24 January 2020

TO:   Joanie Schmidgall, Sweet Home Ranger District, Willamette NF

VIA: <https://cara.ecosystem-management.org/Public/CommentInput?Project=57351>

**Subject: Quartzville Middle Santiam (QMS) Project — scoping comments**

Please accept the following comments from Oregon Wild concerning the Quartzville Middle Santiam (QMS) Project, <https://www.fs.usda.gov/project/?project=57351>. Oregon Wild represents 20,000 members and supporters who share our mission to protect and restore Oregon’s wildlands, wildlife, and water as an enduring legacy. Our goal is to protect areas that remain intact while striving to restore areas that have been degraded. This can be accomplished by moving over-represented ecosystem elements (such as logged and roaded areas) toward characteristics that are currently under-represented (such as roadless areas and complex old forest).

The purpose and need includes: timber supply, restoring dense young plantation in LSR, and maintaining a minimum sustainable road network. The proposed action alternative involves:

* 7,900 acres of logging
  + 5,410 acres Thinning
  + 180 acres Shelterwood with reserve
  + 630 acres Dominant tree release
  + 170 acres Gap creation
  + 1,500 acres Skips
* 32 miles of temporary road construction, (5 miles on new footprints, and 27 miles of reopening closed roads)
* 14 miles road decommissioning
* 18 miles road closure
* 275 miles of road maintenance and reconstruction

**Summary**

* We urge the Forest Service to develop a preferred alternative that focuses on variable thinning of dense young stands near existing roads across both matrix and LSR land allocations, including all of the proposed road decommissioning.
* Mature forests, regardless of land allocation, are just too valuable for clean water, habitat, and carbon storage. The trade-offs from logging mature forests greatly outweigh any alleged benefits. The goals for wood production in the matrix are outdated. Society gains far more from conserving mature forests that will help stabilize our climate and water supply than from logging mature forests to feed an industry that booms and busts and tends to destabilize local communities, especially when doing so will also harm our climate and water.
* All streams should be generously buffered. The rationale for logging riparian reserves does not hold up to scientific scrutiny, because commercial logging will capture mortality, remove valuable woody structure, and retard recruitment and attainment of desired dead wood habitat that is necessary to meet objectives throughout the inner and outer riparian corridor.
* Road construction should be avoided as much as possible. There are already far too many roads on the landscape, and temporary roads in fact have long-term adverse impacts on vegetation, soil, and water. We support road decommissioning, but it should be expanded to strategically “grow” roadless areas that are under-represented compared to the historic range of variability and are critical to conserving wildlife that evolved with much larger and more numerous blocks of unfragmented habitat than is currently available.
* The approach described above will produce more than enough wood as a byproduct of net beneficial restoration actions.
* The approach described above might qualify for an EA, whereas the current approach would seem to require an EIS to address the significant effects described in these scoping comments.

Please carefully consider all of the potentially significant impacts of logging and roads listed below, and develop alternatives that will mitigate these trade-offs:

1. Logging  and roads will reduce carbon storage and increase carbon emissions, exacerbating both global climate change and ocean acidification. 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>; Oregon Governor’s Natural Resource Office. Oregon’s Ocean Acidification and Hypoxia Action Plan. August 2019. <https://www.oregonocean.info/index.php/ocean-documents/oah-hypox/june-2018-oah-action-plan-public-comment-documents/1924-draft-oregon-s-oah-action-pan-2019/file>. The significant and widespread effects of global climate change threaten to violate BLM's multiple mandates under the O&C Act, including managing forests for permanent forest product, to regulate stream flow, to sell timber on a "normal market." The RMP EIS did not adequately address this issue. See Conservation Groups’ 5-12-2016 Protest of the Proposed RMP. (See pages 34-49.) <https://westernlaw.org/sites/default/files/WOPR%20Jr%20Protest%20FINAL.pdf>;
2. Logging  and roads will reduce recruitment of snags and dead wood and all the ecosystem services they provide. One of the most significant and lasting effects of stand replacing disturbance, including regeneration logging, is to bring the process of snag recruitment to a virtual standstill for many decades. Especially, when trees are removed by logging, the snag population is reduced to ensure safe conditions for workers and remains low for many decades because the pool of green trees available for snag recruitment is greatly reduced. This results in a multi-decade “snag gap” that has serious adverse consequences for habitat and many other ecological processes. See Rose, C.L., Marcot, B.G., Mellen, T.K., Ohmann, J.L., Waddell, K.L., Lindely, D.L., and B. Schrieber. 2001. Decaying Wood in Pacific Northwest Forests: Concepts and Tools for Habitat Management, Chapter 24 in Wildlife-Habitat Relationships in Oregon and Washington (Johnson, D. H. and T. A. O'Neil. OSU Press. 2001) <http://web.archive.org/web/20060708035905/http://www.nwhi.org/inc/data/GISdata/docs/chapter24.pdf>;
3. LSR conditions require abundant snags and dead wood habitat, but thinning will capture mortality and reduce recruitment of desired habitat features for many decades. The objectives for LSR treatments (and the NEPA analysis) must explicitly harmonize and balance competing objectives for live trees and dead wood goals. The scoping notice describes the “desired condition” for LSRs as a series to logging activities. Logging is not the desired condition for LSRs. The Forest Service should restate the desired condition as a set of specific ecological attributes appropriate for the LSR, including abundant dead wood habitat, dense wildlife cover, abundant prey base for spotted owls, etc (all of which will be degraded by logging). The scoping notice says thinning LSRs will enhance “stand vigor.” This makes no sense. Trees have vigor, not stands. Desired conditions in LSRs requires retention of ecological processes, including tree mortality. The NEPA analysis must address the fact that commercial tree removal will directly and immediately remove trees that are providing valuable habitat and would continue to provide habitat as live and dead tree for decades or centuries to come.
4. The spotted owl recovery plan (Recovery Action 5, FRP page 20) encourages actions such as thinning that have short-term impacts and long-term benefits. The recovery plan does not define “short-term,” but the WOPR FEIS (p 4-479) says that short-term impacts last for 10 years, yet thinning will delay recruitment of desired levels of dead wood for much longer than 10 years. Also, these activities must have *demonstrated* long-term benefits. In most cases, long-term benefits of logging are assumed, but not yet demonstrated. See the SAT Report.
5. The scoping notice says “The NWFP encourages ‘the use of silvicultural ... to reduce the risk to the Late-Successional Reserve from severe impacts resulting from large-scale disturbances and unacceptable loss of habitat’ ... [O]verstocked stands have contiguous vegetation that can escalate the potential for high severity wildfires.” This is very problematic and a reveals a serious misunderstanding about the relative risks of logging and wildfire embedded within the purpose and need for this project. Best available science indicates that logging suitable owl habitat will do far more harm than good. Logging degrades owl habitat and is far more likely to harm spotted owl habitat than fire. No one can predict where or when severe fire will occur, and this project area and in fact experiences severe fire relatively infrequently, therefore any fuel reduction logging treatment intended to interact favorably with wildfire is highly likely to fail simply because there is an extremely low probability that logging treatments will interact with fire during the relatively brief time period after logging and before fuels regrow. For an in-depth explanation, see Heiken, D. 2010. Log it to save it? The search for an ecological rationale for fuel reduction logging in Spotted Owl habitat. Oregon Wild. V 1.0. May 2010. <https://www.dropbox.com/s/pi15rap4nvwxhtt/Heiken_Log_it_to_save_it_v.1.0.pdf?dl=0>.
6. The scoping notice says “These stands will continue to experience increased mortality and stress if conditions do not change.” This indicates that tree mortality is bad, but elsewhere in the scoping notice it is suggested that tree mortality is good, e.g., mortality from thinning will “increase growing space for individual trees, reduce competition for resources and increase overall stand vigor. ... creating breaks in the overstory canopy [will] allow[] younger, small trees to establish.” The FS can’t have it both ways., describing mortality from natural process as bad, and mortality form thinning as good.
7. Restoration of Reserves Should Not be Rushed. LSRs were designed to be big enough to allow natural processes to flourish. LSRs can tolerate both fire and the slow process of forest recovery. We do not need to intervene to rush things along. In fact, if we do try to rush things it may be counter-productive. For instance, (i) thinning to accelerate establishment of multiple tree cohorts and complex understories will significantly reduce recruitment of snag habitat over a long time period; (ii) tree planting after logging, fire or other disturbance will truncate an important stage of natural succession typified by complex early seral vegetation; (iii) salvage logging will dramatically simplify stands by removing legacy features that help provide a bridge between previous and future forests affected by disturbance. The purpose and need for this project should include conserving and perpetuating the unique ecological features associated with natural rates of forest succession.
8. Regen logging  and roads will increase fire hazard for many decades by leading to the establishment of dense young stands with dense continuous fuels close to the ground.  See Harold S. J. Zald, Christopher J. Dunn. 2018. Severe fire weather and intensive forest management increase fire severity in a multi‐ownership landscape. Ecological Applications. *Online Version of Record before inclusion in an issue.* 26 April 2018. <https://doi.org/10.1002/eap.1710>. Also, <https://phys.org/news/2018-04-high-wildfire-severity-young-plantation.html>;
9. Regen logging and roads will increase peak flows immediately after logging. Artificial peak flows cause erosion, turbidity, and adverse impacts on fish populations. Grant, Gordon E.; Lewis, Sarah L.; Swanson, Frederick J.; Cissel, John H.; McDonnell, Jeffrey J. 2008. Effects of forest practices on peak flows and consequent channel response: a state-of-science report for western Oregon and Washington. Gen. Tech. Rep. PNW-GTR-760. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 76 p. <http://www.fs.fed.us/pnw/pubs/pnw_gtr760.pdf>;
10. Regen logging, roads, and tree planting will cause reduced summer stream flows due to development of dense young stands that have high rates of transpiration and high rates of water use. Artificially low summer stream flows cause adverse effects on stream temperature, reduced water availability, and reduced quantity and quality of fish habitat. Perry, T. D., and Jones, J. A. (2016) Summer streamflow deficits from regenerating Douglas-fir forest in the Pacific Northwest, USA. Ecohydrology, doi: [10.1002/eco.1790](http://dx.doi.org/10.1002/eco.1790). <http://onlinelibrary.wiley.com/doi/10.1002/eco.1790/full>;
11. Logging and roads will adversely affect listed species. Removing or degrading suitable habitat for the spotted owl will increase adverse competitive interactions with barred owls. To mitigate for the invasion of the barred owl into the entire range of the spotted owl, scientists recommend retention of more suitable habitat, not just the small subset of *high quality* suitable habitat. Forsman, E.D., Anthony, R.G. et al “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>; See also, 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>.
12. Logging  and roads will adverse impacts to spotted owl prey base, e.g., flying squirrel, red tree vole.  Wilson, Todd M.; Forsman, Eric D. 2013. Thinning effects on spotted owl prey and other forest-dwelling small mammals. In: Anderson, Paul D.; Ronnenberg, Kathryn L., eds. Density management for the 21st Century: west side story. Gen. Tech. Rep. PNW-GTR-880. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 79–90. <https://www.fs.fed.us/pnw/pubs/pnw_gtr880.pdf>;
13. The checkerboard lands in the southern part of the project area present a potential barrier to habitat connectivity. Treatments in this area should be minimal, so as to mitigate for practices on non-federal lands that are unfriendly to fish, wildlife, and carbon storage. Rigorously implementing red tree vole surveys and buffers in this area would partially mitigate for adverse effects. Logging and roads will fragment interior forests with adverse effects on wildlife due to altered microclimate, predation, nest predation, etc. We urge the agency to identify blocks of ”interior forest,” consider alternatives to reduce fragmentation of forest in or near interior forest, prioritize roads that could be decommissioned (or not built) in or near interior forest, identify and protect potential wildlife corridor stands that could provide connectivity between interior forest. Ontario Extension Notes. Conserving The Forest Interior: A Threatened Wildlife Habitat. LRC 70. <http://www.lrconline.com/Extension_Notes_English/pdf/forInterior.pdf>; BC Ministry of Forests 1998. Extension Note 21. Biodiversity and Interior Habitats: The Need to Minimize Edge Effects. <https://www.for.gov.bc.ca/hfd/pubs/docs/en/en21.pdf>.
14. Logging, roads, and heavy equipment, and burn piles will degrade soil functions and increase erosion. These activities kill native vegetation that normally share carbohydrates and feed a vast below-ground ecosystem. Soil compaction and disturbance reduces the flow of air and water vital to the below ground ecosystem. Ingham, Elaine, The Soil Foodweb: Its Importance in Ecosystem Health, <http://www.rain.org/~sals/ingham.html>; See also, Amaranthus, M.P.; Molina R.; and Trappe J. M. 1990. Long-term forest productivity and the living soil. Chapter 3. In Perry D.A. ed. Maintaining Long-term Forest Productivity in the Pacific Northwest Forest Ecosystem. Timber Press. Portland, OR 97208; See also: Wall DH, V Behan-Pelletier, AP Covich, and P Snelgrove. 2007. Hidden Assets: Biodiversity Below-Surface. UNESCO & SCOPE. <http://www.icsu-scope.org/unesco/USPB05_SOIL_En.pdf>;
15. Logging  and roads will spread weeds by exposing mineral soil, transporting seeds, and removing native vegetation thus giving more light and nutrients to weeds. Inventories show that weeds are closely associated with roads and recently logged areas. Consider alternatives that avoid creating the conditions that spread weeds. Parendes, L. A. and J. A. Jones. 2001. Role of Light Availability and Dispersal in Exotic Plant Invasion along Roads and Streams in the H. J. Andrews Experimental Forest, Oregon. Conservation Biology. Vol. 14, No. 1 (Feb., 2000), pp. 64-75. <https://doi.org/10.1046/j.1523-1739.2000.99089.x>; See also, Gray, Andrew N. 2005 Nonnative Plants in the Inventory of Western Oregon Forests. In: McRoberts, Ronald E.; Reams, Gregory A.; Van Deusen, Paul C.; McWilliams, William H.; Cieszewski, Chris J., eds. Proceedings of the fourth annual forest inventory and analysis symposium; Gen. Tech. Rep. NC-252. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 11-16. <http://ncrs.fs.fed.us/pubs/gtr/gtr_nc252/gtr_nc252_011.pdf>;
16. Logging  and roads will degrade water quality and fish habitat, including increase stream temperature and increase sediment and turbidity. Logging and roads reduce stream shade, reduce stream flow both leading to an increase in stream temperature. Erosion and sediment from logging and roads also adversely affect stream morphology and fish habitat;
17. Logging  and roads in and adjacent to stream buffers will degrade the microclimate in riparian reserves, reduce wood recruitment in and near streams, degrade water quality and fish habitat. See 1993 FEMAT Report, pp V-13, V-25;  Anderson, Paul D.; Larson, David J.; Chan, Samuel S. 2007. Riparian Buffer and Density Management Influences on Microclimate of Young Headwater Forests of Western Oregon. Forest Science, Volume 53, Number 2, April 2007 , pp. 254-269(16). <http://www.ingentaconnect.com/content/saf/fs/2007/00000053/00000002/art00012>; Pollock, M. 2013. An analysis of the effects of riparian forest harvest on the development of late-successional forest structure and instream wood production - A review of timber harvest in Riparian Reserves proposed by the Bureau of Land Management for federal lands in the Coquille watershed in southwest Oregon as part of the Lone Pine Biological Assessment; v.08.23.2013. NMFS; Thomas Spies, Michael Pollock, Gordon Reeves, and Tim Beechie 2013. Effects of Riparian Thinning on Wood Recruitment: A Scientific Synthesis - Science Review Team Wood Recruitment Subgroup. Jan 28, 2013, p 36. <http://www.mediate.com/DSConsulting/docs/FINAL%20wood%20recruitment%20document.pdf>;
18. Consider logging in ways that are least harmful to the ecosystem by restoring ecological features that are in short-supply and by mimicking natural processes. This means leaving mature forests unlogged, so that natural mortality processes and snag recruitment are not adversely affected. In young stands, BLM should thin variably while retaining generous unthinned skip where mortality processes and dead wood recruitment can continue to mitigate the cumulative effects of widespread logging on public and private lands.
19. Please consider all reasonable alternatives, including thinning a portion of stands that are dense and young, and leaving older stands unlogged. Thinning young stands will extend culmination of mean annual increment and provide a more harmonious mix of public benefits where production of timber volume is required. Logging older stands will virtually always lead to net negative effects on the public interest. Any land allocation or purpose-and-need to obtain timber volume from logging older stands must be reconsidered in light of the urgent need to address the climate crisis by retaining carbon in the forest and avoid carbon emissions from forest degradation. (See Moomaw et al 2019 cited above). See Heiken, Doug. 2009. The Case for Protecting Both Old Growth and Mature Forests, Version 1.8. Oregon Wild. <https://www.dropbox.com/s/4s0825a7t6fq7zu/Mature%20Forests%2C%20Heiken%2C%20v%201.8.pdf?dl=0>.
20. Units like 166 should be dropped. Stands like this have lots of legacy trees and snags. Stands like this are home to red tree vole and other sensitive wildlife that live in mature & old-growth forests. Stands like this represent high quality owl habitat protected by Recovery Action 32. Stands like this are relatively high elevation and will take a long time to recover. Stands like this are valued by the public and logging them will be controversial.
21. Many of the effects described above may be significant and may become significant when logging and roads are considered cumulatively across the landscape.
22. Many of the effects listed above will interact unfavorably with global climate change making effects much worse than they would be in the absence of climate change. Dalton, M.M., K.D. Dello, L. Hawkins, P.W. Mote, and D.E. Rupp (2017) The Third Oregon Climate Assessment Report, Oregon Climate Change Research Institute, College of Earth, Ocean and Atmospheric Sciences, Oregon State University, Corvallis, OR. <http://www.occri.net/media/1042/ocar3_final_125_web.pdf>;

## Unit-specific Concerns

We wish to reinforce the concerns raised by Friends of Douglas Fir National Monument with regards to specific units:

Specific unit recommendations

* Unit 66 contains Minniece Point and numerous other unique outcroppings visible from FS 1155. It should be dropped for viewshed reasons. Cutting the unit as shown on the map would result in Minniece Point looking like an un-natural island in the sky.



* Unit 137: This unit lies directly adjacent to a long segment of a tributary of Swamp Creek, which is an important waterway that drains into the Wilderness. The forest directly south of this unit and along the same waterway is some of the most spectacular preserved old growth in this entire region, some of which is inside the Wilderness boundary and some of which is outside. Timber harvest should not be done on the southern two-thirds of unit 137, or on any area west of FR 648 to avoid harm to this ecosystem. The entire strip just east of the Wilderness boundary extending to the Chimney Peak Trail should be under permanent protection.
* Unit 166: Has documented red tree vole nests and should have been designated LSR. Buffering the nest will not provide adequate protection. The unit should be dropped.
* Unit 176, Units 177 and 189: These units are directly adjacent to the Middle Santiam Wilderness and to an important trail system as well as the main stem of Pyramid Creek. It would have significant impact on recreation in his area and should be dropped.
* Unit 147: This unit lies directly in the watershed of multiple important waterways that ultimately drain into the Wilderness. This unit should be withdrawn to protect water quality and riparian habitat.
* Unit 285: Has at least one documented red tree vole nest. Buffering the nest will not provide adequate protection. The unit should be dropped.

## The Purpose and Need should Address The Unmet Need for Carbon Storage

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

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

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

Katharine R.E. Sims, Jonathan R. Thompson, Spencer R. Meyer, Christoph Nolte, Joshua S. Plisinski. 2019. Assessing the local economic impacts of land protection. Conservation Biology. 26 March 2019 <https://doi.org/10.1111/cobi.13318>,

<https://harvardforest.fas.harvard.edu/sites/default/files/Sims_et_al-2019-Conservation_Biology.pdf>.

## New Information Requires Modification of Matrix Objectives.

This project is based on part on the need to produce timber to meet LRMP objectives. There is a trade-off between ecological objectives and timber objectives, and new information indicates that these trade-offs are becoming more acute. Before sacrificing older forests , or conducting regen harvest, in order to produce timber, the agency needs to carefully consider new information developed since the Northwest Forest Plan was adopted in 1994. Several significant new developments indicate a need to increase emphasis on conservation and restoration of more mature & old-growth forests, and reduced emphasis on Matrix objectives such as timber production from logging of mature & old-growth forests. Unfortunately, the agencies have not taken steps to account for new information and has failed to adjust Matrix objectives accordingly.

A few of the most important new issues include:

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

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

The FS is using RA32 to mitigate for the barred owl, but in reality all suitable habitat should be conserved. When the agency discovers that its plans are out of date and adopts new strategies, the agency must follow NEPA and NFMA procedures to amend its forest plan. *ONRC and HCPC v. Forsgren*, 252 F. Supp. 2d 1088 (D. Or. 2003) March 11, 2003. <http://law.justia.com/cases/federal/district-courts/FSupp2/252/1088/2424683/> Here, RA 32 is a new strategy that the FS is using as a *de facto* plan amendment to justify logging suitable habitat. This is not allowed without following legal requirements.

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

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

Stan G. Sovern, Eric D. Forsman, Katie M. Dugger, Margaret Taylor. 2015. Roosting Habitat Use and Selection By Northern Spotted Owls During Natal Dispersal. The Journal of Wildlife Management 79(2):254–262; 2015; DOI: 10.1002/jwmg.834.

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

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

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

Undisturbed ecosystems and late successional forests are more resistant and resilient to climate change. György Kröel-Dulay et al (2015). Increased sensitivity to climate change in disturbed ecosystems. Nature Communications, 2015; 6: 6682. <http://web.ics.purdue.edu/~jsdukes/Kr%C3%B6el-DulayEtAl_NC_2015.pdf>. Climate change is a huge new stress on ecosystems that are already stressed. We can help ecosystems better withstand climate change by reducing anthropogenic stress caused by logging, roads, grazing, etc. Climate change is expected to amplify the hydrologic cycle. This calls for increased protection of whole watersheds and especially streams buffers (and reducing road/stream interactions). There may be a need for modest reductions in tree density, but only in limited areas. For wildlife that depend on dense forest conditions (i.e., most of our threatened & endangered species), logging to reduce stress or reduce fire hazard will only make things worse. Wildlife are more threatened by the combined effects of logging plus fire, than by fire alone. See Heiken, D. 2010. Log it to save it? The search for an ecological rationale for fuel reduction logging in Spotted Owl habitat. Oregon Wild. v 1.0. May 2010. <https://www.dropbox.com/s/pi15rap4nvwxhtt/Heiken_Log_it_to_save_it_v.1.0.pdf?dl=0>

**Dead wood standards** — Large accumulations of dead wood are essential for meeting objectives for fish & wildlife habitat, water quality, and carbon storage. Past and ongoing forest management has greatly reduced the prevalence of large snags and dead wood. Northwest Forest Plan standards for dead wood are based on an outdated “potential population” methodology which greatly underestimates the amount of snags and down logs needed to meet the needs of a variety of species associated with dead wood.[[1]](file:///C:\Users\Doug\Dropbox\Forms\!boilerplate.doc#_ftn1) Forests are a dynamic system where the population of all live trees represent the recruitment pool for all dead trees, so if more dead trees are needed over time, that means more live trees need to be retained for long-term recruitment. Before conducting activities like commercial logging (especially regen logging) that will result in long-term reduction in recruitment of snags and dead wood, the agencies should follow NEPA procedures to amend their management plans, consider alternatives, and adopt new standards that assure objectives are met over time and across the landscape.

**Complex early seral forest -**There is some concern that clearcuts on non-federal do not provide high quality habitat for wildlife that prefer complex early seral habitat with abundant legacies and diverse non-conifer vegetation. While this habitat may be under-represented, there are no listed species that depend on it because most of the species associated with ephemeral young forests tend to be mobile, generalist, and/or opportunistic. There are a wide variety of policy options for enhancing early seral that do not require that we sacrifice old forests. K. Norm Johnson, Debora L. Johnson. 2007. Policies to Encourage Diverse, Early Seral Forest in Oregon: What Might We Do? <http://ecoshare.info/2010/10/04/k-norman-johnson-policies-to-encourage-diverse-early-seral-forest-in-oregon-what-might-we-do/> Climate change is expected to increase the prevalence of early seral forests. Regen logging produces lower quality early seral. We should instead stop salvage logging.

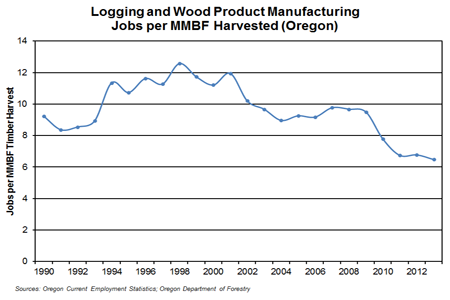
**Fire Hazard** – New information highlights the fact that regen logging increases fire hazard for many decades by causing the establishment of homogeneous young conifer stands with dense fuels close to the ground.  See Harold S. J. Zald, Christopher J. Dunn. 2018. Severe fire weather and intensive forest management increase fire severity in a multi‐ownership landscape. Ecological Applications. *Online Version of Record before inclusion in an issue.* 26 April 2018. <https://doi.org/10.1002/eap.1710>. Also, <https://phys.org/news/2018-04-high-wildfire-severity-young-plantation.html>. This concerns is highlighted by climate change which is extending the fire season. Roads also increase roadside ladder fuels and fire ignition risk. Conversely, another study shows that mature forests are more resilient to wildfire, which brings into question the long-held assumption that time-since-fire is an indicator of fuel build-upand increase dfire hazard. Lesmeister, D. B., S. G. Sovern, R. J. Davis, D. M. Bell, M. J. Gregory, and J. C. Vogeler. 2019. Mixed-severity wildfire and habitat of an old-forest obligate. Ecosphere 10(4):e02696. 10.1002/ecs2.2696. <https://esajournals.onlinelibrary.wiley.com/doi/pdf/10.1002/ecs2.2696>

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

**Pacific Fisher** – In 2014, FWS proposed listing the Pacific fisher as "threatened" under the ESA. A final listing decision is due in Fall 2015. The imminent listing of the fisher requires the agencies to increase connectivity in the NWFP. The current network of reserves was designed more for spotted owls and is not ideal for fishers which have more difficulty in navigating between reserves. William J. Zielinski, et al., Using landscape suitability models to reconcile conservation planning for two key forest predators, Biological Conservation (2006), doi:10.1016/j.biocon.2006.07.003. <http://www.sierraforestlegacy.org/Resources/Conservation/SierraNevadaWildlife/CaliforniaSpottedOwl/CASPO-Zielinski06.pdf> The agencies need to increase conservation of habitats in the matrix that are suitable or potentially suitable for fisher. This includes mature & old-growth forests and riparian reserves.

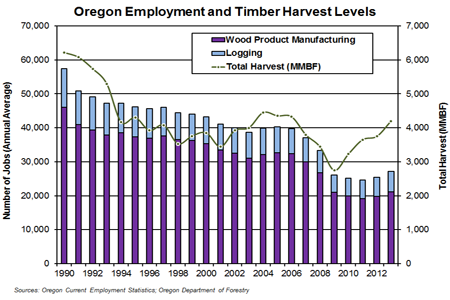
**The PNW economy has changed**. At the NWFP tenth anniversary conference on April 13, 2004 in Portland, USFS PNW Regional Economist Richard Haynes said that the NW economy has “fundamentally changed” over the last ten years since the NWFP was approved. The changes include: growth and diversification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

**The economic and social benefits of logging are decreasing**. As recently as 2001, there were 12 jobs generated per million board feet cut. In 2012, that ratio had declined to 6.5 jobs per million board feet logged. (Oregon Employment Department, July 17, 2014).



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

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

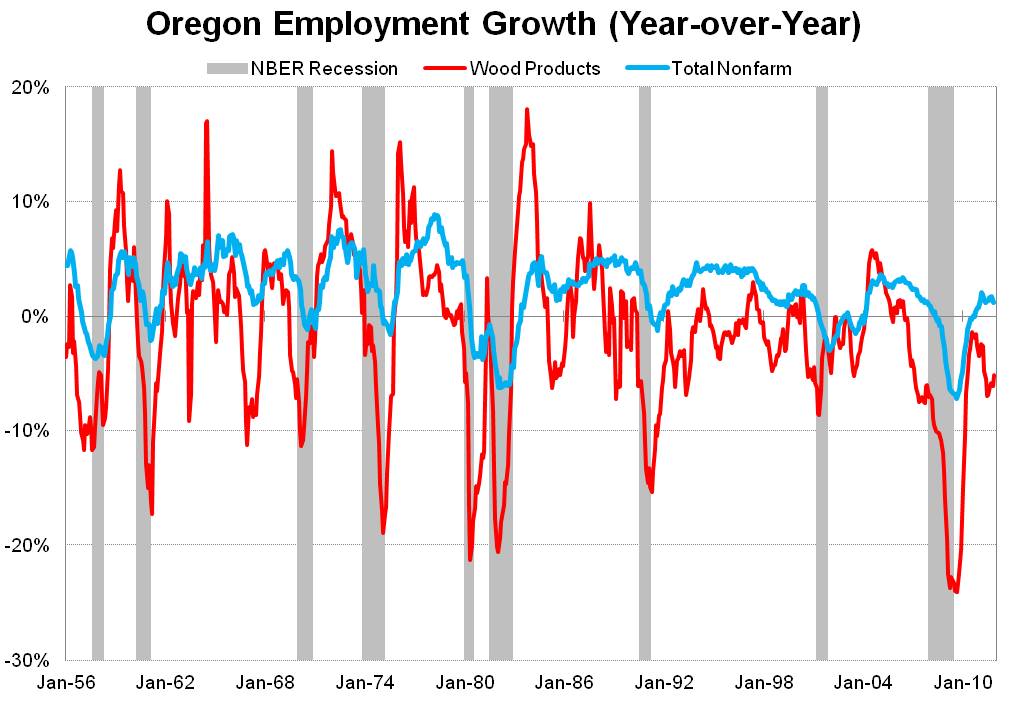


<https://www.qualityinfo.org/-/jobs-per-board-feet-of-timber-harvests-in-oregon>;

**Producing timber from federal lands feeds an inherently volatile industry that perpetuates community instability.** There is significant new information indicating that the timber industry is inherently volatile so proving timber from federal lands causes community instability rather than community stability. BLM’s 2015 Western Oregon Plan Revision DEIS (p 472) said:

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

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



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

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

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

**“Sustained yield” is based on flawed science**. Sustained yield logging in the matrix is premised on the concept of a “regulated forest.” As explained in the Days Creek – South Umpqua Harvest Plan EA “The key to achieving sustained yield is to establish a regulated forest with the proper distribution of stand age and size classes so that over time, approximately equal periodic harvests of the desired size and quality are produced. A ‘regulated forest’ consists of tree sizes in approximately equal parts and age classes that correspond to the size classes. To achieve the desired age class distribution, it is necessary that the harvest type resets the age class or seral stage, i.e. a regeneration harvest of selected stands is necessary, including regeneration harvest of intermediate-age classes. Over time, regeneration harvests can transform or convert an irregular forest structure to a regulated one (Hennes et al., 1971).” Unfortunately, this is only possible on paper. In the real world, none of this is possible, especially if the agency wishes to meet other important objectives such as water quality, climate stability, health populations of fish & wildlife, etc. See Jack Ward Thomas 1997. The Instability of Stability, <http://web.archive.org/web/20001201174000/http://coopext.cahe.wsu.edu/~pnrec97/thomas2.htm> (“The vision that I was taught in school of the "regulated forest" and the resultant predictable outputs of commodities has turned out to have been a dream. … By now it is becoming obvious that this dream was built on the pillars of the seemingly boundless virgin forest and an ethic of manifest destiny coupled with hubris of being able to predict the response of nature and humans. This was coupled with an inflated sense of understanding of forested ecosystems and of human control. Perhaps it is time to recognize that such stability is not attainable in any western region except for relatively short periods of years or decades. … It is increasingly apparent that ecological processes are not as well understood nor as predictable as had been assumed by natural resource managers steeped in Clementsian ecological theory of orderly and predictable succession of plant communities from bare ground to a mature, steady state. … In summary, the timber supply from federal lands is one drought, one insect and disease outbreak, one severe fire season, one election, one budget, one successful appeal, one loss in court, one listing of a threatened or endangered species, one new piece of pertinent scientific information, one change in technology, one shift in public opinion, one new law, one loss of a currently available technological tool, one change in market, one shift in interest rates, et al, away from "stability" at all times. And, these changes do not come one at a time, they come in bunches like banannas [sic] and the bunches are always changing. So, stability in timber supply from the public lands is simply a myth, a dream that was never founded in reality. It is time to stop pretending.”). See also: Donald Ludwig, Ray Hilborn, Carl Waters 1993. Uncertainty, Resource Exploitation, and Conservation: Lessons from History. Science, New Series, Vol. 260, No. 5104 (Apr. 2, 1993), pp. 17-36. <http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/exhibits/swrcb/swrcb_ludwig1993.pdf>

When we bring all these lines of evidence together one realizes that since the NWFP and the matrix land allocation was adopted there are many more reasons to protect forests and fewer reasons to log them. This needs to be considered in a new EIS. Since these significant new issues were not properly considered in the Northwest Forest Plan FEIS, the agency needs to address them in project level NEPA analyses. Since these significant new issues were not properly considered in the Northwest Forest Plan FEIS, the agency needs to address them here.

Preparation of new NEPA documents is a non-discretionary duty of all federal agencies. The CEQ regulations state that:

(c) Agencies:

(1) Shall prepare supplements to either draft or final environmental impact statements if:

… (ii) There are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.

40 CFR 1502.9(c). This duty applies to both EISs and EAs. ISC v. Alexander (9th Circ. 2000).

"A federal agency has a continuing duty to gather and evaluate new information relevant to the environmental impact of its actions.... [W]hen new information comes to light the agency must consider it, evaluate it, and make a reasoned determination whether it is of significance as to require formal NEPA procedures." *Warm Springs Dam Task Force v. Gribble*, 621 F.2d 1017, 1023-24 (9th Cir. 1980). "[T]he decision whether to prepare a supplemental EIS is similar to the decision whether to prepare an EIS in the first instance: If there remains 'major Federal actio[n]' to occur, and if the new information is sufficient to show that the remaining action will 'affec[t] the quality of the human environment' in a significant manner or to a significant extent not already considered, a supplemental EIS must be prepared." *Marsh v. ONRC*, 490 U.S. 360, 374, 109 S. Ct. 1851, 1859 (1989). While BLM is making decision to implement the regen harvest and mature forest thinning aspects of its RMP, it must first prepare a new or supplemental EIS to consider all the new information that has arisen over the last two decades. Most of the new information indicates that forest conservation is even more important than previously realized and that logging is less important than previously realized.

Similarly, under both NMFA and FLPMA, the agencies must “… prepare and maintain on a continuing basis an inventory of all public lands and their resources and other values … This inventory shall be kept current so as to reflect changes in conditions and to identify new and emerging resource and other values …” 43 USC 1711 (similar at 16 USC 1603). The resulting inventory shall be used in creating land use plans which are living documents, not a static end result. “The Secretary shall … develop, maintain, and when appropriate, revise land use plans …” 43 USC 1712 (similar at 16 USC 1604). These provisions, combined with NEPA’s action-driven mandate for considering “new circumstances or information,” and the multiple-use mandate to utilize resources in the combination that “best meet the present and future needs of the American people” (43 USC 1702, 16 USC 1601) create a non-discretionary duty to keep programmatic plans up to date.

The fact that LRMPs and RMPs are all 20 years old (and well beyond the expected life-span of the plans) just adds to the evidence indicating the need for reconsideration of the emphasis on timber production, when conservation is what’s needed.

## Do not rely on the flawed boilerplate climate analyses

As explained below, the Forest Service’s standardized NEPA language regarding carbon and climate change fails to take a hard look that NEPA requires. The analysis makes several highly misleading statements about forest carbon and climate change. The analysis inappropriately mischaracterizes the role of individual logging projects in the cumulative problem of global GHG emissions. The analysis misstates the effects of logging related carbon emissions that are not related to “deforestation.” The analysis grossly misstates the climate effects of logging intended to reduce disturbance. The analysis misleadingly implies that logging benefits the climate by increasing forest productivity.

The NEPA analysis should consider the adverse climate consequences of GHG emissions caused directly and indirectly by logging. The Forest Service should not rely on the boilerplate NEPA language from the regional office which is flawed in many ways. Instead the Forest Service:

* Must recognize the cumulative nature of the GHG emissions and climate problems. It does not matter that this project is small in the global scheme because all emissions matter when the causation is global and cumulative;
* Cannot credibly assert that this project is harmless because it’s not causing deforestation. This is immaterial. All GHG emissions, regardless of the source or how it is labelled, are part of the problem and cause the same climate impacts.
* Cannot credibly assert that thinning for forest health justifies or mitigates emissions from logging. Logging does not increase the capacity for growing trees. To the contrary, logging harms soil and reduces site productivity.
* Must not compare carbon *before and after* logging. That is an improper framework for NEPA analysis. The proper NEPA framework is to compare the effects of different alternatives (over time), so the agency must describe the carbon emissions and carbon storage in the forest over time *with* logging and *without* logging.
* Logging to reduce fire effects does not result in a net increase in forest carbon storage. The agency cannot predict the location, timing, or severity of future wildfires, so most fuel treatments will cause carbon emissions without any offsetting benefits from modified fire behavior. Studies clearly show that the total carbon emissions from logging (plus unavoidable wildfire) are greater than carbon emissions from wildfire alone.
* Cannot credibly assert that carbon storage in wood products is a useful climate strategy. Logging kills trees, stops photosynthesis, and initiates decay and combustion, with the end result being a significant transfer of carbon from the forest to the atmosphere. In stark contrast, an unlogged forest continues to grow and transfer more carbon from the atmosphere to the forest. Carbon emissions caused by logging far exceed the small fraction of carbon transferred to wood products. Carbon accounting methods that attempt to account for *substitution* of wood for other high-carbon building materials are fraught with uncertainty and too often represent maximum potential substitution effects rather than lower realistic estimates.

### Focus on the younger stands, defer the older stands.

Recent research by Tappeiner, Poage, and others indicates that a substantial portion of a tree’s size and character at several hundred years of age can be explained by the tree’s rate of growth at age 50. This leads to a tentative conclusion that thinning stands younger than 50 years old should be a higher priority than thinning stands older than 50 years.

Recent modeling also “found it difficult to alter the development trajectories of well-established young stands that were first managed at age class 50 [years]” and concluded that earlier intervention would have promoted deeper crowns and lead to greater diameter class differentiation. Andrews, Perkins, Thrailkill, Poage, Tappeiner. 2005. Silvicultural Approaches to Develop Northern Spotted Owl Nesting Sites, Central Coast Ranges, Oregon. West. J. Appl. For. 20(1):13-27.

The 1992 draft recovery plan for the Northern Spotted Owl urged early intervention in young stands because they are more “plastic” before crowns become too small and management option diminish. See 1992 Final Draft recovery plan for the Northern Spotted Owl pp 487-489.

Trees that still have a lot more growing to do are far more likely to respond well to thinning because they can put a lot more growth into their still-developing crowns, whereas older trees that are not expected to grow much higher have much less responsive crowns so will not respond as well to thinning. J.C. Tappeiner II, W.H. Emmingham, and D.E. Hibbs. Silviculture of Oregon Coast Range Forests. Chapter 7 in Forest and Stream Management in the Oregon Coast Range. Edited by Stephen D. Hobbs, John P. Hayes, Rebecca L. Johnson, Gordon H. Reeves, Thomas A. Spies, John C. Tappeiner II, and Gail E. Wells, 2002.

Thinning the harvest units that are less than 50 years old will hopefully have minimal impact on the environment (especially soil, water, and wildlife) and thinning such young stands will likely have long-term ecological benefits in terms of accelerating late successional forest characteristics.

However, thinning the harvest units that are over 50 years old is more likely to have significant environmental impacts and the long-term benefits in terms of accelerating development of late-successional characteristics is uncertain at best. Recent science tells us that thinning in older stands is less likely to change the trajectory of the stands. The agency should refocus its efforts on younger stands where the results are likely to be on balance more beneficial.

There is scientific controversy over the question of whether and to what degree it is beneficial to thin older trees to accelerate late-successional characteristics. An EIS is needed to address this question.

Stimulating the development of a diverse understory is often used as a justification for thinning, but this may not be justified in stands older than about 40 years. A systematic review of 917 Forest Inventory and Analysis (FIA) plots in western Oregon (mostly on non-federal lands) found, “Contrary to expectations of canopy closure, mean canopy cover by age class rarely exceeded 85 percent, even in unthinned productive young conifer forests. Possibly as a result, effects of stand age on understory vegetation were minimal, except for low levels of forbs found in 20- to 40-year-old wet conifer stands. … Although heavily thinned stands had lower total cover, canopy structure did not differ dramatically between thinned and unthinned stands. Our findings suggest potential limitations of simple stand succession models that may not account for the range of forest types, site conditions, and developmental mechanisms found across western Oregon.” McIntosh, Anne C.S.; Gray, Andrew N.; Garman, Steven L. 2009. Canopy structure on forest lands in western Oregon: differences among forest types and stand ages. Gen. Tech. Rep. PNW-GTR-794. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 35 p. <http://www.fs.fed.us/pnw/pubs/pnw_gtr794.pdf>. This seems to indicate that the benefits of thinning may be best realized in dense stands younger than 40 years old. This study also showed that in wet conifer stands the mean Canopy Height Diversity Index and the mean Simpson’s Diversity Index of tree heights leveled off at about age 65. This study also looked at canopy conditions after three levels of thinning intensities (heavy, light, and none). “Mean cover of the lower canopy layer was nominal for all three thinning intensities. … There were no evident trends between understory cover and thinning history; both shrub and forb cover were fairly similar among the three thinning intensities. … The lack of a strong effect of crown closure on understory cover may be related to our finding that mean crown cover did not exceed 85 percent. … We expected greater cover of understory vegetation in thinned than in unthinned stands but did not detect significant differences in this analysis.”

Scientists have also presented findings that many young densely stocked stands may not develop into late-successional stands as projected in the Northwest Forest Plan. This is new information that must be addressed in a new EIS to consider the consequences of more thinning of young stands (or the lack thereof) on spotted owls and all the other species dependent upon late-successional habitat.

The NEPA analysis should have a good discussion (in light of recent research results) of the anticipated impacts and benefits of thinning on the different age classes of trees in the different harvest units. The NEPA analysis should include another alternative that considered deferring harvest of the older stands.

“Within stands … lacking in late-successional habitat, those stands that would respond to treatment by accelerated development into late-successional habitat. Younger stands are generally more responsive to treatment, and should be considered higher priority than older mid-successional stands, relative to this objective.” Shasta-Trinity Forest-wide LSR Assessment. 8-26-1999.

A study of the effects of thinning on tree stability and height/diameter ratios found:

The results suggest that plantation H/D values can be lowered and stability promoted through reduced planting densities or early thinning; however, later thinnings may not be effective in promoting stability, since they do not appear to lower H/D values. Higher initial planting densities shorten the time period during which thinning can be expected to effectively lower future H/D values. … [H]igh density stands have limited stand-height window during which thinning can be used to improve future stand stability substantially.

Wilson, J.S., and C.D. Oliver. 2000. Stability and Density Management in Douglas-fir Plantations**,** Can. J. For. Res. 30(6): 910-920 (2000).

See Muir, P.S., R.L. Mattingly, J.C. Tappeiner II, J.D. Bailey, W.E. Elliott, J.C. Hagar, J.C. Miller, E.B. Peterson, and E.E. Starkey. 2002. Managing for biodiversity in young Douglas-fir forests of western Oregon. U.S. Geological Survey, Biological Resources Division, Biological Science Report USGS/BRD/BSR–2002-0006. 76 pp. <http://www.fsl.orst.edu/cfer/pdfs/mang_bio.pdf>.

The Eugene BLM described the expected result of thinning a dense stand of 77 year old Douglas-fir—

Thinning … by itself, would not speed development of late-successional forest structure. Thinning would retain a relatively high overstory density and would result in only a modest increase in diameter growth of the retained trees. Additional thinning or other disturbance that would substantially lower overstory density would be needed before the stand would develop late-successional structure, such as multiple canopy layers, shade-tolerant conifer understory, or a wide range of tree diameters (Spies and Franklin 1991; see also BLM 2003, pp. 66-69, 171-174).

Eugene BLM. Bear Creek Timber Sale EA, April 2004. <http://www.edo.or.blm.gov/planning/nepa/documents/BearCrkEA.pdf> (link broken 7/31/2012).

The age at which a forest is thinned has a strong effect on aboveground C storage. Evidence from the few PCT studies that considered timing of thinning shows that total stem volume, which is a large component of the aboveground C (Harmon et al., 2004), is greater in stands thinned early as compared to stands thinned later (Varmola and Salminen, 2004). This is consistent with stand dynamics theory, which suggests that wood volume growth rates recover more quickly from early thinnings than from late thinnings (Oliver and Larson, 1996; Long et al., 2004; Varmola and Salminen, 2004).

Michael S. Schaedel, Andrew J. Larson, David L.R. Affleck, R. Travis Belote, John M. Goodburn, Deborah S. Page-Dumroese. 2017. Early forest thinning changes aboveground carbon distribution among pools, but not total amount. Forest Ecology and Management 389 (2017) 187–198. <https://www.fs.fed.us/rm/pubs_journals/2017/rmrs_2017_schaedel_m001.pdf>.

All logging, including thinning stands of any age, include some adverse impacts and trade-offs. Some impacts of logging are unavoidable, so there is no such thing as a logging operation that is 100% beneficial. Depending on how thinning is done thinning can have adverse impacts such as soil disturbance, habitat disturbance, carbon removal, spreading weeds, reduced recruitment of snags, road-related erosion and hydrologic impacts, moving fuels from the canopy to the ground, hotter-drier-windier microclimate that is favorable to greater flame lengths and rate of fire spread, etc. Some of these negative effects are fundamentally unavoidable, therefore all thinning has negative effects that must be compensated by beneficial effects such as reducing competition between trees so that some can grow larger faster, increased resistance drought stress and insects, increasing species diversity, possible fire hazard reduction, etc. It is generally accepted that when thinning very young stands, the benefits outweigh the adverse impacts and net benefits are likely. It is also widely understood that thinning older stands tends to have greater impacts on soil, water, weeds, carbon, dead wood recruitment so the impacts very often outweigh the benefits, resulting in net negative ecological outcome on the balance sheet. As we move from young forest to older forests, the net benefits turn into net negative impacts, but where is that line? The authors of the Northwest Forest Plan took all this into account and determined that 80 years is a useful place to draw the line between forests that are likely to benefit from silviculture and those that are likely to experience net negative consequences. There is no new science to change that conclusion. In fact, new information developed since 1994 shows that dead wood is probably more valuable than previously thought - being important for a wide variety of ecological functions, not least of which is providing complex habitat that supports prey species for spotted owl and a variety of other predators both east and west of the Cascades. As stands become mature at around 80 years of age, they begin accumulating snags and dead wood from natural mortality processes. Thinning “captures mortality” and removes it from the forest thus preventing those trees from ever becoming snags and dead wood and interrupting the critical process whereby mature forests accumulate dead wood. The loss of recruitment of dead wood habitat when logging older stands is a long-term impact and provides a very strong argument against logging in stands over 80 years old. For further information see 1993 SAT Report pp 146-152. AND February 1991 Questions and Answers on A Conservation Strategy for the Northern Spotted Owl (prepared in response to written questions from the Senate Energy and Natural Resources Committee to the Interagency Scientific Committee on the May 1990 ISC Report. AND Jerry Franklin, David Perry, Reed Noss, David Montgomery, Christopher Frissell. SIMPLIFIED FOREST MANAGEMENT TO ACHIEVE WATERSHED AND FOREST HEALTH: A CRITIQUE. National Wildlife Federation. <http://www.coastrange.org/documents/forestreport.pdf>.

Robert Anthony reminded the regional executives in 2013 that:

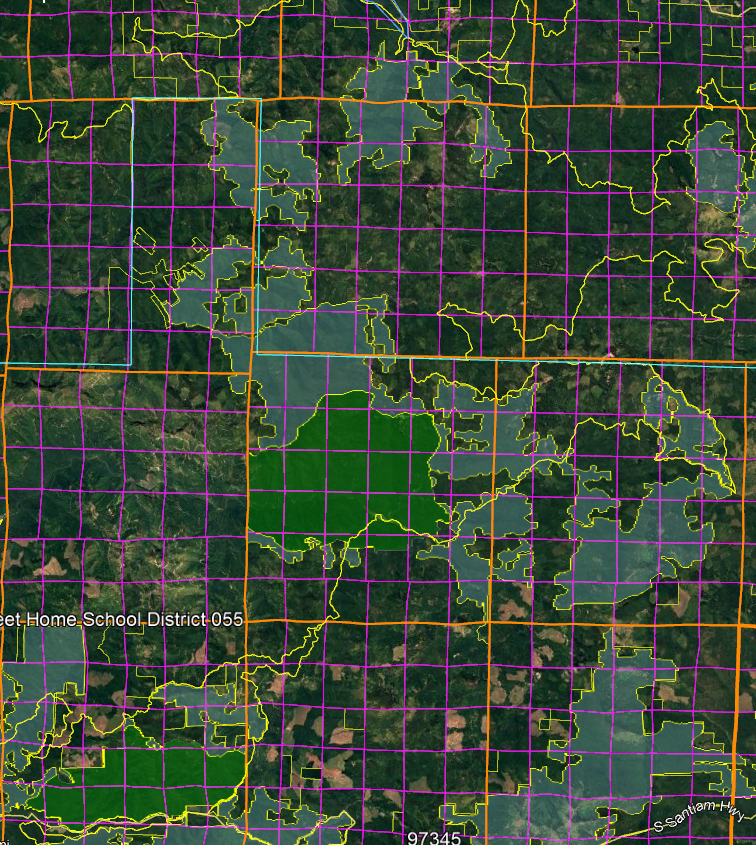
The long-term benefits of thinning in young plantations to create forests with characteristics of late-successional forests (e.g. large diameter standing and down wood) may outweigh any short-term negative effects on owls or their prey. However, as the age of forests selected for thinning increases, the short-term negative effects of such activities will likely increase and the benefits decrease. The Northwest Forest Plan specified a maximum age of 80 years for forests that are slated for thinning. The reasons for this guideline were that (1) it was unclear if thinning could actually accelerate the rate at which naturally regenerated mature forests developed old forest conditions, and (2) spotted owls forage in mature forests, and thinning of these forests will likely reduce their quality as spotted owl habitat both in the short and long term.

Anthony, R.G. 2013. “Effects of Riparian Thinning on Marbled Murrelets and Northern Spotted Owls.” Part III of the Science Review Team for the identification and interpretation of the best available scientific information to determine effects of riparian forest management. 28 January 2013.

Another study that supports the emphasis on early intervention is Peter, David H.; Harrington, Constance A. 2010. Reconstructed old-growth forest stand structure and composition of two stands on the Olympic Peninsula, Washington state. Res. Pap. PNW-RP-583. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 22 p. <http://www.fs.fed.us/pnw/pubs/pnw_rp583.pdf> (“These sites appear to have multiple developmental pathways determined by events **early** in their stand histories that affect stand structure and composition for hundreds of years. This has implications for the possibilities of, and methodologies for, restoration of old-growth structure and function. But, naturally or through silvicultural manipulation, diversification in at least these plant associations is encouraged by lower **early** conifer density, patchy spacing of dominant trees, and prevention of immediate conifer occupancy of openings.”)

# Protect the Values of Inventoried and Uninventoried Roadless and Low-Road-Density Areas

Several proposed harvest units appear to be located within ecologically significant unroaded areas. The blue-gray polygons shown below are unroaded.



Also, see map attached, based on pre-scoping information.

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

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. <http://rspb.royalsocietypublishing.org/content/royprsb/early/2009/11/25/rspb.2009.1771.full.pdf>

Ibisch et al (2016) said

The planet’s remaining large and ecologically important tracts of roadless areas sustain key refugia for biodiversity and provide globally relevant ecosystem services. … Global protection of ecologically valuable roadless areas is inadequate. International recognition and protection of roadless areas is urgently needed to halt their continued loss.

…

The impact of roads on the surrounding landscape extends far beyond the roads themselves. Direct and indirect environmental impacts include deforestation and fragmentation, chemical pollution, noise disturbance, increased wildlife mortality due to car collisions, changes in population gene flow, and facilitation of biological invasions (1–4). In addition, roads facilitate “contagious development,” in that they provide access to previously remote areas, thus opening them up for more roads, land-use changes, associated resource extraction, and human-caused disturbances of biodiversity (3, 4). With the length of roads projected to increase by >60% globally from 2010 to 2050 (5), there is an urgent need for the development of a comprehensive global strategy for road development if continued biodiversity loss is to be abated (6). To help mitigate the detrimental effects of roads, their construction should be concentrated as much as possible in areas of relatively low “environmental values” (7). Likewise, prioritizing the protection of remaining roadless areas that are regarded as important for biodiversity and ecosystem functionality requires an assessment of their extent, distribution, and ecological quality.

…

There is an urgent need for a global strategy for the effective conservation, restoration, and monitoring of roadless areas and the ecosystems that they encompass. Governments should be encouraged to incorporate the protection of extensive roadless areas into relevant policies and other legal mechanisms, reexamine where road development conflicts with the protection of roadless areas, and avoid unnecessary and ecologically disastrous roads entirely. In addition, governments should consider road closure where doing so can promote the restoration of wildlife habitats and ecosystem functionality (4).

…

To achieve global biodiversity targets, policies must explicitly acknowledge the factors underlying prior failures (13). Despite increasing scientific evidence for the negative impacts of roads on ecosystems, the current global conservation policy framework has largely ignored road impacts and road expansion.

…

In the much wider context of the United Nations’ Sustainable Development Goals, conflicting interests can be seen between goals intended to safeguard biodiversity and those promoting economic development (14).

…

Enshrined in the protection of roadless areas should be the objective to seek and develop alternative socioeconomic models that do not rely so heavily on road infrastructure. … Although we acknowledge that access to transportation is a fundamental element of human well-being, impacts of road infrastructure require a fully integrated environmental and social cost benefits approach (15). Still, under current conditions and policies, limiting road expansion into roadless areas may prove to be the most cost effective and straightforward way of achieving strategically important global biodiversity and sustainability goals.

Pierre L. Ibisch, Monika T. Hoffmann, Stefan Kreft, Guy Pe’er, Vassiliki Kati, Lisa Biber-Freudenberger, Dominick A. Dellasala, Mariana M. Vale, Peter R. Hobson, Nuria Selva. 2016. A global map of roadless areas and their conservation status. SCIENCE 16 DEC 2016 : 1423-1427. <http://science.sciencemag.org/content/354/6318/1423>

Our planet is in the midst of a significant extinction event caused by habitat destruction and climate change. Protecting existing wilderness-quality lands will pay huge dividends for biodiversity.

... we model the persistence probability of biodiversity, combining habitat condition with spatial variation in species composition, to show that retaining these remaining wilderness areas is essential for the international conservation agenda. Wilderness areas act as a buffer against species loss, as the extinction risk for species within wilderness communities is—on average—less than half that of species in non-wilderness communities.

Di Marco, M., Ferrier, S., Harwood, T.D. et al. Wilderness areas halve the extinction risk of terrestrial biodiversity. Nature 573, 582–585 (2019) doi:10.1038/s41586-019-1567-7. <https://www.nature.com/articles/s41586-019-1567-7>. See also, Keim, B. 2019. Wilderness areas could reduce extinction risks by more than half. Anthropocene Magazine. October 23, 2019 <http://www.anthropocenemagazine.org/2019/10/importance-of-wilderness/>

Roadless and unroaded areas also play a significant role in both climate change mitigation (through carbon storage) and climate change adaptation (by facilitating connectivity and resilience to disturbance).

**Transportation infrastructure and carbon sequestration**

The topic of the relationship of road restoration and carbon has only recently been explored. [and there are presumably similar carbon benefits from conserving unroaded areas and not building roads in the first place.] There is the potential for large amounts of carbon (C) to be sequestered by reclaiming roads.When roads are decompacted during reclamation, vegetation and soils can develop more rapidly and sequester large amounts of carbon. A recent study estimated total soil C storage increased 6 fold to 6.5 x 107g C/km (to 25 cm depth) in the northwestern US compared to untreated abandoned roads (Lloyd et al. 2013). Another recent study concluded that reclaiming 425 km of logging roads over the last 30 years in Redwood National Park in Northern California resulted in net carbon savings of 49,000 Mg carbon to date (Madej et al. 2013, Table 5).

**...**

**Benefits of roadless areas and roadless area networks to climate change adaptation**

Undeveloped natural lands provide numerous ecological benefits. They contribute to biodiversity, enhance ecosystem representation, and facilitate connectivity (Loucks et al. 2003; Crist and Wilmer 2002, Wilcove 1990, The Wilderness Society 2004, Strittholt and Dellasala 2001, DeVelice and Martin 2001), and provide high quality or undisturbed water, soil and air (Anderson et al. 2012, Dellasalla et al. 2011). They also can serve as ecological baselines to help us better understand our impacts to other landscapes, and contribute to landscape resilience to climate change.

Forest Service roadless lands, in particular, are heralded for the conservation values they provide. These are described at length in the preamble of the Roadless Area Conservation Rule (RACR)4 as well as in the Final Environmental Impact Statement (FEIS) for the RACR5 , and include: high quality or undisturbed soil, water, and air; sources of public drinking water; diversity of plant and animal communities; habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, undisturbed areas of land; primitive, semi-primitive non- motorized, and semi-primitive motorized classes of dispersed recreation; reference landscapes; natural appearing landscapes with high scenic quality; traditional cultural properties and sacred sites; and other locally identified unique characteristics (e.g., include uncommon geological formations, unique wetland complexes, exceptional hunting and fishing opportunities).

The Forest Service, National Park Service, and US Fish and Wildlife Service recognize that protecting and connecting roadless or lightly roaded areas is an important action agencies can take to enhance climate change adaptation. For example, the Forest Service National Roadmap for Responding to Climate Change (USDA Forest Service 2011b) establishes that increasing connectivity and reducing fragmentation are short and long term actions the Forest Service should take to facilitate adaptation to climate change.6 The National Park Service also identifies connectivity as a key factor for climate change adaptation along with establishing “blocks of natural landscape large enough to be resilient to large-scale disturbances and long-term changes” and other factors. The agency states that: “The success of adaptation strategies will be enhanced by taking a broad approach that identifies connections and barriers across the landscape. Networks of protected areas within a larger mixed landscape can provide the highest level of resilience to climate change.”7 Similarly, the National Fish, Wildlife and Plants Climate Adaptation Partnership’s Adaptation Strategy (2012) calls for creating an ecologically-connected network of conservation areas.8

Crist and Wilmer (2002) looked at the ecological value of roadless lands in the Northern Rockies and found that protection of national forest roadless areas, when added to existing federal conservation lands in the study area, would 1) increase the representation of virtually all land cover types on conservation lands at both the regional and ecosystem scales, some by more than 100%; 2) help protect rare, species-rich, and often-declining vegetation communities; and 3) connect conservation units to create bigger and more cohesive habitat “patches.”

Roadless lands also are responsible for higher quality water and watersheds. Anderson et al. (2012) assessed the relationship of watershed condition and land management status and found a strong spatial association between watershed health and protective designations. Dellasalla et al. (2011) found that undeveloped and roadless watersheds are important for supplying downstream users with high-quality drinking water, and developing these watersheds comes at significant costs associated with declining water quality and availability. The authors recommend a light-touch ecological footprint to sustain the many values that derive from roadless areas including healthy watersheds.

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

The Forest Service defines unroaded areas as any area without the presence of classified roads, and of a size and configuration sufficient to protect the inherent characteristics associated with its roadless condition. [http://web.archive.org/web/20010729111100/http://roadless.fs.fed.us/documents/feis/glossary.shtml](http://web.archive.org/web/20010729111100/http:/roadless.fs.fed.us/documents/feis/glossary.shtml). Unroaded areas greater than about 1,000 acres, whether they have been inventoried or not provide valuable natural resource attributes that must be protected. These include: water quality; healthy soils; fish and wildlife refugia; centers for dispersal, recolonization, and restoration of adjacent disturbed sites; reference sites for research; non-motorized, low-impact recreation; carbon sequestration; refugia that are relatively less at-risk from noxious weeds and other invasive non-native species, and many other significant values. See Forest Service Roadless Area Conservation FEIS, November 2000.

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

Before logging roadless areas the agency should consider the impacts to all the values of roadless areas, including:

(1) High quality or undisturbed soil, water, and air;

(2) Sources of public drinking water;

(3) Diversity of plant and animal communities;

(4) Habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, undisturbed areas of land;

(5) Primitive, semi-primitive non-motorized and semi-primitive motorized classes of dispersed recreation;

(6) Reference landscapes;

(7) Natural appearing landscapes with high scenic quality;

(8) Traditional cultural properties and sacred sites; and

(9) Other locally identified unique characteristics.

36 CFR §294.11 (2001). <https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5050459.pdf>

We are aware that the PNW Regional office issued a directive relative to uninventoried roadless areas, aka “undeveloped areas”. This 11-24-04 memo from Lisa Freedman wisely instructs the Forest Service to give consideration to “special” features of undeveloped areas regardless of size. However, this memo also has some troubling instructions that deserve mention. First, the memo instructs Forests not to "establish a permanent identity or inventory for these areas" which not only interferes with efficient management of information and natural resources but also violates the NFMA mandate to maintain an accurate and up-to-date inventory of the renewable resources of the National Forests. See 16 U.S.C. 1603 which says "the Secretary of Agriculture shall develop and maintain on a continuing basis a comprehensive and appropriately detailed inventory of all National Forest System lands and renewable resources. This inventory shall be kept current so as to reflect changes in conditions and identify new and emerging resources and values." Second, Forests are instructed to focus their analysis on the "effects of the proposed activity where the effects occur rather than on identification or inventory of the undeveloped area." How can the effects of management be adequately disclosed “where they occur” or anywhere else for that matter, UNLESS the qualities of the area are fully understood through identification and inventory. This memo essentially instructs the Forest Service to (i) routinely destroy factual information about resources under its management, and (ii) provide uninformed disclosure of the effects of proposed management action without collecting and considering contextual information about roadless/undeveloped areas that could be affected. If the Forest Service follows these instructions they will be violating NEPA, so don’t do it.

The Forest Service adopted new guidance concerning ecological restoration and resilience which urges managers to “Identify opportunities to sustain ecological refugia that may serve as vital sources of ecological diversity.” FSM 2020.3 – Policy. <http://web.archive.org/web/20090511091720/http://www.fs.fed.us/im/directives/fsm/2000/id_2020-2008-1.doc>. This is an opportunity to look at uninventoried roadless areas in a fresh new light.

“It is well established in this [9th] Circuit that logging in an unroaded area is an ‘irreversible and irretrievable’ commitment of resources and ‘could have serious environmental consequences.’” and therefore requires an EIS. Sierra Club v. Austin No 03-35419; DC No. CV-03- 00022 DWM (9th Circ. 2003), *citing* Smith v. Forest Service 33 F.3d 1072, 1078 (9th Circ. 1994). This project involves activities in such unroaded areas. The NEPA analysis for this project does not adequately discuss the impacts of proposed activities on all the many significant values of roadless/unroaded areas.

The 9th Circuit has held that the agencies have a NEPA obligation to consider the potential for future wilderness designation before conducting management activities in areas that may be eligible for wilderness, even if they are not inventoried roadless areas. The Lands Council v. Martin, (9th Circ, June 25, 2008). <http://www.ca9.uscourts.gov/datastore/opinions/2008/06/24/0735804.pdf> (The court enjoined salvage logging that would have affected uninventoried roadless areas less than 5,000 acres in size that were located adjacent and contiguous with an inventoried roadless area.)

The agency can develop a preliminary map of roadless/unroaded areas >1,000 acres by simply querying your GIS database for polygons between roads that are >1,000 acres. This preliminary map can be made more accurate by subtracting regen harvest units younger than 50 years.

Oregon Wild conducted such an inventory as follows:

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

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

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

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

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

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.

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

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

…

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

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

…

RDAT Recommendation (4): The Regional Executives provide direction to the field units that allow for road construction in undesignated low road density areas only after completion of the mid/fine scale analysis of these areas.  
  
Regional Executive Decision:While we agree that avoiding road construction in low road density areas with high to very high fish values may be desirable, we also recognize that providing direction precluding such development could conflict in some instances with our legal obligations under laws such as the Alaska National Interest Lands Conservation Act (ANILCA) and the 1872 Mining Laws. Rather than totally precluding such development, the BLM State Directors and Regional Foresters, through this transmittal letter, direct field units as follows:

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

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

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

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

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

The Willamette National Forest conducted a Pilot Roads Analysis dated October 1998 in which they identified unroaded areas 1,000 acres and greater. They said:

In recent years, the issue of unroaded lands on National Forests has become greater and more diverse than simply identifying the potential for inclusion in the National Wilderness Preservation System. In a broad sense, there is a diversity of values regarding roadless areas and these values often conflict. As the total amount of roadless area not included in the wilderness system continues to decline on the Forest, there is increased interest in the value of smaller unroaded areas.

…

The key question is: *Where are the significant aquatic, terrestrial wildlife or ecological values associated with unroaded areas?*

Inventoried roadless areas mapped in 1984, total 210,509 acres. Of these, the area still roadless in 1998 is 112,166 acres.

…

Our recommendation is to continue refinement of the unroaded map at the watershed level, identifying areas of significant ecological values and where they overlap with unroaded areas.

http://web.archive.org/web/20050310112742/http://www.fs.fed.us/r6/willamette/manage/pilotroadanalysis/index.html. <http://web.archive.org/web/20050313185628/http://www.fs.fed.us/r6/willamette/manage/pilotroadanalysis/unroaded.pdf>.

The WNF Roadless Values Process Paper, Appendix L goes on to say:

The values associated with roadless can be associated with recreation, symbolism of people's value for wild places, the lifestyle of a community and a variety of ecological values. Many of these values can be met in roadless areas that do not meet the minimum size criteria (5,000 acres) of the RARE I and RARE II inventories.

…

The question about significant ecological values in the inventoried roadless areas and in the unroaded areas was not directly addressed in this analysis.

<http://web.archive.org/web/20050313135045/http://www.fs.fed.us/r6/willamette/manage/pilotroadanalysis/app_g-n.pdf>.

The Willamette National Forest has taken the first steps by: (1) acknowledging the significant loss of almost half of the large roadless/unroaded areas on the forest in the last 20 years; (2) acknowledging the value of smaller unroaded areas; and (3) identifying 1,000+ acre unroaded areas for further analysis, but the proper consideration of roadless/unroaded values requires explicit disclosure of all the values associated with roadless/unroaded areas and an EIS analysis of the impacts of proposed actions on each of those values (e.g., water quality; healthy soils; fish and wildlife refugia; centers for dispersal, recolonization, and restoration of adjacent disturbed sites; reference sites for research; non-motorized, low-impact recreation; carbon sequestration; refugia that are relatively less at-risk from noxious weeds and other invasive non-native species).

The 0.25 mile moving window analysis used in the Willamette NF Pilot Roads Analysis had the effect of shrinking *de facto* roadless/unroaded areas that still contribute significantly to the unroaded values of large intact landscape blocks. Oregon Wild’s roadless/unroaded map is a more accurate representation of the actual area that needs to be protected from logging and road building in order to conserve roadless/unroaded values.

Roadless/unroaded area boundaries are an issue that has never been validated in any NEPA process. Only arbitrary Forest Service designation, outside of any public appeal opportunity, has set these boundaries. As part of this NEPA analysis, the roadless/unroaded boundaries should be validated. This is addressed clearly by the California v. Block decision and others.

An action does not have to occur inside a RARE II boundary to affect a roadless area, because RARE II is not the final word on roadless lands. As the Forest Service is abundantly aware, the court ruled in *California v. Block* that actions affecting wilderness status could not rely on RARE II. The court ruled that RARE II did not comply with NEPA and “was inadequate to support the non-wilderness designations of the disputed areas and therefore violated NEPA.” In the present case, the Forest Service is relying on an illegitimate RARE II boundary of this roadless area to support its contention that logging may occur in de facto roadless land without affecting future wilderness designation.

Further, the Forest Service Washington Office ruled in its appeal decision of the Idaho Panhandle Forest Plan Appeal that roadless areas must be evaluated individually when logging is to occur in them.

The fact that several of the units of this timber sale do not fall within the RARE II boundary but *do* fall adjacent to it and undivided from it by any road requires the Forest Service to address roadless/unroaded impacts per the NFMA and to acknowledge to the public the effects to the roadless/unroaded resource. Judging from the controversy surrounding roadless/unroaded lands these days, such an analysis would need to occur in an EIS.

An EIS is needed to consider the significant environmental impacts of proposed activities in roadless/unroaded areas. The agency should consider the effects of this project on uninventoried roadless areas like the Rogue River National Forest considered unroaded areas in the recent Mill Creek DEIS. (Note: Although the Rogue River National Forest should be commended for considering uninventoried roadless areas in an EIS and for developing an alternative that deferred entry into unroaded and old-growth areas, they did NOT adequately analyze the impact of the proposed project on the values embodied by the uninventoried roadless areas.)

## New information on Unroaded Areas >1,000 acres

The agency cannot limit its analysis of roadless areas to inventoried areas >5,000 acres, because smaller roadless areas that were not inventoried are ecologically relevant and potentially significant. The NEPA analysis must reflect the growing scientific evidence (cited below) indicating the significant value of roadless areas smaller than 5,000 acres and larger than 1,000 acres. Recent scientific literature emphasizes the importance of unroaded areas greater than 1,000 acres as strongholds for the production of fish and other aquatic and terrestrial species, as well as sources of high quality water. Commercial logging and/or road building within large unroaded areas threatens these significant ecological values.

First, it is important to recognize that about 30% of inventoried roadless areas (IRA) nationwide are smaller than 5,000 acres. It is therefore likely that the diverse and significant values of IRAs can be found within many other unroaded areas between 1,000 and 5,000 acres that were simply not inventoried. NEPA requires that these values be recognized and the effects of logging and roads be carefully disclosed and considered. Martin, DeVelice, Brown. 2001. Landscape Analysis and Biodiversity Specialist Report. Forest Service Roadless Area Conservation FEIS. November 2000. <http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm8_035781.pdf>

Small areas are important for conserving biodiversity of species with small home ranges, species with special habitat needs, or for providing linkages between larger areas. … Of the more than 2,800 named inventoried roadless areas, about 70% of these areas are larger than 5,000 acres (USDA Forest Service 2000a).

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>.

# Avoid Roadbuilding

The Forest Service should consider an alternative that does not build any new roads. There are already too many roads on the landscape. Temporary roads are temporary only in name. The actual environmental effects on soil, water, and vegetation are in fact long-lasting.

Problems with roads/culverts include:

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

Logging always has unavoidable adverse impacts on soil, water, weeds, and wildlife, and carbon stores. In order to support the assertion that logging is really restoration and not just timber production under a new name, these adverse impacts must be mitigated with clear conservation benefits. Road building has many adverse and long-lasting impacts on soil, water, weeds, wildlife and carbon. When roads building is a part of a restoration logging project, it becomes much more difficult for the benefits to clearly off-set the additional adverse impacts.

Nothing is worse for sensitive wildlife than a road. Over the last few decades, studies in a variety of terrestrial and aquatic ecosystems have demonstrated that many of the most pervasive threats to biological diversity - habitat destruction and fragmentation, edge effects, exotic species invasions, pollution, and overhunting - are aggravated by roads. Roads have been implicated as mortality sinks for animals ranging from snakes to wolves; as displacement factors affecting animal distribution and movement patterns; as population fragmenting factors; as sources of sediments that clog streams and destroy fisheries; as sources of deleterious edge effects; and as access corridors that encourage development, logging and poaching of rare plants and animals. Road-building in National Forests and other public lands threatens the existence of de facto wilderness and the species that depend on wilderness.

Noss, Reed; The Ecological Effects of Roads;

<http://www.wildlandscpr.org/ecological-effects-roads>; <http://www.eco-action.org/dt/roads.html>.

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

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

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

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

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

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

...

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

...

**Transportation infrastructure and carbon sequestration**

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

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

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

Colombaroli, D. and D.G. Gavin. 2010. Highly episodic fire and erosion regime over the past 2000 years in the Siskiyou Mountains, Oregon. Proceedings of the National Academy of Sciences of the United States of America 107: 18909-18914. <http://www.pnas.org/content/early/2010/10/13/1007692107.full.pdf>.

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

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

…

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

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

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

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

**Roads and Associated Activity**

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

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

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

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

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

…

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

of an individual subwatershed.

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

EPA describes the impacts of roads as follows:

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

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

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

See also NRDC Report: “End of the Road: The Adverse Ecological Impacts of Roads and Logging: A Compilation of Independently Reviewed Research” (1999) which discusses the fact that roads:

1. Harm Wildlife

2. Spread Tree Diseases and Bark Beetles

3. Promote Insect Infestations

4. Cause Invasion by Harmful Non-native Plant and Animal Species

5. Damage Soil Resources and Tree Growth

6. Adversely Impact Aquatic Ecosystems

<http://www.nrdc.org/land/forests/roads/eotrinx.asp>.

## Avoid Roads in Reserves

“An extensive road system is in conflict with LSR objectives. The road network creates contrasting edges of forest habitat, fragments connecting habitat, creates barriers to species movement, and provides access and opportunities for humans to extract natural resources.” Hehe LSR Thin Decision Notice. Willamette National Forest. October 31, 2007. <http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5050106.pdf>

### Avoid unnecessary construction of temporary roads

If young stand thinning requires construction of temporary roads, the agency should do an analysis that illuminates how many acres of thinning are reached by each road segment so that we can distinguish between short segments of spur that allow access to large areas (big benefit, small cost) and long spurs that access small areas (small benefit, big cost). This can help inform the decision-maker’s balancing of the costs and benefits of thinning and roading.

The 1994 NWFP ROD (p 68) says “Standards and guidelines for Alternative 9 require that new road construction be substantially limited. Any road construction associated with silvicultural treatments inside late-successional reserve would be subject to the overall ‘beneficial’ requirement for such activities. That is, if the value of a thinning was negated by the habitat lost through road construction to the thinning, the activity should not proceed.”

The Coos Bay BLM’s Brummit Creek Density Management EA (2005) includes a useful table showing the length of each road (new, renovated, improved), the unit acres that are accessed by each road, and the acres of unit per mile of road. This is a useful way to evaluate and prioritize road work relative the expected benefits of thinning.

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

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

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

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

The Roadless FEIS also says:

Temporary roads present most of the same risks posed by permanent roads, although some may be of shorter duration. Many of these roads are designed to lower standards than permanent roads, are typically not maintained to the same standards, and are associated with additional ground disturbance during their removal. Also, use of temporary roads in a watershed to support timber harvest or other activities often involves construction of multiple roads over time, providing a more continuous disturbance to the watershed than a single, well-designed, maintained, and use-regulated road. While temporary roads may be used temporarily, for periods ranging up to 10 years before decommissioning, their short- and long-term effects on aquatic species and habitats can be extensive. [The FEIS has similar disclosures citing extensive impacts to terrestrial species and habitats, and rare plant populations.]

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

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

The agency assumes that temporary and semi-permanent new roads will have no effect because they are temporary. The agency has shown no scientific evidence for this assumption. In fact, scientific research has shown exactly the opposite. Effectiveness of Road Ripping in Restoring Infiltration Capacity of Forest Roads. Charles H. Luce, USDA Forest Service Intermountain Research Station, 1221 S. Main, Moscow, ID 83843. September 1996. Restoration Ecology, Vol. 5, No. 3. page 268.

Please consider George Wuerthner’s summary of the many problems with so-called temporary roads. George Wuerthner 2009. Temporary Roads Are Like Low Fat Ice Cream, NewWest. 3-17-09. <http://www.newwest.net/topic/article/temporary_roads_are_like_low_fat_ice_cream/C564/L564/> (“The problem is that temporary roads have most of the same environmental impacts as regular roads.”)

Research results, published in *Restoration Ecology,* shows there is nothing temporary about temporary roads, and that ripping out a road is NOT equal to never building a road to begin with. The saturated hydraulic conductivity of a ripped road following three rainfall events was significantly greater than that of the road surface before ripping... most saturated hydraulic conductivities after the third rainfall event on a ripped road were in the range of 22 to 35 mm/hr for the belt series and 7 to 25 mm/hr for the granitics. These conductivities are modest compared to the saturated hydraulic conductivity of a lightly disturbed forest soil of 60 to 80 mm/hr.” id. Even this poor showing of restoring pre-road hydrologic effects worsened with repeated rainfall. “Hydraulic conductivity values for the ripped treatment on the granitic soil decreased about 50% with added rainfall (p(K1=K2)=0.0015). This corresponded to field observations of soil settlement and large clods of soil created by the fracture of the road surface dissolving under the rainfall... The saturated hydraulic conductivity of the ripped belt series soils also dropped from its initial value. Initially, and for much of the first event, the ripped plots on the belt series soil showed no runoff. During these periods, run-off from higher areas flowed to low areas and into macropores.... Erosion of fine sediment and small gravel eventually clogged these macropores... Anecdotal observations of roads ripped in earlier years revealed that after one winter, the surfaces were nearly as solid and dense as the original road surfaces.” Id. Even though ripped roads increase water infiltration over un-ripped roads, it does not restore the forest to a pre-road condition. “These increases do not represent ‘hydrologic recovery’ for the treated areas, however, and a risk of erosion and concentration of water into unstable areas still exists.” Luce, C.H., 1997. Effectiveness of Road Ripping in Restoring Infiltration Capacity of Forest Roads, Restoration Ecology; 5(3):265-270. <http://library.eri.nau.edu/gsdl/collect/erilibra/import/Luce.1997.EffectivenessOfRoadRippingIn.pdf>.

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

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

## Plan and implement road systems with big storms in mind.

Big storms are the driving force behind many large geomorphologic events such as floods, landslides, etc, that shape underlying forest hydrology. Project design must look beyond the 2-5 year storms that are typically considered.

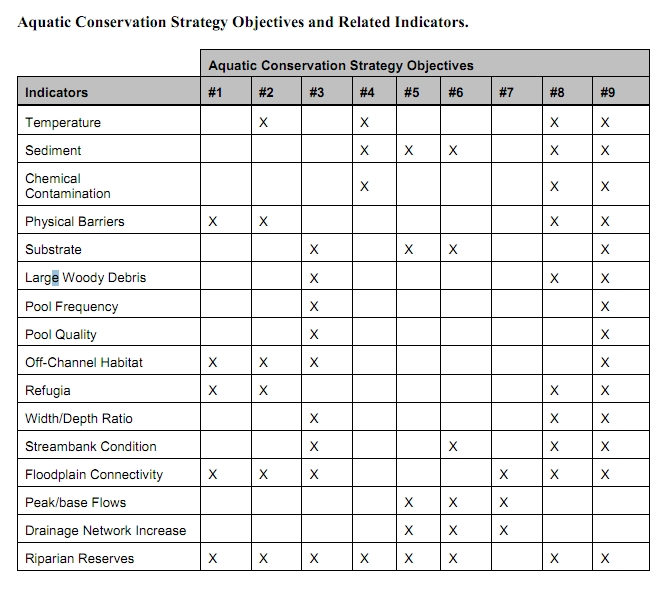
Roads and their artificial water drainage structures are long-lasting alien features in the forest landscape and the effects of big storms are particularly important to consider in the decision whether, where and how to build roads and how to drain them.

Road-stream crossings can be high dynamic during large storms, so they must consider large events, and not just rosy scenarios where culverts remain unblocked.

## Weigh the trade-offs associated with logging in riparian reserves.

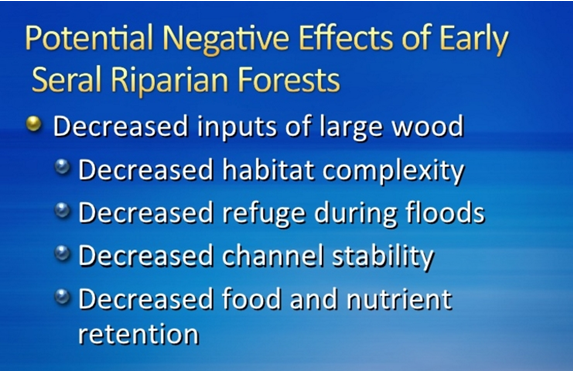
The agency often claims that logging in riparian reserves is necessary to improve attributes other than large wood. However, these benefits are often minor and transitory, and do not outweigh the significant long-term adverse effect of logging on recruitment of dead wood. The agency must focus on the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

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



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

Stan Gregory notes the following trade-offs associated with logging riparian reserves to enhance early seral vegetation:



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

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

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

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

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

**Large Wood**

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

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

…

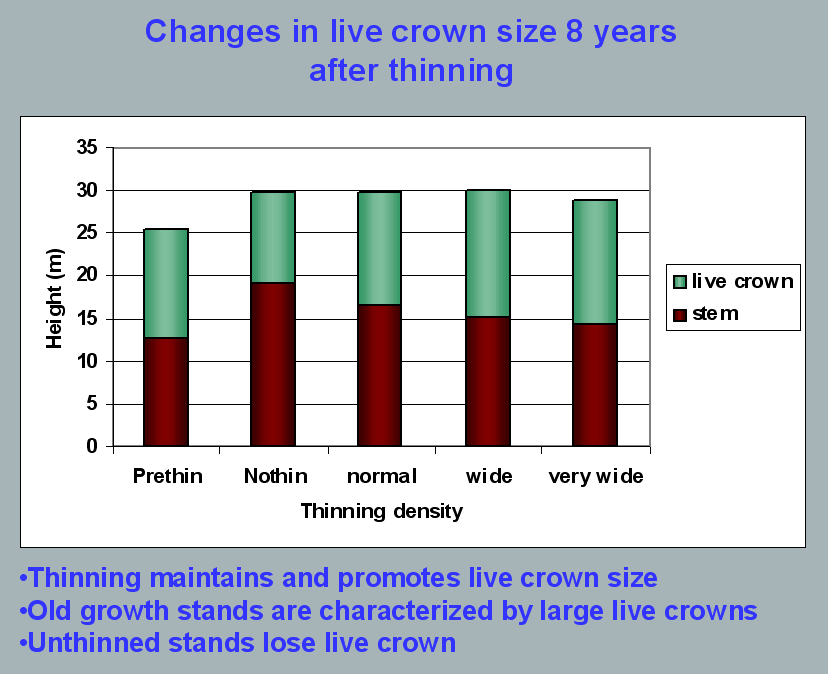
**Riparian Ecosystem Components**

…

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

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

The effects of thinning on crown development are not very significant.



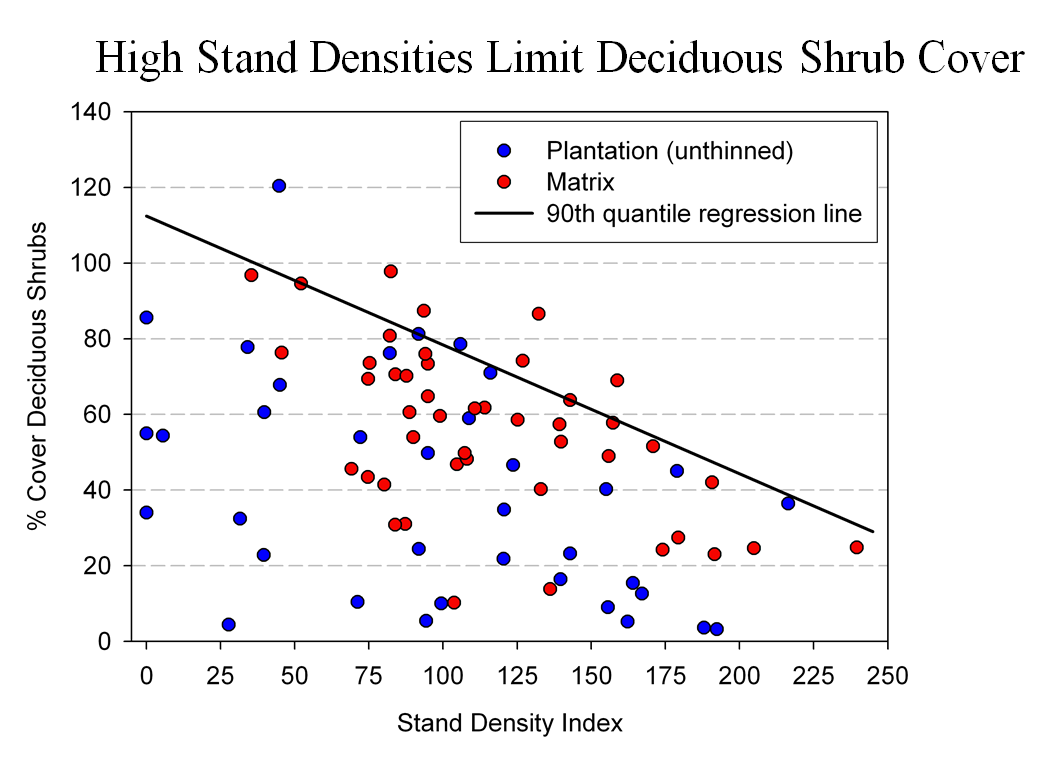
Aquatic/Riparian Ecosystem Dynamics and Associated Management Implications - Recent Findings. Powerpoint, 32.6M. This topic was presented at the Regional Interagency Executive Committee meeting on January 7, 2003. <https://web.archive.org/web/20161221100307/http://www.reo.gov/library/presentations/Szaro_present_Aquatic_Rip_Final.ppt>.

Stimulating the development of a diverse understory is often used as a justification for thinning, but this may not be justified in stands older than about 40 years. A systematic review of 917 Forest Inventory and Analysis (FIA) plots in western Oregon (mostly on non-federal lands) found,

Contrary to expectations of canopy closure, mean canopy cover by age class rarely exceeded 85 percent, even in unthinned productive young conifer forests. Possibly as a result, effects of stand age on understory vegetation were minimal, except for low levels of forbs found in 20- to 40-year-old wet conifer stands. … Although heavily thinned stands had lower total cover, canopy structure did not differ dramatically between thinned and unthinned stands. Our findings suggest potential limitations of simple stand succession models that may not account for the range of forest types, site conditions, and developmental mechanisms found across western Oregon.

McIntosh, Anne C.S.; Gray, Andrew N.; Garman, Steven L. 2009. Canopy structure on forest lands in western Oregon: differences among forest types and stand ages. Gen. Tech. Rep. PNW-GTR-794. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 35 p. <http://www.fs.fed.us/pnw/pubs/pnw_gtr794.pdf>. This seems to indicate that the benefits of thinning may be best realized in dense stands younger than 40 years old. This study also showed that in wet conifer stands the mean Canopy Height Diversity Index and the mean Simpson’s Diversity Index of tree heights leveled off at about age 65. This study also looked at canopy conditions after three levels of thinning intensities (heavy, light, and none). “Mean cover of the lower canopy layer was nominal for all three thinning intensities. … There were no evident trends between understory cover and thinning history; both shrub and forb cover were fairly similar among the three thinning intensities. … The lack of a strong effect of crown closure on understory cover may be related to our finding that mean crown cover did not exceed 85 percent. … We expected greater cover of understory vegetation in thinned than in unthinned stands but did not detect significant differences in this analysis.”

While one can generalize that vegetation diversity is more likely to flourish when conifer density is lower, there are data showing a wide range of conifer density can support a wide range of deciduous shrub cover. Thinning is not always necessary. The NEPA analysis should carefully document the site-specific “need” for thinning.



Spies, T. 2008. Powerpoint: Assumptions behind thinning young stands to create late successional riparian habitat. Presented at Riparian Thinning: Logic Paths for Silvicultural Prescriptions -- March 20, 2008. <https://ecoshare.info/projects/central-cascade-adaptive-management-partnership/workshops/riparian-thinning-logic-paths/>

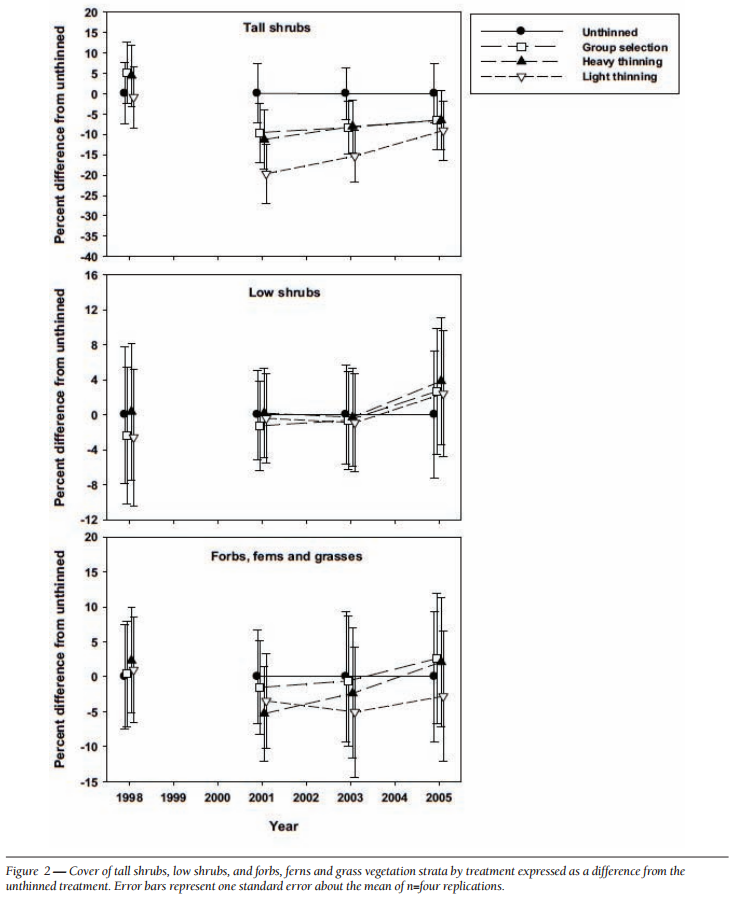
It is also worth noting that where understories are well-stocked, midstory development can be enhanced by focusing on treating the understory itself rather than killing canopy trees.

[R]esults show that individual understory trees can be selectively favored for increased growth into the midstory by being released from competing saplings in the understory cohort. …Our results suggest that understory release treatments can be used to target individual saplings for increased growth, thereby recruiting a shade tolerant midstory cohort and accelerating the development of vertical foliar connectivity and a multi-layered stand structure. Abundance of non-coniferous understory vegetation is also augmented by this treatment. … [Note] The extent to which released understory trees collectively form a cohesive midstory canopy stratum is dependent on the density and horizontal arrangement of those released individuals. … . Inducing spatial variability within the midstory tree cohort would emulate the finescale disturbances of natural stands that create gaps and patches.

Taylor, Andrew 2016. : Understory Vegetation Dynamics and Midstory Development Following Understory Release Treatments in Northwest Oregon Thinned Douglas-fir Stands. OSU MS Professional Paper.

Anderson (2007) looked at the effects of thinning in young Douglas fir forests and found -

[T]hinning treatments … had little impact on the abundance, size, or diversity of understory vegetation. Disturbance resulted in short-term decreases in understory vegetation cover, particularly tall shrubs. However, within five years of treatment, understory vegetation abundance returned to approximate pretreatment condition. … The general lack of understory vegetation response to the thinning treatments was likely due to the inherent resistance and resilience of the plant communities to disturbance, as well as the low intensity of disturbance attributable to the treatments.



[Four years after thinning] tall shrub cover that was approximately four to nine percent less than the unthinned treatment … [C]over by low shrub species was unchanged by the harvest activity … Forbs, ferns, and grasses [experienced] little difference in cover between thinned and unthinned stands. … [F]ollowing treatment, the mean number of species declined somewhat, [then] return[ed] to pretreatment levels… [T]he evenness component of diversity did not differ among treatments or vary over time …. [T]here was little evidence of substantial alterations of understory shrub and herbaceous vegetation. This lack of strong understory vegetation response in terms of composition, abundance, or size is consistent with several studies of thinning in Douglas-fir. In a recent review of seven operational-scale silviculture experiments, Wilson and Puettmann (2007) report that percent cover by shrubs and percent cover by herbs, one to seven years following thinning showed little difference across a wide range of residual basal area.

Paul D. Anderson 2007. Understory Vegetation Responses to Initial Thinning of Douglas-fir Plantations Undergoing Conversion to Uneven-Age Management. Proceedings of the 2007 National Silviculture Workshop. <http://www.fs.fed.us/pnw/publications/gtr733/PNW_GTR_733_4.pdf> This paper was published in: Deal, R.L., tech. ed. 2008. Integrated restoration of forested ecosystems to achieve multi-resource benefits: proceedings of the 2007 national silviculture workshop. Gen. Tech. Rep. PNW-GTR-733. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 306 p.

[W]hile specific structural attributes of forest ecosystems have been correlated with certain species, it is uncertain how such species will respond to treatments designed to recreate these features. There is always the possibility that in our attempt to create a structural attribute we think is important, we eliminate another attribute that is equally important, but unrecognized. One example is that attempts to restore spotted owl habitat by heavily thinning to accelerate the development of large diameter nesting trees could actually delay spotted owl recovery by reducing production of the large down wood utilized by the species it preys upon (Forsman et al., 1984; Carey, 1995; North et al., 1999). Similarly, heavily thinning stands to accelerate the development of marbled murrelet nesting trees also create open stands with a dense understory that is ideal habitat for a number of corvid species that prey on marbled murrelet nest eggs (USFWS, 2010). Riparian thinning efforts to create long-term supplies of very large diameter instream wood that can initiate complex wood jam formation (e.g., key pieces) are also likely to reduce the supply of large diameter wood that will create pools (Beechie and Sibley, 1997; Beechie et al., 2000; Fox and Bolton, 2007). Thus, we suggest that any efforts to actively restore riparian forests for the benefit of certain species should be treated as scientific experiments and proceed cautiously, skeptically, and with robust pre- and post-treatment data collection efforts. Hypothesized effects of thinning on riparian forest structure and the use of that structure by targeted species should be tested against empirical data.

Pollock, Michael M. and Timothy J. Beechie, 2014. Does Riparian Forest Restoration Thinning Enhance Biodiversity? The Ecological Importance of Large Wood. Journal of the American Water Resources Association (JAWRA) 50(3): 543-559. DOI: 10.1111/jawr.12206. <http://oregon-stream-protection-coalition.com/wp-content/uploads/2014/07/Pollock-and-Beechie.-2014.-Riparian-thinning-and-biodiversity.pdf>.

## Thinning in the Matrix must be Restorative and Variable

In the NWFP conservation scheme the role of matrix lands is primarily to support owl dispersal, but also:

* To provide connectivity for dispersal and interaction of owls among HCAs. ….
* To maintain options for returning owls to the forest matrix by retaining older forest structures in the managed landscape.
* To develop and apply experimental silvicultural treatments that may support a viable owl population in the forest matrix.
* To contribute toward a short-term viable population (less than 50 years).

(ISC Report p 318). The quality of matrix lands for meeting these objectives is directly related to the extent that it resembles nesting, roosting, and foraging habitat. If structurally simple stands in the matrix can be modified to be more complex in terms of species diversity, niche diversity, and dead wood abundance, they will support better foraging opportunities which will greatly improve the quality of dispersal habitat.

New information indicates that spotted owl dispersal habitat should be managed for “at least 80%” canopy cover. See Stan G. Sovern, Eric D. Forsman, Katie M. Dugger, Margaret Taylor. 2015. Roosting Habitat Use and Selection By Northern Spotted Owls During Natal Dispersal. The Journal of Wildlife Management 79(2):254–262; 2015; DOI: 10.1002/jwmg.834. (“**Roost Site Selection**. In contrast to the assumption that stands with relatively open canopies provide suitable dispersal habitat for spotted owls, our results suggest that dispersing juveniles selected stands for roosting that had relatively high canopy closure (x = 66 + 2%). … Two hypotheses could explain why dispersing owls selected closed-canopy stands. First, several researchers (Barrows 1981, Forsman et al. 1984, Weathers et al. 2001) have shown that temperature and precipitation appear to influence selection for roost trees and attributes within a roost tree, such as perch height and percent overhead cover. … Second, juvenile northern spotted owls may have selected for closed-canopy forest because their preferred prey were most abundant … **Landscape Scale Selection**. … [O]ur mean estimate of canopy closure from plots at roosts (66%), which was likely an underestimate of canopy cover, was considerably higher than the minimum values recommended by Thomas et al. (1990) [i.e. 50-11-40]. … **Management Implications**. … Based on our study, we recommend that managers should pursue a strategy that exceeds the canopy cover guidelines recommended by Thomas et al. (1990) when managing dispersal habitat for spotted owls. Based on our estimate of mean canopy closure (66%), and our estimate of mean canopy cover from overlaying a dot grid on the same areas (approx. 14% larger), we recommend that the target for canopy cover in stands managed for dispersing spotted owls should be at least 80%.”)

Owl habitat is characterized by large trees, high canopy closure, abundant dead wood, well-developed understories. A few of these qualities can be attained with traditional uniform thinning (large trees and canopy closure), but all of them are more likely to be attained with variable density thinning and managing for decadence. In particular, canopy closure and well-developed understories are best achieved with variable density thinning.

The agency should design matrix thins to support abundant and diverse populations of owl prey species. “[H]abitat elements that support prey [include] (mistletoe, snags, down wood, forage lichens, truffles abundance)” NSO FRP p 114. Where owl prey base is diverse and abundant spotted owl home ranges tend to be smaller which is energetically advantageous and enhances owl survival rates. Carey, A. 2004 Relationship of Prey and Forest Management. Appendix 5 pp 3-24, 3-25 *in* Courtney, SP; J A Blakesley. 2004. Scientific evaluation of the status of the Northern Spotted Owl. <http://www.sei.org/owl/finalreport/finalreport.htm>. “Numerous patches of low foraging quality can have negative impacts on owl demography and behavior (Carey et al 1992).” id. and this is precisely what uniform thinning that “captures mortality” will do to current and future spotted owl home ranges. A large number of owl prey species have some association with snags and down wood either as sites for denning or as a source of fungal food supplies. Traditional thinning will reduce the recruitment of dead trees and down wood and further simplify the forest structure for many decades. Establishing diverse micro-habitats and creating and retaining large numbers of snags and down wood will help the spotted owl through the habitat bottleneck that it is now going through.

Small mammal populations also appear to increase with understory cover which can follow some forms of thinning. Waldien and Hayes. 2006. Influence of Alternative Silviculture on Small Mammals. USGS/CFER Fact Sheet. July 2006. <http://www.fsl.orst.edu/cfer/pdfs/CFERFS05.pdf>.

North et al. (1999) noted in a study of foraging habitat selection by northern spotted owls, “In our study area, stands with high use by owls typically included many ‘legacies’ (large trees and snags) that survived a fire or windstorm that destroyed much of the previous stand. They found that “stands with 142 m3/ha of intact snags and a high diversity of tree heights had medium or high foraging use by spotted owls. In these old-growth stands, biological legacies (e.g., large trees and snags) produced by past disturbance provide important forest structures associated with spotted owl foraging.” North, Franklin, Carey, Forsman, Hamer. 1999. Forest Stand Structure of the Northern Spotted Owl’s Foraging Habitat. For. Sci. 45(4):520-527.

Some have concluded that light, uniform thinnings in young stands are unlikely to attain biodiversity conservation objectives. See Duncan S. Wilson, and Klaus J. Puettmann. Density management and biodiversity in young Douglas-fir forests: challenges of managing across scales. DRAFT submitted to Forest Ecology and Management. August 2006.

Given all the new information on the risks and uncertainties faced by spotted owls, thinning projects in the Matrix should apply variable density thinning techniques because variable density thinning and managing for decadence will help increase the complexity of the forest (structural complexity and plant species diversity) thereby increasing populations of owl prey species and enhancing owl foraging opportunities within owl dispersal/foraging habitat.  
  
VDT will not conflict with matrix objectives. Matrix objectives include timber production as well as habitat and species diversity. Variable thinning will produce potentially more wood products in the short-term as well as significant wood products in the long-term. There is absolutely no requirement that the agencies MAXIMIZE timber production. The ecological benefits of variable density thinning are significant and should not be forgone. There are operational challenges with implementing effective variable thinning prescriptions but the agencies must embrace the challenges and instead of retreating from the ecological objectives of the matrix, the agencies must apply their best thinking and creativity to the objective of creating species-diverse and structurally rich and complex mid-seral forest habitat.

The matrix is supposed to provide wildlife habitat and connectivity and VDT will help the matrix achieve these objectives while also improving the growth of favored commercial tree species. Matrix is not a tree farm. It still has a role to play in providing diverse habitats, so don’t just grow trees, grow forests.

The matrix is an integral part of the management direction included in these standards and guidelines. Production of timber and other commodities is an important objective for the matrix. However, forests in the matrix function as connectivity between Late-Successional Reserves and provide habitat for a variety of organisms associated with both late-successional and younger forests. Standards and guidelines for the matrix are designed to provide for important ecological functions such as dispersal of organisms, carryover of some species from one stand to the next, and maintenance of ecologically valuable structural components such as down logs, snags, and large trees. The matrix will also add ecological diversity by providing early-successional habitat.

…

Matrix objectives for silviculture should include: (1) production of commercial yields of wood, including those species such as Pacific yew and western red cedar that require extended rotations, (2) retention of moderate levels of ecologically valuable old-growth components such as snags, logs, and relatively large green trees, and (3) increasing ecological diversity by providing early-successional habitat.

…

Stands in the matrix can be managed for timber and other commodity production, and to perform an important role in maintaining biodiversity. Silvicultural treatments of forest stands in the matrix can provide for retention of old-growth ecosystem components such as large green trees, snags and down logs, and depending on site and forest type, can provide for a diversity of species. Retention of green trees following timber harvest in the matrix provides a legacy that bridges past and future forests. Retaining green trees serves several important functions including snag recruitment, promoting multistoried canopies, and providing shade and suitable habitat for many organisms in the matrix.

1994 NWFP ROD pp B-1 to B-6 (emphasis added). Clearly VDT, will meet matrix objectives by providing wood products, and by promoting multistoried canopies, providing diversity of species, creating and maintaining structural features such as snags, logs, and large trees, and providing opportunities for early-seral species to persist in mid-seral stands.

According to the 2003 Draft SEIS for survey and manage, “Matrix was also expected to provide for ecologically diverse early-successional conditions and planned timber harvest.” (DSEIS page 68). Variable density thinning is appropriate in the matrix because VDT expands future options for multiple-use/sustained yield in its fullest dimension and VDT does not foreclose any matrix objectives.

Variable Density prescriptions will also improve connectivity by enhancing foraging opportunities for dispersing predators such as spotted owls (and other raptors), marten, fisher, etc. Young and mid-seral forest may not provide ideal nesting/denning conditions but they often do provide for important dispersal functions. If these young and mid-seral forests are species-diverse and structural complex, they are more likely to have healthy populations of small mammals, birds, and other prey species relied upon by predator species of concern.

Variable density thinning can create a variety of micro-habitats that may be suitable for different species. Andy Carey found that VDT could establish patchy habitat patterns that could lead to the development of small mammal populations that are not only more dense but more diverse compared to uniformly thinned stands.

Our results support hypotheses that: (1) biocomplexity resulting from interactions of decadence, understory development, and overstory composition provides pre-interactive niche diversification with predictable, diverse, small mammal communities; (2) these communities incorporate numerous species and multiple trophic pathways, and thus, their integrity measures resiliency and sustainability.

Thus, increasing complexity of the environment through increasing horizontal and vertical heterogeneity in vegetation structure, species diversity in vascular plant composition, and forest-floor structure with coarse woody debris may simultaneously (1) increase multidimensional habitat space (Carey et al., 1999a), (2) reduce frequencies and intensities of interspecies interactions (Grant, 1972; Carey et al., 1980), (3) increase or maintain the already high abundance and diversity of seed fall, fungal fruiting bodies, and invertebrates characteristic of mesic, temperate coniferous forests (Church field, 1990), and (4) allow not only coexistence, but abundance of potentially competing species within communities (Carey and Johnson, 1995, this study). As a result of this complexity, Pacific Northwest forests support the greatest diversity of shrews in North America (Rose, 1994) …

…

These studies do suggest that management can homogenize and simplify (reduce decadence, amounts of coarse woody debris, variety of tree species, diversity and abundance of understory vegetation, and spatial heterogeneity) forest ecosystems. We found local extirpations of a number of species and particularly absence of *G. sabrinus* and *T. townsendii* in multiple plots. These absences raise questions about long-term viability of these species in managed landscapes. Management-induced homogeneity and simplification (1) is a real danger to diversity, resiliency, and susceptibility to invasions of exotic plants (Carey, 1998; Carey et al., 2000; Halpern et al., 1999; Heckman, 1999; Thysell and Carey, 2000), (2) may result in small-mammal communities non-supportive of predators populations (Carey et al., 1992; Carey and Peeler, 1995), …

Andrew B. Carey, Constance A. Harrington; Small mammals in young forests: implications for management for sustainability; Forest Ecology and Management (2001) 154(1-2): 289-309; <http://www.fs.fed.us/pnw/pubs/journals/pnw_2001_carey003.pdf>.

High density and diversity of prey species is clearly advantageous for spotted owls. Dense populations of prey allow for smaller home ranges which is energetically advantageous, while diverse populations reduces the risk that any one species population will decline and leave the owl vulnerable. “[E]xperiments in both terrestrial and aquatic microcosms have tended to find that increasing the number of prey items enhances stability.” Kevin Shear Mccann, The diversity–stability debate. Nature 405, 228 - 233 (11 May 2000). <http://www.iterations.com/protected/dwnload_files/diversity_stability_debate.pdf>. Thinning variably will enhance the habitat for more than one prey species. If one species declines, the owl has other options so diverse prey base tends to have a stabilizing effect on owl populations. The agency can have all these ecological benefits from restoration silviculture and still support some jobs and produce some wood products.

## Logging habitat to save it from fire.

When logging intended to benefit habitat will also reduce the quality of habitat, the NEPA analysis must include some evaluation of ecological costs and benefits — e.g., the probability that logging will degrade habitat vs. the probability that fuel reduction treatments will interact favorably with fire and thus benefit habitat. This evaluation requires an estimate of the probability of future wildfire. To assume, as many analyses do, a 100% chance of future wildfire over-estimates the likelihood of treatments will interact with fire, thus over-estimating the ecological value of fuel treatments, and under-estimating the ecological effects of logging on habitat. See Heiken, D. 2010. Log it to save it? The search for an ecological rationale for fuel reduction logging in Spotted Owl habitat. Oregon Wild. v 1.0. May 2010. <https://www.dropbox.com/s/pi15rap4nvwxhtt/Heiken_Log_it_to_save_it_v.1.0.pdf?dl=0>.

There is a strong interest among the federal land management agencies to conduct widespread logging in suitable spotted owl habitat in order to reduce the effect of fire. The agencies view fuel reduction logging as beneficial to owl habitat because some modeling shows that fire behavior is moderated by fuel reduction, but proponents never seem to conduct a careful evaluation of the relative probability, and the relative harms, of logging versus wildfire. A careful analysis shows that logging to control fire and expecting to benefit spotted owl habitat is analogous to rolling a die and expecting to roll a six every time.

This is an example of the “base rate fallacy” or “neglecting priors” from Bayesian statistics. The probability of a forest stand NOT burning are far greater than the probability of a forest stand burning. Attempts to address a problem that is unlikely to occur, such as by thinning a forest that is unlikely to burn, runs a high risk that unintended negatives effects will overwhelm beneficial effects. <https://en.wikipedia.org/wiki/Base_rate_fallacy> Tips for avoiding the pitfalls ignoring Bayesian thinking include:

1. Remember prior/background probability of events/contingencies.
2. Imagine your theory of the situation is wrong. How would the world look different? Consider the no action alternative.
3. Update incrementally. New data points should lead to small changes in thinking not wholesale reversals

<https://youtu.be/BrK7X_XlGB8>

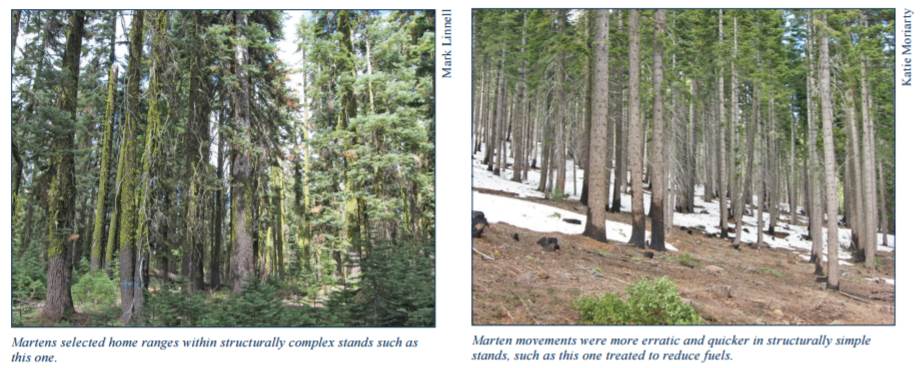
Strangely, the probabilistic aspects of this issue have been largely ignored in the owl science literature, but recently explored in the forest-carbon literature which recently showed that although thinning can modify fire behavior, logging to reduce fire effects is likely to remove more carbon by logging than will be saved by modifying fire. Mitchell, Harmon, O'Connell. 2009. Forest fuel reduction alters fire severity and long-term carbon storage in three Pacific Northwest ecosystems. Ecological Applications. 19(3), 2009, pp. 643–655 <http://www.fs.fed.us/pnw/pubs/journals/pnw_2009_mitchell001.pdf>. The reason for this seemingly counterintuitive outcome is a result of the “law of averages.” As explained by Cathcart et al 2009 —

The question is—if the implementation of fuels treatments within the Drews Creek watershed had the beneficial effect of reducing the likelihood of wildfire intensity and extent as simulated in this study, why is the expected carbon offset from fuels treatment so negative? The answer lies in the probabilistic nature of wildfire. Fuels treatment comes with a carbon loss from biomass removal and prescribed fire with a probability of 1. In contrast, the benefit of avoided wildfire emissions is probabilistic. The law of averages is heavily influenced that given a wildfire ignition somewhere within the watershed, the probability that a stand is not burned by the corresponding wildfire is 0.98 (1 minus the average overall conditional burn probability …

Thus, the expected benefit of avoided wildfire emissions is an average that includes the predominant scenario that no wildfire reaches the stand. And if the predominate scenario for each stand is that the fire never reaches it, there is no avoided CO2 emissions benefit to be had from treatment. So even though severe wildfire can be a significant CO2 emissions event, its chance of occurring and reaching a given stand relative to where the wildfire started is still very low, with or without fuel treatments on the landscape.

Jim Cathcart, Alan A. Ager, Andrew McMahan, Mark Finney, and Brian Watt 2009. Carbon Benefits from Fuel Treatments. USDA Forest Service Proceedings RMRS-P-61. 2010. <http://www.fs.fed.us/rm/pubs/rmrs_p061/rmrs_p061_061_079.pdf>.

Both carbon and spotted owl habitat tend to accumulate in relatively dense forests with intermediate or longer fire return intervals. Thus, we can likely read these studies and replace the word "carbon" with the word "spotted owl habitat" and the results will likely hold.  
  
In an effort to advance the discussion and help the agencies conduct better risk assessments in the NEPA context we have prepared a white paper in an attempt to clarify the critical considerations in a probabilistic risk assessment that compares the risk of logging versus wildfire. Heiken, D. 2010. Log it to save it? The search for an ecological rationale for fuel reduction logging in Spotted Owl habitat. Oregon Wild. v 1.0. May 2010. <https://www.dropbox.com/s/pi15rap4nvwxhtt/Heiken_Log_it_to_save_it_v.1.0.pdf?dl=0>. This report is most relevant in SW Oregon but the proposed evaluative framework is applicable in the east Cascades, northern California, and elsewhere. This report focuses on studies that have so far focused on carbon and spotted owl habitat, but the analysis is relevant for any species or forest value that requires relatively dense forest cover, such as American marten, Pacific fisher, pileated woodpecker, northern goshawk, etc. See for instance, Aubry et al 2013. Meta-Analyses of Habitat Selection by Fishers at Resting Sites in the Paciﬁc Coastal Region. The Journal of Wildlife Management 77(5):965–974; 2013; DOI: 10.1002/jwmg.563. See also, Moriarty, K. M., Epps, C. W. and Zielinski, W. J. (2016), Forest thinning changes movement patterns and habitat use by Pacific marten. The Journal of Wildlife Management. doi: 10.1002/jwmg.1060. <https://www.fs.fed.us/pnw/pubs/journals/pnw_2016_moriarty001.pdf>. (Abstract: “martens avoided stands with simplified structure, and the altered patterns of movement we observed in those stands suggested that such treatments may negatively affect the ability of martens to forage without increased risk of predation. Fuel treatments that simplify stand structure negatively affected marten movements and habitat connectivity. Given these risks, and because treating fuels is less justified in high elevation forests, the risks can be minimized by applying treatments below the elevations where martens typically occur.”) And see, Katie M. Moriarty 2014. Ph.D. Dissertation. Habitat Use and Movement Behavior of Pacific Marten (Martes caurina) in Response to Forest Management Practices in Lassen National Forest, California. November 21, 2014. <https://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/54574/141203_Moriarty_OSU_Dissertation_FINAL.pdf>. And see: Kirkland, J. 2016. Science Findings #192. Striving for Balance: Maintaining Marten Habitat While Reducing Fuels. Dec 2016. <https://www.fs.fed.us/pnw/sciencef/scifi192.pdf> (“[R]esearchers fitted martens with GPS collars and tracked their behavior to learn how the animals responded in forest stands that differed in structural complexity-variability in tree size, depth and overlap of crowns, and distance and uniformity of spacing among trees. The martens traveled several miles a day in search of food, but they avoided open areas and thinned stands (forest areas where small-diameter trees and understory have been removed), most likely because they were more vulnerable to predators in those spaces. They thrived in forests with complex canopies and connected stands, which allowed them to move more freely in search of food with less risk of predation.”)



To justify such fuel reduction logging in suitable owl habitat on ecological grounds requires several findings: (1) that wildfire is highly likely to occur at the site of the treatment, (2) that if fire does occur it is likely to be a severe stand-replacing event, and (3) that spotted owls are more likely to be harmed and imperiled by wildfire than by logging at a scale necessary to reduce fire hazard. Available evidence does not support any of these findings, which raises serious questions about the need for and efficacy of logging to reduce fuels in western Oregon and other forests lacking frequent fire return intervals.   
  
The probabilistic element of the risk equation demands careful consideration. Both logging and fire have meaningful consequences, so the issue really boils down to a comparative probabilistic risk assessment where risk is characterized by two quantities: (1) the magnitude (severity) of the possible adverse consequence(s), and (2) the likelihood (probability) of occurrence of each consequence.

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

The white paper is organized around these risk evaluation parameters.

In spite of what we often hear, federal forests are not at imminent risk of destruction by wildfire. Fire return intervals remain relatively long, due to both natural factors and active fire suppression policies. Wildfire severity also remains moderate. Most wildfires are NOT stand replacing. Most fires are in fact low and moderate severity.

The location, timing, and severity of future fire events cannot be predicted making it difficult to determine which forests will benefit from treatment - consequently fuel treatments must be extensive and many stands will be treated unnecessarily, thus incurring all the costs of fuel logging, but receiving none of the beneficial effects on fire behavior.

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

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

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

As spotted owls are associated with dense, late-successional forests, biologists typically assumed that fires that burned at high intensity were similar to clearcut logging and had a negative impact on long-term survival of the species. Many land managers now believe that high-severity fires pose the greatest natural risk to owl habitat (Davis et al., 2016). Fire, however, is a different type of disturbance than logging. Before data were collected from spotted owls in burned forests, it was not unreasonable to assume that high-severity fire might eliminate habitat because it reduces canopy cover, kills trees, and consumes coarse woody debris—all of which comprise important structure for owls and their prey—but current research is revealing that a surprising number of spotted owl sites continue to be occupied and reproductively successful after experiencing fires of all intensities and that populations are quite resilient to fire. Further, spotted owls utilize complex early seral forests for foraging, providing evidence that severely burned forests can benefit spotted owls depending upon its extent and configuration (Bond et al., 2009; Comfort et al., 2016). Spotted owls evolved in landscapes where severe fire was an important component historically (Baker, 2015) …

One reason why spotted owls remain in burned territories is that fire enhances habitat for some of their primary prey species. … Many small mammal species are more abundant in shrub- and herb-dominated habitats, vegetation typical of recently burned complex early seral forests.

…

**Conclusions: An Emerging New Paradigm About Spotted Owls and Severe Wildfire**

• Most spotted owl pairs generally survive and continue to reproduce in breeding sites that experienced severe fire across the range of the three owl subspecies.

• Lower-quality sites (often vacant and nonreproductive) have lower occupancy with increasing amounts of severe fire, whereas higher-quality sites (occupied and reproductive before fire) remain occupied at similar rates as long-unburned forests, regardless of amount of severe fire.

• Spotted owls nest and roost in forested stands with high canopy cover (unburned/low burned) even in burned landscapes.

• Spotted owls forage in severely burned stands.

• Home-range sizes are similar in burned and unburned landscapes.

• Postfire logging is correlated with site abandonment and reduces survival.

• Studies of spotted owls in burned forests not subjected to postfire logging are necessary in order to separate and understand the relative influence of each disturbance.

Contrary to current perceptions and recovery efforts for the spotted owl (USFWS, 2011, 2012), high-severity fire does not appear to be an immediate, dire threat to owl populations that requires massive landscape-level fuel-reduction treatments to mitigate fire effects (see, eg, Hanson et al., 2009). Empirical studies conducted from 1 to 15 years after fires demonstrate that most burned sites occupied by spotted owl pairs remain occupied and reproductive at the same rates as long-unburned sites, regardless of the amount of high-severity fire in core areas. Burned sites where owls are not detected immediately after fire are often recolonized later, demonstrating the folly of concluding those sites permanently “lost” to spotted owls.

…

Harvesting timber to lower risk of fire has adverse effects on spotted owls (eg, Tempel et al., 2014), whereas fire itself has both costs and benefits depending on many factors. It is important to critically weigh these costs and benefits, especially since spotted owls evolved in landscapes shaped by wildfires (Baker, 2015). Odion et al. (2014) simulated changes in northern spotted owl habitat over a 40-year period following fire and the type of thinning typically proposed by federal land managers. The simulation showed that thinning over large landscapes would remove 3.4–6.0 times more late-successional forest over time in the Klamath and dry Cascades than forest fires would, even given a future increase in the amount of high-severity fire.

Bond, M.L. 2016. The Heat Is On: Spotted Owls and Wildfire. Reference Module in Earth Systems and Environmental Sciences<http://dx.doi.org/10.1016/B978-0-12-409548-9.10014-4>.

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

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

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

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

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

Lehmkuhl et al. (2015) found -

3. **Tradeoffs between fire resistance and NSO habitat quality are real.**Our results demonstrate that balancing the goals of increasing fire resilience while maintaining habitat function, especially nesting and roosting, for the NSO in the same individual stand is a difficult, if not an impossible, task. Even lighter thinning treatments typically reduce canopy cover below 40 percent. The reality is that nesting and roosting NSO habitat is by definition very susceptible to high-severity fire; owl habitat value and fire risk are in direct conflict on any given acre. …

Lehmkuhl, John; Gaines, William; Peterson, Dave W.; Bailey, John; Youngblood, Andrew, tech. eds. 2015. Silviculture and monitoring guidelines for integrating restoration of dry mixed-conifer forest and spotted owl habitat management in the eastern Cascade Range. Gen. Tech. Rep. PNW-GTR-915. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 158 p. ​<http://www.fs.fed.us/pnw/pubs/pnw_gtr915.pdf>. The authors, however, made no meaningful attempt to resolve these trade-offs.

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

Using empirical data, we calculated the future amount of spotted owl habitat that may be maintained with these rates of high-severity fire and ongoing forest regrowth rates with and without commercial thinning. Over 40 years, habitat loss would be far greater than with no thinning because, under a “best case” scenario, thinning reduced 3.4 and 6.0 times more dense, late-successional forest than it prevented from burning in high-severity fire in the Klamath and dry Cascades, respectively. Even if rates of fire increase substantially, the requirement that the long-term benefits of commercial thinning clearly outweigh adverse impacts is not attainable with commercial thinning in spotted owl habitat. It is also becoming increasingly recognized that exclusion of high-severity fire may not benefit spotted owls in areas where owls evolved with reoccurring fires in the landscape.

…

We found that the habitat recruitment rate exceeded the rate of severe fire by a factor of 4.5 in the Klamath and 10 in the dry Cascades, leading to a deterministic increase in dense forest habitat over time, assuming no other disturbance events. In contrast, previous published assessments of fire on spotted owls have not explicitly considered fire and forest regrowth rates (Wilson and Baker 1998, Lee and Irwin 2005, Roloff et al. 2005, 2012, Calkin et al. 2005, Hummel and Calkin 2005, Ager et al. 2007, Lehmkuhl et al. 2007). Not including the probability of high-severity fire, which is low, leads to highly inflated projections of the effects of thinning versus not thinning on high-severity fire (Rhodes and Baker 2008, Campbell et al. 2012).

Our calculations of thinning effects included rates of forest regrowth along with high-severity fire. The calculations illustrate how the requirement that the long-term benefits of thinning clearly outweigh adverse impacts (USFWS 2011) is not attainable as long as treatments have adverse impacts on spotted owl habitat. This is because the amount of dense, late-successional forest that might be prevented from burning severely would be a fraction of the area that would be thinned.

…

This would not be a concern if thinning effects were neutral, but the commercial thinning prescriptions being implemented call for forests with basal area reduced by nearly half to 13.5-27.5 m2/ha, which is mostly well below the minimum level known to function as nesting and roosting habitat (ca. 23 m2/ha) (Buchanan et al. 1995, 1998). … Even an immediate doubling of fire rates due to climate change or other factors would result in far less habitat affected by highseverity fire than thinning. In addition, much of the highseverity fire might occur regardless of thinning, especially if the efficacy of thinning in reducing high-severity fire is reduced as fire becomes more controlled by climate and weather (Cruz and Alexander 2010). Clearly, the strategy of trying to maintain more dense, late-successional forest habitat by reducing fire does not work if the method for reducing fire adversely affects far more of this forest habitat than would high-severity fire, and the high-severity fire might occur anyway because it is largely controlled by climate and weather.

…

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

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

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

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

One justification for the extensive treatment scenario promoted in the 2010 DRRP is that it is needed because of increased fire hypothesized to occur under climate change. By doubling the rate of high severity fire by 2050 with 2/3rds of the landscape treated, closed canopy forest is reduced to 25 percent in the Klamath compared to 60 percent without treatment and 23 percent in the dry Cascades compared to 54 percent without treatment.

Under what scenario might treatments that open forest canopies lead to more closed canopy spotted owl habitat? The direct cost to close forests with treatments that open them is simply equal to the proportion of the landscape that is treated. This reduction in closed canopy forest can only be offset over time if the ratio of forest regrowth to stand-replacing fire is below 1 (5-8 times more fire than today), and shifts to above 1 with the treatments (and most or all stand replacing fire in treated sites is eliminated, as modeled here). Another scenario that allows closed forests to increase would be if treating small areas eliminated essentially all future stand replacing fire, not only in treated areas, but across the entire landscape. This scenario obviously relies on substantially greater control over fire than is currently feasible, and it would increase impacts of fire exclusion if effective.

…

In sum, to recognize effects of fire and treatments on future amounts of closed forest habitat, it is necessary to explicitly and simultaneously consider the rates of fire, forest recruitment, and forest treatment over time, which has not yet been done by the Service.

…

The potential impacts of fuel treatments on spotted owls are not considered. … We also know little about the impacts of fire, yet this has been treated as a major threat, leading to proposing more fuel treatments. However, it is uncertain at this time which is a bigger threats, fires or treatments to reduce risk of fires. … If the plan intends to use the best available science to describe ongoing impacts to spotted owl habitat, information and literature about disturbances to reduce fuels should be included.

… there has been no formal accounting of how closed canopy forests can be maintained with the widespread treatments that are being proposed.

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

### Protect habitat for raptors, like northern spotted owl.

Logging disrupts behavior of nesting birds and could harm other aspects of their life needs. BLM has acknowledged that —

Current research has shown that spotted owls are likely to increase the size of their home ranges to utilize untreated stands in preference to newly treated stands both during and after harvest. Factors that reduce the quality of habitat within a home range or cause increased movement by owls in order to meet prey requirements may decrease the survival and reproductive fitness of owls at that site (Meiman *et al.*, 2003).

Roseburg BLM 2010. Third Elk EA. <http://www.blm.gov/or/districts/roseburg/plans/files/ThirdElkEA.pdf>.

A radio-telemetry study in the north Coast Range of Oregon showed that thinning in 40-65 year old stands near a spotted owl pair resulted in the owl: (1) shifting habitat use patterns to avoid thinned areas, especially heavily thinned areas, (2) enlarging its home range requiring the owl to expend more energy to fulfill its life functions. Before harvest the study made 23 owl locations in the areas to be thinned, only one owl location was made in the thinned area during the harvest period, and only 8 locations were made in the thinned area after harvest. The area added to the home range after harvest was larger than the area harvest. Recognize that this study looked at only one bird and only looked at short-term effects in the first few years after thinning. Long term effects might be different, but because the effects of thinning could affect survival and reproductive success over the course of several breeding seasons, this could be significant for a Threatened species. Based on these preliminary findings, the authors said—

We therefore recommend that thinning operations not be conducted within core use areas in this region until further research on this topic is conducted. … [W]e recommend that land managers identify the best spotted owl habitat (old conifer with multi-layered canopy and abundant snags) around the nest site and designate an area where no timber harvest activities will occur. The mean (100-ha) and maximum (250-ha) size of core use areas in the North Coast Range … should be used as guidelines for delineating reserve areas. Where forest stands are homogenous and/or the best habitat cannot be identified, an area with 600 –m radius (~115-ha) around the nest should be used.

Meiman, S., R. Anthony, E. Glenn, T. Bayless, A. Ellingson, M.C. Hansen, and C. Smith. 2003. Effects of commercial thinning on home-range and habitat-use patterns of a male spotted owl: a case study. Wildlife Society Bulletin. 2003. 31(4):1254-1262.

Salem BLM’s Turner Creek EA made an honest disclosure about thinning that should be acknowledged in other projects. “Overall the No Action alternative would result in much more coarse wood in the next several decades as compared to the Proposed Action which would provide better overall habitat for small mammals which in turn may benefit the spotted owl.” <http://www.blm.gov/or/districts/salem/plans/files/TC_EA.pdf>.

“Snag and down woody debris are important components of spotted owl habitat … [If stands are not thinned] [e]ventually the stands would start to differentiate to varying degrees and show a substantial increase in the levels of snags, down wood and understory development. Where these developments occurred, they would improve the dispersal habitat characteristics ….” Mt Hood NF 2011. Huckleberry Thin EA. <http://a123.g.akamai.net/7/123/11558/abc123/forestservic.download.akamai.com/11558/www/nepa/59590_FSPLT2_034896.pdf>.

Courtney (2004) summarized spotted owl habitat use studies and found positive relationships between spotted owl habitat use and several forest attributes that are *detrimentally affected by thinning*, including: canopy volume, canopy closure, snag basal area or volume, and log volume. Importantly, these relationships appear to hold true whether the owl sites were old growth or non-old growth forest. See Jim Thrailkill 2006. “Effects of Habitat Thinning on Northern Spotted Owls? Literature Summarized Through 2005.” Appendix F *of* Interagency Level 1 Team, North Coast Province. 2010. Biological Assessment of Habitat Modification Projects Proposed During Fiscal Years 2011 and 2012 in the North Coast Planning Province, Oregon, that are Not Likely to Adversely Affect (NLAA) Northern Spotted Owl and Marbled Murrelets and Their Critical Habitats, April 13, 2010 (page 101). *citing* Courtney *et al* 2004, Scientific Evaluation of the Status of the Northern Spotted Owl, SEI, Sept 2004.

Other relevant findings from this Thrailkill white-paper include:

* “Snag volume is correlated with increased [spotted owl] foraging use (North 1999). (p 102)
* “Snag volume is important to owl foraging sites because it influences local prey abundance (Carey 1995).” (p 102)
* “[S]tudies (Carey et al 1999) conducted in the Oregon and Washington Cascades and Coast Ranges have demonstrated a direct relationship between increasing levels of coarse wood debris (CWD) in a stand and the abundance of small mammals (e.g. northern flying squirrel) in those stands.” (p 102)
* “[T]hinning prescriptions should take advantage of creating conditions where coarse wood debris recruitment can be hastened.” (p 102)

Note: This white paper does not address new information since 2005 showing longer-term (multi-decade) adverse effects of thinning on flying squirrels and dead wood recruitment.

It is important to retain unthinned patches as source areas for spotted owl prey.

Sakai and Noon found the highest number of woodrats in sapling and brushy pole timber (20 – 30 year old) although these stands are seldom used by spotted owls (Forsman) probably because woodrats are inaccessible to the owls. Still these areas are a good source of woodrats dispersing out into older stands more frequented by foraging spotted owls and accessible to owls hunting along the edges where old forest meets young.

Heaney, J. 2012. Workshop on spotted owl prey. Ecology of and Habitat Management for the Dusky-Footed and Bushy-Tailed Woodrat. <http://ecoshare.info/wp-content/uploads/2012/08/Ecology-of-and-Habitat-Management-for-the-Dusky-Footed-woodrat.ppt>

The agency should recognize the long-term effects of captured mortality on the habitat needs of small mammals and spotted owls.

Several small mammals, such as the northern flying squirrel form the prey base for the Endangered Species Act (ESA) listed spotted owl and are among the species associated with abundant large dead standing and down wood. This presumably, is why spotted owls prefer to forage in stands with abundant standing and fallen dead wood (Table 2, North et al. 1999). The fruiting bodies of hypogeous fungi are a food source of northern flying squirrels and are also associated with down logs, suggesting that there are complex, indirect paths through which dead wood supports spotted owls (Amaranthus et al. 1994, Carey 2000).

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

North et al. (1999) noted in a study of foraging habitat selection by northern spotted owls, “In our study area, stands with high use by owls typically included many ‘legacies’ (large trees and snags) that survived a fire or windstorm that destroyed much of the previous stand. They found that “stands with 142 m3/ha of intact snags and a high diversity of tree heights had medium or high foraging use by spotted owls. In these old-growth stands, biological legacies (e.g., large trees and snags) produced by past disturbance provide important forest structures associated with spotted owl foraging.” North, Franklin, Carey, Forsman, Hamer. 1999. Forest Stand Structure of the Northern Spotted Owl’s Foraging Habitat. For. Sci. 45(4):520-527.

## Use small, heavily thinned “gaps” to add complexity.

Small “gaps” can be used to increase habitat diversity within stands. Gaps should be small - on the order of a few acres or less than an acre. Smaller gaps need less retained structure. Larger gaps need more retained structure. Gaps should not be mini-clearcuts but should retain abundant structure. Try to mimic disturbances such as fire or beetles killed trees but did not remove them. It is not always desirable to replant conifers in gaps, so that complex early seral conditions can be prolonged. Jo¨rg Mu¨ ller, Heinz Bußler, Martin Goßner, Thomas Rettelbach, Peter Duelli. 2008. The European spruce bark beetle Ips typographus in a national park: from pest to keystone species. Biodivers Conserv (2008) 17:2979–3001. <http://www.toek.wzw.tum.de/fileadmin/1_Datein/PDF_Publikationen/2008-17.pdf> (“As a recommendation to forest management for increasing insect diversity even in commercial forest, we suggest that logging in recent gaps in medium aged mixed montane stands should aim at retention of a part of the dead wood. Planting should be avoided, to lengthen the important phase of sunlit conditions. … For all taxa, our results showed higher species density only in bark beetle gaps [as compared to meadows and clearcuts]. … In [beetle-created] gaps most of the recorded species were inhabitants of complex habitats and occurred only where inflorescences, trees and dead wood are available together.”)

Planting these openings with red alder would delay occupation by shade-tolerant conifers. The natural fertilization from the red alder trees would further encourage conifer size diversification. Shrub and herb understory development under red alder is greater and more diverse than under conifers (Franklin and Pechanec 1968), and conifer replacement of red alder is relatively sparse and slow (Newton et al. 1968) facilitating shrub and herb retention.

Peter, David H.; Harrington, Constance A. 2010. Reconstructed old-growth forest stand structure and composition of two stands on the Olympic Peninsula, Washington state. Res. Pap. PNW-RP-583. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 22 p. <http://www.fs.fed.us/pnw/pubs/pnw_rp583.pdf>.

The Mt Hood NF uses a creative and highly flexible method to increase variability within treatments. In addition to the DxD, they sparingly use colored flagging to mark individual or a few trees with the intent that all trees within X feet of marked trees will be retained. They use different color of flagging to mark individual or a few trees with the intent to remove all trees within X feet of a marked tree. This allows specialists a flexible and scalable tool to create skips and gaps at various scales and it retains valuable structure within the gaps because the marked trees do not get cut.

## Manage for Decadence – retain untreated “skips” for recruitment of mortality

“Two common consequences of conventional thinning practices have been increased uniformity of forest structure and composition, and removal or delay in the development of dead wood as snags or down wood to meet decadence and habitat functions. … Over the past several decades our ecological understanding of decadence and its importance to habitat and biogeochemical processes has increased substantially, but translation of the fundamental knowledge into coherent goals is lagging.”

Paul D. Anderson 2013. Two Decades of Learning about Thinning in the Ecosystem Management Era. <http://www.fs.fed.us/pnw/pubs/pnw_gtr880/pnw_gtr880_001.pdf> in Density Management in the 21st Century: West Side Story PNW-GTR-880. <http://www.treesearch.fs.fed.us/pubs/44695>

“Many species in the Pacific Northwest evolved to use large snags and logs that were historically abundant in the landscape. If snags and logs are lost, biodiversity can be affected and potentially cause a loss of some function in the landscape such as control of forest insects.”

Mt Hood NF 2011. Huckleberry Thin EA. <http://a123.g.akamai.net/7/123/11558/abc123/forestservic.download.akamai.com/11558/www/nepa/59590_FSPLT2_034896.pdf>.

Many animals in Douglas fir forests are strongly associated with habitat features that are best developed in natural forest, such as large trees, snags, and downed logs. The diversity and density of cavity-nesting birds, for example, are positively correlated with the abundance of snags, especially tall and/or large-diameter snags (Nelson 1988, Zarnowitz and Manuwal 1985).

…

It is the cycle of structural development through plant growth, and the retention of structural complexity via legacy, that characterizes natural forests in the Coastal Northwest. Intensive wood production practices may alter this cycle both by truncating succession before large structures develop and by removing most existing structures during harvest. Planting and thinning may further promote uniformity in tree species, size, and spacing.

…

Studies in unmanaged forests teach us that natural disturbance maintains structural complexity within stands and that this complexity promotes plant and animal diversity.

…

Until it is clear that forests managed for wood production can be made suitable for native species, managers should consider retaining within managed forests representative tracts of all natural forest stages, not just old growth.

Hansen, A. J.; Spies, T. A.; Swanson, F. J.; Ohmann, T. L. 1991. Conserving biodiversity in managed forests - Lessons from natural forests. BioScience 41(6):382- 392. <http://www.montana.edu/hansen/documents/downloadables/hansenetal1991.pdf>.

“Dead wood in the form of snags and downed logs is generally common or abundant. Although a notable part of old-growth stands, such material is actually common in unmanaged stands in all successional stages in the Douglas-fir region.” Franklin & Spies 1983. CHARACTERISTICS OF OLD-GROWTH DOUGLAS-FIR FORESTS. Reprinted New Forests for a Changing World. Proceedings of the 1983 SAF National Convention <http://andrewsforest.oregonstate.edu/pubs/pdf/pub120.pdf>

Many natural young and mature stands have some of the attributes of old-growth stands that may not be present in young, managed stands. Perhaps the greatest difference between natural and managed stands is the lower number and volume of large snags and logs in managed plantations (Spies and Cline 1988). Many young natural forests less than 80 years old have high amounts of carry-over of woody debris...

Thomas A. Spies and Jerry F. Franklin 1991. The Structure of Natural Young, Mature, and Old-Growth Douglas-Fir Forests in Oregon and Washington *in* Leonard F. Ruggiero, Keith B. Aubry, Andrew B. Carey, and Mark H. Huff, technical editors 1991. Wildlife and Vegetation of Unmanaged Douglas-Fir Forests. General Technical Report PNW-GTR-285. <http://www.fs.fed.us/pnw/pubs/gtr285/>.

The NEPA analysis should help illuminate trade-off between snag quality (snag size) and snag quantity (number of snags) that follows from the choice between thinning and not thinning. This critically important trade-off may be amenable to quantitative analysis if the agency would conduct a stand simulation model. This is one of the key functions of NEPA to illuminate the consequences of alternative management approaches. With respect to dead wood habitat, what mix of treated and untreated areas will result in the best mix of thinned areas with later-fewer-larger snags, and unlogged areas where dead wood recruitment is more rapid, more abundant, only slightly smaller?

Thinning is often presumed to accelerate attainment of multiple attributes of mature & old-growth forests. This is partially true. Thinning does accelerate the growth rate of the trees that are retained, but thinning has limited effects on canopy structure[[1]](#footnote-1) and generally has adverse effects on snags and dead wood. The NWFP ROD highlighted the importance of dead wood accumulation as young forests develop into mature & old-growth: “Desired late-successional and old-growth characteristics that will be created as younger stands change through successional development include: (1) multispecies and multilayered assemblages of trees, (2) **moderate-to-high accumulations of large logs and snags**, (3) moderate-to-high canopy closure, (4) moderate-to-high numbers of trees with physical imperfections such as cavities, broken tops, and large deformed limbs, and (5) moderate-to-high accumulations of fungi, lichens, and bryophytes.” 1994 ROD p B-5. Thinning will truncate this important ecological process and degrade the quality of future late-successional habitat. When the logs are removed from the site, this adverse effect can be long-lasting.

“Natural processes and disturbances such as windthrow fire and the effects of pathogens and insects are also part of old forest development that thinning does not mimic.” <http://www.fsl.orst.edu/Oldgrowthworkshop/statements/Tappeiner.pdf>.

Mid-seral stands that result from past clearcutting leave few if any legacies from the previous stand. Natural young stands tend to have abundant snags and dead wood, but clearcut stands are artificially deprived of dead wood several decades. At the age of thinning, such stands are starting to experience suppression mortality and will tend to accumulate snags and dead wood over time if left unthinned. However, thinning will perpetuate the artificial shortage of snags and dead wood for another several decades. This is a long-term cumulative impacts that needs to be addressed in the NEPA analysis.

There is a widely held belief that growing big trees faster by thinning, also benefits snag associated wildlife and fish because if there are bigger trees, there must also be bigger snags faster. This assumption does not hold up under scrutiny. Thinning captures mortality and removes it from the forest to the mill. It also increases the vigor of trees and delays mortality. BLM says “Thinning ‘captures’ much of the snag recruitment that results from inter-tree competition and very little density mortality … is expected to occur for 25 years after treatment.” Salem BLM, South Scappoose EA. <http://www.blm.gov/or/districts/salem/plans/files/SSC_EA.pdf>. See this online slideshow which shows the modeled effects of thinning on dead wood habitat. <http://www.slideshare.net/dougoh/effects-of-logging-on-dead-wood-habitat>. Stand simulation models clearly show that we need to count the effects of thinning on dead wood as a “cost” instead of the “benefit”, so we need to consider appropriate methods to avoid and mitigate impacts. Avoidance is just to leave stands unthinned and let them naturally grow and recruit mortality over time. Mitigation can come in several forms. Here are a few ideas:

a) truly mimic natural disturbance by thinning with prescribed fire that creates a pulse of dead trees and does not build roads. This could be combined with light thinning;

b) retain abundant untreated areas such as riparian areas and other “skips” within thinning areas where natural mortality can proceed without interference, and make sure these areas do not get salvaged or thinned in subsequent entries so that mortality gets recruited to the stands, not to the mill;

c) identify which portions of the landscape will remain unthinned in perpetuity and keep the loggers out. Use tools like DecAID determine the appropriate portion of the landscape must be managed to meet the each different tolerance levels in order to attain desired objectives over time for viable populations, carbon storage, soil stability/sediment storage and routing, nutrient cycling, site productivity, water storage, and other ecological services.

NOTE: simply protecting existing snags or artificially creating a few snags during logging has a very short-term effect that does not address the more fundamental issue of continuous snag recruitment over time.

One of the big challenges of any restoration thinning regime, is that virtually all logging tends to “capture mortality,” yet the trees that are removed represent future snags and down logs and are valuable (even essential) components of any complex forest. “Carey et al. (1999) found that coarse woody debris amounts declined significantly as a result of variable density thinning, especially the higher decay classes, despite the intent of the treatment to leave all existing debris in place.”[[2]](#footnote-2) The agency cannot use “average” snag levels as a management objective within treatment areas, because treatments are essentially displacing natural disturbance events which would normally create and retain large numbers of snags, so disturbance areas should have abundant snags, not average levels of snags. Managing for decadence in young stands is not a trivial issue because among the many other valuable attributes of dead wood, it is strongly associated with healthy populations of many small animals species that in turn help support populations of at-risk predators such as spotted owls, goshawk, fisher, marten, etc.

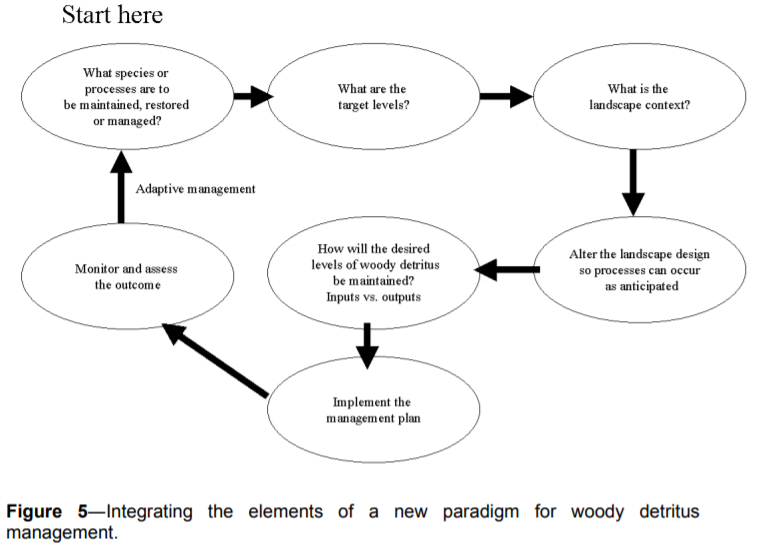
Small logs provide escape cover or shelter for small species. … Tallmon and Mills (1994) have shown that red-backed voles, a primary prey species for the spotted owl, are highly associated with large down material in more advanced decay stages. Truffles, a dietary staple of the northern flying squirrel, have also been loosely associated with down material.

Gregg, M. 2013. Wildlife Report for Management Indicator Species, Species of Concern from the Northwest Forest Plan, and Landbirds - Pole Creek Fire Timber Salvage. <http://a123.g.akamai.net/7/123/11558/abc123/forestservic.download.akamai.com/11558/www/nepa/94141_FSPLT3_1451590.pdf>

The snag dynamics white paper on the DecAID website indicates that timber harvest typically results in the loss of a majority of the standing snags (62% of snags within a variety of timber harvest areas were cut down.) <http://web.archive.org/web/20060520051245/http://wwwnotes.fs.fed.us:81/pnw/DecAID/DecAID.nsf/HomePageLinks/863EEA66F39752C088256C02007DF2C0?OpenDocument>. Also, in the Windjammer EA the Siuslaw NF noted that at least six times more coarse wood carries over from old-growth forests after wildfire compared to after timber harvest, and the CWD left after logging is smaller and decays faster (*citing* Spies & Cline 1988)[[3]](#footnote-3) so young stands are already deprived of dead wood. This is very troubling. The agency must start by carefully designing the project to keep workers away from existing snags. The agency must then consciously and very deliberately manage for decadence in the design of all thinning efforts. One way to think of this is to figure out how many trees the agency thinks they want to kill and remove a small portion of those while leaving the remainder as standing snags or down wood.

Harmon (1999) said:

**Linking Live and Dead Trees -** Although developing a viable morticulture will require new knowledge, in many cases it will require that we apply what we already know. For example, we already know that live trees eventually form dead trees, but it is amazing that this dynamic is often missing from current forest management thinking. … Forest management in the past century has focused on how to lower mortality rates via thinning, fire protection, etc. Ironically, the next century of forest management may be occupied with how to increase mortality when and where we want it. … [H]ow might this new paradigm of morticulture work? It would probably start by answering the question of which species or processes are to be maintained, restored, or otherwise managed (fig. 5). Then the target levels for these functions should be determined. Before assessing the amount of woody detritus to be maintained or added to meet this functional target, the landscape context for the management action should be assessed. Are there limitations of populations or processes that would limit the desired response? If not, a plan to add wood would be designed to maintain the desired level. But if there are landscape limitations, then these should be addressed before planning at the stand-level proceeds.”)



See Harmon, Mark 1999. Moving towards a New Paradigm for Woody Detritus Management. *in* 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/>

<https://www.fs.fed.us/psw/publications/documents/gtr-181/071_Harm.pdf>. Using DecAID or other tools, the agency needs to identify appropriate goals for snags and dead wood habitat based on the needs of wildlife that are most sensitive to the absence of such habitat features. The agency needs to analyze how to achieve those goals by retaining an adequate population of green trees and maintaining natural mortality processes that can act on those trees.

The agency should recognize the long-term effects of captured mortality on the habitat needs of small mammals and spotted owls.

Several small mammals, such as the northern flying squirrel form the prey base for the Endangered Species Act (ESA) listed spotted owl and are among the species associated with abundant large dead standing and down wood. This presumably, is why spotted owls prefer to forage in stands with abundant standing and fallen dead wood (Table 2, North et al. 1999). The fruiting bodies of hypogeous fungi are a food source of northern flying squirrels and are also associated with down logs, suggesting that there are complex, indirect paths through which dead wood supports spotted owls (Amaranthus et al. 1994, Carey 2000).

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

North et al. (1999) noted in a study of foraging habitat selection by northern spotted owls, “In our study area, stands with high use by owls typically included many ‘legacies’ (large trees and snags) that survived a fire or windstorm that destroyed much of the previous stand. They found that “stands with 142 m3/ha of intact snags and a high diversity of tree heights had medium or high foraging use by spotted owls. In these old-growth stands, biological legacies (e.g., large trees and snags) produced by past disturbance provide important forest structures associated with spotted owl foraging.” North, Franklin, Carey, Forsman, Hamer. 1999. Forest Stand Structure of the Northern Spotted Owl’s Foraging Habitat. For. Sci. 45(4):520-527.

Techniques for enhancing decadence may include:

* Retaining all large snags and large dead wood by keeping workers out of the hazard zone if necessary,
* Intentionally retaining leaning trees, and trees with defects, broken tops, forked tops, etc.
* Leaving some untreated skips where future mortality can be expected,
* Mimic natural disturbance processes by killing and leaving some trees.
* When determined to be necessary, snag creation must be a creative endeavor. Trees killed in different way will die and decay in different ways. A variety of techniques should be used within and between stands: high-cutting stumps, girdling, topping, burning, infecting with heart rot fungus or other native pathogens, etc.

Artificial snag creation is often proposed as a mitigation, but this has very short-term benefits. Since logging has long-term adverse effects on snag recruitment, it is necessary to adopt mitigation with long-term effects, such as retaining untreated skips embedded within treatments areas where natural mortality processes can flourish.

The Mt Hood National Forest has made an effort to mange for decadence in the Cloak Thinning EA, 11/2004 <http://web.archive.org/web/20090116060045/http://www.fs.fed.us/r6/mthood/projects/cloak-thinning/CloakEA.pdf>. Design Criteria #6 (p 23) indicates that “live trees would also be selected as leave trees that have the ‘elements of wood decay’ as described in the DecAID advisor. This may include trees with features such as dead tops, broken tops and heart rot.” This technique will be applied not only in thinning native second growth but also in thinning dense young plantations. The agency should incorporate this design element in all projects and instruct marking crews and cutting crews to “look up” so they can retain key elements of structural complexity such as broken tops, forked trees, etc.

The Regional Ecosystem office recommends managing dead wood in young stands within reserves to attain *biologically optimal* levels, not just *average* or *reference* levels. REO said “CWD objectives should be based on research that shows optimum levels of habitat for late-successional forest-related species, and not be based simply on measurements within natural stands.” REO 7-9-1996 Criteria to Exempt Specific Silvicultural Activities in Late-Successional Reserves, <http://www.reo.gov/library/policy/REO-694_comm_thin_criteria.doc>. This means that information from DecAID reference stands should be supplemented with DecAID >80% tolerance levels to determine management objectives for dead wood in LSRs.

The agencies often claim (erroneously) that thinning increases dead wood or improves dead wood habitat, but the laws of conservation of mass prevent the agencies from claiming that they can simultaneously send millions of board feet of wood to the mill and still increase wood in the forest over the long term. The agencies often present the issue of dead wood as if the objective is to produce the first large tree (aka “the hare”), rather than to produce a continuous flow of large trees over the long-term (aka “the tortoise”). By focusing on the treatment that produces a few big trees fast, the agencies ignore important aspects of the decision, including (a) the fact that recruiting dead wood requires two things large trees AND mortality. Logging produces vigorous trees that are less likely to die and produce snags in the near term, and thinning removes less vigorous trees that are more likely to be recruited as forest structure in the near term, and (b) the fact that thinning reduces the absolute number of trees that can ever be recruited as snags and dead wood. Every tree that leaves the forest on a log truck has an alternate future as a snag and dead wood. The agency ignores this opportunity cost of logging. When forest scenarios are put through an accurate model of stand growth and mortality, in almost all cases thinning will result in a reduced flow of large wood over the long-term. For instance, in a thinning project on the Siuslaw National Forest “modeling stand #502073 over a 100-year cycle [using ORGANON] predicts a total stand mortality of 202 trees (>10 inches dbh) for the unthinned stand, while mortality for the thinned stand was two trees. Therefore, thinning will reduce density-dependent mortality within the stand by 99%.” NOAA 2006. Magnuson Act consultation on Essential Fish Habitat and Response to Siuslaw NF Lobster Project BA. April 4, 2006.

If the agency asserts that commercial logging benefits snags and dead wood, they must provide quantitative analysis and state their assumptions.

Zelig modeling by Pabst et. al (figure below, unpublished 2003) has shown no difference in the cumulative number of large snags (>19.7” dbh) in un-thinned vs. thinned + snag creation treatments for the first 35 years. From 35 to 100 years post-treatment, there are slightly more large snags in the thinned +snag creation stands than in the un-thinned. But with review including error bars, the difference is negligible. After 100 years, large snags accumulated at a much higher rate in the un-thinned stands. Since most silvicultural prescriptions on the WNF include only one thinning entry, with plans for regeneration harvest between 40-80 years after treatment (~80-120 year rotations), thinning + snag creation at the densities modeled does provide a small benefit to large snag availability within that time frame.

Cheryl Friesen 2009. THINNING AND DEAD WOOD: “BEST AVAILABLE SCIENCE” December 15, 2009. <http://ecoshare.info/projects/central-cascade-adaptive-management-partnership/synthesis-papers-tools/> In this analysis, the agency assumes that the stand will be regenerated before the long-term benefits of passive management can be realized. It is not proper to rely on this assumption when planning thinning projects in young stands. The future regen is not part of the proposed action, and in reserve allocations regen is not part of the desired future condition.

We are very concerned that heavy thinning “captures mortality” and increases vigor thereby delaying recruitment of snags and delaying development of critical components of old growth forests. This is especially critical in riparian reserves where recruitment of large wood is important. It is often asserted that thinning grows big trees faster and therefore results in more rapid recruitment of large snags faster, but FVS and other tools show this NOT to be true. Thinning both reduces and delays snag recruitment, by removing trees that would otherwise suffer suppression mortality, and by increasing vigor and delaying overall mortality. Thinning may increase growth of individual trees but the alternative to thinning (i.e. natural growth and succession) does NOT result in NO growth. Unthinned stand continue to grow and actually result in more large snags sooner. The effects of this fact must be reflected in the NEPA analysis. The implications are that heavy thinning should be used sparingly and generous unthinned patches should be retained WITHIN thinned stands in order to continue the snag recruitment process and mitigate for captured mortality.

The vast majority of agency NEPA analyses make erroneous conclusions about the effects of logging on snags and dead wood, claiming that logging is beneficial when available evidence indicates the opposite is true. This is not an error about the degree of effect (small versus large effects), but an error on the character and direction of effects (detrimental versus beneficial). See Heiken, D. 2010. Dead Wood Response to Thinning: Some Examples from Modeling Work. <https://www.dropbox.com/s/m4671mhsstg61ss/dead_wood_slides_2.pdf?dl=0>. First, the agencies have put too much faith in professional opinion, which can be fallible. “Models provide a basis but lack variables in the program. Only on-the-ground work of an experienced forester can take in all the variables. Years of experience cannot be replaced by a computer.” Wallowa-Whitman National Forest. 2011. Muddy Sled DN, Appendix E. Second, the agencies appear to suffer from a malady called “belief perseverance.”

“People tend to hold on to their beliefs even when it appears that they shouldn't. Belief perseverance is the tendency to cling to one's initial belief even after receiving new information that contradicts or disconfirms the basis of that belief. … The third type involves *naive theories*, beliefs about how the world works. … At least three psychological processes underlie belief perseverance. One involves use of the “availability heuristic” to decide what is most likely to happen. … A second process concerns “illusory correlation,” in which one sees or remembers more confirming cases and fewer disconfirming cases than really exists. A third process involves “data distortions,” in which confirming cases are inadvertently created and disconfirming cases are ignored. … Research also has investigated ways to reduce belief perseverance. The most obvious solution, asking people to be unbiased, doesn't work. However, several techniques do reduce the problem. The most successful is to get the person to imagine or explain how the opposite belief might be true. This de-biasing technique is known as *counterexplanation*.”

Anderson, C.A. (2007). Belief perseverance (pp. 109-110). In R. F. Baumeister & K. D. Vohs (Eds.), Encyclopedia of Social Psychology. Thousand Oaks, CA: Sage. <http://www.psychology.iastate.edu/faculty/caa/abstracts/2005-2009/07a.pdf>.

Looking at recent stand simulation analyses the effects of thinning on recruitment of large wood, e.g. the Curran-Junetta and Holland Moonsalt Projects on the Cottage Grove Ranger District, it appears that thinned stands may not reach the 80% tolerance levels for large snags, not even in 100 years. If thinning really forecloses that opportunity, then we better set aside large areas of the landscape where thinning does not occur and large snag recruitment can occur at natural levels. These unthinned area need to be planned in advance and left unmanaged for very long periods so this process can operate without the interference of foresters who think they can improve on things with chainsaws. The lesson of the stand simulation models is that virtually any logging, reduces and delays recruitment of large snags. This is very significant and very under-appreciated new information.

Using data from stand exams modeled through FVS-FFE (West Cascades variant) the Umpqua NF found that the actual effect of thinning is to capture mortality and *delay* recruitment of large wood for up to 60 years. Other NEPA analyses should emulate the honest disclosure of thinning impacts on snag habitat found in the Cottage Grove District’s Curran Junetta Thin EA:

There is currently an excess of forested land in this area without snags (roughly 5 times higher than what DecAID recommends) and a deficiency in areas with high snag densities (roughly 12% of what DecAID recommends). Management prescriptions should allow for these extremes because they are ecologically important (White et al. 2002, Mellen et al. 2005). Common natural disturbances that produce areas with high levels of dead wood include wildfire, insects and disease, and wind (blow down) events.

…

The action alternatives cause a decrease in stand levels of snags and down wood caused by incidental falling of snags for logging or safety reasons, and consumption of down wood during the fuels reduction treatments. Thinning would then reduce the amount of suppression mortality within the thinned portions of stands, indirectly affecting future recruitment of CWD. Existing snags and logs would be protected to the extent practical and safe. However, it is probable that the action alternatives would lower levels of these structures (to approximately one to two snags per acre) through mechanical disturbance from tree falling and harvesting. … To mitigate for effect on large snags, the action alternatives would include the inoculation of two trees per acre on 857 acres and five snags per acre on 379 acres (within CHU OR-20) with locally collected native heart rot fungus. Inoculated trees begin to develop heart rot within five years as they continue to grow (Duncan, 1999), eventually producing larger trees with cavities and future snags that remain standing longer than if girdled. Inoculation is a management tool being used to offset the reduction of suppression mortality caused by thinning and to maintain a component of decadence within these managed stands. Additional snag mitigation would occur within CHU OR-20; six snags per acre would be created by fire during fuels reduction activities. In unit seven, mitigation would occur by girdling trees (>15 inch dbh or largest trees available) to achieve six snags per acre within the thinned portions of the unit.

…

Large snag (≥20” DBH) densities within the stands are currently below the levels advised for in DecAID (4.7 snags/acre – 30% tolerance level). Under the no action alternative this level of snags would not be achieved for another two decades (Figure 15). The action alternatives would delay reaching this level by an additional 10 to 30 years (10 years for units thinned to 70 to 90 trees per acre, 30 years for units thinned to 40 to 60 trees per acre).

…

**Cumulative impacts**

Substantial adverse impacts to levels of CWD at both the stand and landscape-scale have resulted from past clearcut timber harvesting, road building, roadside salvage and fire exclusion. The Layng Creek inventory showed an overabundance of land area with no snags, and a deficit of land area with high snag densities (caused by fire exclusion). It would take several decades to restore snag and log conditions to within the ranges advised for in DecAID at these two extreme ends of the range of CWD.

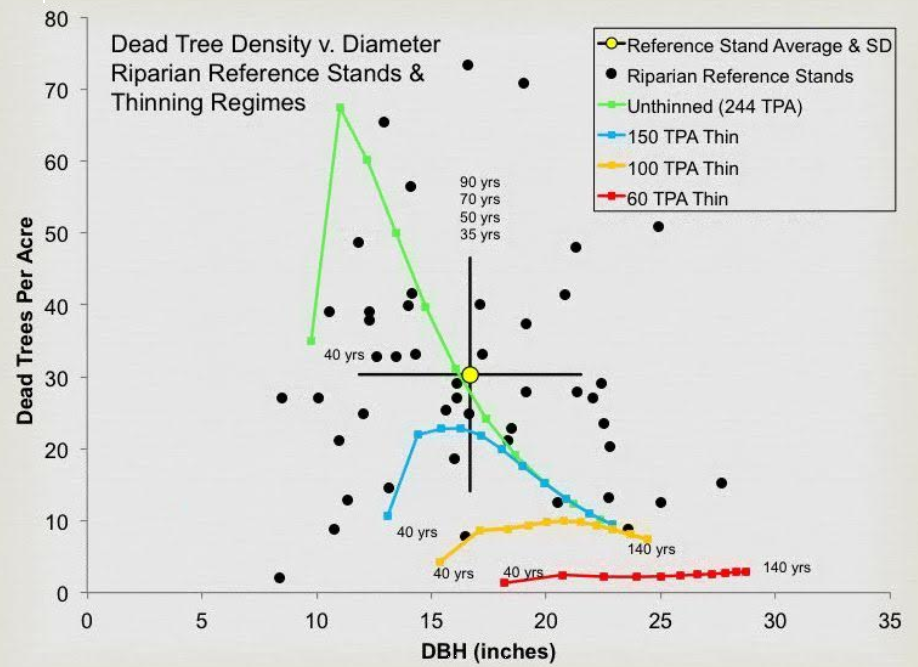
USDA Forest Service. 2007. Curran Junetta Thin EA. Cottage Grove Ranger District, Umpqua National Forest. June 2007. <http://a123.g.akamai.net/7/123/11558/abc123/forestservic.download.akamai.com/11558/www/nepa/32805_FSPLT2_053506.pdf>.

This graph from the Curran Junetta Thin EA shows that heavy thinning delays by more than 60 years the attainment of habitat objectives for large snags (i.e. mid-point of the gray band representing 30-80% tolerance level).



<http://a123.g.akamai.net/7/123/11558/abc123/forestservic.download.akamai.com/11558/www/nepa/32805_FSPLT2_053506.pdf>.

The figure below, from Pollock et al (2012), shows that tree removal through thinning can lead to stand development trajectories that miss the reference condition for dead wood. We point this out to highlight one of the trade-offs involved in thinning, and to encourage careful thinking about mitigation. Leaving the cut trees in the woods is a good short-term mitigation, but the small trees do not last long enough to fill the temporal gap between now and when the stand begins recruiting more dead wood on its own. Leaving unthinned patches within treated stands is a good mid-to-long-term mitigation.



Pollock, M. M., T. J. Beechie, and H. Imaki. 2012. Using reference conditions in ecosystem restoration: an example for riparian conifer forests in the Pacific Northwest. Ecosphere 3(11):98. <http://dx.doi.org/10.1890/ES12-00175.1>

The analysis needs to show that widespread thinning will cause long-term delay in attainment of desired levels of dead wood habitat. Creating 10 snags/acre immediately after harvest is fine as far as mitigation for snags lost due to hazard tree removal, and short-term mitigation for reduced snag recruitment caused by thinning. However, a single pulse of dead wood is short-lived while the adverse effects of widespread commercial thinning on dead wood recruitment last many decades. Snags are in severe deficit as a result on widespread regen harvest in this area over the last 60 years. Every tree that is removed by logging is a forgone opportunity for snag habitat.

“Two common consequences of conventional thinning practices have been increased uniformity of forest structure and composition, and removal or delay in the development of dead wood as snags or down wood to meet decadence and habitat functions. … Over the past several decades our ecological understanding of decadence and its importance to habitat and biogeochemical processes has increased substantially, but translation of the fundamental knowledge into coherent goals is lagging.”

Paul D. Anderson 2013. Two Decades of Learning about Thinning in the Ecosystem Management Era. <http://www.fs.fed.us/pnw/pubs/pnw_gtr880/pnw_gtr880_001.pdf> in Density Management in the 21st Century: West Side Story PNW-GTR-880. <http://www.treesearch.fs.fed.us/pubs/44695>

“Many species in the Pacific Northwest evolved to use large snags and logs that were historically abundant in the landscape. If snags and logs are lost, biodiversity can be affected and potentially cause a loss of some function in the landscape such as control of forest insects.”

Mt Hood NF 2011. Huckleberry Thin EA. <http://a123.g.akamai.net/7/123/11558/abc123/forestservic.download.akamai.com/11558/www/nepa/59590_FSPLT2_034896.pdf>.

Many animals in Douglas fir forests are strongly associated with habitat features that are best developed in natural forest, such as large trees, snags, and downed logs. The diversity and density of cavity-nesting birds, for example, are positively correlated with the abundance of snags, especially tall and/or large-diameter snags (Nelson 1988, Zarnowitz and Manuwal 1985).

…

It is the cycle of structural development through plant growth, and the retention of structural complexity via legacy, that characterizes natural forests in the Coastal Northwest. Intensive wood production practices may alter this cycle both by truncating succession before large structures develop and by removing most existing structures during harvest. Planting and thinning may further promote uniformity in tree species, size, and spacing.

…

Studies in unmanaged forests teach us that natural disturbance maintains structural complexity within stands and that this complexity promotes plant and animal diversity.

…

Until it is clear that forests managed for wood production can be made suitable for native species, managers should consider retaining within managed forests representative tracts of all natural forest stages, not just old growth.

Hansen, A. J.; Spies, T. A.; Swanson, F. J.; Ohmann, T. L. 1991. Conserving biodiversity in managed forests - Lessons from natural forests. BioScience 41(6):382- 392. <http://www.montana.edu/hansen/documents/downloadables/hansenetal1991.pdf>.

“Dead wood in the form of snags and downed logs is generally common or abundant. Although a notable part of old-growth stands, such material is actually common in unmanaged stands in all successional stages in the Douglas-fir region.” Franklin & Spies 1983. CHARACTERISTICS OF OLD-GROWTH DOUGLAS-FIR FORESTS. Reprinted New Forests for a Changing World. Proceedings of the 1983 SAF National Convention <http://andrewsforest.oregonstate.edu/pubs/pdf/pub120.pdf>

Many natural young and mature stands have some of the attributes of old-growth stands that may not be present in young, managed stands. Perhaps the greatest difference between natural and managed stands is the lower number and volume of large snags and logs in managed plantations (Spies and Cline 1988). Many young natural forests less than 80 years old have high amounts of carry-over of woody debris...

Thomas A. Spies and Jerry F. Franklin 1991. The Structure of Natural Young, Mature, and Old-Growth Douglas-Fir Forests in Oregon and Washington *in* Leonard F. Ruggiero, Keith B. Aubry, Andrew B. Carey, and Mark H. Huff, technical editors 1991. Wildlife and Vegetation of Unmanaged Douglas-Fir Forests. General Technical Report PNW-GTR-285. <http://www.fs.fed.us/pnw/pubs/gtr285/>.

## Plantation thinning recommendations

Oregon Wild makes the following recommendations to enhance the restoration benefits of young stand thinning prescriptions:

1. When conducting commercial thinning projects take the opportunity to implement other critical aspects of watershed restoration especially pre-commercial thinning, restoring fish passage, reducing the impacts of the road system, and treating invasive weeds.
2. Use projects as an opportunity to learn by conducting monitoring and research on the effects of thinning. There are many information gaps that need filling. Every project should generate useful information to inform future projects.
3. Young stands do not exist in isolation, so be sure to consider the effects of thinning on adjacent mature & old-growth habitat which may provide habitat for spotted owls, marbled murrelets, and other species. Spotted owls may use young stands for dispersal, foraging, and security from predators. It may be helpful to create a “risk map” that identifies areas that are more or less suitable for thinning based on criteria such as: existing habitat characteristics, proximity to occupied habitat or activity centers, proximity to suitable habitat, and proximity to recently thinned areas, non-habitat, and roads. The agency should also consider adjusting both the location and timing of thinning to minimize the cumulative effects of widespread thinning on the sensitive and listed species.
4. Focus on treating the youngest stands that are most "plastic" and amenable to restoration.
5. Generally retain all the largest trees, and some of the smaller trees in all age-size classes. This can be accomplished in part by retaining untreated “skips” embedded within the stand.
6. Retain and protect under-represented conifer and non-conifer trees. Protect shrubs as much as possible, especially deciduous and tall shrubs, and those that produce insects, berries and mast. "Although usually classified as a shrub and not considered in discussions of forest composition or structure, *A. circinatum* [vine maple] dominated the angiosperm component, and although comprising only 0.9% of the basal area, it was the most abundant woody species in terms of stem count. This is important because *A. circinatum* makes a disproportionate contribution to biodiversity in this evergreen conifer forest, for example by providing food for folivore geometrid larvae that feed Neotropical migrant birds [26] and by providing substrate for epiphytic lichens and bryophytes [27]." Lutz JA, Larson AJ, Freund JA, Swanson ME, Bible KJ (2013) The Importance of Large-Diameter Trees to Forest Structural Heterogeneity. PLoS ONE 8(12): e82784. doi:10.1371/journal.pone.0082784. <http://ctfs.arnarb.harvard.edu/Public/pdfs/LutzEtAl_PLoS2013.pdf>
7. Strive for a variable density outcome. Be creative in establishing diversity and complexity both within and between stands. Use skips and gaps within units to help achieve diversity. Gaps should be small, while skips should be a little larger, but even small clumps and patches of trees are desirable. Gaps should not be clearcut but rather should retain some residual structure in the form of live or dead trees. Landings do not make good gaps because they are clearcut, highly compacted and disturbed, more likely subject to repeated disturbance, and directly associated with roads. Using “designation by description” results in a small amount of within stand variability, but it is a significant compromise compared to the amount of variability that is ecologically desired both within and between stands and that could reasonably be accomplished with a little more effort.



An example showing that old growth trees are not widely or evenly spaced, highlighting the need for variability and retaining clumps of trees.

1. The scale of patches in variable density thinning regimes is important. Ideally variability should be implemented at numerous scales ranging from small to large, including: the scale of tree fall events; pockets of variably contagious disturbance from insects, disease, and mixed-severity fire; soil-property heterogeneity; topographic discontinuities; the imprint of natural historical events; etc.
2. Retain abundant snags and course wood both distributed and in clumps so that thinning mimics natural disturbance. Retention of dead wood should generally be proportional to the intensity of the thinning, e.g., heavy thinning should leave behind more snags not less. Retain wildlife trees such as hollows, forked tops, broken tops, leaning trees, etc.
3. Thinning does not always accelerate development of late successional forests, in particular commercial thinning has an adverse effect on snags and dead wood that are defining characteristics of late successional habitat. Thinning might produce the first large trees, but those trees would be vigorous and less likely to experience mortality, so developing large snags is not direct and immediate result of growing large trees. Thinning also dramatically reduces the pool from which future mortality can be recruited so thinning actually retards development of some attributes of late successional forest and spotted owl habitat including snags and down wood. NEPA analyses often assert that "As a result of thinning, growth of retained live trees would be accelerated, so larger trees would be available sooner for recruitment as snags and CWD than without thinning." This is only half the story and it is very misleading. The agency is not being fully honest about the effects of logging unless statements like this are followed by a loud and clear acknowledgement that accelerating development of a few larger *live trees* (that *might* become snags if a few of them happen to die) *comes at the cost* of a significant reduction in the number of medium and large snags over time. From an ecological perspective, the net result of commercial logging is undeniably adverse to snag habitat. The agency cannot present logging as a benefit to snag habitat when it is really a cost that needs to be mitigated.
4. Continuous recruitment of snags is critical to development of old growth forest habitat. We urge the agency to adopt a process-based approach to snag habitat. Instead of focusing on how many snags there are now and immediately after logging, it is better to focus on (i) whether the project will retain an adequate pool of green trees from which to recruit snags and (ii) whether the project will retain the ecological processes that cause mortality, including density dependent mortality and other mechanisms. Commercial logging will significantly harm both of these snag recruitment factors, so mitigation measures are needed. Green tree retention, including generous unthinned “skips” where density dependent mortality will play out, is necessary to support this process. This is especially critical in previously logged uplands that are already short of snags and in riparian areas where recruitment of large wood is important to stream structure. It is often asserted that thinning grows big trees faster and therefore results in more rapid recruitment of large snags, but FVS and other tools show this NOT to be true. In fact, thinning both reduces and delays recruitment of snags, first by removing trees that would otherwise suffer suppression mortality, and second by increasing stand vigor and postponing overall mortality. See this online slideshow which shows the modeled effects of thinning on dead wood habitat. Heiken, D. 2010. Dead Wood Response to Thinning: Some Examples from Modeling Work. <https://www.dropbox.com/s/m4671mhsstg61ss/dead_wood_slides_2.pdf?dl=0>. The implications are that heavy thinning should be used sparingly and generous unthinned patches should be retained WITHIN thinned stands in order to continue the snag recruitment process and mitigate for captured mortality. To inform the decision, please conduct a stand simulation model to fully disclose the adverse effects of logging on dead wood, especially large snags >20” dbh, and then mitigate for these adverse effects by identifying areas within treated stands and across the landscape that will remain permanently untreated so they can recruit adequate large snags and dead wood to meet DecAID 50-80% tolerance levels as soon as possible and over the long-term.
5. Artificial snag creation is often proposed as mitigation for the loss of snags during logging, but snags fall down and dead wood decays, so a one-time snag creation effort provides very short-term benefits. Since logging has long-term adverse effects on snag recruitment, it is necessary to adopt mitigation with long-term effects, such as retaining generous untreated “skips” embedded within treatments areas where natural mortality processes can flourish.
6. Recognize that dead wood values are sacrificed in thinned areas due to the effect of “captured mortality,” while other late successional values, such as rapid development of large trees and understory diversity may be delayed in unthinned areas, so an important step in the restoration process is to identify the most optimal mix of treated (thinned) and untreated (unthinned) areas. We think this should be a conscious and well-documented part of the NEPA analysis, not just an accidental byproduct of what’s economically thinnable. Tools like DecAID might be used to identify goals for large and small snags that need to be met over time and at the geographic scale of home-ranges of focal species. This can help identify the scale and distribution of untreated “skips.”
7. Thin heavy enough to stimulate development of understory vegetation, but don’t thin too heavy. Recognize that thinning captures mortality and that plantation stands are already lacking critical values from dead wood due to the unnatural stand history of all clearcut and planted stands. Tom Spies made some useful observations in the Northwest Forest Plan Monitoring Synthesis Report: “Certainly, the growth of trees into larger diameter classes will increase as stand density declines (Tappeiner and others 1997). At some point, however, the effect of thinning on tree diameter growth levels off and, if thinning is too heavy, the density of large trees later in succession may be eventually be lower than what is observed in current old-growth stands. In some cases, opening the stand up too much can also create a dense layer of regeneration that could become a relatively homogeneous and dominating stratum in the stand. Furthermore, if residual densities are too low, the production of dead trees may be reduced (Garman and others 2003). Thinning should allow for future mortality in the canopy trees.” <http://web.archive.org/web/20070808101639/http://www.reo.gov/monitoring/10yr-report/documents/synthesis-reports/index.html>.
8. If using techniques such as whole-tree yarding or yarding with tops attached to control fuels, the agency should top a portion of the trees and leave the greens in the forest in order to retain nutrients on site. Achat, Deleuze, et al 2015. Quantifying consequences of removing harvesting residues on forest soils and tree growth – A meta-analysis. Forest Ecology and Management Volume 348, 15 July 2015, Pages 124–141. <http://www.sciencedirect.com/science/article/pii/S0378112715001814> (“Our study showed that, compared with conventional stem-only harvest, removing the stem plus the harvesting residues generally increases nutrient outputs thereby leading to reduced amounts of total and available nutrients in soils and soil acidification, particularly when foliage is harvested along with the branches. … Soil fertility losses were shown to have consequences for the subsequent forest ecosystem: tree growth was reduced by 3-7% in the short or medium term (up to 33 years after harvest) in the most intensive harvests (e.g. when branches are exported with foliage). Combining all the results showed that, overall, whole-tree harvesting has negative impacts on soil properties and trees that may have an impact on the functioning of forest ecosystems.”)
9. Thinning creates activity fuels that can be treated (or not treated) in a variety of ways. Strive to treat fuels in ways that provide public benefits such as wildlife habitat (e.g., complex woody structure) and charcoal production (e.g., enhanced soil carbon storage), and reduce detrimental soil impacts from machine piling and hot burn piles. Deborah S. Page-Dumroese et al. 2017. Methods to Reduce Forest Residue Volume after Timber Harvesting and Produce Black Carbon. Scientifica. Volume 2017 (2017), Article ID 2745764, <https://doi.org/10.1155/2017/2745764>; <https://www.hindawi.com/journals/scientifica/2017/2745764/>
10. Recognize and mitigate adverse effects of thinning on spotted owl prey such as flying squirrels, red tree voles, and chipmunks. Avoid impacts to raptor nests and enhance habitat for diverse prey species. Train marking crews and cutting crews to look up and avoid cutting trees with nests of any sort and retain trees with defects such as forks, broken tops, etc...
11. Take proactive steps to avoid the spread of weeds. Use canopy cover to suppress weeds. Avoid soil disturbance and road construction. Scarifying landings and tempera roads and planting with native seeds is a good idea but please take steps to ensure that it is effective.
12. Buffer streams from the effects of heavy equipment and loss of bank trees and trees that shade streams. Mitigate for the loss of LWD input by retaining extra snags and wood (and green trees for recruitment) in riparian areas. Recognize that thinning “captures mortality” and results in a long-term reduction in recruitment of functional down wood, and that effect is not mitigated by future growth.
13. Avoid road construction. Building new roads will cause degradation that typically erases any alleged benefit of treatments. Roads have a variety of long-lasting adverse impacts on soil, water, and wildlife. Focus treatments on areas accessible from existing roads. Inaccessible areas can be treated non-commercially or become part of the landscape mosaic that is untreated and serve important ecological values such as dense forest cover, carbon storage, and natural rates of snag recruitment.
14. Where road building is necessary, ensure that the realized restoration benefits far outweigh the adverse impacts of the road. Carefully consider the effects of roads on connectivity, especially at road/stream crossings, across ridge tops, and midslope hydrological processes (such as large wood delivery routes). The NEPA analysis should rank new road segments according to their relative costs (e.g. length, slope position, soil type, ease of rehabilitation, weed risk, native vegetation impacts, etc.) and benefits (e.g. acres of restoration facilitated), then use that ranking to consider dropping the roads with the lowest ratio of benefits to costs. Avoid log hauling during the wet season. Once the relative acres accessed per mile of road is determined, take the analysis one step further and determine the “effective road density” of each segment. In other words, extrapolate as if that much road were required to reach each acre of the planning area, then compare the resulting road density to standards for big game, cumulative hydrological impact, etc? For example, if a new spur road accesses thinning opportunities at a rate of 200 acres of forest per mile of road, then divide 640 acres per section by 200 acres per mile to determine the effective road density of 3.2 mi/mi2.
15. If this project involves biomass utilization, the impacts need to be clearly disclosed. How will the biomass be moved from the remote corners of the treatment areas to the landings? Will there be extra passes made by heavy equipment? Will the landings be enlarged to make room for grinders, chip vans, and other equipment? Can the local forest roads accommodate chip vans? Will the roads be modified to make them passable by chip vans? What are the impacts of that? What are the direct, indirect, and cumulative impacts on soil, water, wildlife, and weeds?
16. Adopt a purpose and need to maintain and increase carbon storage in forest ecosystems. Develop an alternative that addresses carbon and climate by (a) deferring harvest of older forests to store carbon and provide biodiversity and connectivity and (b) thin younger stands to increase forest resilience and diversity and connectivity. Recognize that there is a carbon cost associated with thinning. As stands develop from young to mature to old, they recruit large amounts of material from the live tree pool to the dead wood pool and this pool continues to accumulate large amounts of carbon for centuries. Logging, even thinning, can dramatically affect the accumulation of carbon in the dead wood pool by capturing mortality, diverting it from the forest, and accelerating the transfer of carbon to the atmosphere. Carbon stays out of the atmosphere much longer if it remains in the forest as live and/or dead trees, instead of being converted to wood products and industrial and consumer waste.
17. If the stands to be thinned are younger than 80 years, the agency may rely on the Pechman exemption and not complete surveys for rare and uncommon species. However, this exemption is intended to apply to even-aged stands. If there are distinguishable legacy trees (more than 2 per acre) those areas are not part of the younger stand, and not eligible for the Pechman exemption, therefore the agency must survey for red tree voles and other survey and manage species.
18. Descriptions of the effect of NOT thinning dense young stands should incorporate the information presented in Lutz. J.A. 2005. The Contribution of Mortality to Early Coniferous Forest Development. MS Thesis. University of Washington. <http://faculty.washington.edu/chalpern/Lutz_2005.pdf>. This MS Thesis looked at long-term transect data from young forests in Western Oregon and found that non-competitive mortality and gap forming processes are very much in operation in dense young planted stands. This indicates that in young stands the homogenizing influence of stand growth and competitive mortality is significantly counter-balanced by non-competitive mortality that tends toward heterogeneity and structural diversification. This means that if young stand management is to effectively mimic natural patterns and processes, that variable density treatments must be the rule, and the scale of the mosaic must be very fine scale. Note: The study sites were located in the HJ Andrews Experimental Forest and were not naturally regenerated, so it is likely that in young stands that are naturally regenerating after disturbance such as fire, the heterogeneity and gap-forming processes would be even more pronounced. See also Lutz & Halpern 2006. Tree Mortality During Early Forest Development: A Long-Term Study Of Rates, Causes, And Consequences. Ecological Monographs, 76(2), 2006, pp. 257–275. <http://cfr501.jamesalutz.com/Lutz_Halpern_Mortality_EM_2006.pdf> and Franklin, J. F., T. A. Spies, R. Van Pelt, A. B. Carey, D. A. Thornburgh, D. R. Berg, D. B. Lindenmayer, M. E. Harmon, W. S. Keeton, D. S. Shaw, K. Bible, and J. Chen. 2002. Disturbances and structural development of natural forest ecosystems with silvicultural implications, using Douglas-fir as an example. Forest Ecology and Management 155:399-423. <http://www.fs.fed.us/pnw/pubs/journals/pnw_2002_franklin001.pdf>
19. Focus the analysis on “trade-offs” related to logging. All logging, including thinning stands of any age, include some adverse impacts and trade-offs. Some impacts of logging are unavoidable, so there is no such thing as a logging operation that is 100% beneficial. Depending on how thinning is done, it can have adverse impacts such as soil disturbance; habitat disturbance; damage to the shrub layer; carbon removal; spreading weeds; reduced populations of prey for carnivorous species; reduced recruitment of snags; road-related impacts on soil, water, site productivity, and habitat; moving fuels from the canopy to the ground, hotter-drier-windier microclimate that is favorable to greater flame lengths and rate of fire spread, etc. Some of these negative effects are fundamentally unavoidable, therefore all thinning has negative effects that must be compensated by beneficial effects such as reducing competition between trees so that some can grow larger faster, increased resistance drought stress and insects, possible increasing species and structural diversity, possible fire hazard reduction, etc. It is generally accepted that when thinning very young stands, the benefits outweigh the adverse impacts and net benefits are likely. It is also widely understood that thinning older stands tends to have greater impacts on soil, water, weeds, carbon, dead wood recruitment so the impacts very often outweigh the benefits, resulting in net negative outcome on the balance sheet. Thus, as we move from young forest to older forests, the net benefits turn into net negative impacts. See Klaus J. Puettmann, Adrian Ares, and Erich Dodson. 2011. Over- and understory vegetation responses to thinning treatments: Can we accelerate late successional stand structures? Symposium: Density Management In The 21st Century: West Side Story. <http://oregonstate.edu/conferences/event/densitymanagement2011/agenda.pdf> (“growth of large trees was less responsive to thinning and low mortality rates for larger trees resulted in little recruitment of large snags or coarse woody debris (down wood). In general, thinning increased abundance and diversity of early-seral understory species, with little effect on late-seral species. On sites where shrub cover was already high harvesting initially reduced the cover, but shrubs recovered over time. Exotic species slightly increased in response to treatment …”); and Erich K. Dodson, Adrian Ares, and Klaus J. Puettmann. 2011. Thinning effects on tree mortality and snag recruitment. Symposium: Density Management In The 21st Century: West Side Story. <http://oregonstate.edu/conferences/event/densitymanagement2011/agenda.pdf> (“…thinning did little to accelerate the development of large snags and coarse downed wood that provide critical wildlife habitat…”) These are some of the trade-offs that must be disclosed and weighed in the NEPA document.
20. Provide clear and detailed rationale that connects proposed actions to desired conditions. Test the rationale for actions and effects analysis against the scientific evidence, including the full range of evidence, reasonable opposing viewpoints, and the evidence presented in these comments. For each treatment unit, provide clear descriptions of silvicultural prescriptions and marking guides in the NEPA document.
21. Make the NEPA analysis thorough, explicit, and transparent on all these issues.

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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Sincerely,



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1. In young Douglas-fir stands “canopy structure did not differ dramatically between thinned and unthinned stands. … There were no evident trends between understory cover and thinning history; both shrub and forb cover were fairly similar among the three thinning intensities [including the unthinned control stands]. The difference in mean shade-tolerant canopy cover was not significantly lower in LT [light thin] and HT [heavy thin] than in ND [undisturbed] stands … We expected greater cover of understory vegetation in thinned than in unthinned stands but did not detect significant differences in this analysis.” McIntosh, Anne C.S.; Gray, Andrew N.; Garman, Steven L. 2009. Canopy structure on forest lands in western Oregon: differences among forest types and stand ages. Gen. Tech. Rep. PNW-GTR-794. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 35 p. <http://www.fs.fed.us/pnw/pubs/pnw_gtr794.pdf> [↑](#footnote-ref-1)
2. Jan 2004 SEIS for Removing Survey and Manage Mitigation, page 189. *citing* Carey, A.B., D.R. Thysell, and A. Brodie. 1999. The forest ecosystem study: background, rationale, implementation, baseline conditions, and silvicultural assessment. USDA Forest Service. General Technical Report PNW-GTR-457. Pacific Northwest Research Station. Portland, Oregon. <http://www.treesearch.fs.fed.us/pubs/2984> [↑](#footnote-ref-2)
3. Spies, T. A., and S. P. Cline. 1988. Coarse woody debris in forests and plantations of coastal Oregon. Pp. 5-23 in: C. Maser, R. F. Tarrant, J. M. Trappe, and J. F. Franklin, ed. From the forest to the sea: a story of fallen trees. Gen. Tech. Rpt. PNW- GTR-229. USDA Forest Service, Portland OR. <http://www.fs.fed.us/pnw/pubs/229chpt1.pdf>. [↑](#footnote-ref-3)