July 18, 2025

Middle Fork District
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Submitted online via https://cara.fs2c.usda.gov/Public/CommentInput?Project=67448

Re: Dead Mountain Project – Scoping

Please consider the following comments on the Dead Mountain project, submitted on behalf of Cascadia Wildlands and Oregon Wild. Founded in 1998, Eugene-based Cascadia Wildlands represents approximately 15,000 members and supporters with a mission to defend and restore Cascadia's wild ecosystems in the forests, in the courts, and in the streets. Cascadia Wildlands envisions vast old-growth forests, rivers full of wild salmon, wolves howling in the backcountry, a stable climate, and vibrant communities sustained by the unique landscapes of the Cascadia bioregion. 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 old forest).

Project Description

This project proposes timber harvest, small diameter fuels reduction, roadside fuels reductions, burn blocks, recreation management, and travel management across 7,641 acres near the town of Oakridge, Oregon. Stands targeted for logging are 45- to 60-year-old previously managed Douglas-fir plantations. Variable density thinning treatments on 1,750 acres would include skips and ½- to 3-acre large gaps, with tree planting proposed in gaps over 1 acre in size. The district anticipates that commercial logging would generate 25-30 million board feet of timber.

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Proposed actions also include approximately 200 acres of stand-level small diameter fuel reduction, 154 acres of shaded fuel break creation along potential control lines (PCLs), 967 acres of prescribed fire burn blocks, and 2 miles of new trail construction. Road work included in the proposed action would include road maintenance or reconstruction of about 34 miles of forest roads with the potential of decommissioning approximately 4 miles of roads and closing up to 10 miles of roads. Scoping Notice at 1.

Please consider the following as you develop this project.

Public Engagement

The overall intent of the project is good: let fire burn, focus on previously managed stands, strategically use existing landscape features, focus efforts on high-risk areas, and prioritize community safety. We support efforts to focus efforts on community safety and utilize collaboration to identify priority areas for risk mitigation efforts.

Cascadia Wildlands staff joined the Forest Service field tour to the Dead Mountain project area and appreciate being able to connect with staff involved in preparing this project. Cascadia is coordinating with the Southern Willamette Forest Collaborative to host an informational tour of the project area later this month as well for members and volunteers, with the goal of helping the public gain understanding of existing conditions in the project area, community fire risk concerns, what treatments area being proposed, and how they could compare to previously implemented fuels reduction projects. We appreciate the district's efforts to engage the public in this project and incorporate public input through the NEPA process to reach an informed decision.

PODS/Shaded Fuel Breaks/PCLs

How were PODs chosen? How were the objectives for each POD determined? What is the historical fire frequency for the project area? How will the district monitor and evaluate effectiveness of PODs? Please include this information in the EA.

We generally support focusing light, small-diameter, variable thinning from below on young, treated stands. However, we are concerned that young stand thinning proposed as part of the network of shaded fuel breaks (SFB) could create more problems than it solves.

For area thinning, what prescription will the district implement? Heavier thinning may create problems related to warm/dry/windy microclimate, and excessive future growth of hazardous surface and ladder fuels. How wide will roadside shaded fuel breaks be? The EA needs to consider these risks.

We are concerned that young stand thinning proposed as part of the network of shaded fuel breaks (SFB) may create more problems than it solves. Heavy thinning (say, to as low as 40% canopy cover) would open the stand too much likely create problems such as:

- Warm/dry/windy microclimate that dries fuels more rapidly and increases flame lengths.
- Heavy thinning moves more fine fuels for the canopy to the ground where they are more vulnerable to fire. Treating these activity fuels is expensive and rarely entirely effective. Plus, there is a time period after the fuels are put on the ground and before they are treated.
- Opening the canopy will make resources available to stimulate excessive growth of future hazardous surface and ladder fuels.
- Greater growth of surface fuels requires more frequent and more expensive retreatment that the agency lacks funding for. The agency may be tempted to keep removing mature trees to pay for removal of small trees and brush, but this causes a vicious cycle of unwanted fuel growth and funding shortfalls.

If area thinning is too heavy, it would open the stand and stimulate growth of fuels that the agency does not have adequate resources to retreat. So, when the fire does come, the agency would be left with a brushy condition that it cannot safely put defensive fire into. Use a lighter thinning prescription and retain a more densely shaded condition along all the roads that are part of the SFB network. Please consider these risks in the NEPA analysis.

The changing climate is creating drier fuels and longer fire seasons. This increases the potential for extreme fire behavior where embers can travel long distances during high fire growth periods and render shaded fuel breaks ineffective at stopping or slowing fire spread. Fuel breaks can have significant trade-offs, including: spreading weeds through soil and canopy disturbance, habitat fragmentation and edge effects, exacerbating barriers to wildlife movement, impaired wildlife connectivity, loss of wildlife cover, loss of snag and dead wood habitat, facilitating unauthorized OHVs, increased carbon emissions, etc. NEPA analysis is needed to disclose and consider these trade-offs and develop alternatives that avoid, minimize, and mitigate adverse effects.

The agency should retain, not reduce, canopy fuels because canopy fuels actually help maintain a favorable microclimate and reduce surface and ladder fuels which are the greater hazard. If there is a perceived need to reduce the continuity of canopy fuels, the road itself serves that purpose. Hakkenberg et al. (2024) showed that ladder fuels were the main driver of wildfire severity, whereas dense, high canopy fuels tend to reduce fire severity, even during extreme fire conditions.

> Here we employed GEDI space-borne lidar to consistently assess how pre-fire forest fuel structure affected wildfire severity across 42 California wildfires between 2019–2021. Using a spatial-hierarchical modeling framework, we found a positive concave-down relationship between GEDI-derived fuel structure and wildfire severity, marked by increasing severity with greater fuel loads until a decline in severity in the tallest and most voluminous forest canopies. Critically, indicators of canopy fuel volumes (like biomass and height) became decoupled from severity patterns in extreme topographic and weather conditions (slopes >20°; winds > 9.3 m/s). On the other hand, vertical continuity metrics like layering and ladder fuels more consistently predicted severity in extreme conditions – especially ladder fuels, where sparse understories were uniformly associated with lower severity levels.
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> Vertical fuel continuity is especially important for lower stratum ladder fuels, where greater continuity may enable flames to transition from ground and surface fires to higher canopy strata, thereby increasing contagion … [W]e observed that steep slopes, dry conditions and high winds overwhelmed most fuel structural conditions to constrain landscape severity patterns. Importantly, the sole exception to this pattern occurred with ladder fuels …
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> … This finding suggests that high-intensity fuel treatments (which target entire forest canopies rather than focusing on lower stratum ladder fuels only) may have a limited effect on wildfire severity in extreme conditions. Conversely, sparse understories (<10 m) – even those that concurrently possess robust mid- strata (>10 m) – were associated with reduced wildfire severity. This result has important management implications, especially for treatment interventions that focus on vertical fuel continuity such as understory thinning or cultural burns, which have been found to be effective in reducing high-severity burns2. Understory treatments have also been found to lessen externalities associated with more intensive thinning operations71 and simultaneously promote culturally- and ecologically-beneficial wildfire outcomes across a wide variety of topographic, weather and climate contexts1,72.

Hakkenberg, C. R., Clark, M. L., Bailey, T., Burns, P., & Goetz, S. J. (2024). Ladder fuels rather than canopy volumes consistently predict wildfire severity even in extreme topographic-weather conditions. *Communications Earth & Environment*, *5*(1), 1-11. https://doi.org/10.1038/s43247-024-01893-8; pdf.

If used correctly, shaded-fuel breaks can be a useful tool for fire management. Done incorrectly they can make the situation worse and cause a lot of unintended adverse trade-offs. Shaded fuel breaks implemented non-commercially with significant canopy retention may be an effective fuel treatment, IF they are maintained over time. If fuel breaks remove too much canopy and are accomplished with heavy equipment that disturbs too much soil, fuel breaks can stimulate the growth of hazardous fuels and weeds, making fire hazard worse instead of better, while making long-term maintenance more difficult and more expensive. We are concerned about the agency's existing resources and capacity and potential limits to long-term maintenance of fuel breaks.

Fuel breaks are largely untested with potentially uncertain ecological effects.

Shinneman *et al*. (2019) reported that there is little scientific information available regarding their [fuel breaks] ecological effects. They report that fuel breaks can: (1) directly alter ecosystems; (2) create edges and edge effects; (3) serve as vectors for wildlife movement and plant invasions; and (4) preemptively fragment otherwise contiguous sagebrush landscapes.

Kauffman, Beschta et al 2020. Comments on Boise BLM's Tri-State Fuel Break Project. 22 Dec 2020. https://drive.google.com/open?id=1AEA3PTs31Sv_-RZZnMsduhHCb1hniZ_e *citing* Shinneman, Douglas J.; Germino, Matthew J.; Pilliod, David S.; Aldridge, Cameron L.; Vaillant, Nicole M.; Coates, Peter S. 2019. The ecological uncertainty of wildfire fuel breaks: examples from the sagebrush steppe. Frontiers in Ecology and the Environment 17(5):279-288. https://doi.org/10.1002/fee.2045. ("Fuel breaks are increasingly being implemented at broad scales (100s to 10,000s of square kilometers) in fire-prone landscapes globally, yet there is little scientific information available regarding their ecological effects (e.g. habitat fragmentation). … 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."). See also Shinneman, D.J., Aldridge, C.L., Coates, P.S., Germino, M.J., Pilliod, D.S., and Vaillant, N.M., 2018, A conservation paradox in the Great Basin—Altering sagebrush landscapes with fuel breaks to reduce habitat loss from wildfire: U.S. Geological Survey Open-File Report 2018–1034, 70 p., https://doi.org/10.3133/ofr20181034.

PODs and fuel breaks should be explicitly planned and designed to facilitate the return of fire to the landscape, not to perpetuate the failed policy of continued suppression of wildfire. If the fuels breaks are intended for continued fire suppression, then the NEPA analysis should disclose the adverse environmental effects of that outdated policy. Timothy Ingalsbee 2005. Fuelbreaks for Wildland Fire Management: A Moat or a Drawbridge for Ecosystem Fire Restoration? Journal of Fire Ecology, Pages: 85-99.

DOI:10.4996/fireecology.0101085.
https://web.archive.org/web/20070818123112/http://www.fireecology.net/pdfs/7_ingalsbee.pdf.

We think some of the trade-offs of shaded fuel breaks and PODs can be minimized by following guidelines, such as:

- Well-shaded fuel breaks will be much more effective than linear clearings, or heavy thinning. 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 ~59 meters each side of the road, or 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, help suppress the growth of surface and ladder fuels (which also minimizes maintenance costs), and provide a bit more cover to mitigate for adverse effects on wildlife mobility;
- Retain deciduous hardwoods which can serve as heat sinks during fires;
- Adjust prescriptions in response to different forest types, retaining a bit more density in moist forest types, and a bit less in dry forest types;
- 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 ratio 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.

Please develop a NEPA alternative that follows these guidelines.

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 fuel breaks 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 fuel breaks, and disclose the general effects on soils, watersheds, and species of interest.

We are concerned about the spread of weeds due to project actions. Weeds are 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 warned that fuel breaks are of unproven effectiveness in the face of extreme fire weather and suggested 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 breaks can incrementally serve a variety of potential purposes during fire suppression efforts, however in a survey of fuel breaks in California "… only four first stopped at the fuel break without aid from suppression resources, while 29 either required the use of suppression resources or failed, which is in agreement with previous research …" In testing various fuel break configurations, the authors found, "In the fuel break only scenario, all model runs showed a slight increase in burn probability in the near vicinity of the fuel break. … likely due to the increase in light and flashy fuels in the fuel break area. … The final modeling scenario of a simulated firing operation shows large decreases in burn probability on the lee side of all fuel breaks." 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. The effectiveness of fuel breaks depends a lot on whether they are used as firing lines for burnout operations.

The efficacy of fuel breaks needs to be closely examined:

> …fuel break performance and benefit is based on the questionable expectation that fire suppression will be capable of "stopping" fires after initial attack fails (see Expectations above). Large fires escape initial attack for many reasons that include resource scarcity due to high numbers of ignitions, and spotting and crown fire behaviors that make holding a pre-defined position by firefighters untenable and perhaps dangerous. Furthermore, the only firefighting tactics supported by fuel breaks are categorized as "indirect" (Brown and Davis 1973). This means that the rest of firefighting tactics (direct attack and parallel attack) are not enhanced regardless of the current fire behavior or fire position on the landscape relative to the location of the fuel break. A large fire that slows before reaching a fuel break (because of a change in weather conditions, nighttime, etc.) must be attacked (by direct or parallel tactics) with no benefit of the fuel break. Utilizing fuel breaks involves a large burnout operation, which may be of a size equal to the original wildfire, take place regardless of the fire behavior at its current location, and produce negative effects on wildland vegetation greater than the original wildfire. Maintenance costs of fuel breaks are often ignored by proponents but maintenance is a perpetual burden that is likely to divert efforts from managing fuels and vegetation on the remaining majority of the landscape.
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> Evidence that fuel breaks surrounding urban zones are sufficient to reduce threats to urban values is lacking. Because of their location on the periphery of wildlands, fuel breaks cannot reduce losses of wildland values associated with a community. Although it is commonly argued that fuel breaks will reduce wildfire intensities adjacent to residential development and thereby allows firefighters to protect homes, wildland-urban fire disasters tend to occur during severe fire conditions when fire behavior characteristics often overwhelm fire protection resources.

Finney and Cohen. 2003. Expectation and Evaluation of Fuel Management Objectives. USDA Forest Service Proceedings RMRS-P-29.
http://www.fs.usda.gov/rm/pubs/rmrs_p029/rmrs_p029_351_366.pdf.

The proposed treatments include skips and gaps. Large gaps as mini-clearcuts do not mimic natural processes. How many trees per acre will be retained? Gaps should be 1 acre or smaller, unless they retain significant live and dead tree structure (e.g., 10 tpa). Gaps should also not be randomly located. Variability is fine, but do not put gaps in places that have existing ecological features that should be retained, such as snag patches, large or legacy trees, rock piles, well-developed understory, etc.

The scoping notice indicates that gaps will be replanted. The Forest Service should not be logging heavy enough that replanting is needed. This will create a thinning unit embedded with small plantations. Pritchard et al concluded that gaps embedded within thinning units have extremely negative fire consequences. Please consider an alternative that minimizes gap creation, or limits the size of gaps so that replanting is not required. Large gap creation within a fuel project is two steps forward, three steps back.

Thinning treatments are proposed in young, previously managed stands. Are there any legacy trees in the proposed treatment areas, and will these be maintained? The Forest Service should consider a diameter limit to protect any extant legacy structure. These trees will contribute to the overall fire resiliency of the stand, could be culturally relevant legacies, and have numerous wildlife habitat benefits. Consider alternatives with a higher end diameter limit.

Wildlife Impacts and Habitat Connectivity

We are concerned about the impacts of the project on wildlife habitat, their prey, and connectivity.

Burn blocks are proposed in pileated woodpecker habitat and Riparian Reserves. There are 132 acres of late-successional reserve (LSR) in the project area, with a burn block proposed within and harvest proposed adjacent to LSR. Are there northern spotted owls in the project area? Has the agency conducted surveys?

Thinning has adverse effects on a variety of spotted owl prey, including flying squirrels, red tree vole, red-backed voles, chipmunks, etc. Minimize and mitigate adverse effects on spotted owl prey by retaining more trees, more down wood, shrub cover, and "mid-canopy occlusion" that flying squirrels use for cover when gliding. The agency should design matrix thins to support abundant and diverse populations of owl prey species.

Spotted owl prefer to disperse through higher quality habitat (as close as possible to nesting, roosting habitat) that provides some foraging opportunities. See 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.

A main ecological concern with shaded fuel breaks is that they create unnatural linear features across the landscape that can impact wildlife movement patterns and create edge effects and modify the presence and abundance of certain wildlife species. See Connor, E.F., McCoy, E.D. (2013) Species–Area Relationships Encyclopedia of Biodiversity, Pages 640-650.

Agencies have a duty to consider habitat connectivity in their NEPA analyses. CEQ issued guidance saying "… agencies should consider and be transparent about the positive or negative impacts of proposed actions and alternatives on connectivity and corridors. Through the NEPA review process, Federal agencies can consider measures to advance corridors and connectivity as components of proposed actions, alternatives to proposed actions, or mitigation for proposed actions' effects." Mallory, B. 2023. CEQ Guidance for Federal Departments and Agencies on Ecological Connectivity and Wildlife Corridors. March 21, 2023. https://www.whitehouse.gov/wp-content/uploads/2023/03/230318-Corridors-connectivity-guidance-memo-final-draft-formatted.pdf.

Young stands do not exist in isolation, so be sure to consider the effects of thinning on adjacent mature and old-growth habitat which may provide habitat for spotted owls, marbled murrelets, and other species. Spotted owls may use young stands for dispersal, foraging, and security from predators. Consider existing habitat characteristics, proximity to occupied habitat or activity centers, proximity to suitable habitat, and proximity to recently thinned areas, non-habitat, and roads. The agency should also consider adjusting both the location and timing of thinning to minimize the cumulative effects of widespread thinning on the sensitive and listed species.

The EA should focus the NEPA analysis on "trade-offs" related to logging. All logging, including thinning stands of any age, include some 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. Depending on how thinning is done, it can have adverse impacts such as soil disturbance; habitat disturbance; damage to the shrub layer; carbon removal; spreading weeds; reduced populations of prey for carnivorous species; reduced recruitment of snags; road-related impacts on soil, water, site productivity, and habitat; moving fuels from the canopy to the ground, hotter-drier-windier microclimate that is favorable to greater flame lengths and rate of fire spread, etc. Some of these negative effects are fundamentally unavoidable, therefore all thinning has negative effects that must be compensated by beneficial effects such as reducing competition between trees so that some can grow larger faster, increased resistance drought stress and insects, possible increasing species and structural diversity, possible fire hazard reduction, etc. It is generally accepted that when thinning very young stands, the benefits outweigh the adverse impacts and net benefits are likely. It is also widely understood that thinning older stands tends to have greater impacts on soil, water, weeds, carbon, dead wood recruitment so the impacts very often outweigh the benefits, resulting in net negative outcome on the balance sheet. Thus, as we move from young forest to older forests, the net benefits turn into net negative impacts. See Klaus J. Puettmann, Adrian Ares, and Erich Dodson. 2011. Over- and understory vegetation responses to thinning treatments: Can we accelerate late successional stand structures? Symposium: Density Management In The 21st Century: West Side Story. http://oregonstate.edu/conferences/event/densitymanagement2011/agenda.pdf ("growth of large trees was less responsive to thinning and low mortality rates for larger trees resulted in little recruitment of large snags or coarse woody debris (down wood). In general, thinning increased abundance and diversity of early-seral understory species, with little effect on late-seral species. On sites where shrub cover was already high harvesting initially reduced the cover, but shrubs recovered over time. Exotic species slightly increased in response to treatment …"); and Erich K. Dodson, Adrian Ares, and Klaus J. Puettmann. 2011. Thinning effects on tree mortality and snag recruitment. Symposium: Density Management In The 21st Century: West Side Story. http://oregonstate.edu/conferences/event/densitymanagement2011/agenda.pdf ("…thinning did little to accelerate the development of large snags and coarse downed wood that provide critical wildlife habitat…") These are some of the trade-offs that must be disclosed and weighed in the NEPA document.

Please take a hard look at impacts to imperiled species, including habitat, prey, and connectivity, in the EA.

Riparian Reserves

It is important to adjust fuel prescriptions in riparian reserves to ensure fulfillment of the desired future conditions and standards and guidelines for this land allocation. Riparian reserves are naturally a fuel-rich condition, so aggressive thinning is not desired. Non-commercial thinning of small trees might be okay in riparian reserves, but commercial removal of trees and or canopy reduction may not be consistent with the Aquatic Conservation Strategy, especially related to microclimate, stream temperature, and long-term wood recruitment. The NEPA analysis should consider this. And while this project focuses treatments on young managed stands, impacts to LSR in the area and habitat connectivity should be considered as well.

Roads

We appreciate that this project involves decommissioning and storing roads (4 and up to 10 miles, respectively). The scoping notices indicates 3 miles of temporary road construction and maintenance and reconstruction activities on about 34 miles of existing roads.

Roads have significant environmental effects on soil, water, habitat, carbon, fuels, and fire ignition risk. The agency should strive to keep those adverse effects to a minimum, by focusing treatments on areas that are accessible from existing roads. Construction of roads, including temporary roads, should be avoided and minimized.

Temporary roads still cause serious adverse impacts to soil, water, wildlife, fire ignition risk, carbon, and spread weeds. Decommissioning such roads is not entirely successful and the soil compaction effects can last for decades. The agency should consider avoiding building spurs by treating some areas non-commercially (e.g. thin lightly, create lots of snags, and leave the material on site).

We urge the agency to accurately disclose the effects of road construction, reconstruction, and road use, and avoid road construction, including temporary road construction. The ecological costs of road construction almost always outweigh any benefits of the associated commercial logging activity. Since an optimal landscape restoration plan includes a mix of treated and untreated areas, the agency can easily avoid road construction by co-locating untreated areas and inaccessible areas.

Temporary roads have many of the same impacts as permanent roads, including complete vegetation removal, severe soil disturbance and compaction, severe modification of the flow of water and air through the soil, impairment of soil biological activity, wildlife habitat fragmentation (especially for microfauna), and wildlife cover loss. In spite of the fact that some roads may only be used by heavy equipment on a temporary basis, the biophysical effects of temporary roads can be long-lasting. The FS may even come back and use these temporary roads for future vegetation management or fire management. The temporal effects of temp roads can also be extended by legal or illegal use by off highway vehicles, woodcutters, hunters, mushroom collectors, etc.

The November 2000 National Forest Roadless Area Conservation FEIS p 3-30 says that temporary roads are not designed and constructed to the same standard as classified roads and therefore result in a "higher risk of environmental impacts." The NEPA analysis must account for this increased risk of temporary roads compared to permanent roads.

The Roadless FEIS also says:

> Temporary roads present most of the same risks posed by permanent roads, although some may be of shorter duration. Many of these roads are designed to lower standards than permanent roads, are typically not maintained to the same standards, and are associated with additional ground disturbance during their removal. Also, use of temporary roads in a watershed to support timber harvest or

> other activities often involves construction of multiple roads over time, providing a more continuous disturbance to the watershed than a single, well-designed, maintained, and use-regulated road. While temporary roads may be used temporarily, for periods ranging up to 10 years before decommissioning, their short- and long-term effects on aquatic species and habitats can be extensive. [The FEIS has similar disclosures citing extensive impacts to terrestrial species and habitats, and rare plant populations.]

Roadless Area Conservation FEIS — Specialist Report for Terrestrial and Aquatic Habitats and Species prepared by Seona Brown and Ron Archuleta, EIS Team Biologists http://web.archive.org/web/20040515020554/http://roadless.fs.fed.us/documents/feis/specrep/xbio_spec_rpt.pdf.

"Temporary roads are constructed with no engineering specifications since they are targeted to be used for a short time (ideally a single season), and then obliterated. This lack of construction design makes it particularly important to follow Project Design Criteria for avoiding potentially unstable slopes, even with potentially short time frame of use. That is because even temporary roads which are constructed with road cuts in steep, unstable terrain can trigger debris avalanches and slope failures by removing downslope support and interfering with surface and subsurface water flows that can weaken slopes."

USDA 2020. Stella Landscape Restoration Project Draft Environmental Impact Statement. Page III-30. Rogue River Siskiyou National Forest. https://www.fs.usda.gov/project/?project=53241.

For the semi-permanent roads that will be tilled, BLM's own soils scientist has little faith in the restorative value of this technique. He says: "What I have seen so far have been nothing more than modified rock rippers and little lateral fracture of the soil occurs and the extent of de-compacting is very limited." Coos Bay BLM, Big Creek Analysis file, section F, Soils Report. page 4.

Please consider George Wuerthner's summary of the many problems with so-called temporary roads. George Wuerthner 2009. Temporary Roads Are Like Low Fat Ice Cream, NewWest. 3-17-09. http://www.newwest.net/topic/article/temporary_roads_are_like_low_fat_ice_cream/C564/L564/ ("The problem is that temporary roads have most of the same environmental impacts as regular roads."). See also, Wuerthner's April 2020 blog post showing the persistent impacts of temporary roads. http://www.thewildlifenews.com/2020/04/22/are-temporarily-roads-ecologically-invisible/.

The agency typically assumes that temporary roads will have little or no effect because they are temporary. The agency has shown no scientific evidence to support this assumption. In fact, scientific research has shown exactly the opposite. Research results, published in *Restoration Ecology,* shows there is nothing temporary about temporary roads, and that ripping out a road is NOT equal to never building a road to begin with.

The saturated hydraulic conductivity of a ripped road following three rainfall events was significantly greater than that of the road surface before ripping... most saturated hydraulic conductivities after the third rainfall event on a ripped road were in the range of 22 to 35 mm/hr for the belt series and 7 to 25 mm/hr for the granitics. These conductivities are modest compared to the saturated hydraulic conductivity of a lightly disturbed forest soil of 60 to 80 mm/hr." id. Even this poor showing of restoring pre-road hydrologic effects worsened with repeated rainfall. "Hydraulic conductivity values for the ripped treatment on the granitic soil decreased about 50% with added rainfall (p(K1=K2)=0.0015). This corresponded to field observations of soil settlement and large clods of soil created by the fracture of the road surface dissolving under the rainfall... The saturated hydraulic conductivity of the ripped belt series soils also dropped from its initial value. Initially, and for much of the first event, the ripped plots on the belt series soil showed no runoff. During these periods, run-off from higher areas flowed to low areas and into macropores.... Erosion of fine sediment and small gravel eventually clogged these macropores... Anecdotal observations of roads ripped in earlier years revealed that after one winter, the surfaces were nearly as solid and dense as the original road surfaces." Id. Even though ripped roads increase water infiltration over un-ripped roads, it does not restore the forest to a pre-road condition. "These increases do not represent 'hydrologic recovery' for the treated areas, however, and a risk of erosion and concentration of water into unstable areas still exists.

Luce, C.H., 1997. Effectiveness of Road Ripping in Restoring Infiltration Capacity of Forest Roads, Restoration Ecology; 5(3):265-270. https://www.fs.usda.gov/t-d/programs/im/road_decomission/forms/luce_ripping_97_preprint.pdf.

The Rogue River-Siskiyou National Forest's Rustler EA (2010) says:

> Temporary roads are also expected to have an irretrievable reduction in soil productivity since they are bladed (soil is mixed and displaced) and compacted. Even once rehabilitated, the soil profile is modified to a degree that may take many years to return to the productive state of the undisturbed forest soils adjacent to it.

https://www.fs.usda.gov/project/rogue-siskiyou/?project=26575

To help weigh trade-offs, the agency should do an analysis that illuminates how many acres of accessed by each road segment so that we can distinguish between short segments of spur that allow access to large areas (large accomplishment of goals, with small cost/trade-off) and long spurs that access small areas (small accomplishment, large cost/trade-off).

This can help inform the decision-maker's balancing of the costs and benefits of logging and roading.

Avoid using heavy equipment on wet soils and wet weather log hauling that poses too great a risk of soil damage and water pollution. It is in the public interest to protect water quality and aquatic habitat by limiting heavy equipment and log hauling dry conditions.

Vapor Pressure Deficit

The EA needs to consider that there is a good chance that logging to reduce competition for soil moisture has much less benefit than previously thought, and may even cause a net loss of resilience, because thinning allows penetration of warm dry air into the stand which increases vapor pressure deficit and adds to the significant drought stress that trees already experience due to global climate change.

The NEPA analysis needs to consider new evidence that thinning may make the stand less resilient instead of more resilient to drought. Thinning will increase penetration of warm dry air into the stand and expose trees to greater vapor pressure deficit. There is new evidence that drought stress and mortality risk experienced by Douglas-fir trees is less a function of soil water availability, but is rather strongly related to atmospheric water availability, specifically vapor pressure deficit. Tree density and thinning may have some minor effect on soil water but will have no beneficial effect on atmospheric water availability, so thinning is much less likely to provide beneficial effects on tree stress than previously believed. In fact, thinning likely increases drought stress on trees by increasing penetration of warm dry air within thinned forest stands. Lighter thinning would partially mitigate the effect compared to heavy thinning. The agency should consider and disclose these effects and consider a mitigating alternative with light non-commercial thinning of the understory.

Watts, Andrea; Wondzell, Steve; Jarecke, Karla; Bladon, Kevin. 2024. Hot air or dry dirt: Investigating the greater drought risk to forests in the Pacific Northwest. Science Findings 268. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 6 p. https://www.fs.usda.gov/pnw/sciencef/scifi268.pdf. See also, Karla M. Jarecke, Linnia R. Hawkins, Kevin D. Bladon, Steven M. Wondzell 2023. Carbon uptake by Douglas-fir is more sensitive to increased temperature and vapor pressure deficit than reduced rainfall in the western Cascade Mountains, Oregon, USA. Agricultural and Forest Meteorology, Volume 329, 15 February 2023, 109267. https://www.sciencedirect.com/science/article/abs/pii/S0168192322004543.

The airmass warming and drying effect caused by logging adds cumulatively to the already significant increase in AED (atmospheric evaporative demand) caused by global warming. Gebrechorkos, S. H., Sheffield, J., M., S., Funk, C., Miralles, D. G., Peng, J., Dyer, E., Talib, J., Beck, H. E., Singer, M. B., & Dadson, S. J. (2025). Warming accelerates global drought severity. *Nature*, 1-8. https://doi.org/10.1038/s41586-025-09047-2, pdf. ("… by developing an ensemble of high-resolution global drought datasets for 1901–2022, we fnd an increasing trend in drought severity worldwide. Our fndings suggest that AED has increased drought severity by an average of 40% globally. Not only are typically dry regions becoming drier but also wet areas are experiencing drying trends.")

High air temperatures caused by thinning can even cause plants to lose water through their cuticle, even when their stomata are closed. Garen, J. C., & Michaletz, S. T. (2025). Temperature governs the relative contributions of cuticle and stomata to leaf minimum conductance. *New Phytologist*, *245*(5), 1911-1923. https://doi.org/10.1111/nph.20346; https://nph.onlinelibrary.wiley.com/doi/epdf/10.1111/nph.20346. ("We found that the pathway of water loss varied with temperature, such that the cuticular pathway increasingly dominated at higher temperatures. … We further found that as temperature increased, the proportion of water escaping the leaf via the cuticle typically increased … Such high-temperature increases in gcw may be due to phase transitions in the cuticular wax, or thermal expansion of the cuticular matrix resulting in the opening of additional pathways for diffusion in the cuticle surface, … ").

Similarly, thinning often also transitions stands from being sun limited to water limited.

It may be counter-intuitive, but even in a dry landscape, a stand that is "overstocked" may not be limited by moisture. The competition for sunlight slows growth before it's limited by water, but solar limits are not lethal. Silviculturists often suggest "opening up the stand" to reduce competition for resources including water. However, they might "release" the trees from the solar limitation to the point that they bump into the water limitation, which is in fact lethal and likely exacerbated by increased solar radiation and wind heating and drying soils faster.

Carbon Storage and Climate Refugia

The purpose and need and effects analysis should address the unmet need for carbon storage and climate refugia. Every project must be designed to avoid and minimize greenhouse gas emissions. The Forest Service cannot meet its legal obligations unless it works to reduce climate change. Those legal obligation emanate from the Forest Service Organic Act, the National Forest Management Act, the Endangered Species Act, Multiple-Use Sustained-Yield Act, and the applicable Land and Resources Management Plan. "Public forest reservations are established to protect and improve the forests for the purpose of securing a permanent supply of timber for the people and insuring conditions favorable to continuous water flow." 1897 FS Organic Act. https://winapps.umt.edu/winapps/media2/wilderness/NWPS/documents/publiclaws/ORGANIC-ACT-OF-1897.pdf. Climate change is expected to disrupt forest ecosystems and hydrologic systems to an extent that threatens to violate the very foundations of the agency's Organic Act. The FS should make every effort to reduce GHG emissions that exacerbate global climate change.

The scoping notice says one of the purposes of this project is to provide a supply of wood products to the public. The agency should reconsider timber targets in light of the fact that the public *needs* carbon storage to reduce global climate change much more than they *need* wood products. The NEPA analysis also needs to account for the fact that managing forests for water quality, water quantity, quality of life, and carbon storage for a stable climate will contribute far more to community stability than propping up the timber boom-bust industry with subsidized logging.

The agency must recognize that wood products are already underpriced and over-supplied due to "externalities" (costs that are not included in the price of wood, so those costs are shifted from wood product producers and consumers to the general public who suffer the consequences of climate change without compensation from those who receive artificially inflated profits from logging related externalities). Ecosystem carbon storage on the other hand is under-supplied because there is not a functioning market for carbon storage and climate services. The agency is in a position to address these market imperfections by focusing on unmet demand for carbon storage instead of offering wood products that are already oversupplied.

Land protection, both public and private, provides substantial ecological benefits by avoiding conversion of natural systems to intensive, developed uses. These benefits include carbon sequestration, watershed functioning, soil conservation, and the preservation of diverse habitat types (e.g., Daily 1997, Brauman et al. 2007, Kumar 2012, Watson et al. 2014). Land protection also solves a key market failure: private markets tend to underprovide socially beneficial land uses such as natural forests, agricultural lands, or managed timberlands. The reason for this failure is that many of the benefits of these lands go to the public in general, not individual landowners. When private values and market transactions determine land uses, less land will be devoted to socially beneficial uses than if citizens could collectively determine use on the basis of social values (e.g., Angelsen 2010, Tietenberg and Lewis 2016).

Katharine R.E. Sims, Jonathan R. Thompson, Spencer R. Meyer, Christoph Nolte, Joshua S. Plisinski. 2019. Assessing the local economic impacts of land protection. Conservation Biology. 26 March 2019 https://doi.org/10.1111/cobi.13318, https://harvardforest.fas.harvard.edu/sites/default/files/Sims_et_al-2019-Conservation_Biology.pdf.

Forest conservation is also needed to help forests, watersheds, and fish and wildlife adapt to global climate change:

- Mature forests serve as climate refugia where wildlife can find essential cool-moist conditions as the climate warms;
- Dense forests maintain cool-moist conditions and reduce stress (and mortality) on trees caused by vapor pressure deficit, which is exacerbated by clearcutting and thinning; and
- Dense forests with high canopies are more resistant and resilient to wildfire compared to forests that are clearcut or thinned.

Forest conservation to mitigate these effects should be considered as an alternative in the NEPA analysis.

Dense forests also provide wildlife with refuge from extreme heat and cold. Conserving these forests is becoming more critical as the climate changes and brings more extreme conditions that challenge the ability of wildlife to thermally regulate. NRDC (2023) provides a nice science summary of the biodiversity benefits of conserving mature and old-growth forests, including as climate refugia. https://www.climate-forests.org/post/biodiversity-co-benefits-of-mature-forests ("Mature and old-growth forests and trees provide diverse habitat for wildlife and vegetation to a degree that younger forests cannot. Older trees develop unique features that support complex habitats, often serving as biodiversity hotspots. Mature forests are far less prevalent across the U.S. than they once were and are the increasingly scarce preferred habitat for a myriad of imperiled species. Conversely, relative to mature forests, there is generally no shortage of young forests, undermining justifications for logging to convert mature stands to an earlier successional state. Logging of mature and old-growth trees in the United States removes these remaining cornerstones of ecosystem integrity, compounding the ongoing biodiversity crisis.").

The complex structure and multi-layered canopy of mature and old-growth forests provides a buffer against thermal extremes which means that older forests can serve as climate refugia as the climate warms. OPB interviewed one of the authors of the study and reported:

> … the kind of forest makes a big difference on temperature.

"The more structurally complex the forest, the more big trees, the more vertical layers – the cooler it was," he says.

The research showed differences as much as 4.5 degrees on warm days. Old growth forests also held in heat during cold weather. Overall, these forests have a moderating effect on temperature extremes.

One reason, researchers suspect, is that tree plantations, even mature ones, don't have nearly the understory material – small trees, shrubs, ground cover – as more complex stands. Nor do these single-age plantations have a lot of big trees – unlike old growth stands.

"We think one of the mechanisms causing this is thermal inertia," Betts says. "That takes these trees longer to warm up and longer to cool down. And that could be providing some of the buffering capacity of these older forests."

Betts says these stands of old growth could provide refuges for temperature-sensitive wildlife in the face of climate change.

Jes Burns 2016. Old-Growth Forests Provide Temperature Refuges In Face Of Climate Change: Study. OPB/EarthFix | April 22, 2016 http://www.opb.org/news/article/forest-refuges-climate-change/ *citing* Sarah J. K. Frey, Adam S. Hadley, Sherri L. Johnson, Mark Schulze, Julia A. Jones, Matthew G. Betts. 2016. Spatial models reveal the microclimatic buffering capacity of old-growth forests. SCIENCE ADVANCES. 22 APR 2016 : E1501392. http://advances.sciencemag.org/content/advances/2/4/e1501392.full.pdf. The buffering provided by mature and old-growth forests is relatively stable even in a dynamic climate regime, so "To maintain microrefugia in a rapidly changing climate, conservation of old-growth and other structurally complex forest habitat is critical" Christopher Wolf, David M. Bell, Hankyu Kim, Michael Paul Nelson, Mark Schulze, Matthew G. Betts, Temporal consistency of undercanopy thermal refugia in old-growth forest. Agricultural and Forest Meteorology, Volume 307, 15 Sept 2021, 108520, ISSN 0168-1923, https://doi.org/10.1016/j.agrformet.2021.108520. See also Xiyan Xu, Anqi Huang, Elise Belle, Pieter De Frenne, And Gensuo Jia 2022. Protected areas provide thermal buffer against climate change. SCIENCE ADVANCES. 2 Nov 2022. Vol 8, Issue 44. DOI: 10.1126/sciadv.abo01. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9629704/pdf/sciadv.abo0119.pdf ("Protected forests can effectively cool the land surface. The latitudinal gradient of the cooling effects of protected forests on LST [land surface temperature], i.e., decreasing cooling effects from the tropics to the poles, is similar to the spatial pattern of cooling effects of forest cover on land surface (21). This spatial pattern is also supported by ground observations of air temperatures measured within and outside forest canopies, indicating that the below-canopy microclimate is buffered by tree canopies. The buffering effect of forests on subcanopy microclimate tends to be greater than the magnitude inferred from LST that represents the temperature at the top of the canopy. Subcanopy air temperatures are even lower, most likely because of the shading and light interception of the canopy structure (20). However, the effect is much stronger than the mean effect of forests (protected and nonprotected) on LSTs compared to open land (grasslands and croplands). The cooling effects are high in tropical and temperate forests, … The buffering effect of PAs [protected areas] on increased temperatures therefore stabilizes the impacts of climate change at the global level. It is generally recognized that nature conservation contributes to global climate targets by preventing carbon emission from land-use change and by enhancing carbon removal from the atmosphere (12, 14). Here, we show that the effectiveness of PAs in stabilizing the local climate cannot be ignored. The stabilized climate in regions of high PA coverage is particularly important for providing climate change refugia and protecting species and communities from the negative impacts of climate change (45), whereas land-use change and disturbances result in greater warming that modifies habitats and threatens species. The buffering effects of PAs along a latitudinal gradient, i.e., stronger buffering at higher latitudes, are particularly important for species and communities at higher latitudes, where climate warming is more pronounced than that at lower latitudes. … The buffering effects of PAs on local microclimate are mainly achieved through the moderation of energy budgets by natural intact vegetation. Natural and seminatural vegetation, particularly forests, have much higher ET and surface roughness due to dense and tall canopies than croplands, where the land surface is cooled down by turbulent heat loss (32). … We find higher LAI [leaf area index] in PAs than NPAs [non-protected areas], which results in lower aerodynamic resistance and enhances turbulent heat transfer from the land surface to the atmosphere, thereby cooling the land surface (47) in temperate forests, tropical forests, grasslands, and savannas (fig. S8B). The cooling effect of land cover with higher LAI through aerodynamic resistance plays a major role in cooling the land surface compared to other biophysical effects (48).”).

Another study showed that as the climate warms forests, especially natural forests, become an increasingly important refuge for mammals. Tourani et al 2023. Maximum temperatures determine the habitat affiliations of North American mammals. PNAS December 4, 2023. 120 (50) e2304411120 https://doi.org/10.1073/pnas.23044111, https://www.pnas.org/doi/pdf/10.1073/pnas.2304411120.

Mature forests are relatively resistant and resilient to wildfire -

> 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. The PNW Research Station put out a press release on this study on July 2, 2019 which said:

> Old-growth forests have more vegetation than younger forests. Researchers expected that this meant more fuel would be available for wildfires, increasing the susceptibility of old-growth forests to severe fire, high tree mortality, and resulting loss of critical spotted owl nesting habitat. However, the data suggested a different effect.
>
> Lesmeister and his colleagues classified fire severity based on the percentage of trees lost in a fire, considering forest that lost less than 20% of its trees to fire subject to low-severity fire and those with more than 90% tree loss subject to high-severity fire. They found that old-growth forest was up to three times more likely to burn at low severity–a level that avoided loss of spotted owl nesting habitat and is generally considered to be part of a healthy forest ecosystem.
>
> "Somewhat to our surprise, we found that, compared to other forest types within the burned area, old-growth forests burned on average much cooler than younger forests, which were more likely to experience high-severity fire. How this actually plays out during a mixed-severity wildfire makes sense when you consider the qualities of old-growth forest that can limit severe wildfire ignitions and burn temperatures, like shading from multilayer canopies, cooler temperatures, moist air and soil as well as larger, hardier trees."
>
> Because old-growth forests may be refuges of low-severity fire on a landscape that experiences moderate to high-severity fires frequently, they could be integral as biodiversity refuges in an increasingly fire-prone region.

U.S. Forest Service Pacific Northwest Research Station 2019. Old-growth forest may provide valuable biodiversity refuge in areas at risk of severe fire. July 8, 2019. https://yubanet.com/california/old-growth-forest-may-provide-valuable-biodiversity-refuge-in-areas-at-risk-of-severe-fire/; https://www.fs.usda.gov/pnw/news-releases/old-growth-forests-may-provide-valuable-biodiversity-refuge-areas-risk-severe-fire. Notably, mature forests are less resilient after logging due to hotter/drier microclimate, logging slash, and stimulated growth of surface and ladder fuels. The Stella Project FEIS said "Larger trees, such as ponderosa pine and Douglas-fir, develop a thick bark that insulates the cambium from damaging heat. Even if the bark is considerably scorched, the cambium can remain undamaged. In addition, the crowns of larger trees are more elevated, thus protecting the buds and foliage from heat scorch." Rogue River Siskiyou National Forest. 2021. Stella Restoration Project Final EIS. https://usfs-public.app.box.com/v/PinyonPublic/file/934132398930.

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.

Betts et al (2017) also found old growth to be of value to wildlife in terms of microclimate buffering:

> **Results**
>
> We found a significant negative effect of summer warming on only two species. However, in both of these species, this relationship between warming and population decline was not only reduced but reversed, in old-growth-dominated

landscapes. Across all 13 species, evidence for a buffering effect of old-growth forest increased with the degree to which species were negatively influenced by summer warming.

Main conclusions

These findings suggest that old-growth forests may buffer the negative effects of climate change for those species that are most sensitive to temperature increases. Our study highlights a mechanism whereby management strategies to curb degradation and loss of old-growth forests—in addition to protecting habitat—could enhance biodiversity persistence in the face of climate warming.

Matthew G. Betts, Ben Phalan, Sarah J. K. Frey, Josée S. Rousseau, Zhiqiang Yang.

2017. Old-growth forests buffer climate-sensitive bird populations from warming.

Diversity and Distributions. Volume 24, Issue 4. April 2018. Pages 439-447, https://onlinelibrary.wiley.com/doi/pdf/10.1111/ddi.12688. Supported by Kim, H., McComb, B. C., Frey, S. J. K., Bell, D. M., & Betts, M. G. (2022). Forest microclimate and composition mediate long-term trends of breeding bird populations. Global Change Biology, 00, 1– 14. https://doi.org/10.1111/gcb.16353, https://onlinelibrary.wiley.com/doi/pdf/10.1111/gcb.16353. ("We provide the first empirical evidence that complex forest structure and vegetation diversity confer microclimatic advantages to some animal populations in the face of climate change. Conservation of old-growth forests, or their characteristics in managed forests, could help slow the negative effects of climate warming on some breeding bird populations via microclimate buffering and possibly insurance effects.") See also, USDA/USDI 1994. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. Vol I, pp 3&4-29 -31. https://www.blm.gov/or/plans/nwfpnepa/ ("Small patches of old-growth forest can provide thermal and mesic refugia for a variety of organisms. Understory habitats in old-growth forests can escape freezing conditions due to the thermal buffering of dense tree canopies. Deer and other vertebrates may rely on these thermal refuges during harsh storms or during dispersal to larger forest stands of suitable habitat. Many invertebrates migrate locally to mesic refugia during summer. During very dry periods in forests east of the Cascade Range, many invertebrates may require dense forest cover and mesic understory habitats to avoid desiccation").

Research in European forests have found similar climate buffering effects -

> The researchers also discovered that forests have so far done a remarkable job of buffering plants against the broader climate change going on outside them.
>
> Temperature measurements revealed that forests often have significantly different temperatures from what weather stations – always placed far from trees – record. In summer, for example, they are on average 4°C cooler. This is not only because thick canopies keep out the light, but also because evapotranspiration of water through the leaves and into the atmosphere sucks heat out of the forest, and the vegetation keeps out breezes that would mix warm air into the cool.
>
> Climate models don't take into account this buffering, despite the fact that two thirds of the world's species live in forests and forest processes such as carbon and nutrient cycling depend on temperature, says Professor Pieter de Frenne, a bioscientist also at Ghent University …

Aisling Irwin 2020. Forest darkness helps stave off effects of nitrogen pollution – but this is set to change. Horizon – EU Research and Innovation Magazine. 01 October 2020. https://horizon-magazine.eu/article/forest-darkness-helps-stave-effects-nitrogen-pollution-set-change.html. The microclimate buffering effects of mature forest become increasingly valuable as time passes because climate change is expected to increase rates of disturbance and make mature forests more scarce. See also, Christopher Wolf, David M. Bell, Hankyu Kim, Michael Paul Nelson, Mark Schulze, Matthew G. Betts, Temporal consistency of undercanopy thermal refugia in old-growth forest. Agricultural and Forest Meteorology, Volume 307, 15 Sept 2021, 108520, ISSN 0168-1923, https://doi.org/10.1016/j.agrformet.2021.108520. ("To maintain microrefugia in a rapidly changing climate, conservation of old-growth and other structurally complex forest habitat is critical, …").

Harmonize climate change mitigation and adaptation.

The NEPA analysis should avoid the conclusion that it is more important to create resilience in these stands rather than store more carbon to address the underlying cause of climate change and reduce the worse effects of climate change. The NEPA analysis needs to take a hard look at these trade-offs. Logging related carbon emissions will make life harder for these forests and all other climate stressed ecosystems around the world. Why is resilience here more important than that?

The agency has decided that meeting the purpose of this project requires logging that will emit greenhouse gases to the atmosphere and which will exacerbate global climate change (and ironically increase the climate stress imposed on the forest). These are very significant effects that require an EIS and consideration of mitigating alternatives. The agency can mitigate the effects of logging-related GHG emissions by retaining more trees, thinning less aggressively, forgoing logging in some areas, etc.

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

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

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

Addressing climate change requires the agency to both mitigate AND prepare for global climate change. 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.

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.

Logging and the entire wood products supply chain causes significant emissions of CO2, this makes fire worse in several ways. It not only warms the atmosphere and extends the fire season, CO2 is also a “floating fertilizer” that stimulates the growth of hazardous fuels. When the agency says they are logging to make the forest more resilient to climate change, they must address these countervailing risks, and consider alternatives that better harmonize climate change resilience/adaptation and climate change mitigation (emissions avoidance). Allen, R. J., Gomez, J., Horowitz, L. W., & Shevliakova, E. (2024). Enhanced future vegetation growth with elevated carbon dioxide concentrations could increase fire activity. *Communications Earth & Environment*, *5*(1), 1-15. https://doi.org/10.1038/s43247-024-01228-7. (“… the spatial pattern of the NPP response is quite similar to the corresponding spatial pattern of the fFire response (Fig. 2)-not only for 1% per year CO_2 and 1% per year CO_2-bgc, but interestingly also for 1% per year CO_2-rad. This is also the case for other vegetation parameters, including leaf area index (LAI; Supplementary Figs. 10–11 and Supplementary Note 4). This implies that the increase in fFire is largely due to the increase in biomass production (i.e., more fuel to burn) and likewise for decreases. The corresponding correlations (between the NPP and fFire responses) across grid boxes yield significant positive MMM correlations at 0.34, 0.26 and 0.17 for 1% per year CO_2, 1% per year CO_2-bgc, and 1% per year CO_2-rad, respectively. ”).

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

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

> *Climate adaptation*
>
> Actions that provide adaptation benefits through reduced risk of unintended climate impacts can provide carbon benefits through avoided carbon emissions. Some disturbances or forest health issues may also decrease carbon uptake through plant growth. While not all adaptation actions provide carbon benefits, there are many actions that address risks to ecosystem health that sustain or improve the capacity of systems to sequester carbon.
>
> *Carbon optimization*
> While national forests and grasslands can play an important role in climate change mitigation through land management, balancing the numerous environmental benefits provided by healthy ecosystems is paramount to achieving our mission. Carbon stewardship aims to optimize carbon benefits on the landscape in a way that recognizes the importance of achieving other management objectives. Maximizing ecosystem carbon stocks can create undesirable tradeoffs with other environmental benefits, and in some landscapes may result in lower carbon benefits where carbon stability is compromised. Maximizing carbon is therefore not necessary, and is often counter to, achieving effective carbon stewardship.

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

Do not rely on the flawed boilerplate climate analyses.

As explained below, the Forest Service's standardized NEPA language handed down from the regional office regarding carbon and climate change fails to take a hard look that NEPA requires. The analysis makes several highly misleading statements about managing forests for carbon storage, climate resilience, and the effects on climate change. The analysis inappropriately mischaracterizes the role of individual logging projects in the cumulative problem of global GHG emissions. The analysis misstates the effects of logging related carbon emissions that are not related to "deforestation." The analysis grossly misstates the climate effects of logging intended to reduce disturbance. The analysis misleadingly implies that logging benefits the climate by increasing forest productivity.

The NEPA analysis should consider the adverse climate consequences of GHG emissions caused directly and indirectly by logging. The NEPA analysis should estimate the quantity of GHG emitted by logging and associated activities throughout the wood products supply chain, and describe the contribution of this project to cumulative impacts of excess GHG in the atmosphere. The NEPA analysis should use a proxy such as the social cost of carbon dioxide emissions to describe effects.

The Forest Service should not rely on the boilerplate NEPA language from the regional office which is flawed in many ways. Instead the Forest Service:

- Must recognize the cumulative nature of the GHG emissions and climate problems. It does not matter that this project is small in the global scheme because all emissions matter when the causation (and effects) of climate change are global and cumulative;
- Cannot credibly assert that this project is harmless because it's not causing deforestation. This is immaterial. All GHG emissions, regardless of the source or how it is labelled, are part of the problem and cause the same climate impacts.
- Cannot credibly assert that thinning for forest health justifies or mitigates emissions from logging. Logging does not increase the capacity for growing trees. To the contrary, logging harms soil and reduces site productivity. Storing carbon in wood products is not preferable to storing carbon in forests. Evidence shows that forests are a more secure way of storing carbon. If this forest is not logged, or if more green tree are retained *in situ*, the agency cannot conclude that natural mortality will be greater than logging mortality. In fact, it is quite easy to predict that logging causes significantly more mortality than natural processes.
- Must not compare carbon *before and after* logging. That is an improper framework for NEPA analysis. The proper NEPA framework is to compare the effects of different alternatives (over time), so the agency must describe the carbon emissions and carbon storage in the forest over time *with* logging and *without* logging.
- Logging to reduce fire effects does not result in a net increase in forest carbon storage. The agency cannot predict the location, timing, or severity of future

wildfires, so most fuel treatments will cause carbon emissions without any offsetting benefits from modified fire behavior. Studies clearly show that the total carbon emissions from logging (plus unavoidable wildfire) are greater than carbon emissions from wildfire alone.

- Cannot credibly assert that carbon storage in wood products is a useful climate strategy. Logging kills trees, stops photosynthesis, and initiates decay and combustion, with the end result being a significant transfer of carbon from the forest to the atmosphere. In stark contrast, an unlogged forest continues to grow and transfer more carbon from the atmosphere to the forest. Carbon emissions caused by logging far exceed the small fraction of carbon transferred to wood products. Carbon accounting methods that attempt to account for *substitution* of wood for other high-carbon building materials are fraught with uncertainty and too often represent maximum potential substitution effects rather than lower realistic estimates.

The FS website links to a 2009 document explaining how to incorporate "Climate Change Considerations in Project Level NEPA Analysis." Since then the agency has regressed to a misleading and incomplete non-quantitative analysis of how carbon emissions from logging contribute to global climate change. The FS should now be following the latest 2023 CEQ guidance on fulfilling NEPA requirements for projects that affect the carbon cycle and emit GHG.

Supplemental Considerations for Variable Density Thinning

The FS should consider the following in designing thinning prescriptions that offer relatively high ecological benefits and relatively lower environmental trade-offs.

Recognizing the need for landscape level diversity of habitat and stand trajectories, the agencies should be doing things very differently from non-federal forest managers. The trends on non-federal lands are toward: younger age and size classes, shorter rotations, higher planting density, greater use of herbicides to control competing vegetation, increased use of planting stock with a narrow genetic bandwidth, reduced or delayed pre-commercial and commercial thinning (due to the disappearing price premium for large logs). Talbert and Marshall. 2005. Plantation Productivity in the Douglas-fir Region Under Intensive Silvicultural Practices: Results From Research And Operations. Journal of Forestry. March 2005. pp 65-70. These trends are very bad because they tend to increase conifer dominance at the expense of biodiversity. Federal forest managers should manage forests differently in an effort to moderate conifer dominance and increase biodiversity.

We wish that you would use variable density thinning prescriptions in all young stand thinning projects regardless of land allocation. Uniform spacing basically sets up the need for future thinning that the agency may not have sufficient funding, capacity, and public support to accomplish. Whereas variable density thinning leaves more options for either more or less intensive management in the future and is a good hedge against uncertainty. The benefits of variable density thinning include: creating a patchy variety of conditions of light, heat, wind, moisture, competitive stress, and hiding cover within the stand and the landscape; setting up the stand so that there are future "winners" and "losers" (the winners become big trees and the losers become snags and coarse woody debris), etc. Andy Carey has found that:

"Conventional thinning alone produced few flying squirrels or Douglas' squirrels, but many chipmunks; high plant species diversity but dominated by clonal natives with many exotic species; relatively abundant winter birds, but few woodpeckers; abundant small mammals but in imbalanced communities; and diverse fungi, low in abundance."

Carey, Andrew. **THINKING AND THINNING ECOLOGICALLY**, slideshow http://web.archive.org/web/20030427160424/http://www.fs.fed.us/pnw/olympia/efb/flash/thinking_&_thinning_ecologically.swf.

Conventional thinning in the Western Hemlock Zone may result in very low flying squirrel populations through negative effects on truffle production and arboreal travelways (Colgan et al. 1999, Carey 2000b) and reduced foraging by spotted owls (Meiman et al. 2003) for a long time while increasing numbers of forest-floor rodents (Wilson and Carey 2000). Conventional thinning, however, may result in uniform dense understories unfavorable to both flying squirrels and owl foraging in the midterm. Variable-density thinning, however, hold promise for acceleration of the development of spotted owl habitat and dense prey populations (Carey 1995, 2001, 2003a. Carey et al. 1999a,b; Carey and Wilson 2001; Muir et al. 2002) especially when appropriate attention is paid to decadence (snags, cavity trees, and coarse woody debris) (Bunnell et al. 1999; Carey et al. 1999a, b; Carey 2002). There may be a short-term impact on truffle production, flying squirrel abundance, and owl foraging, the ecosystem recovers more quickly and begins to develop more quickly and completely than following conventional thinning. Variable-density thinning has all the positive effects of conventional thinning, such and increased growth of trees, crown differentiation, development of understory, and increased flowering and fruiting of understory plants (Harrington et al. 2002, Wender et al. 2004) that provide important ancillary foods to spotted owl prey (Carey 2000a) without the same extent of negative mechanical impacts, loss of canopy connectivity, loss of spatial heterogeneity, loss of woody plant diversity (variable-density thinning stresses multi-species management).

Carey, A. 2004 Relationship of Prey and Forest Management. Appendix 5 pp 3-24, 3-25 *in* Courtney, SP; J A Blakesley. 2004. Scientific evaluation of the status of the Northern Spotted Owl.

http://web.archive.org/web/20120423191509/http://www.sei.org/owl/finalreport/Chapter5HabitatAssociations.pdf.

Scientists recognize that "Historically, [dry forests] displayed much spatial heterogeneity, consisting of fine-scale, low contrast structural patchworks" and they recommend that projects like this —

"Restore characteristic levels of within-stand spatial heterogeneity - this refers to a non-uniform distribution of forest structural elements, such as trees, snags, and canopy density. Such spatial heterogeneity is characteristic of older forest stands and landscapes in both Moist and Dry Forest regions (Franklin et al. 2002; Franklin and Van Pelt 2004). The practitioner of ecological forestry will typically look to the heterogeneity inherent in stands and landscapes as a beginning point or guide in incorporating heterogeneity in treatments.

...

The need for spatial heterogeneity

Spatial heterogeneity is an essential element in restoring and sustaining Dry Forests and landscapes. Restoration activities need to build upon and enhance existing residual spatial heterogeneity. Ecological restoration will rarely involve extensive areas of uniform treatments. A complex pattern of open and dense forest, meadows, and glades should result with:

1) Small dense patches of seedlings and saplings. Johnson et al. (2008) proposed at least 10% of these “skips”;

2) Medium-sized dense patches (300+ acres in size) scattered over the landscape to help provide habitat for species such as the Northern Spotted Owl and its prey; and

3) Variability in landscape-level forest and non-forest patches.

...

Long-term management of Dry Forest sites in the Pacific Northwest can also be based on principles of ecological forestry. Initial silvicultural activities would be designed to restore ecological conditions that are both sustainable and provide for a full array of ecological values. These are sometimes referred to as “restoration” and include the following considerations:

...

3) silvicultural activity in harvest areas build upon and enhance the spatial heterogeneity (fine scale, low contrast structural mosaic) that is characteristic of the Dry Forest types, including provision for denser untreated patches;

John & Franklin. 2009. Restoration of Federal Forests in the Pacific Northwest: Strategies and Management Implications.
https://web.archive.org/web/20170221082525/http://www.blm.gov/or/districts/medford/plans/files/FranklinJohnson.pdf.

Prescriptions should retain and enhance existing diversity -

any treatment prescription that can accommodate already existing variability within the homogenous stands that are to be restored will likely be more efficient at increasing heterogeneity in that stand (Puettmann et al. 2016). For example, a goal to provide more broadleaf shrubs and trees may be achieved more easily with prescriptions that protect existing patches of broadleafs during harvesting than by creating open conditions that facilitate their development (Davis et al. 2007).

Spies et al. 2018. Synthesis of science to inform land management within the Northwest Forest Plan area. Chapter 3: Old Growth, Disturbance, Forest Succession, and Management in the Area of the Northwest Forest Plan. GENERAL TECHNICAL REPORT PNW-GTR-966. https://www.fs.usda.gov/pnw/pubs/pnw_gtr966_chapter3.pdf

We urge you to prescribe variable spacing for all thinning projects. The great benefits in terms ecosystem processes far outweigh any minor loss of future timber value. The Matrix is not a tree farm. It still has a role to play in providing diverse habitats, so don't just grow *trees*, grow *forests.* According to the 2003 Draft SEIS for survey and manage, "Matrix was also expected to provide for ecologically diverse early-successional conditions and planned timber harvest." (DSEIS page 68). Variable density thinning is appropriate in the matrix because VDT expands future options for multiple-use/sustained yield in its fullest dimension and VDT does not foreclose any matrix objectives.

A concern with evenly spaced thinning is that the uniformly open canopy will encourage a homogenous understory dominated by a few species instead of a patchy and heterogeneous understory. Liane R. Davis, and Klaus J. Puettmann, Gabriel F. Tucker. 2007. Overstory Response to Alternative Thinning Treatments in Young Douglas-fir Forests of Western Oregon. Northwest Science 81(1). 2007.

Refer to the following resources to inform your implementation of variable density thinning:

- Duncan S. Wilson, and Klaus J. Puettmann. Density management and biodiversity in young Douglas-fir forests: challenges of managing across scales. DRAFT submitted to Forest Ecology and Management. August 2006. ("Spatially variable treatments provide for variable canopy structure and understory vegetation and results from the LSMEs suggest incorporating these into thinning prescriptions may be beneficial where biodiversity is of concern. The need for spatially variable treatments is highlighted by the hierarchical habitat-selection framework of various wildlife species. This framework provides a basis for matching spatial variability in forest structure and vegetation to the spatial scales that wildlife species perceive and respond to. Silvicultural prescriptions that increase within-stand variability can provide important habitat features across multiple scales and enhance habitat quality beyond that provided by stand-level prescriptions. … [M]anaging for biodiversity necessarily includes activities on several disturbance and spatial scales, which may include variable-density thinning, creating gaps and unthinned patches of different sizes, and creating two-storied stands through natural regeneration or underplanting (Carey et al., 1999; Hayes and Hagar, 2002; Puettmann et al., 2004). … The added objective of increasing understory vegetation for wildlife habitat and other ecological functions likely will require more intensive density management in order to ensure adequate resources for understory development (McComb et al., 1993; Hayes et al., 1997). … Complex vertical canopy structures are of interest when managing for biodiversity because they have been associated with increased songbird diversity and use (Carey, 1996). … Windstorms and disease that kill trees are common in young stands (Lutz and Halpern, 2006) and may result in natural gaps of widely varying sizes (from single trees to entire stands). … [M]anaging for understory vegetation and diverse habitat features will require either multiple, or heavy thinnings. Alternatively, variable density thinnings with areas of extremely low density or gap creation may provide long term openings. … Managing large deciduous tree patches to minimize overtopping by conifers will be advantageous for developing large crowns, large durable snags, and heavy seed production. Many songbird and bat species nest or roost in deciduous trees, and retention of these in thinning operations can provide vital features in otherwise suitable habitat (Hayes and Hagar, 2002). … Young stands with high understory vegetation cover and diverse composition will benefit many wildlife species especially where this habitat is rare, such as in dense unthinned stands (Hayes and Hagar, 2002; Beggs, 2005). … Providing within-stand heterogeneity of understory vegetation can further increase the odds that suitable habitat will be available at the correct spatial scales for multiple species. … Understory deciduous trees and shrubs are especially important habitat, as they provide berries and seeds (Wender et al., 2004), small mammal cover (Martin and McComb, 2002), contribute to foliage height diversity, and are an important substrate for lichen growth. Abundance of arthropods, an important food source for most neotropical songbirds, has been linked to the deciduous shrub component (Schowalter, 1995; Muir et al., 2002). A diverse understory composition is also beneficial, as deciduous shrubs, grasses and forbs are generally more palatable than evergreen plants and thus serve as an important food source for small mammals and invertebrates (Muir et al., 2002). … Density management tends to homogenize shrub cover slightly when pre-treatment cover is relatively high. In contrast, thinning tends to increase shrub cover and greatly increase within-stand variability where shrub cover is absent before treatment (Harrington et al., 2005).

High uniform shrub cover of a few species might reduce diversity of function, and treatments such as variable-density thinning or gap creation have been proposed to increase spatial variability in shrub cover and thus stand diversity. … In contrast to early thinning results, retrospective studies, which documented conditions 10–30 years postharvest, generally showed no effect or a strong increase in tall and short shrub cover. … The distinction between early and late responses to thinning also needs to consider trends in stand dynamics where stands develop higher shrub and herb cover as they move from the stem exclusion to the understory initiation and old-growth stages (Spies, 1991; Wender et al., 2004). … Herb cover generally responds either neutrally or slightly negatively to thinning … competition from rapidly increasing shrub cover may have confounded the impacts of overstory removal (Beggs, 2005). … Ten to thirty years after thinning, herb cover was higher in thinned than unthinned stands (Bailey et al., 1998; Thysell and Carey, 2001). Herb response to thinning, however, may be negatively correlated with the response of the competing shrub and tree layers (He and Barclay, 2000). … Unthinned patches have been proposed to promote diversity and better mimic natural stand development patterns, especially patterns of spatial diversity in overstory cover and species composition (Carey et al. 1999). … Small patches that were 36 and 50-m in diameter (0.1 and 0.2 ha, respectively) at the DMS study were compositionally similar to the thinned stand (200 tph residual density), whereas the interiors of 71-m diameter patches (0.4 ha) were compositionally similar to the unthinned stands (Wessell, 2006). Unthinned patches of any size supported several species not present in the thinned stands, suggesting the value of these patches to within-stand heterogeneity and potential for propagation into adjacent areas. … Thinning disturbs existing vegetation and frees up resources, compounding the risk that interfering species will expand and dominate understory vegetation. … Too much regeneration, however, especially of shade-tolerant species, can provide a "secondary stem exclusion" that results in nearly complete loss of shrub and herb cover (Alaback and Herman, 1988; Bailey and Tappeiner, 1998). Although none of the short-term results of the LSMEs documented this response … In areas where tall shrub cover is of special concern, harvesting activities may be designed to protect shrub patches. …

- Kevin W. Zobrist. 2005. A literature review of management practices to support increased biodiversity in intensively managed Douglas-fir plantations. Final Technical Report to the National Commission on Science for Sustainable Forestry (NCSSF). http://www.ruraltech.org/pubs/working/ncssf/tech_a/tech_report_a.pdf ("To meet the needs of a broad range of species, structural diversity is needed to provide a variety of habitat elements (Helgerson and Bottorff 2003, Muir et al. 2002). This requires complex three-dimensional canopy attributes and spatial relationships … Structural manipulations … should greatly shorten the time necessary for occupancy [by late-seral dependent species]. … Stem exclusion stage … supports few wildlife species. … the positive effects of thinning [is to] allow light to reach the forest floor. This provides better developed understories … Studies have found direct links between thinning and wildlife abundance … more winter birds … abundance of small mammals … Old forest conditions [are] most lacking on the landscape and difficult to replace … Instead of traditional, uniform thinning, irregular thinning with different densities, unthinned areas, and openings can greatly enhance structural diversity (Curtis et al. 1998, Helgerson and Bottorff 2003). This is also called variable density thinning, which treats alternating areas of usually around 0.25 to 0.5 acres leaving two or more different levels of residual density (Carey and Curtis 1996, Carey and Johnson 1995, Carey et al. 1999b, Carey and Wilson 2001). Variable density thinning is intended to mimic natural forest processes of suppression and mortality to create a structural mosaic and maintain wind stability (Carey et al. 1999b). … Another important way to increase stand-level structural diversity is to retain biological legacies … such as large, live trees, snags, and downed wood can better mimic natural disturbances and give plantations a structure more similar to natural stands (Franklin et al. 2002, Hansen et al. 1991). … The practices described above can be combined to create "biodiversity pathways" for forest management. Biodiversity pathways begin with legacy retention at the time of harvest, less intensive site preparation to conserve downed wood and other forest floor substrates, and planting at wider spacing. Successive variable density thinnings are done over longer rotations. These thinnings are heavier than traditional commercial thinnings and favor multiple species. The goal of biodiversity pathways is to minimize the dense stem-exclusion stage and accelerate the development of old forest structure and function to support increased biodiversity (Carey and Curtis 1996, Carey et al. 1996).")

- Poage, Nathan, J. 2005, Variability in Older Forest Structure in Western Oregon. U.S. Geological Survey, Open-file Report 2005-1385, 28 p. http://fresc.usgs.gov/products/papers/1445_Poage.pdf (Vegetation patterns are highly variable within and between stands. Patch size and density generally decreased with increasing stand diameter class. Observed patterns and trends "are most likely reflection of the normal processes of tree mortality and snag production and decay within stands. As the trees in a patch increase in size, self-thinning reduces patch density and—by creating gaps within a patch—can divide the original patch into two smaller ones. Similarly, tree growth and mortality lead to fewer but larger snags in a patch. Decay also decreases the patch density of snags and can lead to the formation of gaps within patches of snags. The formation of gaps within patches appears somewhat random … "
- SÁNDOR BARTHA et al. 2004. On the Importance of Fine-Scale Spatial Complexity in Vegetation Restoration Studies. International Journal of Ecology and Environmental

Sciences 30: 101-116, 2004 https://www.researchgate.net/profile/Giandiego-Campetella/publication/46734299_On_the_importance_of_fine-scale_spatial_complexity_in_vegetation_restoration_studies/links/09e415087057791a8e000000/On-the-importance-of-fine-scale-spatial-complexity-in-vegetation-restoration-studies.pdf ("Effective restoration should start from an understanding of the spontaneous processes of vegetation succession and utilize the natural "self-repair" mechanisms.... This context dependence of local vegetation dynamics is emphasized by the non-equilibrium ecological paradigm. This paradigm views the developing plant community as a complex dissipative system, which involve a methodology with explicit representation of spatiotemporal patterns. …. Descriptive and experimental evidences on natural succession (especially the accumulating data from long-term permanent plots and paleo-pollen spectra) revealed that succession is highly stochastic and the related mechanisms are far more complex than expected. … The variability of succession trajectories and the individualistic nature of local community dynamics can be understood by considering the effects from the spatiotemporal neighbourhoods at various scales. By temporal neighbourhood effects we mean the long lasting influence of initial conditions and the accumulating effects of specific events experienced during the site history … The neighbourhood relationships enfold along a hierarchy of scales. This means that history and spatial context are of vital at finer scales as well. Since restoration is the reassembly of community through human intervention (MacMahon and Hall 2001), understanding the community's assembly rules is of considerable importance (Wilson 1999). Fine-scale contingencies are probably more significant in plant communities where individuals are sessile and interactions are local (Czárán and Bartha 1992). … [W]e propose a simple and quick method appropriate for monitoring the finescale structural complexity of developing vegetation, and well able to collect additional information relevant for manipulating both rates and directions of processes. … The under-estimated complexity of natural systems implies that we might restore over-simplified versions of target communities. … [W]e showed that ignoring the fine-scale, within-stand community patterns, complexity would be underestimated again, and the resulting limited knowledge might lead to wrong restoration decisions. … Our case studies illustrated that the number of realized species combinations (as a measure of fine-scale structural complexity) is a better indicator of the early stage of degradation and the optimum disturbance regimes, than the stand-scale aggregated averages…. We argue that non-equilibrium conditions require specific methodology which ables [sic] to represent the spatiotemporal variation and dependence at multiple scales.")

- Franklin J.F.; Van Pelt R. 2004. Spatial Aspects of Structural Complexity in Old-Growth Forests. Journal of Forestry, Volume 102, Number 3, April/May 2004, pp. 22-28(7). ("We find a gradual evolution of (1) canopies from simple, top-loaded, single-layered canopies in young stands to the vertically continuous, bottom-loaded canopies in older forests; and (2) spatial heterogeneity from uniform young stands that are initially dominated by competitive processes to the fine-scale structural patchwork of old-growth forests. … Old temperate forests can be viewed as fine-scale structural mosaics that are developed and maintained as a consequence of chronic disturbances. Forests subject to stand replacement disturbances evolve through an even-aged cohort that is initially homogenized by competitive-based mortality before arriving at the developmental stage where chronic disturbances become the dominant influence on stand structure. … [T]he functional old-growth forest consists of a fine-scale structural mosaic in which all elements of the structural mosaic are needed to achieve a complete old-growth forest.")

- Competitive mortality tends to homogenize. Episodic intermediate disturbances act on the homogeneous forest to create spatial heterogeneity.
- Non-competitive mortality (insects, disease, wind, low to mixed-severity fire) tends to be contagious, creates canopy gaps and decadence, and tends toward heterogeneity.
- Chronic low- to moderate-intensity disturbance maintains fine scale structural mosaic until an uncommon stand replacing event occurs.
- This fine scale mosaic is characteristic of old forests in both stand-replacing and gap-replacing disturbance regimes.
- Natural canopy gaps tend to be 1/4 to 1/2 acres, a scale that is smaller than those proposed for group selection, so group selection may not be consistent with HRV.
- Spatial patterns exist at multiple scales. [Perhaps ~1/f distribution of habitat patchiness. With many small and a few large patches, but most habitat represented in the large patches. Fractal edge dimensions. Contagious disturbance takes long path. See e.g. Gisiger, T. 2001. Scale invariance in biology: coincidence or footprint of universal mechanism? Bio. Rev. (2001) 76 pp 161-209. http://www3.sympatico.ca/thomas.gisiger/Gisiger_2001.pdf and Manrubia, S. C., Solé, R. V. (1997) On forest spatial dynamics with gap formation. Journal of Theoretical Biology 187, 159–164. Sole and Manrubia http://www.sciencedirect.com/science/article/pii/S0022519397904094.
- Epicormic branches are excellent habitat platforms for birds, mammals, and epiphytes.
- Older stands have higher leaf areas.
- All stand development process are simultaneously present within the stand, so new definition of forest "stand" may be need to account for the wide range of processes and conditions present concurrently within an otherwise "uniform" distinguishable stand.

- NOTE: Franklin and Van Pelt may have over-simplified the range of processes in operation within young stands. See: Lutz. J.A. 2005. The Contribution of Mortality to Early Coniferous Forest Development. MS Thesis. University of Washington. http://faculty.washington.edu/chalpern/Lutz_2005.pdf.This MS Thesis looked at long-term transect data from young forests in Western Oregon and found that non-competitive mortality and gap forming processes are very much in operation in young stands. A major conclusion of this study is the homogenizing influence of stand growth and competitive mortality in young stands is significantly counter-balanced by non-competitive mortality that tends toward heterogeneity and structural diversification. This means that if young stand management is to effectively mimic natural patterns and processes, that variable density treatments must be the rule, and the scale of the mosaic must be very fine scale. See also Lutz & Halpern 2006. Tree Mortality During Early Forest Development: A Long-Term Study Of Rates, Causes, And Consequences. Ecological Monographs, 76(2), 2006, pp. 257–275. http://cfr501.jamesalutz.com/Lutz_Halpern_Mortality_EM_2006.pdf
- Carey, Andrew B., Janet Kershner, Brian Biswell, and Laura Dominguez de Toledo. 1999. Ecological Scale and Forest Development: Squirrels, Dietary Fungi, and Vascular Plants in Managed and Unmanaged Forests. Wildlife Monographs, No 142, Supplement to the Journal of Wildlife Management, Vol. 63 No. 1, January 1999. http://www.fs.usda.gov/pnw/pubs/journals/pnw_1999_carey003.pdf. ("[S]ilviculture can contribute to simplification or to diversification of the ecosystem.

  ...

  It is our contention that aggradation and redistribution of biomass, living and dead, results in niche diversification, an expansion of the niche hyperspace of the ecosystem and the community it contains....It is this expansion that may result in emergent properties through symbiosis and synergy.... Thus we hypothesize that conservation of biodiversity could be achieved in managed forests through planned human-caused disturbances and gradual change that create a multidimensional space of particular dimensions; it is those dimensions we seek to describe here.

  ...

  Crown-class differentiation accounted for more variance in our data set than any other factor. Similarly, Carey et al. (1991b) reported that dbh alone could separate age classes in their sample, and Spies and Franklin (19901) reported that most variance among age classes across the Pacific Northwest could be reduced to a single canonical variate related to the standard deviation of dbh and the density of large trees.

  ...

In our study, crown-class differentiation accounted for 25% of variance in vegetation structure, but proved to be a major dimension of the realized habitat of chipmunk abundance.

...

Crown-class differentiation is perhaps the factor of forest development most amenable to management: (1) species composition can be determined managerially at initiation of a new stand by legacy retention, planting, and precommercial thinning, (2) management of stem density and growth rates is well founded (Curtis and Carey 1996), and (3) spacing can be varied tree to tree or patch to patch within stands (Carey 1995, Carey et al. 1996a,b). Growth of large trees and time lead to disease, injury, decay, and death of trees and consequent expansion of multidimensional niche space. Decay processes seem less deterministic; management of decadence is more problematic.

...

Of all the habitat elements we measured, coarse woody debris proved to be the best predictor of the realized habitat space, activity; and carrying capacity of northern flying squirrels and carrying capacity for Townsend's chipmunk.

...

If catastrophic disturbance sets the stage, it is small-scale disturbances in the canopy that determines the pace of the ecosystem development. Whitmore (1989) claimed that gaps drive the forest cycle in all forests; but the ecological process of tree death (Franklin et al. 1987) is particularly important in expansion of niche space.

...

... biodiversity is suppressed in competitive exclusion (which historically was rare in many landscapes; Tappeiner et al. 1997a) and there is expansion of niche space and increased biodiversity in understory-reinitiation and niche-diversification stands.

...

... Ecosystem dynamics... suggest active ecosystem management would be more effective than passive management (withdrawals or reserves) for conservation of biodiversity in second-growth forests.

...

Thinnings, active promotion of decadence, and legacy retention hold potential in managing forests for biodiversity, but spatial scale of management is important.

...

Thinning

In the Pacific northwest, the best opportunities for conservation of biodiversity through ecosystem management lie in the millions of hectares of second growth forest <50 years old. (DeBell et al 1997, Hayes et al 1997). Crown class differentiation, canopy stratification, understory development, and habitat breadth can be enhanced through thinning, but spatial patterning is important.... Traditional, light commercial thinning will not preclude or move a stand out of competitive exclusion and will not increase habitat breadth. Heavy thinning with even spacing can cause stands to become drier through increase wind and sunlight, could result in salal brushfields (simple structure with low habitat breadth), and if applied in a dense stand) could disrupt mycorrhizal links and increase probability of massive windthrow (Carey et al 1996b).

...

Variable-density thinning on a 0.1-0.5 ha scale that removes subordinate or codominant trees appears to have potential for increasing crown-class differentiation, canopy stratification, understory development, and habitat breadth.... [W]e suggest that maintaining relative densities of 0.5 and 0.35 in a ratio of 2:1 over the stand could result in accelerating the development of stand structure and heterogeneity characteristic of late-seral, natural forests. Hagar et al. (1996) recommended variable-density thinning with relative densities of 0.2 -0.7. Actual choice of relative densities should entail consideration of risk of windthrow, potential for creation of salal or salmonberry (*Rubus spectabilis*) brushfields, the silvics of the species being managed, and site conditions. Multiple thinnings would be necessary to (1) keep the disturbance intermediate to small scale, (2) avoid disrupting connectivity among tree crowns (3) prevent excessive drying of the forest floor, (4) avoid development of a sparse overstory with a dense salal brushfield underneath, and (5) keep the canopy from closing into a stage of competitive exclusion.

...

... Traditional commercial thinning with systematic spacing allowed quick (ca. 10 yr) canopy closure and return to competitive exclusion; biodiversity targets were not met.... In forests being restored for late-seral wildlife, biodiversity thinnings appeared to have substantial value in creating late-seral forest relatively quickly. In forest managed for economic values....

...

Managing for decadence

Managing decadence is the most challenging aspect of intentional ecosystem management. Our research shows that decadence is more than snags and logs; it is a process that is influential in multiple aspects of ecosystem development from providing cavities for wildlife, to creating gaps in the canopy, to altering forest floor microclimate and structure.")

- "To simulate this type of natural disturbance [openings created by beetles], logging in medium-aged mixed montane stands should aim to create gaps with retention of a part of the dead wood. Planting after logging should be delayed, to lengthen this important phase of sunlit conditions otherwise rarely found in a landscape of young and dense commercial forests." Jorg Muller, Heinz Butler, Martin Goßner, Thomas Rettelbach, Peter Duelli, 2008. The European spruce bark beetle Ips typographus in a national park: from pest to keystone species. Biodivers Conserv (2008) 17:2979–3001.
- There may be value in varying the shape(s) of harvest units and the harvest and nonharvest areas within units so they are less blocky and more sinuous with a greater ratio of edge-to-area. This has proven beneficial for pollinators, and may benefit other wildlife as well. Parmentier, L., Kerckvoorde, A. V., Couckuyt, J., Calster, H. V., Smagghe, G., & Haesaert, G. (2025). Sinus management: Meandering mowing as a novel method to improve pollinator biodiversity and habitat heterogeneity in mesic grasslands. *Agriculture, Ecosystems & Environment*, *382*, 109478. https://doi.org/10.1016/j.agee.2025.109478.

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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.

Please post to the project website before the public comment period, georeferenced maps of the proposed activity units that can be used to navigate in the field using apps such as Avenza.

Please provide our groups with timely notice of any forthcoming comment opportunities, and any draft and final decisions on this project. If the agency discovers new information or changed circumstance or modifies the project or the analysis after the decision, we request to be notified and provided an opportunity to comment.

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

Thank you for considering these comments.

Sincerely,

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