OREGON WILD

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Subject: Scoping Comments on Eastside Screens Plan Amendment, Eastside Oregon National Forests

Please accept the following scoping comments from Oregon Wild, Klamath Siskiyou Wildlands, Cascadia Wildlands, Greater Hells Canyon Council, Center for Biological Diversity, and The Larch Company, concerning the Eastside Screens Plan Amendment for the National Forests in Eastern Oregon, https://www.fs.usda.gov/detail/r6/landmanagement/planning/?cid=FSEPRD710229. The signatory groups represents tens of thousands of members and supporters who share their interest in forest conservation and have a particular fondness of large trees and the diverse values they support. The signatory groups have a long history active engagement in forest planning and projects on the National Forests in eastern Oregon, and have consistently advocated for retention of large trees.

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Introduction

The proposed action involves amending the LRMPs for the National Forests in eastern Oregon to "to revise a provision that limits harvesting trees larger than 21 inches in diameter … in light of current forest conditions and the latest scientific understanding of forest management in areas that have frequent disturbances."

We find no compelling ecological rationale for this plan amendment. The Eastside Screens, especially the large tree retention requirement, remains well-founded. Removing large trees has marginal benefits, and significant negative trade-offs. The Forest Service can meet virtually all of its forest management goals attributed to this proposal by focusing on reducing the density of small young trees. There are many reasons to retain large trees, including for habitat, carbon storage, and fire hazard reduction. Before allowing commercial removal of large trees, there are many alternatives that the Forest Service should consider, including: letting natural competition sort things out and let the fittest trees survive; kill large, young white fir trees in direct competition with legacy Ponderosa pine trees and retain those trees on-site as snags, down wood, or habitat features, or use them elsewhere on the landscape where large wood is scarce; or allow large young trees to be used for tribal cultural purposes.

We are concerned that the lack of rationale for this plan amendment contrasts with compelling evidence for a number of conservation-oriented plan amendments, such as those needed to address climate change, climate-change-related need for increased biogenic carbon storage, out-dated snag habitat standards, out-dated salvage standards that conflict with goals for conservation of early seral forests following natural disturbance, the need to conserve all suitable spotted owl nesting, roosting, foraging habitat to mitigate for adverse competitive interactions between spotted owls and barred owls, new information on the destabilizing influence of the boom-bust timber industry, livestock grazing, continued fire suppression policies, protecting smaller old growth, etc.

Some say the 21” dbh limit is arbitrary, but it’s no more arbitrary than highway speed limits. There are good reasons we don’t grant people discretion to choose their own speed, and we are similarly convinced that the 21” diameter limit helps save the Forest Service from themselves by preventing them from doing counter-productive and controversial things. We are very concerned that if the Forest Service grants themselves more discretion to cut large trees, the agency has many institutional incentives that will lead them to abuse that discretion and undermine public trust in the agency that has much more important work to do than remove large trees.

Even if there may be exceptional circumstances where retention of large, young trees may interfere with plausible restoration goals, there are many ecological trade-offs associated with removing large trees, and there are many alternative beneficial uses of those trees that do not involve commercial extraction. Simply put, cutting and removing large trees is not a high-priority restoration action on the National Forests in eastern Oregon. There is plenty of more important work to do, including right-sizing the road system, protecting watersheds and water quality, reintroducing natural fire regimes, removing weeds, addressing the damage from past logging, grazing, roads, and fire suppression. The Forest Service should reprioritize to focus on higher priority restoration efforts.

Purpose & Need: There is No Compelling Ecological Rationale for Removing Large Trees

The purpose and need for this proposal must recognize that the Forest Service is trying to advance multiple, potentially competing, objectives, even when ecological restoration is the overarching goal. This requires harmonizing goals that may be in conflict, rather than maximizing any particular goal. The existing requirements of the Eastside Screens already permit harmonizing of diverse goals.

Adjusting species composition in areas that have been encroached by an uncharacteristic abundance of shade-tolerant conifers, is a laudable goal, but it should not be pursued to the detriment of large tree restoration. Species composition can be corrected to a great degree by focusing on thinning the overabundant small trees, and will be further advanced when the disturbance regime is restored. The goal of restoring large trees and large snags requires conserving large trees and snags. The large tree restoration goal will be significantly delayed if this amendment is approved.

There are many trade-offs associated with removing large trees. The purpose and need cannot be one-sided and ignore these trade-offs. The purpose and need for this proposal should include maintaining and restoring the full suite of values associated with large trees and relatively dense forest canopies, including: large green tree habitat, large snag habitat, accumulations of large down wood, carbon storage in the forest, cool-moist microclimate, inter-tree competition leading to natural selection of genotypes fit for survival, clumpy spatial patterns among trees, mitigation for shortages of large tree values on-site and elsewhere on the landscape, meeting the objectives of the Eastside Screens, etc.

In 2003, PNW Regional Forester Linda Goodman issued a memo saying – "science findings ... reinforce the importance of retaining and recruiting large, old trees in the eastside landscape. ... The objective of increasing the number of large trees and LOS stands on the landscape remains." These science findings remain well-supported.

The enclosure to the 2003 Goodman memo says "It is critical that silvicultural prescriptions provide for large snags in adequate numbers (as indicated by DecAID and other tools) through time to provide habitat for these species." Sadly, the existing snag standards are scientifically discredited and the Forest Service has not updated their snag standards to ensure that large snags are provided in adequate numbers. This "critical" policy cannot be followed until snag standards are brought into conformance with the best available science.

In 2015, Regional Forester James Peña's issued a memo saying to "consider site-specific Forest plan amendments where this will better meet LOS objectives by moving the landscape towards HRV, *and providing LOS for the habitat needs of associated wildlife species*." This clearly indicates that restoring species composition should not trump conservation of LOS components and wildlife conservation. All these purposes of large tree conservation need to be explicitly considered and met.

The NEPA analysis must also consider and disclose the fact that the agency can substantially meet ALL of its goals related to density reduction, fuel reduction, and species composition, and legacy tree culturing by focusing on removal of young trees less than 21” dbh.

The purpose and need, effects analysis, alternatives and mitigation need to address all the evidence both for and against removing large trees. The Forest Service must address reasonable opposing viewpoints. Likely effects of large tree removal, and sound reasons to conserve rather than remove large trees include:

1. Killing and removing large trees will transfer carbon from the forest to the atmosphere and forego additional carbon sequestration in large trees that are allowed to keep growing. This will exacerbate global climate change and ocean acidification.
2. Killing and removing large trees will reduce the population of large trees and the valuable habitat they provide, including and bark habitat (used by bats, birds and arboreal mammals), canopy habitat, etc.
3. Killing and removing large trees will eliminate an important source of large snag and large wood recruitment. This is a significant long-term effect exacerbated by the fact that all the applicable LRMPs lack scientifically credible standards for maintaining and restoring depleted snag habitat and ensuring viable populations of wildlife associated with dead wood. Increase removal of large trees, combined with the ongoing effects of widespread density reduction on the eastside National Forests, will have significant, long-term effects on recruitment of large snags and large wood.
4. Killing and removing large trees will increase fire hazard by stimulating growth of smaller trees and shrubs; increasing slash production and the risks that go along with leaving slash on the ground and/or disposing of it; altering the microclimate making stands hotter; dryer, windier; and eliminating canopy that helps suppress surface and ladder fuels.
5. Killing and removing large trees will increase public distrust of the agency. Large trees are highly valued by the public as a resource that not only provides immediate scenic and recreational values, but the public also understands that large trees contribute to wildlife habitat, carbon storage, hydrology, etc.

Jerry Franklin highlighted the importance of large trees. He said, “Removal of legacies is most profound long-term impact” because of the –

Importance of Coarse Wood:

- Habitat for species
- Organic seedbeds (nurse logs)
- Modification of microclimate
- Protection of plants from ungulates
- Sediment traps
- Sources of energy & nutrients

- Sites of N-fixation
- Special source of soil organic matter
- Structural elements of aquatic ecosystems

Jerry Franklin - What is a 'Good' Forest Opening? – Powerpoint http://courses.washington.edu/esrm315/Lectures/FranklinEarlySuccession.pdf. Each of these issues should be carefully considered and mitigated. See also Rose et al (2001) which provides a detailed description of the functional roles of large trees and large wood. Rose, C.L., Marcot, B.G., Mellen, T.K., Ohmann, J.L., Waddell, K.L., Lindely, D.L., and B. Schrieber. 2001. Decaying Wood in Pacific Northwest Forests: Concepts and Tools for Habitat Management, Chapter 24 in Wildlife-Habitat Relationships in Oregon and Washington (Johnson, D. H. and T. A. O'Neil. OSU Press. 2001) http://web.archive.org/web/20060708035905/http://www.nwhi.org/inc/data/GISdata/docs/chapter24.pdf.

Another important ecological function provided by conservation of large trees, and eventual natural mortality of large trees, is that it promotes evolutionary adaptation, which is critical right now in the face of climate change.

> [R]esearchers were surprised to find that the mortality of established trees considerably promotes the adaptation of forests to the changing environment. … Evolution is promoted by the mortality of established trees. The researchers assumed that demographic characteristics of the trees would have a notable impact on their adaptability. Tree species differ for example so that birch matures at a considerably younger age than pine, and birch seeds spread more effectively than pine seeds. However, the results showed that these differences had only minor impacts. Instead, the mortality of established trees played a large role in the evolutionary adaptation.

Northern forests do not benefit from lengthening growing season. UNIVERSITY OF HELSINKI. PUBLIC RELEASE: 12-JAN-2010. http://www.eurekalert.org/pub_releases/2010-01/uoh-nfd011210.php. Importantly, for natural selection to occur, mortality must be caused by natural events like drought, insects, and fire, rather than through human choices about which trees will live and which will die.

The recently proposed plan amendment for the Fremont-Winema would allow removal of large white-fir trees for wide variety of different reasons, e.g., "where needed, to protect old-growth trees, restore species composition and stand structure, maintain diversity components, and improve forest resiliency to fire, drought, insects and disease." Each of these reasons needs its own rationale, but none have been provided, and none have been weighed against all the reasons to conserve large trees. This whole proposal would be easier to swallow if it were limited to a plausible ecological objective such as saving legacy pine trees by girdling *some* of the 21-25" dbh white fir trees <120 years old within the drip-line of legacy pine trees.

Prepare an EIS to Address Significant Effects. Do Not Use an EA or CE.

The project website does not disclose what NEPA process will be used for this plan amendment. This lack of transparency is disconcerting. And the Forest Service does not appear to be soliciting scoping comments. In a project of this cultural and ecological significance, the public should definitely have a chance to identify alternatives and issues for analysis?

Pursuant to NEPA, the agency must analyze and disclose the direct, indirect and cumulative environmental effects of the proposed action, which are likely to be significant and require an EIS.

The Fremont-Winema NF suggested a similar amendment might be done with a Categorical Exclusion. That would be highly improper and objectionable. The Forest Service NEPA regs at 36 CFR 220.6(c)(16) provides that a CE may be appropriate for plan amendments that "... provide broad guidance and information for project and activity decision-making in a NFS unit." This plan amendment does not provide "broad guidance and information." This language is left over from a misguided era when the Forest Service tried and failed to assert that forest plans are *aspirational* and do not have on-the-ground impacts on the environment. This CE is facially incorrect and improper. The FS should not rely on it. Forest plan direction results in actual, physical effects to the environment. *Citizens for Better Forestry v. U.S. Dept. of Agriculture*, 341 F.3d 961, 973 (9th Cir. 2003). Reducing or eliminating environmental standards or constraints in a forest plan will result in lesser or no environmental standards at the site-specific level. *Id*. at 975.

In the alternative, the Forest Service should recognize that this particular plan amendment is clearly NOT aspirational. This plan amendment will remove explicit, mandatory protection for specific large trees affecting large portions of the eastside National Forests. This plan amendment relaxes a very specific limitation on logging large trees that will be applied at the individual-tree scale in virtually every timber sale on Oregon's eastside forests. This is the farthest thing from "aspirational" or "broad guidance" so this plan amendment does not fit the category.

Furthermore, all of the issues described in the preceding section provide a strong indication that the effects of this plan amendment (removal of large number of live trees and the ecological functions they provide) are likely to be significant and require an EIS, including potentially significant cumulative effects on:

- carbon storage and climate change and ocean acidification,
- habitat for terrestrial and aquatic species associated with forest canopies, tree bark, snags, down wood, etc. Many of these are Forest Service sensitive species that are specifically included as extraordinary circumstances (36 CFR §220.6(b)(1)(i)),

- increased fire hazard caused by increasing slash production and reducing canopy that helps suppress growth of surface and ladder fuels,
- loss of diverse ecological functions provided by large trees;
- controversial effects and loss of public trust,
- and other effects.

If a CE is pursued, these issues and effects will clearly trigger a finding of extra-ordinary circumstances. If an EA is prepared, these issues and effects are likely to make a FONSI improper.

The Forest Service should at least prepare an EA to ensure consideration of all of the indicators of significance listed in 40 CFR 1508.27, not just the shorter list of "resource conditions" listed as "extraordinary circumstances" in 36 CFR §220.6(b).

The NEPA analysis needs to clearly describe how an age-based limitation on tree cutting is much harder to implement than a dimeter-based cutting limit.

The Forest Service Must Consider All Reasonable Alternatives

The Forest Service has a duty to consider all reasonable alternatives. The NEPA analysis should consider a range of alternatives that resolve the trade-offs associated with logging large trees in different ways, and a preferred alternative that best harmonizes all the trade-offs.

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 USFS 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 40 C.F.R. § 1501.2 (c)." *Id*. Environmental analysis documents must "[r]igorously explore and objectively evaluate all reasonable alternatives" to the project. 40 C.F.R. § 1502.14(a). The Council on Environmental Quality (CEQ), characterizes the discussion of alternatives as "the heart of the environmental impact statement." 40 C.F.R. § 1502.14. A decisionmaker must explore alternatives in sufficient enough detail to "sharply defin[e] the issues and provid[e] a clear basis for choice among options by the decisionmaker and the public." *Id.* § 1502.14.

The Forest Service should consider several alternatives:

(i) Return to the original intent of the screens by adopting a 20" dbh limit (not 21") protecting all large trees as recommended by scientists when the screens were first proposed, and incorporate new science by protecting large trees both live and dead trees and protecting all old trees (>120 years) regardless of size;

(ii) Accept the outcome of natural competition between large trees. Focus density reduction on small trees that can go a long way to meeting goals related to adjusting species composition, reducing hazardous fuels, reduce drought stress, reducing competition between trees, and protecting legacy trees;

(iii) Girdle and/or fall and leave large trees, in the rare instance where large, young shade-tolerant trees in direct competition with well-defined shade-intolerant legacy trees. This will meet additional important restoration goals related to large snag habitat and down wood habitat;

(iv) Fall and use the large, young shade-tolerant in habitat restoration efforts, such as wood placement in RHCAs or instream, adding down wood to tens of thousands of acres of old clearcuts or salvage units where down wood is severely lacking;

(v) Allow commercial removal of large trees only in extraordinary circumstances;

(vi) Exclude certain areas and/or land allocations from this plan amendment, such as areas where there is a shortage of large trees, RHCAs, wildlife habitat/big game areas, scenic/recreation areas, unroaded areas >1,000 acres, etc.;

(vii) Mitigate the loss of large trees by using species-specific diameter limits, slightly larger than 20" dbh for shade-tolerant species, and slightly smaller than 20" for shade-intolerant species, e.g., 16" dbh for Ponderosa pine, and 24" dbh for white fir;

(viii) Mitigate the loss of large trees by allowing the killing (and some limited removal) of large, young shade-tolerant trees within the dripline of shade-intolerant legacy trees, and narrowly define legacy trees, e.g., >36" dbh;

(ix) Protect large live AND dead trees. This is consistent with recent science and the expert recommendations in the May 11, 2020 Science Forum;

(x) Treat only a subset of large, young shade-tolerant trees within the dripline of legacy trees. Retain well-distributed clumps of trees that are common in natural forests;

(xi) Allow tribal members to use some of the large, young shade-tolerant trees within the dripline of legacy trees for cultural purpose;

(xii) Where large, young shade-tolerant tree have long canopies that may serve as ladder fuels, the Forest Service should consider alternatives such as: (i) prune lower branches to raise the canopy base height, (ii) maintain the clumpy spatial pattern of trees on the landscape and tolerate group torching which is a natural feature of mixed severity fire regimes, and (iii) focus fuel reduction on smaller fuels closer to communities (especially the structure ignition zone) as the science recommends.

(xiii) Consider a full suite of conservation plan amendments described in these comments (below) to bring eastside forest management in line with current science regarding, fire management, livestock grazing, carbon storage, snag habitat, salvage logging, early seral habitat, and to protect and restore unroaded areas >1,000 acres.

Removing Large Trees Undermines a Key Purpose of the Eastside Screens

The Eastside Screens say "2) Outside of LOS, many types of timber sale activities are allowed. The intent is still to maintain and/or enhance LOS components in stands subject to timber harvest … Manipulate vegetative structure that does not meet late and old structural (LOS) conditions, … in a manner that moves it towards these conditions as appropriate to meet HRV. … Manipulate vegetation in a manner to encourage the development and maintenance of large diameter, open canopy structure." 1995 Regional Forester's Forest Plan Amendment #2. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5288660.pdf

Looking at the old-growth definition from ICBEMP (http://www.icbemp.gov/pdfs/sdeis/Volume2/Appendix17a.pdf:

> "old growth is typically distinguished from younger growth by several of the following attributes: 1. Large trees for species and site. 2. **Wide variation in tree sizes and spacing**. 3. **Accumulations of large-size dead standing and fallen trees** that are high relative to earlier stages. 4. Decadence in the form of broken or deformed tops or bole and root decay. 5. **Multiple canopy layers**. 6. Canopy gaps and understory patchiness."

(emphasis added) Removing large trees will directly and significantly interfere with efforts to restore LOS components including especially "Accumulations of large-size dead standing and fallen trees."

LOS "components" to be maintained or enhanced include large trees and large snags and accumulations of dead wood, so thinning small, dense understory trees might help move stands toward LOS, but any action that would remove large trees would not be consistent with the intent of the Eastside Screens.

Recognizing the fact that past logging practices have greatly reduced the abundance of large trees and snags, the Eastside Screens also require that projects use the best available science to meet the intent of 100% potential populations of primary cavity excavators. While the potential population methodology has been discredited the Forest Service must still meet the intent by not taking any action that could reduce populations of primary cavity excavators. This proposed plan amendment directly implicates the conflict between tree removal and snag recruitment. Since the current snag standards are discredited, the FS must adopt new scientifically sound snag standards are part of this process.

When exceptions to the Eastside Screens are being considered, such as removing white fir larger than 21" dbh, the agency must recognize that compelling ecologic justification for removal of large trees are lacking. Where large trees appear to be abundant, they are helping to compensate for large areas lacking large trees. Where large trees appears to be in competition and at risk of mortality, they are just furthering the natural processes that recruit valuable large snags and dead wood. It is unavoidable that logging large trees has net negative ecological effects and cannot be justified on ecological grounds. The agency must consider all the trade-offs carefully.

Before considering any amendment to the diameter limit in the Eastside Screens the Forest Service must document its consideration of, and consistency with, the available guidance about when such amendments might be appropriate. In this case, the most recent guidance is Regional Forester James Peña's September 10, 2015 guidance to Forest Supervisors regarding site-specific amendments to the Eastside Screens. This guidance says "The Eastside Screens were **intended to conserve old forest abundance and wildlife habitat** in late and old structural stages. **I emphasize these intentions remain in place**. The direction in this letter and its enclosure, which provides additional information regarding the importance of maintaining Screens …" (emphasis added).

Peña's 2015 memo is a revision of the 2003 Goodman memo. The bulk of Peña's guidance regards the *site-specificity* of plan amendments. Other important considerations regarding plan amendments for removal of large trees are addressed in Regional Forester Linda Goodman's June 11, 2003 memo to eastside Forest Supervisors. The NEPA analysis for this project needs to provide a clear explanation of how this project meets the requirements of the 2003 guidance memo which says -

> "**science findings ... reinforce the importance of retaining and recruiting large, old trees in the eastside landscape**. ... **The objective of increasing the number of large trees and LOS stands on the landscape remains**. Economic considerations are important but are not considered adequate justification alone for conducting harvest activities in LOS stands. I encourage you to coordinate with the Regional screens team and Regional planning staff as site-specific Forest Plan amendments are developed."

The memo does not recommend changing the underlying restoration goal of the screens, but rather "to consider site-specific Forest plan amendments where this will better meet LOS objectives by moving the landscape towards HRV, and providing LOS for the habitat needs of associated wildlife species." Amendments calling for removal of large trees, especially those not in direct competition with legacy trees, ARE changing the goals of the Eastside Screens to emphasize restoring species composition, and de-emphasize large tree conservation. There is no compelling ecological support for this change.

The enclosure to the 2003 Goodman memo says "These findings reinforce the importance of retaining and recruiting large, old trees in the eastside landscape, ... **It is critical that silvicultural prescriptions provide for large snags in adequate numbers (as indicated by DecAID and other tools) through time to provide habitat for these species**." This indicates not only that retention of large trees continues to be important, but also indicates that the FS must use quantitative methods (such as DecAID) to determine when adequate numbers of large snags and large green recruitment trees are available.

The enclosure to the Regional Forester's memo specifically mentions five wildlife species that need adequate numbers of large trees that turn into large snags,

> Pygmy nuthatch: 18-34 inches or larger
> White-headed woodpecker: 18-36 inches or larger
> Pileated woodpecker (an MIS): 20-35 inches or larger
> Flammulated owl: 6-53 inches or larger [and]
> Fisher ... Data from DecAID indicate that 70 percent of fishers use snags between 27 and 47 inches DBH. Radio telemetry studies indicate that snag densities in telemetry locations of fishers are significantly greater than those of random sites.

Many additional species are also reliant on dead wood and intended to benefit from the LOS restoration standards in the Eastside Screens, and DecAID provides a long list of key ecological functions of snags in Ppine/Doug fir forests. https://apps.fs.usda.gov/r6_decaid/legacy/decaid/queries/emcf-e-cscds-bmt/lrgr-trs/narrative.html#ECOLOGICAL%20FUNCTIONS%20AND%20PROCESSES%20OF%20DECAYED%20WOOD%20ELEMENTS. Any amendments proposed for removal of large trees must disclose whether and how the needs of these species will be met over time.

The NEPA analysis must take a hard look at the habitat needs of primary cavity excavators over the long term. It is not enough to meet the needs of woodpeckers for a few years after harvest. Maintaining viable populations of primary cavity excavators will require retention of virtually all the overstory trees so that there is a long-term supply of snags and dead wood.

Shifting species composition has become a popular rationale for removing large trees. Johnson & Franklin (2013) review several considerations that the agency should make:

> **Shift Tree Composition towards More Fire- and Drought-Tolerant Species**
>
> Restoring the dominance of fire- and drought-tolerant species in Dry Forests is fundamental to increasing resilience. ….
>
> The desired proportion of fire-tolerant to fire-intolerant species will vary by PAG. On sites historically dominated by ponderosa pine, meeting wildlife, fire and fuels, and resilience objectives may involve leaving almost 100% of a stand's post-treatment basal area in pines. In the more productive Dry Mixed-Conifer stands, some Douglas-fir or grand/white fir may need to be left to achieve residual basal area objectives.
>
> Restoring species composition towards historical levels can often mean removing large but younger (<150 year) grand/white fir and Douglas-fir to favor pines and western larch. Hard diameter limits, such as a 21-inch dbh limit, can make it difficult or impossible to achieve desired composition in many Mixed-Conifer Forests, which would compromise their future resilience. At the same time, large, young fir trees provide important wildlife

habitat in their live, standing dead and down states, so some often should be retained (Box 5).

…

Box 5: Deciding Which Larger Grand/White Fir to Retain or Remove During Restoration

Deciding how many and which larger grand or white fir to retain and which to remove can be a challenging question for managers, stakeholders, and marking crews, particularly when there are no diameter limits (e.g., trees >21" dbh) or where diameter limits have been suspended. Large grand/white firs are often abundant on sites where they are poorly adapted or unwanted as potential fuel or a continuing source of grand/white fir seed. On the other hand, **larger grand/white firs often make up a large percentage of the basal area and provide important wildlife habitat.** So, what to do? Let's begin by looking at some attributes of grand/white firs and then examine factors favoring retention or removal. Do remember that all older (e.g., greater than approximately 150 year old) grand/white firs should generally be retained along with older trees of other species.

Grand/white firs have the potential to grow fast and to larger sizes relatively quickly on sites that are environmentally favorable, such as Moist Mixed-Conifer sites. They are aggressive regenerators, producing large seed crops at frequent intervals. Grand/white firs are highly shade tolerant and typically retain lower branches as they grow into saplings and poles, creating potential fuel ladders. While growth during the first century is often rapid, grand/white firs are relatively short-lived species with low resistance to trunk, butt, and root rots, insect defoliators (especially spruce budworm), and bark beetles, among other afflictions (Table 1). Hence, mature (e.g., approximately 100 year old) stands dominated by white or grand fir can be expected to fall apart during their second century because of high levels of tree mortality, although individual trees may survive for 200 years or more. Grand/white firs are decay prone in the dead as well as the live state, so persistence as a snag or down log is short. Grand/white firs are also highly vulnerable to damage or death by wildfire or drought.

Why would we retain larger young grand/white firs in restoration treatments, given their vulnerability to disease, insects, fire, and drought? One major reason might be the desire to retain some larger diameter trees as part of the residual stand, and a second may be that retaining grand/white fir could help achieve the target residual stand structure (e.g., basal area or tpa) where this species is a major component. Grand/ white firs may be a good choice for retention where rapid growth in wood volume is a major objective in the restored stand, however wildlife habitat is more likely to be a reason for retaining larger grand/white firs. **Larger grand/white firs often have decadent features, like cavities, decay pockets, and brooms, which are useful to wildlife. Furthermore, many of these trees are important sources of snags and logs, since most will die in the near future (e.g., 50 years). For example, grand/white firs**

hollowed by Indian paint fungus may be opened up by pileated woodpeckers and later used by Vaux swifts. Finally, grand/white firs produce seed crops that are valuable to some wildlife, including Douglas squirrels.

Why should many or most of the larger grand/white firs be removed during restoration treatments? First, they compete aggressively with ponderosa pine and other fire- and drought-resistant species and may provide significant fuel ladders. Hence, the location of larger grand/white firs relative to pines and larches or even Douglas-fir may be an important factor in deciding which ones to retain. Grand/white firs are also relatively short-lived and highly susceptible to fires and defoliators; they are not likely to make a long-term contribution to the live basal area of the stand or to contribute to its resilience. There are many examples where larger grand/white firs were retained to maintain the basal area of restored stands but died within the next decade. Of course, this is fine if an objective is to generate short-lived snags and down logs for wildlife. Finally, removal of larger grand/white fir will substantially reduce the amount of grand/white fir seed source present on the site and, potentially, its abundance in regeneration.

So, what are the most appropriate larger grand/white firs to retain in restoration treatments? First, retain any grand/white fir older than approximately 150 years of age. Guides for visual identification of these older trees are under development and initial results are reported above. With larger grand/white firs that are less than 150 years of age, **consider retaining individuals that are not threatening older pines or western larches either as fuel ladders or competitors, especially in Moist mixed-Conifer Stands.** Further, where a choice is between trees with significant defects, such as cavities and stem rots, and sound trees of comparable size, retaining defective trees is generally the better choice ecologically and economically. Trees with defects generally will have the greatest wildlife value both in the short- and long-term.

Franklin, J.F., Johnson, K.N., et al 2013. Restoration of Dry Forests in Eastern Oregon – A Field Guide. The Nature Conservancy, Portland, OR. 202 pp. http://nature.ly/dryforests

Consider applying the mitigations at least as good as those adopted in the Fremont-Winema NF's Burnt Willow Project:

1) Each large white fir trees to be removed is determined to be in direct competition with a large fire resistant tree species (>21" dbh) , i.e., large white fir should not be removed where the pines that will allegedly benefit are located outside the reach of the roots of the white fir tree(s) to be removed. Put another way, indirect fuel reduction benefits should not justify this exception.
2) The removal of large white fir is exceptional in scale and limited to a small subset of the larger project.
3) This proposal will take place in areas already identified for harvest in the Burnt Willow EA and won't require any additional road building.

Substantial Portions of the Science Whitepaper Support the Retention of Large Trees

Section 5 of the science whitepaper "Contributions of large trees to biodiversity, aquatic and terrestrial habitats" describes numerous ecological values provided by large trees, and represents a compelling rationale for retaining the large tree retention requirement of the Eastside Screens.

Other Portions of the Science Whitepaper Are Flawed.

Large trees serve a diverse array of ecological functions, regardless of age and species. The science whitepaper says "tree diameter was used as a surrogate for tree age" when the screens were adopted. This is not accurate. The stated intent of the large tree retention requirement of the Eastside Screens is to "maintain and/or enhance LOS [late old structure] components" and it is not disputed that large trees serve as late old structure regardless of their age. Those functions include: habitat for a wide variety of fish, birds, mammals, reptiles, amphibians, invertebrates, fungi, lichen, etc. whose relationship with large trees is NOT species specific; favorable microclimate/microsite, suppressing growth of ladder fuels, soil conservation, slope stability, carbon storage, capture/storage/release of water/nutrients/energy, etc. The Forest Service should carefully review the wide array of ecological functions provided by large trees (and large snags, because every large live tree removed also sacrifices all the benefits of large trees after they die), that would be sacrificed if large shade-tolerant trees are removed from eastside forest ecosystems. Some suggested places to start that investigation include:

- David B. Lindenmayer and William F. Laurance. 2016. The ecology, distribution, conservation and management of large old trees. Biol. Rev. (2016), pp. 000–000. doi: 10.1111/brv.12290 https://partnersinforestry.com/Documents/2016%20The%20ecology,%20distribution,%20conservation%20and%20management%20of%20large%20old%20trees%20-%20BiolRev%20DOI.pdf.
- Lutz et al (2018). Global importance of large-diameter trees. Global Ecology and Biogeography. 2018:1-16. DOI: 10.1111/geb.12747. https://www.fs.fed.us/rm/pubs_journals/2018/rmrs_2018_lutz_j001.pdf.
- Lutz JA, Larson AJ, Swanson ME, Freund JA (2012) Ecological Importance of Large-Diameter Trees in a Temperate Mixed-Conifer Forest. PLoS ONE 7(5):e36131. doi:10.1371/journal.pone.0036131. https://pdfs.semanticscholar.org/6370/916128ae1725586f26ec1c177b5a6fb70fa8.pdf.
- Rose, C.L., Marcot, B.G., Mellen, T.K., Ohmann, J.L., Waddell, K.L., Lindely, D.L., and B. Schrieber. 2001. Decaying Wood in Pacific Northwest Forests: Concepts and Tools for Habitat Management, Chapter 24 in Wildlife-Habitat Relationships in Oregon and Washington (Johnson, D. H. and T. A. O'Neil. OSU Press. 2001) http://web.archive.org/web/20060708035905/http://www.nwhi.org/inc/data/GISdata/docs/chapter24.pdf;

- Marcot, B. 2003. DECAID: Ecosystem Processes Related to Wood Decay. https://apps.fs.usda.gov/r6_decaid/legacy/decaid/pages/Ecosystem-Processes.html;
- Bruce G. Marcot & Madeleine Vander Heyden. 2001. Key Ecological Functions of Wildlife Species. Chapter 6 *in* D.H. Johnson and T. A. O'Neil, ed. 2001. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis OR. Wildlife Habitat Relationships in Oregon and Washington. https://apps.fs.usda.gov/r6_decaid/legacy/decaid/pages/documents/JandOchapter6.pdf; (Large trees and large snags support wildlife. Fewer large trees and snags means fewer wildlife which diminishes the ecological functions associated with those wildlife.);
- DECAID: Summary Narrative: Advice on Decayed Wood in the Eastside Mixed Conifer Forest E Cascades/Blue Mnts., Larger Trees Vegetation Condition. ECOLOGICAL FUNCTIONS AND PROCESSES OF DECAYED WOOD ELEMENTS https://apps.fs.usda.gov/r6_decaid/legacy/decaid/queries/emcf-e-cscds-bmt/lrgr-trs/narrative.html#ECOLOGICAL%20FUNCTIONS%20AND%20PROCESSES%20OF%20DECAYED%20WOOD%20ELEMENTS.
- Bruce G. Marcot. 2002. An Ecological Functional Basis for Managing Wood Decay Elements for Wildlife. USDA Forest Service Gen. Tech. Rep. PSW-GTR-181. 2002. https://pdfs.semanticscholar.org/177e/c9c018e78b1ed8da4a8b070702bb75211caa.pdf.
- Overall List of Key Ecological Functions from the Oregon-Washington Species-Habitat Project. https://web.archive.org/web/20080405154205/http://www.fs.fed.us/wildecology/decaid/decaid_background/decaid_kefs.htm.
- Sedell, J., and C. Maser. 1994. From the forest to the sea: the ecology of wood in streams, rivers, estuaries, and oceans. St. Lucia Press, Delray Beach, FL. 200 pp.
- Alan Moore, Why Fish Love 'Large Woody Debris.' Trout Unlimited. 2-4-2013. http://troutunlimitedblog.com/large-woody-debris-makes-for-fishy-rivers/.
- Hannah Ettema 2014. Seven Reasons Why Fish Need Wood. https://www.nationalforests.org/blog/seven-reasons-why-fish-need-wood.
- BLICHARSKA, M. and MIKUSIŃSKI, G. (2014), Incorporating Social and Cultural Significance of Large Old Trees in Conservation Policy. Conservation Biology, 28: 1558-1567. doi:10.1111/cobi.12341. https://conbio.onlinelibrary.wiley.com/action/showCitFormats?doi=10.1111%2Fcobi.12341.

The May 11, 2020 science forum sponsored by the FS affirmed that large shade-intolerant trees are still in short supply. In that case, it makes sense to protect large shade-tolerant trees because they can serve many if not most of the same ecological functions. The science white paper even says "when large individuals of early-seral species are not available, late-seral species (e.g., grand or white fir) may provide the only opportunity for providing large tree habitat structures."

The whitepaper says “Key findings include recent research showing that older trees (more than 150 years), especially those of early seral species, contribute important ecological values not present in younger large trees.” This is incomplete and misleading, because it ignores the compelling evidence that many ecological functions are provided by large trees regardless of age or species. It would be quite disingenuous for the Forest Service to focus on a few ecological functions of large trees that may be age-specific or species-specific, while dismissing the multitude of ecological functions provided by large trees that are NOT age- or species-specific.

Removing key protections of the Eastside Screens requires adoption of a comprehensive ecosystem management plan.

The whitepaper says that the Eastside Screens were intended to be temporary but it’s important to remember the context. They screens were supposed to be replaced by a science-based comprehensive ecosystem management plan (ICBEMP) that was never finalized and adopted as plan standards. If this important screens requirement is lifted now, without a comprehensive ecosystem management plan, then it will violate the intent of the screens adoption.

Decades of logging and fires have left forests less than homogeneous. The FS has the tools to diversify forests without removing large trees.

The whitepaper says “Many forests are now homogenized, with conditions no longer resembling those existing prior to Euro-American settlement.” This statement is incomplete and misleading because it fails to recognize that there have been 25 years worth of thinning and fires since the screens were adopted, and the agencies forest health objectives can be met by continuing to focus on removal of trees less than 21” dbh.

“Seed rain” should be addressed by reintroducing fire, not logging large trees.

The whitepaper says “Regeneration harvests or severe fires may be needed to remove local seed sources and competition from undesirable shade-tolerant trees, in order to fire or climate change adapt certain patches of forest.” This statement is incomplete and misleading because seed sources of shade-tolerant trees have always been present (as evidenced by the extensive presence of native shade-tolerant trees on the landscape today). The problems is not seed sources, it’s the lack of frequent fire that tended to kill young shade-tolerant trees. The Forest Service has long said they are doing fuel reduction as a precursor to reintroduce prescribed fire. If this is true, then the alleged problem of seed sources will be addressed by the application of natural processes. (fire) that will kill seedlings and saplings.

Reduced reproduction of shade-intolerant trees is vastly overstated.

The proponents of this plan amendment often say that white fir cast too much shade and prevent shade-intolerant trees species such as Ponderosa pine form establishing new cohorts of trees. This problem is vastly over-stated based on the following considerations:

- Most importantly, there are often long temporal gaps between pulses of tree establishment. Continuous recruitment of new trees is not necessary for stand maintenance or restoration.

- Natural, historic fire regimes were frequent and often eliminated seedlings. Many people are calling for agency to reintroduce frequent fire which will kill many the young shade-intolerant trees.
- Shade-intolerant trees have many opportunities to establish under existing policy and existing environmental conditions, such as:
    - when shade is removed by thinning trees less than 21" dbh,
    - after wildfire or prescribed fire occurs,
    - after the mature shade-tolerant trees die (they tend to be short-lived compared to Ponderosa pine), and
    - when canopy gaps occur due to other natural causes (wind, snow, mistletoe, root rot, beetles), etc.
- People are most often complaining that forests are too dense. The failure of conifer regeneration seems to imply they are not sense enough. This is contradictory.

These conifer establishment opportunities are occurring on tens of thousands of acres per year and many of these mechanisms are expected to increase as a result of climate change. There is simply not a scientifically credible concern that adequate numbers of shade-intolerant trees are failing to establish.

Wildfires continue to burn with a characteristic mix of mostly low and mixed severity effect. It is not clear that fire severity has increased.

The whitepaper says "Disturbance regimes have become more severe." This statement is incomplete and misleading because the evidence for increasing fire severity is mixed at best. The best available science (as opposed to anecdotes) shows that wildfires across the region continue to burn with a characteristic mix of mostly low and mixed severity effects. A careful review of the scientific literature will turn up many studies that contradict the assertion that fires have become more severe.

- Schwind, B. (compiler). 2008. MTBS: Monitoring Trends in Burn Severity: Report on the PNW & PSW Fires — 1984 to 2005. https://web.archive.org/web/20130214220819/http://www.mtbs.gov/reports/MTBS_pnw-psw_final.pdf ("MTBS data does not support the assumption that wildfires [in the PNW] are burning more severely in recent years. ... The majority of area burned falls within the unburned to low severity range, with relatively low annual variation in these severity classes. The high and moderate severity classes show higher relative variation between years, suggesting that these classes may be most influenced by variation in climate, weather, and seasonal fuel conditions.")
- Vaillant & Reinhardt 2017. An Evaluation of the Forest Service Hazardous Fuels Treatment Program—Are We Treating Enough to Promote Resiliency or Reduce Hazard? J. For. 115(4):300 –308. July 2017. https://doi.org/10.5849/jof.16-067. https://www.fs.fed.us/pnw/pubs/journals/pnw_2017_vaillant001.pdf (Nationwide, only 11% of fires burn uncharacteristically.)

- Law, B.E., Waring, R.H. 2015. Review and synthesis - Carbon implications of current and future effects of drought, fire and management on Pacific Northwest forests. Forest Ecology and Management 355 (2015) 4–14. http://people.forestry.oregonstate.edu/richard-waring/sites/people.forestry.oregonstate.edu.richard-waring/files/publications/Law%20and%20Waring%202015.pdf (This study reported no significant trend in area burned, number of fires, or fire severity for the state of Oregon.)
- Ray Davis et al 2015. RMP Revisions for Western Oregon BLM DEIS. Appendix D – Modeling Wildfires and Fire Severity. http://www.blm.gov/or/plans/rmpswesternoregon/files/draft/RMP_EIS_Volume3_appd.pdf. ("… examined the MTBS data for any obvious temporal trends in wildfire severity [within the range of the spotted owl], but did not detect a strong signal (Figure D-6). Over the course of 25 years, there appears to be a slight increase in the percentage of area burned by low and moderate severity wildfire, and a slight decrease in the percent of area burned in high severity wildfire, although these trends are not statistically significant. …")
- Alisa Keyser and Anthony Westerling, 2017. Climate drives inter-annual variability in probability of high severity fire occurrence in the western United States, Environmental Research Letters. Accepted Manuscript online 4 April 2017 https://doi.org/10.1088/1748-9326/aa6b10. ("We tested trends for WUS [western United States], each state, and each month. We found no significant trend in WUS high severity fire occurrence over 1984-2014, except for Colorado (table S1). While some studies have shown increasing fire season length, we saw no significant increase in high severity fire occurrence by month, May through October (figure S1). We found no correlation between fraction of high severity fire and total fire size, meaning increasing large fires does not necessarily increase fractional high severity fire area.")
- Brendan P. Murphy, Larissa L. Yocom, Patrick Belmont. 2018. Beyond the 1984 perspective: narrow focus on modern wildfire trends underestimates future risks to water security. Earth's Future, 2018; DOI: 10.1029/ 2018EF001006 https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/2018EF001006 ("Compiling several datasets, we illustrate a comprehensive history of western wildfire, demonstrate that the majority of western settlement occurred during an artificially and anomalously low period of wildfire in the 20th century, ... A crucial first step toward realigning public perspectives will require scientists and journalists to present recent increases in wildfire area within the context and scale of longer-term trends. ... A review of Science, Nature, and PNAS reveals that 77% of wildfire-related articles published about the western U.S. since 2000 (n=52) only address fire trends from the past few decades. In many of these studies, as well as in principal wildfire databases (Eidenshink et al., 2007; NIFC, 2017), ca. 1984 is frequently the first year presented, because this marks the beginning of consistent, satellite-derived records (Short, 2015). Wildfire area has rapidly increased since 1984, as ecosystems realize their potential to burn in an era of lengthening fire seasons and warming temperatures (Abatzoglou & Williams, 2016). However, this "1984 perspective" of wildfire is problematic. First and foremost, the 1980s represent the end of an anomalously low period for wildfire during the mid-20th century, and western U.S. landscapes remain well below historical wildfire activity (Barrett, et al., 1997; Leenhouts, 1998; Stephens et al., 2007; Littell et al., 2009; Swetnam et al., 2016). ... Historical

reconstructions of annual area burned demonstrate that wildfire area in the pre-settlement western U.S. was many times greater than the supposed 'record highs' of today (Barrett, et al., 1997; Leenhouts, 1998; Stephens et al., 2007) (Fig. 1A&C). Borne out by hundreds of fire-history studies, research consistently shows that dry western forests frequently burned by wildfire over the past few centuries (Falk et al., 2010). Although wildfire activity naturally oscillates over millennial timescales (Marlon et al., 2012), area burned across the West began to rapidly decline in the late 19th century with the introduction of railroads and livestock (Swetnam et al., 2016). This was especially true in dry forest ecosystems, where livestock ate the fine fuel necessary to carry widespread surface fires. By the mid-20th century (ca. 1950s to mid-1980s), the area burning annually across all western ecosystems had plummeted from 7-18 Mha to less than 0.5 Mha due to fire suppression activities (Leenhouts, 1998; Littell et al., 2009) (Figure 1A). This West-wide decline in area burned is corroborated by subregional records (Figure 1C) and is consistent with the 20^{th} century "fire deficit" observed in fire scar and charcoal influx records Marlon et al., 2012). ... The annual area burned, as well as burn severity, are projected to continue increasing across the western U.S. through the 21st century due to climate change and, in some ecosystems, excess fuel loading from fire suppression (Brown et al., 2004; Westerling et al., 2011; Hawbaker & Zhu, 2012; Abatzoglou & Williams, 2016; Abatzoglou et al., 2017).")

- Baker, W. L. 2015. Are high-severity fires burning at much higher rates recently than historically in dry-forest landscapes of the Western USA? PLoS ONE 10(9): e0136147;
- Collins, B.M. et al. 2009. Interactions among wildland fires in a long-established Sierra Nevada natural fire area. Ecosystems 12:114–128;
- Dillon, J.K. et al. 2011, Both topography and climate affected forest and woodland burn severity in two regions of the western US, 1984 to 2006. Ecosphere 2: Article 130;
- Hanson, C. T. and D.C. Odion, 2014. "Is fire severity increasing in the Sierra Nevada, California, USA? International Journal of Wildland Fire 23: 1–8;
- Hanson, C.T. and D.C. Odion, 2015. Sierra Nevada fire severity conclusions are robust to further analysis: a reply to Safford et al. International Journal of Wildland Fire 24: 294-295;
- Keyser, A. and A.L. Westerling 2017. Climate drives inter-annual variability in probability of high severity fire occurrence in the western United States. Environmental Research Letters 12 065003;
- Miller, J.D. et al. 2012. Trends and causes of severity, size, and number of fires in northwestern California, USA. Ecological Applications 22: 184-203;
- Odion, D.C. et al. 2014. Examining historical and current mixed-severity fire regimes in Ponderosa pine and mixed-conifer forests of western North America. PLoS ONE 9(2): e87852;
- Picotte et al. 2016. 1984-2010 Trends in fire burn severity and area for the coterminous US. International Journal of Wildland Fire 25: 413-420;
- Schwind, B. 2008. Monitoring trends in burn severity: report on the Pacific Northwest and Pacific Southwest fires (1984 to 2005). US Geological Survey.

Fire helps forests adapt to climate change. Removing large trees does not.

The whitepaper says "Under climate change, disturbance regimes will change further, leading to broadening changes in forest structure and species composition. Proactive management may be helpful to facilitate some transitions." This statement is incomplete and misleading because, while it is true that fire activity may increase under climate change, it does not follow that the FS needs to remove large trees. If forests are going to become adapted to the future climate and the future disturbance regime, it needs to experience that disturbance regime, not be protected from it. The Forest Service should use wildfires as an opportunity to facilitate establishment of current and future climate-adapted species and communities.

> Wildfire is a global Earth system process that both integrates and influences many other interactions between ecosystem and the climate system. Fire mediates other ecosystem responses to changing climate, for example by modulating forest density and composition, and thus providing a mechanism by which ecosystems adapt to changing climate conditions. Uncertainties in key elements of climate projections could be compounded by nonlinear responses of fire to climate variability. Fires may also act as triggers for abrupt and irreversible change to novel configurations under Direct and indirect controls on annual wildfire area burned future climate [44], [83]. As climate change progresses, the projected changes in the area affected annually by fire may be an important multiplier of these effects in coming decades.

Kitzberger T, Falk DA, Westerling AL, Swetnam TW (2017) Direct and indirect climate controls predict heterogeneous early-mid 21st century wildfire burned area across western and boreal North America. PLoS ONE 12(12): e0188486. https://doi.org/10.1371/journal.pone.0188486.

> While increased wildfires can be a threat to biodiversity, especially in landscapes where habitat has been altered by logging and land-use change, they also provide a benefit by creating diverse early successional conditions and opportunities for natural or artificial regeneration of new genotypes and species that may be better adapted to the climate than those in existing stands. The challenge to planners and managers is deciding when and where to allow fires to burn and what to do afterwards.

Spies, Geisen, Franklin, Swanson, Lach, Johnson 2010. Climate change adaptation strategies for federal forests of the Pacific Northwest, USA: ecological, policy, and socio-economic perspectives. Landscape Ecol. DOI 10.1007/s10980-010-9483-0. https://www.fs.fed.us/pnw/pubs/journals/pnw_2010_spies001.pdf

Ecological restoration does not require commercial logging, especially not large trees

The whitepaper says "The eastside federal timber supply is important to supporting local mills, which are necessary for making restorative treatments financially feasible. … Including larger trees in restoration prescriptions can increase the acres where fuel treatments are financially feasible." This statement is incomplete and misleading because it fails to account for the extensive adverse trade-offs caused by commercial logging, especially removal of large trees. Those trade-offs include: water pollution, carbon emissions, habitat loss, degraded scenic/recreation values, weeds, soil erosion, etc. Alternatives that are not adequately considered include greater reliance on non-commercial thinning, prescribed fire, road/weed removal, and service contracts.

Real restoration requires an investment in our forests, not more profit-taking through removal of large trees. In fact, if large trees are taken it's arguably not restoration any more. The Report to the President that forms the foundation for the National Fire Plan recommends that we "Invest in Projects to Reduce Fire Risk. **Addressing the brush, small trees, and downed material** that have accumulated in many forests because of past management activities, especially a century of suppressing wildland fires, **will require significant investments** to treat landscapes through thinning and prescribed fire." Whitehouse. Managing the Impact of Wildfires on Communities and the Environment. A Report to the President In Response to the Wildfires of 2000. September 8, 2000. http://www.forestsandrangelands.gov/resources/reports/documents/2001/8-20-en.pdf The main point here is that the fuels that need to be removed are small fuels, including brush and down wood that will require "investments" as opposed to commercial sized material. Rainville et al (2008) found that large trees are simply not present in most of the stands in greatest need of thinning because they were previously clearcut or high-graded. The Forest Service has already removed too much of the economic value from these forests. Taking more large trees would not be restoration. "[E]ven when considered under the most favorable of assumptions, most densely stocked stands would not be treatable without significant investments." Rainville, Robert; White, Rachel; Barbour, Jamie, tech. eds. 2008. Assessment of timber availability from forest restoration within the Blue Mountains of Oregon. Gen. Tech. Rep. PNW-GTR-752. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 65 p. http://www.fs.fed.us/pnw/pubs/pnw_gtr752.pdf.

If the agency is sincerely interested in the most cost-effective way to restore forests for resilience, they should stop suppressing fire when weather conditions are favorable, and focus on managing via wild and prescribed fire. There is also plenty of work to do reducing road density, restoring degraded streams, removing weeds, etc.

The science whitepaper statement above also assumes that timber sales are an effective and desirable way to get restoration done. This is not well-supported. Under the banner of "pace & scale" the agencies are moving across the landscape often using commercial logging as a tool to aggressively manage fuels and reducing stand density which causes significant cumulative impacts on soil, water, wildlife habitat, carbon storage, and other values. These public resources are now exposed to the unprecedented compound effects of logging, roads, and unavoidable fire. The agency thinks it has found great alignment between its desire for timber production, risk reduction, and other restoration goals, but this view is just too convenient. It requires constant validation and reassessment. The prevailing view that everything aligns is hiding significant trade-offs and causing the agency to overlook other viable options, such as decreasing reliance on logging and increasing reliance on fire as tools to achieve more optimal forest management outcomes. The accumulation of evidence does not support logging for fuel reduction as a sound strategy to manage fuel and fire.

- *Most fires are climate-driven, rather than fuel-driven.* The warming climate is likely to make this effect even more pronounced. Schoennagel et al 2017. Adapt to more wildfire in western North American forests as climate changes. PNAS 2017; published ahead of print April 17, 2017. www.pnas.org/cgi/doi/10.1073/pnas.1617464114; https://headwaterseconomics.org/wp-content/uploads/Adapt_To_More_Wildfire.pdf; Odion, D.C. et al 2014. Examining Historical and Current Mixed-Severity Fire Regimes in Ponderosa Pine and Mixed-Conifer Forests of Western North America. PLOS One. February 2014 | Volume 9 | Issue 2 http://www.californiachaparral.org/images/Odion_et_al_Historical_Current_Fire_Regimes_mixed_conifer_2014.pdf; See also, Alisa Keyser and Anthony Westerling, 2017. Climate drives inter-annual variability in probability of high severity fire occurrence in the western United States, Environmental Research Letters. Accepted Manuscript online 4 April 2017 https://doi.org/10.1088/1748-9326/aa6b10.
- *There is NOT a significant trend toward more severe fires in the west.*
    - [See above.]
- *There is a relatively low probability that fuel treatments will interact with wildfire before fuels regrow and render the fuel reduction effort ineffective*. "A recent study conducted by researchers at the University of Montana found that only about 7 percent of fuel-reduction treatment areas in the entire United States were subsequently hit by wildfires since 1999. … If someone had the magical ability to predict, within the past decade, that a major fire was going to strike that particular portion of the 240,000-acre Scapegoat Wilderness, then thinning and logging theoretically could have helped. But it doesn't work that way, and fires are sparked in random places by lightning and humans, and they are pushed by erratic winds and weather. … According to Tania Schoennagel, a forest landscape ecologist and fire researcher at the University of Colorado, … 'it's little bit of a crapshoot probability game whether the treatment you put in is going to encounter wildfire in the 10 to 15 years it remains effective in reducing fire severity. Simply because forests in the West are so vast, the chance of burning in a place we've pre-treated is so low. It's not a very effective lever. We don't know where fires are going to happen.'" David Erickson (2017). Experts: More logging and thinning to battle wildfires might just burn taxpayer dollars. CREDIT: MISSOULIAN.COM. Oct 1, 2017. http://www.america.easybranches.com/montana/Experts--More-logging-and-thinning-to-battle-wildfires-might-just-burn-taxpayer-dollars-152776 *citing* Kevin Barnett, Sean A. Parks, Carol Miller, and Helen T. Naughton. 2016. Beyond Fuel Treatment Effectiveness: Characterizing Interactions between Fire and Treatments in the US. Forests [open access] 2016, 7, 237; doi:10.3390/f7100237. http://www.mdpi.com/1999-4907/7/10/237. See also, William L. Baker, Jonathan J. Rhodes. 2008. Fire Probability, Fuel Treatment Effectiveness and Ecological Tradeoffs in Western U.S. Public Forests. pp.1-7 (7). The Open Forest Science Journal, Volume 1. 2008. http://api.ning.com/files/1kp0vDW*F1cqOeO4-GdXE1AHOATghmIAN2x9qLpH3aA_/FireandFuelTreatments.pdf; "According to a recent analysis, annually less than one percent of U.S. Forest Service fuel reduction treatments in

forested areas subsequently burned, on average. From 2000 to 2015, almost 17 million acres of federal land were treated for fuels reduction, equating to approximately four percent of U.S. Forest Service and Bureau of Land Management lands. During the same time period, more than 93 million acres burned. The odds of putting fuel treatments in the wrong place are extremely high." Pohl, Kelly 2019. "For communities, land use planning is more effective than logging on federal lands to reduce future wildfire disasters." https://headwaterseconomics.org/wildfire/solutions/land-use-planning-is-more-effective/. Also, "In real landscapes treatments are static, restricted to a small portion of the landscape and against a background of stochastic fire and dynamic vegetation, thus the likelihood of fire encountering a treatment during the period treatments remain effective is small. ... Allocating priorities to treat based on merchantable timber (THIN), vegetation departure (VDEP), area suitable for prescribed fire and restoration wildfire (FIRE) and conditional flame length (CFL) had similar or lower success odds than random allocation ... [S]uccess odds declined sharply as desired success levels increased suggesting that fuel management goals need to be tempered to consider the stochastic nature of wildfire." Barros, Ana M. G.; Ager, A. A.; Day, M. A.; Palaiologou, P. 2019. Improving long-term fuel treatment effectiveness in the National Forest System through quantitative prioritization. Forest Ecology and Management. 433: 514-527. https://www.fs.fed.us/rm/pubs_journals/2019/rmrs_2019_barros_a001.pdf.

- *The effects of fuel reduction are modest*. Even extensive fuel reduction reduces the extent of wildfire by less than 10 percent. See M. A. Cochrane, C. J. Moran, M. C. Wimberly, A. D. Baer, M. A. Finney, K. L. Beckendorf, J. Eidenshink, and Z. Zhu. 2012. Estimation of wildfire size and risk changes due to fuels treatments. International Journal of Wildland Fire. http://dx.doi.org/10.1071/WF11079. http://www.publish.csiro.au/?act=view_file&file_id=WF11079.pdf. Andrew Larson, a forest ecologist from the University of Montana said

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

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

https://news.ucmerced.edu/news/2019/scientists-simulate-forest-fire-dynamics-understand-area-burn-future-wildfires

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

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

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

- *The agencies are failing to treat the areas of highest hazard and choosing instead to treat areas that produce profitable timber sales*. Vaillant & Reinhardt 2017. An Evaluation of the Forest Service Hazardous Fuels Treatment Program—Are We Treating Enough to Promote Resiliency or Reduce Hazard? J. For. 115(4):300 –308. July 2017. https://doi.org/10.5849/jof.16-067. https://www.fs.fed.us/pnw/pubs/journals/pnw_2017_vaillant001.pdf. ("[W]e evaluated the [nationwide] extent of fuel treatments and wildfire occurrence within lands managed by the National Forest System (NFS) between 2008 and 2012 … The very high hazard class had the lowest treatment percentage and the highest incidence of uncharacteristically high-severity wildfire out of all the hazard classes. … Areas of very low hazard often are favored for treatment because they are less complex to plan and implement, are more economical to treat, … [T]reatments may be placed where they can accomplish multiple objectives, including production of wood products. This may result in selection of locations that are less important for hazard mitigation.")
- *Building codes and land use planning are more effective than logging to reduce community wildfire hazard*. Pohl, Kelly 2019. "For communities, land use planning is more effective than logging on federal lands to reduce future wildfire disasters." https://headwaterseconomics.org/wildfire/solutions/land-use-planning-is-more-effective/. ("[W]e have the knowledge and tools to reduce risk posed by homes in wildfire-prone areas. ... [T]here are many land use planning tools available that can mean the difference between home survival and loss."). The fire threat to communities is caused by, and may be best addressed by, land use practices, not forest fuels. Forest fuels policy needs to recognize that structures themselves represent hazardous fuels that can carry fire from structure-to-structure, or from structure-to-forest. There are already too many homes in the wildland urban interface, and more are being built every day. Radeloff, Helmers, Kramer et al 2017. Rapid growth of the US wildland-urban interface raises wildfire risk. Proceedings of the National Academy of Sciences. Mar 2018, 2017. https://www.pnas.org/cgi/doi/10.1073/pnas.1718850115. ("Abstract: … Here we report that the WUI in the United States grew rapidly from 1990 to 2010 in terms of both number of new houses (from 30.8 to 43.4 million; 41% growth) and land area (from 581,000 to 770,000 km2; 33% growth), making it the fastest-growing land use type in the conterminous United States. The vast majority of new WUI areas were the result of new housing (97%), not related to an increase in wildland vegetation. Within the perimeter of recent wildfires (1990–2015), there were 286,000 houses in 2010, compared with 177,000 in 1990. Furthermore, WUI growth often results in more wildfire ignitions, putting more lives and houses at risk. Wildfire problems will not abate if recent housing growth trends continue."). This also shows

that people are quite willing to tolerate fire hazard in order to enjoy the quality of life associated with living near the forest.

- *Unlogged areas provide many benefits such as wildlife cover, snag & wood recruitment, carbon storage, soil/watershed quality, microclimate buffering, etc.* Forests are naturally adaptive and natural processes will accomplish many of the benefits attributed to thinning. "Counter to many regional studies, our results indicated that treated and long-unaltered, untreated areas may be moving in a similar direction. Treated and untreated areas experienced declines in tree density, increases in the size of the average individual, and losses of surface fuels in most size classes. The number of large trees increased in untreated areas, but decreased in treated areas. Our results suggested that untreated areas may be naturally recovering from the large disturbances associated with resource extraction and development in the late 1800s, and that natural recovery processes, including self thinning, are taking hold. ... In a study of forest restoration need across eastern Washington and Oregon, over 25% of required restoration could be achieved through transition to later stages of forest stand development through successional processes as western landscapes recover from widespread historic degradation (Haugo et al., 2015)." Zachmann, L. J., D. W. Shaw, and B. G. Dickson. 2018. Prescribed fire and natural recovery produce similar long-term patterns of change in forest structure in the Lake Tahoe basin, California. Forest Ecology and Management 409:276–287. http://www.csp-inc.org/wp-content/uploads/2017/11/Zachmann_et_al_2017.pdf
- *Wildfire effects are more ecologically beneficial than logging.* The 2017 Fuels Report for the 130,000 acre East Hills Project on this Fremont-Winema NF admits that wildfires are expected to have beneficial effects even under the no action alternative - "Overall expected value of fire effects is moderately beneficial. This assumes that fires burn throughout the range of conditions – actual current practice is to suppress fires that are most likely to be beneficial." https://www.fs.usda.gov/nfs/11558/www/nepa/101283_FSPLT3_4264365.pdf. This would indicate a need to modify fire suppression practices and work *with* fire when weather conditions are favorable.

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

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

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

> Key aspects of an adaptive resilience approach are (i) recognizing that fuels reduction cannot alter regional wildfire trends; (ii) targeting fuels reduction to increase adaptation by some ecosystems and residential communities to more frequent fire; (iii) actively

managing more wild and prescribed fires with a range of severities; and (iv) incentivizing and planning residential development to withstand inevitable wildfire. … Managing ecosystems, people, and wildfire in a changing climate is a complex but critical challenge that requires effective and innovative policy strategies. Our key message is that wildfire policy and management require a new paradigm that hinges on the critical need to adapt to inevitably more fire in the West in the coming decades. … Three primary factors have produced gradual but significant change across western North American landscapes in recent decades: the warming and drying climate, the build-up of fuels, and the expansion of the wildland–urban interface. … Increasing the use of prescribed fires and managing rather than aggressively suppressing wildland fires can promote adaptive resilience as the climate continues to warm. … Strategic planning for more managed and uncontrolled wild fires on the landscape today may help decrease the proportion of large and severe wildfires in the coming decades and may enhance adaptive resilience to changing climate. Prescribed fires, ignited under cooler and moister conditions than are typical of most wildfires, can reduce fuels and minimize the risk of uncontrolled forest wildfire near communities. In contrast to wildfires, prescribed fire risks are relatively low, and more than 99% of prescribed fires are held within planned perimeters successfully. … We need to develop a new fire culture. Despite these and various legal and operational challenges, the benefits of prescribed fire and managed wildfires to ecosystems and communities are high. Promoting more wildfire away from people and prescribed fires near people and the WUI are important steps toward augmenting the adaptive resilience of ecosystems and society to increasing wildfire. … [T]he effectiveness of this [fuel reduction] approach at broad scales is limited. Mechanical fuels treatments on US federal lands over the last 15 y (2001–2015) totaled almost 7 million ha (Forests and Rangelands, https://www.forestsandrangelands.gov/), but the annual area burned has continued to set records. Regionally, the area treated has little relationship to trends in the area burned, which is influenced primarily by patterns of drought and warming. Forested areas considerably exceed the area treated, so it is relatively rare that treatments encounter wildfire. … [R]oughly 1% of US Forest Service forest treatments experience wildfire each year, on average. The effectiveness of forest treatments lasts about 10–20 y, suggesting that most treatments have little influence on wildfire. … [T]he prospects for forest fuels treatments to promote adaptive resilience to wildfire at broad scales, by regionally reducing trends in area burned or burn severity, are fairly limited. … Home loss to wildfire is a local event, dependent on structural fuels (e.g., building material) and nearby vegetative fuels. Therefore, fuels management for home and community protection will be most effective closest to homes, which usually are on private land in the WUI where ignition probabilities are likely to be high. … The majority of home building on fire-prone lands occurs in large part because incentives are misaligned, where risks are taken by homeowners and communities but others bear much of the cost if things go wrong. Therefore, getting incentives right is essential, with negative financial

> consequences for land-management decisions that increase risk and positive financial rewards for decisions that reduce risk. …

Schoennagel et al 2017. Adapt to more wildfire in western North American forests as climate changes. PNAS 2017; published ahead of print April 17, 2017. www.pnas.org/cgi/doi/10.1073/pnas.1617464114; https://headwaterseconomics.org/wp-content/uploads/Adapt_To_More_Wildfire.pdf

> *The timber industry is a source of economic instability. The regional economy and local communities benefit from conservation.*

The whitepaper says a "survey found that residents of Baker, Union, and Wallowa counties in northeast Oregon were more likely than nationwide samples to prioritize jobs and economic forest uses over some conservation concerns, such as forest fragmentation, overharvest, and wildfire (Hamilton et al. 2012). Of these respondents, 79% believed it was more important to use natural resources to create jobs than to conserve them for the future, and 85% said that loss of forestry jobs or income was a serious threat to them or their community (Hamilton et al. 2014). Only 34% said over-harvesting or heavy cutting of timber was a serious threat. Taken together, this research reveals the importance of recreational and economic uses of NFs on the eastside." This statement is incomplete and misleading because it fails to recognize that (1) these are national forests that belong to all Americans, not the residents of local communities, and (2) resource extraction is a source of community instability, while conservation that enhances ecosystem services and quality of life is a source of local and regional economic diversity and stability.

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

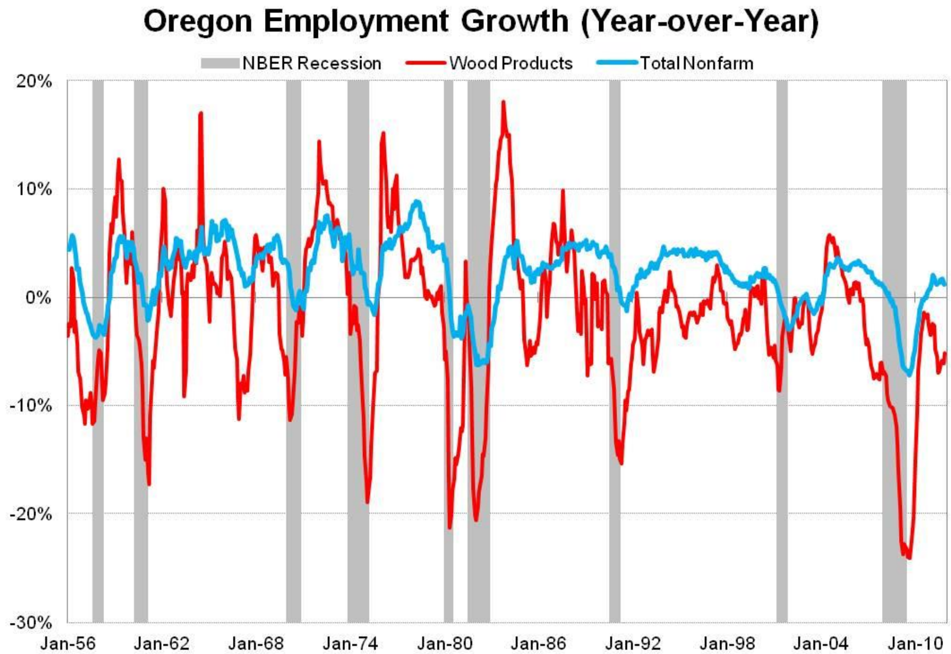
> Rapid growth in the Pacific Northwest over the 1980s and 1990s has been difficult to explain in the context of traditional economic models of regional growth. The input-output framework used by many economic development organizations predicted that reductions in logging due to environmental policy would have permanent negative effects on the economies of the affected areas. Instead, the region experienced strong economic growth over this time period. It has been suggested that this economic growth might have resulted in part because of the protection of natural resources in the area, rather than in spite of it.
>
> This possibility is consistent with a fairly extensive empirical literature showing that variations in region-specific amenities can account for persistent differences in real wages across regions. The presence of an amenity valued by workers generates negative compensating wage differentials, as a higher supply of workers drives down wages in that area. At the same time, the presence of an amenity increases demand for housing in the

> region, which generates positive rent differentials. Such amenities can generate sizeable effects on wages.
> …The empirical literature to date has considered only amenities that are in the same location (usually the county or the metropolitan statistical area) as the household. The argument tested here is that environmental amenities at some distance from but accessible to urban areas may have a value to consumers that can lead to negative compensating wage differentials. These wage differentials, in turn, serve as production amenities, attracting industrial and commercial activity and generating economic growth.
>
> …Our results suggest that natural resource amenities outside the metropolitan area do generate compensating wage differentials, as workers are willing to accept lower wages to live in accessible proximity to "nice" places. This implies that "nice" places provide a positive externality to those communities that find them accessible. It will therefore generally be very difficult to assure optimal provision of the amenity, either through market or nonmarket means. It is difficult enough to organize local jurisdictions to produce amenities efficiently within their own borders. Here the problem is much more complicated, as the relevant amenities will generally be produced in jurisdictions that are distinct from those in which the affected employers and employees transact their business. The effects that we estimate are quantitatively important, suggesting that these externalities should be taken into account in the making of environmental and natural resource policy.

Schmidt, L. and P. N. Courant (2006). "Sometimes Close is Good Enough: The Value of Nearby Environmental Amenities." Journal of Regional Science 46(5): 931-951. https://ideas.repec.org/p/wil/wileco/2003-07.html. It should be noted that the economic benefits of conservation that accrue to urban areas spill-over to also benefit rural areas. These benefits include direct local tax revenue, income generated from visitors, public services that are funded from state tax revenues, and rural areas' access to specialized urban services. Cortright, Joseph. 2011. Who Pays, Who Benefits? An Analysis of Taxes and Expenditures in Oregon. In Michael Hibbard, Ethan Seltzer, Bruce Weber, Beth Emshoff (eds) Toward One Oregon. https://muse.jhu.edu/book/2135.
("It seems apparent that the availability of public services in much of nonmetropolitan Oregon hinges vitally on the economic health of the Portland metropolitan area.") Castle, Emery N., JunJie Wu, and Bruce Weber. 2011. Place Orientation and Rural-Urban Interdependence. Applied Economic Perspectives and Policy. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1009.3704&rep=rep1&type=pdf.
("Overall, there is a substantial net flow of resources from the metropolitan area to the remainder of Oregon [about $500 million per year for schools alone]. Those whose primary interest is in rural development need to learn about the role of cities."). Martin, Sheila. 2011.Critical Linkages: Strengthening Clusters in Urban and Rural Oregon. *In* Michael Hibbard, Ethan Seltzer, Bruce Weber, Beth Emshoff (eds) Toward One Oregon. https://muse.jhu.edu/book/2135.

("[U]rban and rural Oregonians are also linked by the state's revenue-sharing system that is used to equalize the services available for the citizens of its state, especially for education and health care. This linkage is critical, because it means that economic vitality in one part of the state provides benefits to citizens in other parts. In effect, we all benefit from economic success in one part of the state because state tax revenues are shared statewide.")

The best available science shows that resource extraction industries are inherently tend to boom-and-bust and cause economic and social instability in local communities.



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

Timber industry volatility would have its greatest effect in local communities that have the lowest levels of economic diversity, the greatest dependence on commodity production, and would therefore see the greatest fluctuations in jobs and income.

Local communities would likely be better off both economically and otherwise if they embraced non-extractive uses of nearby national forests, so they can support ecosystem services like clean water, carbon storage, recreation, and quality of life that would support a much more diverse and stable economic base. The proposition that natural resources are a source of wealth is disproven by the evidence that "Remoteness, as measured by urban influence code, has a negative effect on every measure of economic development indicator. It reduces income, employment, housing prices and total developed areas." If natural resources were a source of wealth remoteness would enhance wealth but the evidence shows that it does just the opposite. Note however, that the negative effects of remoteness can be mitigated in part through natural amenities that attract people who are willing to trade lower wages for higher quality of life. These are important considerations in the analysis of community welfare related to federal land management. JunJie Wu, Munisamy Gopinath. 2005. How Do Location Decisions of Firms and Households Affect Economic Development in Rural America? Selected Paper prepared for presentation at the American Agricultural Economic Association Annual Meeting, Providence, Rhode Island, July 24-27, 2005. http://ageconsearch.umn.edu/bitstream/19229/1/sp05wu02.pdf. http://web.archive.org/web/20090115192759/http://oregonstate.edu/dept/ncs/newsarch/2008/Aug08/remotecommunities.html

Forests are more valuable, and better serve to stabilize communities, when they are protected from logging than when they are logged. Well-conserved forests provide numerous valuable ecosystem services, such as water purification, flood control, slope stability, nutrient cycling, habitat for fish & wildlife, recovery of imperiled species, recreation, scenic views, and quality of life. Conserved forests contribute to our quality of life which is one of the most valuable economic development assets we have. Quality of life provided by forests and watersheds represent a "second paycheck" enjoyed by everyone who lives and visits the northwest. Logging cuts our second paycheck and makes us all poorer. Congrove, Niemi, Fifield. 2000. Seeing the Forest for Their Green: Economic Benefits of Forest Protection, Recreation and Restoration. ECONorthwest 2000. Prepared for the Sierra Club. http://www.econw.com/media/ap_files/FR2-Seeing-Forests-For-Green_ECONorthwest.pdf. See also, Niemi, E. 2017. Memo to Oregon Board of Forestry on Oregon's Forest Economy - Importance Of Unlogged Forests. July 25, 2017. http://www.oregon.gov/ODF/Board/Documents/BOF/20170725/BOFMIN_20170725_ATTCH_02.pdf. This memo describes a compelling analytic framework for describing market and non-market values from consumptive and non-consumptive ecosystem services provided by forests. This analytic framework should be used in the NEPA analysis.

To reinforce the idea that Oregon's economy depends on our quality of life, consider that -

> Migration is vital to Oregon's economic health. It is one of the two primary reasons Oregon outperforms the typical state during an economic expansion. … In both good times and bad, Americans want to live in and move to Oregon. In fact, Americans have been moving to Oregon in droves since Lewis and Clark and are likely to continue to do so. Our state's ability to attract skilled, young working age households is a huge economic benefit. We rank quite well on the brain gain spectrum (the opposite of the brain drain). … Why do they come? Beyond a high quality of life, or high quality of place, migration is usually driven, economically speaking, by job opportunities and relative home prices. … Again, from an economic perspective, all of this migration into Oregon, both from California and elsewhere, is a positive development. It brings both skilled, young households who will set down roots (no, they are not all degree holding baristas) and a strong influx of retirees with a lifetime of experience and some wealth.

Lehner, J. 2015. "Migration (In Defense of Californians)." Oregon Office of Economic Analysis. 9-8-2015. https://oregoneconomicanalysis.com/2015/09/08/migration-in-defense-of-californians/

Removing Large Trees Will Exacerbate the Shortage of Large Trees, Even While Forest Service Standards for Snag Habitat Have Been Scientifically Discredited.

This plan amendment triggers a greater concern that the FS is operating with out-dated and scientifically discredited standards for snag and down wood habitat. The Forest Service must confront that issue head-on before adopting a plan amendment that makes a bad situation even worse in terms of recruitment of large snags and down wood.

> **What's so important about snags and down logs?**
> Snags provide homes to owls, woodpeckers, bats, squirrels, bluebirds, wood ducks, swallows, mergansers, weasels, raccoons and many other animals. More than 50 species of birds and mammals use snags for nesting, feeding and shelter. A lack of snag cavities for nesting can limit populations of some bird species. Snags larger than 20 inches DBH are in short supply on private lands. Snags can be created from live trees, and wildlife respond quickly to their availability.
> You can reduce the cost of leaving snags by selecting rotting or deformed trees. In eastern Oregon, down logs are used by 150 species of wildlife, including amphibians, reptiles, birds and mammals. Logs are also important to certain insects, fungi and plants. … [A] forest without down logs may have fewer species of plants and animals.

Oregon Forest Resources Institute 2011. Oregon' Forest Protection Laws – An Illustrated Manual, Revised Second Edition. http://www.forestresourceinstitute.com/images/or_for_protect_laws_2011.pdf.

Snags are not just nice to have, they are an essential feature of old forests. See discussion above of diverse ecological functions provided by dead trees. The loss of snags from forests has long-term consequences because it takes a long time to replace large snags. "When a tree dies in the forest, … it is not waste. Forests need to keep their dead, or lose their health." Lance Olsen. November, 2009. A stand of big trees without snags is not a healthy forest. The ICBEMP Scientific Analysis Group (SAG) review of selected terrestrial vertebrate populations used "large snag density as a proxy for the structural quality of old-forest habitats." and the SAG found that

> Key model factors contributing most strongly to low environmental index values and low population outcomes—
> *Families 1 and 2 (Old-forest families)—*
> - Low recruitment of large snags composed of shade-intolerant tree species, such as ponderosa pine, western larch, and western white pine, as indexed by moderate and high HRV (Lewis' woodpecker (migrant), pygmy nuthatch, flammulated owl), are the key factors contributing to low environmental index and low population outcomes.
> - Low quality of old-forest structural conditions (lack of diversity of size and decadence of large trees, large snags, and large logs), as indexed by declining large

snag and/or large log trends (northern goshawk [summer], American marten, hoary bat), are the key factors. …

Long-eared myotis (Family 7)—

• … decreasing snag trends (indexing low availability of roost sites) contribute to low environmental index and low population outcomes. …

Western bluebird (Family 8)—

• High HRV departure and declining large snag density (indexing a lack of shade-intolerant tree species recruited as snags) contribute to the low environmental index and low population outcomes.

Martin G. Raphael, Richard S. Holthausen, Bruce G. Marcot, Terrell D. Rich, Mary M. Rowland, Barbara C. Wales, Michael J. Wisdom, 2000. DRAFT Effects of SDEIS Alternatives on Selected Terrestrial Vertebrates of Conservation Concern within the Interior Columbia River Basin Ecosystem Management Project, March 2000, revised June 23 , 2000 and November 14, 2000.

In a dynamic ecosystem life may be fleeting but the snags and logs that persist after mortality provide very critical temporal links from one stand to the next. Under natural conditions, a forest hands down a large legacy of living and dead material from one stand to another even after an intense disturbance. Even non-stand-replacing disturbance creates pulses of dead material that are critical for forest ecosystems. See

1. Franklin, J.F., Lindenmayer, D., MacMahon, J.A., McKee, A., Magnuson, J., Perry, D.A., Waide, R., and Foster, D. 2000. Threads of Continuity. Conservation Biology in Practice. [Malden, MA] Blackwell Science, Inc. 1(1) pp9-16.
2. William F. Laudenslayer, Jr., Patrick J. Shea, Bradley E. Valentine, C. Phillip Weatherspoon, and Thomas E. Lisle *Technical Coordinators.* Proceedings of the Symposium on the Ecology and Management of Dead Wood in Western Forests. PSW-GTR-181. http://www.fs.fed.us/psw/publications/documents/gtr-181/.
3. Lofroth, Eric. 1998. The dead wood cycle. In: Conservation biology principles for forested landscapes. Edited by J. Voller and S. Harrison. UBC Press, Vancouver, B.C. pp. 185-214. 243 p. http://www.for.gov.bc.ca/hre/deadwood/DTrol.htm.
4. Rose, C.L., Marcot, B.G., Mellen, T.K., Ohmann, J.L., Waddell, K.L., Lindely, D.L., and B. Schrieber. 2001. Decaying Wood in Pacific Northwest Forests: Concepts and Tools for Habitat Management, Chapter 24 *in* ***Wildlife-Habitat Relationships in Oregon and Washington*** (Johnson, D. H. and T. A. O'Neil. OSU Press. 2001) http://www.fs.fed.us/wildecology/decaid/decaid_background/chapter24cwb.pdf
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7. Bruce G. Marcot 2017. Ecosystem Processes Related to Wood Decay. PNW Research Note 576. https://www.fs.fed.us/pnw/pubs/pnw_rn576.pdf
8. Jennie Sandström et al. 2019. Impacts of dead wood manipulation on the biodiversity of temperate and boreal forests. A systematic review, Journal of Applied Ecology (2019).

DOI: 10.1111/1365-2664.13395.
https://besjournals.onlinelibrary.wiley.com/doi/pdf/10.1111/1365-2664.13395

The Forest Service even has a public education program called "Animal Inn" intended to inform the public of the value of dead wood, unfortunately the agencies still don't fully recognize these values:

> Nearly a third of all forest creatures depend on standing dead or fallen trees for their survival. ANIMAL INNS provide shelter, nest sites, and feeding areas for over 1200 species of birds, mammals, amphibians, and reptiles; over 60% of which feed on insects. These insect-eating species act as natural biological regulators to dampen the effects of insect outbreaks in forested lands, thereby performing an important ecosystem function. Fish benefit from trees that have fallen into stream channels.

http://web.archive.org/web/20021122150003/http://www.fs.fed.us/r6/nr/wildlife/animalinn/basicneed.htm. See also: http://web.archive.org/web/20021017194337/http://www.fs.fed.us/r6/nr/wildlife/animalinn/habitat.htm

An important and under-appreciated ecological process is the cycle of biomass accumulation (e.g., large snag and dead wood are vastly under-represented on the landscape because management is so focused on controlling and preventing mortality.) The full life-cycle of a tree starts with photosynthesis that captures carbon from the air to build a magnificent tree but it includes decades to centuries of "life" as a snag, down wood, and soil enhancement before it returns to the atmosphere to begin the cycle again. The dead wood portion of this cycle needs to be re-established to enhance biodiversity, hydrology, soil productivity, and carbon storage. The NEPA analysis needs to recognize the full life-cycle of forests including the ecological, hydrological and carbon-cycle value of both live and dead trees.

Dynamic ecosystems historically included large-scale mortality events both pulsed and continuous. Mortality and biomass accumulation are natural and desirable ecological processes that forest management has been working for decades to capture, suppress, and avoid. Large snags are severely under-represented in our forests and logging will capture, reduce and delay recruitment of future large snags. Ohmann et al (1994) found that non-federal forestlands do not retain enough snags to support viable wildlife populations[1], so federal managers likely need to retain more snags on federal lands to compensate. Even when snag removal is not an intentional design feature of a project, hazard tree felling normally occurs in all treatment areas, plus a safety buffer around all treatment areas, plus a safety corridor along roads, and other work areas. Furthermore, non-federal lands are not managed for snag habitat. These are some of the reasons why Korol et al (2002) found that large snag habitat is below historic range of variability, and in

[1] Ohmann, McComb, & Zumrawi; SNAG ABUNDANCE FOR PRIMARY CAVITY-NESTING BIRDS ON NONFEDERAL FOREST LANDS IN OREGON AND WASHINGTON; *Wildl. Soc. Bull. 22:607-620*, 1994 http://web.archive.org/web/20041107222037/http://www.fs.fed.us/pnw/pubs/journals/ohmann-snagabundance.pdf

the future, even if we apply enlightened forest management on federal lands in the Interior Columbia Basin for the next 100 years, we will still reach only 75% of the historic large snag abundance, and most of the increase in large snags will occur in roadless and wilderness areas. Jerome J. Korol, Miles A. Hemstrom, Wendel J. Hann, and Rebecca A. Gravenmier. 2002. Snags and Down Wood in the Interior Columbia Basin Ecosystem Management Project. PNW-GTR-181. http://www.fs.fed.us/psw/publications/documents/gtr-181/049_Korol.pdf.

Wisdom et al (2008) found that snag abundance in the Pacific northwest forests is inversely related to past harvest and proximity to roads. Wisdom, M.J., and Bate, L.J. 2008. Snag density varies with intensity of timber harvest and human access. For. Ecol. Manage. 255: 2085–2093. doi:10.1016/j.foreco.2007.12.027.
http://www.fs.fed.us/pnw/pubs/journals/pnw_2008_wisdom001.pdf ("Our highest snag density … occurred in unharvested stands that had no adjacent roads. … Stands with no history of timber harvest had 3 times the density of snags as stands selectively harvested, and 19 times the density as stands having undergone complete harvest. Stands not adjacent to roads had almost 3 times the density of snags as stands adjacent to roads.")

This analysis must not make the common mistakes of under-estimating how much snags and down wood a healthy forest should have, and the long-term adverse effects of logging on dead wood recruitment. The 2017 Science Synthesis for the NW Forest Plan says partial cutting in older forests will "strongly impact dead wood amounts, and the accompanying road and harvest system will add additional impacts."

Snags have been severely depleted across the eastside forests. The ICBEMP Scientific Analysis Group found that "Across the [interior Columbia River] basin (all lands) large snags have declined more than 30 percent. This was most likely a reflection of the loss of late-seral forests, particularly in the dry and moist PVGs." Miles A. Hemstrom, Wendel J. Hann, Rebecca A. Gravenmier, Jerome J. Korol. 2000. [SAG] Landscape Effects Analysis of the [ICBEMP] SDEIS Alternatives. USDA/USDI, *draft* March 2000.

The Eastside Screens interim wildlife standard recognizes that maintaining healthy wildlife populations requires abundant dead wood and that past practices have depleted the dead wood resource:

> Snags, Green Tree Replacements and Down Logs:
> INTENT STATEMENT – Most (if not all) wildlife species rely on moderate to high levels of snags and down logs for nesting, roosting, denning and feeding. Large down logs are a common and important component of most old and late structural forests. Past management practices have greatly reduced the number of large snags and down logs in managed stands.

The Screens call for application of the following MINIMUM standards with respect to snag habitat …

> 100% potential population levels of primary cavity excavators. This should be determined using the best available science on species requirements as applied through current snag models or other documented procedures.

Unfortunately, the Eastside Screens still rely on the discredited potential population method. The Forest Service has numbers for meeting 100% potential population levels and strives to meet targets that are known to be inadequate. Even if the agency aims for a target above 100% potential population levels, the agency is still using an invalid reference point that does not belong in the NEPA analysis. The best available science has not been incorporated into the standards. The agency lacks the "documented procedures" for meeting snag habitat requirements called for in the Eastside Screens.

The 9th Circuit recently reiterated that "species viability may be met by estimating and preserving habitat '*only* where *both* the Forest Service's knowledge of what quality and quantity of habitat is necessary to support the species *and* the Forest Service's *method for measuring the existing amount of that habitat are reasonably reliable and accurate*.' *Earth Island Inst. v. U.S. Forest Serv.*, 442 F.3d 1147, 1175-76 (9th Cir. 2006) (quoting *Native Ecosystems Council v. U.S. Forest Serv.*, 428 F.3d 1233, 1250 (9th Cir. 2005))" ONRC v. Goodman (Mt Ashland case, 9th Circuit Sept 24, 2007) (emphasis added).
http://caselaw.findlaw.com/us-9th-circuit/1151013.html
and http://caselaw.findlaw.com/us-9th-circuit/1094367.html.

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

An unavoidable impact of all commercial logging is to "capture mortality" which reduces valuable snag habitat in the short-term (via hazard tree felling) and in the long-term (via delayed recruitment and reduced overall recruitment). Thinning will reduce density-dependent mortality within logged stands. This plan amendment to allow removal of large trees will make a bad situation worse.

Dead wood in forests is thought to follow a U-shaped pattern over time "from the combined and lagged effects of legacy wood decay and the recruitment of new dead wood," (Harmon 1986, Hudiburg 2009) resulting in abundant dead wood legacies from the previous stand in young forests, less dead wood in middle-aged stands as the legacies decay, and more again in older stands as natural mortality processes manifest. If the goal is to restore high quality old forest habitat, the agencies must respect this dynamic by recognizing that dead wood recruitment requires (1) "surplus" biomass and (2) it's a process that takes time, so managers should ensure that middle-aged stands accumulate biomass and begin to recruit and accumulate snags and dead wood. The low of dead wood in middle aged stands is not universal or necessarily desirable, and since many young stands were deprived of the legacies they normally enjoy, it would be advisable to start accumulating snags and dead wood as soon as possible, not wait for mature stages.

The federal forest agencies now recognize that current methods and assumptions concerning snag habitat standards are outdated, and the old snag standards do not ensure enough snags to meet the intent of the standard, yet the agencies have not adjusted their management plans to account for this new information nor have they developed new standards that are consistent with the latest scientific information.

As explained on the DecAID website:

> **Why is DecAID needed?**
> National Forest LRMP standards and guidelines for management of snags and down wood in the Pacific Northwest were based on wildlife species models and tools that were developed in the 1970s and 1980s (Thomas et al. 1979, Neitro et al. 1985, Marcot 1992, Raphael 1983). New information about the ecology, dynamics, and management of decayed wood has been published since then, and the state of the knowledge continues to change. Rose et al. (2001) report that results of monitoring indicate that the biological potential models are a flawed technique (page 602). There has been an evolution from thinking of large woody material as habitat structures, to thinking of decaying wood as an integral part of complex ecosystems and ecological processes.
>
> This paradigm shift has made the management of dead wood a much more complex task. We can no longer expect to go to our LRMPs or the biological potential model to get one number for the amount or size of snags and down wood that we can apply to all projects and to all acres. We are directed to use the best available science to manage ecosystems, and the best available science simply will not support business as usual for managing dead wood.

Region 6 - USDA Forest Service. A Guide to the Interpretation and Use of the DecAID Advisor. June, 2006. http://www.fs.fed.us/r6/nr/wildlife/decaid-guide/

A few of the problems with the old standards are:

- They failed to account for the fact that the number of snags needed for roosting, escape, and foraging can exceed the number of snags needed for nesting;
- They failed to recognize that the number of snags needed to support viable populations of secondary cavity users may exceed the needs of primary cavity excavators;
- The old standard failed to account for the size height of snags favored by some species;

- In applying the old standards the agencies often fail to account for rates of snag fall and recruitment;
- The old standards fail to recognize non-equilibrium conditions in our forests, i.e. some species rely on the natural large pulses of snags associated with large disturbances;
- The old standards fail to account for the differential use of space and population density of different species;
- The old standards ignore other important habitat features of dead wood, e.g. loose bark, hollow trees, broken tops, etc.

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

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

Bruce G. Marcot , Janet L. Ohmann, Kim L. Mellen-McLean, and Karen L. Waddell. Synthesis of Regional Wildlife and Vegetation Field Studies to Guide Management of Standing and Down Dead Trees. Forest Science 56(4) 2010.
http://www.fs.fed.us/pnw/pubs/journals/pnw_2010_marcot002.pdf

The Forest Service has previously recognized serious problems with the LRMP snag standards.

> Bull et al. (1997) states current direction for providing wildlife habitat on public forest lands does not reflect the new information available, which suggests that to fully meet the needs of wildlife, additional snags and habitat are required for foraging, denning, nesting, and roosting. Rose et al. (2001) also state that several major lessons have been learned in

the period 1979 to 1999 that have tested critical assumptions of earlier management advisory models, including some assumptions used to develop current recommendations in the LRMP Standards and Guidelines. Some assumptions include:

- Calculation of numbers of snags required by woodpeckers based on assessing their "biological (population) potential" is a flawed technique (Rose et al., 2001). Empirical studies are suggesting that snag numbers in areas used and selected by some wildlife species are far higher than those calculated by this technique (Rose et al., 2001).

- Numbers and sizes (DBH) of snags used and selected by secondary cavity nesters often exceed those of primary excavators (Rose et al., 2001).

This suggests the current direction of managing for 100 percent population levels of primary excavators may not represent the most current knowledge of managing for cavity nesters and that these snag levels, under certain conditions, may not be adequate for some species.

Barry Point Fire Salvage EA, Fremont-Winema NF: http://a123.g.akamai.net/7/123/11558/abc123/forestservic.download.akamai.com/11558/www/nepa/91686_FSPLT3_1450222.pdf

Bull et al. states that the current direction for providing wildlife habitat on public forest lands does not reflect the new information that is available which suggests that to fully meet the needs of wildlife, additional snags and habitat are required for foraging, denning, nesting, and roosting (1997). Johnson and O'Neil (2001) and Rose et al. (2001) also state that several major lessons have been learned in the period 1979 to 1999 that have tested critical assumptions of earlier management advisory models (2001), including some of the assumptions used to develop the current recommendations in the LRMP Standards and Guidelines, as amended by the Regional Forester's Amendment #2. Some assumptions include:

- calculation of numbers of snags required by woodpeckers based on assessing their "biological (population) potential" is a flawed technique (Johnson and O'Neil 2001). Empirical studies are suggesting that snag numbers in areas used and selected by some wildlife species are far higher than those calculated by this technique (Johnson and O'Neil 2001).

- numbers and sizes (dbh) of snags used and selected by secondary cavity nesters often exceed those of primary excavators (Johnson and O'Neil 2001).

This suggests the current direction of managing for 100 percent population potential levels of primary excavators may not represent the most meaningful measure of managing for cavity-nesters and that these snag levels, under certain conditions, may not be adequate for some species.

Fremont-Winema NF. Barnes Valley-Long Branch Restoration and Enhancement Project EA Appendix B – DecAID Information. http://www.fs.fed.us/r6/frewin/projects/analyses/barneslong/ea/appb.pdf (Broken 8/10/2012).

http://www.fs.fed.us/outernet/r6/winema/management/analyses/barneslong/prelimea.pdf.

The Forest Service recognizes that

> Forest Plan standards were based on a model that did not account for snags required for foraging (EA p. 68 and Appendix K p. 45). There is general consensus in the scientific and professional community that using the biological potential model (which was used in developing the Forest Plan standard) is flawed and does not provide adequate nesting, roosting, or foraging structure for cavity excavating birds …

North Fork John Day RD, Umatilla NF. 2011. Mirage Vegetation Management Project DN. http://a123.g.akamai.net/7/123/11558/abc123/forestservic.download.akamai.com/11558/www/nepa/53012_FSPLT2_055455.pdf.

> **Lessons Learned During the Last Fifteen Years**
>
> …
>
> Several major lessons have been learned in the period 1979-1999 that have tested critical assumptions of these earlier management advisory models:
>
> - Calculations of numbers of snags required by woodpeckers based on assessing their 'biological potential' (that is, summing numbers of snags used per pair, accounting for unused snags, and extrapolating snag numbers based on population density) is a flawed technique. Empirical studies are suggesting that snag numbers in areas used and selected by some wildlife species are far higher than those calculated by this technique.[226]
> - Setting a goal of 40% of habitat capability for primary excavators, mainly woodpeckers,[369] is likely to be insufficient for maintaining viable populations.
> - Numbers and sizes (dbh) of snags used and selected by secondary cavity-nesters often exceed those of primary cavity excavators.
> - Clumping of snags and down wood may be a natural pattern, and clumps may be selected by some species, so that providing only even distributions may be insufficient to meet all species needs.
> - Other forms of decaying wood, including hollow trees, natural tree cavities, peeling bark, and dead parts of live trees, as well as fungi and mistletoe associated with wood decay, all provide resources for wildlife, and should be considered along with snags and down wood in management guidelines.
> - The ecological roles played by wildlife associated with decaying wood extend well beyond those structures per se, and can be significant factors influencing community diversity and ecosystem processes.

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

The potential population models are based on the number of trees needed for nesting cavity-excavator birds, however, "[t]he high value of large, thick-barked snags in severely burned forests has as much to do with feeding opportunities as it does with nesting opportunities they provide birds." (Hutto. ConBio 20(4). 2006. http://web.archive.org/web/20060904175645/http://avianscience.dbs.umt.edu/documents/hutto_conbio_2006.pdf. The number of snags needed to support bird feeding, escape from predators, and other life functions, is different than, and likely higher than, the number of snags needed to support nesting, so the agencies' existing "potential population" snag standards are arbitrary and capricious.

New science indicates that meeting the needs of cavity excavators requires retaining far more snags than managers realize.

> … at-risk species, namely the black-backed and the white-headed woodpeckers, were nesting within burns that contained 86 to 96 percent of trees with unsuitably hard wood. This suggests that past studies that did not measure wood hardness counted many sites as available to cavity-excavating birds when actually they were unsuitable. "By not accounting for wood hardness, managers may be overestimating the amount of suitable habitat for cavity-excavating bird species, some of which are at risk," Lorenz says.
>
> In their study plots, the researchers did not find reliable visual cues to distinguish between suitable and unsuitable trees. Snag decay class was a poor indicator of internal wood properties—and this was not the first study to demonstrate that fact, although it was the first study to do so in ornithology (past studies had been done by foresters and published in forestry journals).
>
> "Currently, the best solution we can recommend is to provide large numbers of snags for the birds, which can be difficult without fire," Lorenz says. According to the researchers' calculations, if one of every 20 snags (approximately 4 percent) has suitable wood, and there are five to seven species of woodpeckers nesting in a given patch, approximately 100 snags may be needed each year for nesting sites alone. This does not account for other nuances, like the fact that most species are territorial and will not tolerate close neighbors while nesting, or the fact that species like the black-backed woodpecker need more foraging options. Overall, more snags are needed than other studies have previously recommended.

Vizcarra, Natasha 2017. Woodpecker Woes: The Right Tree Can Be Hard to Find. PNW Science Findings, Issue 199, August 2017. https://www.fs.fed.us/pnw/sciencef/scifi199.pdf. *citing* Lorenz, T.J.; Vierling, K.T.; Johnson, T.R.; Fischer, P.C. 2015. The role of wood hardness in limiting nest site selection in avian cavity excavators. Ecological Applications. 25: 1 016–1033. https://www.treesearch.fs.fed.us/pubs/49102.

There is evidence that retaining more than the minimum number of snags has significant benefits for cavity dependent species. Comparing two sites in Northern California, Blacks Mountain Experimental Forest (BMEF) with little past logging and lots of snags, and Goosenest Adaptive Management Area (GAMA) with lots of logging and fewer snags, the author's found "… three times as many snags (6.38/acre vs. 2.04/acre, respectively) … The use of snags by cavity-nesting bird species was dramatically different between the sites. Thirty-one cavity-nesting pairs from 10 species were detected at BMEF, while only one pair each of two species were detected at GAMA.... This fifteenfold difference is much greater than any measure of snags or cavities reported. …"

> We feel that forest managers may well be asking a misleading question. "Snags per acre" requirements implicitly assume an equilibrium condition and reflect only one ecological requirement for a given cavity-nesting species. … [C]onsideration of foraging habitat and other ecological requirements must be part of the "snags per acre" management considerations. This is an important, but somewhat daunting proposition, as potential cavity-nesting species are diverse, and each species likely has very different foraging ecologies, as well as other differences in habitat requirements. … [C]avity nesters at BMEF used larger snags on average … [T]he loss of large trees due to logging in eastside pine and other forests, over the past century has major implications for cavity-nesting birds. … [F]orest managers must have a sense of snag recruitment in relationship to snag fall, and the patterns and processes that underlie them, when addressing wildlife needs. … We view the understanding of these complexities to be of primary importance in forest management for wildlife.

Steve Zack, T. Luke George, and William F. Laudenslayer, Jr. 2002. Are There Snags in the System? Comparing Cavity Use among Nesting Birds in "Snag-rich" and "Snag-poor" Eastside Pine Forests. USDA Forest Service Gen. Tech. Rep. PSW-GTR-181.
http://www.fs.fed.us/psw/publications/documents/gtr-181/017_Zack.pdf.

Another recent science publication asked that the agencies salvage polices be brought up to date with current science.

> **Inadequacy of Current Snag Guidelines**
> Current snag-retention guidelines for most North American plant community types fall between 1 and 8 snags/ha. These guidelines emerged primarily from a consideration of the nesting requirements of cavity-nesting vertebrate species in the now classic Blue Mountains book (Thomas 1979). The retention of 8 snags/ha was judged to support 100% of the maximum population density of any of the woodpecker species that occur in the Blue Mountains area (Thomas 1979: Appendix 22). Bull et al. (1997) concluded that about 10 snags/ha in ponderosa pine and mixed-conifer forests should support viable populations of cavity-nesting birds. Thus, most current U.S. National Forest guidelines generally converge on the recommendation to retain 6–10 trees/ha, as do guidelines for

Washington State, the Ontario Ministry of Natural Resources, the U.S. Army Corps of Engineers, and many other land management agencies.

It has been acknowledged that snag guidelines should be sensitive to forest type and forest age because “the wildlife species that use snags are influenced by the stage of forest succession in which the snag occurs” and by the breakdown stage of the snag (Thomas et al. 1979). Moreover, snag types, sizes, and densities vary significantly with vegetation type (Harris 1999; Harmon 2002; White et al. 2002). Therefore, it follows necessarily that the desired snag types and densities will differ with both plant community type and successional stage and that we need as great a variety of guidelines as there are community types and successional stages (Bull et al. 1997; Everett et al. 1999; Rose et al. 2001; Kotliar et al. 2002; Lehmkuhl et al. 2003). Unfortunately, we have generally failed to adjust snag-retention recommendations to specific forest age, and nowhere is that failure more serious than for those special plant community types that were ignored in the development of the generic guidelines—recently burned conifer forests. Such forests are characterized by uniquely high densities of snags (Angelstam & Mikusinski 1994; Hutto 1995; Agee 2002; Drapeau et al. 2002), and snag use by most woodpeckers in burned forests requires high snag densities because they nest in and feed from burned snags.

These facts have been overlooked in the development and implementation of meaningful snag-management guidelines. Indeed, these guidelines have generally converged toward an average of 6–7 trees/ha because that number was deemed more than adequate to meet the nesting requirements of cavity-nesting wildlife species (Thomas et al. 1979:69). Snag guidelines were not originally developed with an eye toward non-nesting uses of snags or from an attempt to mirror snag densities that typically occur on unmanaged reference stands. Snag guidelines are still much narrower than numerous authors have suggested they ought to be, and we currently run the risk of managing coarse woody debris with uniform standards across historically variable landscapes, which is entirely inappropriate. Instead, we should be managing for levels of coarse woody debris that more accurately mirror levels characteristic of the natural disturbance regime (Agee 2002). Clearly, we need more data on what might constitute meaningful snag targets for all forest types and successional stages, and those targets should be set on the basis of reference conditions from natural post disturbance forests, not from managed forest stands and certainly not from consideration of only a single aspect of an organism’s life history.

Newer guidelines that are appropriate for snag dependent species that occupy standing dead forests at the earliest stage of succession are beginning to trickle in (Saab & Dudley 1998; Haggard & Gaines 2001; Saab et al. 2002; Kotliar et al. 2002), and authors suggest that 200–300 snags/ha may better address the needs of wildlife in burned forests. The issue has yet to receive the serious management attention it deserves, but the comprehensive review of habitat needs of vertebrates in the Columbia River Basin (Wisdom et al. 2000) and the recently developed DecAID modeling effort in Washington and Oregon represent important efforts toward providing that kind of management guidance (Marcot et al. 2002).

Hutto, R.L., 2006. Toward Meaningful Snag-Management Guidelines for Postfire Salvage Logging in North American Conifer Forests. Conservation Biology Volume 20, No. 4, 984–993. http://web.archive.org/web/20090205212350/http://avianscience.dbs.umt.edu/documents/hutto_conbio_2006.pdf

> "In general, wildlife species that use dead wood for nesting, roosting, or foraging prefer larger diameter logs and snags (>20 inches). Although we tallied dead wood in this size class throughout Oregon, the estimated density may not be sufficient for some wildlife species. For example, inventory results show a mean of almost 3 snags per acre in this size class in western Oregon and 1 per acre in eastern Oregon. This may indicate that large-diameter snags are currently uncommon in Oregon habitat and that management may be necessary to produce a greater density of large snags."

Donnegan, Joseph; Campbell, Sally; Azuma, Dave, tech. eds. 2008. Oregon's forest resources, 2001–2005: five-year Forest Inventory and Analysis report. Gen. Tech. Rep. PNW-GTR-765. Portland, OR: U.S. Forest Service, Pacific Northwest Research Station. 186 p. http://www.fs.fed.us/pnw/publications/gtr765/pnw-gtr765b.pdf.

The bottom line is that current management at both the plan and project level does not reflect all this new information about the value of abundant snags and down wood. The agency must avoid any reduction of existing or future large snags and logs (including as part of this project) until the applicable management plans are rewritten to update the snag retention standards. See also PNW Research Station, "Dead and Dying Trees: Essential for Life in the Forest," Science Findings, Nov. 1999 (http://www.fs.fed.us/pnw/sciencef/scifi20.pdf) ("Management implications: Current direction for providing wildlife habitat on public forest lands does not reflect findings from research since 1979; more snags and dead wood structures are required for foraging, denning, nesting, and roosting than previously thought.") and Jennifer M. Weikel and John P. Hayes, HABITAT USE BY SNAG-ASSOCIATED SPECIES: A BIBLIOGRAPHY FOR SPECIES OCCURRING IN OREGON AND WASHINGTON, Research Contribution 33 April 2001, http://www.fsl.orst.edu/cfer/snags/bibliography.pdf.

Before adopting a plan amendment allowing widespread reduction in large trees available for snag recruitment, the Forest Service needs to prepare a EIS to consider a replacement methodology for maintaining viable populations of wildlife (and other functions) associated with dead wood. This is especially critical because adequate dead wood is recognized as an essential feature of healthy forests and the Forest Service has identified lots of “management indicator species” associated with dead wood habitat.

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

Plan Amendments are Needed for Conservation, Not Just Resource Extraction

The science whitepaper on the project website suggests that an amendment is required to “allow decisionmakers and managers to act on scientific advances gained over the past 25 years.” This is amazing because the agency has been quite willing to overlook scientific advances over the last 25 years when new science calls for increased ecosystem conservation. Any attempt to weaken the protection of large trees should be part of a comprehensive effort to bring forest plan standards in line with current science. To that end, the Forest Service should consider other plan amendments that are needed even more urgently, such as:

1. Mitigate for global climate change by reducing logging to reduce GHG emissions, and increase carbon storage.
2. Prepare ecosystems for climate change by emphasizing biodiversity, connectivity, microclimate buffering, watershed protection, and natural disturbance regimes.
3. Adopt new standards for managing forests before, during and after fire, that recognize the adverse effects of fuel reduction and fire suppression, and recognize the ecological value of the full range of fire severity, the value of legacy trees/snags/down-wood, and the value of complex early seral habitat.
4. Adopt new science-based standards for snag and dead wood habitat to replace the scientifically discredited “potential population” methodology, and to respond to all the new information in the DecAID Advisor.
5. Respond to new information showing that continued livestock grazing is adverse to aquatic/riparian/watershed functions, as well as adverse to forest health, and the increase in shade-tolerant trees on the landscape coincides with the initiation of wide-scale livestock grazing, not just fire exclusion.
6. Respond to new information on the destabilizing influence of the boom-bust timber industry by changing the role of the National Forest in enhancing quality of life and spurring economic diversification.
7. Mitigate for the invasion of the barred owl by protecting all suitable nesting, roosting, foraging habitat for northern spotted owl.

8. The adverse impacts of roads on soil, water, wildlife, and weeds is greater than understood when the LRMPs were adopted, and the value of unroaded areas is greater than understood when the LRMPs were adopted. There is need to amend forest plan standards to discourage road construction, and protect/restore large blocks of unmanaged habitat (e.g., unroaded areas) consistent with the historic range of variability.

The FS needs to explain why they are prioritizing this plan amendment that makes it easier to log and remove large trees, but not considering numerous plan amendments where significant new science indicates a need for greater conservation, such as:

> *A plan amendment is needed to manage the forest for significantly more snags and dead wood, and retain significantly more green trees for future recruitment over the life of the stand.*

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

> *A plan amendment is needed to manage the forest for carbon storage to mitigate climate change.*

On June 25, 2013, President Obama released his Climate Action Plan which includes forest conservation among the “first pillar” of efforts to reduce emissions, saying: “Preserving the Role of Forests in Mitigating Climate Change: America’s forests play a critical role in addressing carbon pollution, removing nearly 12 percent of total U.S. greenhouse gas emissions each year. … Conservation and sustainable management can help to ensure our forests continue to remove carbon from the atmosphere … ” U.S. Dept of State 2013. draft 6th Climate Action Report - U.S. Biennial Report - Highlights.
http://www.state.gov/documents/organization/214979.pdf; http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf “[A]dvancing efforts to protect our forests” is also mentioned in the 6th U.S. Climate Action Report under the United Nations Framework Convention on Climate Change (UNFCCC). According to the US Department of Energy "Enhancing the natural processes that remove CO2 from the atmosphere is thought to be the most cost-effective means of reducing atmospheric levels of CO2. … R&D in this program area seeks to increase this rate while properly considering all the ecological, social, and economic implications. There are two fundamental approaches to sequestering carbon in terrestrial ecosystems: (1) protection of ecosystems that store carbon so that carbon stores can be maintained or increased; and (2) manipulation of ecosystems to increase carbon sequestration beyond current conditions."
https://web.archive.org/web/20090401175835/http://www.fossil.energy.gov/programs/sequestration/terrestrial/index.html.

A plan amendment is need to reform fire policy.

The is an extensive body of scientific literature showing that historic and current fire suppression practices are outdated. Fire can play a significant beneficial role in meeting the objectives of this proposal plan amendment including killing trees with low hanging branches such as white-fir, thinning the forest to reduce drought stress and increase resilience, making room for regeneration of shade-intolerant species, enhancing landscape heterogeneity and biodiversity in all its dimensions, etc.

A plan amendment is needed to conserve rare complex early seral habitat from salvage logging.

See Della Sala, D. et al (2013) Open Letter to Members of Congress from 250 Scientists Concerned about Post-fire Logging. October 30, 2013. http://geosinstitute.org/images/stories/pdfs/Publications/Fire/Scientist_Letter_Postfire_2013.pdf or http://www.scribd.com/doc/181401520/Open-Letter-to-Members-of-Congress-from-250-Scientists-Concerned-about-Post-fire-Logging-October-30-2013; "Conservation of diverse young forests has received little attention in forest policy." USDA PNW Research Station. *Science Findings #56 - Seeing The Trees For The Forest: Mapping Vegetation Biodiversity In Coastal Oregon Forests.* Sept 2003. http://www.fs.fed.us/pnw/sciencef/scifi56.pdf. "[T]here's a looming shortage of diverse young forests - where seedlings intermingle with fallen logs, standing dead snags, and shrubs - that provide specialized habitat for certain animals and plants. … there's a looming gap in diverse, young, early-successional conifer forest, the type of forest that once came in naturally after forest fires. These young forests, up to 10 years old, have a diversity of forest structures - fallen logs and dead snags - and a diversity of plant life. They are important habitat for the western bluebird and other birds that prefer open areas, as well as some shrub species. Today, because of intense timber management on private lands, young forests don't get the chance to develop much diversity." OSU. 2001. Press Release: Researchers Assess Forest Sustainability. http://web.archive.org/web/20060914032259/http://oregonstate.edu/dept/ncs/newsarch/2001/Oct01/assess.htm.

A plan amendment is needed to conserve old trees regardless of size.

Many trees are ecologically valuable and deserving of conservation even if they are not larger than 21" dbh. Especially here where growing conditions are not highly favorable, trees less than 21 inches dbh can be old and valuable for the forest ecosystem. We urge the agency to adopt a plan amendment to protect trees with "old-growth morphology" regardless of size. (e.g. Yellow-barked ponderosa pine or any species with large drooping limbs, twisted trunks or flattened tops.) Science indicates that slow-growing small old trees tend to be resilient and add to the diversity and resilience of forests. Black, Colber, and Pederson. 2008. Relationship between radial growth rates and lifespan within North American tree species. Ecoscience 15(3), 349-357 (2008). http://fate.nmfs.noaa.gov/documents/Publications/Black_et_al_2008_Ecoscience.pdf (See also Tobias Züst, Bindu Joseph, Kentaro K. Shimizu, Daniel J. Kliebenstein and Lindsay A. Turnbull, Using knockout mutants to reveal the growth costs of defensive traits, in: *Proceedings of the Royal Society B,* 2011, Jan. 26, doi:10.1098/rspb.2010.2475.

Franklin & Johnson (2013) explain why it is important to conserve small old trees:

Box 8: Removal of Small Old Ponderosa Pine Trees in Dry Forest Restoration Projects

Removal of small (<21" dbh), older (>150 yr) ponderosa pine trees is sometimes proposed as a part of Dry Forest restoration projects. These older trees are important ecological components of Dry Forests, despite their smaller size, which is why we recommend their retention along with larger old trees. Ponderosa pine >150 years include older mature pines (150 to 200 years) that are beginning to develop old-growth attributes and will become fully developed old-growth trees after about 200 years.

Small old trees fulfill many of the functions that larger old trees provide. These trees have:

1. A significant percentage of heartwood, which exhibits different patterns of decay than sapwood (in live trees, snags, and logs). Young ponderosa pine have relatively little and poorly developed heartwood. Snags from old trees persist for a longer time than snags from younger trees of comparable (or even larger) diameter, and down wood (either bole or branches) decays differently than that of young trees.

2. Distinctive complex crowns and large branches that differ from those found on younger pines and that often have developed various defects (e.g., forks, brooms, and cavities) not present in younger ponderosa pine.

3. Greater value for wildlife than young trees of comparable or even larger diameter as a consequence of the preceding points – complex and distinctive crowns and significant heartwood content, which is reflected in quality wildlife habitat in both living and dead trees.

4. Bark that is thicker and fire resistant relative to the tree's diameter, making the trees more resistant to fire than younger trees of comparable diameter. Since these smaller old trees exhibit many of the attributes of larger old trees, albeit it on a smaller scale, their retention is part of ecologically-focused restoration treatments.

When clusters of old ponderosa pine trees that include small old trees are encountered, silviculturists sometimes assume that significant competition must be taking place within these clusters, particularly if they observe mortality of individual trees. This inference of significant competition is unwarranted, however, and may reflect the silviculturist's projection of the competitive processes of tightly spaced young trees. The old trees in these clusters have not only survived that period of youthful competition but almost certainly have established mutual relationships with each other, such as significant root grafting and shared mycorrhizal masses. Thus, these clusters of old trees are more likely to be mutually supportive than competitive.

Nevertheless, proposals for removal of removal of small older pine trees will arise and the following points should be considered:

1. An ecological justification for the removal of small (<21" dbh), old (>150 yr) ponderosa pine trees has not been established.

2. Proposals for removal of small old ponderosa pine trees would need to be based on economic necessity—that removal of some or all of these trees is necessary to create an economically viable or an economically more valuable restoration project.

3. If a project is calculated to be non-viable economically, we recommend consideration of the following adjustments prior to planning removal of small old ponderosa pine trees:
- ■ Adjustment of the boundaries of the project area so as to include additional areas that will generate larger volumes of wood during restoration;
- ■ Increase in the amount of wood marked for removal in trees <150 years even if this requires modification of target restored stand basal areas or trees/acre;
- ■ Elimination of restoration activities included as costs in the calculation of sale economics that are not essential to accomplishing the stand-level restoration goal; and,
- ■ Consider the potential for collaborators and partners to find funds.

4. If the restoration project remains non-viable after making the above adjustments, consider the alternative of whether or not to remove some small older ponderosa pine trees, including an assessment of how many such trees would have to be removed in order to achieve economic viability.

5. Calculation of economic viability should be based on the appraisal or other formal analysis that includes actual cruise or inventory data.

6. If a decision is made to proceed with cutting sufficient small older ponderosa pine trees to achieve viability, select only a sufficient number of such trees to achieve the economic break-even point.

7. The older trees selected for removal should come from the mature (150 to 200 year) age class; removal of fully developed (>200 year old) ponderosa pine should be avoided.

8. The decision process should be transparent, well documented to ensure that stakeholders and collaborative groups understand the basis for removing old trees.

Franklin, J.F., Johnson, K.N., et al 2013. Restoration of Dry Forests in Eastern Oregon – A Field Guide. The Nature Conservancy, Portland, OR. 202 pp. http://nature.ly/dryforests

See also, University of Montana. June 18, 2019. Cell structure linked to longevity of slow-growing Ponderosa Pines. https://www.sciencedaily.com/releases/2019/06/190618174358.htm ("Slow-growing ponderosa pines may have a better chance of surviving longer than fast-growing ones, especially as climate change increases the frequency and intensity of drought, according to new research from the University of Montana. ... [A] key difference between fast and slow growers resides in a microscopic valve-like structure between the cells that transport water in the wood, called the pit membrane. The unique shape of this valve in slow-growing trees provides greater safety against drought, but it slows down water transport, limiting growth rate."). *citing* Beth Roskilly, Eric Keeling, Sharon Hood, Arnaud Giuggiola, Anna Sala. Conflicting functional effects of xylem pit structure relate to the growth-longevity trade-off in a conifer species. Proceedings of the National Academy of Sciences, 2019; 201900734 DOI: 10.1073/pnas.1900734116.

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

> Growth rates have fitness consequences and selection is expected (23). Indeed, we found significant genetic responses to selection on growth rates, but importantly, these responses changed in direction and strength over time (Fig. 2A). Fast growth was positively selected before the outbreak, but negatively selected during the outbreak, clearly showing that intense herbivory shifted selection patterns. Fast growth in trees under competitive environments is critical for light acquisition and resource capture, and slow growth is selected against and underrepresented at mature stages (27). Consistently, selection for fast growth was strongest during early seedling establishment when density-dependent mortality in trees typically occurs (38) and when the proportion of seeds that attain maturity is usually very small (6). The MPB outbreak, however, caused significant selection differentials in the opposite direction (positive selection for slow-growing phenotypes), which triggered a negative genetic response after the outbreak (Fig. 2A). Our results are consistent with studies showing that fast early growth within tree species correlates with decreased longevity (29) and increased herbivory at maturity (30), and provide strong empirical evidence of the conflicting effects of growth rates on fitness during ontogeny.
>
> …
>
> Our results also have important management implications. Tree improvement programs supply seed resources for managed tree plantations, and for restoration purposes after natural and human-caused disturbances (e.g., fire, severe drought, and reclamation). These programs have traditionally focused on selection on growth-related traits (52), although efforts to breed for tree resistance against insects and pathogens are currently in place (53). Our results indicate that the traditional focus on fast-growth by tree breeding programs may reduce survival under intense, unpredictable stress (54).

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

A plan amendment is needed to conserve more spotted owl habitat to mitigate for all the habitat occupied by barred owls.

Portions of the eastside National Forests are occupied by Threatened spotted owls. New science indicates that conserving more suitable owl habitat increases the chances that barred owls and spotted owls can co-exist, while logging suitable habitat increases the likelihood of competitive exclusion. See Wiens, J.D., Anthony, R.G., and E.D. Forsman. 2014: Competitive Interactions and Resource Partitioning Between Northern Spotted Owls and Barred Owls in Western Oregon. Wildlife Monographs 185:1–50; 2014; DOI: 10.1002/wmon.1009. https://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/48214/AnthonyRobertFisheriesWildlifeCompetitiveInteractions.pdf; Forsman et al 2010. "Population Demography of Northern Spotted Owls." DRAFT COPY 17 December 2010. This draft manuscript is in press at the University of California Press with a projected publication date of July 2011. It will be No. 40 in Studies In Avian Biology, which is published by the Cooper Ornithological Society. http://www.reo.gov/monitoring/reports/nso/FORSMANetal_draft_17_Dec_2010.pdf;

A plan amendment is needed to consider the effects of livestock grazing on forest health

Livestock grazing has a direct influence on the same vegetation structure that this project is designed to address. The Forest Service must analyze the effect of past and future grazing which will tend to reduce palatable fine fuels like grasses and shift the plant community toward less palatable conifers and shrubs which are more hazardous as ladder fuels. Livestock grazing probably contributed to the development of plant communities where grass and forbs are underrepresented and shade-tolerant conifers are over-represented. Future livestock grazing will tend to cause these same trends, so the analysis for this project must consider the connected and cumulative impacts of livestock grazing.

This project should take steps to address the threat that livestock grazing causes to forest health. There is little point in the agency's efforts to mechanically reduce tree density unless other underlying causes of overstocking are dealt with, e.g. livestock grazing. The Council on Environmental Quality directs agencies to analyze actions together when the actions are similar in timing or geography, when doing so is the best way to assess the combined impacts of the actions (40 CFR §1508.25). As recognized by BLM, "Evaluating both actions in the same EA allows BLM to better assess the combined effects and to consider complementary design features to reduce potential conflicts among potentially competing uses." Thurston Hills Trails and Forest Management EA, https://eplanning.blm.gov/epl-front-office/projects/nepa/75350/142227/174633/2018_04_23_THills_EA_Final_Print.pdf

Grazing reduces the density and vigor of grasses which usually outcompete tree seedlings, leading to dense stands of fire-prone small trees. Cows also decrease the abundance of fine fuels which are necessary to carry periodic, low intensity surface fires. This reduces the frequency of fires, but increases their severity. See Belsky, A.J., Blumenthal, D.M., "Effects of Livestock Grazing on Stand Dynamics and Soils in Upland Forest of the Interior West," Conservation Biology, 11(2), April 1997. http://web.archive.org/web/20030409094020/http://www.onda.org/library/papers/standdynamics.

pdf. See also Wuerthner, George. Livestock Grazing and Fire. January, 2003. http://web.archive.org/web/20040107135236/http://www.onda.org/library/papers/Livestock_Grazing_and_Fire.pdf.

The court's decision in League of Wilderness Defenders v. USFS, Civil No. 04--488—HA. 2004 U.S. Dist. LEXIS 24413. November 19, 2004, makes clear that the agency has a duty to take a hard look at the effects of grazing in the context of making timber sale decisions. The agency must disclose cumulative impacts and cannot compartmentalize.

Further evidence of the adverse forest health effects of livestock are presented in Madany et al (1983):

> Abstract. Major differences were found between the vegetation structure of ponderosa pine-dominated communities on the Horse Pasture Plateau and those on the nearby but isolated Church and Greatheart Mesas in Zion National Park. The Horse Pasture Plateau was heavily grazed by livestock in the late 19th and early 20th centuries, while the mesas were never grazed. Conditions on the mesas now approximate the pre-European situation of the region as described in the earliest written accounts. Pine, oak, and juniper sapling density and cover were much higher on the formerly grazed plateau than on the relict mesas. Herbaceous species dominated the groundlayer in mesa ponderosa pine savanna stands, while grass and forb cover was low on analogous sites of the plateau. Age-class distributions of major tree species further substantiated that major physiognomic changes have occurred on the plateau since the arrival of European man. Analysis of fire scars showed that prior to 1881, the mean fire-free interval for ponderosa pine stands on the plateau was 4 to 7 yr, while the interval for Church Mesa was 69 yr. Since there were no recorded fires on Church Mesa between 1892 and 1964, and yet no corresponding increase in sapling density, the increased understory density of plateau stands should not be attributed primarily to cessation of fires. Instead, heavy grazing by livestock and associated reduction of the herbaceous groundlayer promoted the establishment of less palatable tree and shrub seedlings, Fire, however, played an important secondary role in maintaining savanna and woodland communities.

Michael H. Madany, and Niel E. West. 1983. Livestock Grazing-Fire Regime Interactions within Montane Forests of Zion National Park, Utah. Ecology: Vol. 64, No. 4, pp. 661-667.

The agency often erroneously concludes that livestock grazing will not affect upland vegetation of fuel profiles because fire suppressed stands are too dense to allow livestock access, but this is a gross oversimplification. The agency is conducting so-called "restoration" projects to reduce fuels and vegetation density which will allow livestock increased access to stands where the conifer encroachment processes that unfolded in the decades following the 1860s may repeat themselves. The NEPA analysis for this project must consider plan amendments to reduce the adverse effects of grazing on forest health, and disclose how livestock grazing interacts with the so-called forest restoration projects. The goal of restoration is a more open stand, and the agency wants more grass and forbs and fewer conifers, but grazing in those "restored" stands will cause the opposite effect – more conifers and less grass and forbs – thereby conflicting with the restoration objectives.

A plan amendment is needed to protect roadless areas.

This project must address significant new information about the impacts of roads since the forest plan was adopted:

> As research and analysis techniques have become more sophisticated, particularly with the advent of geographic information systems (GIS) and high-resolution remote imagery, the study of effects of roads on terrestrial and aquatic communities has evolved into a unique discipline of "road ecology" (Forman et al. 2003). Road effects are far more pervasive than originally believed and include such disparate consequences as population and habitat fragmentation, accelerated rates of soil erosion, and invasion of exotic plants along roadways. Indeed, "in public wildlands management, road systems are the largest human investment and the feature most damaging to the environment" (Gucinski et al. 2001:7). Summaries of the effects of roads on wildlife habitats and biological systems in general have been compiled by Forman and Alexander (1998), Trombulak and Frissell (2000), Gucinski et al. (2001), Forman et al. (2003), and Gaines et al. (2003).

Rowland, M. M., M. J. Wisdom, B. K. Johnson, and M. A. Penninger. 2004. Effects of Roads on Elk: Implications for Management in Forested Ecosystems. Transactions of the North American Wildlife and Natural Resource Conference 69: in press. http://www.fs.fed.us/pnw/lagrande/starkey_na/PDFs_Preprints/ms-04_Rowland.pdf *citing* Forman, R. T. T., D. Sperling, J. A. Bissonette et al. 2003. *Road ecology: science and solutions*. Washington, DC: Island Press. Forman, R. T. T., and L. E. Alexander. 1998. Roads and their major ecological effects. *Annual Review of Ecology and Systematics* 29:207-231. http://arjournals.annualreviews.org/doi/abs/10.1146/annurev.ecolsys.29.1.207. Gucinski, H., M. H. Brooks, M. J. Furniss, and R. R. Ziemer. 2001. *Forest roads: a synthesis of scientific information*. U.S. Department of Agriculture, Forest Service, General Technical Report PNW-GTR-509, Portland, Oregon. http://www.fs.fed.us/pnw/pubs/gtr509.pdf. Gaines, W. L., P. H. Singleton, and R. C. Ross. 2003. *Assessing the cumulative effects of linear recreation routes on wildlife habitats on the Okanogan and Wenatchee National Forests*. U.S. Department of Agriculture, Forest Service, General Technical Report PNW-GTR-586, Portland, Oregon. http://www.fs.fed.us/pnw/pubs/gtr586.pdf. Trombulak, S. C., and C. A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. *Conservation Biology* 14:18-30. http://roadecology.ucdavis.edu/pdflib/TTP_289/W08/Trombulak%20and%20Frissell%202000.pdf. See also: Andreas Seiler. 2001. Ecological Effects of Roads: A review. Introductory Research Essay No 9. Swedish University of Agricultural Sciences. Department of Conservation Biology, SLU Uppsala http://idd00s4z.eresmas.net/doc/transp/ecoeffectsonroads.pdf (links to all of "Ecological Effects of Roads: A Review.")

Large unroaded areas are important simply due to the fact that they better represent the historic condition that species evolved with but they are now rare on the landscape due to human activities that have degraded and fragmented the majority of the landscape. The Northwest Forest Plan LSOG Effectiveness Monitoring Plan says that "perhaps 80 percent or more [of the historic late-successional old-growth forest] would probably have occurred as relatively large (greater than 1,000 acres) areas of connected forest." Miles Hemstrom, Thomas Spies, Craig Palmer, Ross Kiester, John Teply, Phil McDonald, and Ralph Warbington; Late-Successional and Old-Growth Forest Effectiveness Monitoring Plan for the Northwest Forest Plan, USFS General Technical Report PNW-GTR-438; December 1998; http://www.fs.fed.us/pnw/pubs/gtr_438.pdf. Currently, these 1,000 acre and larger patches are rare on the landscape.

Boakes et al (2009) explained why it is important to retain large unroaded areas.

> **Abstract:** Habitat clearance remains the major cause of biodiversity loss, with consequences for ecosystem services and for people. In response to this, many global conservation schemes direct funds to regions with high rates of recent habitat destruction, though some also **emphasize the conservation of remaining large tracts of intact habitat**. If the pattern of **habitat clearance is highly contagious**, the latter approach will help **prevent destructive processes gaining a foothold** in areas of contiguous intact habitat. Here, we test the strength of spatial contagion in the pattern of habitat clearance. Using a global dataset of land-cover change at 50x50 km resolution, we discover that intact habitat areas in grid cells are refractory to clearance only when all neighbouring cells are also intact. The **likelihood of loss increases dramatically as soon as habitat is cleared in just one neighbouring cell**, and remains high thereafter. **This effect is consistent for forests and grassland, across biogeographic realms and over centuries, constituting a coherent global pattern**. Our results show that landscapes become vulnerable to wholesale clearance as soon as **threatening processes begin to penetrate**, so actions to prevent any incursions into large, intact blocks of natural habitat are key to their long-term persistence.

Elizabeth H. Boakes, Georgina M. Mace, Philip J. K. McGowan and Richard A. Fuller 2009. Extreme contagion in global habitat clearance. Proceedings of the Royal Society B: Biological Sciences. November 25, 2009. doi: 10.1098/rspb.2009.1771

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

> Small roadless areas share many of attributes in common with larger ones, including:
>
> • Essential habitat for species key to the recovery of forests following disturbance such as herbaceous plants, lichens, and mycorrhizal fungi

- Habitat refugia for threatened species and those with restricted distributions (endemics)
- Aquatic strongholds for salmonids
- Undisturbed habitats for mollusks and amphibians
- Remaining pockets of old-growth forests
- Overwintering habitat for resident birds and ungulates
- Dispersal “stepping stones” for wildlife movement across fragmented landscapes

WWF CBI 200x. Importance of Roadless Areas in Biodiversity Conservation: A Scientific Perspective - Executive Summary.
http://magicalliance.org/download/ecological-importance-of-roadless-areas.pdf

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

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

Letter to President Clinton from 136 scientists (Dec. 10, 1997).
https://docs.google.com/open?id=0B4L_-RD-MJwrRzhFcm5QcFR0MHM

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

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

Oct 24, 2013 Press release: EUROPEAN PARLIAMENT BACKS THE PROTECTION OF ROADFREE AREAS. http://kritonarsenis.gr/eng/actions/view/european-parliament-backs-the-protection. Federal land managers should recognize the tremendous carbon values in unroaded/unmanaged forests and avoid actions that would threaten these values. See also, William R. Moomaw, Susan A. Masino, and Edward K. Faison. 2019. Intact Forests in the United States: Proforestation Mitigates Climate Change and Serves the Greatest Good Front. For. Glob. Change, 11 June 2019 | https://doi.org/10.3389/ffgc.2019.00027; https://www.frontiersin.org/articles/10.3389/ffgc.2019.00027/full.

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

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

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

In 1994, several scientific societies submitted a report to Congress and the President recommending conservation of roadless areas larger than 1,000 acres. This report is describe by the Interior Columbia Ecosystem Management Project as a "Major Stud[y] of Eastside Ecosystems and Management."

> Because roads crisscross so many forested areas on the Eastside, existing roadless regions have enormous ecological value. … Although roads were intended as innocuous corridors to ease the movement of humans and commodities across the landscape, they harm the water, soils, plants, and animals in those landscapes. [p 6]
>
> …
>
> **4. Do not construct new roads or log within existing (1) roadless regions larger than 1000 acres or (2) roadless regions smaller than 1000 acres that are biologically significant.**
>
> Roadless regions constitute the least-human-disturbed forest and stream systems, the last reservoirs of ecological diversity, and the primary benchmarks for restoring ecological health and integrity. Roads fragment habitat; alter the hydrological properties of watersheds; discharge excessive sediment to streams; increase human access and thus disturbance to forest animals; and influence the dispersal of plants and animals, especially exotic species, across the landscape. Because many forested areas in eastern Oregon and Washington are heavily dissected by roads, the ecological value of existing roadless regions is especially high. [pp 8, 202]
>
> …
>
> Our analysis defined a roadless region as any region where all points within an LS/OG stand were at least 100 meters from a road or trail.
>
> …
>
> What remains of ponderosa pine and Douglas fir LS/OG is the least protected today. In the four national forests within the Blue Mountains, 48% of the land base above 6000 feet lies in wilderness areas, whereas only 10% of the land below 6000 feet, where ponderosa pine occurs, receives such protection … [p 110]
>
> … Fifth, roads, whose impact on aquatic and terrestrial resources is well documented, are widely distributed in eastside forests. Road densities in western Colville, Winema, and Ochoco National Forests average 2.5, 3.5, and 3.7 miles per square mile, respectively. Densities reach 8.8 and 11.9 miles per square mile in some watersheds. In the national forests of Oregon's Blue Mountains (Table 5.2), less than 10% of roadless regions on slopes steeper than 60% are now protected, less than 15% on slopes of 30-60%. Moreover, roadless regions, like LS/OG patches, are extensively fragmented. In northern Ochoco National Forest, nearly one-third (38,882 acres) of 128,140 acres of roadless region consists of patches smaller than 1000 acres. (RARE II surveys underestimated total roadless area in this region [45,700 acres] because they considered only areas larger than 5000 acres.) [p 110]
>
> …
>
> CONCLUSIONS

> Watersheds outside wilderness and roadless regions in eastern Oregon and Washington are highly degraded. Without an intensive restoration effort on federal and private lands, many native aquatic stocks and species risk extinction. [p 160]
> …
> Because the distribution of many native fishes in Oregon's national forests has receded into steep headwater areas, USPS has a vital role in protecting the few remaining watershed refugia and preventing further damage to already degraded habitats downstream. Critical to securing eastside [aquatic diversity areas] ADAs as aquatic refugia are the remaining roadless regions, sources of large wood from LS/OG forests, and the integrity of riparian corridors on national forestlands. [p 168]
> …
> 7. High road densities harm many forms of wildlife.
> The ecological integrity of existing LS/OG patches and other roadless regions can only be maintained if these sites are not disturbed by the construction of roads. Roadless regions serve as critical refuges for terrestrial wildlife sensitive to human disturbance. Road densities in LS/OG patches that already have roads should be reduced to less than 1 mi/mi^2. Achieving this goal is vital to rehabilitation of eastside fisheries and terrestrial resources. [p 197]

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

Rhodes et al (1994) prepared a report for the National Marine Fisheries Service and said:

> **ROADLESS RESERVES**
> Available information indicates that much of the Snake River Basin has been degraded. Existing roadless and wilderness areas provide the only high-quality habitats and islands of natural functioning systems left in the Snake River Basin. The extent of these areas is limited. It may not be possible to enter roadless systems without compromising their natural function and/or without degrading habitat conditions. Roadless, unlogged tracts form the cornerstones of habitat recovery efforts. Continued diminishment of areas functioning somewhat naturally increases the risk of failing to improve habitat conditions at scales ranging from the reach to the region.
>
> **Recommendation**: Given existing habitat degradation and uncertainties, it is prudent to require that most of the degraded habitat be improved prior to taking risks with the scarce areas having high quality habitat. We recommend that roadless tracts greater than 1000 acres should not entered, at least, until monitoring documents that habitat

conditions in >90% of managed watersheds either meet habitat standards or have exhibited statistically significant improvement over at least five years. Smaller roadless tracts may also have important ecological value. We recommend that smaller roadless tracts should not be disturbed unless it can be shown through peer-reviewed analysis that the disturbance will not affect habitat conditions, impede habitat recovery, or foreclose options for habitat recovery. [p xxix]

…

3.6 ROADLESS RESERVES

3.6.1 Effects on salmon: Through a variety of mechanisms, the cumulative effects of activities that disturb vegetation and soils can lead to increased levels of fine sediment, loss of LWD and pool volumes, channel widening, loss of structural channel diversity, summer water temperature elevation, and elevated peak flows. As discussed, these changes in habitat condition caused by logging-related disturbance tend to reduce salmon survival and habitat productivity, especially when combined … [p 98]

…

The consequences of entry into undisturbed systems are probably lowly reversible. Although accelerated surface erosion may only persist for 6-10 years, hydrologic alteration may persist for more than 20 years (Harr and Coffin, 1990). Accelerated erosion from roads, as well as other effects, persist for as long as the roads exist, and then some. Even after obliteration, roads continue to erode at levels far in excess of natural for several years (Potyondy et al., 1991). Functions provided by large downed wood, such as terrestrial sediment storage, require more than 100 years after trees have been removed for recruitment to be re-established. The prospects for recovery of channel morphology and sediment cycling are extremely poor for steep headwater streams in non-cohesive soils that have been degraded, even if the cause of degradation is arrested (Rosgen, 1993). [p 99]

…

Despite existing data, many have speculated that roadless areas can be entered without degrading habitat conditions via careful planning, avoidance of high risk areas such as riparian areas to the extent considered feasible, and implementation of "Best Management Practices" (BMPs). However, BMP effectiveness remains a matter of speculation. Most studies of the effects of BMPs have been too short in duration to capture lagged effects or provide an indication of long-term effects. Little is known about the cumulative effectiveness of BMPs in the face of significant landscape alteration. While many assessments of BMPs have focused on estimating the short-term reduction in accelerated pollutant loading, most studies have not examined whether aquatic habitat is fully protected over the long term (USEPA, 1993). There has been extremely limited assessment of the cumulative effectiveness of BMPs. Appendix B contains a thorough historical perspective on how the reliance on BMPs and unwarranted planning assumptions led to the continued degradation of salmon habitat on the Clearwater National Forest.

…

Scientific evaluations (Anderson et al., 1993; USFS, 1993b; USFS et al., 1993; Henjum et al., 1994) have consistently noted that roadless, unlogged tracts form the cornerstones of habitat recovery efforts. Existing roadless and wilderness areas provide the only high-quality habitats and islands of natural functioning systems left in the entire Snake River Basin. The extent of these areas is limited. It has not been shown under ecologically applicable experimental conditions that it is possible to enter roadless systems without compromising their natural function and/or without degrading habitat conditions, over time. Logging of roadless areas puts efforts to protect nondegraded and degraded habitats at risk (USFS et al., 1993). [p 101]

…

in aggregate, available information indicates that increased landscape disturbance and the development of previously undisturbed areas increase the risk that salmon habitat will be degraded via alteration in watershed scale hydrology and material transfers. Given what is known about the effects of land disturbance on habitat conditions together with the existing inability to accurately predict cumulative effects it is not prudent to introduce disturbance into undisturbed areas. … It is unlikely that habitat degradation can be arrested and reversed without protecting and restoring the natural functions of watersheds (USFS et al., 1993). Undisturbed areas (provided they are minimally influenced by alterations to upstream areas or neighboring watersheds) provide zones where the natural terrestrial processes can operate, and through linkages with the stream system produce habitat conditions typical of those in which the salmon evolved. [p 102]

…

Given the existing extent and magnitude of habitat degradation, uncertainties about the prospects of habitat improvement in heavily damaged watersheds, and the irreversibility of effects, it is prudent to require that most of the degraded habitat be improved prior to taking any risks with the scarce areas with high quality habitat. As noted by Henjum et al., (1994) roadless tracts greater than 1000 acres are ecologically important because of existing forest fragmentation and widespread degradation. Therefore, we recommend that roadless tracts greater than 1000 acres should not logged or roaded, at least until substantial habitat recovery has been documented in most habitat conditions in managed watersheds in the Snake River Basin. In order to provide some assurance that some habitats remain as refugia for geographically isolated spawning populations, it is prudent to protect existing roadless areas at least until habitats in 90% of the managed watersheds in the Snake River Basin either meet all habitat standards or have exhibited statistically significant ($p<0.05$) improving trends over at least five years as documented through monitoring. In the event that degraded habitats do not improve and/or salmon are extirpated from some watersheds, refugia afforded by roadless tracts can provide some level of protection to populations that could ultimately recolonize barren salmon habitat. Smaller roadless areas may also be ecologically important. Therefore, we also recommend that smaller roadless areas should not be logged or roaded unless it can be demonstrated via peer-reviewed scientific study that it will have no negative effect on watershed conditions and will not foreclose management options for the recovery of salmon habitat. [p 103]

Rhodes, J.J., D.A. McCullough, and F.A. Espinosa. 1994. A Coarse Screening Process for Potential Application in ESA Consultations. Technical Report 94-4. Prepared for National Marine Fisheries Service. http://66.162.129.14/tech/94-4report.pdf

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

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

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

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

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.

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