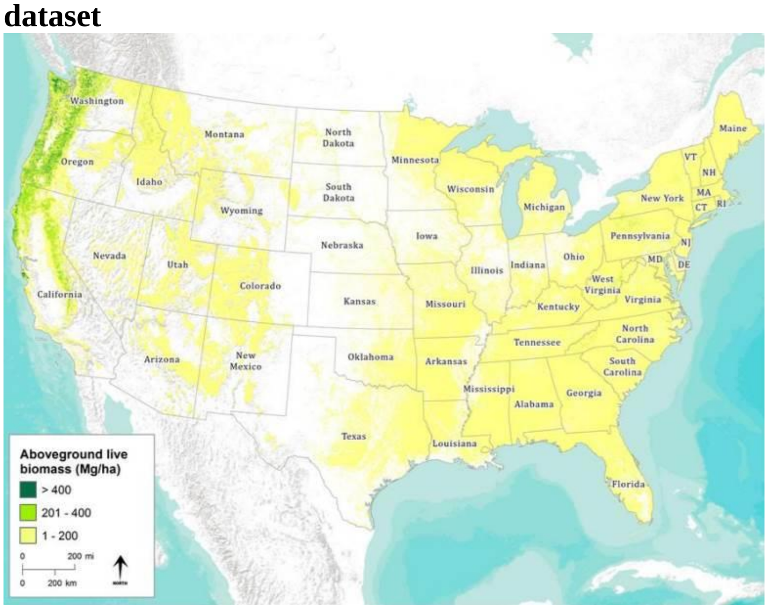
USDA 2018. Synthesis of Science to Inform Land Management Within the Northwest Forest Plan Area. General Technical Report. PNW-GTR-966 Vol. 1. June 2018. https://www.fs.fed.us/pnw/pubs/pnw_gtr966_vol1.pdf. The NEPA analysis needs to recognize that every timber sale causes carbon storage and sacrifices global climate stability. How the federal forests are managed has a real and substantial impact on how much carbon is stored. "The C sequestration potential in the future depends not only on the footprint of individual ecosystems but also on each federal agency's land use and management." Zhengxi Tan, Shuguang Liu, Terry L. Sohl, Yiping Wu, and Claudia J. Young. 2015. Ecosystem carbon stocks and sequestration potential of federal lands across the conterminous United States. PNAS. vol. 112 no. 39. Sept 28, 2015. doi: 10.1073/pnas.1512542112.

Krankina et al (2014) explain the importance of conserving high-biomass forests like those in the PNW:

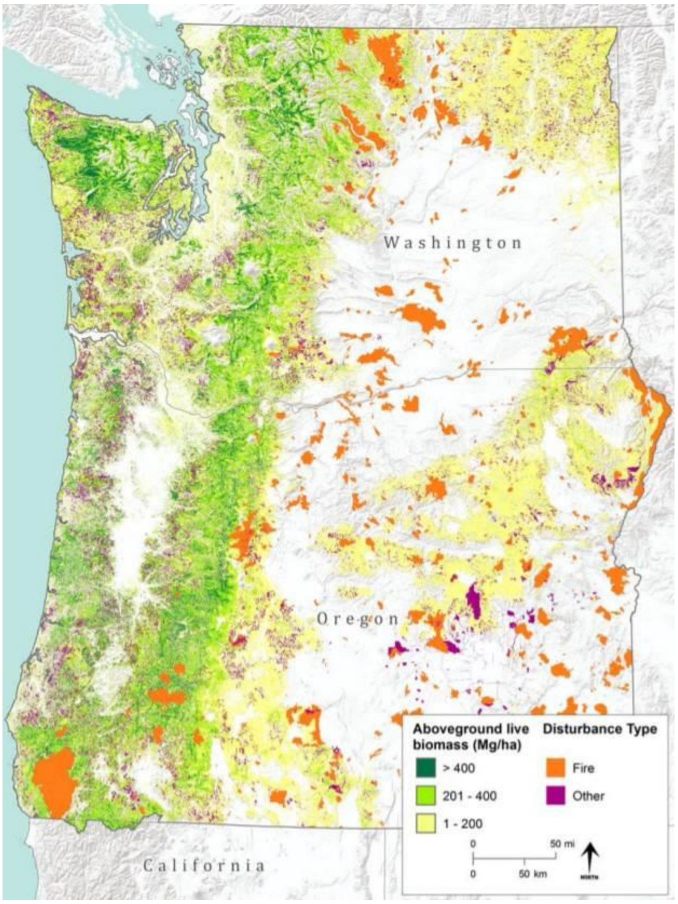
> The PNW forests contain substantial remnants of productive, high-biomass old-growth forests (Smithwick et al. 2002; Spies 2004; DellaSala 2011), whereas in other temperate regions these forests have been eliminated for centuries. Protecting biodiversity of late-successional forests was among the primary goals of the Northwest Forest Plan (NWFP) that shifted forest management on *10 million ha of federal lands in the PNW from predominately timber extraction to ecosystem management and biodiversity conservation (Fig. 1; NWFP 2002; Mouer et al. 2005; DellaSala and Williams 2006). This change in management resulted in a considerable increase in C stores on federal forest lands within the first decade of plan implementation and this trend can be expected to continue into the future if the limits on timber harvest set under the NWFP are maintained (Krankina et al. 2012). ... [T]he scarcity of high-biomass forests and their extreme overall concentration in western United States is evident: high-biomass forest occupies \3 % of all forest land in conterminous US, and the PNW and Pacific Southwest regions combined hold 89 % of those forests (Fig. 1; Online Resource 2). ... Among ownership types in the PNW, USFS lands (primarily National Forests) contained the largest area of high biomass forests (48.4 % of regional total ... More than half of very high-biomass area was on USFS lands ... Overall, the area of high-biomass forest logged on private lands exceeded the total area burned across all ownerships (Table 1). Among public ownerships, the rate of forest loss was greatest on BLM lands (1.25 % per year in high-biomass forest; Fig. 4), mostly to non-fire disturbance (logging). ... 31 % of all high-biomass forest lands in WA were in high-protection GAP status compared to only 9 % in

OR. ... IRAs contained 496,000 ha or 17.5 % of all high-biomass forest lands in USFS ownership in our study area [OR + WA] (Table 2) and 132,000 ha or 18.4 % of very high-biomass forests ... Thinning has become a major type of logging on NWFP lands, and thinned stands were presumed to retain their LDF [large diameter forest] status (Healey et al. 2008) but thinning significantly reduces forest biomass store. Clearly, the NWFP offers less protection for high-biomass forests compared to LDF or old growth, especially for the most productive stands that can reach 200 Mg/ha biomass level when they are relatively young (*40 years old). Protecting high-biomass forest may be a greater challenge as it presents a more direct conflict with economic gains from timber harvest than protection of old growth, especially old growth with relatively low biomass stores. ... The disturbance of high-biomass forests especially timber harvest results in net C losses to the atmosphere that can take a new generation of trees many decades or centuries to offset (e.g., Houghton et al. 2009; Krankina et al. 2012). ... [T]here is a surprising discrepancy in protection level of high biomass forests in OR and WA and overall limited protection from harvest (GAP3, GAP4 or no-GAP) for *70 % of high-biomass forests managed under NWFP (Table 2). Among publicly owned forest lands, BLM has the highest concentration of high-biomass forests (Fig. 3), which were harvested at a higher rate compared to other public ownerships in 2000–2008 (Fig. 4). ... [C]ontinued harvest on public lands depletes the cohort of stands where old-growth characteristics can develop over time. In addition, fire and other natural disturbances in high-biomass forests transfer C from live biomass into dead biomass pool, but the total C store on site remains high, while logging moves C off-site leaving a greatly reduced total C store on forest land (Krankina and Harmon 2006). ...

Online Resource 2: Continental forest biomass map derived from NBCD2000 dataset



Online Resource 3: Map of Forest Biomass Classes and Disturbance between 2000-08 in the Pacific Northwest



Krankina, O. N., D. A. DellaSala, J. Leonard, and M. Yatskov. 2014. High-Biomass Forests of the Pacific Northwest: Who Manages Them and How Much is Protected? Environmental Management 54:112-121. https://www.oregon.gov/ODF/ForestBenefits/Documents/Forest%20Carbon%20Study/High-Biomass-Forestry-of-the-PNW-Who-manages-them-and-how-much-is-protected-Krankina.pdf.

The proposed amendment needs to recognize that the existing Northwest Forest Plan is already well suited to help ecosystems and species persist during a climate transition, with reserves and other mitigation that serve both as stable climate refugia, and as a network of well-connected habitat that helps wildlife move across gradients of elevation and latitude. To address the accelerating climate crisis and meet the requirements of various Executive Orders, the plan must incorporate a Climate Strategy which:

- Facilitates persistence of fish and wildlife populations by maintaining mature and old-growth forests as climate refugia, and maintaining reserves to facilitate movement of wildlife toward favorable habitat conditions within a dynamic landscape;
- Manages ecosystems to avoid carbon emissions and to maintain and increase carbon storage toward each ecosystem’s biological potential;
- Manages ecosystems to be resilient to climate change and amplified disturbance processes, while harmonizing with carbon storage goals by minimizing carbon emissions;

- Considers the social cost of carbon dioxide emissions when making decisions that will cause carbon emissions, such as logging.

The amendment should retain and improve the existing Northwest Forest Plan and conservation of species associated with late successional forests which represents a sound strategy to prepare for and mitigate global climate change.

The NW Forest Plan is by happenstance an excellent starting-place for a strategy for climate change preparation and adaption, but this plan is also under threat and could be strengthened and improved upon. The following elements of the NW Forest Plan (NWFP) make it a good climate strategy:

1. The plan spans a large dynamic landscape; The plan covers large contiguous federal ownerships which may permit the restoration of natural disturbance processes such as fire that can diversify the landscape, optimize carbon storage consistent with the carbon carrying capacity, and facilitate climate-driven changes in vegetation communities.
2. The plan includes a system of forest reserves that are large, well-distributed, redundant, and the spacing among reserves was consciously intended to facilitate dispersal of mobile organisms (and has a safety net for species that are less mobile). The reserve system is arranged along north-south gradients including the coastal ranges, and Cascades, as well as across elevational gradients and topographically diverse areas. This will help species move with changing climes. The reserves are managed under a rule set intended to protect and restore late successional ecosystems that have inherent ecological inertia, resistance, and resilience.
3. The Plan has an emphasis on maintaining biodiversity which is necessary to maintain the adaptive capacity of natural systems over the long term. The Plan helps maintain relatively large populations of imperiled species (viable populations instead of populations on the verge of jeopardy) which helps ensure that long-term persistence of species, populations, and genes.
4. The Plan helps reduce non-climate stressors by reducing the rate of logging and other activities, and imposing standards and guidelines that help minimize environmental impacts.
5. The Plan includes a variety of requirements for Watershed Analysis, Reserve Assessments, and monitoring that can act as an early warning sign for climate driven shifts in natural systems.
6. The forests covered by the NWFP contain a large amount of carbon that needs to be protected from logging and these forest landscapes have the capacity to store far more carbon if young forests are allowed to grow;
7. The original plan (before BLM approved the 2016 RMPs) emphasizes interagency cooperation and involves BLM lands that provide critical linkages between the Oregon Coast Range and Oregon Cascades.
8. There is an Aquatic Conservation Strategy that will help make hydrologic systems and aquatic ecosystems more resilient to climate change by moderating cumulative watershed effects, reducing the extent of the road system, emphasizing maintenance of riparian

areas, shade, floodplain processes, recruitment of large wood from both near stream areas and unstable slopes, and connectivity and fish passage.

The NWFP climate strategy could be improved by:

- closing some of the loopholes such as logging unprotected late-successional old-growth forests in the "matrix;"
- expanding the reserve system by including inventoried roadless areas, and uninventoried roadless areas 1,000-5,000 acres;
- reforming post-disturbance management practices such as salvage logging in order to protect complex early seral forests and facilitate diversity, resiliency, climate adaptation, and carbon storage;
- a more explicit emphasis on restoring ecological process that create and maintain resilient late successional ecosystems;
- adding an explicit goal to harmonize carbon storage, climate preparation, and ecological structure, function, and process;
- reaffirming that commodity production is a by-product of restoration, and climate preparation and mitigation; and
- greater emphasis on reducing the extent of the road system and storm-proofing the roads that are needed in order to prepare for an accelerated hydrologic cycle.

The Forest Service needs to refrain from a narrow focus on climate adaptation actions (such as density reduction with commercial log removal) that will actually increase carbon emissions and exacerbate global climate change. The agency instead need to work on actions that meaningfully harmonize climate change adaptation and climate change mitigation, such as non-commercial thinning + prescribed fire, increased riparian protection, mature and old-growth forest conservation, and road system rescaling and storm-proofing.

Global climate change is a new and significant threat not only to imperiled species, but also whole forest ecosystems and human communities. To reduce the severity of global climate change requires, among other things, that the global carbon cycle be managed to store more carbon. Carbon-rich ecosystems like mature & old-growth forests of western Oregon present a tremendous opportunity to increase carbon storage and mitigate climate change.

The NOI for the Northwest Forest Plan amendment gives lip service to climate change mitigation but is far too vague and non-committal about the role that Pacific Northwest National Forests can play. With the 1994 adoption of the NWFP and the significant reduction in logging, federal forests switched from a net source to a net sink of GHG emissions. Every timber sale diminishes progress toward goals for GHG emissions reductions.

Climate change is a new and significant reason to conserve forests and reduce logging. A science review will show that long-lived forests are a great place to store carbon, while wood products are relatively short-lived and not a good place to store carbon. Also, carbon can't be moved from the forest to durable wood products without causing significant net GHG emissions. Alleged benefits of wood products substitution for steel and concrete are vastly over-estimated. All high biomass forests should be conserved, and many young forests should be allowed to grow.

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

> "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; … to reduce greenhouse gas emissions; to bolster resilience to the impacts of climate change; … 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."

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.

A warmer world with more seasonal extremes of wet and dry also creates uncertainty about our ability to sustain older forests, and about whether we can recreate functional old forests starting from young, planted stands. If climate change brings increasing frequency and severity of drought and natural disturbance, it may be harder to sustain existing older forests and harder to establish new forests and sustain them through long periods of forest succession required to reach habitat goals for imperiled species like spotted owls, marbled murrelet, and salmon. This highlights the old adage that "a bird in the hand is worth two in the bush." We should retain all the older forests that we currently have (and carefully nurture likely recruitment forests). Climate uncertainty alone represents an increased risk for spotted owl recovery.

Undisturbed ecosystems and late successional forests are more resistant and resilient to climate change. György Kröel-Dulay et al (2015). Increased sensitivity to climate change in disturbed ecosystems. Nature Communications, 2015; 6: 6682. http://web.ics.purdue.edu/~jsdukes/Kr%C3%B6el-DulayEtAl_NC_2015.pdf. Climate change is a huge new stress on ecosystems that are already stressed. We can help ecosystems better withstand climate change by reducing anthropogenic stress caused by logging, roads, grazing, etc. Climate change is expected to amplify the hydrologic cycle. This calls for increased protection of whole watersheds and especially streams buffers (and reducing road/stream interactions). There may be a need for modest reductions in tree density, but only in limited areas. For wildlife that depend on dense forest conditions (i.e., most of our threatened & endangered species), logging to reduce stress or reduce fire hazard will only make things worse. Wildlife are more threatened by the combined effects of logging plus fire, than by fire alone.

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.

President Obama also established a clear policy mandate to minimize and mitigate 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.
> … Sec 2. Definitions … (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.
> …
> Sec. 3. Establishing Federal Principles for Mitigation. … (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).
>
> …
>
> 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 "worst-case" 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.
>
> …
>
> Some of the most obvious synergies between adaptation and mitigation are those aimed at enhancing carbon stocks in natural forests, … 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. … Recent research, however, indicates that old trees "do not act simply as senescent carbon reservoirs" 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.
>
> …
>
> It is not always obvious, however, when conservation and climate mitigation efforts might be in alignment or in conflict. … 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.

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.

Climate Resilience is Best Achieved Through Natural Processes, Not Logging

We are concerned that this amendment is motivated by 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 amendment should be adjusted accordingly and the agency should consider alternatives that are based on working with, instead of against, natural processes.

Science indicates that logging is still a greater adverse influence on ecosystem services compared to global climate change. A study comparing the loss of ecosystem services caused by climate change versus logging showed that "the effects of management on the future supply of these [ecosystem services] were, on average, 11 times higher than the effects of climate change …" Triviño, M., Morán-Ordoñez, A., Eyvindson, K., Blattert, C., Burgas, D., Repo, A., Pohjanmies, T., Brotons, L., Snäll, T., & Mönkkönen, M. (2023). Future supply of boreal forest ecosystem services is driven by management rather than by climate change. *Global Change Biology*, *29*(6), 1484-1500. https://doi.org/10.1111/gcb.16566. (Phys.org reported on this study: "Intensive forest management for timber production will have an overall negative effect on the ecosystem services provision (in five out of seven of the non-timber services evaluated), especially for forest biodiversity. On the contrary, climate change will have an overall positive effect on the ecosystem services provision (in six out of eight of the services evaluated). …[I]f the society wishes to retain high level of forest multifunctionality the focus should be on increasing forest protection.")

The federal land management 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. Ecosystems 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.

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 10–15,000 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).
>
> …
>
> 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.

…

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

…

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.

…

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).

…

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—and in many cases are less so—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).

…

[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).

…

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).

…

[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.

The NEPA analysis must be conducted within a framework of well-supported scientific facts, not outdated views of fire and management:

- *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 — 1984 to 2005. https://web.archive.org/web/20130214220819/http://www.mtbs.gov/reports/MTBS_pnw-psw_final.pdf ("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.")
    - Vaillant & Reinhardt 2017. An Evaluation of the Forest Service Hazardous Fuels Treatment Program—Are We Treating Enough to Promote Resiliency or Reduce Hazard? J. For. 115(4):300 –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) 4–14. 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 – Modeling Wildfires and Fire Severity. http://www.blm.gov/or/plans/rmpswesternoregon/files/draft/RMP_EIS_Volume3_appd.pdf. ("… 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. …")
- 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. ("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.")
- 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 ("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 "1984 perspective" 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 'record highs' 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 "fire deficit" 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).")

- *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 "is like trying to scoop water out of the ocean to make it less wet." "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. … 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't work that way, and fires are sparked in random places by lightning and humans, and they are pushed by erratic winds and weather. … According to Tania Schoennagel, a forest landscape ecologist and fire researcher at the University of Colorado, … 'it'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've pre-treated is so low. It's not a very effective lever. We don't know where fires are going to happen.'" 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; "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." Pohl, Kelly 2019. "For communities, land use planning is more effective than logging on federal lands to reduce future wildfire disasters." https://headwaterseconomics.org/wildfire/solutions/land-use-planning-is-more-effective/. Also, "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." 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 "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." 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 "… decades of data show that intense logging creates more destructive fires than the ones that burn through roadless areas, parkland and wilderness." 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, 3691–3703, 2013. https://www.biogeosciences.net/10/3691/2013/bg-10-3691-2013.pdf. ("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)") 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. ("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. …"). Montana Public Radio reported on Senator Daines' statement that "'radical environmentalists' 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 — standing dead trees — 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, 3691–3703, 2013. https://www.biogeosciences.net/10/3691/2013/bg-10-3691-2013.pdf. ("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)"). "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." 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. "**…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 ± 18.67 [mean ± SE]) vs. BLM forests (398.87 ± 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." 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 ("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. … [W]e found that on lands where active forestry is allowable, thinning of most densely stocked stands would not be economically viable. … 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. … 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 (± 4,600) acres, or less than 10 percent of the densely stocked acres (table 4-8). … … even when considered under the most favorable of assumptions, most densely stocked stands would not be treatable without significant investments.")
- *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—Are We Treating Enough to Promote Resiliency or Reduce Hazard? J. For. 115(4):300 –308. July 2017. https://doi.org/10.5849/jof.16-067. https://www.fs.fed.us/pnw/pubs/journals/pnw_2017_vaillant001.pdf. ("[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 … 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. … Areas of very low hazard often are favored for treatment because they are less complex to plan and implement, are more economical to treat,

… [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.")

- *Building codes and land use planning are more effective than logging to reduce community wildfire hazard*. Pohl, Kelly 2019. "For communities, land use planning is more effective than logging on federal lands to reduce future wildfire disasters." https://headwaterseconomics.org/wildfire/solutions/land-use-planning-is-more-effective/. ("[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."). 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. ("Abstract: … 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 (1990–2015), 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."). 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. "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)." 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 409:276–287. 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 - "Overall expected value of fire effects is moderately beneficial. This assumes that fires burn throughout the range of conditions – actual current practice is to suppress fires that are most likely to be beneficial." 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. … 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. … 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–urban interface. … Increasing the use of prescribed fires and managing rather than aggressively suppressing wildland fires can promote adaptive resilience as the climate continues to warm. … 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. … 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. … [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 (2001–2015) 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. … [R]oughly 1% of US Forest Service forest treatments experience wildfire each year, on average. The effectiveness of forest treatments lasts about 10–20 y, suggesting that most treatments have little influence on wildfire. … [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. … 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. … 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. …

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. M P North, R A York, B M Collins, M D Hurteau, G M Jones, E E Knapp, L Kobziar, H McCann, M D Meyer, S L Stephens, R E Tompkins, C L Tubbesing. 2021. Pyrosilviculture Needed for Landscape Resilience of Dry Western United States Forests, Journal of Forestry; https://doi.org/10.1093/jofore/fvab026 ("A management paradigm shift in fire use is needed to restore western forest landscape resilience. We propose a "pyrosilviculture" approach with the goals of directly increasing prescribed fire and managed wildfire and modifying thinning treatments to optimize more managed fire.") We would caution adoption of this paper's recommendation of using "revenue thinning" 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.

Disclose the Social Cost of Carbon Dioxide as a proxy for the impacts of GHG emissions.

The social, economic, and environmental costs of unmitigated climate change are astronomical. With a recognition that nature-based carbon storage can help mitigate those costs, it is becoming clear that conservation of nature, especially forests, creates far more value than natural resource extraction. Bradbury, R.B., Butchart, S.H.M., Fisher, B. et al. The economic consequences of conserving or restoring sites for nature. Nat Sustain (2021). https://doi.org/10.1038/s41893-021-00692-9. https://rdcu.be/cgpdK ("At $31/tonne [of carbon] the nature-focused state NPV was greater than the alternative state NPV at 100% of forest sites. … [W]hile these patterns hold for all goods combined and for non-excludable goods, the alternative state was often more valuable when only excludable goods were considered. Our findings thus provide a strong economic justification for incentives to encourage private landowners towards decisions that favour nature-focused land management to enhance overall social value.").

It is important for the NEPA analysis to quantify the total carbon emissions from logging then use proxies such as the social cost of carbon dioxide emissions to help explain the effects of those emissions.

The Biden Administration says it is *essential* that federal decision-making consider the full cost of agency actions that may harm the climate:

> **Sec. 5. Accounting for the Benefits of Reducing Climate Pollution**. (a) It is essential that agencies capture the full costs of greenhouse gas emissions as accurately as possible, including by taking global damages into account. Doing so facilitates sound decision-making, recognizes the breadth of climate impacts, and supports the international leadership of the United States on climate issues. The "social cost of carbon" (SCC), "social cost of nitrous oxide" (SCN), and "social cost of methane" (SCM) are estimates of the monetized damages associated with incremental increases in greenhouse gas emissions. They are intended to include changes in net agricultural productivity, human health, property damage from increased flood risk, and the value of ecosystem services. An accurate social cost is essential for agencies to accurately determine the social benefits of reducing greenhouse gas emissions when conducting cost-benefit analyses of regulatory and other actions. …
> (b) There is hereby established an Interagency Working Group on the Social Cost of Greenhouse Gases …
> (ii) Mission and Work. The Working Group shall, as appropriate and consistent with applicable law:
> (A) publish an interim SCC, SCN, and SCM within 30 days of the date of this order, which agencies shall use when monetizing the value of changes in greenhouse gas emissions resulting from regulations and other relevant agency actions until final values are published;
> (B) publish a final SCC, SCN, and SCM by no later than January 2022;

Biden 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/. Experts offered 8 steps to restating the social cost of carbon dioxide emissions. Gernot Wagner, David Anthoff, Maureen Cropper, Simon Dietz, Kenneth T. Gillingham, Ben Groom, J. Paul Kelleher, Frances C. Moore & James H. Stock. 2021. Eight priorities for calculating the social cost of carbon. Nature | Vol 590 | pp 548-550 | 25 February 2021. https://media.nature.com/original/magazine-assets/d41586-021-00441-0/d41586-021-00441-0.pdf. (1. Reverse Trump's changes. 2. Seek broad input. 3. Update damage functions. 4. Reappraise climate risks. 5. Address equity. 6. Review discount rates. 7. Update socio-economic pathways. 8. Clarify limitations.). See also, Wagner, Gernot. "Recalculate the social cost of carbon," *Nature Climate Change* (29 March 2021). doi:10.1038/s41558-021-01018-5.

Gifford Pinchot said "Where conflicting interests must be reconciled, the question shall always be answered from the standpoint of the greatest good of the greatest number in the long run." The social cost of carbon dioxide emissions is a useful yardstick for measuring "the greatest good to the greatest number" because it allows the agency to compare the centralized economic value of timber to the decentralized economic costs of greenhouse gases emissions from logging.

GHG emissions from fossil fuels, logging, and other land management activities impose significant costs on society, such as the cost of damage caused by climate change and the costs of adapting to climate change and the cost of sequestering carbon to mitigate emissions. The Social Cost of Carbon Dioxide could be referred to as the "climate misery index" related to the human impacts of greenhouse gas emissions. CEQ's draft guidance on NEPA and Climate Change recognizes that the Social Cost of Carbon Dioxide (SCC) is a "harmonized, interagency metric that can provide decision-makers and the public with some context for meaningful NEPA review." 79 Fed. Reg. 77802, 77827. "The SCC estimates the benefit to be achieved, expressed in monetary value, by avoiding the damage caused by each additional metric ton (tonne) of carbon dioxide (CO2) put into the atmosphere." Ruth Greenspan and Dianne Callan 2011. More than Meets the Eye: The Social Cost of Carbon in U.S Climate Policy, in Plain English (World Resources Institute, July 2011) at 1, http://pdf.wri.org/more_than_meets_the_eye_social_cost_of_carbon.pdf; Wentz, J. 2016. EPA's Use of the Social Cost of Carbon is Not Arbitrary or Capricious http://blogs.law.columbia.edu/climatechange/2016/03/07/epas-use-of-the-social-cost-of-carbon-is-not-arbitrary-or-capricious/. The NEPA analysis should carefully disclose these social costs. The express purpose of SCC analysis is to provide an apples-to-apples basis for comparing a project's economic benefits with GHG pollution impacts (costs). Where SCC is not analyzed and disclosed, these impacts (costs) are hidden from the public and, in fact, often "paid for" by the broader environment and public in the form of degraded ecological resiliency, public health impacts, and more.

For an example of how the social cost of carbon can be incorporated into NEPA analysis see Niemi (2015):

> Actions that reduce the amount of carbon stored in federal forests contribute to disruption of the global climate by increasing atmospheric concentrations of carbon dioxide. The climate disruption raises the risk of economic harm—locally, nationally, and globally—from extreme weather events, higher temperatures, changes in precipitation, rising sea levels, acidification of oceans, and changes in ecosystems. Laws and executive orders require managers of federal forests to account for these risks. This paper describes the recent failure of the Bureau of Land Management (BLM), to satisfy the requirements. It also describes the steps the BLM must take to meet its obligations, and illustrates the method the BLM and other federal forest management agencies should use to account for carbon-related risks in the future.
>
> The BLM failed to account for climate-related risks when it selected its Preferred Alternative for managing federal forests in western Oregon. If implemented, this alternative would yield more timber but less forest carbon than another alternative. Using old data and a conservative view of risk, the BLM provided information that indicates the additional climate-related costs may:
>
> - *Outweigh the additional timber-related benefits by 2-to-1.*
> - *Equal $91,000 per additional timber-related job.*
> - *Equal $4 for every $1 of additional timber-related payments to local counties.*
>
> Current data, plus a widely accepted view of risk indicates the additional climate-related costs may:
>
> - *Outweigh the additional timber-related benefits by more than 30-to-1.*
> - *Equal $1.6 million per additional timber-related job.*
> - *Equal $68 for every $1 of additional timber-related payments to local counties.*
>
> The BLM disregarded this information when choosing its Preferred Alternative. To satisfy its legal and administrative requirements, the BLM should fully and clearly describe the climate related risks that accompany the Preferred Alternative, and explain its justification for imposing these risks on the individuals, households, businesses, and communities that would bear them. This justification should address both the reduction in overall economic wellbeing that would result from implementing the Preferred Alternative and the moral issues that arise from imposing climate-related risk on those that would not enjoy the timber benefits.

Niemi, E. 2015. Accounting for Climate-Related Risks In Federal Forest-Management Decision, 10 May 2015 [draft]. Federal Forest Carbon Coalition Background Paper 2015–2. http://static1.1.sqspcdn.com/static/f/551504/26259333/1432605642583/SocialCostsOfCarbonOClandsNiemiMay2015.pdf?token=wDqoa5RkP8EoBLlsRWIPPRuahzg%3D.

***Stabilizing* Forest Carbon is not a Climate Solution.**

The FAC Subcommittee Ideas and Options Summary, suggests that the Northwest Forest Plan amendment adopt a goal to stabilize carbon in dry forests. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd1162343.pdf. This requires careful consideration, because while "stabilizing" forest carbon is a new buzzword that we often hear, it is NOT a climate solution. If this goal is advanced through this amendment process, the NEPA analysis must take a hard look at the adverse consequences for climate mitigation.

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'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 "savings" 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.

The NWFP EIS Analysis of Carbon and Climate Change is Outdated and Inaccurate.
The Plan Amendment EIS must provide a high quality analysis of the carbon consequences of logging under the Northwest Forest Plan. The EIS cannot tier to the carbon and climate change analysis in the NWFP FSEIS analysis because it is outdated and inaccurate. The 1994 FSEIS includes many flawed assumptions and assertions.

For instance, the 1994 FSEIS says "In mature and old-growth stands, release and absorption of carbon dioxide tend to be in balance." (p 3&4-50) In fact, new science indicates that old forests continue to grow and add substantial carbon. See Stephenson, N. L., A. J. Das, et al. 2014. Rate of tree carbon accumulation increases continuously with tree size. Nature | Letter (2014) doi:10.1038/nature12914
http://www.nature.com/nature/journal/vaop/ncurrent/full/nature12914.html ("Thus, large, old trees do not act simply as senescent carbon reservoirs but actively fix large amounts of carbon compared to smaller trees; at the extreme, a single big tree can add the same amount of carbon to the forest within a year as is contained in an entire mid-sized tree. The apparent paradoxes of individual tree growth increasing with tree size despite declining leaf-level8, 9, 10 and stand-level10 productivity can be explained, respectively, by increases in a tree's total leaf area that outpace declines in productivity per unit of leaf area and, among other factors, age-related reductions in population density.") Also, "Studies here [at the Wind River Canopy Crane] also proved it doesn't make sense from a global-warming perspective to cut older forests and replace them with seedlings, which grow faster and had been thought to absorb more carbon dioxide. Old forests are storehouses for such vast amounts of carbon that it would take many decades for new forests to catch up on the carbon balance sheet." Sandi Doughton. Trees giving bizarre clues to climate change. Seattle Times. Nov 27, 2007.
http://seattletimes.nwsource.com/html/localnews/2004037053_trees27m.html.

Moist forests in the pacific northwest are among the most important living carbon stores on the planet.

> ... the temperate biome contains a diversity of forest ecosystem types that support a range of mature carbon stocks or have a long land-use history with reduced carbon stocks. We describe a framework for identifying forests important for carbon storage based on the factors that account for high biomass carbon densities, including (i) relatively cool temperatures and moderately high precipitation producing rates of fast growth but slow decomposition, and (ii) older forests that are often multiaged and multilayered and have experienced minimal human disturbance.

...

> Our insights into forest types and forest conditions that result in high biomass carbon density can be used to help identify priority areas for conservation and restoration. The global synthesis of site data (Fig. 3 and Table 2) indicated that the high carbon densities of evergreen temperate forests in the northwestern United States, southern South America, New Zealand, and southeastern Australia should be recognized in forest biome classifications.

Heather Keith, Brendan G. Mackey and David B. Lindenmayer. 2009. Re-evaluation of forest biomass carbon stocks and lessons from the world's most carbon-dense forests. PNAS vol. 106 no. 28. 11635–11640, doi: 10.1073/pnas.0901970106
http://www.pnas.org/content/106/28/11635.full.pdf

> "[T]rees accelerate their growth as they get older and bigger, a global study has found. The findings, reported by an international team of 38 researchers in the journal Nature, overturn the assumption that old trees are less productive. It could have important implications for the way that forests are managed to absorb carbon from the atmosphere. "This finding contradicts the usual assumption that tree growth eventually declines as trees get older and bigger," said Nate Stephenson, the study's lead author and a forest ecologist with the US Geological Survey (USGS). "It also means that big, old trees are better at absorbing carbon from the atmosphere than has been commonly assumed." … "Rapid growth in giant trees is the global norm, and can exceed 600kg per year in the largest individuals," say the authors. The study also shows old trees play a disproportionately important role in forest growth. Trees of 100cm in diameter in old-growth western US forests comprised just 6% of trees, yet contributed 33% of the annual forest mass growth."

Vidal, John 2014. NEWS: Trees accelerate growth as they get older and bigger, study finds - Findings contradict assumption that old trees are less productive and could have important implications for carbon absorption" The Guardian, Jan 15, 2014.
http://www.theguardian.com/environment/2014/jan/15/trees-grow-more-older-carbon [*citing* Stephenson, N. L., A. J. Das, et al. 2014. Rate of tree carbon accumulation increases continuously with tree size. Nature | Letter (2014) doi:10.1038/nature12914
http://www.nature.com/nature/journal/vaop/ncurrent/full/nature12914.html ("Thus, large, old trees do not act simply as senescent carbon reservoirs but actively fix large amounts of carbon compared to smaller trees; at the extreme, a single big tree can add the same amount of carbon to the forest within a year as is contained in an entire mid-sized tree. The apparent paradoxes of individual tree growth increasing with tree size despite declining leaf-level and stand-level productivity can be explained, respectively, by increases in a tree's total leaf area that outpace declines in productivity per unit of leaf area and, among other factors, age-related reductions in population density.")]

The 500 year old forests at the site of the Wind River Canopy Crane were found to be sequestering net carbon.

> … researchers have found that the old growth in Wind River is still sequestering new carbon each year, adding to the huge amount it already stores. "Even just putting a thin annual growth layer on such a big cylinder is a huge deal," explains Ben Vierra, who manages NEON's research in the Pacific Northwest. Bible, deep in the grove, says: "This forest is still putting on forest. Quite a bit actually—it could give a young forest a run for its money."

BROOKE JARVIS 2020. Why Old-Growth Trees Are Crucial to Fighting Climate Change - Nature is already socking away a lot of carbon for us. It could soak up a lot more—if we help. WIRED 04.01.2020. https://www.wired.com/story/trees-plants-nature-best-carbon-capture-technology-ever/.

The 1994 FSEIS says "Wildfires have effects similar to logging, but over a shorter period of time." (p 3&4-50) In fact, logging and wildfire have very different effects on carbon flows. Logging tends to release relatively more carbon because logging removes the large wood where most of the carbon is stored, while fire tends to consume small fuels containing less carbon, leaving most of the large fuels (where most of the carbon is stored) unconsumed.

The 1994 FSEIS has an inaccurate analysis of the carbon consequences of fuel reduction:

> "The restoration silviculture permitted under Alternatives 3 and 9 … including prescribed underburning, may reduce forest susceptibility to large, stand-replacing fires. Thinning of small diameter trees in Late-Successional Reserves will accelerate the carbon dioxide absorption of the younger forest stands. Watershed/landscape-level emission trade-off analyses, as described in the following Air Quality Analysis, can determine an optimal level of fuel treatment to reduce carbon dioxide emissions. Thus, it is likely that Alternatives 3 and 9 would have the least impact on the global carbon dioxide balance in spite of having larger harvest levels than some of the other alternatives."

1994 FSEIS p 3&4 – 51.

New science indicates that logging for fuel reduction (or any other reason) is unlikely to provide carbon benefits. In almost all cases, the carbon that is removed by logging vastly exceeds the carbon gained by thinning or reducing fire effects. See 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://scholarsarchive.library.oregonstate.edu/xmlui/bitstream/handle/1957/26174/CampbellJohn.Forestry.CanFuelReductionTreatments.pdf. Mitchell, Harmon, O'Connell. 2009. Forest fuel reduction alters fire severity and long-term carbon storage in three Pacific Northwest ecosystems. Ecological Applications. 19(3), 2009, pp. 643–655.

http://www.fs.fed.us/pnw/pubs/journals/pnw_2009_mitchell001.pdf. 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) 1427–1435. 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; 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; 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.

Since there are significant trade-offs between logging and carbon storage, and since the 1994 FSEIS incorrectly analyzed the effects of logging, incorrectly assumed that logging would enhance carbon storage, and underestimated the importance of forests for carbon storage and climate change mitigation, the agency now has a duty to reconsider and rebalance the different uses of the forest and shift emphasis from logging toward carbon storage. This is especially important in this case, where the proposes to conduct logging that is likely to have a significant long-term impact on forest carbon storage, and this proposal is justified on the basis of following the forest plan which did not address carbon and climate issues. The EIS for this Plan Amendment must take a hard look at this important issue. The agencies' timber sale program may require reconsideration in light of climate change and the critical need for additional carbon storage.

Modernize the Forest Service Relationship With Wildfire

This Plan Amendment should modify fire suppression policies to give managers more discretion to let fires burn when weather conditions are appropriate so that fires can do their ecological work. It's time for the Forest Service to embark on a paradigm shift towards a new relationship with wildland fire and a new role for fire management, starting by amending all forest plans to allow more wildland fire use.

In developing a fire management policy that advances the original goals of the Northwest Forest Plan in the context of global climate change, the Plan Amendment should embrace the developing science of fire ecology as well as traditional ecological knowledge.

Critiques of fire exclusion go back a long time, but the misguided approach continues to this day. More than 100 years ago a letter to the editor in Southern Oregon said:

> The long continued smoky season and the great number of forest fires now burning have brought the subject of better forest protection into unusual prominence.

> There is little doubt that the next Legislature will enact some changes in the fire laws, but there is also little hope that these changes will be in the right direction. It will probably yet take some years of experience and the destruction of much valuable timber to convince the legislators of the entire error of the present system, which is based on the theory of keeping all fire out of the timber forever, an absurd impossibility. The longer fire is kept out of the woods, the more destructive the fire will be when it does come, as it certainly will in time.
>
> The only way to protect the forests is by frequent burnings, the fires of which will not develop heat enough to injure the larger growths. This idea prevails among experienced woodsmen, but not among those who control legislation. The probable amendments to the fire laws now in force will be to make them more stringent and to exact a heavier penalty for their violation.

Rogue River Courier, Sept. 22, 1904. This letter could have been written in 2023.

> Today wildfire is largely approached as a problem that can be controlled through vegetation treatments and firefighting, but that strategy has not stopped the loss of homes and even entire communities. However, new observational and analytical tools have given firefighters, governments, and the public a better understanding of wildfire and how to prepare for it. By redefining the wildfire problem as a home ignition problem, communities can survive even extreme fires and can safely reintroduce fire to the land.
>
> …
>
> **Reintroducing fire to the land**
>
> Understory thinning of shrubs, saplings, and the lower limbs of large trees can help prepare the ground surface for the safe and controlled reintroduction of fire by indigenous, cultural, and prescribed-fire practitioners. This kind of understory thinning more often resembles cutting or pruning, not removal of trees, and it is generally followed by pile and broadcast burning of the ground surface where dead limbs and needles accumulate. These surface and understory fuels are decomposed by soil microbes, providing nutrients for new plants. Fire is the most effective, economical, and natural method for reducing fuels and providing nutrients for vegetation (FDACS n.d.).
>
> …
>
> **Redefining the problem**
>
> Jack Cohen, a retired US Forest Service research physical scientist, says wildfire must be redefined as a building ignition problem, because defining the wildfire itself as the problem is not working or realistic (Cohen n.d.). Fires are inevitable, and there will always be wind-driven fires that escape control. By redefining the problem, Cohen seeks to change the focus from trying to control uncontrollable fires to taking preventive measures that protect homes and communities (Joyce 2018).

Beverly Law, Ralph Bloemers, Nancy Colleton and Mackenzie Allen 2023. Redefining the wildfire problem and scaling solutions to meet the challenge. BULLETIN OF THE ATOMIC SCIENTISTS, 2023, VOL. 79, NO. 6, 377–384, https://doi.org/10.1080/00963402.2023.226694.

> ... [S]ome important research that is raising critical questions about the efficiency and effectiveness of wildfire suppression, especially of large wildfires that are the real budget-busters. Butry et al. (2008) stated, "We find no evidence that large wildfires respond to wildland management ... . Instead, large fires appear sensitive only to weather and landscape conditions." Indeed, Finney et al. (2009) and Butry et al. (2008) demonstrated what firefighters have long known: aggressive suppression actions are ineffective in containing the spread of large wildfires unless and until the fire encounters moderate weather or low fuel conditions. However, Calkin (2014) disclosed that, on average, 35% of firefighting crews and resources are ordered after a large wildfire has stopped growing and essentially defined its own boundaries. Aviation resources are typically one of the most expensive resources and comprise a major portion of total suppression expenditures. There is a common misperception by people that aerial retardant drops extinguish flames, but in fact, retardant only slows down the rate of spread. Accordingly, air tankers are best suited for the initial attack, but 75% of fires with air tanker drops escape the initial attack and become large wildfires (Calkin, 2014). Air tankers are least effective on large wildfires because the weather conditions that fuel large fires overwhelm the effect of chemical retardants; nevertheless, the majority of air tankers are used on large wildfires (Thompson et al., 2013a). Moreover, the largest percentage of air drops occur in late afternoons on steep slopes in dense timber stands—the times, places, and conditions in which aerial retardant is least effective (Calkin, 2014). Given the emerging research that questions the effectiveness of some of the more expensive suppression resources and methods, and factoring in the ecological costs of fire exclusion, the case for finding alternatives to aggressive suppression becomes stronger.

Timothy Ingalsbee and Urooj Raja 2015. The Rising Costs of Wildfire Suppression and the Case for Ecological Fire Use. In The Ecological Importance of Mixed-Severity Fires: Nature's Phoenix. Edited by Dominick A. DellaSala, and Chad T. Hanson. https://www.fusee.org/wp-content/uploads/2018/06/RIising-Costs-of-Suppression-Ch.12.pdf

> We propose that by more rigorously researching suppression actions and refocusing on evidence rather than intuition as the basis for management decisions, the US Forest Service could better understand and improve the quality of its management operations. ... What Does Effective Response Look Like? How Would We Know? The fire community has struggled to define meaningful and actionable performance measures for some time (Booz Allen Hamilton 2015). Perhaps the starkest example is the oft-cited metric that initial attack to unplanned ignitions on federal lands is successful 95–98 percent of the time. Peering behind the curtain, however, reveals some illuminating insights. First,

natural constraints on fire size (e.g., the episodic nature of weather events conducive to high fire-spread potential) means that there is some nontrivial baseline level of fires that would have extinguished absent human intervention (M. Finney, personal communication). Second, choosing to extinguish those fires that might have spread under nonextreme conditions forecloses opportunities to yield ecological benefits, reinforcing the fire paradox (Calkin et al. 2015; Barnett et al. 2016b). Third, and perhaps most important, this metric is effectively premised on the differentiation of fires on the basis of “wanted” versus “unwanted,” a classification that is nonexistent in any federal reporting systems (K. Short, personal communication). Tabulating this metric on the basis of all fires that received a response assumes in effect that all fires are unwanted, seemingly in conflict with Federal Wildland Fire Policy stating that “wildland fire will be used to protect, maintain, and enhance resources and, as nearly as possible, be allowed to function in its natural ecological role” (Fire Executive Council 2009). This appears to create a powerful cognitive dissonance that possibly perpetuates the fire exclusion paradigm and the model of emergency response. That is, there may be intrinsic problems with how initial attack is conceptualized and executed. The Frog Fatality Report (US Forest Service 2016) aptly summarizes the situation as follows: “In the current wildland firefighting culture, aggressive initial attack is highly valued and is generally the standard operating procedure . . . . Firefighters currently see themselves as most successful when they catch the fire and feel like they’ve failed when they lose a fire.”

Questions similarly exist about suppression effectiveness in the more complex large fire environment (i.e., for those rare fires that escape initial attack efforts or are intentionally managed from detection as a resource benefit fire—the latter is even rarer). Research findings indicate that fire weather can be the dominant influence on containment probability, that managers exhibit wide variability in use of suppression resources when responding to fires with similar characteristics, that managers commit substantial levels of resources after fire growth has largely ceased, and that suppression resources are often used outside of conditions where use is likely to be effective (Finney et al. 2009; Stonesifer et al. 2016; Hand et al. 2017; Katuwal et al. 2017). A critical take is that default responses are possibly ineffective during extreme fire weather and possibly counterproductive during moderate fire weather (while recognizing that quiescent periods of weather may provide critical windows for containment in advance of more extreme weather). ...

Only through development of more robust systems of accountability and performance measurement can effective behaviors be identified, evaluated, and rewarded. An objective and attainable approach to performance measurement could begin by examining environmental conditions that influence probability of success. It has been established that under extreme fire weather conditions, certain types of suppression operations are of little use, exceedingly expensive, and can be highly dangerous. Thus, metrics could, for instance, examine the number and type of assignments leading to active suppression operations under extreme weather conditions, with a target of minimizing these types of assignments.

Matthew P. Thompson, Donald G. MacGregor, Christopher J. Dunn, David E. Calkin, and John Phipps. 2018. Rethinking the Wildland Fire Management System. J. For. 116(4):382–390 doi: 10.1093/jofore/fvy020 https://www.fs.fed.us/rm/pubs_journals/2018/rmrs_2018_thompson_m001.pdf.

> Community fire destruction has become a national crisis, a systemic problem that will only worsen without aggressive, appropriate intervention—and this intervention will have to look far different than the current dominant paradigm.
> Climate change is blurring the boundaries that had defined where, when, and how fires burn (1). The needed changes will challenge ideas, institutions, and policies. The first step: reframing, from a focus on the wildlands to one centered on the structure and its immediate surroundings.
> To effectively address this urban conflagration crisis requires that we fundamentally redefine the WU fire problem. …
> Reducing the likelihood that a home will ignite interrupts the disaster sequence by enabling effective structure protection. New construction siting, design, construction materials, and landscaping requirements should take wildfire potential into account. This will improve community resilience and ensure that new development does not increase community risk. The best way to make existing wildfire-vulnerable developments ignition resistant is to work within the limited area of the "home ignition zone"—a home and its surroundings within 100 feet (which may include neighboring homes). There are ways to reduce home ignition risk. Homeowners should install nonignitable roofing materials and flame- and ember-resistant vents; clean gutters of flammable debris; ensure that wooden steps, fences, and decks do not directly contact a home's flammable materials; and remove flammable materials immediately surrounding buildings and under attached decks (9–11). Initiating substantial changes to the built environment requires that all levels of society address deeply rooted cultural expectations and develop a fundamentally new paradigm for community and homeowner responsibility.
> … [R]eforms must recognize an important truth: The current wildfire management approach has inverted the wildfire problem. wildland fires do not, per se, encroach on communities. Rather, it's communities that have impinged on wildlands, where fires play an important ecological role. … Communities and governments need to accept living with wildland fire. They must recognize that fire in the wildlands is ecologically appropriate and inevitable—and it does not significantly influence community fire destruction (16). To do this, we must communicate differently on the nature of the WU fire problem and the ecological necessity of wildland fire. We must empower our public

> land managers and tribal partners to utilize fire appropriately to sustain resilient ecosystems and adapt our communities to this natural reality. … The recent addendum to the "National Cohesive wildland Fire Management Strategy" (19) specifies an important goal: "Human populations and infrastructure are as prepared as possible to receive, respond to, and recover from wildland fire." Achieving this vision means confronting the failed approach of trying to remove fire from our landscapes.
> We have the tools and knowledge to reduce community wildfire risks. But we must address the profound and deeply rooted misalignment of political and social expectations regarding what it means to live with wildfire. Now is the time to invest in longterm, economically efficient solutions, rather than shortterm, risk-averse tactics. We have to live with wildland fire. We don't have to live with fire in our communities.

Calkin, D. E., Barrett, K., Cohen, J. D., Finney, M. A., Pyne, S. J., & Quarles, S. L. (2023). Wildland-urban fire disasters aren't actually a wildfire problem. *Proceedings of the National Academy of Sciences*, *120*(51), e2315797120. https://doi.org/10.1073/pnas.2315797120

Many NEPA analyses present the effects of wildfire under the no action as negative, and the effects of wildfire under the action alternatives as beneficial. However, the 2017 Fuels Report for the East Hills Project on this Fremont-Winema NF admits that wildfires are expected to have beneficial effects even under the no action alternative - "Overall expected value of fire effects is moderately beneficial. This assumes that fires burn throughout the range of conditions – actual current practice is to suppress fires that are most likely to be beneficial." https://www.fs.usda.gov/nfs/11558/www/nepa/101283_FSPLT3_4264365.pdf. Based on this information, the correct way to describe the effects of the action and no action alternatives with respect to how they interact with wildfire is varying degrees of beneficial impacts. This also indicates a need to modify fire suppression practices and work *with* fire when weather conditions are favorable.

> Most contemporary fires in mixed conifer forests of western North America are mixed-severity fires. In the Pacific Northwest, mixed-severity fires include unburned and low severity areas that account for 50%–60% of total burn area, and only 13% of total burn area experiences high severity (90% tree mortality; Halofsky et al., 2011; Law & Waring, 2015).

Polly C. Buotte, Samuel Levis, Beverly E. Law, Tara W. Hudiburg, David E. Rupp, Jeffery J. Kent. Near-future forest vulnerability to drought and fire varies across the western United States. Global Change Biology, 2018; DOI: 10.1111/gcb.14490. https://onlinelibrary.wiley.com/doi/pdf/10.1111/gcb.14490.

Wildfire Resilience and Fuel Management Need to Focus on Effective Strategies, Not Another Excuse for Logging

Addressing the wildfire issue with clarity requires humility. Changes in wildfire are being driven by top down forces that are much larger than any realistic effort we might make to push back.

Modifying wildfire behavior on a meaningful scaler requires an perpetual effort and investment that is unreasonable to expect, and it would also cause unacceptable effects on the biodiversity values that the Northwest Forest Plan was intended to conserve.

The fuel and fire management issue needs to be bifurcated with one part focused on community protection, and another part focused on fire reintroduction in our forests. The goal is to keep fire out of our houses and in our forests where it belongs. Community projection is best achieved with efforts on non-federal land, such as home hardening and fuel work in the structure ignition zone. In our forests, we need a new paradigm that welcomes or at least tolerates fire as a natural process. Much good can be accomplished with non-commercial thinning and prescribed fire during favorable weather.

To put it bluntly, we are concerned that the Forest Service is exploiting a perceived wildfire crisis to reduce forest protection and increase logging— logging that has uncertain benefits at best, and undeniable adverse trade-offs for carbon, water, wildlife, etc. A careful review of fire effects regionally shows that most wildfires burn in a mosaic with large patches of low and moderate severity providing tremendous ecological benefits. A balanced view of wildfire requires that we credit fires for the ecological work they do. Extreme fire effects are driven mainly by extreme weather, making these undesired effects mostly unresponsive to fuel management.

Logging has complex effects on wildfire risk. In many cases logging can make fires more destructive instead of less. For instance, removing medium and large trees reduces the forest canopy, making the forest hotter and dryer. Removing canopy trees also stimulates the growth of highly flammable brush and grasses that can spread fire quickly through the landscape. These surface and ladder fuels are expensive to treat and appear years after the logging occurs, so they are often neglected. If the Forest Service is serious about fire mitigation they should stop clearcutting and heavy thinning that produces highly hazardous fuel conditions, retain mature and old-growth forests that are relatively fire resistant and resilient, and modify fire suppression policies.

The management response to fuel management must be careful and calibrated. Western forests evolved with fire. Mature and old-growth forests are relatively more resistant and resilient to wildfire, compared to managed forests. Wildfires do important ecological work to maintain and diversify forests. There is no compelling evidence that mature and old-growth forest ecosystems receive net benefits from commercial logging to reduce fuels. The best evidence is that the spotted owl and other wildlife would fare better under the influence of wildfire, than under the combined effects of logging plus wildfire.

The Forest Service must recognize that its ability to modify wildfire effects at scale are highly uncertain and modest at best. Attempts to modify fire effects must therefore be highly targeted, and wisely focused on community protection, which science tells us is best achieved by focusing on the structure ignition zone. Outside the structure ignition zone, fuel reduction must be harmonized with the core ecological restoration goals of the Northwest Forest Plan.

There is concern that timber targets that are based on a cycle of regeneration harvest are outdated, and misaligned with priorities such as fire hazard reduction. New information shows that regen logging increases fire hazard for many decades via the establishment of homogeneous young conifer stands with dense fuels close to the ground. See 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. This concern is highlighted by climate change which is extending the fire season. Roads also increase roadside ladder fuels and fire ignition risk. Conversely, another study shows that mature forests are more resilient to wildfire (and can serve as fire refugia for imperiled species), which brings into question the long-held assumption that time-since-fire is an indicator of fuel build-up and increased fire hazard. Lesmeister, D. B., S. G. Sovern, R. J. Davis, D. M. Bell, M. J. Gregory, and J. C. Vogeler. 2019. Mixed-severity wildfire and habitat of an old-forest obligate. Ecosphere 10(4):e02696. 10.1002/ecs2.2696. https://esajournals.onlinelibrary.wiley.com/doi/pdf/10.1002/ecs2.2696.

Shaded fuel breaks implemented non-commercially with significant canopy retention may be an effective tool for fire management, IF they are maintained over time. Fuel breaks along roads also pose a significant risk of weeds, habitat fragmentation, exacerbating barriers to wildlife, impaired wildlife connectivity, loss of wildlife cover, loss of snag habitat, facilitating unauthorized OHVs, etc. If the Plan Amendment encourages the use of fuel breaks or potential operational delineations (PODs), we urge the Forest Service to address the trade-offs and develop standards & guidelines to mitigate these trade-offs:

- Shaded fuel breaks will be much more effective than linear clearings. Maintaining a reasonably dense canopy will mitigate habitat fragmentation effects, as well as lower maintenance costs by suppressing growth of surface and ladder fuels. Focus on small (<9" dbh) surface and ladder fuels within 150 feet of roads;
- Focus fuel break treatments near roads. Fire management goals can typically be met by focusing on small fuels within 150 feet from roads. In a survey of fuel breaks in California "average width of fuel breaks in this sample was 116.9 meters" which is less than 200 feet from roads. Stephens, Collin, Omi, Johnson 2023. FINAL REPORT: Manager Perspectives on Fuel Break Effectiveness and Configurations.   JFSP PROJECT ID: 19-2-01, March 2023. https://mcusercontent.com/5f6de7b069a57255f980944b4/files/68ab7c9b-a224-e68b-a3fa-97077e22b662/19_2_01_1.pdf.

- Focus on treating plantations and previously logged stands. Avoid/minimize treating mature & old-growth, riparian areas, and roadless/unroaded areas.
- Treatments in reserves and land allocations with an ecological mandate should be avoided where possible, and minimized/modified to retain more large wood and diverse vegetation to meet objectives for the RMP.
- Use manual treatments (hand felling, lop-and-scatter, burning small piles) instead of heavy equipment. This will protect soil, water quality, and fire resilient native plants;
- Retain dense, mid-to-high canopy to help maintain a cool, moist microclimate, retain fuel moisture, and help suppress the growth of surface and ladder fuels (which also minimizes maintenance costs);
- Retain deciduous hardwoods which can serve as heat sinks during fires;
- Retain important elements of diversity where possible, such as Pacific yew, and some patches of shrubs that produce berries, nuts, nectar, etc. (food for wildlife), and to provide intermittent opportunities for wildlife crossing the road;
- Consider and minimize the effects on large and small wildlife that need to cross roads. Opening the forest reduces cover and increases barriers to safe movement of wildlife;
- Treat a well-planned network of roads that ideally create polygons with a high ration of area/perimeter. Too much redundancy will create cumulative impacts. Larger PODs have a more favorable ratio of area/perimeter, which reduces cumulative effects. Possibly consider smaller PODs within the WUI, and larger PODs further out. Reduce cumulative effects by avoiding redundant fuel breaks, e.g. avoid treating nearby parallel roads.
- Plan and account for recurring maintenance costs, e.g., manual thinning, prescribed fire, weed control, etc. Avoid commercial logging in the first instance because log values will not be a recurring feature of POD maintenance. The fuels removed should be smaller over time, not larger.
- PODs planning must be truly interdisciplinary, not just in name only.
- NEPA analysis of PODs should be both programmatic and site-specific.

The NEPA analysis should consider the environmental effects of connected actions, including recurring maintenance and fire suppression activities. The NEPA analysis should disclose the essential connection between fuelbreaks and fire suppression, and disclose what kinds of potential suppression activities, such as fireline construction with hand crews or bulldozers, fire retardant chemical dumping, backfire and burnout operations, hazard tree felling could occur within the fuelbreaks, and disclose the general effects on soils, watersheds, and species of interest

Weeds are definitely a potential big problem with fuel breaks, especially the combination of frequent disturbance caused by recurring maintenance, and road use as a vector for weeds.

> "[W]e found that 19 of the 24 fuel breaks had significantly higher relative nonnative cover than the adjacent wildland areas.... Time since construction was strongly associated with nonnative abundance when we evaluated all of the fuel breaks together.... A number of different species assumed dominance... suggesting that many nonnative species may be well adapted to take advantage of the conditions provided by fuel treatments.... [F]uel

breaks with more canopy and ground cover may be less likely to be invaded.... We found that nonnative cover decreased with distance from the fuel break, suggesting that fuel breaks act as sources of nonnative plant seeds during the invasion of adjacent areas."

Merriam, K.E., Keeley, J.E., and Beyers, J.L., 2007, The role of fuel breaks in the invasion of nonnative plants: U.S. Geological Survey Scientific Investigations Report 2006-5185, 69 p. http://pubs.usgs.gov/sir/2006/5185/pdf/sir_2006-5185.pdf.

In another publication, the authors warn that fuel breaks are of unproven effectiveness in the face of extreme fire weather, and suggest that an extensive system of fuel breaks would "create edges and edge effects, serve as vectors for wildlife movement and plant invasions (like cheatgrass), and fragment otherwise contiguous sagebrush landscapes."

Douglas J Shinneman, Matthew J Germino, David S Pilliod, Cameron L Aldridge, Nicole M Vaillant, Peter S Coates 2019. The ecological uncertainty of wildfire fuel breaks: examples from the sagebrush steppe. Frontiers in Ecology and Management. Vol 17, Issue 5, June 2019. Pages 279-288. https://esajournals.onlinelibrary.wiley.com/doi/pdf/10.1002/fee.2045 ("Given uncertain outcomes, we examine how implementation of fuel breaks might (1) directly alter ecosystems, (2) create edges and edge effects, (3) serve as vectors for wildlife movement and plant invasions, (4) fragment otherwise contiguous sagebrush landscapes, and (5) benefit from scientific investigation intended to disentangle their ecological costs and benefits.").

Fuel Reduction is Unlikely to Confer Benefits for Spotted Owl Conservation

Any attempt to amend the Northwest Forest Plan to facilitate fuel reduction logging must openly consider and weigh the trade-offs. Fuel is habitat, so fuel reduction is habitat reduction. New standards need to be developed and applied before fuel reduction logging can be justified in valuable habitat areas. This requires several findings: (1) that wildfire is highly likely to occur at the site of the treatment, (2) that if fire does occur it is likely to be a severe stand-replacing event, and (3) that spotted owls are more likely to be harmed and imperiled by wildfire than by logging at a scale necessary to reduce fire hazard. Available evidence does not support any of these findings, which raises serious questions about the need for and efficacy of logging to reduce fuels in western Oregon and other forests lacking frequent fire return intervals. The probabilistic element of the risk equation demands careful consideration. Both logging and fire have meaningful consequences, so the issue really boils down to a comparative probabilistic risk assessment where risk is characterized by two quantities: (1) the magnitude (severity) of the possible adverse consequence(s), and (2) the likelihood (probability) of occurrence of each consequence. See Heiken, D. 2010. Log it to save it? The search for an ecological rationale for fuel reduction logging in Spotted Owl habitat. Oregon Wild. v 1.0. May 2010. https://www.dropbox.com/s/pi15rap4nvwxhtt/Heiken_Log_it_to_save_it_v.1.0.pdf?dl=0.

Framework for Assessing the Risk of Wildfire vs Fuel Reduction Logging			
	Likelihood of event	Magnitude of harm	Net Benefit

Wildfire	LOW: Stand replacing wildfire is not common in western Oregon. Fire suppression policy prevails. The chance that any given acre of forest will experience wildfire is low.	LOW: The majority of wildfire effects are not stand replacing. Fire is a natural process to which native wildlife are adapted. There is still a deficit of natural fire processes on the landscape.	Fire is likely less harmful to habitat than fuel reduction logging.
Logging	HIGH: To be effective in controlling fire, logging must be very extensive, and sustained. Many more acres would need to be logged than would burn.	HIGH: Widespread logging will have significant impacts on canopy, microclimate, understory vegetation, down wood, and long-term effects on recruitment of large trees and snags.	Fuel reduction logging is likely more harmful to habitat than wildfire.

An insurance analogy might help. People buy fire insurance for their homes because they can pay a small amount in order to receive benefits in the improbable event of fire. Fuel reduction logging is like an insurance policy that hedges against the chance that fire might occur, but instead of paying with money we are paying with late successional habitat units (because logging late successional habitat to reduce fuels unavoidably degrades and removes habitat). We are also expecting benefits in habitat units. This means the agency can conduct an analysis to show whether the fire insurance payments are worth it from a habitat perspective. The agency can quantify whether logging results in a greater assurance of habitat maintenance, or not. When this analysis is conducted it is clear that fuel reduction logging is just not worth it, because, simply put, the price of insurance is far too high. Logging will degrade habitat across many acres that will never experience any benefits from modified wildfire. Fuel reduction logging is like paying 100 habitat units for insurance and receiving 10 habitat units of benefits.

Use of best available science requires the Forest Service to describes "the true condition of its subject matter" (Forest Service Handbook [FSH] 1909.12 sec 07.12, Figure 1). In the case of determining the effectiveness of logging to reduce fuel and modify fire behavior requires the agency to account for the low probability that fuel treatments will interact with wildfire, and therefore the low probability that fuel treatments will confer benefits to wildlife habitat and other values. Any analysis that assumes that fire is likely to affect treated sites is not using best available science.

Furthermore, logging for purposes of fuel reduction has impacts on owl and prey habitat that remain under-appreciated, especially the reduction of complex woody structure, and the long-term reduction in recruitment of large snags and dead wood. Fuel reduction logging also has complex effects on fire hazard with potential to increase fire hazard, especially when fuel reduction efforts involve removal of canopy trees. Ganey et al (2017) said "Existing studies on the effects of fuels reduction treatments on spotted owls universally suggest negative effects from these treatments (Meiman et al. 2003, Seamans and Gutiérrez 2007, Stephens et al. 2014a, Tempel et al. 2014)." Ganey, J.L., H.Y. Wan, S.A. Cushman, and C.D. Vojta. 2017. Conflicting perspectives on spotted owls, wildfire, and forest restoration. Fire Ecology 13(3): 146–165. doi: 10.4996/ fireecology.130318020.
http://fireecologyjournal.org/docs/Journal/pdf/Volume13/Issue03/ganey-318.pdf

BLM admits that "The treatment of a stand to improve its fire resiliency commonly reduces the immediate value of the stand for northern spotted owls." BLM 2016. PRMP and FEIS for the Resource Management Plans in Western Oregon. Appendix W - Response to Comments, p 1985. https://web.archive.org/web/20190304042302/http://www.blm.gov/or/plans/rmpswesternoregon/files/prmp/RMPWO_Vol_4_Appendix_W.pdf

It is important to recognize that forest wildlife evolved in ecosystems with fire so wildfire may not be adverse to wildlife. Bond (2016) reports changing evidence about the effects of fire on the three subspecies of spotted owls.

> As spotted owls are associated with dense, late-successional forests, biologists typically assumed that fires that burned at high intensity were similar to clearcut logging and had a negative impact on long-term survival of the species. Many land managers now believe that high-severity fires pose the greatest natural risk to owl habitat (Davis et al., 2016). Fire, however, is a different type of disturbance than logging. Before data were collected from spotted owls in burned forests, it was not unreasonable to assume that high-severity fire might eliminate habitat because it reduces canopy cover, kills trees, and consumes coarse woody debris—all of which comprise important structure for owls and their prey—but current research is revealing that a surprising number of spotted owl sites continue to be occupied and reproductively successful after experiencing fires of all intensities and that populations are quite resilient to fire. Further, spotted owls utilize complex early seral forests for foraging, providing evidence that severely burned forests can benefit spotted owls depending upon its extent and configuration (Bond et al., 2009; Comfort et al., 2016). Spotted owls evolved in landscapes where severe fire was an important component historically (Baker, 2015) …
>
> One reason why spotted owls remain in burned territories is that fire enhances habitat for some of their primary prey species. … Many small mammal species are more abundant in shrub- and herb-dominated habitats, vegetation typical of recently burned complex early seral forests.
>
> …
>
> **Conclusions: An Emerging New Paradigm About Spotted Owls and Severe Wildfire**
>
> • Most spotted owl pairs generally survive and continue to reproduce in breeding sites that experienced severe fire across the range of the three owl subspecies.
>
> • Lower-quality sites (often vacant and nonreproductive) have lower occupancy with increasing amounts of severe fire, whereas higher-quality sites (occupied and reproductive before fire) remain occupied at similar rates as long-unburned forests, regardless of amount of severe fire.
>
> • Spotted owls nest and roost in forested stands with high canopy cover (unburned/low burned) even in burned landscapes.
>
> • Spotted owls forage in severely burned stands.

• Home-range sizes are similar in burned and unburned landscapes.
• Postfire logging is correlated with site abandonment and reduces survival.
• Studies of spotted owls in burned forests not subjected to postfire logging are necessary in order to separate and understand the relative influence of each disturbance.

> Contrary to current perceptions and recovery efforts for the spotted owl (USFWS, 2011, 2012), high-severity fire does not appear to be an immediate, dire threat to owl populations that requires massive landscape-level fuel-reduction treatments to mitigate fire effects (see, e.g., Hanson et al., 2009). Empirical studies conducted from 1 to 15 years after fires demonstrate that most burned sites occupied by spotted owl pairs remain occupied and reproductive at the same rates as long-unburned sites, regardless of the amount of high-severity fire in core areas. Burned sites where owls are not detected immediately after fire are often recolonized later, demonstrating the folly of concluding those sites permanently "lost" to spotted owls.
> …
> Harvesting timber to lower risk of fire has adverse effects on spotted owls (e.g., Tempel et al., 2014), whereas fire itself has both costs and benefits depending on many factors. It is important to critically weigh these costs and benefits, especially since spotted owls evolved in landscapes shaped by wildfires (Baker, 2015). Odion et al. (2014) simulated changes in northern spotted owl habitat over a 40-year period following fire and the type of thinning typically proposed by federal land managers. The simulation showed that thinning over large landscapes would remove 3.4–6.0 times more late-successional forest over time in the Klamath and dry Cascades than forest fires would, even given a future increase in the amount of high-severity fire.

Bond, M.L. 2016. The Heat Is On: Spotted Owls and Wildfire. Reference Module in Earth Systems and Environmental Sciences http://dx.doi.org/10.1016/B978-0-12-409548-9.10014-4. See also, Bond, Monica L., Tonja Y. Chi, Curtis M. Bradley, and Dominick A. DellaSala. 2022. "Forest Management, Barred Owls, and Wildfire in Northern Spotted Owl Territories" Forests 13, no. 10: 1730. https://doi.org/10.3390/f13101730.

Another study showed that suitable spotted owl habitat is relatively resilient to fire effects.

> Pre-fire nesting/roosting habitat had lower probability of burning at moderate or high severity compared to other forest types under high burning conditions. Our results indicate that northern spotted owl habitat can buffer the negative effects of climate change by enhancing biodiversity and resistance to high-severity fires, which are predicted to increase in frequency and extent with climate change. Within this region, protecting large blocks of old forests could be an integral component of management plans that successfully maintain variability of forests in this mixed-ownership and mixed-severity fire regime landscape and enhance conservation of many species.

Lesmeister, D. B., S. G. Sovern, R. J. Davis, D. M. Bell, M. J. Gregory, and J. C. Vogeler. 2019. Mixed-severity wildfire and habitat of an old-forest obligate. Ecosphere 10(4):e02696. 10.1002/ecs2.2696. https://esajournals.onlinelibrary.wiley.com/doi/pdf/10.1002/ecs2.2696.

Lesmeister et al (2021)--

> We examined the relationship between fire severity and suitable nesting forest in 472 large wildfires (> 200 ha) that occurred in the northern spotted owl range during 1987–2017. … Averaged over all fires, the interior nesting forest burned at lower severity than edge or non-nesting forest. These relationships were consistent within the low severity, very frequent, and mixed severity, frequent fire regime areas. … Over the 30-year study, we found a strong positive trend in the proportion of wildfires that burned at high severity in the non-nesting forests, but not in the suitable nesting forest types. Conclusions: Under most wildfire conditions, the microclimate of interior patches of suitable nesting forests likely mitigated fire severity and thus functioned as fire refugia (i.e., burning at lower severity than the surrounding landscape). With changing climate, the future of interior forest as fire refugia is unknown, but trends suggest older forests can dampen the effect of increased wildfire activity and be an important component of landscapes with fire resiliency.

Lesmeister, D.B., Davis, R.J., Sovern, S.G. et al. Northern spotted owl nesting forests as fire refugia: a 30-year synthesis of large wildfires. fire ecol 17, 32 (2021). https://doi.org/10.1186/s42408-021-00118-z; https://fireecology.springeropen.com/counter/pdf/10.1186/s42408-021-00118-z.pdf.

When all this evidence is put together, it becomes clear that "saving" the spotted owl by logging its habitat to reduce fuels often does not make any sense.

Similar conclusions were reached is several studies, reviews, and expert commentaries, such as:

Lehmkuhl et al. (2015) found -

> 3. **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. …

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. The authors, however, made no meaningful attempt to resolve these trade-offs.

Odion et al. 2014, who looked at the relative effects of fire versus thinning and fire on spotted owl habitat in two regions of interest: the Klamath and dry Cascades --

> Using empirical data, we calculated the future amount of spotted owl habitat that may be maintained with these rates of high-severity fire and ongoing forest regrowth rates with and without commercial thinning. Over 40 years, habitat loss would be far greater than with no thinning because, under a "best case" scenario, thinning reduced 3.4 and 6.0 times more dense, late-successional forest than it prevented from burning in high-severity fire in the Klamath and dry Cascades, respectively. Even if rates of fire increase substantially, the requirement that the long-term benefits of commercial thinning clearly outweigh adverse impacts is not attainable with commercial thinning in spotted owl habitat. It is also becoming increasingly recognized that exclusion of high-severity fire may not benefit spotted owls in areas where owls evolved with reoccurring fires in the landscape.
>
> …
>
> We found that the habitat recruitment rate exceeded the rate of severe fire by a factor of 4.5 in the Klamath and 10 in the dry Cascades, leading to a deterministic increase in dense forest habitat over time, assuming no other disturbance events. In contrast, previous published assessments of fire on spotted owls have not explicitly considered fire and forest regrowth rates (Wilson and Baker 1998, Lee and Irwin 2005, Roloff et al. 2005, 2012, Calkin et al. 2005, Hummel and Calkin 2005, Ager et al. 2007, Lehmkuhl et al. 2007). Not including the probability of high-severity fire, which is low, leads to highly inflated projections of the effects of thinning versus not thinning on high-severity fire (Rhodes and Baker 2008, Campbell et al. 2012).
>
> Our calculations of thinning effects included rates of forest regrowth along with high-severity fire. The calculations illustrate how the requirement that the long-term benefits of thinning clearly outweigh adverse impacts (USFWS 2011) is not attainable as long as treatments have adverse impacts on spotted owl habitat. This is because the amount of dense, late-successional forest that might be prevented from burning severely would be a fraction of the area that would be thinned.
>
> …
>
> This would not be a concern if thinning effects were neutral, but the commercial thinning prescriptions being implemented call for forests with basal area reduced by nearly half to 13.5-27.5 m2/ha, which is mostly well below the minimum level known to function as nesting and roosting habitat (ca. 23 m2/ha) (Buchanan et al. 1995, 1998). … Even an immediate doubling of fire rates due to climate change or other factors would result in far less habitat affected by high-severity fire than thinning. In addition, much of the high-severity fire might occur regardless of thinning, especially if the efficacy of thinning in

reducing high-severity fire is reduced as fire becomes more controlled by climate and weather (Cruz and Alexander 2010). Clearly, the strategy of trying to maintain more dense, late-successional forest habitat by reducing fire does not work if the method for reducing fire adversely affects far more of this forest habitat than would high-severity fire, and the high-severity fire might occur anyway because it is largely controlled by climate and weather.

…

While much of the concern about fire and thinning in dry forests of the Pacific Northwest has focused on spotted owls, it may also apply to other biota associated with dense, old forests, including species of conservation concern, such as Pacific fisher (*Martes pennanti pacifica*), which research indicates may benefit from mixed-severity fire (Hanson 2013), the Northern Goshawk (*Accipiter gentilis*), and, following fire, the Black-backed Woodpecker (*Picoides arcticus*), … Our findings highlight the need to be cautious about conclusions that thinning treatments are needed for species found in dense forest and that they will not have unintended consequences (e.g., Stephens et al.2012) until long-term, cumulative impacts are better understood. As we found with spotted owls, long-term and unintended consequences may be substantial for species that rely on dense, late-successional forests,

Dennis C. Odion, Chad T. Hanson, Dominick. A. DellaSala, William L. Baker, and Monica L. Bond. 2014. Effects of Fire and Commercial Thinning on Future Habitat of the Northern Spotted Owl. The Open Ecology Journal, 2014, 7, 37-51 37.
http://benthamopen.com/toecolj/articles/V007/37TOECOLJ.pdf

The Wildlife Society (TWS) peer review of the 2010 Draft Recovery Plan for the Spotted Owl. The draft plan called for extensive logging to reduce fire hazard ("inaction is not an option"). TWS used state-and-transition model to evaluate the effects of opening dry forests to reduce fire hazard versus the effects of wildfire.

The results of running the model with 2/3rds of the landscape treated leads to open forest becoming predominant after a couple of decades, occupying 51 percent of the forested landscape, while mature, closed forest drops to 29 and 24 percent of the Klamath and dry Cascades forests, respectively (Appendix A, Figure 5, shows the Cascades). Treatments that maintain open forests in 2/3rds of the landscape put such a limit on the amount of closed forest that can occur, even if high severity fires were to be completely eliminated under this scenario, there would only be 35 percent of the landscape occupied by closed forests. In contrast, to the extensive treatment scenario, treating only 20 percent of the landscape reduces mature, closed canopy forest by about 11 percent (Appendix A, Figure 6).

One justification for the extensive treatment scenario promoted in the 2010 DRRP is that it is needed because of increased fire hypothesized to occur under climate change. By doubling the rate of high severity fire by 2050 with 2/3rds of the landscape treated, closed

> canopy forest is reduced to 25 percent in the Klamath compared to 60 percent without treatment and 23 percent in the dry Cascades compared to 54 percent without treatment. Under what scenario might treatments that open forest canopies lead to more closed canopy spotted owl habitat? The direct cost to close forests with treatments that open them is simply equal to the proportion of the landscape that is treated. This reduction in closed canopy forest can only be offset over time if the ratio of forest regrowth to stand-replacing fire is below 1 (5-8 times more fire than today), and shifts to above 1 with the treatments (and most or all stand replacing fire in treated sites is eliminated, as modeled here). Another scenario that allows closed forests to increase would be if treating small areas eliminated essentially all future stand replacing fire, not only in treated areas, but across the entire landscape. This scenario obviously relies on substantially greater control over fire than is currently feasible, and it would increase impacts of fire exclusion if effective.
>
> …
>
> In sum, to recognize effects of fire and treatments on future amounts of closed forest habitat, it is necessary to explicitly and simultaneously consider the rates of fire, forest recruitment, and forest treatment over time, which has not yet been done by the Service.
>
> …
>
> The potential impacts of fuel treatments on spotted owls are not considered. … We also know little about the impacts of fire, yet this has been treated as a major threat, leading to proposing more fuel treatments. However, it is uncertain at this time which is a bigger threats, fires or treatments to reduce risk of fires. … If the plan intends to use the best available science to describe ongoing impacts to spotted owl habitat, information and literature about disturbances to reduce fuels should be included.
>
> … there has been no formal accounting of how closed canopy forests can be maintained with the widespread treatments that are being proposed.

The Wildlife Society 2010. Peer Review of the Draft Revised Recovery Plan for Northern Spotted Owl. November 15, 2010. http://www.fws.gov/oregonfwo/Species/Data/NorthernSpottedOwl/Recovery/Library/Documents/TWSDraftRPReview.pdf.

This analysis is consistent with the findings of Raphael et al (2013) used a state-and-transition model to explore the effects of landscape fuel reduction logging on spotted owls and found:

> Active fuel reduction activities in moderate habitat contributed to substantial short-term (simulation years 0 to 30) population declines under the larger area, higher intensity scenarios. … The combination of BDOW interactions and high-intensity, larger-area treatments contributed to the most substantial NSO population bottlenecks. The combined effects of aggressive fuel reduction treatment approaches and interactions with BDOWs have the potential to contribute to increased extinction risk for NSOs in both analysis areas. … It appears that management regimes that take out owl habitat through treatments (either current

or potential future) do not reduce the amount of habitat that is lost to wildfire enough to make up for the habitats lost through treatments.

Principle Investigator: Dr. Martin G. Raphael. Project Title: Assessing the Compatibility of Fuel Treatments, Wildfire Risk, and Conservation of Northern Spotted Owl Habitats and Populations in the Eastern Cascades: A Multi-scale Analysis. JFSP 09-1-08-31 Final Report, Page 19. http://www.firescience.gov/projects/09-1-08-31/project/09-1-08-31_final_report.pdf. This study also highlights the fact that natural landscapes (under the influence of natural forces like climate, photosynthesis, and natural disturbance) have a lot of ecological inertia, and well-intentioned management interventions are unlikely to significantly change the trajectory.

30x30 Requires More Protection, Not less

The Northwest Forest Plan amendment needs to help advance 30x30 goals. In 2021 President Biden established a goal of "conserving at least 30 percent of our lands and waters by 2030." Executive Order 14008, "Executive Order on Tackling the Climate Crisis at Home and Abroad," (January 27, 2021). The Northwest Forest Plan amendment process should incorporate both the federal "America the Beautiful" 30x30 directive as well as any related state directives. The Northwest Forest Plan, with additional protections, can contribute to such targets along with playing a central role in climate mitigation, biodiversity conservation, and landscape connectivity.

For lands in late-successional and riparian reserve status to qualify as contributing toward 30x30 goals, the lands must be established and protected by not only land allocations, but strong standards. Relying on guidelines would not meet 30x30 requirements. The US Geological Survey defines a *protected area* (PA) as an area "dedicated to the preservation of biological diversity and to other natural (including extraction), recreation and cultural uses, managed for these purposes through legal or other effective means." In addition, any such lands must be withdrawn *from* the application of the federal mining laws, and also reserved *for* the conservation of nature (43 USC 1714).

Implement the National Forest Roadless Rule and Enhance Protection of Uninventoried Roadless Areas

The National Forest Roadless Rule as adopted in 2000 recognized the importance of roadless areas to clean water, habitat, recreation, etc. The Forest Service should expand the Late Successional Reserve network to encompass inventoried roadless areas. In addition, the best available science indicates unroaded areas 1,000 acres and larger are ecologically significant and should be conserved.

Large unroaded areas are important simply due to the fact that they better represent the historic condition that species evolved with but they are now rare on the landscape due to human activities that have degraded and fragmented the majority of the landscape. The Northwest Forest Plan LSOG Effectiveness Monitoring Plan says that "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." 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.

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:
> • Essential habitat for species key to the recovery of forests following disturbance such as herbaceous plants, lichens, and mycorrhizal fungi
> • Habitat refugia for threatened species and those with restricted distributions (endemics)
> • Aquatic strongholds for salmonids
> • Undisturbed habitats for mollusks and amphibians
> • Remaining pockets of old-growth forests
> • Overwintering habitat for resident birds and ungulates
> • Dispersal "stepping stones" 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.

In a 1997 letter to President Clinton, 136 scientists said:

> There is a growing consensus among academic and agency scientists that existing roadless areas–irrespective of size–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' 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…. 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…. 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

To the list of special values found within unroaded areas must be added carbon storage. European policy leaders consider roadless areas effective for carbon storage and climate mitigation:

> [T]he European Parliament has agreed to raise the issue of roadbuilding in intact forests at the UN Climate Change Conference to be held next month in Warsaw (Poland); it calls on parties to use the existence of roads in forest areas as an early negative performance indicator of REDD+ projects, and to prioritise the allocation of REDD+ funds towards road free forests.

Oct 24, 2013 Press release: EUROPEAN PARLIAMENT BACKS THE PROTECTION OF ROADFREE AREAS. http://kritonarsenis.gr/eng/actions/view/european-parliament-backs-the-protection. Federal land managers should recognize the tremendous carbon values in unroaded/unmanaged forests and avoid actions that would threaten these values. 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.

Many of the Best, Large, Contiguous Forest Landscapes are Mature, Not Old-Growth, Forests.

Some large forest fires burned west of the Cascades between 1840 and 1910, and many such areas were skipped over during "harvest scheduling" because there was a higher priority on converting the very old forests to tree plantations. These former fire areas, now mature forests, offer some of our best hopes of recreating large blocks of unfragmented, contiguous old-growth forest, which is an important goal of the Northwest Forest Plan, and critical to the recovery of old-growth associated wildlife.

Leaving mature forests unprotected would leave substantial areas of roadless forests subject to future conflict. Many westside roadless areas may not qualify as old growth, but still provide important values as roadless and mature forests.[2] Examples of roadless areas with significant stands of mature forest include Moose Creek, Mount Hagen, and Hardesty Mountain on the Willamette National Forest, Mt Hebo on the Siuslaw National Forest, Roaring River and Olallie Lakes on the Mt. Hood National Forest, Twin Lakes on the Umpqua National Forest, and Zane

[2] Strittholt, J. 2005. Oregon Legacy Wild Forests. CBI. http://www.consbio.org/what-we-do/oregons-legacy-wild-forests

Grey on the Medford BLM. In northern California, the Kangaroo, Greider Creek, and Orleans Mt. roadless areas on the Klamath National Forest and the Salt Creek and Soldier Creek roadless areas on the Six Rivers National Forest all contain significant areas of mature forest. In Washington, examples include Dark Divide, Horseshoe, Pompey, and Wobbly roadless areas on the Gifford Pinchot National Forest.

Logging mature forests will impair development of important features of old-growth forests, especially snags and dead wood.

The Plan Amendment NEPA analysis must take a hard look at the fact that commercial logging of mature forests will severely impair their development into healthy old growth conditions.[3]

Cutting mature forests and trees is generally not needed for ecological reasons. In fact, commercial logging will most often degrade rather than improve mature forest habitat. Foresters can make an argument that thinning helps grow big trees faster, but that's a tree-farmer's argument that is focused on growing a crop of big trees instead growing complex habitat.

Healthy late-successional forests are so much more than just big trees. Managers of public forests must strive to enhance other important aspects of healthy old forests, including large dead trees called snags, down wood, and multiple canopy layers. Of the six main attributes of old-growth forests, two involve dead trees (i.e., large accumulations of snags and dead wood). Looking at forest development once again as a continuum, restoration of complex old forests will require a reliable flow of material from the live-tree pool into the snag and down-wood pool, but logging interrupts that flow.

Restoring complex old forests requires that extra trees be retained to provide continuous recruitment of large snags and down wood. The latest Forest Inventory and Analysis report for Oregon states, "The presence of dead wood in a forest improves wildlife habitat, enhances soil fertility through nutrient cycling and moisture retention, adds to fuel loads, provides substrates for fungi and invertebrates, and serves as a defining element in old-growth forest. Because of this, the dead wood resource is often analyzed from a variety of perspectives— too much can be viewed as a fire hazard and too little can be viewed as a loss of habitat."[4]

[3] This subsection (and the next two) are direct excerpts from Heiken, D. 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.

[4] Donnegan, Joseph; Campbell, Sally; Azuma, Dave, tech. eds. 2008. Oregon's forest resources, 2001–2005: five-year Forest Inventory and Analysis report. Gen. Tech. Rep. PNW-GTR-765. Portland, OR: U.S. Forest Service, Pacific Northwest Research Station. 186 p. http://www.fs.fed.us/pnw/publications/gtr765/pnw-gtr765b.pdf (citations omitted). It is important to note that large wood that is most valuable for wildlife and does not present a significant fire hazard and small hazardous fuels do not provide as much habitat value as large wood, so compatibility can be achieved if managers focus on removing small hazardous fuels while retaining medium and large trees.

The Scientific Panel on Ecosystem Based Forest Management explained:

> The fact that dead trees and logs are as important to ecosystem function as living trees challenges traditional forestry models that treat such materials as waste, fire hazards, and mechanical impediments. To move away from ecologically simplistic models, new forest management regimes must address questions such as: How much coarse woody debris is needed? and: How many snags in various stages of decay are required? to fulfill important ecological functions."[5]

Unfortunately, the agencies continue to rely on scientifically outdated methods that perpetuate the deficit of large snags and down wood,[6] and they continue to remove medium-sized trees that should be allowed to continue to grow and become ecologically valuable snags and dead wood. Heavy thinning of maturing forest has been shown to significantly delay attainment of snag objectives.[7] Which means that commercial thinning may be preventing or delaying development of essential features of old forest ecosystems, features that are important to spotted owls, salmon, and their prey.

The Eastside Scientific Societies Panel explained the keystone role of woodpeckers and the critical importance of snags and dead wood to the overall functioning of the forest. "The predatory impact of woodpeckers on pest insects is only part of the total predatory impact of the entire avian community. Many bird species continually feed on insect populations, and many depend on woodpeckers to construct the cavities they use. Therefore, maintenance of natural densities of woodpeckers may be crucial to the natural ecological response systems to insect irruptions."[8]

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[5] Franklin, J.F., D.A. Perry, R. Noss, D. Montgomery and C. Frissell. 2000. Simplified Forest Management to Achieve Watershed and Forest Health: A Critique. National Wildlife Federation, Seattle, Washington. http://www.coastrange.org/documents/forestreport.pdf (citations omitted).

[6] PNW Research Station, "Dead and Dying Trees: Essential for Life in the Forest," Science Findings, Nov. 1999 (http://www.fs.fed.us/pnw/sciencef/scifi20.pdf) ("Management implications: Current direction for providing wildlife habitat on public forest lands does not reflect findings from research since 1979; more snags and dead wood structures are required for foraging, denning, nesting, and roosting than previously thought."). Rose, C.L., Marcot, B.G., Mellen, T.K., Ohmann, J.L., Waddell, K.L., Lindely, D.L., and B. Schrieber. 2001. Decaying Wood in Pacific Northwest Forests: Concepts and Tools for Habitat Management, Chapter 24 in Wildlife-Habitat Relationships in Oregon and Washington (Johnson, D. H. and T. A. O'Neil. OSU Press. 2001) http://www.nwhi.org/inc/data/GISdata/docs/chapter24.pdf. Steve Zack, T. Luke George, and William F. Laudenslayer, Jr. 2002. Are There Snags in the System? Comparing Cavity Use among Nesting Birds in "Snag-rich" and "Snag-poor" Eastside Pine Forests. USDA Forest Service Gen. Tech. Rep. PSW-GTR-181. http://www.fs.fed.us/psw/publications/documents/gtr-181/017_Zack.pdf.

[7] USDA Forest Service. 2007. Curran Junetta Thin Environmental Assessment. Cottage Grove Ranger District, Umpqua National Forest. June 2007. Using data from stand exams modeled through FVS-FFE (West Cascades variant) the Umpqua NF found that the actual effect of heavy thinning is to capture mortality and delay recruitment of desired levels of large snag habitat for 60 years or more.

[8] 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

> A few scattered snags retained by forest management are not sufficient to provide nesting and roosting habitat into the future. Snags and logs in harvested areas and logs in streams remain only a finite time; the next generation of snags and large woody debris—in other words, live old trees—must be protected. Saving the remaining old-growth is thus a critical first step in conserving old-growth-dependent species, but preservation must be supplemented with plans for generating future old growth.
>
> Forest management that preserves selected snags does not adequately meet the foraging needs of LS/OG-associated species. Eliminating foraging habitat by extensive salvaging or selective cutting will have adverse consequences for pileated woodpeckers and other forest species dependent on cavities excavated by woodpeckers. Continual recruitment of standing dead and downed coarse woody material is absolutely necessary to support the diversity of organisms, including fungi and insects, that in turn provide a productive forest system for woodpeckers and other sensitive wildlife species.
>
> Elimination of deadwood habitat from the forest thus has adverse consequences on bird populations and seriously skews natural predator-prey relationships that may have a major influence on insect populations.[9]

In response to the significant loss of large and old trees on the eastside, ICBEMP proposed the following standards and objectives:

> Maintain and/or restore large shade-intolerant trees and snags in densities that are consistent with the range of historical conditions. … *Large trees* is a relative term dependent on species and site. Large trees are a future source of large snags, and large snags are a future source of coarse woody debris, another important habitat component for many species. It is important to have present and **future sources of large trees** and snags at adequate levels though time. Larger snags are generally better than smaller snags because they exist longer. Large trees and/or snags are essential habitat components for many species …
>
> …
>
> Maintain and/or recruit adequate numbers, species, and sizes of snags and levels of downed wood to meet the needs of wildlife, invertebrates, fungi, bryophytes,

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crest, Oregon and Washington. The Wildlife Society Technical Review 94-2. Bethesda, MD. 245 pp. (aka the report of the Eastside Scientific Societies Panel) http://andykerr.net/downloads/EastsideScien.pdf

[9] Henjum (1994) (citations omitted).

saprophytes, lichens, other organisms, long-term soil productivity, nutrient cycling, carbon cycles, and other ecosystem processes.[10]

Meeting these goals will require retention of plenty of recruitment trees in the mature age class. Unfortunately, ICBEMP science has not yet been implemented or incorporated into existing forest plans.

After Congressman Charles Taylor commissioned Oliver et al. (1997)[11] to prepare a report urging more logging to make our National Forests healthier, the Ecological Society of America responded with a report confidently concluding that "there is no scientific basis for asserting that silvicultural practices can create forests that are ecologically equivalent to natural old-growth forests, although we can certainly use our understanding of forest ecology to help restore managed forests to more natural conditions."[12] The NRC Report (2000) concurred, explaining that "proponents of active timber harvest on all or most of the landscape argue their approach reflects current ecological thinking, which recognizes nature is inherently dynamic. … This view recently was critiqued by a panel of the Ecological Society of America (ESA) which disagreed strongly with the conclusions of Oliver and colleagues (Aber 2000). This committee concurs with the ESA panel ..."[13] The authors point out that reserves are not static, rather reserves should be extensive enough to subsume the natural disturbance processes that create and maintain complex forests, and "there is little evidence that managed stands are healthier than unmanaged stands. In fact, quite the contrary …"

In all forest types, recognize that logging has trade-offs.
The Plan Amendment NEPA analysis must account for the trade-offs caused by logging.

There's no free lunch. All logging—including thinning stands of any age—involves adverse impacts and trade-offs. Some impacts of logging are unavoidable, so there is no such thing as a logging operation that is 100% beneficial to ecological restoration. Depending on how it is done thinning can have adverse impacts such as:

- soil compaction and disturbance;

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[10] USDA/USDI 2000. ICBEMP SDEIS p 3-66 – 3-68.

[11] Oliver, C., D. Adams, T. Bonnicksen, J. Bowyer, F. Cubbage, N. Sampson, S. Schlarbaum, R. Whaley, and H. Wiant. 1997. Report on forest health of the United States by the Forest Health Science Panel. A panel chartered by Charles Taylor, Member, U.S. Congress. Washington, D.C.

[12] Aber, J., N. Christensen, I. Fernandez, J. Franklin, L. Hidinger, M. Hunter, J. MacMahon, D. Mladenoff, J. Pastor, D. Perry, R. Slangen, H. van Miegroet. 2000. Applying ecological principles to management of the U.S. National Forests. Issues in Ecology, No.6, 20pp. http://esa.org/science_resources/issues/FileEnglish/issue6.pdf

[13] NRC 2000. pp 189-190. The heavy-handed silvicultural approach was also roundly criticized by The Scientific Panel on Ecosystem Based Forest Management: Jerry Franklin, David Perry, Reed Noss, David Montgomery, and Christopher Frissell. See Franklin et al. (2000).

- habitat disturbance and wildlife displacement;
- carbon emissions to the atmosphere;
- introducing and spreading weeds;
- removal and reduced recruitment of snags and large wood;
- road-related erosion and hydrologic modification, and opening access for fire ignition and OHV trespass;
- moving flammable small fuels from the canopy to the ground; and
- creating a hotter-dryer-windier microclimate that is favorable to greater flame lengths and rate of fire spread.

Some of these negative effects are fundamentally unavoidable. Therefore, all thinning has negative effects that may be partially compensated by beneficial effects such as:

- reducing competition between trees so that some can grow larger faster;
- increased resistance to drought stress and insects;
- increasing species diversity; and
- possible (but by no means certain) fire hazard reduction.

It is generally accepted that when thinning occurs in very young stands, net benefits are more likely to arise because the benefits outweigh the adverse impacts. Conversely, when thinning occurs in older stands, net benefits are unlikely because negative impacts on soil, water, weeds, carbon, and dead wood recruitment will tend to outweigh the benefits, resulting in a negative ecological balance sheet. The ICBEMP Team said that "there are instances where long-term benefits may not exceed short-term environmental costs or adverse ecosystem impacts, making passive restoration approach more appropriate."[14] As we move along the continuum from thinning young forests to logging older forests, net benefits very often turn into net negative impacts, but where is that line? Within the range of the owl, the Northwest Forest Plan found 80 years to be a good place to draw the line. In dry forests being managed to reduce fire hazard, the Scientific Panel on Ecosystem Based Forest Management concluded that thinning mature stands would likely lead to problems that exceed any benefits, so thinning programs should be limited to younger stands. "Thinning only small and intermediate trees less than 100 years old could decrease fire risk, depending on how much new risk is introduced by logging slash (or its

[14] Thomas Quigley, ed., Integrated Scientific Assessment for the Interior Columbia Basin. PNW-GTR-382, Sept 1996. p 177.

disposal). … The challenge is to alleviate one problem without exacerbating others or creating new ones (Perry 1995). Therefore, each project requires careful thought and analysis."[15]

In moist provinces, mature forests just need time, not logging.
The Plan Amendment NEPA analysis must account for the beneficial role of natural processes.

Mature forests are already starting to exhibit complex forest characteristics and they will continue to develop and improve without human intervention. As recognized in the Northwest Forest Plan standards and guidelines for Late Successional Reserves, stands over 80 years old in the moist westside provinces are most likely to become old growth in the absence of silvicultural manipulation.[16] The transition from mature forest to old growth is a process that takes time and varies depending on factors such as location, species, and disturbance events. In a mature forest, all the ingredients are there to make old growth (e.g., large and growing trees, material for recruitment of snags and logs, mortality processes that create canopy gaps, etc.). These forests don't need logging; they need time to develop.

In moist areas, young forests are most likely to benefit from thinning. The most appropriate use of logging technology is to thin dense young stands that developed following clearcutting. The Northwest Forest Plan prohibits logging of stands 80 years or older in the Late Successional Reserves for several reasons: (a) such stands are beginning to acquire late successional characteristics and provide valuable habitat for spotted owls and other wildlife; (b) there is a lack of evidence to support the hypothesis that logging in stands >80 years old is beneficial to habitat development; and (c) logging will likely do more harm than good.

This reasoning is articulated in several scientific reports, including the 1990 Interagency Scientific Committee (ISC) Report, the 1993 SAT Report, and various reports to Congress where the scientists were being asked to explain to a skeptical committee in Congress why logging old forests could not be compatible with conserving late-successional forest ecosystems. The ISC report said "no consensus exists about whether any silvicultural systems would produce the desired results. The ability to harvest timber in currently suitable owl habitat and have that habitat remain suitable has not been clearly demonstrated."[17]

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[15] Franklin, J.F., D.A. Perry, R. Noss, D. Montgomery and C. Frissell. 2000. Simplified Forest Management to Achieve Watershed and Forest Health: A Critique. National Wildlife Federation, Seattle, Washington. http://www.coastrange.org/documents/forestreport.pdf

[16] USDA/USDI 1994. Northwest Forest Plan ROD, Attachment A, pages B-6, C-11, C-12. April 1994. *and* Pers. Comm. David Perry (Professor [emeritus], Oregon State University School of Forestry) to David Dreher (Legislative Assistant to U.S. Rep. Peter DeFazio), 15 June 2002.

[17] Thomas, J.W., E.D. Forsman, J.B. Lint, E.C. Meslow, B.R. Noon, and J. Verner. 1990. A Conservation Strategy for the Northern Spotted Owl. A report by the Interagency Scientific Committee to address the conservation of the northern spotted owl. USDA, Forest Service, and U. S. Department of the Interior, Fish and Wildlife Service, Bureau of Land Management, and National Park Service. Portland, OR (*herein* ISC Report), 1990, p 104.

The SAT noted that “considerable additional research is likely required” before we will know whether silviculture can be compatible with spotted owls, and while the spotted owl is relatively well studied, the risks and uncertainty are even more pronounced for the hundreds of other species associated with old-growth.[18] It should also be recognized that President Clinton’s Mission Statement directed the FEMAT team to ensure that “tests of silviculture should be judged in an ecosystem context and not solely on the basis of single species or several species response.”[19]

The 1993 Report of the Scientific Analysis Team (SAT) specifically highlighted the risks associated with logging in suitable owl habitat, saying “intentions to selectively cut forest stands to create conditions favorable for spotted owls, represents increased risks to the viability of the spotted owl.”[20] The Scientific Analysis Team said there are several factors that support this conclusion and affirm the Interagency Scientific Committee’s decision to exclude logging in old growth reserves and rely on natural processes to maintain and restore habitat:

a. “Lacking experience with selective cutting designed to create spotted owl habitat, such practices must be considered as untested hypotheses requiring testing to determine their likelihood of success. ... Given the uncertainty of achieving such expectations, it is likely that some silvicultural treatments, which have been characterized as largely experimental, may well have an opposite effect from that expected. Consequently, such treatments may hinder the development of suitable habitat or they may only partially succeed, resulting in development of marginal habitat that may not fully provide for the needs of spotted owls. Results which fall short of the expected conditions could occur because of delay or failure to regenerate stands that have been cut, increased levels of windthrow of remaining trees, mechanical damage during logging to trees remaining in the logging unit, the spread of root rot and other diseases. Increased risk of wildfires associated with logging operations that increase fuels and usually employ broadcast burning to reduce the fuels also increase the risk of not attaining expected results. Such events may spread to areas adjacent to stands that are logged, thereby affecting even more acreage than those acres directly treated.” [SAT p 147-148] The SAT indicates that these comments apply equally to density management and patch cutting, both of which are being promoted as tools to enhance owl habitat. The SAT also cited concerns about the effect of logging on snags and down woody debris which are essential features of owl habitat.

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[18] Thomas, JW, Raphael, MG, Anthony, RG, Forsman ED, Gunderson, AG, Holthausen, RS, Marcot, BG, Reeves, GH, Sedell, JR, and DM Solis. 1993. Viability Assessments and Management Considerations for Species Associated with Late-Successional Old-Growth Forests of the Pacific Northwest. The Report of the Scientific Analysis Team (*herein* SAT Report), 1993, p 147.

[19] FEMAT Report, p iii.

[20] SAT Report p 145.

b. "Planning produces a description of desired future conditions [and] culminates in a final plan for a project which, for timber sales, involves legal contracts obligating the purchaser and the seller to specific provisions. … Our experience is that commonly not all provisions of the plan are thoroughly incorporated into such contracts, nor are all contract provisions thoroughly administered to ensure compliance." [SAT p 148-149].

c. "There are also probabilities associated with how well monitoring will identify 'trigger points' that indicate a management plan may need modification. The more complex the plan (i.e., the more variables there are to monitor) the less likely the monitoring plan will successfully detect problems. Manipulation of forest stands to accelerate development of spotted owl habitat on a landscape scale, as prescribed in the Bureau of Land Management Preferred Alternative, is an extremely complex issue involving a myriad of variables over a very long timeframe. Development of a monitoring plan intensive enough to isolate the causes of observed variations for wide-scale implementation of the Bureau of Land Management Preferred Alternative seems unlikely to us. … [I]nadequate monitoring will increase, perhaps dramatically, the risk of failure of a plan that relies heavily on adaptive management." [SAT p 149].

d. "A basic requirement for a viable adaptive management strategy is the existence of resources necessary to make the required adjustments. Adaptive management can only be expected to reduce risk if options to adjust management to fit new circumstances are not eliminated. Adaptive management, therefore, can be considered a means to reduce risk associated with a Resource Management Plan commensurate with the options for adjustment which remain during the time the plan is in effect." [SAT p 149-150] In other words, silvicultural manipulation of mature forests has long-term consequences and is likely to foreclose some future options in those stands, thus reducing the utility of adaptive management. A prime example is the fact that logging "captures mortality," yet mortality is an essential feature of old-growth habitat used by both spotted owls and their prey.

e. SAT then noted the cumulative effects of all these uncertainties: "The combined risks associated with treatment of spotted owl habitat or stands expected to develop into suitable habitat for spotted owls, as discussed above, will likely result in situations where either habitat development is inhibited or only marginal habitat for spotted owls is developed. The exact frequency of these partial successes or failures is unknown. Given the likely cumulative relationship among the risks for each factor, it appears to us that the overall risk of not meeting habitat objectives is high. … Members of the Interagency Scientific Committee indicated that, because a plan (the Interagency Scientific Committee's Strategy) was put forth which proposes to reduce the population of a threatened species by as much as 50 percent, providing the survivors with only marginal habitat would be extremely risky and certainly in their minds not 'scientifically credible' (USDA 1991:45)." [SAT p 151].

f. The SAT concluded, “The transition period (1-50 years) between implementation of the Interagency Scientific Committee’s Strategy and achievement of an equilibrium of habitat and spotted owls is a critical consideration. … Given the existing risks that face owl populations and the sensitivity of the transition period, the short-term effect of these actions on habitat loss may be much more significant than the long-term predicted habitat gains. We further conclude that, although research and monitoring studies are presently being initiated, no significant new data exist which suggest that the degree of certainty that is expressed in the Bureau of Land Management Draft Resource Management Plans for developing owl habitat silvicultural treatments is justified. Therefore, it is our opinion that the course prescribed in the Interagency Scientific Committee’s Strategy, pertaining to timber harvest in Habitat Conservation Areas, remains the most likely course to result in superior habitat conditions within reserves (i.e., Old-Growth Emphasis Areas). The approach prescribed by the Interagency Scientific Committee’s Strategy preserves options for adjustments in the course of management under a philosophy of adaptive management.” [SAT p 151-152].

The authors of the Northwest Forest Plan took all this into account and determined that 80 years is a useful place to draw the line between younger forests that are likely to benefit from careful thinning and older forests that are likely to experience net negative consequences.[21] There is no new science to change that conclusion. In fact, new information developed since 1994 shows that dead wood is probably more valuable than previously thought. It is important for a wide variety of ecological functions, not least of which is providing complex habitat to support owl prey species. Thinning stands over 80 years will remove many large trees and prevent them from ever becoming snags and dead wood. The long-term loss of recruitment of dead wood habitat in older stands is a very strong argument against logging in stands over 80 years old.[22]

Structure-based management (SBM) is often suggested as a way to produce logs and habitat from the same forests, but this is not a well-supported approach to managing older forests. There are well-founded critiques which point out that structure-based management is untested, uncertain, high risk, and unlikely to result in desired outcomes. Consider the well-developed critique of structure based management set forth by the Scientific Panel on Ecosystem Based Forest Management:

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[21] See 1993 SAT Report pp 146-152. AND February 1991 Questions and Answers on A Conservation Strategy for the Northern Spotted Owl (prepared in response to written questions from the Senate Energy and Natural Resources Committee to the Interagency Scientific Committee on the May 1990 ISC Report. AND Jerry Franklin, David Perry, Reed Noss, David Montgomery, Christopher Frissell. Simplified Forest Management To Achieve Watershed And Forest Health: A Critique. National Wildlife Federation. http://www.coastrange.org/documents/forestreport.pdf

[22] USDA Forest Service. 2007. Curran Junetta Thin Environmental Assessment. Cottage Grove Ranger District, Umpqua National Forest. June 2007. http://www.fs.fed.us/r6/umpqua/projects/projectdocs/curran-junetta-thin/index.shtml This EA revealed that heavy thinning in young stands would delay attainment of objectives for recruitment of dead wood for 6 decades or more.

> The concept that all forests must be silviculturally manipulated (logged) and eventually replaced in order to provide desired goods and services, including the continued health of forest landscapes, is an old and honored tradition. … The proposition that forest values are protected with more, rather than less logging, and that forest reserves are not only unnecessary, but undesirable, has great appeal to many with a vested interest in maximizing timber harvest. … Our interpretation of the scientific literature, combined with our professional experience, leads us to some very different conclusions about appropriate approaches. Scientifically based strategies for the conservation of forest ecosystems, with a sound theoretical basis in conservation biology—including biodiversity and critical ecological services—have inevitably incorporated reserves along with ecologically sensitive management of unreserved areas (e.g., FEMAT 1993). … In our view, the assumptions underpinning simplified structure-based management (SSBM) are not supported by the published scientific literature on structural development of natural forests, disturbance ecology, landscape ecology and conservation biology, or by the relationships between ecosystem structures and processes. … We do not believe, however, that scientific literature or forestry experience supports the notions that intensively managed forests can duplicate the role of natural forests, or that sufficient knowledge and ability exist to create even an approximation of a natural old-growth forest stand.[23]

Allowing logging in stands up to 80 years old may be too generous. Trees that still have a lot of growing to do are far more likely to respond well to thinning because they can put more growth into their still-developing crowns. Older trees that are not expected to grow much taller have much less responsive crowns and will not respond as well to thinning.[24] Some studies indicate that stands over 50 years old may be less amenable to thinning. Recent research indicates that a substantial portion of a tree's size and character at several hundred years of age can be explained by the tree's rate of growth at age 50, and recent modeling "found it difficult to alter the development trajectories of well-established young stands that were first managed at age class 50," and concluded that earlier intervention would have promoted deeper crowns and greater diameter class differentiation.[25] This leads to a tentative conclusion that thinning stands younger

[23] Jerry Franklin, David Perry, Reed Noss, David Montgomery, Christopher Frissell. Simplified Forest Management To Achieve Watershed And Forest Health: A Critique. National Wildlife Federation. http://www.coastrange.org/documents/forestreport.pdf

[24] Tappeiner, J.C., II, Emmingham, W.H., and D.E. Hibbs 2002. Silviculture of Oregon Coast Range Forests. Chapter 7 in Forest and Stream Management in the Oregon Coast Range. Edited by Stephen D. Hobbs, John P. Hayes, Rebecca L. Johnson, Gordon H. Reeves, Thomas A. Spies, John C. Tappeiner II, and Gail E. Wells, 2002.

[25] Andrews, Perkins, Thrailkill, Poage, Tappeiner. 2005. Silvicultural Approaches to Develop Northern Spotted Owl Nesting Sites, Central Coast Ranges, Oregon. West. J. Appl. For. 20(1):13-27. (emphasis added).

than 50 years old should be a higher priority than thinning stands older than 50 years.

Dead Wood Standards are Outdated, Need Updating

Large accumulations of dead wood are essential for meeting objectives for fish & wildlife habitat, water quality, and carbon storage. Past and ongoing forest management has greatly reduced the prevalence of large snags and dead wood. Northwest Forest Plan standards for dead wood are based on an outdated "potential population" methodology which greatly underestimates the amount of snags and down logs needed to meet the needs of a variety of species associated with dead wood. See Rose, C.L., Marcot, B.G., Mellen, T.K., Ohmann, J.L., Waddell, K.L., Lindely, D.L., and B. Schrieber. 2001. Decaying Wood in Pacific Northwest Forests: Concepts and Tools for Habitat Management, Chapter 24 in Wildlife-Habitat Relationships in Oregon and Washington (Johnson, D. H. and T. A. O'Neil. OSU Press. 2001) http://web.archive.org/web/20060708035905/http://www.nwhi.org/inc/data/GISdata/docs/chapter24.pdf. Forests are a dynamic system where the population of all live trees represent the recruitment pool for all dead trees, so if more dead trees are needed over time, that means more live trees need to be retained for long-term recruitment. Before conducting activities like commercial logging (especially regen logging) that will result in long-term reduction in recruitment of snags and dead wood, the agencies should follow NEPA procedures to amend their management plans, consider alternatives, and adopt new standards that assure objectives are met over time and across the landscape.

The Forest Service cannot provide any assurance that its plans and projects will assure viable populations of native wildlife that depend on dead trees. The Forest Service does not know how many snags are necessary to support viable populations of cavity associated species. The Forest Service has provided no credible link between DecAID tolerance levels, potential population levels, and/or viable populations. The Forest Service has also failed to reliably quantify existing and projected habitat for snag associated species.

An unavoidable impact of all commercial logging is to "capture mortality" which reduces valuable snag habitat in the short-term (via hazard tree felling) and in the long-term (via delayed recruitment and reduced overall recruitment). All types of commercial logging adversely affect dead wood recruitment and need to be minimized and mitigated.

- **Regen harvest** leaves too few trees to serve as a pool for recruitment of future snags and dead wood. Regen logging also does not mimic natural disturbance because it removes the vast majority of the habitat structure, such as snags and large down wood, that early seral wildlife depend on. Eighty five percent of vertebrates tied to edges and early seral forest in the western Cascades need dead wood. C. Friesen 2010. Early Seral Forests – A Conservation Conundrum. http://www.ecoshare.info/uploads/ccamp/Early-Seral-Forest-Friesen.ppt; http://ecoshare.info/projects/central-cascade-adaptive-management-partnership/synthesis-papers-tools/. "Key attributes" of high quality early seral habitat include "exceptionally high quantities of large dead wood," a condition that is not provided by commercial timber harvest that exports the vast majority of wood from the site. "[P]rompt reforestation and few legacies is unlikely to approximate the role of naturally generated early-seral conditions" 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) 160–171. http://www.sierraforestlegacy.org/Resources/Conservation/Biodiversity/BD-Swanson-etal-EarlySeral2014.pdf. Modelling by Harris (2000) suggests that since snags are ephemeral and need to be continually replaced, 12 or more green trees need to be retained for every snag we want to maintain over the life of the stand. Harris, R.B. 2000. Estimating large snag recruitment needs in regeneration timber harvests. Western Journal of Applied Forestry. 15: 140-146. http://www.cas.umt.edu/facultydatabase/FILES_Faculty/1152/Harris%202000%20LargeSnagRecruitment%20Western%20J.%20Appl.%20For.pdf. This paper also highlights the concern that without numerical guides, managers could erroneously assume that they are maintaining adequate numbers of snags across the landscape even though they are retaining too few green trees to achieve that goal.

- **Mature Forest Thinning**. Mature forests are at a stage when they naturally begin accumulating dead wood and snags which provide essential habitat and others functions typical in mature forests. Commercial logging in mature forests will significantly retard that natural process, and leave too few green trees to support levels of dead wood appropriate for old growth conditions. See subsection above "Logging mature forests will impair development of important features of old-growth forests, especially snags and dead wood."
- **Plantation thinning.** Young stands are plastic and still have a lot of growing to do, so if enough green trees are retained, plantations remain a fruitful arena for restoration thinning. However, moderate-to-heavy thinning can still significantly delay attainment of desired levels of snags an dead wood. To highlight this issue, consider the graph below from the Curran Junetta Thin EA (on the Cottage Grove Ranger District of the Umpqua NF) shows that typical thinning prescriptions delays by more than 60 years the attainment of habitat objectives for large snags (i.e. mid-point of the gray band representing 30-80% tolerance level).

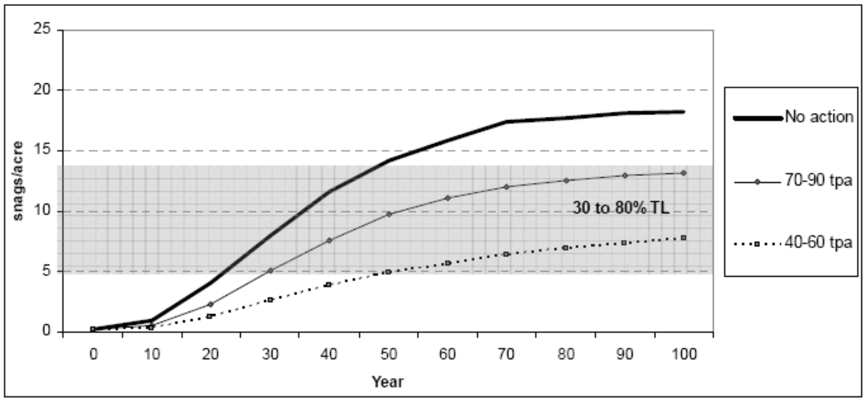


Figure 15. Short and long-term changes to ≥20" dbh snags.

http://a123.g.akamai.net/7/123/11558/abc123/forestservic.download.akamai.com/11558/www/nepa/32805_FSPLT2_053506.pdf. As another example, consider the Lobster Thinning Project on the Siuslaw National Forest- "modeling stand #502073 over a 100-year cycle [using ORGANON] predicts a total stand mortality of 202 trees (>10 inches dbh) for the unthinned stand, while mortality for the thinned stand was two trees. Therefore, thinning will reduce density-dependent mortality within the stand by 99%." NOAA April 4, 2006 Magnuson Act consultation on Essential Fish Habitat and Response to Siuslaw NF Lobster Project BA. Thinning is a subtractive endeavor. There is no reason to think that thinning in densely stocked forests elsewhere would be any different. The best mitigation is to thin lightly and leave generous unthinned skips where natural levels of dead wood can be recruited.

The NEPA analysis must account for new information on the importance of dead wood and the inadequacy of existing standards.

Lessons Learned During the Last Fifteen Years

…

Several major lessons have been learned in the period 1979-1999 that have tested critical assumptions of these earlier management advisory models:

- Calculations of numbers of snags required by woodpeckers based on assessing their 'biological potential' (that is, summing numbers of snags used per pair, accounting for unused snags, and extrapolating snag numbers based on population density) is a flawed technique. Empirical studies are suggesting that snag numbers in areas used and selected by some wildlife species are far higher than those calculated by this technique.[226]
- Setting a goal of 40% of habitat capability for primary excavators, mainly woodpeckers,[369] is likely to be insufficient for maintaining viable populations.
- Numbers and sizes (dbh) of snags used and selected by secondary cavity-nesters often exceed those of primary cavity excavators.
- Clumping of snags and down wood may be a natural pattern, and clumps may be selected by some species, so that providing only even distributions may be insufficient to meet all species needs.

- Other forms of decaying wood, including hollow trees, natural tree cavities, peeling bark, and dead parts of live trees, as well as fungi and mistletoe associated with wood decay, all provide resources for wildlife, and should be considered along with snags and down wood in management guidelines.
- The ecological roles played by wildlife associated with decaying wood extend well beyond those structures per se, and can be significant factors influencing community diversity and ecosystem processes.

Rose, C.L., Marcot, B.G., Mellen, T.K., Ohmann, J.L., Waddell, K.L., Lindely, D.L., and B. Schrieber. 2001. Decaying Wood in Pacific Northwest Forests: Concepts and Tools for Habitat Management, Chapter 24 *in* ***Wildlife-Habitat Relationships in Oregon and Washington*** (Johnson, D. H. and T. A. O'Neil. OSU Press. 2001) http://web.archive.org/web/20060708035905/http://www.nwhi.org/inc/data/GISdata/docs/chapter24.pdf

The authors of DecAID describe some of the limitations of the old methods of managing snag habitat.

> **Limitations of Existing Approaches for Assessing Wildlife-Dead Wood Relations.**
>
> Models of relationships between wildlife species and snags in the Pacific Northwest typically are based on calculating potential densities of bird species and expected number of snags used per pair. This approach was first used by Thomas et al. (1979). Marcot expanded this approach in Neitro et al. (1985) and in the Snag Recruitment Simulator (Marcot 1992) by using published estimates of bird population densities instead of calculating population densities from pair home range sizes. This approach has been criticized because the numbers of snags suggested by the models seem far lower than are now being observed in field studies (Lundquist and Mariani 1991, Bull et al. 1997). In addition, the models provided only deterministic point values of snag sizes or densities and of population response ("population potential") instead of probabilistic estimates that are more amenable to a risk analysis and risk management framework.
>
> In addition, existing models have focused on terrestrial vertebrate species that are primary cavity excavators. Thomas et al. (1979) and Marcot (1992) assumed that secondary snag-using species would be fully provided for if needs of primary snag-excavating species were met. However, McComb et al. (1992) and Schreiber (1987) suggested that secondary cavity nesting birds may be even more sensitive to snag density than are primary cavity excavators.
>
> Furthermore, existing models do not address relationships between wildlife and down wood, nor do they account for species that use different types of snags and partially dead trees, such as hollow live and dead trees used by bats (Ormsbee and McComb 1998, Vonhof and Gwilliam 2007), Vaux's swift (*Chaetura vauxi*) (Bull and Hohmann 1993), American marten (*Martes americana*) (Bull et al. 2005), and fisher (*Martes pennanti*) (Zielinski et al. 2004).

Bruce G. Marcot , Janet L. Ohmann, Kim L. Mellen-McLean, and Karen L. Waddell. Synthesis of Regional Wildlife and Vegetation Field Studies to Guide Management of Standing and Down

Dead Trees. Forest Science 56(4) 2010.
http://www.fs.fed.us/pnw/pubs/journals/pnw_2010_marcot002.pdf

The agencies need to prepare a EIS to consider a replacement methodology for maintaining species and other values associated with dead wood. This is especially critical because adequate dead wood is recognized as an essential feature of healthy forests and the Forest Service has identified lots of "management indicator species" associated with dead wood habitat.

Back in the early 1990s the Forest Service recognized the their forest plans were not adequate to maintain populations of spotted owls and they tried to develop plans to conserve spotted owl without following NEPA and NFMA procedures. The courts said they had to stop cutting owl habitat until they had complied with environmental laws. This is the same situation we find ourselves in today with dead-wood associated species. The agencies should stop harming dead wood habitat until they have a legal plan to conserve associated species over the long-term. *Seattle Audubon Society v. Epsy*, 998 F.2d 699, 704 (9th Cir. 1998) (an agency must re-examine its decision when the EIS "rests on stale scientific evidence and false assumptions").

A few of the problems with the old standards are:

- They failed to account for the fact that the number of snags needed for roosting, escape, and foraging can exceed the number of snags needed for nesting;
- They failed to recognize that the number of snags needed to support viable populations of secondary cavity users may exceed the needs of primary cavity excavators;
- The old standard failed to account for the size height of snags favored by some species;
- In applying the old standards the agencies often fail to account for rates of snag fall and recruitment;
- The old standards fail to recognize non-equilibrium conditions in our forests, i.e. some species rely on the natural large pulses of snags associated with large disturbances;
- The old standards fail to account for the differential use of space and population density of different species;

The old standards ignore other important habitat features of dead wood, e.g. loose bark, hollow trees, broken tops, etc.

Probably the most important issues related to maintaining dead wood habitat include, accounting for the fact that:

(1) wildlife need more snags and dead wood for a wider variety of life functions than previously recognized,

(2) abundant dead wood is also important for a variety of other ecosystem services, including climate mitigation and adaptation, soil functions, hydrologic functions, etc. (See Rose, C.L., Marcot, B.G., Mellen, T.K., Ohmann, J.L., Waddell, K.L., Lindely, D.L., and B. Schrieber. 2001. Decaying Wood in Pacific Northwest Forests: Concepts and Tools for Habitat Management, Chapter 24 in Wildlife-Habitat Relationships in Oregon and Washington (Johnson, D. H. and T. A. O'Neil. OSU Press. 2001)

http://web.archive.org/web/20060708035905/http://www.nwhi.org/inc/data/GISdata/docs/chapter24.pdf),
(3) non-federal lands provide very low amounts of dead wood, and public lands need to mitigate for that,
(4) commercial logging captures mortality and greatly delays attainment of desired levels of dead wood, and
(5) the best way to mitigate for the adverse effects of logging on snags is to thin lightly and retain generous unlogged areas well distributed so that snags are recruited at natural levels on a meaningful fraction of the landscape.

Complex Early Seral Forest Needs to Be Protected from Salvage Logging
Complex early seral habitats that develop after natural disturbances large and small are recognized as a highly important and biodiverse stage of forest development that is highly degraded by salvage logging and conifer replanting. Salvage logging (and danger tree removal adjacent to extensive road networks) removes the legacy structures that serve valuable ecological functions for decades post disturbance. Rose, C.L., et al. 2001. Decaying Wood in Pacific Northwest Forests: Concepts and Tools for Habitat Management, Chapter 24 in Wildlife-Habitat Relationships in Oregon and Washington (Johnson, D. H. and T. A. O'Neil. OSU Press. 2001) http://web.archive.org/web/20060708035905/http://www.nwhi.org/inc/data/GISdata/docs/chapter24.pdf. Dense planting of conifers, often combined with active control of competing native vegetation, truncates natural succession by replacing the diverse post-disturbance plant community that provides diverse food sources for diverse wildlife, and replaces it with a homogeneous tree farm.

> Indeed, naturally developed early-successional forest habitats, with their rich array of snags and logs and nonarborescent vegetation, are probably the scarcest habitat in the current regional [Pacific Northwest] landscape.

Lindenmayer, David B. and Jerry F. Franklin. 2002. Conserving Forest Biodiversity: A Comprehensive Multiscale Approach. Island Press. Washington, DC: 69. *See also*, DellaSala, D.A., J.E. Williams, C. Deacon-Williams, and J.F. Franklin. Beyond smoke and mirrors: a synthesis of fire policy and science. Conservation Biology, Pages 976–986. Volume 18, No. 4, August 2004.
http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/17521/Beyond%20smoke%20and%20mirrors.pdf

> There has been a loss of diverse young forests on all ownerships. … Conservation of diverse young forests has received little attention in forest policy.

Janet Ohmann; Science Findings, Issue 56; Seeing the trees for the forest: mapping vegetation biodiversity in coastal Oregon forests; (September 2003).
http://www.fs.fed.us/pnw/sciencef/scifi56.pdf.

> Currently, early-successional forests (naturally disturbed areas with a full array of legacies, ie not subject to post-fire logging) and forests experiencing natural regeneration (ie not seeded or planted), are among the most scarce habitat conditions in many regions.

Noss et al. 2006. Managing fire-prone forests in the western United States. Front Ecol Environ 2006; 4(9): 481–487. https://ir.library.oregonstate.edu/downloads/cr56n5219?locale=en

In October 2013, 250 scientists signed a letter urging greater attention to the conservation of complex early seral forests and natural recovery after fire. These scientists conclude that the

> "current state of scientific knowledge, … indicates that [salvage logging] would seriously undermine the ecological integrity of forest ecosystems on federal lands. … This post-fire habitat, known as 'complex early seral forest,' is quite simply some of the best wildlife habitat in forests and is an essential stage of natural forest processes. Moreover, it is the least protected of all forest habitat types and is often as rare, or rarer, than old-growth forest, due to damaging forest practices encouraged by post-fire logging policies. While there remains much to be discovered about fire in our forests, the scientific evidence indicates that complex early seral forest is a natural part of historical fire regimes in nearly every conifer forest type in the western U.S. (including ponderosa pine and mixed-conifer forests) … Numerous studies also document the cumulative impacts of post-fire logging on natural ecosystems, including the elimination of bird species that are most dependent on such conditions, compaction of soils, elimination of biological legacies (snags and downed logs) that are essential in supporting new forest growth, spread of invasive species, accumulation of logging slash that can add to future fire risks, increased mortality of conifer seedlings and other important re-establishing vegetation (from logs dragged uphill in logging operations), and increased chronic sedimentation in streams due to the extensive road network and runoff from logging operations."

DellaSala, D. et al (2013) Open Letter to Members of Congress from 250 Scientists Concerned about Post-fire Logging. October 30, 2013.
http://geosinstitute.org/images/stories/pdfs/Publications/Fire/Scientist_Letter_Postfire_2013.pdf or http://www.scribd.com/doc/181401520/Open-Letter-to-Members-of-Congress-from-250-Scientists-Concerned-about-Post-fire-Logging-October-30-2013

While complex early seral conditions may be under-represented, we must not be distracted from the paramount need to conserve mature and old-growth. There are no listed species that depend on early seral, because most of the species associated with ephemeral young forests tend to be mobile, generalist, and/or opportunistic.

Recognizing the expected increase in fire driven by climate change, and the growing need for sound decisions about what to do post-fire, the Forest Service should use this amendment process to disclose and consider all the significant new information and develop a strategy to conserve complex early seral habitat in post-disturbance landscapes:

a. The natural range of variability and existing rarity of complex young forests (e.g., young forests that are unsalvaged after disturbances). Since there is a deficit of large snags across the landscape, the agency must retain all large snags to start moving the landscape toward the natural range of variability. See Jerome J. Korol, Miles A. Hemstrom, Wendel J. Hann, and Rebecca A. Gravenmier. 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. This paper estimates that even if we apply enlightened forest management on federal lands for the next 100 years, we will still reach only 75% of the historic large snag abundance measured across the interior Columbia Basin, and most of the increase in large snags will occur in roadless and wilderness areas.

b. Daniel C. Donato, John L. Campbell & Jerry F. Franklin 2012. FORUM Multiple successional pathways and precocity in forest development: can some forests be born complex? Journal of Vegetation Science 23 (2012) 576–584 http://people.forestry.oregonstate.edu/john-campbell/sites/people.forestry.oregonstate.edu.john-campbell/files/Donato_2012_JVS.pdf

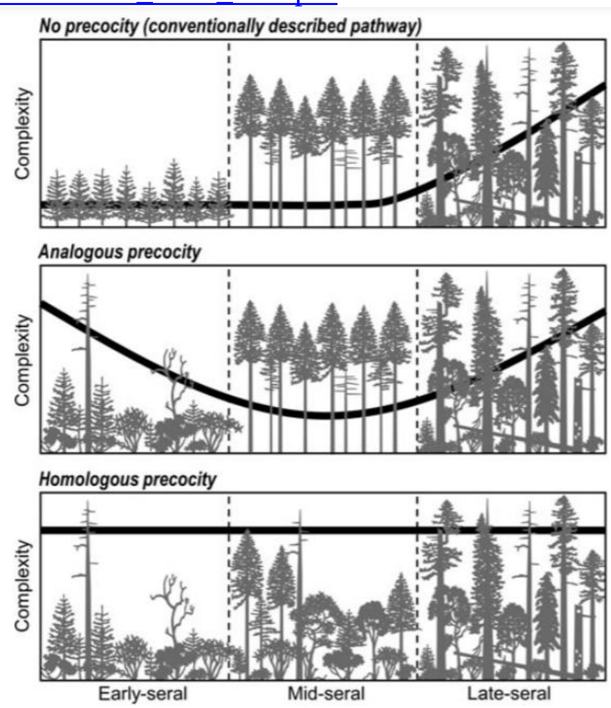


Fig. 3. Three alternate successional pathways for forest development, showing the relative levels of structural complexity exhibited in each seral stage. In the conventional successional model, both early- and mid-seral conditions are dominated by a relatively even-aged tree cohort, and structural complexity does not arise until the latest stage of development. In the case of analogous precocity, early-successional stands exhibit structural complexity in some ways similar to that in old stands, but canopy closure results in reduced complexity during mid-succession. In the case of homologous precocity, the lack of a tree canopy-closure phase results in a continuity of complexity throughout forest development.

c. The ecological values (such as wildlife habitat) associated with snags, dead wood, and complex young forests. See Rose, C.L., Marcot, B.G., Mellen, T.K., Ohmann, J.L., Waddell, K.L., Lindely, D.L., and B. Schrieber. 2001. Decaying Wood in Pacific Northwest Forests: Concepts and Tools for Habitat Management, Chapter 24 *in* ***Wildlife-Habitat Relationships in Oregon and Washington*** (Johnson, D. H. and T. A. O'Neil. OSU Press. 2001) http://web.archive.org/web/20060708035905/http://www.nwhi.org/inc/data/GISdata/docs/chapter24.pdf;

d. Given the regional deficit of young complex forests and the fact that many species, such as woodpeckers and secondary cavity users, appear to be adapted to exploit the structure and resources available within disturbed forests, the agencies should comprehensively consider and disclose the direct and indirect effects of salvage logging on species associated with young complex forests. The Forest Service has numerous Management Indicator Species whose populations have not been monitored, so the agencies lack the information necessary to show that the salvage logging program will maintain species viability.

e. The effects of salvage logging on the development of complex forest habitat; "The early post-disturbance period of forest ecosystem development - pre-tree-canopy closure - is profoundly important!" because it is heterogeneous, light-energy rich, structure rich, biodiversity rich, and process rich. "**Removal of legacies is most profound long-term impact**" because of the "Importance of Coarse Wood:
    - Habitat for species
    - Organic seedbeds (nurse logs)
    - Modification of microclimate
    - Protection of plants from ungulates
    - Sediment traps
    - Sources of energy & nutrients
    - Sites of N-fixation
    - Special source of soil organic matter
    - Structural elements of aquatic ecosystems"

   Jerry Franklin - What is a 'Good' Forest Opening? – Powerpoint
   http://courses.washington.edu/esrm315/Lectures/FranklinEarlySuccession.pdf

f. All the new science related to salvage logging and dead wood, including but not limited to: Beschta R.L., J.J. Rhodes, J.B. Kauffman, R.E. Gresswell, G.W. Minshall, J.R. Karr, D.A. Perry, F.R. Hauer, and C.A. Frissell, 2004. Postfire management on forested public lands of the western USA. Cons. Bio.,. http://pacificrivers.org/files/post-fire-management-and-sound-science/Beschta-etal2004.pdf

g. "Conservation of diverse young forests has received little attention in forest policy." USDA PNW Research Station. *Science Findings #56 - Seeing The Trees For The Forest: Mapping Vegetation Biodiversity In Coastal Oregon Forests.* Sept 2003. http://www.fs.fed.us/pnw/sciencef/scifi56.pdf. "[T]here's a looming shortage of diverse young forests - where seedlings intermingle with fallen logs, standing dead snags, and shrubs - that provide specialized habitat for certain animals and plants. … there's a looming gap in diverse, young, early-successional conifer forest, the type of forest that once came in naturally after forest fires. These young forests, up to 10 years old, have a diversity of forest structures - fallen logs and dead snags - and a diversity of plant life. They are important habitat for the western bluebird and other birds that prefer open areas, as well as some shrub species. Today, because of intense timber management on private lands, young forests don't get the chance to develop much diversity." OSU. 2001. Press Release: Researchers Assess Forest Sustainability. http://web.archive.org/web/20060914032259/http://oregonstate.edu/dept/ncs/newsarc h/2001/Oct01/assess.htm According to the CLAMS project: "Diverse young forests: also rare but receiving less attention. Legacy tree habitat: uncertain future.." Ohmann, Spies, Gregory, Johnson. 2002. Vegetation Biodiversity in the Oregon Coast Range. http://www.fsl.orst.edu/clams/download/presentations/j02s_ohmann_10june02.pdf (slide 24).

h. Hutto, R.L., 2006. Toward Meaningful Snag-Management Guidelines for Postfire Salvage Logging in North American Conifer Forests. Conservation Biology Volume 20, No. 4, 984–993. http://web.archive.org/web/20090310114517/http://avianscience.dbs.umt.edu/documents/hutto_conbio_2006.pdf ("Species such as the Black-backed Woodpecker (*Picoides arcticus*) are nearly restricted in their habitat distribution to severely burned forests. Moreover, existing postfire salvage-logging studies reveal that most postfire specialist species are completely absent from burned forests that have been (even partially) salvage logged. I call for the long-overdue development and use of more meaningful snag-retention guidelines for postfire specialists, and I note that the biology of the most fire-dependent bird species suggests that even a cursory attempt to meet their snag needs would preclude postfire salvage logging in those severely burned conifer forests wherein the maintenance of biological diversity is deemed important.")

i. A recent study of birds that use post-fire mosaics highlighted the importance of resprouting shrubs and forbs on the re-establishment of nesting birds following wildfire. "Of the 39 species for which nests were found, 14 (37%) used cavities and 25 (63%) built open-cup nests.... Species that built cup nests used snags, residual live trees, resprouting hardwoods, and other ground vegetation and downed wood. The associations between the presence of breeding species and forb and shrub cover indicate that these are important components of the early establishment of bird populations following stand-replacing fires. These data suggest that post-fire management of resprouting hardwoods and herbaceous vegetation should consider potential impacts to bird species that nest and forage in burned forests." CFER 2007. Response of Birds to Fire Mosaics. CFER News. Winter 2007. http://www.fsl.orst.edu/cfer/pdfs/Vol7_1.pdf.

j. BLM's 2008 Western Oregon Plan Revision (WOPR) DEIS (pp. LI-LII) admits that structurally complex young forests develop old forest characteristics twice as fast as structurally deprived initial conditions. https://web.archive.org/web/20110524132346/http://www.blm.gov/or/plans/wopr/plan-doc-overview.php ("The retention of structural legacies in regeneration harvested areas, … would result in structurally complex forests that develop almost twice as fast after harvesting as in Alternatives 1 and 2. [with no green tree retention]");

k. Mark E Swanson, Jerry F Franklin, Robert L Beschta, Charles M Crisafulli, Dominick A DellaSala, Richard L Hutto, David B Lindenmayer, and Frederick J Swanson 2010. The forgotten stage of forest succession: early-successional ecosystems on forest sites. Front Ecol Environ 2010; doi:10.1890/090157, https://www.fs.fed.us/pnw/pubs/journals/pnw_2010_swanson001.pdf;

l. Bats find favorable habitat in burned areas with abundant and diverse snags and abundant and diverse flying insects. Salvage logging will remove potential roost sites, and food sources. Carol Chambers and Erin Saunders. BATS IN THE BURNS -

Studying the impact of wildfires and climate change. BATS. Bat Conservation International. Winter 2013, Volume 3, No. 4. http://web.archive.org/web/20140209081630/http://www.batcon.org/index.php/media-and-info/bats-archives.html?task=viewArticle&magArticleID=1154;

m. "Leaving a damaged forest intact means the original conditions recover more readily," says David Foster, … director of the NSF Harvard Forest LTER site. "Forests have been recovering from natural processes like windstorms, fire and ice for millions of years. What appears to us as devastation is actually, to a forest, a natural and important state of affairs." 10-16-2012 Press Release 12-198, In Blown-Down Forests, a Story of Survival To preserve forest health, the best management decision may be to do nothing. http://www.nsf.gov/news/news_summ.jsp?cntn_id=125744; Audrey Barker Plotkin, David Foster, Joel Carlson, and Alison Magill 2013. Survivors, not invaders, control forest development following simulated hurricane. Ecology, 94(2), 2013, pp. 414–423. http://harvardforest.fas.harvard.edu/sites/harvardforest.fas.harvard.edu/files/publications/pdfs/BarkerPlotkin_Ecology_2013.pdf

n. "Unmanaged early-seral stages of forest development are now considered to be among the most threatened habitat types in coniferous regions of the western United States (Noss et al. 2006, Thomas et al. 2006). Not surprisingly, concern has arisen over viability of populations that use broadleaf vegetation in early-seral forest, particularly as this habitat type contributes disproportionately to forest biodiversity (Halpern and Spies 1997). In the northwestern United States, a number of bird species thought to be strongly associated with early-seral broadleaf habitat have declined and are considered conservation priorities (Altman 1999, U.S. Fish and Wildlife Service 2002). Because the PNW represents a substantial portion of the ranges of these species, loss of quality early-seral habitat could increase risk of extinction." M. G. BETTS, J. C. HAGAR, J. W. RIVERS, J. D. ALEXANDER, K. MCGARIGAL, AND B. C. MCCOMB. 2010. Thresholds in forest bird occurrence as a function of the amount of early-seral broadleaf forest at landscape scales. Ecological Applications, 20(8), 2010, pp. 2116–2130. http://www.fsl.orst.edu/flel/pdfs/Betts%20et%20al%202010%20Ecol%20Apps.pdf

o. Salvage logging after disturbance is detrimental to old-growth indicator species, has a homogenizing influence on the forest, and hinders future development of structurally complex forests. Orczewska, A., et al 2019. The impact of salvage logging on herb layer species composition and plant community recovery in Białowieża Forest. Biodiversity and Conservation (2019) 28:3407–3428 https://doi.org/10.1007/s10531-019-01795-8 https://link.springer.com/content/pdf/10.1007%2Fs10531-019-01795-8.pdf. ("We conclude that continuous deterioration of the forest habitats via clearcutting of stands afected [sic] by insect outbreak, followed by tree planting, substantially reduces the chances of successful, natural regeneration towards deciduous, structurally complex and diverse forests. ... [S]alvage logging breaks the natural ecological processes of forest dynamics and facilitates colonization of forest ecosystems by light-demanding, competitive species, associated with disturbed forest sites but hinders the number and cover of late-successional, shade-tolerant forest species.").

p. Many bird species benefit from fire that leaves a rich mix of plants and complex structure of snags and dead wood, but salvage logging removes the complex structure and truncates the early seral vegetation by planting conifers. The quality of habitat that results after fire often depends on the successional stage of the forest pre-disturbance, because much of this structure is carried over after the fire into the future forest. Salvage logging removes most of the trees and with it the structural legacies that bind the past and future forests. Dick Hutto said:

> In a new paper, we show that fire effects cannot be accurately assessed through a simple comparison of recently burned and unburned forest plots. This is because the same species that show negative responses through simplistic comparisons of burned and unburned forests reveal strong POSITIVE responses to more restricted combinations of successional stage and fire severity. With 10 years of post-fire data, we show that the majority of bird species (60%) benefit from fire (as evidenced by greater abundances in burned forest patches belonging to a particular successional stage/fire severity combination than in forest patches that have been long unburned). With data from even longer times-since-fire (say, 15, 20, or 30 years after fire), the percentage of species that clearly benefit from fire is probably closer to 80%!

Describing Richard L. Hutto, and David A. Patterson 2016. Positive effects of fire on birds may appear only under narrow combinations of fire severity and time-since-fire. International Journal of Wildland Fire. http://dx.doi.org/10.1071/WF15228

The Northwest Forest Plan amendment should consider how to enhance complex early seral without sacrificing mature and old-growth forests. Some argue for modified clearcutting on federal lands as a means of developing complex early seral conditions. However, there are a wide variety of policy options for enhancing early seral that do not require that we sacrifice old forests, such as reforming salvage logging, modifying practices on non-federal lands where early seral is created in abundance, and active management of existing very young plantations on federal lands. K. Norm Johnson, Debora L. Johnson. 2007. Policies to Encourage Diverse, Early Seral Forest in Oregon: What Might We Do? http://ecoshare.info/2010/10/04/k-norman-johnson-policies-to-encourage-diverse-early-seral-forest-in-oregon-what-might-we-do/ Climate change is expected to increase the prevalence of early seral forests. Regen logging produces lower quality early seral. We should instead stop salvage logging.

Restoration of Reserves Need Not Be Rushed

LSRs were designed to be big enough to allow natural processes to flourish. LSRs can tolerate both fire and the slow process of forest recovery. We do not need to intervene with commercial logging to rush things along. In fact, if we do try to rush things it may be counter-productive. For instance,

- thinning to accelerate establishment of multiple tree cohorts and complex understories will significantly reduce recruitment of snag habitat over a long time period;

- tree planting after logging, fire or other disturbance will truncate an important stage of natural succession typified by complex early seral vegetation;
- salvage logging will dramatically simplify stands by removing legacy features that help provide a bridge between previous and future forests affected by disturbance;

The purpose and need for this plan amendment should include conserving and perpetuating the unique ecological features associated with natural rates of forest succession.

Marbled Murrelets, New Information

The Northwest Forest Plan amendment should address new information on the marbled murrelet and its habitat conditions. The need to conserve habitat for marbled murrelet is urgent.

> "Given declining murrelet population trends as well as habitat losses, in many areas, it is uncertain whether their populations will persist to benefit from potential future increases in habitat suitability. **This underscores the need to <u>arrest the loss of suitable habitat on all lands</u>, especially on nonfederal lands and in the relatively near term** (3 to 5 decades)."

Falxa, Gary A.; Raphael, Martin G., tech. coords. 2016. Northwest Forest Plan—the first 20 years (1994–2013): status and trend of marbled murrelet populations and nesting habitat. Gen. Tech. Rep. PNW-GTR-933. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 132 p. http://www.fs.fed.us/pnw/pubs/pnw_gtr933.pdf

Additional new information includes the documentation of a "an average rate of decline [in the population of Marbled Murrelet (*Brachyramphus marmoratus*) in Washington, Oregon and northern California] of 3.7% annually (95% CI: –4.8 to –2.7%) from 2001 to 2010. This annual rate suggests a total decline of about 29% during this period. We documented downward trends for Washington (conservation zone 1) and for the outer coast of Washington (conservation zone 2). These declines coincide with reductions in the amount of nesting habitat." Sherri L. Miller, Martin G. Raphael, Gary A. Falxa, Craig Strong, Jim Baldwin, Thomas Bloxton, Beth M. Galleher, Monique Lance, Deanna Lynch, Scott F. Pearson, C. John Ralph, and Richard D. Young. 2012. Recent Population Decline of the Marbled Murrelet in the Pacific Northwest. The Condor 114(4):771–781. The Cooper Ornithological Society.

The agencies should provide a hedge against climate change by providing additional suitable habitat and recruitment habitat that can support a larger murrelet population which is inherently more resilient in the face of stochastic variations. Climate change is likely to adversely affect both ocean conditions (affecting murrelet food supply) and forests (increased fires may reduce murrelet nesting habitat.). See Butler and Taylor. Climate Change and Waterbirds. USDA Forest Service Gen. Tech. Rep. PSW-GTR-191. 2005. http://www.fs.fed.us/psw/publications/documents/psw_gtr191/Asilomar/pdfs/1107-1109.pdf. Due to the long residence time of the greenhouse gases already in the atmosphere, some degree of warming is already unavoidable. Climate warming leads to greater uncertainty for the marbled murrelet in terms of both changing ocean current that could lead to unfavorable ocean conditions, as well as the uncertain persistence of nesting habitat in the face of increasing fire and winter storms. This uncertainty can be somewhat mitigated by protecting more critical habitat so any future losses of habitat or future declines in survival due to unfavorable ocean conditions are mitigated by a larger baseline of suitable habitat and/or murrelet population size. Further logging of mature and old-growth forests will exacerbate climate change and make the murrelet's status even more precarious.

New science indicates that surveys of nesting habitat need to be conducted when ocean conditions are favorable. Murrelets might just hang out in the ocean and choose not to breed when conditions are unfavorable, which could lead to false negative findings during surveys of nesting habitat. Betts, Northrup et al 2020. Squeezed by a habitat split: Warm ocean conditions and old-forest loss interact to reduce long-term occupancy of a threatened seabird. Conservation Letters. 2020. https://conbio.onlinelibrary.wiley.com/doi/pdfdirect/10.1111/conl.12745 This study also affirms that murrelet occupancy is related to extent of older forest., so the more old forest conserved the better. This may be related to the murrelets apparent preference for nesting near other murrelets. The agency should conserve large areas of suitable nesting habitat around occupied nest sites (up to a mile and a half from nest trees).

It is very likely that marbled murrelet populations were significantly adversely affected by bad ocean conditions in 2005. In the near-shore area of the Pacific ocean where Marbled murrelets live and forage, conditions were very bad in 2005. For reasons still unknown, nutrient upwelling was severely curtailed, so plankton populations were very low. Small fish that feed on plankton were affected, and scientists measured significant unprecedented decreases in populations of birds that fed on small fish. A recent news report explained, “Oceanic plankton have largely disappeared from the waters off Northern California, Oregon and Washington, mystifying scientists, stressing fisheries and causing widespread seabird mortality.” Glen Martin, Sea life in peril -- plankton vanishing, Usual seasonal influx of cold water isn't happening, San Francisco Chronicle, July 12, 2005.
http://www.sfgate.com/cgi-bin/article.cgi?file=/c/a/2005/07/12/MNG8SDMMR01.DTL.

The Northwest Forest Plan could do more to protect marbled murrelet from nest predation, for instance when thinning dense young stands adjacent to suitable nesting habitat. The 1997 Recovery Plan for the Marbled Murrelet (pp 121-124) emphasizes protection of buffer habitat to reduce nest predation:

> The short-term actions are critical because of the length of time necessary to develop most new nesting habitat (100-200 years). They should be factored into decisions on which areas should be secured and how habitat (both terrestrial and marine) should be maintained or improved. Short-term actions include: (1) maintaining occupied habitat; (2) maintaining large blocks of suitable habitat; (3) maintaining and enhancing buffer habitat; and (4) decreasing risks of loss of nesting habitat due to fire and windthrow.

Because low productivity or breeding success appears to be a substantial problem, minimizing disturbance and reducing
predation at nest sites is also an important first step in the recovery process. ...

Long-term actions include increasing the amount, quality and distribution of suitable nesting habitat. Increasing the stand size of suitable habitat to provide more interior forest conditions and increasing the number of stands of suitable nesting habitat are considered key to long-term recovery. Within secured habitat areas, this means protecting currently unsuitable habitat to allow it to become suitable, reducing fragmentation, providing replacement habitat for current suitable nesting habitat lost to disturbance events and habitat lost to both timber harvest and disturbance events in the past. In the long term, the distribution of nesting habitat should be improved. Silvicultural techniques also might increase the speed of habitat development and the structural qualities of the habitat.

...

C. Recovery Actions

The following narrative outline identifies actions necessary to address the recovery objectives. These actions include:

...

o Implementing short-term actions to stabilize and increase the population that include maintaining potential suitable habitat in large contiguous blocks and buffer areas; maintaining habitat distribution and quality; decreasing risk of fire and windthrow; decreasing adult and juvenile mortality; reducing nest predation; increasing recruitment; and initiating research to determine impacts of disturbance in both marine and terrestrial environments.

o Implementing long-term actions to stop population decline and increase population growth by increasing the amount, quality and distribution of suitable nesting habitat, decreasing fragmentation, protecting "recruitment" habitat, providing replacement habitat through silvicultural techniques, and improving marine habitat quality.

USFWS 1997. Recovery Plan for the Marbled Murrelet, https://www.fws.gov/wafwo/species/Fact%20sheets/USFWS%20Recovery%20Plan%201997.pdf.

The Pacific Seabird Group wrote to President Obama on October 18, 2013 urging : "Increased Protections Needed for the Threatened Marbled Murrelet" The attachment said "the goals for creating and protecting murrelet nesting habitat and minimizing predation should include:"

…

• Protecting all suitable and occupied habitat and minimizing fragmentation near suitable and occupied habitat;

• Providing large buffers to occupied and suitable habitat that will protect them from windthrow, microclimate changes, and predation;

• Developing and creating habitat in large blocks to create more interior habitat and thereby decreasing the possibility of avian predation;
• Improving the distribution of habitat across the listed range of the murrelet, thereby improving the distribution of their populations;
• Minimizing the size of canopy openings near or adjacent to murrelet habitat to minimize the risk of predation;
• Determining ways to create new murrelet habitat in young forests (<60 years old) through thinning without increasing the risks of predation in current habitat. This should include funding research to look at the impact of thinning on predation risk;
…

Stanley Senner, PSG Vice Chair for Conservation. 10-18-2013 letter to President Obama. Attachment "Marbled Murrelet Habitat Requirements and Conflicts with Current Logging Proposals" Prepared by the Marbled Murrelet Technical Committee of the Pacific Seabird Group, October 2013. http://www.pacificseabirdgroup.org/policy/PSG_President.MAMU.pdf.

> We compared the fates of experimental murrelet nests at paired edge and interior locations at 52 sites in two regions of south-western British Columbia, Canada. Sites were chosen at ''hard'' edges (recent clearcuts), ''soft'' edges (regenerating forest), and natural edges (i.e., riparian areas). We used nest cameras to distinguish disturbances caused by known predators of real nests. Accounting for landscape-scale fragmentation, disturbances by avian predators were significantly more frequent at hard edges relative to interiors, but less frequent at soft edges. There were no edge effects at natural-edged sites. These results imply that detrimental edge effects adjacent to recent clearcuts may decline with time due to successional processes.

Matl & Lank 2007. Temporal dynamics of edge effects on nest predation risk for the marbled murrelet. Biological Conservation 140:160-173. https://www.researchgate.net/publication/223672217_Temporal_dynamics_of_edge_effects_on_nest_predation_risk_for_the_marbled_murrelet

Fragmentation effects are complicated. Valente et al (2023) found:

> We aggregated a 29-year breeding survey dataset for the endangered Marbled Murrelet (*Brachyramphus marmoratus*) from >42,000 forest sites throughout the Pacific Northwest (Oregon, Washington, and northern California, USA). We built a species distribution model (SDM) linking occupied sites with Landsat imagery to quantify murrelet-specific habitat, then used occupancy models to test the hypotheses that (1) fragmentation negatively affects murrelet breeding distribution, and (2) these effects are amplified with distance from the marine foraging habitat towards the edge of the species' nesting range. Murrelet habitat declined in the Pacific Northwest by 20% since 1988 while the proportion of habitat comprising edges increased by 17%, indicating increased fragmentation. Furthermore, fragmentation of murrelet habitat at landscape scales (within

2 km of survey stations) negatively affected occupancy of potential breeding sites, and these effects were amplified near the range edge. On the coast, the odds of occupancy decreased by 37% (95% confidence interval [CI]: -54% to 12%) for each 10% increase in edge habitat (i.e., fragmentation), but at the range edge (88 km inland) these odds decreased by 99% (95% CI: 98% to 99%). Conversely, odds of murrelet occupancy increased by 31% (95% CI: 14% to 52%) for each 10% increase in local edge habitat (within 100 m of survey stations). Avoidance of fragmentation at broad scales but use of locally fragmented habitat with reduced quality may help explain the lack of murrelet population recovery. Further, our results emphasize that fragmentation effects can be nuanced, scale-dependent, and geographically variable.

Valente, J. J., Rivers, J. W., Yang, Z., Nelson, S. K., Northrup, J. M., Roby, D. D., Meyer, C. B., & Betts, M. G. (2023). Fragmentation effects on an endangered species across a gradient from the interior to edge of its range. Conservation Biology, 00, 00– 00. https://doi.org/10.1111/cobi.14091. (accepted pdf)

Federal lands must be managed to address the severe deficit of older forests in the Coast Range, and the continuing loss and fragmentation of habitat. See this animation showing habitat impacts in the central Coast Range from 1984-2012. https://earthengine.google.org/#timelapse/v=44.85742,-123.70911,9.608,latLng&t=0.00

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.

Table 1 | Scale-dependent change in forest interior area from 2001 to 2006. Forest interior area was measured at five spatial scales defined by neighborhood size and was summarized for the conterminous United States

	Forest interior area			
	2001	2006	Change	
Neighborhood size (ha)	(Thousand km²)	(Thousand km²)	(Thousand km²)	(Percent)
4.41	1,419	1,374	−45	−3.2
15.2	1,151	1,102	−49	−4.3
65.6	867	817	−50	−5.8
590	523	482	−41	−7.8
5,310	277	248	−29	−10.5

These fragmentation effects are particularly acute within the range of the marbled murrelet.

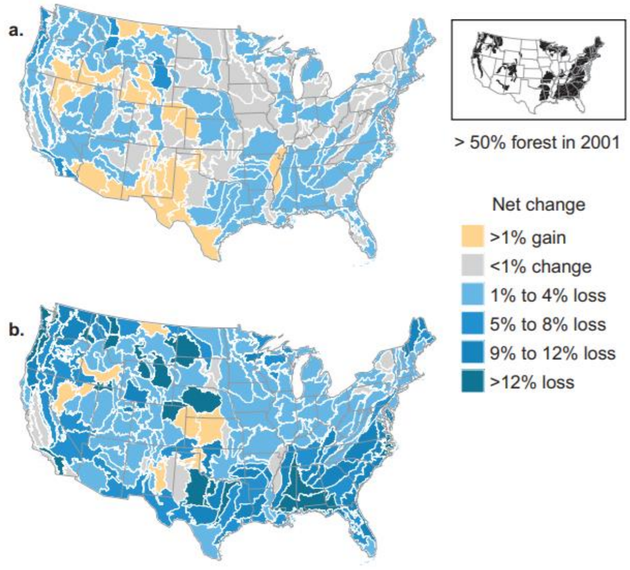


Figure 2 | Net change in forest area from 2001 to 2006. (a) All forest. (b) Forest interior in a 65.6-ha neighborhood. Ecological sections[44] are shaded and State boundaries are shown for comparison. In the inset map, forest-dominated ecological sections are those that contained more than 50% forest in 2001.

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

Plantation Thinning Provides Common Ground
Areas that were previously clearcut and replanted as dense monocultures remain vastly over-abundant. These areas can be managed to put them on a trajectory better aligned with public demand for water quality, fish & wildlife, climate stability, recreation, fire resilience, and quality of life.

The Forest Service should recommit to focus on less-controversial activities such as plantation thinning and non-commercial fuel reduction. The Forest Service is breaking public trust by attempting to increase logging in older forests and protected areas. There is a 20-year record of success in thinning dense young plantations to improve habitat and help the timber industry transition away from dependence on logging mature and old-growth on our public lands. These unnaturally dense planted forests cover vast areas of the Pacific Northwest National Forests and are more departed from historical conditions, and more in need of intervention, compared to natural forests. Careful thinning in young plantations also meets the Forest Service goals of producing logs, reducing fire hazards, and making forests more resilient to climate change. We urge the Forest Service to continue to focus on less controversial management activities like plantation thinning.

Aquatic Conservation Strategy
Though the Notice of Intent lacks any meaningful details, we are concerned that the Forest Service may reduce protection of streamside forests and increase logging in riparian reserves, which puts at risk one of the most important and successful parts of the Northwest Forest Plan. Some of the FACA members are advocating for such changes. This has significant implications for drinking water, salmon conservation, carbon storage, and climate refugia. Existing riparian reserves must be retained, and allowed to develop mostly under the influence of natural processes as prescribed in the Northwest Forest Plan.

Through this amendment, the Forest Service should recommit to reducing road density in watersheds, especially given that roads interact unfavorably with climate change, both as sources of unnatural peak flows and fire ignitions.

The plan amendment should address the Forest Services' current flawed interpretation of the ACS that allows excessive logging in riparian reserves without weighing the significant trade-offs on wood recruitment that is essential for both aquatic and terrestrial wildlife that were intended to benefit from conservation of riparian reserves. Logging captures and exports functional wood and reduces shade. The Forest Service needs to do a better job of weighing trade-offs and start enforcing an 80 year limit on logging in riparian reserves. "The risk has been shifted under the Aquatic Conservation Strategy because each project must meet the maintenance and restoration criteria by maintaining or restoring the physical and biological processes required by riparian-dependent resources within a watershed." 1994 FSEIS p 3&4 – 69.

FEMAT page IV-109 indicates that logging in riparian reserves stands older than 80 years is not appropriate. Such stands were presumed to remain unharvested as mitigation for Bryophytes and other species that prefer dense forest cover and abundant dead wood.

> **Mitigation for Bryophytes**
> Bryophytes should receive considerable protection under riparian prescriptions, especially those with full SAT riparian buffers. … Riparian stands older than 80 years should not be thinned or harvested.

In January 2013, the Science Review Team Wood Recruitment Subgroup reported their "Key Points" regarding the effects of commercial thinning on wood recruitment in riparian reserves:

> Key Points
> 1. Thinning is most beneficial in dense young stands. Existing literature and stand development theory suggest that the greatest potential ecological benefits of thinning to accelerate the development of older forest structure (e.g. large trees, large dead trees, spatial structural and compositional heterogeneity, etc.) comes in dense uniform plantations less than 80 years and especially less than 50 years old. The benefits of thinning for older forest ecological objectives are less clear in stands over 80 years of age. Hence, our report focused primarily on plantations less than 50 years of age.

Thomas Spies, Michael Pollock, Gordon Reeves, and Tim Beechie 2013. Effects of Riparian Thinning on Wood Recruitment: A Scientific Synthesis - Science Review Team Wood Recruitment Subgroup. Jan 28, 2013, p 36. http://www.mediate.com/DSConsulting/docs/FINAL%20wood%20recruitment%20document.pdf

Restoring functional wood to riparian reserves requires conservation, not logging. Monitoring of the Aquatic Conservation Strategy shows that the natural abundance of large wood (>24" dbh) is still declining. This is because too many large and old trees were removed before the Northwest Forest Plan, large wood has a finite residence time, and tress grow slowly, so it will take a very long time to restore the conditions necessary to recruit natural levels of large wood necessary to support riparian and aquatic biodiversity.

> Across the sampled sites in the AREMP area, overall survey results indicate that the density of wood pieces per length of stream consistently declined for the large size category, but they remained relatively constant for the intermediate and in some cases increased for the small size Across the AREMP area, the overall trend in wood piece density was -24.9 percent per decade (95-percent credibility intervals from -32.6 to -16.4 percent), and 83 percent of subwatershed-level trends were negative (95-percent credibility intervals from 71 to 95 percent) for the largest size class D. … All aquatic provinces experienced declines in density of the largest pieces of wood (class D) … Declines in density of larger sizes of wood (class D) were consistent across LUAs, with a 24-percent per decade decrease in LSRs, a 27-percent decrease in matrix, and a 29-percent decrease in congressional reserves. … Overall, trends indicating losses of larger instream wood are consistent with the concept of slow attrition of pieces derived from older, larger trees recruited to streams prior to widespread forest harvest in the region and subsequent protections imposed in accordance with the NWFP.
>
> … For instream wood, we also observed declines in the quantity of the largest size class, presumably as recruitment of these largest pieces mainly occurred prior to the extensive removal of old-growth forests preceding the NWFP. Recovery of larger wood recruitment from older trees occurs on time scales that far exceed the 25-year period of this report.

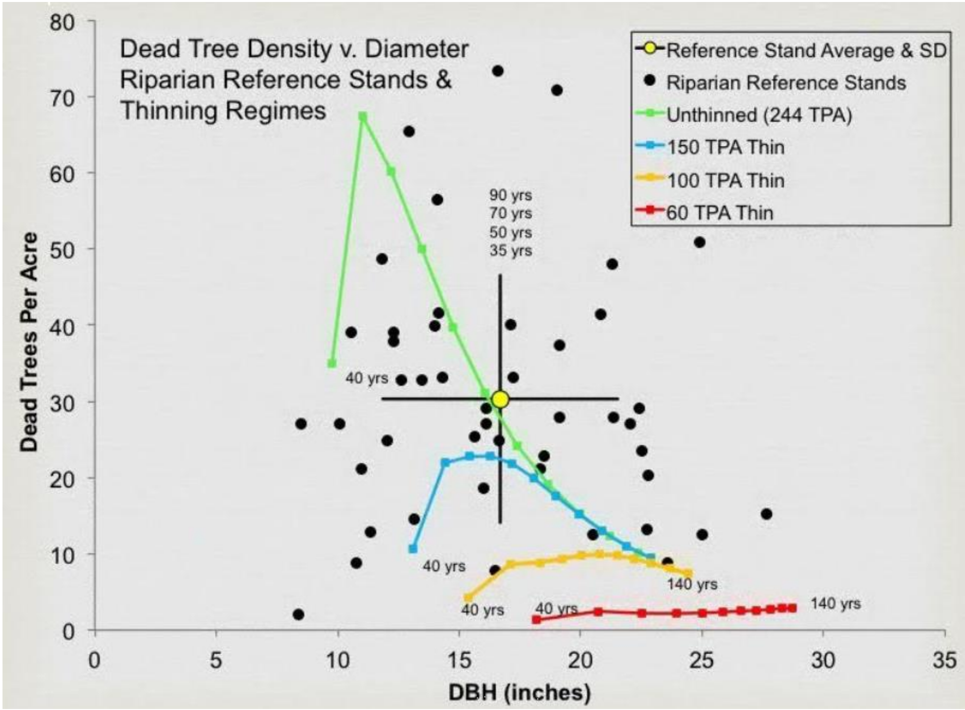
Dunham, Jason; Hirsch, Christine; Gordon, Sean; Flitcroft, Rebecca; Chelgren, Nathan; Snyder, Marcia; Hockman-Wert, David; Reeves, Gordon; Andersen, Heidi; Anderson, Scott; Battaglin, William; Black, Tom; Brown, Jason; Claeson, Shannon; Hay, Lauren; Heaston, Emily; Luce, Charles; Nelson, Nathan; Penn, Colin; Raggon, Mark. 2023. Northwest Forest Plan the first 25 years (1994 2018): watershed condition status and trends. Gen. Tech. Rep. PNW-GTR-1010. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 163 p. https://doi.org/10.2737/PNW-GTR-1010. [Notably, the data also show a decline in wood 18-24" dbh in the Western Cascades Provinces]. The long-lasting adverse effect of past mismanagement can be mitigated or made worse depending on how riparian forests are managed going forward. More riparian logging will remove trees that would othersie grow and be recruited as riparian wood, thus making a bad situation worse. While strict conservation of riparian forests will allow those trees to grow and be recruited. Keep in mind that where there is a shortage of large wood, the presence of abundant small wood can partially mitigate that shortage.

Logging is a subtractive endeavor that is adverse to recruitment of dead wood. So, the agency often claims that logging in riparian reserves is necessary to improve attributes other than large wood. However, these benefits are often minor and transitory, and do not outweigh the significant long-term adverse effect of logging on recruitment of dead wood. The agency must focus on the most significant contributions of vegetation toward ACS objectives and the most significant effects of logging on the ACS objectives.

New science brings into question the ecological value of commercial logging as a restoration tool in riparian reserves in the Coast Range and western Cascades of Washington and Oregon.

> … our data suggest that mature, late-successional conifer dominated forests have well developed structural characteristics in terms of abundant large trees in the overstory, abundant large snags, and a well-developed understory of shade-tolerant trees. We modeled the growth of young conifer stands to assess whether a common restoration treatment [thinning to 150 trees per hectare] would accelerate development of structural characteristics typical of reference conditions. We found that left untreated, the stands followed a trajectory towards developing forest structure similar to the average reference condition. In contrast, the restoration treatment followed a developmental trajectory along the outside range of reference conditions.

Pollock, M. M., T. J. Beechie, and H. Imaki. 2012. Using reference conditions in ecosystem restoration: an example for riparian conifer forests in the Pacific Northwest. Ecosphere 3(11):98. http://dx.doi.org/10.1890/ES12-00175.1 The following figure from this study shows that all types of thinning cause stand development to miss the reference stand trajectory for dead wood.



While careful and limited thinning of very young stands may be appropriate to help grow large trees in riparian reserves, the benefits of logging mid-seral and older stands becomes highly questionable. The NWFP ROD was clear that "Appropriate practices [for riparian reserves] may include … thinning densely-stocked young stands to encourage development of large conifers," but older stands are not mentioned. 1994 ROD p B-31; 1993 FEMAT Report, page V-57.

Since streams are already severely degraded by logging, any further logging in riparian reserves should be very carefully scrutinized to avoid further adverse effects. Any claimed benefits of logging in riparian reserves should be clearly justified and supported by compelling scientific evidence. And that is just what the NWFP Aquatic Conservation Strategy calls for. ACS Objective #8 calls for restoring and maintaining "amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability." Existing large wood levels are deficient across the landscape due to past and ongoing harvest practices. The objectives require retention and long–term recruitment of abundant trees and wood especially large wood that provides long-lasting ecological services.

If the agency intends to log in riparian reserves to increase some nebulous goal like "vegetation diversity and complexity," then please explain why the biophysical indicators for the ACS objectives (set forth below) do not include any mention of vegetation diversity or complexity. See the Jazz Thinning Preliminary Analysis, 2011. http://bark-out.org/sites/default/files/bark-docs/Jazz_PA_0.pdf.

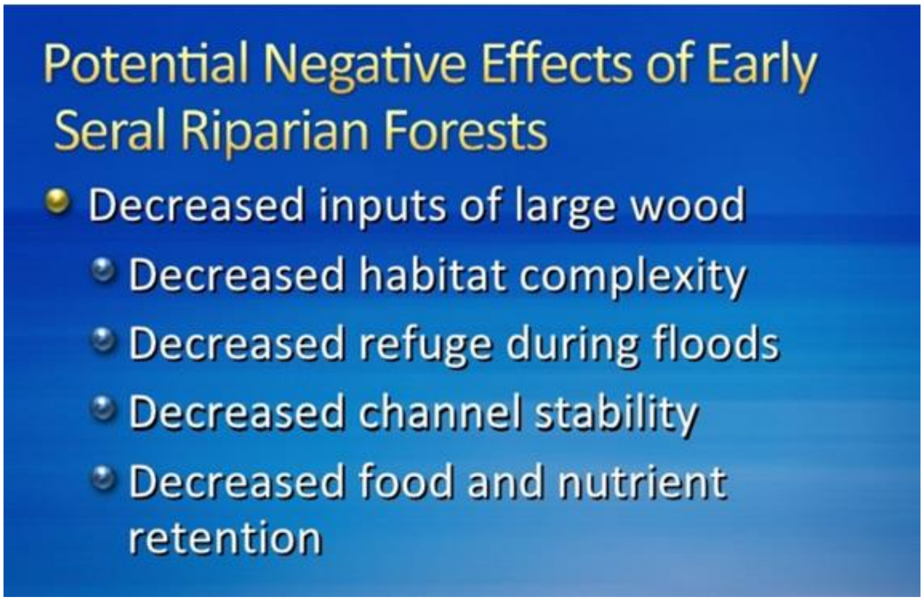
Aquatic Conservation Strategy Objectives and Related Indicators.

	Aquatic Conservation Strategy Objectives								
Indicators	**#1**	**#2**	**#3**	**#4**	**#5**	**#6**	**#7**	**#8**	**#9**
Temperature		X		X				X	X
Sediment				X	X	X		X	X
Chemical Contamination				X				X	X
Physical Barriers	X	X						X	X
Substrate			X		X	X			X
Large Woody Debris			X					X	X
Pool Frequency			X						X
Pool Quality			X						X
Off-Channel Habitat	X	X	X						X
Refugia	X	X						X	X
Width/Depth Ratio			X					X	X
Streambank Condition			X			X		X	X
Floodplain Connectivity	X	X	X				X	X	X
Peak/base Flows					X	X	X		
Drainage Network Increase					X	X	X		
Riparian Reserves	X	X	X	X	X	X		X	X

These ACS objectives and biophysical indicators are consistent throughout the Pacific Northwest and are not unique to the Mt Hood NF.

The Northwest Forest Plan and its supporting documentation make clear that the primary value of riparian vegetation is as a source of large wood and shade, not vegetation diversity and canopy layering, as often asserted by the agency to justify logging in riparian reserves. BLM admits "The primary function of Riparian Reserves is to provide shade and a source of large wood inputs to stream channels." Medford BLM 2013. Pilot Thompson EA, p 3-76. http://www.blm.gov/or/districts/medford/plans/files/PT_EA_ForWeb.pdf

NEPA requires consideration of trade-offs. *California v. Block*, 690 F.2d 753, 771 (9th Cir. 1982) (NEPA was designed to "ensure that an agency is cognizant of all the environmental trade-offs that are implicit in a decision"). Stan Gregory notes the following trade-offs associated with logging riparian reserves to enhance early seral vegetation:



Gregory, Stan 2010. What About Riparian Systems: Who Benefits From an Early Seral Forest Condition. Workshop - Early Seral Forest - We know we need it -- How do we get it? Presentation sponsored by the Central Cascades Adaptive Management Partnership and NW Oregon Ecology Group http://ecoshare.info/2010/07/06/what-about-riparian-systems-who-benefits-from-an-early-seral-forest-condition-gregory/

The Northwest Forest Plan Aquatic Conservation Strategy Objectives (1994 ROD p B-11) enumerates specific purposes for "Maintain[ing] and restor[ing] the species composition and structural diversity of plant communities in riparian areas and wetlands" that is -

> "to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability."

All these values are provided as well or better by unthinned riparian stands.

The effects of logging on dead wood are significant and long term, adversely affecting a core function of the reserves, while the purported benefits to vegetation diversity are minor and transitory, and affect secondary purposes of the reserves.

Large Wood

Large quantities of downed trees are a functionally important component of many streams (Swanson et al. 1976; Sedell and Luchessa, 1982; Sedell and Froggat, 1984; Harmon et al. 1986; Bisson et al. 1987; Maser et al. 1988; Naiman et al. 1992). Large woody debris influences channel morphology by affecting longitudinal profile, pool formation, channel pattern and position, and channel geometry (Bisson et al. 1987). Downstream transport rates of sediment and organic matter are controlled in part by storage of this material behind large wood (Betscha 1979). Large wood affects the formation and distribution of habitat units, provides cover and complexity, and acts as a substrate for biological activity (Swanson et al. 1982; Bisson et al. 1987). Wood enters streams inhabited by fish either directly from the adjacent riparian zone from tributaries that may not be inhabited by fish, or hillslopes (Naiman et al. 1992).

Large wood in streams has been reduced due to a variety of past and present timber harvesting practices and associated activities. Many riparian management areas on federal lands are inadequate as long term sources of wood.

…

Riparian Ecosystem Components

…

Riparian vegetation regulates the exchange of nutrients and material from upland forests to streams (Swanson et al. 1982; Gregory et al. 1991). Fully functional riparian ecosystems have a suite of characteristics which are summarized below. Large conifers or a mixture of large conifers and hardwoods are found in riparian zones along all streams in the watershed, including those not inhabited by fish (Naiman et al. 1992). Riparian zone-stream interactions are a major determinant of large woody debris loading (House and Boehne 1987; Bisson et al. 1987; Sullivan et al. 1987). Stream temperatures and light levels that influence ecological processes are moderated by riparian vegetation (Agee 1988; Gregory et al. 1991). Streambanks are vegetated with shrubs and other low-growing woody vegetation. Root systems in streambanks of the active channel stabilize banks, allow development and maintenance of undercut banks, and protect banks during large storm flows (Sedell and Beschta 1991). Riparian vegetation contributes leaves, twigs, and other forms of fine litter that are an important component of the aquatic ecosystem food base (Vannote et al. 1980).

1993 FEMAT Report, pp V-13, V-25.

Climate change highlights an additional trade-off related to logging riparian buffers. New science shows that more frequent drought makes upland habitats less suitable, so increasing numbers of upland birds flock to riparian corridors, which become more crowded, with negative effects on riparian-dependent species. The agency should do more to increase space for wildlife that need moist streamside habitat during droughts. Gabrielsen, Paul 2021. In dry years, rivers become birds' crowded corridors. University of Utah @THEU. https://attheu.utah.edu/uncategorized/in-dry-years-rivers-become-birds-crowded-corridors/ ("New research from the University of Utah and the Utah Division of Wildlife Resources (UDWR) finds that in dry years, birds funnel into the relative greenness of riparian (adjacent to river) environments. That increased diversity is accompanied by overcrowding that may cause increased competition for habitat and resources, the study finds, and an overall decrease in populations of birds who call the river home. … Neate-Clegg and his colleagues noticed that during particularly dry years they were finding more birds than usual in the mist nets near rivers.

… The multi-year data showed that total bird captures and total species were higher in hotter and drier years, El Niño years, and less green years. The effect was strongest for non-riparian species, suggesting that in harsh conditions, birds from all over the landscape found their way to the rivers. "This suggests that the wider landscape is unable to support migrants and so they are forced to use greener areas," Neate-Clegg says. But just as an influx of tourists can crowd out locals, the uptick in birds may have taken its toll on typically riparian species, especially those that breed on river banks…. In warmer years, population growth rates slowed for 47% of riparian bird species. The slowing, the researchers found, wasn't due to more birds deaths, but rather to fewer new birds joining the population. There could be several reasons that bird breeding goes down in hotter years, but the authors suspect that more species in riparian habitats can mean more competition and fewer resources to go around. 'This study shows how native bird populations utilize these habitats,' Norvell says. 'As droughts intensify, this becomes increasingly the refuge that everything's relying on. And I don't think humans are all that different in this case. We're all increasingly relying on these very same areas.' Neate-Clegg says that rivers provide connections for birds across the landscape, enabling them to transport nutrients or disperse seeds. A hotter, drier climate could affect those important functions that birds provide, called 'ecosystem services.'")

Thinning in riparian reserves does in fact raise ambient air temperatures that the microclimate effects must be accounted for. Anderson, Paul D.; Larson, David J.; Chan, Samuel S. 2007. Riparian Buffer and Density Management Influences on Microclimate of Young Headwater Forests of Western Oregon. Forest Science, Volume 53, Number 2, April 2007 , pp. 254-269(16). http://www.ingentaconnect.com/content/saf/fs/2007/00000053/00000002/art00012.

> ... concern about cumulative effects of thinning, which involves an understanding of the spatial and temporal dimensions of the issue in whole-stream networks. To address these cumulative effects we are studying experimental riparian thinning treatments in adjacent stream networks and forests managed by the Green Diamond Resource Company and the National Park Service (Redwood National Park) in northern California. Thinning was implemented in multiple locations, allowing us to evaluate effects of these local treatments in the context of larger stream networks. To track local treatments, we followed a before-after-control-impact approach to quantify spatial and temporal patterns of riparian shade, light, and stream temperatures as possible responses to riparian thinning. To evaluate how the potential effects of these local treatments resonate at broader extents, we have quantified shade, light, and stream temperatures across entire networks. Spatial statistical models were applied to these data to determine the spatial extent to which localized thinning propagated through stream networks. Preliminary results from tracking local treatments indicate an immediate response in stream temperature associated with the reductions in shade and increases in light associated with riparian thinning. At the network extent this resulted in variable downstream propagation of the effects of upstream thinning.

David Roon, Jason Dunham. 2018. Spatial Patterns of Riparian Shade, Light, and Stream Temperature in Response to Riparian Thinning in Redwood Headwater Streams. Speed Talks. 2018 Oregon Chapter of the American Fisheries Society 54th Annual Meeting. http://orafs.org/wp-content/uploads/2017/10/2018-Annual-Meeting-Abstracts.pdf

Climate change is expected to increase stream temperatures and reduce fish habitat quality and quantity. "Riparian vegetation can potentially off-set future increases in water temperature [related to global climate change]." Gordy Reeves, 4-22-2020 Presentation to the Oregon Board of Forestry. https://www.oregon.gov/odf/Board/Documents/BOF/20200422/B_Item%20Two_Presentation.pdf (p 63/66).

Hydrologic Effects of Logging and Roads
New information indicates that logging and roads have significant and long-lasting adverse effects on hydrology, including artificial peak flows during storms, especially in the years immediately after logging; as well as artificial low stream flows during summer, which lasts for several decades after dense young conifers are established after logging. Perry & Jones (2016) found "… Long-term paired-basin studies extending over six decades revealed that the conversion of mature and old-growth conifer forests to plantations of native Douglas-fir produced persistent summer streamflow deficits of 50% relative to reference basins, in plantations aged 25 to 45 years. This result challenges the widespread assumption of rapid "hydrologic recovery" following forest disturbance … " Perry, T. D., and Jones, J. A. (2016) Summer streamflow deficits from regenerating Douglas-fir forest in the Pacific Northwest, USA. Ecohydrology, doi: 10.1002/eco.1790. http://onlinelibrary.wiley.com/doi/10.1002/eco.1790/full. Jones & Grant (1996) found ""This study demonstrated that road construction combined with patch clear-cutting ranging from 10 to 25% of basin area produced significant, long-term increases in peak discharges in small and large basins in the western Cascades.... In the western Cascades, clear-cutting and vegetation removal influence water balances by affecting evapotranspiration and possibly snow accumulation and melt, whereas road construction influences hillslope flow paths by converting subsurface flow to surface flow." Jones, J.A., Grant G.E., "Peak flow response to clear-cutting and roads in small and large basins, western Cascades, Oregon," Water Resources Research, 32(4) 959-974, April 1996 https://www.wou.edu/las/physci/taylor/g473/refs/jones_grant_1996.pdf. The National Climate Assessment concludes that global climate change is expected to reduce the ability of watersheds and ecosystems to regulate water quality and water flow and buffer extreme events. http://nca2014.globalchange.gov/ Efforts toward watershed and riparian conservation should therefore be increased.

Buffer-on-Buffer Required to Ensure Wood Recruitment and Protect Microclimate

This amendment process must recognize the full rationale for the Aquatic Conservation Strategy. Protection of riparian reserves is not just about protecting instream habitat, instream wood recruitment, or microclimate at the stream center. Riparian reserves are intended to support the needs of a wide variety of wildlife that live in riparian reserves, including many terrestrial wildlife that benefit from the riparian microclimate and abundant wood throughout the full extent of the riparian reserves, not just instream. The authors of the NWFP Aquatic Conservation Strategy (ACS) recognized that logging outside stream buffers already depletes the amount of dead wood that could potentially fall into the riparian reserves, and they extended the reserves beyond a single-site-potential tree distance in order to buffer the buffer and ensure that upland areas of riparian reserves would maintain natural levels of dead wood accumulation. The analysis does not seem to recognize this, and proposes to log riparian reserves in opposition to the purposes and intent of the Aquatic Conservation Strategy.

The Northwest Forest Plan ACS explicitly recognized the problem of reduced wood recruitment in narrow riparian buffers adjacent to logged sites. Simply put, logging adjacent to riparian reserves removes a source of wood recruitment within riparian reserves. The 1993 FEMAT Report, an appendix to the EIS supporting the NWFP explained:

> Large wood on the ground is an important habitat component in riparian areas. Maintaining the integrity of the vegetation is particularly important for riparian-dependent organisms including amphibians, arthropods, mammals, birds, and bats (see appendix V-E for greater detail).
>
> …
>
> **Riparian Processes as a Function of Distance from Stream Channels**
>
> …
>
> **Large wood delivery to riparian areas**. Large downed logs are recruited into riparian areas from the riparian forests and from upslope forests. Similar to large wood delivery from riparian areas into streams, the effectiveness of upland forests to deliver large wood to the riparian area is naturally expected to decline at distances greater than approximately one tree height from the stand edge (Thomas et al.., 1993). Timber harvest adjacent to the riparian area creates an edge that eliminates one source of large wood. Thus, long-term levels of large wood may diminish in the riparian zone.

1993 FEMAT Report, pp V-25 - V-26.

Riparian reserves are intended to protect numerous species that do not live *in* the stream, rather, they live in the stream-side forest extending hundreds of feet from the stream, but they still require a relatively cool-moist microclimate, complex forest structure, and abundant wood, and these species will be adversely affected by logging adjacent to narrower riparian reserves. This is part of the reason the NWFP adopted a *buffer-on-the-buffer*, that is, an outer buffer of shade and cover to maintain suitable microclimate conditions for wildlife that live in the inner buffer.

The EIS supporting the NWFP states:

> Riparian areas are widely considered to be important wildlife habitat. Cool air temperatures due to the presence of cool and turbulent surface waters, typically dense vegetative canopy cover, and their location in the lowest portions of watersheds combine to maintain a distinct microclimate along stream channels and in the adjacent riparian area. Maintaining the integrity of the vegetation in these areas is particularly important for riparian-dependent species of amphibians, arthropods, mammals, birds, and bats. Many species of amphibians, birds, and mammals use late-successional and old-growth riparian areas, including associated streams, ponds and wetlands, for reproducing, foraging, roosting, and as travel corridors (Table 3&4-11). The many wildlife species, along with lichens, mosses, vascular plants and mollusks, listed in Table 3&4-11 depend on diverse and complex riparian and aquatic habitats.
> …
> The principal factor influencing the outcomes for amphibians related to the width of Riparian Reserves.79 [1994 FSEIS pp 3&4 - 61, 3&4 - 81]

> The NWFP recognized that forest openings adjacent to a riparian buffer would create "edge effects" that change the microclimate in the buffer and reduce the recruitment of wood to the buffer. The NWFP addressed this problem by adopting a *buffer-on-the-buffer* so that at least the inner portion of the riparian reserves would have near-natural microclimate and wood recruitment processes.

Heiken, D. 2013. Riparian Reserves Provide Both Aquatic & Terrestrial Benefits - A Critical Review of Reeves, Pickard & Johnson (2013). https://www.dropbox.com/s/yc13jrg0ya93yht/Heiken%202013.%20Review%20of%20Reeves%20et%20al%20Riparian%20Proposal.pdf?dl=0. The analysis in the EA does not fully and accurately disclose the original purposes of riparian reserves nor does it clearly and accurately disclose the effects of commercial tree removal within and adjacent to reserves.

Studies show that the widest buffers have the most beneficial effect on riparian fish and wildlife.

> Analyses showed significant effects of buffer treatments on abundance of all fish species and amphibian species, including stream-breeding amphibians, sculpins, coastal giant salamanders, and both southern and Columbia torrent salamander species. Animal counts were higher in the one site-potential 200 to 240 foot tree height riparian buffer treatment than in the three other buffers [0, 20, 50 feet].

Headwater stream buffer effects on animals after two thinnings: The plot thickens! Presenter: Deanna H. (Dede) Olson Additional coauthors: Adrian Ares, Klaus Puettmann. January 2019 Headwater Streams Symposium. OSU. https://traskstudy.forestry.oregonstate.edu/sites/default/files/documents/Abstracts_Olson_ARM.pdf.

Pacific Fisher and Red Tree Vole

The Pacific fisher was petitioned for listing in 2000. In 2014, FWS proposed listing the Pacific fisher as "threatened" under the ESA. The imminent listing of the fisher requires the agencies to increase connectivity in the NWFP. The current network of reserves was designed more for spotted owls and is not ideal for fishers which have more difficulty in navigating between reserves. William J. Zielinski, et al., Using landscape suitability models to reconcile conservation planning for two key forest predators, Biological Conservation (2006), doi:10.1016/j.biocon.2006.07.003. http://www.sierraforestlegacy.org/Resources/Conservation/SierraNevadaWildlife/CaliforniaSpottedOwl/CASPO-Zielinski06.pdf The agencies need to increase conservation of habitats in the matrix that are suitable or potentially suitable for fisher. This includes mature & old-growth forests and riparian reserves.

There is also a distinct population segment of the red tree vole living in the Oregon Coast Range north of the Siuslaw River that is warranted for ESA listing. This species is also dispersal limited, and the plans need to be adjusted to reduce logging in the matrix in order to ensure viable populations of this species. Red tree voles outside the North Coast DPS deserve equal protection because of the threat of logging and climate change. Recent fires have likely had a significant effect on the species. The Forest Service's "high priority site" procedure is a serious loophole in RTV conservation efforts. The high priority sites somehow always end up in places the agency isn't planning to log.

Tribal Inclusion

We support the Forest Service intention to incorporate more tribal knowledge in this planning process, especially in the area of fire management, first foods, biodiversity, etc. and expressed in the preliminary proposed action: "Add plan direction incorporating Indigenous Knowledge into planning and plan implementation, including future project design, to identify and support tribal goals, achieve forest management goals and meet the agency's trust responsibilities."

We agree with the NOI statement that:

> The development and implementation of the NWFP in 1994 could have involved more consultation, engagement, and partnership with tribes and the inclusion of ecological and traditional ecological knowledge. It is imperative that Tribal governments, representatives, and communities across the NWFP area have the opportunity to engage in amendment of the NWFP to ensure that Tribal sovereignty and treaty rights are accurately addressed and to integrate co-stewardship and co-management frameworks for accomplishing plan objectives.

It takes time and effort to establish good communication and nurture trust with Indigenous communities. The Forest Service should extend its timeline and take the time to do this right.

Social and Economic Values

A major development over the last 30 years is the diversification of the Northwest economy. The region has grown tremendously and replaced many times over any timber jobs lost due to the adoption of logging restrictions. There is also a better understanding that well-protected public forests provide direct and indirect contributions to our survival and quality of life, and serve as a foundation for regional economic development and far exceed the value of logs produced for the timber industry.

The socioeconomic benefits of the Northwest Forest Plan include much more than wood products. The economic benefits of clean water, biodiversity, watershed protection, climate stability, fire moderation, recreation, and quality of life need to be recognized as first-order economic benefits of forest conservation. The plan amendment must recognize that the value of avoided GHG emissions alone vastly exceeds the economic effects of logging.

There is a lot of important work to do restoring northwest forests that have been degraded by past logging, road-building, and fire exclusion, and doing this work well will require a lot of talented workers, in particular a skilled fire and fuels management workforce. We urge the Forest Service to expand its imagination about the range of economic values served by our public forests and the kinds of jobs both in the woods that will enhance ecological integrity and wildfire resilience, and jobs out of the wood that will reap the benefits of ecologically and hydrologically intact landscapes.

The NEPA analysis needs to quantify the economic value of conserving biodiversity and ecosystem structure/function/processes.

> Biodiversity loss is among the top global risks to society. The planet is now facing its sixth mass extinction, with consequences that will affect all life on Earth, both now and for millions of years to come. Humans have destroyed or degraded vast areas of the world's terrestrial, marine and other aquatic ecosystems.
>
> ...
>
> Human pressures are undermining the biodiversity that underpins all life on land and below water. Ecosystem services delivered by biodiversity, such as crop pollination, water purification, flood protection and carbon sequestration, are vital to human well-being. Globally, these services are worth an estimated USD 125-140 trillion (US dollars) per year, i.e. more than one and a half times the size of global GDP.
>
> ...
>
> The costs of inaction on biodiversity loss are high. Between 1997 and 2011, the world lost an estimated USD 4-20 trillion per year in ecosystem services owing to land-cover change and USD 6-11 trillion per year from land degradation. Action to halt and subsequently reverse biodiversity loss needs to be scaled up dramatically and urgently. Biodiversity protection is fundamental to achieving food security, poverty reduction and more inclusive and equitable development.
>
> There exists a strong business case for scaling up action on biodiversity. Business impacts and dependencies on biodiversity translate into risks to business and financial organisations, including ecological risks to operations; liability risks; and regulatory, reputational, market and financial risks. Acknowledging and measuring these dependencies and impacts on biodiversity can help businesses and financial organisations manage and prevent biodiversity-related risks, while harnessing new business opportunities.

...

Conserving, sustainably using and restoring biodiversity is vital to achieving many other policy objectives, including human health, climate-change mitigation and adaptation, disaster risk reduction, and water and food security. The associated economic values can be considerable: for example, the annual market value of crops dependent on animal pollination ranges from USD 235 billion to USD 577 billion.

The benefits derived from biodiversity and ecosystem services are considerable, but are systematically undervalued or unvalued in day-to-day decisions, market prices and economic accounting. Conventional accounting approaches and measures of economic performance (such as GDP) provide only a limited picture of an economy's health, and generally overlook the costs of ecosystem degradation.

Ongoing efforts to better assess and value biodiversity and ecosystem services, and integrate these values into decision-making are vital for halting biodiversity loss.

OECD (2019), Biodiversity: Finance and the Economic and Business Case for Action, report prepared for the G7 Environment Ministers' Meeting, 5-6 May 2019. https://www.oecd.org/environment/resources/biodiversity/G7-report-Biodiversity-Finance-and-the-Economic-and-Business-Case-for-Action.pdf.

"It is hard to image a more important priority than protecting the ecosystem services underpinned by biodiversity," says Professor Georgina Mace of Imperial College, London, and Vice-Chair of the international DIVERSITAS program. "Biodiversity is fundamental to humans having food, fuel, clean water and a habitable climate." http://diversitasconference.wordpress.com/2009/10/11/world-wont-meet-2010-biodiversty-target/. http://www.eurekalert.org/pub_releases/2009-10/d-wwm100409.php.

The ID Team should carefully review and incorporate the economic framework set forth in European Communities. 2008. THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY – An Interim Report. http://ec.europa.eu/environment/nature/biodiversity/economics/pdf/teeb_report.pdf.

> … Different species promoted ecosystem functioning during different years, at different places, for different functions and under different environmental change scenarios. Furthermore, the species needed to provide one function during multiple years were not the same as those needed to provide multiple functions within one year. Our results indicate that even more species will be needed to maintain ecosystem functioning and services than previously suggested by studies that have either (1) considered only the number of species needed to promote one function under one set of environmental conditions, or (2) separately considered the importance of biodiversity for providing ecosystem functioning across multiple years, places, functions or environmental change scenarios. Therefore, although species may appear functionally redundant when one function is considered under one set of

environmental conditions7, many species are needed to maintain multiple functions at multiple times and places in a changing world.

Forest Isbell, Vincent Calcagno, Andy Hector, John Connolly, W. Stanley Harpole, Peter B. Reich, Michael Scherer-Lorenzen, Bernhard Schmid, David Tilman, Jasper van Ruijven, Alexandra Weigelt, Brian J. Wilsey, Erika S. Zavaleta, Michel Loreau. High plant diversity is needed to maintain ecosystem services. Nature, 2011; DOI: 10.1038/nature10282. http://www.nature.com/nature/journal/vaop/ncurrent/full/nature10282.html.

Recent research is showing that even small players in the ecosystem have an important stabilizing effect on the foodweb.

Abstract: The pattern of predator–prey interactions is thought to be a key determinant of ecosystem processes and stability. Complex ecological networks are characterized by distributions of interaction strengths that are highly skewed, with many weak and few strong interactors present. Theory suggests that this pattern promotes stability as weak interactors dampen the destabilizing potential of strong interactors. Here, we present an experimental test of this hypothesis and provide empirical evidence that the loss of weak interactors can destabilize communities in nature. We ranked 10 marine consumer species by the strength of their trophic interactions. We removed the strongest and weakest of these interactors from experimental food webs containing >100 species. Extinction of strong interactors produced a dramatic trophic cascade and reduced the temporal stability of key ecosystem process rates, community diversity and resistance to changes in community composition. Loss of weak interactors also proved damaging for our experimental ecosystems, leading to reductions in the temporal and spatial stability of ecosystem process rates, community diversity, and resistance. **These results highlight the importance of conserving species to maintain the stabilizing pattern of trophic interactions in nature, even if they are perceived to have weak effects in the system**.

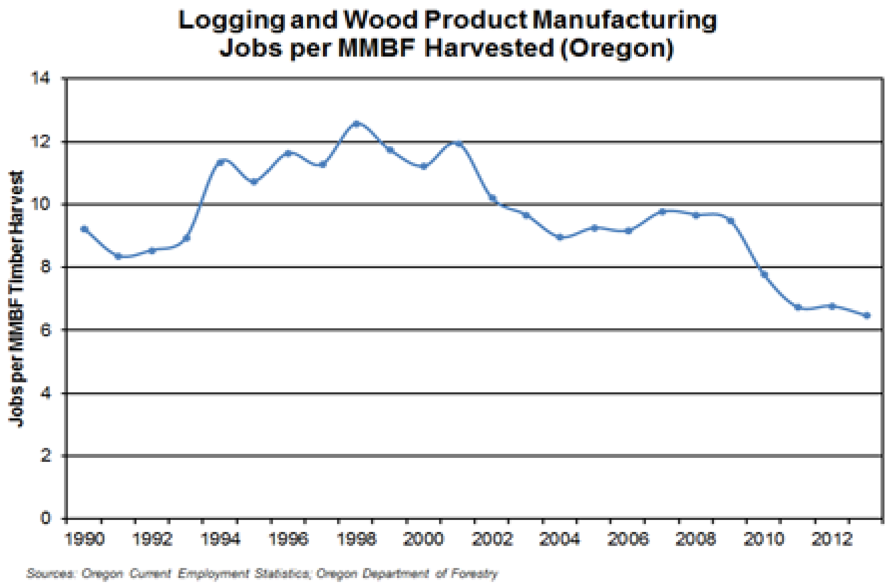
Eoin J. O'Gorman, and Mark C. Emmerson 2009. Perturbations to trophic interactions and the stability of complex food webs. PNAS. http://www.pnas.org/content/106/32/13393.full.pdf.

The PNW Economy has Changed

The soft landing has already occurred. There is no need to prop up the timber industry with logging that undermines other important social goals including climate stability, economic diversity, and quality of life.

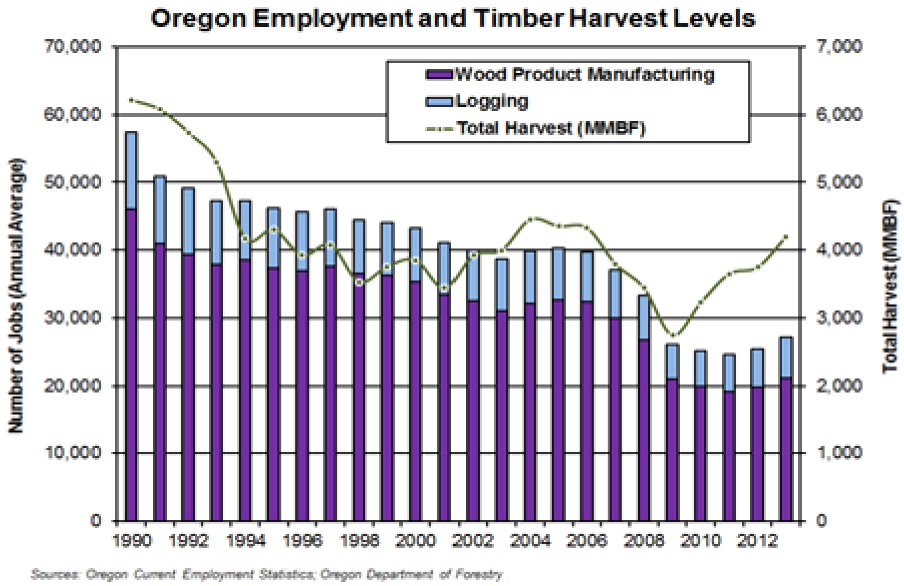
At the NWFP tenth anniversary conference on April 13, 2004 in Portland, USFS PNW Regional Economist Richard Haynes said that the NW economy has “fundamentally changed” over the last ten years since the NWFP was approved. The changes include: growth and diversification of the overall economy so that the timber industry plays a much smaller role in the overall economy, structural changes in the timber industry both regionally and nationally so that few mills remain dependent upon federal old-growth log supply, and serious decline of the export market so the logs from private lands are now more available to domestic mills. This raises a significant issue about whether the NWFP should continue to log any more late-successional old-growth at all and take continued risks with population viability of late-successional old-growth dependent species. Changed economic circumstances represent significant new information and requires the agency to prepare an EIS to consider protecting all remaining mature and old-growth forests and shifting efforts toward restoration including thinning dense young plantations.

The Economic and Social Benefits of Logging are Decreasing.
As recently as 2001, there were 12 jobs generated per million board feet cut. In 2012, that ratio had declined to 6.5 jobs per million board feet logged. (Oregon Employment Department, July 17, 2014).



https://www.qualityinfo.org/-/jobs-per-board-feet-of-timber-harvests-in-oregon;

Since 2010, timber harvest and jobs have become decoupled. There is no reason to think that increased timber harvest will result in increased employment.



https://www.qualityinfo.org/-/jobs-per-board-feet-of-timber-harvests-in-oregon;

Community Stability is Threatened by the Boom-Bust Timber Industry

The plan amendment should not rely on counter factual assumptions such as that the timber industry is a stabilizing force for rural communities. There is significant new information indicating that the timber industry is inherently volatile so proving timber from federal lands causes community instability rather than community stability. BLM'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'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's Wood Product Industry. http://oregoneconomicanalysis.com/2012/01/23/historical-look-at-oregons-wood-product-industry/

Timber industry volatility would have its greatest 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.

Use Best Available Science

The Forest Service's 2012 planning regulations require the Forest Service to use the best available science and document how the best available science was used.

> Role of science in planning. The responsible official shall use the best available scientific information to inform the planning process required by this subpart. In doing so, the responsible official shall determine what information is the most accurate, reliable, and relevant to the issues being considered. The responsible official shall document how the best available scientific information was used to inform the assessment, the plan decision, and the monitoring program …

36 C.F.R. §219.3 (2012).

Forest Service directives further define the best available science criteria from the Planning Rule as follows:

> (1) Accurate information estimates, identifies, or describes "the true condition of its subject matter" (Forest Service Handbook [FSH] 1909.12 sec 07.12, Figure 1). This can include specific measurements of conditions or estimation of trends. Accurate scientific information should be quantitatively unbiased and free of systematic error.
> (2) Reliable information is precise and unaffected by random error; multiple samples represent the same condition (Figure 1). Appropriate scientific methods, including study design, assumptions, analytical approach, and conclusions, should be well-referenced and described, with citations to relevant, credible literature.
> (3) Relevant information is that which pertains to the issues under consideration and relate to the appropriate temporal and spatial scales. Both accurate and reliable science need to be assessed for applicability to the management question. This includes the ability to transfer results to a management question from different systems, species, or geographies or via different methodologies.
> The directives note that sometimes a clear scientific consensus might not exist, and in such cases, conflicting information can be acknowledged without necessarily choosing one "best" source of information (FSH 1909.12 sec 07.12).

Esch et al. 2018. Using Best Available Science Information: Determining Best and Available. J. For. 116(5):473–480. doi: 10.1093/jofore/fvy037. https://www.researchgate.net/publication/327738915_Using_Best_Available_Science_Information_Determining_Best_and_Available. See also, Sullivan, P. J., J. M. Acheson, P. L. Angermeier, T. Faast, J. Flemma, C. M. Jones, E. E. Knudsen, T. J. Minello, D. H. Secor, R. Wunderlich, and B. A. Zanetell. 2006. Defining and implementing best available science for fisheries and environmental science, policy, and management. American Fisheries Society, Bethesda, Maryland, and Estuarine Research Federation, Port Republic, Maryland. http://web.archive.org/web/20080705101501/http://www.uec-utah.org/PDF/Sullivan%20et%20al.%202006_AFS%20science.pdf

“Sustained Yield” is Based on Flawed Science.
The FAC Subcommittee Ideas and Options Summary, suggests that the Northwest Forest Plan amendment change the name of the Matrix to emphasize a purpose of sustained-yield forest management. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd1162343.pdf. This is not only inconsistent with the original intent of the Matrix, but also not a well-supported scientific goal for forest management.

Matrix lands were never intended to be a tree farm. The Northwest Forest Plan explicitly said that matrix lands have a role to play in conserving biodiversity.

> The matrix is an integral part of the management direction included in these standards and guidelines. Production of timber and other commodities is an important objective for the matrix. However, forests in the matrix function as connectivity between Late-Successional Reserves and provide habitat for a variety of organisms associated with both late-successional and younger forests. Standards and guidelines for the matrix are designed to provide for important ecological functions such as dispersal of organisms, carryover of some species from one stand to the next, and maintenance of ecologically valuable structural components such as down logs, snags, and large trees. The matrix will also add ecological diversity by providing early-successional habitat.
>
> …
>
> Matrix objectives for silviculture should include: (1) production of commercial yields of wood, including those species such as Pacific yew and western red cedar that require extended rotations, (2) retention of moderate levels of ecologically valuable old-growth components such as snags, logs, and relatively large green trees, and (3) increasing ecological diversity by providing early-successional habitat.
>
> …
>
> Stands in the matrix can be managed for timber and other commodity production, and to perform an important role in maintaining biodiversity. Silvicultural treatments of forest stands in the matrix can provide for retention of old-growth ecosystem components such as large green trees, snags and down logs, and depending on site and forest type, can provide for a diversity of species. Retention of green trees following timber harvest in the matrix provides a legacy that bridges past and future forests. Retaining green trees serves several important functions including snag recruitment, promoting multistoried canopies, and providing shade and suitable habitat for many organisms in the matrix.

1994 NWFP ROD pp B-1 to B-6 (emphasis added).

PSQ needs to be reconsidered. Timber targets based on a cycle of regeneration logging is outdated and unsuited to conserving the diversity of values that public lands are expected to provide. Logging to produce a “sustained yield” of timber is premised on the concept of a “regulated forest.” As explained in the Days Creek – South Umpqua Harvest Plan EA “The key to achieving sustained yield is to establish a regulated forest with the proper distribution of stand age and size classes so that over time, approximately equal periodic harvests of the desired size and quality are produced. A ‘regulated forest’ consists of tree sizes in approximately equal parts and age classes that correspond to the size classes. To achieve the desired age class distribution, it is necessary that the harvest type resets the age class or seral stage, i.e. a regeneration harvest of selected stands is necessary, including regeneration harvest of intermediate-age classes. Over time, regeneration harvests can transform or convert an irregular forest structure to a regulated one (Hennes et al., 1971).” Unfortunately, this is only possible on paper. In the real world, none of this is possible, especially if the agency wishes to meet other important objectives such as water quality, climate stability, health populations of fish & wildlife, etc.

The plan amendment should not rely on counter factual assumptions such as that the Forest Service can supply a steady flow of logs to the timber industry. Jack Ward Thomas may have said it best:

> The vision that I was taught in school of the "regulated forest" and the resultant predictable outputs of commodities has turned out to have been a dream. … By now it is becoming obvious that this dream was built on the pillars of the seemingly boundless virgin forest and an ethic of manifest destiny coupled with hubris of being able to predict the response of nature and humans. This was coupled with an inflated sense of understanding of forested ecosystems and of human control. Perhaps it is time to recognize that such stability is not attainable in any western region except for relatively short periods of years or decades. … It is increasingly apparent that ecological processes are not as well understood nor as predictable as had been assumed by natural resource managers steeped in Clementsian ecological theory of orderly and predictable succession of plant communities from bare ground to a mature, steady state. … In summary, the timber supply from federal lands is one drought, one insect and disease outbreak, one severe fire season, one election, one budget, one successful appeal, one loss in court, one listing of a threatened or endangered species, one new piece of pertinent scientific information, one change in technology, one shift in public opinion, one new law, one loss of a currently available technological tool, one change in market, one shift in interest rates, et al, away from "stability" at all times. And, these changes do not come one at a time, they come in bunches like banannas [sic] and the bunches are always changing. So, stability in timber supply from the public lands is simply a myth, a dream that was never founded in reality. It is time to stop pretending.

Thomas, Jack Ward. 1995. The Instability of Stability. Paper presented at the Landscapes and Communities in Asia and the PNW Conference, Missoula, MT.
http://web.archive.org/web/20001201174000/http://coopext.cahe.wsu.edu/~pnrec97/thomas2.htm
See also: Donald Ludwig, Ray Hilborn, Carl Waters 1993. Uncertainty, Resource Exploitation, and Conservation: Lessons from History. Science, New Series, Vol. 260, No. 5104 (Apr. 2, 1993), pp. 17-36.

http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/exhibits/swrcb/swrcb_ludwig1993.pdf

When we bring all these lines of evidence together one realizes that since the NWFP and the matrix land allocation was adopted there are many more reasons to protect forests and fewer reasons to log them. This needs to be carefully considered in the NEPA analysis.

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.

Please post to the project website, links to all relevant ESA and EFH consultation documents, RMPs, watershed analyses, and other supporting documents relied on in the NEPA analysis.

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
dh@oregonwild.org

Attachments:

1. *KS Wild v BLM*, IVM opening brief
2. 2015 Northwest Forest Plan Revision Principles
3. 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
4. Heiken, D. 2010. Log it to save it? The search for an ecological rationale for fuel reduction logging in Spotted Owl habitat. Oregon Wild. V 1.0. May 2010. https://www.dropbox.com/s/pi15rap4nvwxhtt/Heiken_Log_it_to_save_it_v.1.0.pdf?dl=0
5. DellaSala, Dominick A., Rowan Baker, Doug Heiken, Chris A. Frissell, James R. Karr, S. Kim Nelson, Barry R. Noon, David Olson, and James Strittholt. 2015. "Building on Two Decades of Ecosystem Management and Biodiversity Conservation under the Northwest Forest Plan, USA" *Forests* 6, no. 9: 3326-3352. https://doi.org/10.3390/f6093326