Cascadia WILDLANDS
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Submitted online via https://cara.fs2c.usda.gov/Public/CommentInput?Project=61142

Re: Steeple Rock Rigdon Draft Environmental Assessment #61142

Dear Forest Service:

Please incorporate analysis of the following issues into your planning documents for the Steeple Rock Rigdon project. These comments are submitted on behalf of Cascadia Wildlands and Oregon Wild.[1]

Project Description

The Steeple Rock Rigdon project area consists of approximately 21,653 acres along Hills Creek Reservoir and is located on the Middle Fork Ranger District approximately 14 miles south of the city of Oakridge in Lane County. The project would treat managed stands using a combination of commercial thinning, skips, and gaps on 3,169 acres of managed stands less than 80 years old. The project would also involve non-commercial treatments (288 acres), fuel reduction treatments (1,450 acres), and meadow enhancement (30 acres). EA at 6. The project would decommission up to approximately 7.1 miles of roads and store up to approximately 30.6 miles in a hydrologically stable condition. EA at 19.

Purpose and needs for the project:

- Improve stand and landscape diversity, structure, and resiliency
  Hazardous fuels reduction to reduce risk and increase land management opportunities across the landscape
- Identify a sustainable road system needed for safe and efficient travel and for

[1] Founded in 1998, Eugene-based Cascadia Wildlands represents approximately 15,000 members and supporters with a mission to defend and restore Cascadia's wild ecosystems in the forests, in the courts, and in the streets. Cascadia Wildlands envisions vast old-growth forests, rivers full of wild salmon, wolves howling in the backcountry, a stable climate, and vibrant communities sustained by the unique landscapes of the Cascadia bioregion.

Oregon Wild represents 20,000 members and supporters who share our mission to protect and restore Oregon's wildlands, wildlife, and water as an enduring legacy. Oregon Wild's goal is to protect areas that remain intact while striving to restore areas that have been degraded.

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administration, utilization, and protection of National Forest System Lands
- Provide a sustainable supply of forest products

EA at 7-12. The agency only evaluated one action alternative (the proposed action, summarized in the table below) in comparison with no action.

Proposed Activity	Unit of Measure	No Action	Proposed Action
Commercial Thinning with Gap Creation	Acres	0	2,379*
Skips in Harvest Stands (No Harvest, No Gap Creation)	Acres	0	790*
Helicopter	Acres	0	624
Skyline	Acres	0	1,322
Ground Based	Acres	0	433
Volume Produced	MMBF	0	40
Road Decommissioning	Miles	0	7
Road Storage	Miles	0	31
Temporary Road Construction	Miles	0	5 new / 1 existing
Road Maintenance	Miles	0	100
Quarry Management	Each	0	2
Other Restoration Activities			
Meadow Restoration	Acres	0	30*
Floodplain Restoration	Acres	0	12*
Commercial Thinning in Riparian Reserves	Acres	0	823*
Fall and Leave in Riparian Reserves	Acres	0	243*
Tree Tipping and Log Placement in Riparian Reserves	Acres	0	7*
Aquatic Organism Passage	Acre	0	1
Non-commercial thinning in Young Managed Stands	Acres	0	288*
Planting in Gaps	Acres	0	19
Burn Blocks	Acres	0	1,450*
Roadside Understory Fuel Treatments	Acres	0	410*
Gertrude Lake Dispersed Site Reconfigured and Conversion	Square Feet	0	9,500

EA at 16 (Table 2. Comparison of alternatives).

We appreciate this project's focus on thinning young stands as well as the focus on maintaining the existing road network as opposed to adding to it. This avoids much of the ecological harm and controversy associated with logging older stands and/or regeneration harvest. That said, thinning still involves concerning trade-offs, including but not limited to: carbon emissions that exacerbate global climate change, soil impacts from heavy equipment, impacts from road construction, impacts to spotted owls and their prey species, long-term impacts to future recruitment of snags and dead wood both in upland and riparian areas, increased weeds, potential for increased fire hazard due to modified microclimate and increased growth of surface and ladder fuels, etc. Our comments below highlight many of these trade-offs and possible mitigations.

Has the Forest Service invested in the research and monitoring to evaluate the many trade-offs associated? We urge the Forest Service to embrace a process of continuous improvement in the planning and implementation of thinning projects.

Ideally, the Forest Service would develop a preferred alternative that:

- focuses thinning on areas accessible from existing roads, so that destructive road construction is not required, and road density is not increased;
- retain enough green trees to mitigate effects on spotted owls and their prey;
- thin variably with retained clumps and small structure-rich “gaps” that mimic natural forest processes;
- retain small clumps of 2-5 trees and snags, not just a lone tree;
- retain large untreated areas where natural processes can recruit near-natural levels of snags and dead wood;
- avoid commercial tree removal within 150 feet of streams, so that microclimate and wood recruitment are maintained; and
- maintain high canopy cover in shaded-fuel breaks along roads to avoid stimulating the growth of surface and ladder fuels and reduce maintenance costs.

These trade-offs need to be carefully described and considered in the NEPA analysis. We highlighted some of these trade-offs in our scoping comments, dated March 21, 2022, and incorporated by reference. Alternatives need to be developed to resolve trade-offs in different ways, so the public can provide informed comment and the decision-maker can become well-informed and find an optimal alternative that best minimizes and mitigates the trade-offs. The draft Environmental Assessment does not consider alternatives.

Please consider the following comments on the Steeple Rock Rigdon project and draft Environmental Assessment.

NEPA is still the law.

Thank you for providing a map of proposed treatment areas and a guided public tour of the project area. Cascadia Wildlands staff attended the tour and appreciated information provided by agency staff. Involving the public early and often is best case scenario for public land management planning processes, and we always appreciate the opportunities to learn more about the project and gain a deeper understanding of what is being proposed.

1. **NEPA Provisions**

While NEPA law may be in flux due to a few radical court decisions and Trump era executive orders, there is still a lot of valid NEPA law that must be followed. Including but not limited to:

1. NEPA is a statute, codified at 42 USC §§ 4321-4347, as amended by the Clean Air Act (42 U.S.C. 7609), and the 2023 Fiscal Responsibility Act (FRA),
2. Extensive NEPA case law interpreting the statute, much of which occurred before the 1978 CEQ regulations were approved, but continuing after the CEQ regulations, for instance, when courts rendered decisions founded on statutory language and interpretation, legislative history, other court decisions, etc.
3. NEPA rules properly promulgated by agencies other than CEQ, e.g., 36 CFR 220.
4. Internal agency guidance that is based on the NEPA statute, NEPA caselaw, and rules properly adopted by agencies with rulemaking authority, e.g., USFS (FSM 1950, FSH 1909.15).
5. CEQ's Feb 19, 2025 memo on implementation of NEPA says " … agencies should apply their current NEPA implementing procedures with any adjustments needed to be consistent with the NEPA statute as revised by the FRA. Moreover, although CEQ is rescinding its NEPA implementing regulations at 40 C.F.R. parts 1500–1508, agencies should consider voluntarily relying on those regulations in completing ongoing NEPA reviews …" We will continue to cite the CEQ regs because it still represents the best available guidance on implementing the NEPA statute.

Some of the core requirements of the National Environmental Policy Act itself include …

NEPA Section 101:

> … [I]t is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.

42 U.S.C. § 4331

NEPA Section 102:

The Congress authorizes and directs that, to *the fullest extent possible*: (1) the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act, and (2) *all agencies of the Federal Government shall*—

(A) utilize a *systematic, interdisciplinary approach* which will ensure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment;

(B) identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by title II of this Act, which will *ensure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations*;

(C) consistent with the provisions of this Act and except where compliance would be inconsistent with other statutory requirements, include in every recommendation or report on *proposals for legislation* and other *major Federal actions significantly affecting the quality of the human environment, a detailed statement* by the responsible official on—

(i) reasonably *foreseeable environmental effects* of the proposed agency action;

(ii) any reasonably *foreseeable adverse environmental effects which cannot be avoided* should the proposal be implemented; '

(iii) a *reasonable range of alternatives* to the proposed agency action, including an analysis of any negative environmental impacts of not implementing the proposed agency action in the case of a no action alternative, that are *technically and economically feasible, and meet the purpose and need* of the proposal;

(iv) the *relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity*; and

(v) any *irreversible and irretrievable commitments* of Federal resources which would be involved in the proposed agency action should it be implemented.

Prior to making any detailed statement, the head of the lead agency shall *consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise* with respect to any environmental impact involved. *Copies of such statement and the comments* and views of the appropriate Federal, State, and local agencies, which are authorized to develop and enforce environmental standards, shall be *made available to* the President, the Council on Environmental Quality and to *the public* as provided by section 552 of title 5, United States Code, and shall accompany the proposal through the existing agency review processes;

(D) *ensure the professional integrity, including scientific integrity*, of the discussion and analysis in an environmental document;

(E) make use of *reliable data and resources* in carrying out this Act;

(F) consistent with the provisions of this Act, study, develop, and *describe technically and economically feasible alternatives*;

(G) …

(H) study, develop, and *describe appropriate alternatives* to recommended courses of action in any proposal which *involves unresolved conflicts concerning alternative uses of available resources*;

(I) consistent with the provisions of this Act, *recognize the worldwide and long-range character of environmental problems* and, where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of mankind's world environment;

(J) make available to States, counties, municipalities, institutions, and individuals, advice and information useful in restoring, maintaining, and enhancing the quality of the environment;

(K) initiate and *utilize ecological information in the planning and development of resource-oriented projects*; and

(L) assist the Council on Environmental Quality established by title II of this Act.

42 U.S.C. § 4332.

NEPA Section 106:

(b) LEVELS OF REVIEW.—

(1) ENVIRONMENTAL IMPACT STATEMENT.—An agency shall issue an environmental impact statement with respect to a proposed agency action requiring an environmental document that has a *reasonably foreseeable significant effect* on the quality of the human environment.

(2) ENVIRONMENTAL ASSESSMENT.—An agency shall prepare an environmental assessment with respect to a *proposed agency action that does not have a reasonably foreseeable significant effect* on the quality of the human environment, *or if the significance of such effect is unknown*, unless the agency finds that the proposed agency action is excluded pursuant to one of the agency's categorical exclusions, another agency's *categorical exclusions* consistent with section 109 of this Act, or another provision of law. Such environmental assessment shall be a concise public

document prepared by a Federal agency to *set forth the basis of such agency's finding of no significant impact or determination that an environmental impact statement is necessary*.

(3) SOURCES OF INFORMATION.—In making a determination under this subsection, an agency—

(A) may make use of any reliable data source; and

(B) is not required to undertake new scientific or technical research unless the new scientific or technical research is essential to a reasoned choice among alternatives, and the overall costs and time frame of obtaining it are not unreasonable.

42 U.S.C. § 4336.

NEPA Section 107:

(c) REQUEST FOR PUBLIC COMMENT.—Each notice of intent to prepare an environmental impact statement under section 102 shall include a request for public comment on alternatives or impacts and on relevant information, studies, or analyses with respect to the proposed agency action.

(d) STATEMENT OF PURPOSE AND NEED.—Each environmental document shall include a statement of purpose and need that briefly summarizes the underlying purpose and need for the proposed agency action.

(e) PAGE LIMITS.—

(1) ENVIRONMENTAL IMPACT STATEMENTS.—

(A) IN GENERAL.—Except as provided in subparagraph (B), an environmental impact statement shall not exceed 150 pages, not including any citations or appendices.

(B) EXTRAORDINARY COMPLEXITY.—An environmental impact statement for a proposed agency action of extraordinary complexity shall not exceed 300 pages, not including any citations or appendices.

(2) ENVIRONMENTAL ASSESSMENTS.—An environmental assessment shall not exceed 75 pages, not including any citations or appendices.

42 U.S.C. § 4336a.

NEPA Section 108. PROGRAMMATIC ENVIRONMENTAL DOCUMENT.

When an agency prepares a programmatic environmental document for which judicial review was available, the agency may rely on the analysis included in the programmatic environmental document in a subsequent environmental document for related actions as follows:

(1) Within 5 years and without additional review of the analysis in the programmatic environmental document, unless there are substantial new circumstances or information about the significance of adverse effects that bear on the analysis.

(2) After 5 years, so long as the agency reevaluates the analysis in the programmatic environmental document and any underlying assumption to ensure reliance on the analysis remains valid.

42 U.S.C. 4336b.

2. Consider a range of reasonable alternatives.

Alternatives are the heart of the NEPA process. Exploring and comparing alternatives help shed light on trade-offs and help the agency find ways of harmonizing competing objectives.

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

Environmental analysis documents must "[r]igorously explore and objectively evaluate all reasonable alternatives" to the project. 40 C.F.R. § 1502.14(a). The Council on Environmental Quality (CEQ), which promulgated the regulations implementing NEPA, characterizes the discussion of alternatives as "the heart of the environmental impact statement." 40 C.F.R. § 1502.14. A decisionmaker must explore alternatives in sufficient enough detail to "sharply defin[e] the issues and provid[e] a clear basis for choice among options by the decisionmaker and the public." *Id*. § 1502.14. All reasonable alternatives must receive a "rigorous exploration and objective evaluation... , particularly those that might enhance environmental quality or avoid some or all of the adverse environmental effects." *Id*. § 1500.8(a)(4). The analysis of the alternatives must be "sufficiently detailed to reveal the agency's comparative evaluation of the environmental benefits, costs and risks of the proposed action and each reasonable alternative." *Id*.

If the NEPA document considers only a restricted range of alternatives this would violate the very purpose of NEPA's alternative analysis requirement, which is to foster informed decision-making and full public involvement. 42 U.S.C. §§ 4331, 4332(2)(E); 40 C.F.R. § 1508.9(b). *See also Robertson v. Methow Valley Citizen's Council*, 490 U.S. 332, 349 (1989). The Ninth Circuit stated in *California v. Block* that "[a]s with the standard employed to evaluate the detail that NEPA requires in discussing a decision's environmental consequences, the touchstone for our inquiry is whether an EIS's selection and discussion of alternatives fosters informed decision-making and informed public participation." *California v. Block*, 690 F.2d 753, 767 (9th Cir. 1982).

The purpose of the multiple alternative analysis requirement is to insist that no major federal project be undertaken without intense consideration of other more ecologically sound courses of action, including shelving the entire project, or of accomplishing the same result by entirely different means. *Environmental Defense Fund v. Corps of Engineers*, 492 F.2d 1123, 1135 (5th Cir. 1974); *Methow Valley Citizens Council v. Regional Forester*, 833 F.2d 810 (9th Cir. 1987), *rev'd on other grounds*, 490 U.S. 332 (1989) (agency must consider alternative sites for a project). The Ninth Circuit has concluded that "the existence of a viable but unexamined alternative renders an environmental impact statement inadequate." *Alaska Wilderness Recreation & Tourism v. Morrison*, 67 F.3d 723, 729 (9th Cir.1995).

Other courts have stated that in order to comply with NEPA, "the discussion of alternatives 'must go beyond mere assertions' and provide sufficient data and reasoning to enable a reader to evaluate the analysis and conclusions and to comment on the EIS." *Citizens Against Toxic Sprays v. Bergland*, 428 F. Supp. 908, 933 (D. Or. 1977). A detailed and careful analysis of the relative merits and demerits of the proposed action and possible alternatives is of such importance in the NEPA scheme that it has been described as the "linchpin" of the environmental analysis. For this reason, the discussion of alternatives must be undertaken in good faith; it is not to be employed to justify a decision already reached. *Id*.

"An alternative may not be disregarded merely because it does not offer a complete solution to the problem." Citizens Against Toxic Sprays v. Bergland, 428 F. Supp. 908. 933 (D. Or. 1977). As one court explained, "[o]bviously, any genuine alternative to a proposed action will not fully accomplish all of the goals of the original proposal. One of the reasons that Congress has required agencies to set out and evaluate alternative actions is to give perspective on the environmental costs, and the social necessity, of going ahead with the original proposal." *Town of Matthews v. United States Dept of Transp.*, 527 F. Supp. 1055, 1058 (W.D.N.C. 1981).

The agency often says that removing medium and large trees is often necessary to ensure a viable timber sale even though the same medium and large trees need to be retained for late successional forest habitat characteristics, dead wood recruitment, to suppress the growth of ladder fuels, and to maintain a cool-moist microclimate that helps mitigate fire hazard. These conflicts were brought to light in PNW Science Findings #85 "requiring landscape treatments to earn a profit negatively impacted both habitat and fire objectives" Thompson, Jonathan; Stevens Hummel, Susan. 2006. Seeing the bigger picture: landscape silviculture may offer compatible solutions to conflicting objectives. Science Findings 85. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 5 p https://www.fs.usda.gov/pnw/sciencef/scifi85.pdf. When economic objectives conflict with ecological objectives and fire hazard objectives, the agency is obligated to consider NEPA alternatives such as reallocating funds within the agency's existing budget or asking Congress for additional appropriations to allow the agency to better balance competing objectives. See Center of Biological Diversity v. Rey, (9th Circ, May 14, 2008) http://web.archive.org/web/20081018102407/http://www.ca9.uscourts.gov/ca9/newopinions.nsf/BBADBE769F43A66D882574490055 21AE/$file/0716892.pdf

"The existence of a viable but unexamined alternative renders an EA inadequate." *Western Watersheds v. Abbey*, 719 F.3d. at 1050. *North Idaho Cmty. Action Network*, 545 F.3d at 1153 (both EA and EIS must consider all reasonable alternatives, but EIS must provide more detail and analysis of those alternatives). When the agency clearly has independent knowledge of specific issues or concerns, "there is no need for a commenter to point them out specifically in order to preserve its ability to challenge a proposed action." Id. at 765; *'Ilio'ulaokalani Coal. v. Rumsfeld*, 464 F.3d 1083, 1093 (9th Cir. 2006); see *Friends of the Clearwater v. Dombeck*, 222 F.3d 552, 559 (9th Cir. 2000) ("Compliance with NEPA is a primary duty of every federal agency; fulfillment of this vital responsibility should not depend on the vigilance and limited resources of environmental plaintiffs").

It is not enough to consider just one action alternative as BLM often does. The CEQ regulations specifically require that Environmental Assessments shall follow the alternatives language in NEPA.

> 40 CFR § 1508.9
>
> "Environmental Assessment":
>
> …
>
> (b) Shall include brief discussions of the need for the proposal, of **alternatives as required by sec. 102(2)(E)**, of the environmental impacts of the proposed action and alternatives …"

The "alternatives provision" of 42 U.S.C. § 4332(2)(E) applies whether an agency is preparing an EIS or an EA and requires the agency to give full and meaningful consideration to all reasonable alternatives. *Native Ecosystems Council v. U.S. Forest Service,* 428 F.3d 1233, 1245 (9th Cir. 2005); *see Bob Marshall Alliance v. Hodel*, 852 F.2d 1223, 1229 (9th Cir. 1988) (The alternatives requirement is triggered where unresolved conflicts as to the proper use of resources exist, whether or not an EIS is required). *Te-Moak Tribe v. Interior, 608 F.3d 592, 601-602 (9th Cir. 2010)* ("Agencies are required to consider alternatives in both EISs and EAs and must give full and meaningful consideration to all reasonable alternatives.")

> Consideration of Alternatives
>
> "[O]ne important ingredient of an EIS is the discussion of steps that can be taken to mitigate adverse environmental consequences" of a proposed action. Robertson, 490 U.S. at 351. As one aspect of evaluating a proposed course of action under NEPA, the agency has a duty "to study all alternatives that appear reasonable and appropriate for study... , as well as significant alternatives suggested by other agencies or the public during the comment period." Roosevelt Campobello Int'l Park Comm'n v. United States EPA, 684 F.2d 1041, 1047 (1st Cir. 1982) (quotations omitted); Valley Citizens for a Safe Env't v. Aldridge, 886 F.2d 458, 462 (1st Cir.

1989); City of Carmel-By-The-Sea v. U.S. Dept. of Transp., 95 F.3d 892, 903 (9th Cir. 1996).

As stated in the Council on Environmental Quality ("CEQ") regulations implementing NEPA, the consideration of alternatives is "the heart of the environmental impact statement." 40 C.F.R. § 1502.14. These implementing regulations are entitled to substantial deference. Robertson, 490 U.S. at 355 (citing Andrus v. Sierra Club, 442 U.S. 347, 358 (1979)). The regulations require that the EIS "[r]igorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated." 40 C.F.R. § 1502.14(a). It is "absolutely essential to the NEPA process that the decisionmaker be provided with a detailed and careful analysis of the relative environmental merits and demerits of the proposed action and possible alternatives, a requirement that we have characterized as 'the linchpin of the entire impact statement.'" NRDC v. Callaway, 524 F.2d 79, 92 (2d Cir. 1975) (citation omitted); see Silva v. Lynn, 482 F.2d at 1285; All Indian Pueblo Council v. United States, 975 F.2d 1437, 1444 (10th Cir. 1992) (holding that a thorough discussion of the alternatives is "imperative"). "The 'existence of a viable but unexamined alternative renders an environmental impact statement inadequate.'" Resources Ltd. v. Robertson, 35 F.3d 1300, 1307 (9th Cir. 1993) (quoting Idaho Conservation League v. Mumma, 956 F.2d 1508, 1519 (9th Cir. 1992)); see Grazing Fields Farm v. Goldschmidt, 626 F.2d 1068, 1072 (1st Cir. 1980) (Even the existence of supportive studies and memoranda contained in the administrative record but not incorporated in the EIS cannot "bring into compliance with NEPA an EIS that by itself is inadequate."). Because of the importance of NEPA's procedural and informational aspects, if the agency fails to properly circulate the required issues for review by interested parties, then the EIS is insufficient even if the agency's actual decision was informed and well-reasoned. Grazing Fields Farm, 626 F.2d at 1072; see Massachusetts v. Watt, 716 F.2d 946, 951 (1st Cir. 1983).

James C. Kozlowski. NEPA/EIS general principles highlighted. PRLS 501, Introduction to Natural Resources Law. Spring Semester 2017. https://mason.gmu.edu/~jkozlows/nepants.htm

Northern Spotted Owls

The EA states that the proposed action is likely to adversely affect the northern spotted owl and its critical habitat. EA at 69. The total amount of northern spotted owl critical habitat in the project area is 9,380 acres; 5,960 of those acres are suitable habitat. EA at 71. We are concerned about these impacts, as continued habitat loss and barred owl competition drive the species to extinction.

1. **Protect habitat for raptors, including northern spotted owl.**

Logging disrupts behavior of nesting birds and could harm other aspects of their life needs. The 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- to 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.

"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. https://usfs-public.app.box.com/v/PinyonPublic/folder/158150413008. Salem BLM's Turner Creek EA acknowledged "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." https://web.archive.org/web/20160522082645/http://www.blm.gov/or/districts/salem/plans/files/TC_EA.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.

Spotted Owl foraging is positively associated with snag volume and dead wood volume, both of which are adversely affected by commercial logging, which has long-term adverse effects on dead wood recruitment.

> Foraging activity is positively associated with tree height diversity (North et al. 1999, p. 524), canopy closure and woody debris (Irwin et al. 2000, p. 180; Courtney et al. 2004, pp. 5-15), **snag volume**, density of snags greater than 20 in (50 cm) dbh (North et al. 1999, p. 524; Irwin et al. 2000, pp. 179-180; Courtney et al. 2004, pp. 5-15), density of trees greater than or equal to 31 in (80 cm) dbh (North et al. 1999, p. 524), **volume of woody debris** (Irwin et al. 2000, pp. 179-180), and young forests with some structural characteristics of old forests (Carey et al.1992, pp. 245-247; Irwin et al. 2000, pp. 178-179). Habitat use is influenced by prey availability. Ward (1990, p. 62) found that spotted owls foraged in areas where the occurrence of prey was more predictable within older forests and near ecotones of old forest and brush

seral stages. The availability or abundance of prey can in turn influence reproductive success (Rosenburg et al. 2003, pp. 1720-1723)

FWS 2024. Sand Lake BO. https://usfs-public.app.box.com/v/PinyonPublic/file/1483599380416

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. https://web.archive.org/web/20220120055722/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 m^3/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. https://andrewsforest.oregonstate.edu/sites/default/files/lter/pubs/pdf/pub3549.pdf.

How many acres of the project area and the proposed treatment units are RA32 habitat? The EA concludes that "Harvest treatments would modify but maintain habitat in NSO home ranges." EA at 72. It is important to avoid activities that would degrade suitable northern spotted owl habitat, including both RA32 other suitable habitat. The EA does not fully disclose those impacts and the EA fails to consider alternatives that would minimize or mitigate those impacts.

2. Thinning effects on flying squirrels and owl prey

Flying squirrels are an important prey item for Northern Spotted Owls in all parts of the owl's range. Even in SW Oregon where wood rats represent a large part of the owls diet, flying squirrels are still critically important. See Forsman, Anthony, Meslow, Zabel. 2004. Diets And Foraging Behavior Of Northern Spotted Owls In Oregon. Journal of Raptor Research 38(3):214-230. http://elibrary.unm.edu/sora/jrr/v038n03/p00214-p00230.pdf. Given the importance of flying squirrels to the diet of the spotted owl, managers must ensure that thinning does not significantly reduce the flying squirrel population, but recent evidence shows that thinning does in fact lead to a multi-decade decline in the number of flying squirrels. The agencies must leave significant untreated skips in order to mitigate for this significant adverse effect.

The findings of this study raise questions that the Forest Service has already posed to itself: "If thinning is a treatment to promote late successional forest for spotted owls, but it reduces their primary prey base for a substantial amount of time, we may want to think differently about how we manage for flying squirrel populations across a landscape." Central Cascades Adaptive Management Partnership - Administrative Study Portfolio - Status and Funding Needs, November 2014. (p 3) http://ecoshare.info/projects/central-cascade-adaptive-management-partnership/study-portfolio/ Project purposes and project alternatives need to account for this new information. The finding that thinning reduces, for a couple decades at least, populations of flying squirrels, an important prey for spotted owls throughout their range, reinforces the importance of finding the optimal mix of thinned and unthinned areas within stands and across the landscape (not just for flying squirrels but also for dead wood recruitment and other ecological values). The agencies' current approach does provide a mix, but NEPA analyses fail to seek or find the optimum mix.

Manning et al (2012) found that the thinning is adverse to both flying squirrels and snags, and these effects may be related.

- Flying squirrel density positively associated with snag density
- Snags rare in thinned stands
- Thinning causes decrease in density-dependent mortality

…

- Canopy gaps = exposure to predators
- Tree trunks = safety

Tom Manning, Joan Hagar, Brenda McComb 2012 spotted owl prey workshop. Flying Squirrel Response to Thinning in the Oregon Cascades. http://ecoshare.info/wp-content/uploads/2012/08/Commercial-thinning_flying-squirrels.ppt; http://ecoshare.info/projects/central-cascade-adaptive-management-partnership/workshops/spotted-owl/. See also, Tom Manning, Joan C. Hagar, and Brenda C. McComb. 2011. Thinning of Young Douglas-fir Forests Decreases Density of Northern Flying Squirrels in the Oregon Cascades, [FORECO9370, revised Aug 2011] https://andrewsforest.oregonstate.edu/sites/default/files/lter/pubs/pdf/pub4783.pdf

Wilson & Forsman 2013 state ("thinning reduces the abundance of some tree-dwelling rodents, especially Northern Flying Squirrels (Glaucomys sabrinus) and Red Tree Voles (Arborimus longicaudus), that are important prey species for Northern Spotted Owls (Strix occidentalis caurina)." 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.usda.gov/pnw/pubs/pnw_gtr880/pnw_gtr880_009.pdf.

"Management strategies that involve tree removal, even ones designed to have positive long-term ecological effects, almost always result in reduced squirrel populations. A squirrel-predation connection explains this phenomena …" Wilson, T. 2010. Forest structure is a good indicator of flying squirrel habitat. *In* Mazza, Rhonda 2010. 2010 Science Accomplishments Report of the Pacific Northwest Research Station. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 88 p. https://web.archive.org/web/20170531140755/https://www.fs.fed.us/pnw/pubs/2010-science-accomplishments.pdf.

Twenty years after the spotted owl was listed, there remains an unfortunate dearth of information about the effects of thinning and fuel reduction logging on spotted owls and their prey. There is, however, some new information from Andy Carey and Todd Wilson's long-term study of the effects of thinning on flying squirrels at Fort Lewis. On Jan 19, 2011 Todd Wilson gave a presentation in Corvallis on flying squirrels. http://calendar.oregonstate.edu/event/49175/ and the effects of thinning.

When collecting baseline data in among the young stands in the Fort Lewis study, Andy Carey and Wilson found that stands which had been previously thinned had fewer flying squirrels than those that had not been thinned. After another round of thinning, preliminary results from a few years post-thinning indicated that flying squirrel populations initially declined after thinning, but at the time (a few years ago) they seemed to be rebounding. Now the longer data set shows that the rebound was part of a temporary fluctuation, and the long-term trend shows that the squirrel population continued to decline and remains at very low levels almost two decades after thinning.

In contrast to flying squirrels, chipmunks had a significant positive association with thinning. However, chipmunks are not an important prey item for the spotted owl, probably because they are not nocturnal. Managers must not assume that small mammal biomass is fungible in terms of the spotted owl diet. Todd Wilson's latest findings indicate that if the objective of management is to accelerate development of habitat for spotted owls and their prey, thinning comes with significant trade-offs.

Wilson's study tried to determine the limiting factors for the squirrel populations and the indicators that we might use to determine habitat quality. The main candidates for limiting factors were food supply, den site availability, and predation. It turns out that predation appears to be the most important limiting factor. Useful indicators of predation risk are: the number of large live trees, cover from predators and the amount of (or lack of) vegetation at the 10 meter intercept within the stand. The 10 meter intercept is a measure of how much foliage and tree boles would intercept an imaginary horizontal plane 33 feet off the ground. This is an indicator of how open the stand is and whether the canopy is multi-aged and multi-layered. It is hypothesized that flying squirrels are less vulnerable to predation where there is more visual occlusion, especially in their diagonal glide paths from the canopy to the ground when they are thought to be particularly vulnerable to predation. Thinning opens the stands and results in a period of several decades when squirrels may be relatively vulnerable to predation and the population is held to very low levels until a new cohort of vegetation grows up to occlude the 10 meter intercept. Unthinned stands are better for squirrels in the short term because there may be some visual occlusion and cover provided by tree boles, tall shrubs, suppressed trees, hardwoods, etc. Wilson said that simple visual occlusion might be a good indicator of quality habitat for flying squirrels. If you can see a long ways (as you can after thinning) then it's probably not very good squirrel habitat because there's not much cover from predators, but if you can't see very far into a stand then it may indicate higher quality squirrel habitat.

Todd Wilson’s PhD dissertation says:

> Forests that supported high squirrel abundances generally exhibited high amounts of multi-dimensional structure in the midstory and overstory layers, low to moderate amounts of understory, and few canopy gaps. Three variables, variance in overstory tree d.b.h., area intercept at 10-m above ground, and amount of canopy gaps ≥100m2 could correctly classify 97% of the stands as supporting either high or low squirrel abundances.
>
> …
>
> Variable-density thinning did not promote habitat conditions for flying squirrels 12 years after treatment. … insufficient time had passed for development of a substantive midstory layer of trees …
>
> …
>
> However, both univariate and multivariate analyses showed a negative relationship between understory growth and flying squirrel abundance.
>
> …

Stands that supported high abundances of flying squirrels were comprised of two general forest conditions: (1) a "ground-to-crown" multi-species forest with a multi-layered canopy, variable midstory and patchy understory and (2) dense, closed-canopy forest with high bole density and little or no understory or mid-story.

…

Forest structure provides the interface for interactions between flying squirrels and predators on several levels. … High quantities of structure, found in both complex forest and forest with high bole density, provide occlusion that can reduce visual detection. Structure also dampens and deflects acoustical signals, limiting aural detection … Structure can also be important in dispersing scent. … [C]omplex canopies disperse scent more effectively than simplified canopies due to wind turbulence brought on by variation of tree heights and gaps (Conover 2007, Miller et al. 1991, Stacey et al. 1994). Thus, quantity and complexity of forest structure can help limit the ability of predators to detect squirrels by sight, sound, or smell.

…

Finally, an indirect but important link between forest structure and predation is the inverse relationship between overstory structure and understory development. On the FES, not only did increased understory development result from decreases in overstory structural complexity (due to increased spacing between trees from thinning as well as canopy gaps formed by root rot treatment and natural root rot expansion), but it also resulted in increases in abundances of many forest-floor dwelling prey species like mice, voles, and chipmunks (Carey 2001, Wilson and Carey 2000, Palazzotto and Wilson, in litt.). This in turn may have increased the attractiveness of these sites to both avian and mammalian predators which could opportunistically prey on flying squirrels that became more exposed to predation risk. It could also result in spillover predation into adjacent, non-thinned stands. This may, in part, explain why control stands on the FES, even though generally remaining higher than treated stands, followed similar population declines relative to treated stands after thinning.

…

Without midstory canopies, tree boles become the sole source of occlusion at this vertical layer. In competitive exclusion forest, high densities of relatively small boles (from both live and dead trees) can be sufficiently high to provide substantial occlusion

…

Thick vegetation can provide overhead protective cover while squirrels are foraging on the ground. However the patagium of flying squirrels makes ground travel awkward compared to other squirrels, and there is likely a trade-off between amount of understory and increased noise while traveling on the ground which may attract predators. During this study, technicians could often hear squirrels move through thick woody understory. A patchy understory, resulting from complex midstory and overstory layers may provide the best balance among protective cover, food resources, and a squirrel's ability to move undetected on the forest floor.

…

I found no strong correlation between squirrel abundance and large fallen trees. … [A]lthough large fallen trees could enhance squirrel habitat (e.g., by serving as hosts for fungi and protective cover or travel pathways on the forest floor), it might only do so in forests that maintain high structural occlusion and not if it comes at the expense of greatly opening up the canopy.

…

Some caution appears warranted in the short-term when using thinning to reach long-term forest management goals, including those under the Northwest Forest Plan. Variable-density thinning can have rapid, positive effects for many forest-floor prey species (e.g., mice, voles, chipmunks, neotropical and resident songbirds), especially due to increased understory development (e.g., Carey 2001, Carey and Wilson 2001, Haveri and Carey 2000). However, like most other thinnings, variable-density thinning appeared to keep squirrel populations suppressed and may do so for several decades until long-term ecological processes provides sufficient structural complexity in the midstory and overstory favorable to squirrels.

An important key to the success of variable-density thinning in accelerating squirrel habitat may be focusing early on stimulating mid-story development throughout the stand.

…

squirrel abundance may be much more critical than squirrel presence in a given forest in terms of their ability as a species to fulfill important ecological roles, including serving as abundant prey for spotted owls and other predators, and for promoting fungal diversity.

…

landscape-level strategies that can help transition forests from highly-permeable low-quality habitat to highly-permeable high-quality habitat for flying squirrels over the next several decades. Such strategies might include: (1) keeping some high stem-density young forests on the landscape to provide moderate to high squirrel populations in the short term … ; continue the use of variable-density thinning to promote long-term habitat benefits for squirrels but consider landscape context (stand age, rotation, and juxtaposition) to help facilitate rapid recolonization of thinned stands once stands develop conditions favorable to squirrels …

It is also possible that silvicultural prescriptions could ameliorate some of the negative short-term effects of thinning by focusing on strategies that keep visual occlusion high while still promoting the structural processes that lead to complex forest … This study provides empirical data upon which such prescriptions might be designed and tested. High-quality squirrel habitat that supported moderate to high densities of flying squirrels exhibited: (1) presence of midstory trees, deep crowns and high stem density that provide high structural occlusion 10-20m above the ground, (2) <20% non-creek canopy gaps (as defined by this study—note that percent canopy cover could be less than what is implied here) for multi-layered forest and <15% canopy gaps for high-stem density forest without a mid-story, and (3) few canopy gaps ≥400m2. A silvicultural prescription might include: (1) leaving patches of forest intact (skips) to provide continued horizontal occlusion after treatment (sufficient to limit visibility within the skips and between gaps); (2) keeping gap sizes small (100-400m2), (3) retaining a range of tree size classes rather than thinning from below to promote only the largest trees, and (4) promoting development of shade-tolerant species throughout the stand. Such a prescription might provide sufficient structure to limit predation in the short term, while still helping to accelerate the development of longterm structural complexity in the stand over the long term. A skip-small gap strategy may be most successful in young stands with high stem density, in stands where dead branches of existing trees persist well below the live crown of the overstory, and in mixed-conifer stands where shade-tolerant conifers are already present at layers below the dominant tree crowns. In each of these cases, there is potential to keep occlusion in the mid-story layers relatively high after thinning.

…

A skip-small gap prescription may also be useful in xeric forest where thinning and prescribed fires are being used to reduce heavy fuel loads that have resulted from more than a century of fire suppression (Hessburg and Agee 2003). Lehmkuhl et al. (2006) suggested that patchy harvesting of trees to reduce fuel loads might help keep flying squirrels on the landscape after such treatments. My study supports their hypothesis, but also suggests that the scale of patchiness would be important as would be the retention of structural occlusion in the patches that are not harvested. Leaving patches of high-occlusion forest is consistent with the structurally diverse conditions that can result under some naturally-occurring fire regimes that keep fire fuel loads low (Agee 1993, Harrod et al. 1999, White 1985) but is markedly different than commonly used fuel-reduction strategies that focus instead on wide-scale removal of surface, ladder, and crown fuels (e.g., Peterson et al. 2005) that reduce overall structural occlusion throughout a stand.

…

managing for structural complexity that provides protective cover can in large part be a surrogate for managing for food resources

Wilson, T. 2008. Limiting Factors For Northern Flying Squirrels (*Glaucomys Sabrinus*) In The Pacific Northwest: A Spatio-Temporal Analysis. PhD Dissertation. Union Institute &

University, Cincinnati, Ohio.
http://andrewsforest.oregonstate.edu/pubs/pdf/pub4617.pdf.

Wilson suggests that to mitigate for the effects of thinning, managers should focus on young stands and retain unthinned "skips" in restoration thinning projects. The concept of untreated skips is acknowledged and used by the agencies, but there is no systematic way to determine the appropriate mix of treated and untreated areas. The agencies are implementing a widespread program of aggressive thinning in young stands but the application of skips is haphazard. The agencies do not know whether "some" skips (the arbitrary amount left due to operational limitations) is "enough" skips to perpetuate squirrels at levels needed by spotted owls.

Todd Wilson's findings are supported by new research Tom Manning, Joan C. Hagar, and Brenda C. McComb. 2011. Thinning of Young Douglas-fir Forests Decreases Density of Northern Flying Squirrels in the Oregon Cascades, [FORECO9370, revised Aug 2011] https://andrewsforest.oregonstate.edu/sites/default/files/lter/pubs/pdf/pub4783.pdf.

> We measured densities of northern flying squirrels 11-13 years after thinning of young (55-65 years) Douglas-fir forest stands in the Cascade Range of Oregon, as part of the Young Stand Thinning & Diversity Study. … Thinning decreased density of northern flying squirrels, and squirrel densities were significantly lower in heavily thinned stands than in more lightly thinned stands. Regression analysis revealed a strong positive relationship of flying squirrel density with density of large (>30 cm diameter) standing dead trees and a negative relationship with % cover of low understory shrubs. Maintaining sufficient area and connectivity of dense, closed canopy forest is recommended as a strategy to assure that long-term goals of promoting late-seral structure do not conflict with short-term habitat requirements of this important species.

A study in conducted in the Sierra Nevada forests of California suggests that landscape heterogeneity may compensate for the effects of thinning on Northern flying squirrel populations (Sollmann et al 2016). However, the conclusions of this study likely do not extend to typical agency thinning projects in mesic forests because unlike this study, the agencies rarely retain 1/3 of units in unthinned skips and fail to retain 70% canopy cover. Sollmann et al (2016) studied flying squirrel population response to 4 hectare thinning and burning treatments compared to controls and found -

> When considered by treatment type, densities were highest in control and burn only units, and lowest in thinned units. Whereas thinning had negative effects on Northern flying squirrel density on the scale of a thinning treatment unit, our results suggest that these effects were largely absorbed by the heterogeneous landscape, as animals shifted their distribution into un-thinned areas without a decline in overall density. This highlights the need to incorporate the landscape context when evaluating the effects of forest management on wildlife.
>
> … Typical fuel reduction treatment units are variable in size and often larger than the 4 ha used in this study. Our results cannot be extrapolated to such larger

> disturbances, which could have more pronounced effects on NFS populations (e.g., they may displace individuals where small treatments may only cause them to shift within their home range).
>
> … Density is only one measure of how populations respond to stressors and environmental drivers, and other measures such as physical condition, reproductive success or survival might be more strongly affected by treatments. Increased intraspecific competition resulting from ''crowding" of more individuals into remaining suitable habitat patches may also trigger density dependent population regulation mechanisms (Lehmkuhl et al., 2006).
>
> … because our study only extended to four years after thinning treatments, we cannot speak to potential delayed effects on NFS populations. Without longer term studies investigating population dynamics in more detail, the mechanisms underlying our observations of densities in time and space remain speculative. …
>
> Thinning affected the relationship of NFS density with canopy closure such that it became a stronger predictor of NFS density after thinning treatments. Pre-treatment canopy closure averaged 85–89% across the Control, Central and Western blocks (Table 1) and effects on density in pre-treatment years were variable and mostly small (Fig. 3). After thinning, average canopy closure dropped to 70% in the Central and Western block, and variability increased (Table 1). This indicates that at overall high levels of canopy closure NFS are not sensitive to small fluctuations in that variable, but that it becomes an important determinant of NFS density when forest with high canopy closure is limited (Meyer et al., 2007).

Sollmann, R., A.M. White, G.L. Tarbill, P.N. Manley and E.E. Knapp. 2016. Landscape heterogeneity compensates for fuel reduction treatment effects on Northern flying squirrel populations. Forest Ecology and Management 373 (2016):100-107. https://www.fs.usda.gov/psw/publications/white_am/psw_2016_white003_sollmann.pdf. However, the treatments in this study were only 4 hectares, and within groups of treatment blocks, there were several 4 hectare unthinned blocks. In fact, fully 1/3 of the treatment blocks were burned only and remained unthinned, and because of these significant unthinned areas the average canopy closure across groups of treatment blocks remained above 70%. Flying squirrels may not fare so well in more typical thinning prescriptions that involve heavier thinning, larger treatments, fewer unthinned skips where less than 1/3 of the treatment area is available to serve as a refugia. An unnamed scientist who works on flying squirrels stated:

> Some things that stand out for me that would suggest caution in interpreting or applying their results:
>
> > 1. Their reported densities of NFS were between .17 to .81 per Ha. These would be considered low density populations in areas where spotted owls depend heavily on flying squirrels (good densities would be 2-4/ha). I assume that if there were spotted owls, they are likely much more reliant on woodrats at these sites.

2. 4 ha is well within the range of a single flying squirrel in a low density population. Therefore, each of their 24 units aren't really measuring "populations" of squirrels—more like individuals or small clusters of individuals. As a results, factors outside the experimental design could confound the results. For example, trapping included May and June which can pick up widely roaming males that live outside the study area.

3. Likewise, given these units were right next to each other, some individuals may have been double counted (but not sure to what extent as they didn't report that).

4. They did not report individuals moving into different patches, or use telemetry to track individual, or report that tagged individuals in treated areas started showing up in their control patch, so they really didn't show that "animals shifted their distribution into un-thinned areas". Rather what I see is they started with a low density study area and ended with a low-density study area. IMO, their data points more towards their landscape being relatively low quality habitat for squirrels overall (and therefore patchy thinning and fire isn't going to change things much), rather than the conclusion that negative effects are absorbed by a heterogeneous landscape.

Bottom line—I think one should be very cautious about applying their results to westside mesic OR and WA forests, esp in areas where flying squirrels are a main part of owl diets.

(Personal communication with unnamed wildlife biologist, June 2018)

Salem BLM's Turner Creek EA (2011) provides an example of the kind of trade-offs that can help inform a decision about the best mix of treated and untreated areas "The loss of natural snag production for several to many decades on the thinned acres will reduce the potential for owl use due to the lack of suitable prey habitat. … 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. By not thinning the overstory now during this window of opportunity the trees would be less able to respond in the future and the development of a second canopy layer would be delayed by a few decades thus taking longer to reach the vertical diversity characteristic of late-successional stands." https://web.archive.org/web/20160522082645/http://www.blm.gov/or/districts/salem/plans/files/TC_EA.pdf. The agencies can use this as a springboard to consider important landscape issues and to inform the critical question of how much of these forests should be treated to enhance dead wood and owl prey base, and how much should be thinned to accelerate complex canopy structure.

Some have tried to assert that the spotted owl may benefit from increased access to flying squirrels as a result of thinning. This is a flawed interpretation of the recent science indicating that logging makes flying squirrels vulnerable to predation. First, flying squirrels are preyed upon by a wide variety of species other than spotted owls, so spotted owls do not get all the squirrel kills. Second, the effect of logging is so significant that squirrel populations decline for two decades or more. It is better for the owl to have limited access to a healthy population of flying squirrels than to have easy access to a dramatically reduced population of squirrels.

The adverse effects of thinning on flying squirrels and spotted owls should be considered in the context of the competitive pressure that barred owls impose on populations of flying squirrels, which are the primary prey of both barred owls and spotted owls. Nicholas F. Kryshak, Emily D. Fountain, et al. 2022. DNA metabarcoding reveals the threat of rapidly expanding barred owl populations to native wildlife in western North America, Biological Conservation, Volume 273, 2022, 109678, ISSN 0006-3207,

https://doi.org/10.1016/j.biocon.2022.109678.
https://www.biorxiv.org/content/biorxiv/early/2022/04/20/2022.04.19.488820.full.pdf. Evidence that barred owls impose adverse effects on both flying squirrels and spotted owls should be considered in the analysis of cumulative effects.

The EA lacks analysis of the project's impacts to prey species. Was this considered?

Wet Weather Hauling

We raised concerns about the agency's allowance of wet weather hauling in our scoping comments, as wet weather haul will result in increased sedimentation to streams in the project area. "Hauling logs during wet periods significantly increases erosion from forest roads." EA at 58.

What is the agency's reason for allowing wet weather haul? The timber industry wants the flexibility of hauling logs during wet weather, but we maintain that it is not in the public interest to allow this practice. The public's water quality and the public's fish will be adversely affected. Sediment and turbidity produced by wet weather haul is an *externality* – a real cost created by the timber industry but not included on their balance sheet or included in the price of wood products. By allowing wet weather haul, the agency is effectively shifting costs from the timber industry to the public.

Has the agency determined that hauling logs on wet roads is consistent with the Aquatic Conservation Strategy (ACS), especially where roads cross streams or are in riparian reserves or where road drainage may be connected to streams? The ACS prohibits activities that will retard attainment of ACS objectives, such as ACS Objective #5: "Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport." The natural sediment regime is more episodic, but the sediment regime produced by modern forest management is chronic.

"In summary, wet haul is likely to increase sediment delivery, however with proper administration of PDFs and BMPs, it is unlikely to pose a significant impact to aquatic resources.” EA at 58. How can the agency be certain that mitigation and BMPs will be effective? We are concerned that they will be minimally effective and strongly urge the agency to monitor wet weather hauling impacts and conduct projects without the allowance of wet weather hauling.

Meadow Restoration

We support careful restoration of meadows, including native plant/animal communities and natural hydrology, and urge the agency to balance associated tradeoffs with proactive restoration. Here, “Activities on about 30 acres of meadows are proposed to improve plant diversity, pollinator habitat, and wildlife forage within the Johnson Meadow complex area. Activities would include tree cutting, piling and pile burning, pruning, non-native invasive plant treatment, and underburning. Invasive plant treatment would incorporate manual, mechanical, and chemical methods.” EA at 17.

Our recommendations for meadow restoration:

- Develop a complete plant list for each meadow and know where the rare plants are and buffer them from potential adverse effects, such as jackpot burning, herbicides, etc.
- Avoid pile burning. It has extreme effects on soil, plants, and below-ground ecosystems.
- Avoid heavy equipment in meadows. No machine manipulation of slash.
- Avoid road construction.
- Avoid commercial removal of logs.
- Fell and burn encroaching trees <12” dbh. Consider retaining a few patches of slash as per acre habitat features.
- Use multiple alternative means of killing encroaching trees 12-20 inches dbh, e.g., mechanical girdling, fire girdling, fungi inoculation, blasting tops, etc.
- Retain all trees over 20” dbh and just let natural process sort things out. Fire (or some other natural process) will eventually get them.
- Retain all Pacific yew trees.

Fuel Breaks

The project proposes the creation of shaded fuel breaks and prescribed burning for fuel treatments. 1,860 acres of fuels related treatment would take place in the project area.

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

Fuel breaks can have significant trade-offs, including: spreading weeds through soil and canopy disturbance, habitat fragmentation and edge effects, exacerbating barriers to wildlife movement, impaired wildlife connectivity, loss of wildlife cover, loss of snag and dead wood habitat, facilitating unauthorized OHVs, increased carbon emissions, etc.

Does the agency have the resources necessary to maintain these fuel breaks over time? How did you take habitat connectivity into account when planning fuel breaks?

Thinning and Drought Impacts

The draft EA discusses the threats of drought without action but not related to the proposed action. Thinning may make forests less resilient instead of more resilient to drought. Thinning will increase penetration of warm dry air into the stand and expose trees to greater vapor pressure deficit. Thinning likely increases drought stress on trees by increasing penetration of warm dry air within thinned forest stands. Lighter thinning would partially mitigate the effect compared to heavy thinning. The agency should consider and disclose these effects and consider a mitigating alternative with light, non-commercial thinning of the understory.

Atmospheric water demand, not soil moisture availability, appears to be the primary cause of tree water stress in the late summer. Temperature-driven increases in vapor pressure deficit from climate change are likely to reduce forest productivity regardless of soil moisture availability.

> "How in the world can the trees be water stressed if they haven't used all the water available in the soil?" Wondzell recalls pondering. "We spent a lot of time at the whiteboard asking ourselves, 'Is this data actually correct?'" recalls Bladon.
>
> …
>
> In 2018, Jarecke read up on other studies that researched why trees might experience drought stress. What she learned was that the drought stress could be coming from aboveground. "New studies were emphasizing the impact of increasing vapor pressure deficit on tree water stress," she explains. "And there's a misconception in forest management on how we've been thinking about water stress being all about the belowground drought stress."
>
> Jarecke describes vapor pressure deficit (VPD) as the "drying power of the atmosphere" or phrased another way, how much water vapor or humidity is needed to saturate the air at a given temperature. Hot air can hold more moisture than cold air, which means as temperatures increase without a corresponding increase in humidity, VPD increases. So, how does VPD affect trees? "You can think of a tree as a cluster of tiny straws," explains Wondzell. "As the soil dries out, the tree finds it

> harder and harder to pull soil water into the bottom of these straws. Conversely, aboveground it is the dryness of the air that does the pulling. And as the air gets drier, it pulls harder and harder on the water at the top of the straws."
>
> …
>
> Latewood carbon isotope composition was most strongly correlated to mean daytime VPD between May and September and total rainfall between May and August. The researchers noticed that increased VPD during June, when there was still plenty of soil moisture, decreased the latewood growth, which lent weight to the hypothesis that VPD limits growth even when soil moisture is plentiful.
>
> … Karla's research strongly suggests that at her study site, these trees are highly sensitive to vapor pressure deficit," Wondzell says. "Of course, they're also sensitive to rainfall, but it's actually vapor pressure deficit that is by far and away the bigger driver."
>
> …
>
> If vapor pressure deficit is a primary cause of water stress and a primary limitation to tree growth during the long, dry summers typical of western Oregon, thinning could prove ineffective, or even counterproductive, for increasing drought resilience. Thinning a stand could allow penetration of hot, dry air deeper into the canopy, potentially increasing tree water stress.

Watts, Andrea; Wondzell, Steve; Jarecke, Karla; Bladon, Kevin. 2024. Hot air or dry dirt: Investigating the greater drought risk to forests in the Pacific Northwest. Science Findings 268. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 6 p. https://www.fs.usda.gov/pnw/sciencef/scifi268.pdf. See also, Karla M. Jarecke, Linnia R. Hawkins, Kevin D. Bladon, Steven M. Wondzell 2023. Carbon uptake by Douglas-fir is more sensitive to increased temperature and vapor pressure deficit than reduced rainfall in the western Cascade Mountains, Oregon, USA. Agricultural and Forest Meteorology, Volume 329, 15 February 2023, 109267. https://www.sciencedirect.com/science/article/abs/pii/S0168192322004543. See also, Watts, Andrea; Wondzell, Steve; Jarecke, Karla; Bladon, Kevin. 2024. Hot air or dry dirt: Investigating the greater drought risk to forests in the Pacific Northwest. Science Findings 268. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 6 p. https://www.fs.usda.gov/pnw/sciencef/scifi268.pdf. (". Atmospheric water demand, not soil moisture availability, appears to be the primary cause of tree water stress in the late summer. … *Management Implications …* • The sensitivity of Dougals-fir water stress to vapor pressure deficit has critical implications to managing forests of western Oregon for drought resiliency in a changing climate. Hotter summer temperatures expected from climate change are likely to drive higher vapor pressure deficit and exacerbate water stress in the future. • If vapor pressure deficit is a primary cause of water stress and a primary limitation to tree growth during the long, dry summers typical of western Oregon, thinning could prove ineffective, or even counterproductive, for increasing drought resilience. Thinning a stand could allow penetration of hot, dry air deeper into the canopy, potentially increasing tree water stress.”).

The draft EA has some disclosure of the effects of thinning and not thinning on carbon stocks but the analysis does not compare the effects of alternatives. It is important for the public and the decision-maker to understand that thinning will transfer tons of carbon to the atmosphere and exacerbate global climate change, while the no action alternative would continue to capture and store more carbon and serve as a climate solution.

Wood Products Are a Source of GHG Emissions, not a Sink. The Carbon Value of Wood Products is Over-estimated.

The EA touts carbon storage in wood products. EA at 31. From a climate perspective, wood products represent net carbon emissions, NOT net carbon sequestration, because only a small fraction of the carbon in a logged forest ends up in wood products. Logging to create wood products causes the majority of forest carbon to be transferred to the atmosphere, not to wood products. Science clearly shows that carbon is more safely stored in forests, not in wood products.

More than 200 scientists recently wrote to Congress saying –

> We find no scientific evidence to support increased logging to store more carbon in wood products, such as dimensional lumber or cross-laminated timber (CLT) for tall buildings, as a natural climate solution. The growing consensus of scientific findings is that, to effectively mitigate the worst impacts of climate change, we must not only move beyond fossil fuel consumption but must also substantially increase protection of our native forests in order to absorb more CO2 from the atmosphere and store more, not less, carbon in our forests (Depro et al. 2008, Harris et al. 2016, Woodwell 2016, Erb et al. 2018, IPCC 2018, Law et al. 2018, Harmon 2019, Moomaw et al. 2019).

Moomaw et al 2020. Scientists Letter to Congress Urging Protection of Forests to Mitigate the Climate Crisis. May 13, 2020. https://96a.96e.myftpupload.com/wp-content/uploads/2020/05/200TopClimateScientistCongressProtectForestsForClimateChange13May20.pdf.

Carbon emissions from the forest sector are often reported as net emissions which account for forest growth. This is not a proper way to account for emissions. The emissions from logging and the wood products supply chain must be reported separately, because carbon uptake via forest growth occurs whether forests are logged or not. Bysouth, D., Boan, J. J., Malcolm, J. R., & Taylor, A. R. (2024). High emissions or carbon neutral? Inclusion of “anthropogenic” forest sinks leads to underreporting of forestry emissions. *Frontiers in Forests and Global Change*, *6*, 1297301. https://doi.org/10.3389/ffgc.2023.1297301; Polanyi, Skeene, and Simard 2024. LOGGING EMISSIONS UPDATE - Reported greenhouse gas (GHG) emissions from logging in Canada double after revision to government data. https://naturecanada.ca/wp-content/uploads/2024/09/2024-Logging-Emissions-Update-

Report.pdf. The NEPA analysis must accurately disclose to the public and the decision-maker the benefits of forest growth and continued carbon sequestration if the forest is conserved, versus all the GHG emissions from logging and associated activities.

World Resources Institute conducted a thorough analysis and concluded that increased use of wood does not provide climate benefits and has significant trade-offs, such as adverse effects on biodiversity.

1) Most wood (and its stored carbon) is lost during production.
2) Harvesting wood is not carbon-neutral.
3) Using wood in construction will most likely increase climate warming for decades.
4) Relying only on plantation forests in warm climates for mass timber might yield climate benefits from a specific hectare, but not when factoring in the growing needs for wood.
5) Mass timber would have large adverse effects on the world's forests.

Tim Searchinger, Liqing Peng, Richard Waite and Jessica Zionts. July 20, 2023. Wood Is Not the Climate-friendly Building Material Some Claim it to Be. https://www.wri.org/insights/mass-timber-wood-construction-climate-change, *citing* Timothy Searchinger, Liqing Peng, Jessica Zionts, And Richard Waite 2023 The Global Land Squeeze: Managing The Growing Competition For Land. World Resources Institute. https://doi.org/10.46830/wrirpt.20.00042; https://files.wri.org/d8/s3fs-public/2023-07/the-global-land-squeeze-report.pdf ("■ Initiatives to increase demands for bioenergy and mass timber for construction would vastly increase land-use competition.

■ Wood use is not "carbon neutral," even if forests are managed "sustainably," once one accounts for the loss in forest carbon from harvests. In most scenarios, harvesting additional wood, even for construction, will likely increase atmospheric carbon for decades.

■ Solutions require strategies that produce, protect, reduce, and restore: produce more food and wood on already managed land, protect native habitats, reduce demand for land-intensive products, and, if successful, restore forests and other habitats.

■ In general, policies should not increase demand for land-based products until the world shows that it can meet rising food and wood demands without additional land conversion.

Our analysis also shows that "sustainable forest management," as conventionally understood, does not mean that wood use is carbon neutral or that using wood in construction in place of concrete and steel necessarily provides a net climate benefit. Harvesting wood comes with a time-discounted cost in lost carbon in the forest. The climate benefits of harvesting wood include the storage of some of that forest carbon elsewhere and avoided emissions from other carbon-intensive products such as concrete and steel. But the climate costs are reduced storage of carbon in the forest.

According to our analysis, large net climate benefits from wood harvesting probably require that a high percentage of this wood is used to replace concrete and steel in construction—perhaps at levels not realistic—and that the wood come from or be associated with the establishment of fast-growing forest plantations. If these plantations come at the expense of natural forests, they would have high biodiversity costs.”).

Applying discounting to the carbon costs of forest management improves accuracy. Peng, L., Searchinger, T.D., Zionts, J. et al. The carbon costs of global wood harvests. Nature (2023). https://doi.org/10.1038/s41586-023-06187-1. https://www.nature.com/articles/s41586-023-06187-1.pdf (“[H]arvests of wood have major, although often ignored, carbon costs that should be attributed to human activity. ... [W]e present results of a new model that uses [4%] time discounting to estimate the present and future carbon costs of global wood harvests under diferent scenarios. We fnd that forest harvests between 2010 and 2050 will probably have annualized carbon costs of 3.5–4.2 Gt CO_2e yr^{-1}. … These findings are, in a sense, good news because they imply that if people could reduce forest harvests, forest growth could do more to reduce atmospheric carbon, a potential mitigation ‘wedge’ that is rarely identified in climate strategies.”).

> Various forest management mitigation strategies based on modifying conventional management of forests for commodity production in ways that reduce logging emissions and take account of the carbon stored in wood products have been proposed as constituting the most effective mitigation (Fusset al 2020, Verkerk et al 2020). However, other empirical case studies have challenged these proposals (Keith et al 2015) and shown that alternative forest management practices such as reduced impact logging do little to reduce atmospheric CO_2 compared to forest protection and regrowth (i.e. allowing growth to continue) whereas tree harvesting immediately releases large amounts of CO_2 (Law et al 2018).

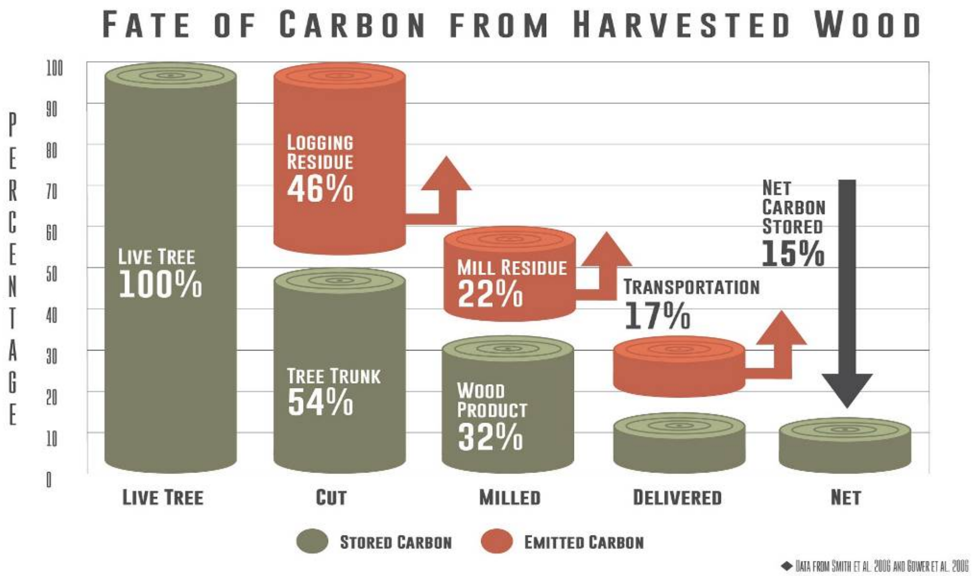
Brendan Mackey et al 2022. Net carbon accounting and reporting are a barrier to understanding the mitigation value of forest protection in developed countries. Environ. Res. Lett. 17 054028. DOI 10.1088/1748-9326/ac661b. https://iopscience.iop.org/article/10.1088/1748-9326/ac661b/pdf.

Some argue that wood products are a good place to store carbon. This is a counter-productive climate strategy, because –

Only a small fraction of carbon from logged forests ends up in long-term storage in wood products, most is transferred to the atmosphere. Of all the carbon that is killed and/or exposed to accelerated decay in a logging operation only a small fraction ends up as durable goods and buildings -- most ends up as slash, sawdust, waste/trim, hog fuel, and non-durable goods like paper. Some say that converting forest to wood products "delays" emissions, but in fact logging accelerates emissions because they are the result of a process that kills trees that would continue to actively sequester carbon if not logged, and logging involves tremendous waste in the logging process, milling process, construction/manufacturing process.

OFRI says “in 2013. Of the [log] volume delivered to sawmills, 49.4% became finished lumber or other sawn products and 48% became mill residues…” Kuusela, Rossi et al 2019. Forest Resources And Markets: Trends And Economic Impacts. The 2019 Forest Report.

OFRI. https://theforestreport.org/wp-content/uploads/2019/07/OFRI-2019-Forest-Sector-Economic-Report-Web.pdf. There are additional losses throughout the wood products supply chain, resulting in logging waste, milling waste, plus GHG emissions from processing and transportation.



Carbon remains stored much longer in forests than in wood products. Much of the wood products which can reasonably be considered "durable" are in fact less durable than leaving the carbon stored safely inside a mature tree that might live to be hundreds of years old. Most of our wood products are disposable. It turns out that well-conserved forests on average store carbon more securely than our "throw-away" culture and economy does. Law, B. & M.E. Harmon 2011. Forest sector carbon management, measurement and verification, and discussion of policy related to mitigation and adaptation of forests to climate change. Carbon Management 2011 2(1). https://archives.corvallisoregon.gov/public/ElectronicFile.aspx?dbid=0&docid=4256162 ("To the extent that management can direct carbon into longer lived pools, it can increase the stores of carbon in the forest sector. Harvest of carbon is one proposed strategy to increase carbon stores. However, harvesting carbon will increase the losses from the forest itself and to increase the overall forest sector carbon store, the lifespan of wood products carbon (including manufacturing losses) would have to exceed that of the forest. Under current practices this is unlikely to be the case. A substantial fraction (25–65%) of harvested carbon is lost to the atmosphere during manufacturing and construction depending on the product type and manufacturing method. The average lifespan of wood buildings is 80 years in the USA, which is determined as the time at which half the wood is no longer in use and either decomposes, burns or, to a lesser extent, is recycled. However, many forest trees have the potential to live hundreds of years (e.g. 800 years in the Pacific northwest USA). Mortality rates of trees are generally low, averaging less than 2% of live mass per year in mature and old forests; for example, in Oregon, mortality rates average 0.35–1.25% in forests that are older than 200 years in the Coast Range and Blue Mountains, respectively [8]. Moreover, the average longevity of dead wood and soil carbon is comparable to that of live trees. When the loss of carbon associated with wood products manufacturing is factored in, it is highly unlikely that harvesting carbon and placing it into wood products will increase carbon stores in the overall forest sector. This explains why in all analyses conducted to date, wood products stores never form the majority of total forest sector stores.")

"Of the cumulative wood harvested in the past 115 years, 65% is in the atmosphere, 16% is in landfills, and 19% is in long-lived products (Hudiburg et al. 2019)." Law, B. 2021. Response to Questions for the Record, *attached to* STATEMENT OF DR. BEVERLY LAW, PROFESSOR EMERITUS, OREGON STATE UNIVERSITY, BEFORE THE UNITED STATES HOUSE OF REPRESENTATIVES, SUBCOMMITTEE ON NATIONAL PARKS, FORESTS AND PUBLIC LANDS, APRIL 29, 2021, CONCERNING "WILDFIRE IN A WARMING WORLD: OPPORTUNITIES TO IMPROVE COMMUNITY COLLABORATION, CLIMATE RESILIENCE, AND WORKFORCE CAPACITY" https://web.archive.org/web/20210501190104/https://naturalresources.house.gov/imo/media/doc/Law,%20Beverly%20-%20Testimony%20-%20NPFPL%20Ov%20Hrg%2004.29.21.pdf (link to Statement, without Response to Questions) *citing* Hudiburg, T.W, B.E. Law, W.R. Moomaw, M.E. Harmon, J.E. Stenzel. 2019. Meeting GHG reduction targets requires accounting for all forest sector emissions. Env. Res. Lett. 14: 095005. https://iopscience.iop.org/article/10.1088/1748-9326/ab28bb/pdf.

Aquatic Impacts

We are concerned about impacts to aquatic habitat due to commercial thinning in Riparian Reserves. Please consider the following on thinning in Riparian Reserves.

Chris Frissell summarizes some of the issues related to thinning riparian reserves:

> Riparian thinning proponents consider stand density in riparian areas as a static factor that can be controlled and enhanced by "proper" management--often that is thinning, to benefit a narrowly defined aspect of biodiversity, or to attain a specific stand structural outcome.
>
> In my experience, natural disturbance processes are so diverse, so frequent, so unpredictable, and expressed across a broad enough range of scales in riparian forests that there is little or no justification for imposing additional human disturbance, in the form of thinning, tree tipping, or similar practices, with the expectation of producing a specific stable-state outcome. In fact, the complex and dynamic regime of natural disturbance renders any active human intervention highly unlikely to produce the anticipated or desired outcome for any significant length of time. In truth the interaction of unpredictable natural disturbance with imposed human disturbance makes it far more likely that unanticipated and undesired outcomes will occur (e.g., greatly accelerated and more widespread windthrow, with resulting floodplain and streambank instability and erosion).

This is precisely why FEMAT ACS rules emphasized process-based conservation actions (in terms of both restrictions and outcomes) in riparian forests--not state-based ones.

Riparian thinning proponents often point to homogeneous, low-diversity undesirable vegetation conditions, such as "stunted, overcrowded forests." that in their view demand thinning. I have observed that any syndrome of homogeneity or static supposedly static vegetation state is rather limited to a few locales, with the vast majority of sites showing every sign of natural processes of vegetation succession and natural disturbance generating sufficient diversity of sites, species and growth rates to assure that future forest outcomes, left unaltered, would be just fine and beneficial for water quality and biological diversity outcomes. I note that Pollock and Beechie's (NMFS Northwest Science Center) stand modeling work, based on field-verified processes and rates of tree species recruitment, growth and mortality in the forest types of concern, shows this same outcome (and their simulations don't even include external stand disturbances like wildfire, floods, landslides, or major wind events).

Chris Frissell, personal communication, January 15, 2019.

Dead wood is important to meeting many aquatic and terrestrial wildlife habitat values. Dead wood is also important for ecological services such as the capture, storage and release of water, sediment, and nutrients including, carbon. Most riparian reserves are short of dead wood due to past and ongoing logging, roads, fire suppression, etc. Natural processes of stand growth and mortality will correct this shortage, whereas logging will capture and export mortality and reduce and delay recruitment of wood to both streams and uplands within riparian reserves. This is not a minor short-term effect, but rather a significant long-term effect. Such effects are inconsistent with the Aquatic Conservation Strategy which prohibits logging in riparian reserves unless it is needed to meet objectives, and requires that management actions “maintain” and "not retard" ACS objectives, including dead wood. Any proposal to log riparian reserves must address these factors, develop clear goals, provide clear linkages between proposed actions and desired outcomes. Any alleged benefits of logging must be weighed against likely adverse effects on dead wood recruitment.

Riparian areas are widely considered to be important wildlife habitat. Cool air temperatures due to the presence of cool and turbulent surface waters, typically dense vegetative canopy cover, and their location in the lowest portions of watersheds combine to maintain a distinct microclimate along stream channels and in the adjacent riparian area. Maintaining the integrity of the vegetation in these areas is particularly important for riparian-dependent species of amphibians, arthropods, mammals, birds, and bats.

…

Large quantities of down logs are an important component of many streams. Coarse woody debris influences the form and structure of a channel by affecting the profile of a stream, pool formation, and channel pattern and position. The rate at which sediment and organic matter are transported downstream is controlled in part by storage of this material behind coarse woody debris. Coarse woody debris also affects the formation and distribution of habitat, provides cover and complexity, and acts as a substrate for biological activity. Coarse woody debris in streams comes directly from the adjacent riparian area, from tributaries that may not be inhabited by fish, and from hillslopes.

1994 Northwest Forest Plan FSEIS page 3&4-61.

The riparian reserve land allocation must be respected. The general rule is that silviculture is prohibited unless needed. The riparian reserves do not *need* to have their dead wood recruitment reduced for the next 50 years.

Under the NWFP: "The risk has been shifted under the Aquatic Conservation Strategy because each project must meet the maintenance and restoration criteria by maintaining or restoring the physical and biological processes required by riparian-dependent resources within a watershed." 1994 FSEIS p 3&4 – 69. Clearly, this requires the agency to show there is a need for intervention. The 1993 SAT Report (which underpins the ACS) said "Within these protection areas, timber management and other ground disturbing activities are prohibited unless a site-specific watershed analysis indicates such activities will accelerate meeting desired ecological conditions." And "Within the Riparian Habitat Conservation Areas, timber management and other land management activities are essentially prohibited unless the watershed analysis indicates such activity is necessary to accelerate meeting desired ecological conditions." 1993 SAT Report. Ch 5, p 296. "[F]or areas where riparian conditions are presently degraded, management activities must be designed to improve habitat conditions." 1993 SAT Report. Ch 5, p 464.

> Large wood in streams—preferably whole trees with root wads and all—provides the randomness and dynamic environment that fish absolutely need to survive in the ever-changing waters they occupy. Wood breaks up the current and spreads water sideways across its natural floodplain, creating wonderful, dynamic and necessary diversity while also absorbing energy that could cause serious damage downstream otherwise, such as flooding or unnatural erosion. It sorts gravels during high flows, creating those beautiful spawning gravel beds laid out like blankets among bigger rock. It makes those current breaks downstream of log jams. It provides cooling shade and cover, and slow pools and edge habitat that baby fish need after emerging from those gorgeous gravels to ride out high flows, find food and hide from prying eyes. Decomposing wood and the nutrients it produces jumpstarts that the natural processes critical to insect, animal, amphibian and plant life.

Alan Moore, Why Fish Love 'Large Woody Debris.' Trout Unlimited. 2-4-2013. http://troutunlimitedblog.com/large-woody-debris-makes-for-fishy-rivers/ Joshua J. Roering, professor of geological sciences at the University of Oregon studies the processes that create fish habitat and concluded: "[Coho salmon] seem to respond to the heterogeneity that is so inherent in most real landscapes. Nature is messy, and the fish have adapted to that." University of Oregon (2013, February 11). Large, ancient landslides delivered preferred upstream habitats for coho salmon. ScienceDaily. Retrieved from http://www.sciencedaily.com/releases/2013/02/130211135045.htm

> The presence of LWM within a stream channel is critical to maintaining the integrity of the system, in fact, there cannot be an overabundance of LWM. … Riparian Reserves provide important wildlife habitat, which justifies the heavy loading of LWM in the creeks and the floodplains. … In the Riparian Reserves … it is desirable to maintain healthy forest stands over the long-term while maintaining high snag densities and green tree replacements. … It is recognized that Riparian Reserves constitute an area where higher risks are taken (including reduced fire suppression efforts) in order to allow natural processes to occur and continue without human intervention.

Deschutes NF 1999. Odell Watershed Analysis, pages 164-165. https://hdl.handle.net/1794/7220.

> In an undisturbed forest ecosystem, wood is naturally "recruited" to streams in various ways. Riparian trees growing along the channel fall into the channel when they are undercut by the stream, toppled by beavers, burned by fire or blown down during storms. Upslope trees can be transported into the channel by events such as avalanches or landslides. Flooding can wash trees into the channel and during highwater they may be pushed downstream.
>
> In-stream woody debris has been drastically reduced in some streams by historical forest management practices. Logging near rivers and streams limited the number of trees that could fall into streams. Road building that channeled streams through culverts prevented downstream wood recruitment. "Stream cleaning" was sometimes conducted to remove fallen trees from streams, for beautification, to prevent damage to infrastructure downstream, or in a misguided attempt to assist fish migration.
>
> Scientists have now come to understand that in-stream LWM [large woody material] is ecologically important for a number of reasons:
>
> 1. LWM can help spawning gravels accumulate , by stopping the gravel from moving downstream;
> 2. Pools can form behind LWM, which provide important juvenile rearing habitat, as well as habitat for all fish during periods of low-flows;
> 3. LWM can help slow stream speed , which helps adult fish as they move upstream and shelters rearing juveniles from using too much energy fighting currents;
> 4. LWM provide shade , offering pockets of cooler water, and can help to lower the temperature of an entire stream;
> 5. LWM provides fish with refuge from predators;
> 6. LWM can help to stabilize banks, prevent erosion and decrease sediment movement that can harm downstream fish habitat;

7. LWM is important to the aquatic food chain, because it traps organic matter and provides habitat for insects and invertebrates, which are both food for fish.

All of these elements add "complexity" to a stream. When it comes to fish habitat, complexity is a good thing. And one of the best ways to make a stream complex is to simply add wood.

Hannah Ettema 2014. Seven Reasons Why Fish Need Wood. https://www.nationalforests.org/blog/seven-reasons-why-fish-need-wood

Abundant dead wood is not just important for fish and other aquatic species, but we are learning that it is also useful for a wide variety of terrestrial wildlife. OSU researchers say

> … little is known about how large wood in streams impacts birds and land-based animals.
>
> Oregon State University scientists Ezmie Trevarrow and Ivan Arismendi are beginning to change that with a just-published paper in Biodiversity and Conservation that outlines what they observed from one year of footage from motion-triggered video cameras they set up near multiple large log jams in a creek just west of Corvallis.
>
> "This study reveals a hidden role of large wood in streams," said Trevarrow, who conducted the research as an undergraduate in the Honors College at Oregon State and is now a research associate at the University of Georgia. "The findings are valuable for land managers because they demonstrate additional value of restoration projects that involve wood placement into streams."
>
> In the paper, Trevarrow and Arismendi focused their attention on what species they saw, the most common observed activities and the seasonality of the detections. Among their findings:
>
> - Forty species were observed during the study period. The most common species included mule deer, raccoon belted kingfisher, Townsend's chipmunk, deer mouse western grey squirrel, Virginia opossum and American robin.
> - The most common animal activities around the log jams included movement (68%), rest (18%), and food handling/eating (9%), suggesting that large wood in streams acts as lateral corridors, or highways as Trevarrow put it, connecting land habitats year-round for wildlife.
> - A strong seasonality in detections and species richness with the highest values occurring in summer and spring, and the lowest values in winter. For example, the most species were seen in summer (27), followed by spring (23), fall (22) and winter (16).
>
> …

> While the benefits of large wood in streams for fish, particularly salmon, have been well studied, few studies have focused on the impact on land-based animals, the Oregon State researchers said.
>
> For their study, they set up 13 cameras between June 2020 and June 2021 along Rock Creek, about 15 miles west of Corvallis. They collected 1,921 videos containing at least one animal detection, …

KTVZ News 6-21-2022. OSU research looks at importance of large wood in streams for land-based animals. https://ktvz.com/news/environment/2022/06/21/osu-research-looks-at-importance-of-large-wood-in-streams-for-land-based-animals/ *citing* Trevarrow, E., Arismendi, I. The role of large wood in streams as ecological corridors for wildlife biodiversity. Biodivers Conserv (2022). https://doi.org/10.1007/s10531-022-02437-2 https://link.springer.com/article/10.1007/s10531-022-02437-2.

The agency should not manage for *minimum* levels of dead wood because *optimal* levels of dead wood are much higher than minimums. In fact, there may not be any maximum. "The presence of LWM within a stream channel is critical to maintaining integrity of the system, in fact, there cannot be an overabundance of LWM." Deschutes NF, 1997. Big Marsh Watershed Analysis. https://hdl.handle.net/1794/7225. 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.

Where streams are degraded, management of riparian forests should strive to meet the high end of the natural range for large wood, not the central tendency. This brings into question the minimum requirements that pervade current standards. Fox & Bolton (2007) recommend -

> In degraded streams, where management is needed to restore favorable conditions, wood loads are often no longer found in the upper distribution of these ranges, or the distribution is centered around a lower mean. In these cases, merely managing for the mean or median will not restore the natural ranges of heterogeneity. Thus, for management purposes intending to restore natural wood-loading conditions, establishing instream wood targets based on the upper portion of the distribution observed in natural systems (i.e., the 75th percentile) rather than the lower portion of the distribution are reasonable as well as prudent to restore natural ranges.

Martin Fox & Susan Bolton (2007) A Regional and Geomorphic Reference for Quantities and Volumes of Instream Wood in Unmanaged Forested Basins of Washington State, North American Journal of Fisheries Management, 27:1, 342-359, DOI: 10.1577/M05-024.1. http://dx.doi.org/10.1577/M05-024.1

Restoration of riparian reserves requires several things, including accumulation of basal area and conifer regeneration, both of which require retention of abundant live trees. The 1993 report of the Scientific Analysis Team (SAT), an appendix to FEMAT and the NFWP says:

> Several studies (Steinblums 1977, Franklin et al. 1981, Heimann 1988, Andrus et al. 1988, Ursitti 1991, and Morman 1993) have found the basal area of conifers, which reflects the size and number of trees present, to be less in riparian areas of second-growth forests than in late-successional and old-growth forests. …
>
> Maintenance of riparian forests in late-successional and old-growth forests and restoration in second-growth forests will depend on regeneration rates of conifers in the future. Regeneration of conifers in the riparian zones of natural stands is dependent, at least in part, on downed large trees. Researchers at the Pacific Northwest Research Station, Corvallis, Oregon found that more than 80 percent of conifer regeneration in the riparian zones along coastal Oregon streams that they studied occurred on down logs. The role of nurse trees in forest regeneration in the Pacific Northwest is widely recognized (Harmon et al. 1986). in riparian zones, nurse trees originate within 0 to 400 feet of the active channel. Greater retention of live trees and snags in riparian stands and adjacent upslope source areas will enhance the generation of future riparian forests

1993 SAT Report, page 460. The agency may claim that thinning helps regenerate conifers, but it comes at the expense of basal area and recruitment of nurse logs.

The NWFP EIS discloses that there are 199 species (not including fish) that are associated with late-successional and old-growth forests and riparian areas, including 13 amphibians, 38 birds, 29 mammals, and a wide variety of non-vertebrates. Table FSEIS page 3&4-11, page 3&4-62.

> Current amounts of large woody debris in coastal streams of Oregon and Washington are a fraction of historical levels (Bilby and Ward 1991, Bisson et al. 1987, NRC 1992). … Stream surveys by private timber companies and federal land management agencies in the Northwest reveal an overall loss of stream habitat quality (FEMAT 1993, Kaczynski and Palmisano 1993, Wissmar et al. 1994) that is strongly related to changes in riparian vegetation, especially harvest of merchantable riparian timber.

Everest, Fred H.; Reeves, Gordon H. 2006. Riparian and aquatic habitats of the Pacific Northwest and southeast Alaska: ecology, management history, and potential management strategies. Gen. Tech. Rep. PNW-GTR-692. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 130 p. http://www.fs.usda.gov/pnw/pubs/pnw_gtr692.pdf.

The FEMAT Report explained that logging in reserves must be well-planned and clearly documented:

> Prescriptions to be used for each stand should be well thought out and documented. They will be designed to produce stand structure and component associated with late-successional conditions. These components include large trees, snags, logs, and dense, multi-storied canopies. Prescriptions should show the treatments to be applied and the anticipated effects on the stand over time. They should also include a discussion of the actions, coordination efforts, and oversight that will be necessary for successful implementation. This discussion should draw on previous efforts made to implement similar prescriptions. Finally, the prescriptions should identify key stand attributes or accomplishments that should be monitored. For example, if snags are to be created, or regeneration established, the accomplishment of these actions and their results should be monitored.

1993 FEMAT Report at page III-34; 1994 FSEIS Vol II, page B-73. This means that the agencies cannot rely on analysis-free assertions that logging will enhance or accelerate late successional conditions or riparian conditions in some general way. The NEPA analysis must be much more explicit in terms of objectives, rationale, and the logical connection between intentions, actions and outcomes.

In order to retain options for recruitment of large wood in degraded stream systems, scientific recommendations include retention of trees >12" dbh.

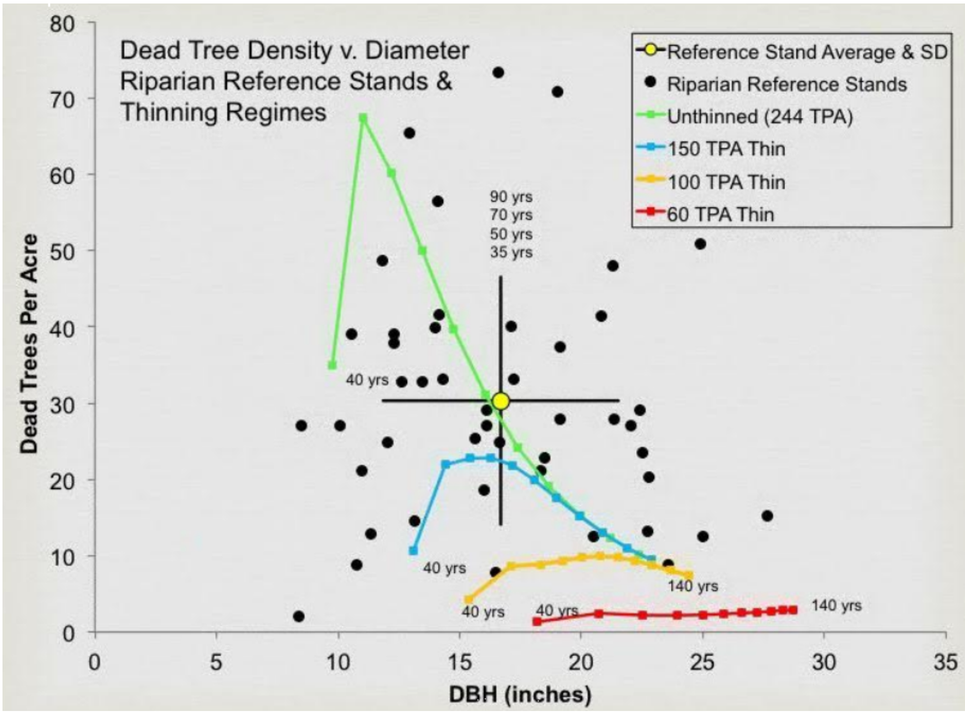
> Removal of trees from riparian zones may delay the recovery of fish habitat. At a minimum, the largest trees (that is, those > 12 inches in diameter at breast height) should be left in riparian areas for future sources of in-stream wood. This would apply to all streams, as recommended by Anderson and others (1992). Smaller trees could be removed as part of a program for riparian vegetation restoration.

Gordon H. Reeves and Fred H. Everest. 1994. REDUCING HAZARD FOR ENDANGERED SALMON STOCKS, *in* Eastside Forest Ecosystem Health Assessment; Volume IV. Everett, Richard L., comp. 1994. Restoration of Stressed Sites, and Processes. Gen. Tech. Rep. PNW-GTR-330. Portland, OR: USDA, Forest Service, Pacific Northwest Research Station. https://www.fs.usda.gov/pnw/pubs/pnw_gtr330.pdf. (p 23).

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

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

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



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

"The effect that wood has on [fish] habitat is related to the size of the piece of wood relative to the channel size and gradient." East Alsea Landscape Management Project – EA Appendix H - Fish BE, 4-18-2011. The NEPA analysis should therefore disclose the effects of logging not only on absolute size of wood but on the size of wood relative to stream size and gradient. Dead wood of all sizes is important to streams and riparian function. In small streams, small wood can even perform the ecological and hydrological functions normally thought to require large wood. If the goal of logging is to create large trees faster, the NEPA analysis should document the size, gradient, and other characteristics of streams adjacent to each logging area and determine the size of wood that can serve key ecological and hydrological functions, then disclose the effects of logging relative to those relevant wood sizes.

Dead wood is important to both aquatic and terrestrial purposes of the riparian reserves network, so the NEPA analysis cannot just focus on recruitment of wood to streams, but must also address the need to recruit optimal levels of snag and dead wood to meet the needs of terrestrial wildlife (primary cavity excavators, secondary cavity users, amphibians, mollusks, lichen, fungi, etc.) which were intended to be benefited by riparian reserves. Wood loading in small streams helps them perform their many critical ecological functions. Meyer J.L. et al 2007. WHERE RIVERS ARE BORN: The Scientific Imperative for Defending Small Streams and Wetlands. Sierra Club and American Rivers. https://www.americanrivers.org/wp-content/uploads/2016/05/WhereRiversAreBorn_report.pdf

We are concerned that thinning captures mortality which reduces and delays recruitment of large wood needed to meet ACSO #8 among others. Thinning is often conducted in riparian areas based on the false assumption that thinning accelerates the recruitment of large trees and therefore large snags, but rigorous analysis using stand simulation software clearly shows that assumption to be false. Note ACSO #8 is based on the aquatic objective more clearly stated in the SAT Report as "Maintain or restore riparian vegetation to provide an amount and distribution of large woody debris characteristic of natural aquatic and riparian ecosystems." 1993 SAT Report. Ch 5, p 456.

Thinning in stands of trees that are not yet of "pool forming" size may be beneficial, but after trees are of pool-forming size, thinning just captures and removes the mortality that should end up in the stream. (In simplistic terms, a pool-forming tree is one big enough to fall all the way across the stream, so it varies by stream size, but in general it only takes a small tree to form a pool in a small stream). See Roni, Philip, Timothy J. Beechie, Robert E. Bilby, Frank E. Leonetti, Michael M. Pollock, And George R. Pess. 2002. **A Review of Stream Restoration Techniques and a Hierarchical Strategy for Prioritizing Restoration in Pacific Northwest Watersheds.** *North American Journal of Fisheries Management* 22:1–20, 2002 American Fisheries Society 2002 http://www.crab.wa.gov/LibraryData/RESEARCH_and_REFERENCE_MATERIAL/Environmental/020923StreamRestoreTechPNW.pdf.

Looking at the total miles of streams, small streams dominate, therefore most logging takes place along small streams. BLM has admitted that small wood can be functional in small streams.

TABLE 1. DIAMETER OF FUNCTIONAL WOOD PIECE AS IT RELATES TO WIDTH OF ACTIVE STREAM CHANNEL

Width of Stream (ft.)	Diameter of functional wood (in.)
15	4.5
20	6
30	9
40	12
50	15
>50	>20

From Beechie et al. 2000

BLM 2014. Planning Criteria - Western Oregon RMP Revisions, p 49. http://www.blm.gov/or/plans/rmpswesternoregon/plandocs.php. It's also worth noting that small streams are disproportionally ecologically important. "While small-stream habitats have only about 20% of the available salmon in the watershed, they provide 50% of bear consumption of salmon. 'This tells us that populations of sockeye salmon that spawn in little streams are disproportionately important to bears,' said study lead author Jonny Armstrong, an ecologist at Oregon State University. 'Bears profit from these small streams because they offer salmon at unique times of the season. To capitalize on plentiful salmon runs, bears need them to be spread across time.' Small streams typically have cold water, which leads to populations of salmon that spawn much earlier in the season when no other populations are available to predators such as bears." Branam, C. 2019. Easy prey: The largest bears in the world use small streams to fatten up on salmon. December 19, 2019. https://today.oregonstate.edu/news/easy-prey-largest-bears-world-use-small-streams-fatten-salmon *citing* Jonathan B. Armstrong, Daniel E. Schindler, Curry J. Cunningham, William Deacy, Patrick Walsh. 2019. Watershed complexity increases the capacity for salmon–wildlife interactions in coastal ecosystems. Conservation Letters. Published: 20 November 2019 https://doi.org/10.1111/conl.12689 https://conbio.onlinelibrary.wiley.com/doi/pdfdirect/10.1111/conl.12689.

Rosenfeld & Huato (2003) found that large wood formed pools more reliably than small wood. Wood >24" dbh formed pools 42% of the time, while wood 6-12" dbh formed pools 6% of the time. However, this does not mean that small wood is of no use, especially if it's abundant. The cumulative influence of several pieces of small wood can approach the pool-forming function of large wood. Rosenfeld, J. S., and Huato, L. 2003. Relationship between LWD characteristics and pool formation in small coastal British Columbia streams. North American Journal of Fisheries Management 23:928–938. https://web.archive.org/web/20170808131553/http://www3.telus.net/jordanrosenfeld/Home%20Page/Publications/Rosenfeld%20and%20Huato%202003.pdf. Similarly, Bilby and Ward (1989) surveyed characteristics of large wood in western Washington streams and found that size of stable pieces of large wood increases with stream size. Their values suggest that streams under 5 m in width require trees of about 30–35 cm in diameter to be useful as fish habitat and to be able to persist as stable LWM in the channel. Streams of about 10 m in width require larger trees of about 45 cm (1.5 ft) in diameter. Bilby, R. E.; Ward, J. W. 1989. Changes in characteristics and function of woody debris with increasing size of streams in western Washington. Transactions of the American Fisheries Society 118: 368-378. These publications show the direct and cumulative value of small wood (which is often captured and exported by logging). This means that the agency cannot ignore or discount the value of small wood recruitment to streams. In sum, NEPA analyses must account for the effects of logging on both the quantity and quality of wood.

The effects of logging in riparian reserves should be described in terms of the number of pieces and the volume of wood, not just the size wood. Scientists recommend wood volume as a more meaningful measure of wood's value instream. "Total volume of wood through time was reported for all simulations, which is a more conservative measure of wood abundance than the number of pieces." Mark A. Meleason, Stanley V. Gregory, And John P. Bolte. 2003. Implications Of Riparian Management Strategies On Wood In Streams Of The Pacific Northwest. Ecological Applications, 13(5), 2003, pp. 1212–1221. http://www.geo.oregonstate.edu/classes/geo582/week_5_1_wood_movement/Meleasonetalstrategies.pdf.

Also, when the objective of riparian thinning is to develop structures suitable for instream habitat structures, there is a trade-off between quality and quantity. "Quality" is represented by the size of woody pieces. Larger is generally better, and thinning typically increases the growth rate of retained trees. "Quantity" is represented by the number of stems or the total volume of wood available for recruitment to streams and riparian uplands. Unthinned stands tend to have much higher number of stems and total wood volume, and they tend to recruit dead wood sooner. To justify logging, the agencies too often focus on growing large wood faster without acknowledging the adverse effects on wood quantity and delayed recruitment. The focus on wood size fails to tell a complete story because:

(1) Pieces of wood much smaller than 20 or 24" diameter can be ecologically functional. Many streams in adjacent to thinning projects are small and lack the power to move much wood, so small trees are still functional;

(2) Average stand diameter does not reflect actual wood recruitment to riparian reserves. A stand of large vigorous trees is not experiencing the ecological processes (mortality) necessary to recruit wood to streams and riparian uplands;

(3) Average stand QMD does not account for the number of stems or the volume of wood available for recruitment toward ecological services. A few large stems do not serve the same ecological function as a large number of slightly smaller stems.

Even when looking at the size and number of pieces, there is no long-term benefit from thinning. "Thinning accelerated the development of large diameter trees by about 20 years such that there were more live trees > 18" dbh in the two decades following thinning, relative to the unthinned stand, but this advantage was short-lived. Three decades after thinning, there were more live trees > 18" dbh in the unthinned stand and five decades after thinning there were twice as many live trees >18" dbh in the unthinned stand relative to the thinned stand. A similar trajectory was observed for the live trees > 24" dbh." Kim Kratz, Ph.D., Issue Paper for Western Oregon. NMFS, Oregon State Habitat Office. 7-23-2010. Appendix 1. page 38. https://www.blm.gov/or/districts/medford/forestrypilot/files/kswildetal-attach4.pdf. The most notable effect of thinning is to reduce recruitment of larger wood. Even during the brief period that the thinned stand had more large trees, those trees are unlikely to be recruited to the stream, because they are more vigorous as a result of thinning.

Contrary to common assumptions, thinning is not a zero sum game, especially not in the years immediately following thinning. The wood that is captured and removed does not regrow for decades, and if a disturbance event comes along during that time, the absolute volume of wood recruited to streams WILL be adversely affected. "[T]he data have not supported early expectations of 'bonus' volume from thinned stands compared with unthinned. … [T]hinnings that are late or heavy can actually decrease harvest volume considerably." Talbert and Marshall. 2005. Plantation Productivity in the Douglas-fir Region Under Intensive Silvicultural Practices: Results From Research And Operations. Journal of Forestry. March 2005. pp 65-70 *citing* Curtis and Marshall. 1997. LOGS: A Pioneering Example of Silvicultural Research in Coastal Douglas-fir. Journal of Forestry 95(7):19-25. "In this as in other LOGS installations, the unthinned plots have consistently produced more total volume (CVTS) than any of the thinning treatments." Curtis, Robert O.; Marshall, David D. 2009. Levels-of-growing-stock cooperative study in Douglas-fir: report no. 18—Rocky Brook, 1963–2006. Res. Pap. PNW-RP-578. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 91 p. http://www.fs.usda.gov/pnw/pubs/pnw_rp578.pdf.

NMFS Biological Opinion for the Siuslaw National Forest says that thinning close to streams sacrifices a lot of potential wood recruitment:

> According to the Organon forest growth model (Spies *et al.* 2013), and the RAIS in-stream wood recruitment models (McDade *et al.* 1990), thinning with 120-foot no-cut buffers adjacent to LFH would capture approximately 90-95% of existing wood recruitment. Thinning with 100-foot no-cut buffers would capture approximately 82-90% of existing wood recruitment, and 75-foot no-cut buffers would capture approximately 70-80% of the existing wood recruitment (McDade *et al.* 1990, Spies *et al.* 2013). Thinning with 30-foot no-cut buffers would capture approximately 40-50% of the existing wood recruitment (McDade *et al.* 1990, Spies *et al.* 2013). Thinning with 15-foot no-cut buffers would capture approximately 25% of wood recruitment.

NMFS 2020. Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Siuslaw National Forest Vegetation and Aquatic Restoration Program (USFS File Code: 2600). NMFS Reference: WCRO-2019-04010. Sept 3, 2020.

> Modeling studies in western Washington indicate that riparian thinning increases LWM recruitment when trees in the initial stand are too small to create pools (LWM size required to create pools increases with increasing channel width) (Beechie et al. 2000). When trees in the initial stand already are large enough to form pools, thinning reduces the number of trees available for recruitment. For modeled Douglas fir stands, thinning increased LWM recruitment when channels were at least 15 m (49 feet) and the quadratic mean diameter of the stand was about 10 cm (3.9 inches) less than the minimum pool-forming diameter for the channel size. Recruitment was not enhanced by thinning for channels narrower than those described above.

NFMS 2005. Forest Practices on Non-Federal Lands and Pacific Salmon Conservation. Project Team Leader: Jeff Lockwood. Project Team Members: Steve Keller, Don Anderson, and Rick Edwards. NOAA/NMFS. January, 2005.

http://www.blm.gov/or/plans/wopr/pub_comments/paper_documents/Paper_1764-1924/WOPR_PAPER_01921.10001.pdf.

> We found that single and double entry thinning, with no mitigation (buffers or mechanical tipping of trees into the stream) can lead to large losses of in-stream wood over a century time scale; single and double entry thins on one side of the stream leads to reductions of 33–42 % of instream wood with simultaneous thinning on both sides of the stream doubling those losses.

Lee E. Benda, S. E. Litschert, Gordon Reeves, Robert Pabst. 2015. Thinning and in-stream wood recruitment in riparian second growth forests in coastal Oregon and the use of buffers and tree tipping as mitigation. J. For. Res. DOI 10.1007/s11676-015-0173-2. https://web.archive.org/web/20220320070113/https://www.fs.fed.us/pnw/lwm/aem/docs/reeves/2015_benda_etal_tree_tipping.pdf. This study showed that tree-tipping mitigated for the loss of wood recruitment caused by thinning compared to no action, but the study did not look at tree tipping independently of thinning, so the cost of thinning itself remains unaccounted for in that context.

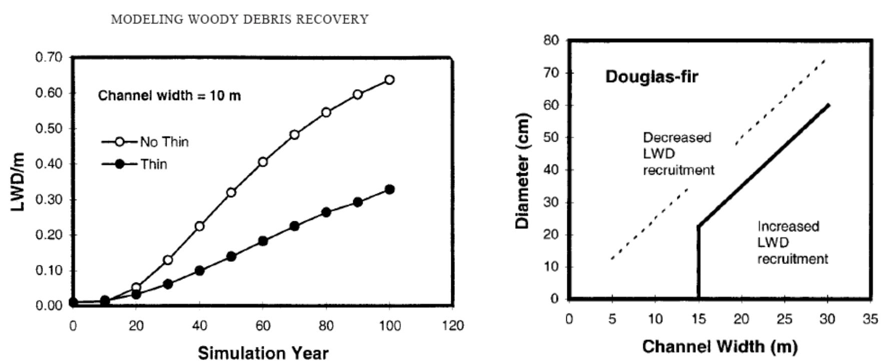
> "Available research (et al., Beechie and Sibley 1997, Bilby and Ward 1989) indicates that trees as small as 5-6 inches in diameter can form pools in small streams. Thinning along small streams with wood deficits can significantly reduce recruitment of wood to streams (Beechie et al. 2000), and the risks of this happening appear to be significantly increased by the above management actions. [i.e. "thinning in riparian areas for all stream sizes"]
> ...
> Alternatives 2 and 3 will substantially decrease the large wood contribution to fish bearing streams relative to the No-Action Alternative, and the decreases will be long-term. This is because thinning will remove wood large enough to form pools from the riparian zone (if the term large wood is defined by its ability to form pools rather than the arbitrary value of >20 inches diameter) (Beechie et al. 2000)."

NMFS, Comments on DEIS for the WOPR dated 01-11-2008. pp 8-9, 21. http://www.blm.gov/or/plans/wopr/files/NOAA_comments.pdf. See also Roni, Philip, Timothy J. Beechie, Robert E. Bilby, Frank E. Leonetti, Michael M. Pollock, And George R. Pess. 2002. **A Review of Stream Restoration Techniques and a Hierarchical Strategy for Prioritizing Restoration in Pacific Northwest Watersheds.** *North American Journal of Fisheries Management* 22:1–20, 2002 American Fisheries Society 2002 http://www.crab.wa.gov/LibraryData/RESEARCH_and_REFERENCE_MATERIAL/Environmental/020923StreamRestoreTechPNW.pdf. "Beechie et al. (2000) provided guidance for determining when thinning is appropriate and when it will result in a loss of near-term recruitment of LWD that may create fish habitat." Beechie found that

> "The models predict that thinning of the riparian forest does not increase recruitment of pool-forming LWD where the trees are already large enough to form pools in the adjacent channel and that thinning reduces the availability of adequately sized wood. Thinning increases LWD recruitment where trees are too

small to form pools and, because of reduced competition, trees more rapidly attain pool-forming size"

To evaluate effects of various stand treatments on LWD recruitment, we modeled treatments and controls for a range of initial mean diameters and channel widths. We modeled Douglas-fir stands of four different initial quadratic mean diameters (initial DBHq = 12, 23, 38, and 51 cm). For each initial DBHq we applied control (unthinned) and treatment (thinned) scenarios to channels 5, 10, 15, 20, 25, and 30 m wide. We applied three different levels of thinning for each combination of channel width and initial DBHq (Table 2) and selected the treatment providing the most LWD over the next 100 years to compare with the unthinned scenario. Large woody debris recruitment for the thinning treatment was then compared with the unthinned control, and the result was recorded as negative (thinning produced less LWD than control), positive (thinning produced more LWD than control), or neutral. … We estimated the proportion of riparian forests having trees that are large enough to create pools, using three thresholds for pool-forming diameter of LWD (*D*pf = 10, 30, and 38 cm) corresponding to channel widths of 4, 12, and 15 m. … When we compared thinned to unthinned scenarios for a range of initial stand diameters and channel widths in Douglas-fir stands, we found that thinning increases cumulative LWD abundance when the DBHq of the stand is about 10 cm less than the minimum pool-forming diameter for the adjacent channel (Figure 6). … **The models predict that thinning of the riparian forest will not increase recruitment of pool-forming LWD on any channel less than 15 or 20 m wide.** Because relatively small debris can form pools in these channels and the trees reach poolforming size rapidly, thinning simply reduces the availability of adequately sized wood. Thinning may increase LWD recruitment to large channels because thinning reduces competition among trees and increases growth rates.



Beechie, T., G. Pess, P. Kennard, R. Bilby, and S. Bolton. 2000. Modeling Recovery Rates and Pathways for Woody Debris Recruitment in Northwestern Washington Streams. North American Journal of Fisheries Management. 20:436–452. https://afspubs.onlinelibrary.wiley.com/doi/abs/10.1577/1548-8675%282000%29020%3C0436%3AMRRAPF%3E2.3.CO%3B2.

Don't make the mistake of assuming that thinning is always consistent with the ACS because it helps grow large trees faster. First, thinning captures mortality and actually delays recruitment of large wood. Second, the agencies often misinterpret the Northwest Forest Plan ROD by confusing accelerated attainment of ACS objectives with ACS compliance. The NWFP ROD actually says that silviculture in riparian reserves is generally prohibited, and allowed only "if needed to attain" ACS objectives, not (as implied by the EA) if needed to "accelerate" ACS objectives. This is a common "group-think" misinterpretation of the ACS. The appropriate evaluation is to ask "will ACS objectives eventually be met without intervention?" If the answer is "yes," then silviculture is technically not allowed. Confusion may stem from the fact that the ACS also has a "do not retard" standard, but this is separate from the "if needed" test, and is itself a criteria to limit active management, not an excuse to reject the no action alternative. The "do not retard" standard cannot be interpreted to <u>require</u> active management whenever and wherever it would accelerate attainment of ACS objectives. That would lead to all kinds of problems, such as cumulative impacts, unintended consequences, and sacrificing some aquatic objectives in the pursuit of others. Oregon Wild is not absolutely opposed to treatment of riparian reserves but we want to avoid the slippery slope of just assuming "it's all good" without careful analysis and justification.

Under the NWFP: "The risk has been shifted under the Aquatic Conservation Strategy because each project must meet the maintenance and restoration criteria by maintaining or restoring the physical and biological processes required by riparian-dependent resources within a watershed." 1994 FSEIS p 3&4 – 69. Clearly, this requires the FS to show there is a need for intervention.

The NEPA analysis must reflect accurate scientific analysis such as that presented by the NMFS:

> A strategy of thinning to accelerate the development of a few healthy, large-diameter trees does not translate into more large wood in streams. … Overall, an unthinned stand will produce a higher number of both live and dead trees across a range of diameter classes and will produce far more dead wood over a much longer time frame relative to a heavily thinned stand. … The tradeoff of getting a few more large standing live trees sooner at the expense of a continuous supply of both large and small trees over the long term period always needs to be considered.
>
> …
>
> Numerous studies suggest that all organic matter, including the various sizes of wood, has functional value in streams (and riparian areas), and that these functions vary with size (Bilby and Likens 1980, Beechie and Sibley 1997, Gurnell et al. 2002). Of particular note is that large wood that cannot singly form pools will form pools in combination with other pieces of wood and other obstructions by forming "wood jams." Wood jams are common feature of natural streams of all sizes, and contain a distribution of wood sizes that, in concert, can form a semipermeable structure that can retain sediment (such as that used for spawning), nutrients and organic material, as well as form pools upstream and downstream of the obstruction (Bilby and Likens 1980, Bilby 1981, Bilby and Ward 1991).
>
> …

Reid and Hilton (1998) found that 30% of the trees falling into streams were triggered by trees falling from farther upslope. More research on this subject is needed, but it speaks to the indirect importance of trees in the outer portion of the riparian zone for wood delivery to streams.

…

Managing for large instream wood also results in the creation of large riparian wood and large snags, both of which are beneficial to numerous species other than salmonids, such as cavity nesting birds and certain amphibians.

…

[NMFS's Northwest Fisheries Science Center's quantitative analysis of the East Alsea Landscape Management Project, Pollock, M.M.] (Appendix 1) suggests that typical riparian thinning regimes will result in a mature forest with fewer large diameter trees, fewer large diameter snags, and fewer large diameter pieces of wood on the riparian forest floor and in streams, relative to natural conditions. This largely stems from excessive thinning. In regards to stream habitat, many of the negative impacts created by the existing riparian thinning proposals could be largely avoided with wider no-thin buffers (e.g., see Appendix 1) and removing far fewer trees during thinning operations.

…

The exclusive use of the 24-inch/50-ft wood indicator by the USFS and BLM does not satisfy the requirement in 50 CFR 402.14 that both the action agency and NMFS use the best available scientific and commercial data, or (2) the requirement in 50 CFR 402.02 that the action agencies and NMFS analyze all effects of the proposed action … which would mean consideration of a broader range of sizes of wood.

…

Recommendations

- The USFS and BLM should include all sizes of wood in describing environmental baseline conditions and in analyzing the effects of its proposed actions, not just pieces of wood that are greater than 24 inches in diameter and greater than 50 ft in length.
- The USFS and BLM should adjust their tree diameter targets based on stream size. Databased curves are available for both functional-sized and key pieces of wood (e.g., Fox and Bolton 2007).
- The USFS and BLM should leave more thinned trees on the ground in riparian areas, particularly close to streams, on floodplains, and on steep sideslopes where some trees are likely to slide down into streams, than are required to meet wildlife needs.
- In order to better portray environmental baseline conditions and to understand the likely effects of thinning proposals, the USFS and BLM should develop stand data separately for riparian and upland forests.

- In order to insure adequate recruitment of conifer wood to streams, the USFS and BLM should measure riparian buffers from the outer edge of streamside hardwood forests, where present.
- The USFS and BLM should work with NMFS to develop reliable methods of wood recruitment modeling and procedures that could be used routinely in ESA section 7 consultations to promote decisions based on data instead of concepts and generalizations from the scientific literature.

  …

Kratz, K.W. 2010. Response to April 1, 2010, Request by the Interagency Coordinating Subgroup for Position Paper to Support the February 23, 2010 Elevation of Two Northwest Forest Plan Issues to the Regional Executives. NOAA/NMFS July 23, 2010.

From Appendix 1 of the NMFS Memo quoted above:

> Thinning did accelerate the development of large diameter trees by about 20 years relative to the unthinned stand, but this benefit was short-lived because the higher number of trees in the unthinned stand allowed it to produce far more large diameter live and dead trees in the long run. A century after thinning, a 60 foot no cut buffer between a stream and the thinned forest provided 56% of the stream wood relative to an unthinned stand, while a 150 foot no cut buffer provided 91% of the stream wood relative to an unthinned stand. Our results suggest that the thinning regimes proposed by the Siuslaw National Forest will delay the development of key structural elements of forest and stream habitat by more than a century. The delay in stream habitat recovery can be minimized by creating a no cut buffer of 150 feet or more in width between streams and any forest thinning operations. Some of the delay in forest structure development caused by thinning might also be reduced by removing far fewer trees.
>
> …
>
> [Analysis based on a 37 year old Douglas-fir stand thinned to 55 TPA]
>
> **MORTALITY TREES — …** Trees in the thinned stand increased diameter rapidly, and in 20 years following thinning, had a greater number of > 18" diameter trees relative to the unthinned stand. However, from 30-100 years after thinning, the unthinned stand had more > 18" dbh trees, and by year 135 had over 5 [dead]TPA, compared to just 0.6 [dead]TPA in the thinned stand. Neither stand produced many trees > 24" dbh by year 135. The thinned stand produced slightly more > 24" [dead]TPA for each decade following thinning through year 115 (e.g. 0.5 v. 0.4 > 24" [dead]TPA at year 115), but by year 135 the unthinned stand was producing more large trees (0.7 v. 0.5 > 24" [dead]TPA). Further, at year 135, the trend of the > 24" dbh [dead]TPA in the unthinned stand was increasing, while in the thinned stand the > 24" dbh class had leveled off, suggesting that beyond year 135 the unthinned stand would continue to produce a greater number of large dead trees. … Comparison of the thinned and unthinned mortality curves graphically illustrates that thinning greatly reduced riparian tree mortality and thus reduces the potential

for snags, forest wood and instream wood. It is noteworthy that the proposed thinning reduces tree mortality during the period of stand development when tree mortality and thus snag and wood loading, is at its' highest. For example, for an unthinned stand at age 135, about 50 years past peak mortality, will still be producing about 10 trees per acre per decade. In contrast, a thinned stand will have about 0.5 [dead]TPA for the same time period. … The 30 foot no cut buffer, which approximates what the Siuslaw National Forest proposed …, would provide less than 30% of the in stream wood relative to a 250 foot no cut buffer at year 135.

…

[T]he vast majority of stands likely grew at densities higher than 55 TPA, and there is no evidence that such low density conifer stands were found in riparian environments. For example, Poage and Tappeiner (2002) estimated growth rates from the stumps of 505 large diameter Douglas-fir on upland sites and concluded that at age 50, about 75% of them were growing at tree densities higher than 53 TPA Since riparian forests generally are more productive and have higher tree densities than upland forests (Pollock et al., in review), we expect that the occurrence of young, low density riparian stands would be even less than in upland environments.

…

Even if the uncut buffer is 150 feet wide and the thinning is confined to the outer 100 feet of the Riparian Reserve, a century after thinning, the recovery rate of instream wood will still be lowered by about 10%. This is a significant decrease for a program that is ostensibly designed to improve riparian function. We conclude that the thinning of riparian forests to the degree contemplated in the Siuslaw National Forest will delay creation of late successional forest structure by more than a century. … Thinning treatments may exist which will accelerate the

development of late successional forest structure in Riparian Reserves and that are consistent with the goals of the Northwest Forest Plan Aquatic Conservation Strategy, but they most assuredly will involve the removal of far fewer trees. … Future research should more comprehensively assess the conditions under which thinning accelerates or retards the development of key structural attributes of riparian forests.

Michael M. Pollock and co-authors to be determined. [*in review 2010*] Effects of Riparian Thinning on Development of Late-Successional Forest Structure in the Alsea Watershed, Oregon, USA. NOAA Fisheries, Northwest Fisheries Science Center, Seattle, Washington.

Riparian reserves do a good job of providing connectivity within watersheds, but not between watersheds. Consider extending the riparian buffers to provide headwater linkages across ridgetops in order to provide interbasin connectivity for amphibians and other species. Science Findings, Issue 120 (February 2010) Linked in: Connecting riparian areas to support forest biodiversity, based on science by Kelly Burnett and Deanna Olson. http://www.fs.usda.gov/pnw/sciencef/scifi120.pdf.

Recommendations related to thinning in riparian reserves must be reconsidered in light of new information showing that logging does NOT increase the recruitment of functional wood, and the minor increase in very large live trees comes at great cost in terms of a significant reduction in recruitment of functional wood in medium and large size classes (smaller than “very large.”)

> [T]here are long-term habitat tradeoffs associated with different thinning intensities. Species that utilize large diameter live trees will benefit most from heavy thinning, whereas species that utilize large diameter deadwood will benefit most from light or no thinning. Because far more vertebrate species utilize large deadwood rather than large live trees, allowing riparian forests to naturally develop may result in the most rapid and sustained development of structural features important to most terrestrial and aquatic vertebrates.
>
> …
>
> Over the course of the simulation, the most intensively thinned stands produced a third as many mortality trees >30 cm (145vs. 461) and half as many mortality trees >50 cm (127vs. 250) relative to the unthinned stands (Figures 5a and 5b). In contrast, the heaviest thin produced slightly more mortality trees >100 cm, a cumulative average production of 42 mortality trees >100 cm for the heaviest thin, relative to 37 mortality trees >100 cm for the unthinned stands (Figure 5a).
>
> Relative to the no thin scenario, thinning reduced the mortality peak of boles in the 30-50 cm and 50-100 cm size classes that occurred 10-60 years posttreatment in the passively managed stands, with the reduction in mortality proportional to the intensity of the thin (Figure 4).
>
> In summary, thinning minimally increased the production of large diameter deadwood >100 cm, while causing substantial losses in deadwood 30- 50 cm and 50-100 cm diameter, with no acceleration in the production of these size classes (Figure 5). This suggests that the thinning regimes we examined are not an effective approach for increasing the abundance of ecologically functional deadwood. The no thin scenario produced substantially more deadwood across a wide range of sizes useful to a variety of vertebrate species (Table 1).
>
> …
>
> Examination of Table 1 suggests that deadwood >30 cm diameter creates habitat that is used by many species, but that deadwood >50 cm provides even more habitat benefits, and that maximizing the production of deadwood>50 cm diameter may be a suitable management target if the goal is to benefit the most vertebrates. There were far fewer species that preferred live trees or deadwood >100 cm, , but larger diameter dead trees will take longer to decompose, extending the length of time that habitat benefits are provided.

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. This paper provides a nice graphic showing mortality recruitment per decade under various thinning scenarios and showing that no-treatment performs best:

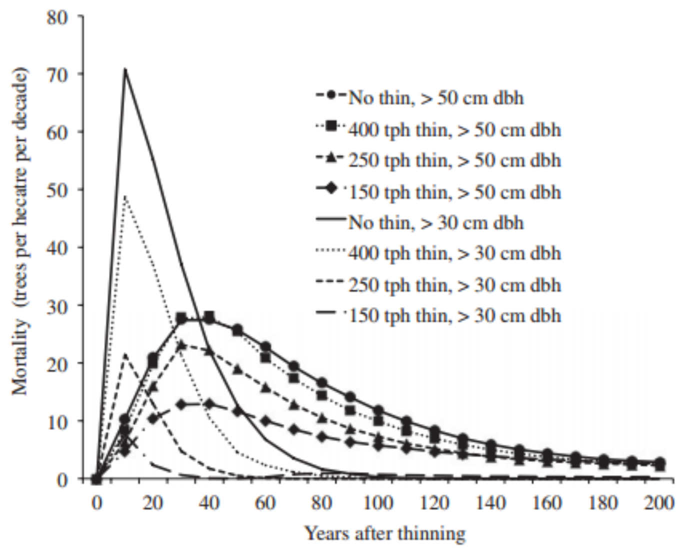


FIGURE 4. Graph Showing Projected Average Mortality Rates (number of trees dying per decade) of Trees >30 cm Diameter and Trees >50 cm Diameter, for each of the Four Simulated Treatments. The 10-year mortality rate of trees >100 cm diameter is low for all treatments throughout the length of the simulation and is not shown in the figure.

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

> … In general, there is very little published science about the effects of thinning on dead wood recruitment and virtually none on thinning effects on wood recruitment in riparian zones. We conducted some limited simulation modeling to illustrate some of the relationships between thinning and dead wood recruitment. The simulations (and comparison of models) were not comprehensive or a rigorous analysis of thinning effects and should be viewed as preliminary. Below we provide 15 key points from our efforts:
>
> Key Points
>
> 1. Thinning is most beneficial in dense young stands. Existing literature and stand development theory suggest that the greatest potential ecological benefits of thinning to accelerate the development of older forest structure (e.g. large trees, large dead trees, spatial structural and compositional heterogeneity, etc.) comes in dense uniform plantations <u>less than 80 years and especially less than 50 years old</u>. The benefits of thinning for older forest ecological objectives are less clear in stands

over 80 years of age. Hence, our report focused primarily on plantations less than 50 years of age.

2. Results may not be applicable to all stand conditions. For this synthesis, many of our conclusions were based on modeling the effects of thinning 30 to 40 year old Douglas-fir plantation stands that range in density from 200 to 270 trees per acre (tpa). We consider such stands moderately dense, as young plantation stand densities range from less than 100 to greater than 450 tpa. In terms of dead wood production, higher density stands are likely to see more benefits from thinning, and lower density stands less benefits. [Portions of this project are probably less dense and less in need of thinning, compared to the very dense, very young stands addressed in this report.]

3. Accurate assessments of thinning effects requires site-specific information. The effects of thinning regimes on dead wood creation and recruitment (relative to no-thinning) will depend on many factors including initial stand conditions, particularly stand density, and thinning prescription—it is difficult to generalize about the effects of thinning on dead wood without specifying the particulars of the management regime and stand conditions. [The NEPA analysis needs to provide a site-specific, quantitative analysis to show that silviculture is needed to meet ACS objectives in these riparian reserves.]

4. Conventional [i.e., commercial] thinning generally produces fewer large dead trees. Thinning with removal of trees (conventional thinning) will generally produce fewer large dead trees across a range of sizes over the several decades following thinning and the life-time of the stand relative to equivalent stands that are not thinned. Generally, recruitment of dead wood to streams would likewise be reduced in conventionally thinned stands relative to unthinned stands. [This result is highly relevant to the proposed logging to meet ACS objectives.]

5. Conventional [i.e., commercial] thinning can accelerate the development of very large diameter trees. In stands that are conventionally thinned, the appearance of very large diameter dead trees (greater than 40") may be accelerated by 1 to 20 years relative to unthinned plantations, depending on thinning intensity and initial stand conditions. Trees of such sizes typically begin to appear 5 to 10 decades after thinning 30 to 40 year old stands. [Note: The appearance of a few "very large" trees in the decades after thinning comes with the loss of a much larger volume of "large functional" trees that were exported from the site before they were allowed to grow and recruit to the stream. Any small gains in *very large* trees, comes at the expense of large numbers of *large* trees, so net benefits to ACS objectives are highly unlikely.]

6. Nonconventional [i.e., non-commercial] thinning can substantially accelerate dead wood production. Stands thinned with prescriptions that leave some or all of the dead wood may more rapidly produce both large diameter dead trees in the short-term and very large diameter dead trees (especially greater than 40") in the long-term, relative to unthinned stands. Instream wood placement gets wood into

streams much sooner than by natural recruitment, and can offset negative effects of thinning on dead wood production.

7. Assessments of thinning effects may vary depending on the forest growth model. The previous statements are supported by three stand simulation models (FVS, ORGANON, and ZELIG). However, the magnitude and timing of effects of thinning on dead wood recruitment and stand growth varied among models.

8. Dead wood in streams comes from multiple sources. Dead wood in streams is primarily recruited through near-stream inputs (e.g. tree mortality and bank erosion) and landslides and debris flows. All types of recruitment are important and the relative importance varies with site and stream characteristics.

9. 95% of near-stream wood inputs come from within 82 to 148 feet of a stream. The distance of near-stream inputs to streams varies with forest conditions and geomorphology. Empirical studies indicate that 95% of total instream wood (from near-stream sources) comes from distances of 82 to 148 feet. Shorter distances occur in young, shorter stands and longer distances occur in older and taller stands. [Don't forget: riparian reserves were established to serve both aquatic and terrestrial objectives, and many terrestrial wildlife depend on abundant snags and dead wood.)

10. Thinning can increase the amount of pool-forming wood under certain conditions. Thinning can increase the amount of pool-forming wood only when the thinned trees are smaller in diameter than the average diameter of pool-forming wood (which varies with stream size). [Smaller wood is functional in smaller streams, which means that thinning any commercial-sized trees near small streams is unlikely to advance ACS objectives.]

11. The function of instream wood varies with size and location. Large instream wood can serve as stable “key” pieces that create instream obstructions and form wood jams by racking up numerous smaller pieces of wood that are mobile during high flows. Such wood jams typically consist of a wide range of piece sizes and provide multiple ecological functions that vary with stream size and gradient.

12. Effects of thinning on instream wood needs to be placed in a watershed context. Assessing the relative effect of riparian thinning on instream wood loads at a site and over the long term requires an estimation of the likely wood recruitment that will occur from the opposite bank, from upstream transport, and the rate of decay and downstream transport of wood from the site.

13. The ecological effects of thinning needs to be placed in a watershed context. Watershed-scale perspectives are needed to restore streams and riparian vegetation. The ecological effects of thinning on instream habitat will vary depending upon location in the stream network. Riparian management practices can be varied to match the ecological functions of streams.

14. Variation in thinning is essential (i.e. don't do the same thing everywhere). Variation in thinning prescriptions will produce more variable forest and wood recruitment conditions, which may more closely mimic natural forest conditions. Using a variety of treatments is also consistent with the tenets of adaptive management in situations where the outcomes of treatments are uncertain.

15. Healthy, diverse forests contain many dead trees. Numerous terrestrial forest species require large dead or dying trees as essential habitat. Some directly, others indirectly; to support the food web within which they exist. Abundant large snags and large down wood on the forest floor are common features of natural forests and essential for the maintenance of biological diversity.

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. https://web.archive.org/web/20220120055722/http://www.mediate.com/DSConsulting/docs/FINAL%20wood%20recruitment%20document.pdf.

The statement in #5 that "thinning can accelerate development of very large diameter trees" should be kept in proper perspective:

- The alleged gain in very large trees is very minor, compared to not logging;
- The alleged gain in very large trees is overwhelmed by the significant loss of functional wood in smaller size classes (including "large" wood), and even "medium " and "small" wood that serves vital functions in small streams that are typical in most projects; and
- The alleged gain in very large trees is in the distant future and more speculative; while the loss of smaller functional wood is in the near-term and more certain. Predicting future mortality in thinned stands is difficult. If the trees do not die and fall down there is no benefit in terms of down wood.

The apparent dissonance between the fact that thinning reduces wood recruitment (#4), but also has the potential to increase production of the very large trees (#5) might be resolved by looking to the right mix of different treatments as suggested in #14 – with some riparian reaches left unthinned to provide for recruitment of large amounts of wood in a range of sizes, some areas thinned non-commercially, and some riparian patches thinned to produce those very large trees. Also, the statement in #10 that thinning can increase pool-forming wood depending on stream size, needs more explanation. Most riparian thinning occurs near small streams where small wood can be pool-forming.

Thinning to produce very large wood in the distant future at the expense of more abundant wood recruited over time is not advised. The SAT Report, upon which the ACS is founded, was clear that continuous input of wood is important. "Riparian zones along larger channels need protection to limit bank erosion due to trampling, grazing, and compaction, to ensure an adequate and continuous supply of large wood to channels …" 1993 SAT Report. Ch 5, p 455. Commercial removal of pool forming wood creates a gap in the wood recruitment process and is inconsistent with the goal of continuous wood recruitment.

Analyses by National Marine Fisheries Service experts are consistently showing that thinning riparian reserves is adverse to dead wood recruitment, so, rather than accelerating desired riparian habitat conditions, it should be accurately seen as an adverse effect that must be limited and mitigated. A recent analysis done for the Coos Bay BLM's Lone Pine Project says:

> The Bureau of Land Management (BLM) proposes to harvest timber on a series of tracts (1832 acres) in the Coquille watershed in southwestern Oregon details of which are described in the Lone Pine Biological Assessment (LPBA) (BLM 2013). These lands are managed under the Northwest Forest Plan …
>
> The BLM (2013) proposes to thin stands estimated to be between 30-80 years of age …
>
> In this analysis, I utilized data provided by BLM (Appendix A) to assess the effects of the proposed RT and CT thinning treatments on the development of late-successional forest characteristics, with an emphasis on large dead wood production, particularly the production of large dead wood that can fall into streams. The importance of dead wood as habitat components of late-successional forest and stream ecosystems is widely recognized …
>
> The proposed BLM harvest units … are relatively diverse forests, with a mix of conifer and deciduous species. Douglas-fir is the most common species, followed by bigleaf maple, red alder and grand fir.
>
> I was able to consolidate the treatments into two basic types, a commercial thin (CT) and a riparian thin (RT). I also added an additional simulation, which was a no thin or natural thin option (NT), so as to be able to compare the effect of the proposed artificial thinning treatments against what would happen if the stands were allowed to naturally self-thin (i.e. a no treatment control).
>
> Live tree and mortality outputs from the FVS simulations were tabulated and categorized to compare large live tree and dead wood production under the CT, RT sand NT scenarios for trees 12-24' and trees > 24" in diameter. The mortality outputs were also used to estimate instream dead wood production over the 50 year period …
>
> RESULTS
>
> Both the RT and CT treatments substantially reduced the number of large diameter dead trees relative to the NT treatment (Table 2). For example, the RT and CT treatments reduced production of dead trees > 24" diameter by 52% and 67%, respectively, and reduced production of 12-24" diameter dead trees by 69% and 83%, respectively. The thinning treatments did not increase the abundance of large diameter live trees. Relative to the NT treatment, large live trees > 24" diameter were reduced by 6% and 17% for the RT and CT treatments, respectively. Fifty years post-treatment, the two thinning regimes also reduced tree species diversity and structural diversity (Table 2). …

Instream dead wood production is directly related to the dead wood production in the forest and thus followed a similar trend (Table 3). Relative to the NT treatment, a 30 ft no-cut buffer followed by the RT or CT treatment for the remainder of the SPTH distance, reduced the abundance of instream wood by an average of 38% and 47%, respectively. For a 50 foot no-cut buffer, under similar scenarios, instream wood abundance was reduced by 24% and 31% for the RT and CT treatments, respectively. …

DISCUSSION

The results from this analysis support a growing body of evidence that indicates riparian thinning, as practiced on federal lands managed under Northwest Forest Plan, delays the recovery of late-successional structure in riparian forests and delays the recovery of instream habitat. Such restoration thinning, as currently practiced, delays rather than accelerates ecosystem recovery, primarily because it reduced the production of large diameter dead wood and reduces the abundance of large diameter live trees, most of which will later die to become large dead wood at some point in the future if left uncut. The thinning regimes proposed in the [Lone Pine] BA are typical of thinning regimes on federal lands in Oregon …

Of the management options examined, the quickest path to recovery, consistent with the Northwest Forest Plan (USDA and USDI 1994, 2004), is to allow the stands to continue to develop naturally. …

In general, thinning is most likely to accelerate the recovery of structurally complex forests when applied to dense stands of small diameter trees of approximately the same height, and mostly of the same species (e.g. Douglas fir). Diverse stands that have species with different shade tolerances, growth forms and water needs and stands that may be less diverse but have a wide distribution of tree sizes and have already differentiated into competitive dominants and subordinants, are not good candidates for restoration thinning.

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.

The agencies often manage roadside hazards by felling hazard trees within “striking distance” of roads, e.g., 1.5 times the height of the trees. The agencies should apply the same logic to protecting riparian trees. If the agency is worried about trees hitting roads from 1.5 tree heights away, stream buffers also should be equal to 1.5 tree heights, so that those trees can contribute to instream wood values. If trees within 1.5 tree heights pose a meaningful safety hazard, they also contribute meaningfully to instream wood.

See also, Frissell, Christopher A., Baker, Rowan. J., DellaSala, Dominick A., Hughes, Robert M., Karr, James R., McCullough, Dale A., Nawa, Richard. K., Rhodes, Jon, Scurlock, Mary C., Wissmar, Robert C. 2014. CONSERVATION OF AQUATIC AND FISHERY RESOURCES IN THE

PACIFIC NORTHWEST: Implications of New Science for the Aquatic Conservation Strategy of the Northwest Forest Plan, FINAL REPORT, July 30, 2014. https://web.archive.org/web/20150203193501/http://coastrange.org/documents/ACS-Finalreport-44pp-0808.pdf. This report summarizes the available information and concludes that non-commercial thinning in very young stands might advance aquatic objectives, but that commercial logging is unlikely to provide net benefits due to wood removal, road requirements, soil impacts, etc.

The project involves 7 acres of tree tipping and log placement for aquatic restoration. We want to note that tree tipping by itself (without logging) might provide some aquatic restoration benefits by accelerating recruitment of wood and creating growing space for residual trees, but tree tipping as mitigation for the adverse effects of logging is not well supported. Chris Frissel says:

> Benda et al. (2016) recently proposed "tree tipping" as a means of mitigating the effects of thinning on depletion of large wood recruitment. This idea rests on the premise that setting aside a portion of logged trees within the riparian area for direct felling into stream channels can offset the medium and long-term reduction of wood recruitment to streams when natural mortality is reduced by riparian forest thinning, by increasing the directional efficiency and speed of debris delivery. While Benda et al.'s successional modeling of wood recruitment effects through a century of post-treatment forest succession produces results similar to Pollock and Beechie (2014) with regard to thinning's depletion of woody debris sources to streams, we find the utility of this model in justifying management practices is limited due to its simplification and non-specificity of key parameters known to govern natural wood dynamics in riparian areas. For example, the model appears to represent only riparian areas dominated by stands of high-density post-clearcut Douglas-fir, but this is not a prevalent condition in many riparian areas in the Pacific Northwest, where even within extensive second-growth forest plantations, diverse species of conifer and hardwood trees naturally regenerate within most riparian areas.
>
> Moreover, a variety of natural gap-creating disturbance processes (Everest & Reeves 2007), including windthrow, flood, fluvial erosion, slope erosion and deposition, herbivory, and pathogens often operate at substantially greater frequency in riparian areas than in adjacent uplands, but this is not acknowledged by Benda et al., nor apparently represented in their model. Further, Benda et al.'s modeling does not appear to account for accelerated windthrow from increased wind sheer stress in riparian areas that is known to follow logging of adjacent uplands (Liquori 2006, MacDonald et al. 2003, Huggard et al. 1999). Episodes of windthrow following thinning commonly result in mature live tree and standing snag densities and shade much lower than pre-disturbance conditions, and much lower than predicted by

successional models that do not account for change in windthrow vulnerability (C.A. Frissell and M. Pollock, unpublished data). Moreover post-logging windthrow in riparian areas either replaces, or greatly magnifies the desired effect of tree tipping—that is, increasing wood recruitment in the near term by reducing the supply of large wood to support recruitment to streams in future decades (Liquori 2006).

Benda et al. justify thinning in riparian areas on the basis of increasing the growth and eventual size of trees that are left uncut, but they do not detail the conditions under which tree size is ecologically critical; more smaller pieces that are well-distributed and recruit frequently may convey more habitat benefit over time to some species and functions than do fewer, far more scattered larger pieces, except in very large streams where channel width exceeds the length of tree boles (Pollock and Beechie 2014, Collins et al. 2002) Consideration of windthrow effects likely renders tree tipping redundant or undesirable—for example, beyond the depletion effect on future wood recruitment of hastened tree mortality, the cumulative shade losses associated with thinning, tree tipping, and subsequent windthrow (MacDonald et al. 2003, Burton et al. 2016) are likely to often produce stream warming that is harmful to coldwater fishes, amphibians, and other biota.

Another major concern is feasibility of implementation. According to the findings of Benda et al., tree tipping could only reach the ideal levels of sustainable debris recruitment sufficient to offset the wood-depleting effects of thinning if an unlogged buffer of 10-30 m is left along streams (to support future natural wood recruitment to the stream), and thinning and tree tipping are implemented along both sides of the stream. This means extensive mechanized equipment operations alongside both streambanks, in near-stream areas that often include highly erodible soils and erosion-prone slopes. Skid trails and soil disturbance by logging equipment within about 60-220 m of steams can produce rilling or gully erosion that delivers sediment to channels (Rashin et al. 2006, Litschert and MacDonald 2009). Because much logging within the Pacific Northwest occurs in rainfall-dominated rather than snow-dominated areas, there is limited opportunity to mitigate erosion by operating logging equipment over snow and frozen ground. Therefore the primary mitigation measure for reducing sediment delivery to streams from logging disturbances is to exclude ground-based equipment operations within a zone from 60-200 m of surface waters. Such an exclusion greatly limits capability to access riparian forests for aggressive management measures like tree tipping. Finally, directional felling of trees from an outer riparian zone through an unlogged inner riparian stand of 10-30 m width is a difficult proposition. Many felled trees are certain to "hang up" on standing trees under this condition, and are unlikely to reach the intended stream channel. As a result many more trees would have to be cut than acknowledged in the Benda et al. analysis to attain the in-channel tree tipping targets specified as necessary to mitigate thinning-related debris losses—causing further ancillary harms as outlined above.

Conclusion

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. References are available at https://www.dropbox.com/sh/ctippifimdczyk6/AACp2fJYnsIjRuyFh96ocie3a?dl=0 or upon request.

Please keep us informed of all subsequent NEPA documents and decisions for this project. Thank you for considering our input and for your time and effort spent developing this project and engaging with the public.

Sincerely,

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