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https://cara.fs2c.usda.gov/Public/CommentInput?Project=64745

RE: Comments on Northwest Forest Plan Amendment Draft Environmental Impact Statement

Dear Regional Foresters Buchanan and Eberlien and the Northwest Forest Plan Amendment Team,

On behalf of Bird Alliance of Oregon, Cascadia Wildlands, Center for Biological Diversity, Environmental Protection Information Center, Friends of the Shasta River, Klamath Forest Alliance, Mount Shasta Bioregional Ecology Center, Northcoast Environmental Center, Safe Alternatives for our Forest Environment, and Western Watersheds Project, the Western Environmental Law Center submits these comments on the Draft Environmental Impact Statement (DEIS) for the U.S. Forest Service's (Forest Service) proposed amendments to the Northwest Forest Plan (NWFP), a landmark ecosystem management framework established in 1994 to balance conservation,

ecological integrity, and sustainable use across 24 million acres of federal lands in the Pacific Northwest. For over three decades, the NWFP has served as a global model for science-based forest management, achieving significant progress in protecting late-successional and old-growth forests, conserving imperiled species such as the northern spotted owl and marbled murrelet, and enhancing watershed resilience. Despite these successes, the original plan was imperfect, most notably in its failure to engage Tribes in collaborative decisionmaking—a foundational flaw that sidelined Indigenous perspectives and stewardship.

The DEIS takes meaningful steps to address this historical wrong, proposing Tribal inclusion through plan components that respect sovereignty, honor treaty rights, and integrate Indigenous Knowledge into forest management. We commend the Forest Service for this effort to rectify past exclusion and foster co-stewardship and strongly encourage the Forest Service to adopt all Tribal inclusion components presented in each of the DEIS action alternatives, as further informed by public comment, particularly comments submitted by Tribes and Tribal members.

The DEIS includes significant analytical mistakes and omissions elsewhere, though, stemming from a flawed process and analysis not adequately grounded in science. The DEIS falters with its emphasis on expanded logging and active management, a fundamentally flawed carbon storage analysis, a complete lack of analysis on impacts to threatened and endangered wildlife and their habitats—instead deferring impermissibly to future Endangered Species Act consultations—and inadequate consideration of cumulative effects. These shortcomings undermine the agency's obligations under the National Forest Management Act, the National Environmental Policy Act, and the Endangered Species Act. The Forest Service has the opportunity to refine this proposal and its analysis into a plan that honors the NWFP's legacy and serves both ecological and community needs.

I. LEGAL FRAMEWORK

A. The National Forest Management Act & Forest Planning Rules

The National Forest Management Act (NFMA), 16 U.S.C. § 1604, and implementing regulations, 36 C.F.R § 219 *et seq*. (also referred to as the 2012 Forest Planning Rule), require the development of land and resource management plans for all units of the National Forest System (NFS). These plans guide management of NFS lands to ensure National Forests are:

> ecologically sustainable and contribute to social and economic sustainability; consist of ecosystems and watersheds with ecological integrity and diverse plant and animal communities; and have the capacity to provide people and communities with ecosystem services and multiple uses that provide a range of social, economic, and ecological benefits for the

> present and into the future. These benefits include clean air and water; habitat for fish, wildlife, and plant communities; and opportunities for recreational, spiritual, educational, and cultural benefits.

36 C.F.R. § 219.1(c). Forest Plans set the stage for ongoing management of our forests, and all actions and projects on the forest must be consistent with the plan guidance and directives. 36 C.F.R. § 219.15.

The plan must provide for sustainability in the ecological context as follows: (1) *Ecosystem Integrity*—by providing components "to maintain or restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds," including components "to maintain or restore structure, function, composition, and connectivity," 36 C.F.R. § 219.8(a)(1); (2) *Water*—by providing components to maintain or restore water quality and water resources, including guidance to prevent or mitigate detrimental changes in water quantity, quality, and availability, 36 C.F.R . § 219.8(a)(2); and (3) *Riparian Areas*—by providing plan components to maintain or restore function, composition, and connectivity of riparian areas, including components that ensure no management practices will cause detrimental changes in water temperature or chemical composition, blockages of water courses, or deposits of sediment that would adversely affect water conditions or fish habitat in riparian management zones, 36 C.F.R. § 219.8(a)(3). Forest Plans must also include components to guide the plan area's contribution to social and economic sustainability by considering social, cultural, and economic conditions; sustainable recreation; multiple uses that contribute to local, regional, and national economies in a sustainable manner; ecosystem services; cultural and historic resources and uses; and opportunities to connect people with nature. 36 C.F.R. § 219.8(b).

Additionally, Forest Plans must include components on both ecosystem-wide and species-specific levels that provide for the diversity of plant and animal communities within the plan area. 36 C.F.R. § 219.9. These components must include standards or guidelines to maintain or restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds in the plan area, 36 C.F.R. § 219.9(a)(1); and components that maintain or restore the diversity of ecosystems and habitat types throughout the plan area, 36 C.F.R. § 219.9(a)(2). The plan must also contain additional, species-specific components to ensure contribution to the recovery of federally listed threatened and endangered species, ensure conservation of proposed and candidate species, and ensure maintenance of viable populations of species of conservation concern, as necessary. 36 C.F.R. § 219.9(b)(1).

Importantly, the planning process must incorporate "the best available scientific information." 36 C.F.R.§ 219.3. And, a forest plan amendment "requires preparation of an environmental impact statement" under the mandates of the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 *et seq*.

B. The National Environmental Policy Act

The National Environmental Policy Act (NEPA), 42 U.S.C. §§ 4321–4370m, is the bedrock federal statute ensuring government agencies disclose and examine environmental and related social and economic consequences before making decisions that may significantly affect the human environment. In NEPA, Congress stipulated that federal agencies must further the statute's purpose by "all practicable means," including preparing a detailed Environmental Impact Statement for all major federal actions that may significantly affect the environment. 42 U.S.C. §§ 4331(a), (b), 4332(C). In other words, NEPA requires the consideration of environmental concerns be "integrated into the very process of agency decision-making." *Andrus v. Sierra Club*, 442 U.S. 347, 350 (1979).

NEPA's twin aims are to (1) foster environmentally informed decisionmaking within the federal government, and (2) facilitate full public participation in that process. *See, e.g., Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 349 (1999); *Baltimore Gas & Elec. Co. v. NRDC*, 462 U.S. 87, 97 (1983). As courts have acknowledged since shortly after NEPA was enacted in 1970 with broad bipartisan support, this requires agencies to take the requisite "hard look" at the environmental impacts of proposed actions. In *Calvert Cliffs' Coordinating Comm., Inc. v. U.S. Atomic Energy Comm'n*, 449 F.2d 1109, 1114 (D.C. Cir. 1971), decided shortly after NEPA's passage, the D.C. Circuit explained that NEPA "makes environmental protection a part of the mandate of every federal agency," thereby obligating agencies to meaningfully consider all potential environmental consequences before committing resources. *See also Natural Resources Defense Council v. Morton*, 458 F.2d 827, 834–36 (D.C. Cir. 1972) (discussing NEPA's goal of ensuring an informed decision); *Minnesota Pub. Interest Research Grp. v. Butz*, 498 F.2d 1314, 1320–22 (8th Cir. 1974) (reinforcing that agencies must evaluate "reasonably foreseeable" effects). Although NEPA does not dictate a particular outcome, its procedural mandates "ensure that the agency will not act on incomplete information, only to regret its decision after it is too late to correct." *Id*. at 349.

As such, courts have long recognized NEPA's requirement for agencies to consider all reasonably foreseeable direct, indirect, and cumulative effects, including those that may extend beyond the immediate lifespan of the project. *See Kleppe v. Sierra Club*, 427 U.S. 390, 410–14 (1976); *Hanly v. Kleindienst*, 471 F.2d 823, 830–31 (2d Cir. 1972). This includes evaluating cumulative effects. *See City of Rochester v. U.S. Postal Serv.*, 541 F.2d 967, 973–74 (2d Cir. 1976); 36 C.F.R. § 220.4(f); CEQ, *Considering Cumulative Effects Under the National Environmental Policy Act* (Jan. 1997) ("*Considering Cumulative Effects*").

NEPA's informed decisionmaking mandate also requires an agency to "[r]igorously explore and objectively evaluate all reasonable alternatives," including a no-action alternative. 42 U.S.C. 4332(2)(C)(iii). Detailed consideration of reasonable alternatives provides interested parties with an informed basis to question any initial predispositions and "to rethink the wisdom of the action." *Calvert Cliffs Coordinating Comm. v. U.S. Atomic Energy Comm'n*, 449 F.2d 1109, 1114 (D.C. Cir. 1971). The rigorous alternatives analysis

NEPA requires can only be carried out if any agency adequately discloses, considers, and analyzes an action's direct, indirect, and cumulative impacts, along with the impacts associated with all alternatives. 42 U.S.C. §§ 4332(2)(C)(i)–(v).

NEPA's success as a planning tool is contingent on effective public involvement. "[B]y requiring agencies to take a 'hard look' at how the choices before them affect the environment, and then to place their data and conclusions before the public, NEPA relies upon democratic processes to ensure … that the 'most intelligent, optimally beneficial decision will ultimately be made.'" *Or. Natural Desert Ass'n v. Bureau of Land Mgmt.*, 625 F.3d 1092, 1099–1100 (9th Cir. 2010) (citation omitted). "NEPA places upon federal agencies the obligation to consider every significant aspect of the environmental impact of a proposed action. It also ensures that an agency will inform the public that it has considered environmental concerns in its decision-making process." *Citizens Comm. to Save Our Canyons v. Krueger*, 513 F. 3d 1169, 1177–78 (10th Cir. 2008) (internal quotation and citations omitted); *see also Dep't of Transp. v. Public Citizen*, 541 U.S. 752, 768 (2004) ("The very purpose of public issuance of an environmental impact statement is to provide a springboard for public comment."). This public participation mandate ensures the agency is "fully informed" of public concerns and fosters accountability in decisionmaking. *Baltimore Gas, 462 U.S. at 97; see also Or. Natural Desert Ass'n*, 625 F.3d at 1121 n.24 (calling NEPA a "democratic decisionmaking tool"). Without robust public involvement, an agency's analysis fails to satisfy NEPA's essential promise of transparency and informed deliberation.

II. COMMENTS ON THE DEIS

A. Tribal Inclusion.

The 17 national forests under the NWFP encompass the ancestral homelands of over 80 federally recognized Tribes, where Indigenous peoples practiced sustainable stewardship for millennia. The forced removal of Tribes and suppression of their land management practices led to profound ecological and social consequences, including increased wildfire vulnerability, loss of biodiversity, and severe harm to Tribal communities.

The original 1994 NWFP failed to engage Tribes meaningfully, excluding Indigenous Knowledge and perspectives from its framework. The agency's DEIS presents an unprecedented effort to rectify this exclusion, incorporating Tribal leadership and Indigenous Knowledge into forest management. However, while a significant improvement, the proposed amendment must go further.

The Forest Service must adopt all Tribal inclusion components across the DEIS action alternatives and expand its analysis in the Final EIS to fully reflect the impacts on Tribes. In doing so, the Forest Service must especially account for all comments on the DEIS received from Tribes and Tribal organizations. The agency should build on the

groundbreaking work of the Federal Advisory Committee (FAC) and other Tribal engagement to produce an improved Final EIS and amended NWFP that centers Indigenous Knowledge and collaboration with Tribes in forest management policies, programs, and practices in perpetuity.

B. The Northwest Forest Plan Must Stay True to its Conservation Origins.

Adopted in 1994, the NWFP is the largest comprehensive ecosystem management plan worldwide, encompassing the entire northern spotted owl range in the contiguous United States. The plan ushered in a historic shift in forest management, from the unconstrained logging that dominated the mid- to late-20th century to a science-based approach prioritizing the conservation of mature and old-growth forests, watersheds, and wildlife, including the northern spotted owl and marbled murrelet. While the NWFP has fallen short of fully achieving its conservation targets—fully arresting the decline of certain listed species—it has nevertheless made essential strides in preserving and enhancing late-successional and old-growth habitat and ecosystem integrity across the region.

The NWFP is the outgrowth of an unprecedented planning effort. NWFP Record of Decision at 1. After decades of intensive logging, by the early 1990s, only about ten percent of old-growth forests within the range of the northern spotted owl remained, with the majority on federal lands managed by the Forest Service, Bureau of Land Management, and National Park Service. *Seattle Audubon Soc. V. Evans*, 771 F. Supp 1081, 1088 (W.D. Wash. 1991). Logging had diminished old-growth stands to such an extent that old-growth dependent species, such as the northern spotted owl and marbled murrelet, were on the brink of extinction. The Report of the Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl, issued in April 1990, concluded:

> [T]he owl is imperiled over significant portions of its range because of continuing losses of habitat from logging and natural disturbances. Current management strategies are inadequate to ensure its viability. Moreover, in some portions of the owl's range, few options for managing habitat remain open, and available alternatives are steadily declining throughout the bird's range. For these reasons, delay in implementing a conservation strategy cannot be justified on the basis of inadequate knowledge.

Following the owl's listing, all timber sales that would log northern spotted owl suitable habitat were enjoined pending the Forest Service's adoption of a management plan in compliance with NFMA. *Id.* at 1096; 55 Fed. Reg. 26,115 (June 26, 1990). The Forest Service's repeated attempts to comply with this directive for northern spotted owl, and to develop a plan that maintained adequate viability for late-successional forest-associated species broadly, as required by the NFMA, were rejected by the court as falling short of legal requirements. *Seattle Audubon Soc. v.*

Lyons, 871 F. Supp. 1291, 1301–02 (W.D. Wash. 1994); *see also* 16 U.S.C. § 1604(g)(3)(B).

It was only through the full-scale mobilization of an interdisciplinary team of expert scientists, economists, sociologists, and others that the Clinton administration was able to produce a plan that withstood legal scrutiny. This team—the "Forest Ecosystem Management Assessment Team," or FEMAT—was directed to develop a landscape-level plan spanning federally-administered lands in the range of the northern spotted owl that was "scientifically sound, ecologically credible, and legally responsible."[1] Significant effort was expended to ensure the plan was based on the best available science and not influenced by agency agendas. As K. Norman Johnson, Jerry Franklin, and Gordon Reeves, chief architects of the NWFP, recount:

> The scientists and resource professionals worked in the US Bank Building . . . A guard stood just inside the door and admitted only team members . . . The administration had put its chips on scientists to find a solution to the impasse and did not want anyone or anything interfering with their work. Agency line officers and timber management staff also were not asked to participate. Early on, Thomas and Johnson . . . recognized that [including agency officials] could create both the perception and reality that the work was subject to agency agendas, as most federal timber harvest in the owl's range came from [late-successional/old-growth] forests central to protection of the species and ecosystems that FEMAT would assess. Both the scientists and the Clinton administration were determined to avoid that outcome.[2]

FEMAT approached its task from the following standpoint: (1) what system of reserves and management of intervening forests was needed to protect Late-successional/Old-growth-associated species, particularly northern spotted owl and marbled murrelet; (2) what actions were needed to protect and restore aquatic ecosystems, especially habitat for salmon populations; and only after addressing the first two points did FEMAT consider (3) what level of timber production was possible under the management strategies proposed to address the first two points. *Id.* at 183.

FEMAT initially developed fifty-four alternatives which were evaluated against ecological criteria. These were narrowed down to thirty-five for more detailed review, and then ultimately ten for intensive assessment. FEMAT assessed the predicted effects these ten alternatives would have on more than a thousand animal and plant species over the

[1] FEMAT (1993) at ii.
[2] Johnson et al. (2023) at 180.

ensuing century. This was, as Judge Dwyer noted, "an unparalleled effort." *Lyons*, 871 F. Supp. at 1303.

The option ultimately adopted—option 9—is a landscape-scale ecosystem management plan rooted in two complimentary tenants of conservation biology: a course filter reserve network and fine filter protections for species outside reserves.[3] The plan's foundation is a network of late-successional and riparian reserves widely distributed throughout the plan area. While these (particularly the late-successional reserves) were principally designed to support the viability and dispersal of the northern spotted owl, the reserves were also explicitly intended to support the resilience and representation of species across multiple taxa and communities, with the northern spotted owl serving as an indicator species for old-growth ecosystems and late-successional associated species broadly. The NWFP fine filter is the "survey and manage" program, a systematic approach to protect known locations and ensure the viability of some "400 late-successional species of amphibians, bryophytes, fungi, lichens, mollusks, vascular plants, arthropod functional groups, and one mammal, including many endemics that otherwise may not persist outside the reserve network."[4]

Even with this unparalleled effort and strictures to ensure the NWFP was built on science and not agency agendas, the plan just barely passed legal scrutiny. Judge Dwyer, in upholding the NWFP, warned that "any more logging sales than the plan contemplates would probably violate the law. Whether the plan and its implementation will remain legal will depend on future events and conditions." *Lyons*, 871 F. Supp. at 1300.

Considering this, it is a testament to FEMAT's efforts, and their commitment to creating a "scientifically sound, ecologically credible, and legally responsible" plan, that not only does the NWFP remain on the books, but it is, on the whole, working. As some of commentors noted in their scoping comments:

> The Northwest Forest Plan was designed to be a 100-year plan. At roughly thirty years into the plan, ecologically and socially the Plan is working as intended. Ecologically, the Plan has broadly accomplished what it was designed to do: protect and develop late-successional forests; protect species closely associated with late-successional forest habitat; ensure that late-successional forests are well-distributed across the landscape in reserves; maintain habitat connectivity through the matrix; and protect and restore spawning and rearing habitat for anadromous fish and riparian and other habitat for aquatic organisms. It has had the added benefit of being a rare climate change success story by reducing carbon emissions[5] and

[3] DellaSala et al. (2015).
[4] DellaSala et al. (2015).
[5] Krankina et al. (2012) at 171–82.

retaining significant amounts of carbon across an entire region, with most of the carbon stored on federal lands being on those managed under the Plan.[6]

Regarding late-successional forests, the Plan has stemmed the loss of these forests on federal lands such that without the plan's protective standards and guidelines many late-successional forests in accessible areas would have been logged by this decade.[7] The Forest Service has observed that losses of older forests have been "small (a 2.8 to 2.9 percent net decrease)," with planned forest recruitment of late-seral forests over time in the reserve network helping to mitigate temporary losses from wildfire, logging, insects and other natural causes.[8]

Late-successional forest protections have, in turn, blunted the impact of other less anticipated impacts to northern spotted owls from invasive barred owls; although that risk has been elevated by rapid expansion of the barred owl since the plan's development.[9] Additionally, while there has been an overall net loss of marbled murrelet habitat across its range, within lands governed by the Plan, and mainly in the reserve network, murrelet habitat increased by 2.93 percent; a net increase of 18,574 acres.[10] Thus, we cannot understate that the success story of the Plan is tied to the coarse scale (reserve network), fine scale (survey and manage) and other provisions that stem from fundamental principles of conservation biology that hold to this day, and are perhaps even more important today.

Another clear success of the Plan is the related improvements to watershed integrity. For instance, the Plan has resulted in a slight overall increase in canopy cover (70-72%), recruitment of 80+ year old forests (57% in 1993 to 61% in 2017), and road removal (1,608 km (6.6% reduction), with associated improvements in water quality via declines in sediment delivery (4.0%) and landslide risk associated with roads (11%).[11] Despite these improvements many management indicators, such as increased large instream wood, are lagging because pre-Plan management reduced the availability of large logs that could be retained in streams. It's important to note that these losses are also much more significant on industrially logged private lands and thus the Plan is the best hope for restoring entire watersheds.[12]

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[6] Krankina et al. (2014) at 112–21; Law et al. (2018).
[7] DellaSala et al. (2015).
[8] USDA (2015).
[9] Franklin et al. (2021); *see also* Long & Wolfe (2019).
[10] Lorenz et al. (2021).
[11] Dunham et al. (2023).
[12] EPIC et al., Re: Notice of Intent for Northwest Forest Plan Amendment (Feb. 2, 2024).

This success, and the NWFP's persistence broadly, is particularly remarkable considering the numerous attempts over the years to undermine and chip away at its foundation. These include the 1995 Salvage Rider, which temporarily increased harvest and paused the ability to challenge timber sales under federal law, and numerous efforts to remove or pare back the NWFP's Survey and Manage program and Aquatic Conservation Strategy. The plan's ability to endure and progress toward its original conservation and ecosystem management goals highlights the strength and clarity of its standards and structure.

Plan amendments must adhere to the same science-based priorities that guided FEMAT's original development process, addressing three questions through established conservation biology principles: (1) what measures are necessary to protect late-successional/old-growth associated species, particularly the northern spotted owl and marbled murrelet; (2) what specific actions are required to protect and restore functional aquatic ecosystems, especially salmon habitat; and only after resolving these ecological imperatives, (3) what sustainable timber production levels are compatible with the management strategies proposed to address the first two priorities.[13] This hierarchical approach remains the only viable framework for plan amendments that are scientifically and ecologically sound and legally defensible. The Forest Service must also heed Judge Dwyer's warning that "any more logging sales than the plan contemplates would probably violate the law. Whether the plan and its implementation will remain legal will depend on future events and conditions." *Lyons*, 871 F. Supp. at 1300.

C. The Northwest Forest Plan Amendment Was Flawed from the Outset and Contradicts the NWFP's Purpose.

The Forest Service did not heed the lessons from the creation of the original NWFP in crafting this amendment. The rushed process was guided by the agency's agenda and centered on negotiations among stakeholders rather than scientific rigor. The result is an amendment that will reverse many of the gains achieved under the original NWFP, and that cannot withstand legal scrutiny.

The Secretary of Agriculture established a Federal Advisory Committee (FAC) to help guide the amendment process. A stakeholder-led process was intended to include diverse in perspectives, but unlike the FEMAT, which was entirely composed of scientific experts—including 24 terrestrial ecologists alone—and included strict protections to isolate the team from outside influence, the FAC had limited scientific representation and diversity of expertise on the myriad complex ecological issues at issue in the NWFP.[14] The FAC met with the Forest Service regularly, with the agency repeatedly constraining the committee's

[13] Johnson et al. (2023) at 183; *see also* DellaSala et al. (2015).

[14] *Compare* FAC Charter (noting FAC composition) with FEMAT 1993 at v to xi (listing FEMAT composition).

work and redirecting it toward agency priorities over the FAC's objections.[15] The FAC also recurrently spoke out against the Forest Service's timeline for the amendment.[16]

Wildlife considerations were largely excluded from the amendment process. Several FAC members "expressed their frustration and concern about the exclusion of a sixth subcommittee regarding wildlife biodiversity/endangered species."[17] Although that subcommittee was ultimately formed, its recommendations were largely ignored after the Forest Service "announced that the amendment focus was shifting away" from biodiversity.[18]

Commentors do not intend to denigrate the work the FAC put in. Just the opposite. FAC members displayed an incredible level of dedication to navigating a complex process on an unreasonably constrained timeline, committing significant time beyond that required by their regular jobs to participate in the process. And as noted above, commentors fully support the FAC's recommendations on "Tribal Inclusion and Honoring Tribal, Treaty, Reserved, Retained, and Other Similar Rights and Trust Responsibilities," as additionally informed by comments from Tribes on this DEIS. There was broad consensus among the FAC that the history of Tribal exclusion from the NWFP is an issue that urgently needs to be remedied. Commentors wholeheartedly agree.

Rather, the issue is the process as structured by the Forest Service. From the outset, the Forest Service defined the amendment parameters in such a way that the process would inevitably result in an amendment that increased commercial timber harvest, defining the scope to include topics such as "improving fire resistance" and "providing a predictable supply of timber and non-timber products." 88 Fed. Reg. 87,393 (Dec. 18, 2023). The Forest Service then limited the ability of the FAC to consider wildlife biodiversity and endangered species in its recommendations, as discussed above.

This is antithetical to the purpose of the NWFP and the process by which it was created. The plan was created for the conservation and management of the northern spotted owl and other late-successional associated species and ecological communities, through a process focused first and foremost on biodiversity conservation and structured to ensure the plan was founded on the best available science. Here, the Forest Service effectively reversed this operation, focusing on active management and foreclosing any consideration of wildlife.

The result is a proposal that would significantly increase commercial timber harvest, particularly under Alternatives B and D, while severely curtailing protections for

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[15] FAC Meeting Notes Nov. 14–16, 2023, Jan. 30 – Feb. 1, 2024.

[16] FAC Meeting Notes Nov. 14–16, 2023 (noting many FAC members "shared their continued consternation over the truncated timeline"); FAC Meeting Notes Jan. 30 – Feb. 1, 2024 (same).

[17] FAC Meeting Notes Nov. 14–16, 2023.

[18] FAC Meeting Notes Jan. 30 – Feb. 1, 2024.

late-successional forests and associated wildlife and ecological communities. The Forest Service has effectively decided to ignore Judge Dwyer's warning that "any more logging sales than the plan contemplates would probably violate the law." Alternatives B and D would double annual logging from 2023 baseline levels. Current logging across the 17 National Forests within the NWFP area totaled 504 million board feet in 2023, while the proposed alternatives would authorize harvest exceeding 1 billion board feet annually.[19] In total, the DEIS proposes treatment of up to 2.65 million acres per decade across all land allocations, including logging up to approximately 964,000 acres—a full third of dry forest stands across all land use allocations—over 15 years.[20] This volume would be concentrated on substantially less land than under the original NWFP, as the plan included 2.6 million acres of Bureau of Land Management lands until BLM withdrew from the NWFP in 2016. This concentration of impacts on a smaller land base will necessarily increase the severity of adverse impacts. The amendment also proposes to transform management of Late Successional Reserves (LSRs) through incorporating early seral habitat in reserves and allowing treatment in stands between 80 and 120 years old. This is all done without any substantive analysis of how these changes would impact the very species that led to the creation of the NWFP in the first place.

D. Wildlife

The NWFP was specifically crafted to comply with the Endangered Species Act (ESA) and NFMA by providing for the conservation and recovery of listed species and the viability of hundreds of late-successional associated species in the range of the northern spotted owl. These requirements remain and pertain to this amendment. It is, therefore, remarkable that the DEIS for the most significant amendment to the Northwest Forest Plan since its inception includes no substantive analysis of how the amendment will impact threatened and endangered or other species in the plan area. Instead, the DEIS at section 3.5.2.2 improperly defers meaningful evaluation of effects to northern spotted owl, marbled murrelet, and other threatened and endangered species to future ESA consultations, promising the preparation of Biological Assessments (BAs) at some unspecified future date, and to the final Biological Evaluation.[21] This despite identifying 73 federally listed species whose ranges overlap with the NWFP area and will be "potentially affected" by the amendment.[22]

While BAs and subsequent Biological Opinions (BiOps) under the ESA are legally required and essential, they are not a substitute for the comprehensive species-specific analysis mandated by NEPA. The purpose of the ESA and NEPA are not the same. NEPA "gives the public the assurance the agency 'has indeed considered environmental

[19] DEIS at 3-118.
[20] DEIS at 2-18, 2-21.
[21] DEIS at 3-74.
[22] DEIS at 3-52 to 3-55.

concerns in the decisionmaking process,' and, perhaps more significantly, provides a springboard for public comment." *San Luis & Delta-Mendota Water Authority v. Jewell*, 747 F.3d 581, 650 (quoting *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 350 (1989). "[T]here is no substitute in the Endangered Species Act for the public comment commanded by NEPA." *Portland Audubon Soc. v. Lujan*, 795 F. Supp. 1489, 1509 (D. Or. 1992); *see also Fund for Animals v. Hall*, 448 F. Supp. 2d 127, 136 (D.D.C. 2006) (noting same).

The Forest Service has effectively subverted the public's opportunity to meaningfully comment on the amendment's impacts to threatened and endangered species by failing to provide any substantive analysis of this issue in the DEIS. The public is deprived of any information on and evaluation of the amendment's potential impacts to these species and the opportunity to compare and evaluate how such impacts would differ under the alternatives presented in the DEIS. Without this, the DEIS cannot serve as the "springboard" for public comment NEPA requires.

NEPA requires that environmental impacts, especially on threatened and endangered species, be disclosed, evaluated, and presented to the public for meaningful review and comment during the NEPA process—not after. The DEIS's approach of deferring species viability and impact analyses to future ESA consultations violates NEPA's core procedural requirements for informed public involvement. Moreover, this deferral effectively shields critical analyses from public scrutiny, undermining NEPA's central purpose of transparency and accountability, as well as the Administrative Procedure Act's (APA) mandate for reasoned decisionmaking. To comply with NEPA, the Forest Service must provide detailed, species-specific viability and population analyses for the northern spotted owl and marbled murrelet within this EIS, not relegated to subsequent Biological Opinions.

The Forest Service also fails to demonstrate compliance with NFMA. The Forest Service updated its forest planning regulations in 2012, which only strengthened requirements for conserving wildlife and ecological communities broadly. The 2012 Planning Rule retains a viability standard and, more broadly, requires the Forest Service to "maintain or restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds in the plan area." 36 C.F.R. § 219.8, 219.9. These requirements apply to the Forest Service's amendment here, as the agency clearly stated in its Record of Decision for the 2012 Planning Rule that "[a]ny significant change in resource management would need to be consistent with the sustainability and other requirements in the [2012 Planning Rule]." 77 Fed. Reg. 21,162, 21,237 (Apr. 9, 2012).

The Forest Service recognizes that the 2012 Planning Rule's ecological integrity and viability requirements apply to the amendment, yet it fails to provide any analysis

demonstrating compliance with those standards.[23] Nor can it, as proposed plan components are insufficient to meet this requirement as well.

The amendment will significantly alter the management and structure of forests throughout Forest Service lands in the NWFP area from how they have been managed since the plan was enacted three decades ago. Yet the DEIS reflects that the Forest Service has given little consideration to wildlife impacts and has not performed any substantive analysis of potential impacts to threatened and endangered species, including the very species that led to the creation of the NWFP in the first place—the northern spotted owl and marbled murrelet.[24] This approach and the Forest Service's analysis are inconsistent with the purpose of the NWFP and run afoul of the ESA, NFMA, and NEPA, as further discussed below.

1. Northern spotted owls.

The historic range of the northern spotted owl extended from southwestern British Columbia down through the Cascade Mountains, coastal ranges, and forested areas in Washington, Oregon, and California, reaching as far south as Marin County, California. Today, the owl's range has contracted significantly, and the species has been extirpated or become uncommon in areas including southwestern Washington and British Columbia. These losses are primarily attributable to timber harvest activities that have eliminated, reduced, or severely fragmented suitable habitats.[25]

In June 1990, the U.S. Fish and Wildlife Service (USFWS) listed the northern spotted owl as "threatened" under the ESA, citing extensive habitat loss, ongoing habitat modification, and inadequate regulatory protections. 55 Fed. Reg. 26,114 (June 26, 1990). Critical habitat for the northern spotted owl was initially designated in 1992 and most recently revised in 2021. In 2020, the USFWS determined that uplisting the northern spotted owl from "threatened" to "endangered" was warranted, citing increasing threats such as continued habitat loss from logging and high-severity wildfires, and the intensifying invasion of the barred owl. 85 Fed. Reg. 81144 (Dec. 15, 2020). Although uplisting was found to be warranted, the action was deferred due to other priorities.

The USFWS has expressed grave concerns about the long-term persistence of the northern spotted owl throughout the Pacific Northwest, noting that the threats, particularly competition from barred owls and high-severity wildfires, are now so severe and imminent that the northern spotted owl faces a substantial risk of extinction. The agency has recognized that effective conservation requires addressing both barred owl management and conserving adequate amounts of high-quality habitat distributed across the

[23] DEIS at 1-6 to 1-7; DEIS Section 3.5.

[24] DEIS Sections 3.5.1.2 & Section 3.5.2.2 (deferring information on any analysis of impacts to threatened and endangered species to future biological analyses and the final biological evaluation).

[25] FEMAT (1993); USFWS (2011).

landscape. The 2021 Northern Spotted Owl Critical Habitat Rule and the associated Species Status Report underscore these concerns, emphasizing the essential role that maintaining sufficient habitat and landscape connectivity will play in preventing the northern spotted owl's extinction. 86 Fed. Reg. 62,606 (Nov. 10, 2021).

Since the mid-1990s, rangewide data from 11 demographic study areas (DSAs) have been used to evaluate trends in northern spotted owl populations. In the most recent meta-analysis, covering 26 years of data through 2018, researchers documented a substantial and accelerating decline of northern spotted owl populations, with a rangewide annual rate of decline averaging 5.3 percent.[26] Populations within these DSAs have declined by between 32 and 80 percent since monitoring began in the mid-1990s. These declines reflect reduced apparent survival, declining recruitment, increased territorial extinction, decreased colonization rates, reduced fecundity, and diminished occupancy. Scientists have warned that, should these trends continue, northern spotted owls will become extirpated throughout large portions of their current range within the next decade.[27] Indeed, the species may already be caught in an "extinction vortex," characterized by feedback loops of demographic stochasticity, increased inbreeding, and disrupted behaviors that drive rapid extinction.[28] Notably, in a recent Biological Opinion for the South Fork Sacramento Project on the Shasta-Trinity National Forest, the USFWS estimated that there may be fewer than 3,000 individual northern spotted owls remaining across their entire range,[29] acknowledging that even this number may be an overestimate.

Against this backdrop, the Forest Service's proposed amendment, specifically Alternatives B and D, would open hundreds of thousands of acres of northern spotted owl habitat to increased logging, allowing logging of previously protected older trees that provide essential habitat for northern spotted owls. Yet, despite the magnitude of these proposed changes, the DEIS itself provides no substantive analysis of effects on northern spotted owls.[30] Instead, the closest it comes is passing references to background documents, notably the Synthesis of Science (2018) and the Bioregional Assessment (2020), outside the document's threatened and endangered species analysis section.[31] While these background documents contain valuable historical context and prior analysis, much of it is outdated, and none of it substitutes for a detailed analysis within the DEIS itself. Most critically, neither these documents nor the DEIS include analysis of how the proposed amendment would impact the species—lacking the site-specific assessment of

[26] Franklin et al. (2021); Dugger et al. (2016).
[27] Franklin et al. (2021); Dugger et al. (2016).
[28] Rockweit et al. (2023); Franklin et al. (2021); Yackulic et al. (2019).
[29] USFWS (2023b).
[30] *See* DEIS at § 3.5.2.2.
[31] *See* DEIS at 1–3.

potential consequences that is essential for meaningful environmental review and informed decisionmaking under NEPA.

The Synthesis of Science highlights the precarious state of northern spotted owl populations across their range. Population declines have been consistently observed in every demographic study since standardized monitoring began in 1985.[32] Suitable nesting and roosting habitat continues to decline as well, posing severe challenges for the species' long-term survival.[33] Without substantial intervention, the persistence of northern spotted owls within the NWFP area is highly uncertain.[34] The Synthesis of Science emphasizes that the most effective conservation strategy must include protections for old forest habitats along with efforts to mitigate barred owl impacts.[35] Additionally, conserving currently occupied northern spotted owl sites, as well as historically occupied ones, remains vital for the species' persistence.[36]

The Synthesis of Science also defines suitable northern spotted owl habitat: forests older than 125 years, with average tree diameters generally above 20 inches diameter at breast height (dbh), at least some trees exceeding 30 inches dbh, canopy cover typically greater than 60 percent, and multiple canopy layers.[37] Timber harvesting activities, including thinning operations in dense forests, are known to significantly reduce populations of key prey species such as northern flying squirrels and red tree voles for decades, thus adversely affecting northern spotted owl habitat use.[38] The document also clarifies that while mixed-severity fires can create heterogeneity that is not inherently detrimental to northern spotted owls, timber harvesting—especially when combined with salvage logging after fire—generally results in habitat degradation and increased likelihood of site abandonment.[39]

Importantly, the Synthesis of Science notes that timber harvesting differs significantly from wildfire disturbance, primarily due to the removal of structural features (live trees, snags, logs) and associated ground disturbances.[40] Unlike logging, wildfire tends to leave behind valuable biological legacies essential for biodiversity and forest succession.[41] Clark et al. (2013), cited by the Synthesis of Science, determined that sites subject to timber harvest, high-severity wildfire, or salvage logging had increased probabilities of northern spotted owl local site extinction. Moreover, when wildfire and

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[32] Spies et al. (2018) at 246.
[33] USFWS (2011) at B-7; Spies et al. (2018) at 279.
[34] Spies et al. (2018) at 262, 279.
[35] Spies et al. (2018) at 59, 280.
[36] Spies et al. (2018) at 59.
[37] Spies et al. (2018) at 252.
[38] Spies et al. (2018) at 264; Wilson and Forsman (2013).
[39] Spies et al. (2018) at 264, 268; Clark et al. (2013); Bond et al. (2022).
[40] Spies et al. (2018) at 266–67.
[41] Spies et al. (2018) at 266–67; Swanson et al. (2011); Clark et al. (2013).

salvage logging occur in combination—particularly in the core of northern spotted owl territories—the probability of site abandonment sharply increases.

Given this evidence, the Forest Service must use the most recent peer-reviewed data on spotted owl habitat use in post-fire landscapes when fulfilling its obligations under the ESA and NEPA. Doing so is necessary to understand the project's impacts, avoid unauthorized incidental take, and ensure habitat protections reflect current scientific understanding of the interactions among wildfire, logging, and barred owl competition.

The Synthesis of Science acknowledges the considerable challenge forest managers face in balancing restoration treatments designed to reduce high-severity wildfire risk against the negative short-term impacts these treatments have on northern spotted owls.[42] Climate change further complicates the scenario by altering vegetation patterns, prey abundance, and weather conditions—all factors associated with northern spotted owl reproductive success and survival.[43] Additionally, genetic threats such as increased hybridization with barred owls and loss of genetic diversity amplify northern spotted owls' vulnerability to extinction.[44] While the Synthesis of Science expressed uncertainty about populations after two decades of NWFP implementation, it stated clearly that continued implementation of the NWFP's standards and guidelines, alongside active management to reduce barred owl competition, is essential for the species' persistence.[45]

Since publication of the Synthesis of Science, new demographic studies have documented further declines and increased extinction risks for northern spotted owls. The most recent meta-analysis by Franklin et al. (2021) assessed 26 years of demographic data (1993–2018) across multiple study areas, finding significant declines in all demographic metrics, including survival, recruitment, occupancy, and fecundity.[46] Annual northern spotted owl population declines now range from 2 to 9 percent across the study areas, with an overall rangewide decline averaging 5.3 percent per year.[47] These alarming declines indicate a significantly elevated extinction risk compared to conditions at the time of ESA listing, with populations in some demographic study areas declining by over 80 percent since monitoring began. Without immediate conservation interventions, northern spotted owl populations in Washington and the Oregon Coast Ranges face a greater than 50 percent probability of extirpation.

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42 Spies et al. (2018) at 269.
43 Spies et al. (2018) at 270.
44 Spies et al. (2018) at 271.
45 Spies et al. (2018) at 277, 283.
46 Franklin et al. (2021).
47 Franklin et al. (2021).

Further, Rockweit et al. (2022) underscored the risks of an extinction vortex scenario for northern spotted owls, highlighting that rapidly declining populations experience increased inbreeding, disrupted dispersal behaviors, and demographic instability, all contributing to swift population collapse. Rockweit and colleagues warned explicitly that without rapid intervention, northern spotted owls may become extinct across large portions of their range within the next decade. This finding aligns with other recent analyses identifying dramatic long-term declines in site occupancy, survival, and population change, underscoring that the long-term survival of northern spotted owls is unlikely without immediate, substantial protective measures.

Despite these troubling demographic findings, recent Biological Opinions from the USFWS fail to acknowledge the severity of northern spotted owl declines.[48] These opinions still rely on outdated population estimates modeled twelve years ago, which projected a hypothetical "steady-state" northern spotted owl population size of approximately 3,000 female individuals. This model, based on 2006 habitat imagery and barred owl densities from that period, was never intended as a current population count. The lack of updated monitoring data, coupled with the cessation of regular northern spotted owl demographic studies and no clear replacement monitoring program, leaves the true current population size unknown and greatly complicates efforts to plan adequate mitigation.[49]

The DEIS completely fails to disclose or analyze the effects of its preferred alternative—or any alternatives—on northern spotted owl populations or habitat. Nor has the agency provided the public with a biological assessment to evaluate these impacts. The Forest Service did not even designate effects on northern spotted owls as a "significant issue" requiring detailed analysis under NEPA regulations. 40 C.F.R. § 1501.2. Instead, under the umbrella of "Biological Resources," the agency included only a single brief paragraph addressing the northern spotted owl, where it acknowledges that despite marginal gains in nesting and roosting habitat, northern spotted owl populations continue their severe decline toward likely extirpation.[50] Nevertheless, the Forest Service proposes amendments that threaten northern spotted owl survival by substantially weakening existing habitat protections, permitting the logging of large and old trees (up to 120 years in moist forests and 175 years in dry forests), allowing salvage logging in critical habitat reserves, and setting ambitious timber production targets that will undoubtedly accelerate habitat degradation.[51]

The latest rangewide demographic studies suggest strongly that northern spotted owls may already be in a persisting state of jeopardy.[52] Yet the DEIS does not reconcile how

[48] USFWS (2023b).
[49] Rockweit et al. (2022).
[50] DEIS at 3-75.
[51] DEIS at 2-17, 2-18, 2-19.
[52] Franklin et al. (2021).

substantially expanding logging—even in stands once reserved for late-successional development—aligns with a species at imminent risk, nor does it address the best available science indicating heightened extinction risks.[53] By failing to analyze whether weakening these long-established habitat protections could push northern spotted owl populations deeper into decline, the Forest Service falls short of NEPA's requirement to take a "hard look" and fully disclose the risks posed by this amendment.

The DEIS's reliance on arbitrary calendar dates instead of tree ages for identifying logging eligibility further increases risks, as discussed below.[54] Collectively, these changes guarantee significant negative impacts to northern spotted owls and their habitat—impacts the DEIS completely fails to disclose or analyze. Given the severity of current northern spotted owl population declines and the clear scientific consensus that habitat conservation remains critical, these amendments constitute a direct threat to the species' viability and recovery.

In conclusion, the best available scientific data shows the proposed NWFP amendment would likely cause significant harm to northern spotted owl populations, deepening the existing jeopardy condition. By failing to adequately disclose or analyze these impacts in the DEIS, the Forest Service violates NEPA's fundamental requirement to provide a detailed, species-specific viability analysis and to fully inform the public of the ecological consequences of its actions. The DEIS also fails to ensure the viability of the threatened northern spotted owl as required by NFMA and provide for its conservation and recovery as the ESA mandates.

2. Marbled Murrelet

The marbled murrelet (*Brachyramphus marmoratus*) is unique among seabirds in that while it spends the majority of its life in marine environments, it nests in late successional forests. The species has narrow habitat requirements, requiring large, tall conifer trees with numerous broad, moss or other thick substrate-covered platforms and extensive horizontal and vertical cover for nesting—in other words, complex, late successional forests.[55] This is required for the marbled murrelet's distinctive nesting behavior. Instead of constructing a nest, they lay a single egg on a large, usually moss-covered branch each breeding season.[56]

The Washington, Oregon, and California marbled murrelet distinct population segment was listed as threatened under the ESA in September 1992 largely because of loss and modification of late successional forest nesting habitat from timber harvest. 57 Fed.

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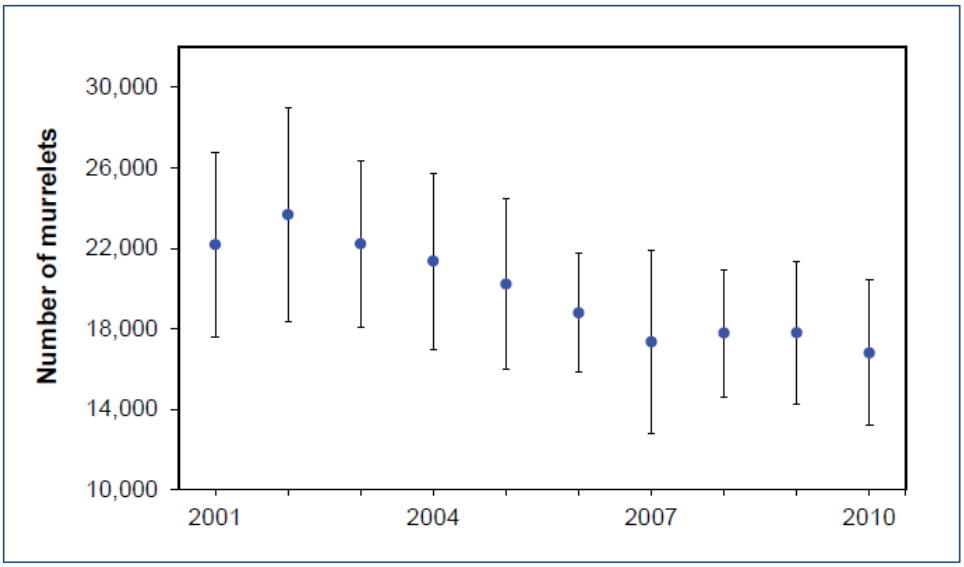
[53] *See* Franklin et al. (2021), Rockweit et al. (2022).
[54] DEIS at 2-17.
[55] Hamer et al. (2021); Nelson & Wilson (2002); Raphael et al. (2018).
[56] Nelson & Hamer (1995); ODFW (2018a).

Reg. 45,328 (Oct. 1, 1992). The species' population numbers continued on a downward trend following listing, declining nearly 30% between 2000 and 2010.[57]



From 2001 to 2010, marbled murrelet populuation declined about 30 percent in Washington, Oregon, and northern California.

[58]

While recent monitoring results indicate population numbers may have stabilized around a lower baseline, they have not showed any signs of recovery.[59] This is largely due to poor breeding success caused by a loss of suitable nesting habitat and decline in the quality of nesting habitat that is available.[60] Recent studies show poor contemporary breeding success through the species' federally-listed range, with success in Oregon estimated as low as 36%.[61]

The NWFP has been essential for the species' survival, stemming the decline of suitable nesting habitat on federal lands. Since its creation, habitat has increased 2.93% on federal lands in the NWFP area, with most gains on reserve lands.[62] Yet these gains are in marginal edge and scatter habitat. As Lorenz (2021) states:

> The original goal of the NWFP was to increase habitat for the marbled murrelet, and our results indicate this is not occurring for the highest quality habitat. We saw increases mostly in edge and scatter habitat, and research indicates that fragmented and edge habitats increase the risk of nest failure in this species (Malt and Lank 2007, 2009; Nelson and Hamer 1995; Raphael et al. 2002). In 2017, we estimated that 75 percent of the higher probability

[57] Miller et al. (2012); Strong (2020); Strong (2024).
[58] USDA (2013).
[59] Strong (2020); Strong (2024).
[60] ODFW (2018b); ODFW (2021).
[61] *Id.*
[62] Lorenz et al. (2021).

> nesting habitat in the NWFP area was scatter, leaving only 25 percent in larger, contiguous patches of core habitat that occurred primarily in Washington.[63]

Despite acknowledging recent habitat gains on federal lands are marginal and predominantly in smaller, scattered, and edge areas rather than large core areas, the DEIS does not sufficiently evaluate how the proposed amendments would alter this trajectory.[64] While the DEIS emphasizes the use of "ecological forestry" to maintain or restore murrelet habitat—expanding treatments from thinning to broader forest management activities[65] —it remains unclear how these interventions will preserve the large, contiguous nesting platforms that old-growth conditions provide, rather than further fragmenting existing habitat. Indeed, the DEIS lacks the necessary specificity as to how murrelet nesting success could be affected by the proposal to treat between 65,000 and 81,000 acres per decade under Alternative B and 130,000 and 163,000 acres per decade under Alternative D in moist forest Matrix areas.[66] It further fails to analyze how, under Alternatives B and D, the Forest Service expands 'forest management activities' in stands up to 120 years old,[67] which could further fragment core habitat if those treatments occur near or within murrelet nest sites. These large-scale interventions may reduce canopy cover or create new edges contrary to murrelet habitat needs if not carefully circumscribed.

There is also no detailed assessment of whether such activity will degrade high-value, contiguous core nesting habitat or how shifting forest composition and structure at the edge of suitable habitat could reduce murrelet nesting success. This omission is especially significant given that both past research and the DEIS recognize murrelet breeding success depends on adequately protected core habitat.[68] Without specifically addressing whether the amendments will retain or improve these core nesting stands and limit edge impacts—particularly within stands slated for more intensive management—the proposed approach fails to fully disclose the potential effects on marbled murrelet survival and recovery.[69] Alternatives B and D, in particular, should outline precise metrics for measuring and safeguarding core habitat values against further fragmentation.

As the USFWS explained in its five-year status review for the species, timber harvest negatively impacts marbled murrelet in several ways:

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[63] *See also* ODFW (2018b) (noting nearly 90% of potential habitat on nonfederal lands in Oregon are "edge," and 70-80% of federal lands in the state are edge); ODFW (2021).
[64] DEIS at 3-74; DEIS Section 3.5.2.2.
[65] DEIS at 2-16–17.
[66] DEIS at 2-17.
[67] *See* DEIS at 2-16, 2-17, 3-35.
[68] DEIS at 3-74.
[69] DEIS at 2-17, 3-35.

> Timber harvest includes a range of activities such as removal of trees and operation of heavy equipment, which can change the structure and availability of nesting habitat and result in elevated sound levels and visible human activity near nests. The loss and modification of nesting habitat reduces site availability and displaces murrelets with site fidelity, and can have several impacts on murrelets, including nest site abandonment, delayed breeding, failure to initiate breeding in subsequent years, and failed breeding due to increased predation risk at a marginal nesting location (Divoky and Horton 1995, p. 83; Raphael et al. 2002, p. 232). These outcomes reduce nesting success, which ultimately influences recruitment of juvenile birds into the local population (Raphael et al. 2002, pp. 231–233).[70]

One of the primary impacts of timber harvest is increased predation from forest fragmentation and "edge effects" associated with artificially created forest boundaries, or "hard edges." Predation is the leading cause of marbled murrelet nest failure. Burger et al. (2004) found a significantly higher percent occurrence and abundance of marbled murrelet predators, particularly corvids, at timber harvest boundaries and along roads, compared with undisturbed forests. This finding is consistent with other studies that have demonstrated marbled murrelet predators are more concentrated in fragmented habitat and along artificially created forest edges.[71]

Timber harvest and associated infrastructure, such as roads, create abrupt edges in otherwise contiguous forest, altering the microclimate to conditions less suitable for murrelet nesting. These "edge environments" often experience higher temperatures, increased solar radiation, lower humidity, and stronger winds relative to the forest interior.[72] These factors reduce epiphyte colonization, growth, and survival, thereby limiting the availability of suitable murrelet nest platforms. Such edge effects can extend 50 to 150 meters into the forest.[73]

Allowing early seral habitat to develop through natural disturbance avoids introducing these edge effects present at hard edges.[74] Yet the proposed amendment would artificially create early seral conditions in stands up to 120 years old, offering little analysis of how that approach might create or compound edge effects or degrade core marbled murrelet nesting habitat.[75] By assuming that harvest-based treatments can replicate natural disturbances without rigorously evaluating their potential to increase fragmentation of late successional forests and introduce edge effects, the DEIS fails to take

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[70] USFWS (2024).
[71] Marzluff et al. (2004); ODFW (2021); *see also* Nelson & Hamer (1995).
[72] Van Rooyen et al. (2011).
[73] Burger & Page (2007); Malt et al. (2007).
[74] Malt (2007); Malt et al. (2009).
[75] DEIS at 2-16–17.

the "hard look" NEPA requires. Consequently, the record does not adequately disclose how artificially induced early seral habitats could undermine the high-quality nesting areas murrelets depend on for survival and recovery.

Marbled murrelet habit degradation and displacement has compounding effects. Nesting murrelets aggregate in stands and exhibit high rates of nest site fidelity.[76] This site fidelity may lead murrelets to remain in areas of degraded habitat and associated reduced reproductive success, as there's often a several-year lag between habitat degradation and when murrelets abandon a degraded area.[77] Loss or degradation of previously occupied nesting habitat causes displaced breeders to prospect for new nest sites. In areas with no unoccupied available habitat, this could result in birds being prevented from breeding, attempting breeding in suboptimal habitat, or increasing the distance dispersed from the previous breeding sites. Each of these is likely to result in a decrease in reproductive output.[78] Murrelets may also be forced to disperse to nesting habitat further from foraging habitat, creating longer commutes between nesting and foraging habitat. This can contribute to low productivity through sapping energy that would otherwise go towards nesting and rearing chicks.

While the NWFP has helped stabilize nesting habitat loss on federal lands, timber harvest continues to fragment, degrade, and destroy marbled murrelet habitat on state and private lands in the species range.[79] Timber harvest remains the leading cause of nesting habitat loss, accounting for 71% of all habitat loss across the murrelet's range. In 2012 alone, Oregon saw a net loss of 78,600 acres of higher-suitability nesting habitat, most of it on non-federal lands.[80] Because those lands are often managed on shorter rotations that prevent the development of mature nesting structures, such habitat losses typically will not recover.[81] This increases murrelets' reliance on remaining habitat on federal lands, magnifying the impacts of any action that further degrades those remaining stands.

In light of these threats, the Forest Service must take a hard look at the cumulative impacts of the proposed amendments, especially for a "habitat-split" species like the marbled murrelet,[82] which depends on multiple type of habitat—coastal marine foraging areas and inland forest nesting grounds—and the connectivity between them, and are consequently more sensitive to anthropogenic pressures.[83] The Forest Service's cumulative impacts analysis must explicitly address how murrelet survival demands adequate nesting habitat on federal lands, suitable foraging habitat offshore, and unimpeded movement

[76] Valente et al. (2021); Burger et al. (2009).
[77] Meyer et al. (2002).
[78] Divoky & Horton (1995).
[79] DEIS at 3-74; USDA (2019).
[80] ODFW (2018b).
[81] ODFW (2018b).
[82] Betts et al. (2020).
[83] USFWS (2024).

between the two. Without such an analysis, the DEIS fails to meet NEPA's requirement for a robust evaluation of how federal thinning, harvest, and other management actions combine with ongoing habitat loss outside federal lands and the impacts to foraging habitat discussed below to impair murrelet survival and recovery.

Climate change is a multi-dimensional threat that impacts both the murrelets terrestrial and marine environments. These changes have been particularly pronounced in the species' marine habitat. Changes in sea surface temperature, increased frequency, severity, and duration of marine heatwaves, and increased ocean acidification, as well as fisheries management, have led to a decrease in the abundance and nutritional quality of forage fish, as well as increases in and the species exposure to harmful algal blooms.[84] These changes in forage conditions negatively impact the species' already low reproductive success and recruitment. Marbled murrelets forego breeding when forage conditions are moderate to poor, and if they do breed, experience decreased reproductive success.[85] Such conditions also impact rearing, as food limitations can result in poor growth, delayed fledging, increased chick mortality, and nest abandonment.[86]

Coastal and nearshore development is prevalent throughout the species range, posing a particular threat in areas with dense human population such as Puget Sound. Coastal and nearshore development degrades foraging habitat by disrupting natural shoreline processes and reducing prey availability.[87] Development activities themselves, as well as increased human presence in these areas, also directly affect murrelets through increased noise and visual disturbance that contributes to avoidance behaviors, diving, increased vigilance, aborted feeding attempts, physiological stress, auditory injury, and barotrauma.[88] These activities are so widespread in certain portions of the species' range as to have population-level effects.

While the NWFP has helped to stabilize nesting habitat losses on federal lands, the marbled murrelet still faces persistent threats from habitat fragmentation, edge effects, and the cumulative effects of climate change and nearshore development. The DEIS does not adequately examine how the proposed forest management activities—especially in reserves and in stands up to 120 years old—would affect the core, contiguous nesting areas essential for murrelet breeding success. Nor does it provide clear metrics for preserving old-growth conditions and minimizing edge impacts. Absent such an analysis, the DEIS fails to meet NEPA's "hard look" requirement. It also fails to ensure the viability of the threatened marbled murrelet as required by NFMA, and to provide for its conservation

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[84] Betts et al. (2020); Fountain et al. (2023); Norris et al. (2007); ODFW (2018b); Raphael et al. (2015); USDA (2019); Yen et al. (2004).
[85] USFWS (2024).
[86] USFWS (2024).
[87] Lorenz et al. (2016); USFWS (2024); Yet et al. (2004).
[88] USFWS (2024).

and recovery as the ESA mandates. By more thoroughly evaluating how artificially created early seral habitat may fragment remaining stands in combination with other pressures across the murrelet's range, the Forest Service can fulfill its statutory obligations and help ensure the species' survival and recovery.

3. Coastal Marten

The coastal distinct population segment of Pacific marten (*Martes caurina*) ("coastal marten") was listed as threatened under the ESA in 2020 predominantly due to habitat loss and associated changes in habitat quality and distribution from timber harvest. 85 Fed. Reg. 63,806 (Oct. 8, 2020). Coastal marten are particularly reliant on late-successional forest habitat with dense canopy structure and understory. Surveys in northern coastal California documented 97% of a typical female's range consists of late-successional forest, and 77% of a typical male's range included the same. Studies document that when late-successional forests are reduced below 70% on a landscape, coastal marten population density declines.[89] Females are particularly dependent on late-successional habitat because cavities in large and dead trees provide denning habitat in close proximity to prey resources needed to support the energetic demands of lactation and providing food for kits. Yet both males and females overwhelmingly select for late-successional forest habitat. These forests provide food resources and, of special importance for coastal martens, resting sites. Coastal martens use resting sites, specifically large–diameter live trees with large horizontal limbs, standing snags with cavities or chambers, and downed hollow logs, daily between foraging bouts for thermoregulation and protection from predators.

Logging activities have decimated 93% of coastal marten habitat. As USFWS's Species Status Assessment notes:

> Older forests, which generally represent suitable habitat for martens in much of the analysis area, have declined substantially from historical amounts. Temperate coniferous forests specifically are considered one of the most heavily impacted terrestrial habitats in western North America (Ricketts *et al*. 1999, pp. 83–87, 93–98). Within the analysis area, older forests historically encompassed >75 percent of the coastal California area, 50 percent of the Klamath and Siskiyou region in northern California and southwest Oregon (Strittholt *et al*. 2006, p. 367), and 25 to 85 percent of the Oregon Coast Range (Ripple 1994, pp. 46–47; Strittholt *et al*. 2006, pp. 367–368; Teensma *et al*. 1991, pp. 2–4, 8–9; Wimberly *et al*. 2000, p. 167). Remaining older forests in the redwood region, Oregon Coast Range, and Klamath–Siskiyou region is estimated at 5, 18–24, and 38 percent, respectively, of what occurred historically (Bolsinger and Waddell 1993, p. 3; USFWS 1997, p. 4;

[89] Thompson et al. (2012); USFWS (2023a).

Wimberly *et al.* 2000, p. 176; Strittholt *et al.* 2006, p. 367; Mooney and Dawson 2016, p. 548).

> Not only has the amount of older forest substantially declined, but the composition and spatial distribution has changed as well. Historically, old forest patches were large (2,100 to 8,500 km2, 810 to 3,280 mi2), in near proximity to younger stands, and ranged from 25 to as much as 75 percent of the Coast Range Province (Wimberly *et al.* 2000, p. 167; Wimberly 2002, p. 1322; Wimberly *et al.* 2004, p. 152). Conversely, forest patches less than 80–years old were generally less than 2,000 km2 (772 mi2). Today, the composition has reversed, with the largest old–growth forest patch (>200 yrs) in the province being 6.5 km2 (2.5 mi2) ha, while the largest patch of <80–year forests is larger than 3,000 km2 (1,160 mi2) (Wimberly *et al.* 2004, p. 152). Historically, forests greater than 200 years old were well dispersed in large patches across the Oregon Coast Range Province (Wimberly *et al.* 2004, p. 152). After large–scale disturbance events, large tracts of old–forest habitat were available and could serve as refugia for associated species while adjacent disturbed areas grew into habitat (Wimberly *et al.* 2000, p. 177). These historically large patches no longer occur, limiting martens to a more fragmented landscape with smaller refugia patches.[90]

Coastal marten are now limited to four isolated populations, largely on federal lands in the NWFP area.[91]

[90] USFWS (2023a).
[91] USFWS (2023a).

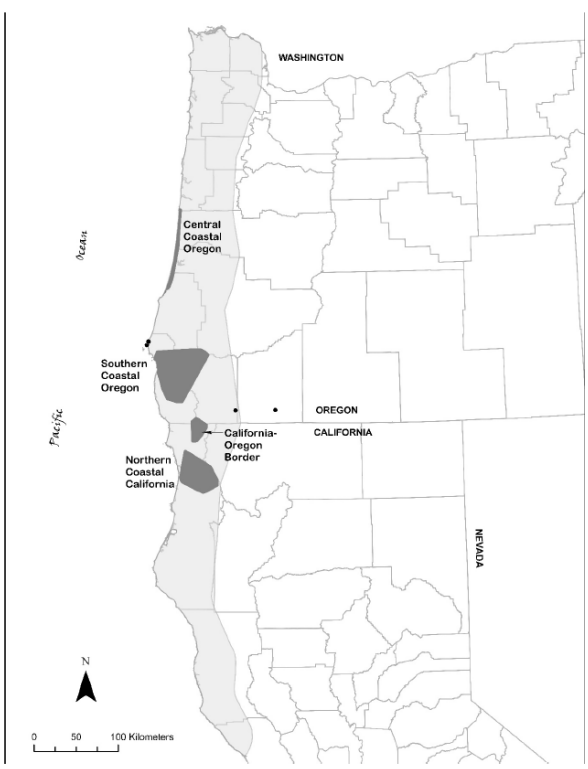
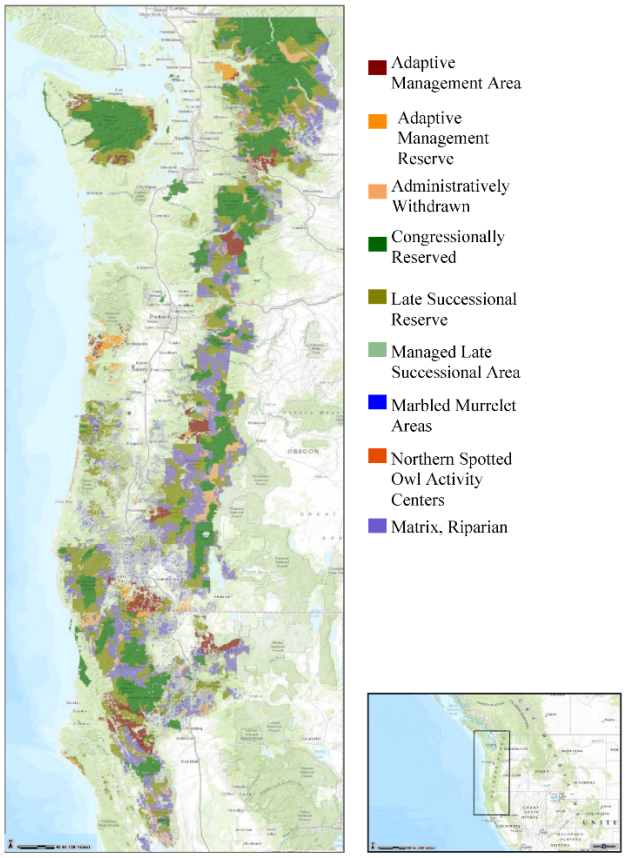


Figure 4.3 Dark shaded areas are the four current populations based on survey effort and verifiable marten detections from Figure 4.2 and updated information. Points indicate detections that do not constitute a population. Light gray is the historical range of coastal marten.



Each of these four populations is at low levels for resiliency and there is no connectivity between the populations, as each is surrounded by heavily harvested private timber lands that coastal marten are unable to cross.[92] Due to this low resiliency, any level of human-caused mortality or habitat loss greatly increases these populations' probability of extirpation, and if that happens, the impacted area could not be recolonized due to the current lack of connectivity.[93] As the USFWS concluded in its SSA, "[a]s a consequence of these current conditions, the viability of the coastal marten now primarily depends on maintaining the remaining isolated populations and potentially establishing new populations in formerly occupied habitat and in strategic locations to restore connectivity between populations."[94]

The protections embedded in the NWFP are one of the main reasons the coastal marten continues to exist. The NWFP significantly decreased forest disturbance on federal lands within the coastal marten's range. As private lands in this same area have been heavily logged, these federal lands provide the last remaining habitat for the species. As shown in the images above, all federal lands within the coastal marten's historic range are

[92] *Id.* (noting marten to sensitive to fragmentation, as it "creates large expanses of unsuitable habitat with little cover, which martens are reluctant to cross or venture into for risk of exposure to predators").

[93] *Id.*

[94] USFWS (2023a) at 98.

managed under the NWFP, with the four remaining coastal marten populations largely on LSRs and Congressionally Reserved lands in this area. Any changes to LSR management could significantly impact the species, particularly considering the coastal marten's low levels of resiliency, redundancy, and representation, and must be carefully analyzed.

The amendment's proposal to significantly increase thinning and open new late-successional stands to treatment by increasing the age of "young" stands from 80 to 120 years in moist LSRs, along with the amendment's ambitious thinning goals broadly, will, as the Forest Service acknowledges, "open up tree canopies" and "negatively impact some closed-canopy dependent species."[95] The coastal marten is one such species. Moriarty (2016) found that forest thinning to reduce fuel density, as the amendment proposes, changes coastal marten movement patterns and habitat use. Thinning decreases forest complexity, requiring martens to expend significantly more energy foraging, as they must move faster and longer distances to avoid predators in more open stands. This is particularly detrimental to coastal marten, as their small size, high metabolic rate, and spatial requirements require high energy expenditure. Any additional expenditure can lower body condition and negatively affect predator elusion and avoidance, foraging, reproduction, and ability to fight off disease and infection.[96] As a result, Moriarty found coastal marten largely avoid openings and stands without significant complexity and recommends fuel treatments occur outside marten habitat.

The DEIS acknowledges treatments in coastal marten critical habitat will increase under Alternatives B and D but alleges "the objectives for those treatments are meant to be consistent with the conservation of those areas and the species that rely on these habitats."[97] Yet the DEIS provides no explanation for how such treatments would be consistent with coastal marten conservation objectives. Considering the findings in Moriarty (2016) outlined above, the Forest Service must explain how proposed treatments would accomplish this.[98]

The amendment's proposal to manage LSRs to create early seral habitat through active management will also negatively impact coastal marten. As described above, coastal marten avoid open stands, as they present an increased risk of predation. Introducing early seral habitat to LSRs will decrease the amount of habitat suitable to the species and further fragment available habitat. Marten are particularly sensitive to

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[95] DEIS at 3-37.

[96] USFWS (2023a).

[97] DEIS at 3-35.

[98] *See also* USFWS (2023a) at 56 (noting that while some thinning may benefit coastal marten in the long term, such projects would "likely result in a short-term degradation, loss, or fragmentation" of suitable habitat and must be "carefully planned" to minimize impacts.

fragmentation as they are unwilling to cross or venture into unsuitable habitat with little cover that exposes them to predators.[99]

The amendment's proposed provisions for salvage logging, including allowing salvage logging in moist LSRs "along existing roads" and, under Alternative D, permitting salvage logging in moist LSR stands up to 120 years old, will also negatively impact the species. Post-fire logging has become a dominant form of extraction in the Northwest's forests, often occurring on federal and private lands under categorical exclusions from environmental review.[100] A drive to "salvage" merchantable timber after a fire disrupts post-fire renewal, especially in riparian areas and late-successional habitats, produces serious impacts to water quality, soil health, biodiversity, future wildfire risk, and forest succession. As such, the salvage logging proposed under the amendment will have direct, indirect, and cumulative impacts on coastal marten.

Logging in fire affected forests is a significant threat to the coastal marten's viability—indeed, recent studies have shown that populations of Pacific marten strongly avoid salvage-logged areas. For instance, Volkmann and Hodges (2021) found that the Pacific marten's ability to persist on the landscape post-fire was tied to the quality of residual habitats, and salvage-logged areas were unsuitable to both coastal marten and their prey due to low overhead cover and low structural complexity. As a result, the animals rarely crossed habitats that had been salvage-logged, as they lack remnant trees and other structures essential to coastal martens. Collier (2024) made similar findings—in that study, Pacific marten selected burned areas with relatively high basal area and stand density index values, highlighting the importance of post-fire forest density, regardless of tree mortality. Salvage logging thus decreases suitable coastal marten habitat and isolates populations.

The Forest Service must also consider the project's cumulative impacts when added to other past, present, and reasonably foreseeable future actions. Logging on state and private lands has severely fragmented and reduced coastal marten habitat, posing an ongoing threat since the species was listed as threatened in 2020. Since the listing decision, hundreds of Timber Harvest Plans ("THPs") have been approved for private lands in counties that support marten populations, including 50 THPs authorized for Green Diamond Resource Company in Del Norte County, California between January 2020 and December 2024 (CalTREES, n.d.). In Oregon, the two known coastal marten populations persist mainly on federal lands bordered by private industrial timber plantations, with some detections occurring on those private lands. Oregon's lax regulation of plantation forestry allows intensive logging practices such as clear-cuts and heavy-equipment roadbuilding,

[99] *Id*.
[100] Bell (2021).

which further degrade habitat connectivity and increase the probability of high-severity wildfire.[101]

Anticoagulant rodenticide ("AR") poisoning from cannabis operations as well as residential uses has emerged as a serious threat to the northwest's wildlife, causing lethal and sublethal effects to exposed animals. Cannabis grows are common in the range of the coastal marten, and individuals have tested positive for anticoagulant rodenticides. And in 2021, when two of five Pacific martens necropsied in northeastern California tested positive for ARs, one of the mortalities was found to be directly caused by AR toxicosis.[102] While recognized as a threat to the coastal marten when the species was listed in 2020, new information demonstrates that the threat of ARs may be more severe than previously known.

Wengert et al. (2021) mapped the distribution of likely cannabis sites in forested regions of California and southern Oregon, then overlayed the grow-site risk map with a map of the coastal marten's "core" habitats. Even without using a map of all suitable coastal marten habitat, the study found that there was over 37% overlap of key habitat core areas with moderate-high grow site likelihood, indicating that the threat of ARs from trespass grows is "significant."

The threat of AR poisoning was previously perceived as affecting only individual coastal martens rather than their population as a whole. However, because over 37% of the coastal marten's core habitats have a moderate to high likelihood of overlapping with trespass grow sites, this threat is likely more pervasive than previously thought. Further, the model did not address AR exposure from residential areas, which is likely higher for the Central Coastal Oregon ("CCO") population area. Given the high extinction risk associated with the loss of even a few individual coastal martens, AR poisoning likely represents a population-level threat to the species, warranting its listing as endangered.

In conclusion, the best available scientific data indicates the proposed NWFP amendment would likely cause significant harm to coastal marten. By failing to adequately disclose or analyze these impacts in the DEIS, the Forest Service violates NEPA's fundamental requirement to provide a detailed, species-specific viability analysis and to fully inform the public of the ecological consequences of its actions. The DEIS also fails to ensure the viability of the threatened coastal marten as required by NFMA, and to provide for its conservation and recovery as the ESA mandates.

3. Survey and Manage Species and Other Wildlife

The Forest Service's failure to adequately analyze impacts extends beyond federally listed species to the hundreds of other wildlife species dependent on late-successional

[101] Zald & Dunn (2018).
[102] Martin et al. (2022).

forest ecosystems throughout the NWFP area. The DEIS lacks substantive analysis of how the proposed increases in commercial timber harvest, creation of early seral habitat in LSRs, and changes to forest structure would affect wildlife communities more broadly. Survey and Manage (S&M) species—approximately 400 late-successional forest-dependent amphibians, bryophytes, fungi, lichens, mollusks, vascular plants, arthropods, and mammals—receive particularly short shrift in the analysis, despite being a critical "fine filter" component of the original NWFP's conservation strategy.

This analytical gap is particularly concerning given Alternative D's proposal to exempt vegetation management within 0.25 mile of certain areas from pre-disturbance surveys for S&M species and associated management requirements.[103] While the DEIS acknowledges this would reduce constraints on mechanical treatments and potentially impact "up to 10 acres per hypothetical undetected occurrence," it fails to quantify how many such occurrences might exist across the landscape or analyze the cumulative effect of these exemptions on population viability. The DEIS admits these changes "may negatively impact unknown locations of S&M species requiring closed canopy forests, down wood, or undisturbed soil or litter habitat conditions" but provides no scientific analysis of the magnitude or ecological significance of these impacts.

The DEIS attempts to justify these exemptions by suggesting there would be "short- and long-term benefits by reducing the threat of habitat loss or degradation due to high severity fire within and adjacent to areas being treated."[104] However, this conclusion rests on dubious and unsubstantiated assumptions about treatment efficacy that are not supported by site-specific analysis or scientific literature addressing the specific habitat needs of affected S&M species. Many late-successional forest-dependent species have evolved with and adapted to natural disturbance regimes, including periodic fire, but are highly vulnerable to habitat alterations from mechanical treatments that remove key structural elements like canopy cover, down wood, and soil structure.

The Forest Service has failed to provide both the ecosystem-wide and species-specific plan components required by the 2012 Planning Rule (36 C.F.R. § 219.9). Despite acknowledging that increased active management might adversely impact species (DEIS 1-7, 3-34), the agency simply asserts—without scientific support or reasoned analysis—that it does not "anticipate a substantial adverse impact to a species or population because of the proposed amendment."[105] This unsupported conclusion is impossible to reconcile with the proposal to significantly expand logging in late-successional reserves and other forest habitats, including exemptions from critical survey requirements, and the admission that logging in critical habitat areas is expected to increase under Alternatives B and D.[106]

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[103] DEIS at 3-65.
[104] DEIS at 3-66.
[105] DEIS at 1-7.
[106] DEIS at 3-35.

For a plan amendment that would fundamentally alter a landscape-scale ecosystem management framework specifically designed to maintain wildlife diversity, this analytical gap is inexcusable and legally indefensible under both NEPA and NFMA. The Forest Service must conduct a rigorous analysis of impacts to S&M species and other wildlife before proceeding with any amendment to the NWFP, particularly one that would weaken the very survey requirements designed to ensure these species' persistence.

F. Proposed Amendments Undermine Late-Successional Reserves.

The Forest Service defined one clear objective for LSRs in the NWFP: "*Protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth related species including the northern spotted owl.*"[107] With these species in continued decline and the ongoing loss of mature and old-growth forest habitats across their ranges, this purpose remains as vital today as it was when the NWFP was adopted.

The DEIS introduces significant changes to LSR management, particularly by expanding the age threshold for eligible treatments in moist forests from 80 to 120 years. Under the 1994 NWFP, management activities in moist LSRs were generally restricted to stands under 80 years old to accelerate late-successional conditions. Both Alternatives B and D raise this threshold, allowing forest management activities in moist LSRs up to 120 years old.[108] The DEIS states that this change is intended to provide more opportunities to promote late-successional characteristics while incorporating newer scientific understandings of forest development.[109]

While the Forest Service insists it is not proposing changes to the land use allocation map and will retain existing LSR and Riparian Reserve boundaries,[110] the proposed management revisions effectively overhaul the entire land use allocation framework, marking a significant departure from over 30 years of practice.

1. Raising the 'Young Stand' Threshold from 80 to 120 Years Undermines the Purposes of LSRs.

The proposed change to increase the upper age limit for "young" stands from 80 to 120 years expands the area subject to active management within moist LSRs.[111] This adjustment effectively reclassifies approximately 824,000 acres of previously protected forest as eligible for treatment, without a clear basis in science or identified shortcomings of existing management.[112]

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[107] Northwest Forest Plan, Standards and Guidelines at C-9 (1994).
[108] DEIS at 2-14 (FORSTW-LSR-MOI-STD-01-B/D).
[109] DEIS at 3-25–26.
[110] DEIS at 3-32.
[111] DEIS at 3-25.
[112] DEIS at 3-26.

The NWFP's network of conservation reserves and ecosystem management approach has been effective in supporting late-successional forest recovery over its first three decades. DellaSala et al. (2015) conducted a comprehensive assessment of the NWFP's implementation and found that the plan's reserve network has successfully protected many mature and old-growth forest ecosystems from logging. Based on this progress, the authors recommend continued protection of all remaining late-successional and old-growth forests to sustain these gains in the face of climate change and increasing land-use pressures.[113]

Mixed conifer forests in the Pacific Northwest require biomass accumulation and the natural recruitment of downed wood to develop late-successional characteristics. Wilson and Forsman (2013) found that thinning in mature forests reduces midstory structural complexity, and that midstory recovery "may take several decades or longer" before it provides adequate cover and canopy connectivity for wildlife including spotted owls and their prey species.[114] This extended recovery period raises concerns about whether increasing thinning in older stands aligns with the long-term objectives of LSRs.

The DEIS's singular focus on stand age neglects the importance of other critical habitat parameters such as canopy cover. Sovern et al. (2019) found that northern spotted owls selected for areas with high canopy cover regardless of stand age, with canopy cover being a more reliable predictor of habitat use than forest age alone. Similarly, Sovern et al. (2014) demonstrated the importance of high canopy cover for dispersing juvenile northern spotted owls. By focusing narrowly on age thresholds without adequately considering these other habitat parameters, the DEIS fails to consider essential aspects of northern spotted owl habitat conservation.

Raising the threshold from 80 to 120 years also risks exacerbating competition between northern spotted owls and barred owls. As old-forest habitat becomes more fragmented and scarce, northern spotted owls are forced to travel farther to locate suitable nesting, roosting, and foraging areas, pushing them into direct conflict with barred owls that occupy overlapping ranges. Hamer et al. (2007) found that northern spotted owl home ranges expand as the amount of old forest declines—an effect not seen to the same degree in barred owls—amplifying pressure on the already vulnerable spotted owl.[115] Dugger et al. (2011) likewise demonstrated that barred owls negatively affect spotted owl occupancy and survival, concluding that these intensifying competitive pressures "increase the importance of conserving large amounts" of old-growth habitat to support spotted owl

[113] DellaSala et al. (2015).
[114] Wilson & Forsman (2013) at 84.
[115] Hamer et al. (2007).

persistence.[116] Wiens (2014) found that spotted owls actively avoid areas used by barred owls and that survival of both species was positively associated with the proportion of old (>120 years) conifer forest within their home ranges, indicating that "availability of old forest was a potential limiting factor in the competitive relationship between the two species." Baumbusch (2023) recently further confirmed this competitive dynamic, finding that barred owls' broad diet and generalist habitat use have enabled them to expand throughout the northern spotted owl's range and outcompete this threatened species. Baumbusch's analysis of over 1,300 barred owl specimens revealed that while barred owls consume many of the same prey species as spotted owls, they achieve much higher population densities and have greater energetic demands, intensifying resource competition across shared territories.[117] By extending the definition of "young" forests to 120 years and opening more older stands to logging, the DEIS risks forcing northern spotted owls to range even farther afield, thereby heightening the likelihood of encounters with barred owls—encounters that seldom end in the spotted owl's favor.

Despite all this evidence cautioning against raising the age of "young" standards from 80 to 120 years, plus the essential carbon storage role played by trees in the 80 to 120 years range as discussed below, the Forest Service proposes to make this change without providing adequate justification for its proposal. The Administrative Procedure Act requires federal agencies to provide reasoned explanation for significant shifts in policy, such as changing the age of "young" stands that underpins the structure of the NWFP. Yet the agency's meager explanation here is that this change is to account for the passage of time since the NWFP was enacted. Yet the math does not add up. The NWFP was adopted in 1994—30 years before the Forest Service published this DEIS, while the Forest Service proposes to increase the age of "young" stands by 40 years. The Forest Service does not explain this discrepancy.

The proposed shift in age threshold from 80 to 120 years is inconsistent with the purpose of LSRs—to "serve as habitat for late-successional and old-growth related species including the northern spotted owl"—as outlined above. If the purpose of raising the threshold from 80 to 120 years is, as the Forest Service alleges, to "provide more opportunities for treatments to accelerate the development of late-successional and old-growth characteristics," the Forest Service must at minimum delineate between stand origin.[118] While there may be some conceivable explanation for treatment in former plantations, there is no justification for treatment in areas that have naturally regenerated

[116] Dugger et al. (2021); *see also* Weisel (2015), which found that both owl species use similar habitat features but in different ways, highlighting how reducing complex forest structures through logging further may constrain the spotted owl's ability to coexist with barred owls.

[117] Baumbusch (2023).

[118] DEIS at ES-7. This still does not justify increasing the age of young stands.

and, as the best available science indicates, have entered the "mature phase of stand development" and begun to display late-successional characteristics.[119]

2. New Logging Exceptions in Moist LSRs.

The proposed action (Alternative B) and Alternative D would authorize logging in moist "young" stands up to 120 years old—a significant expansion from previous restrictions.[120] Additionally, all alternatives include exceptions permitting logging to "restore habitat for other species that depend upon younger stands" and to "achieve other desired conditions."[121] These vague, open-ended exceptions lack clear parameters or scientific justification.

Northern spotted owls are highly dependent on structurally complex older forests.[122] Spotted owls strongly select for old forest habitat, with Hamer et al. (2007) finding 57% of individuals using old forests more than expected based on availability, and none using less. The authors also found spotted owl home range size is strongly negatively correlated with the amount of old forest available, indicating that higher quality habitat allows owls to meet their needs in smaller areas.[123] Promoting early seral characteristics through active management will not benefit northern spotted owls and is therefore inconsistent with the purpose of the Late Successional Reserves: to protect the habitat of species that depend on ***late–successional*** forest conditions.

The DEIS proposes expanded salvage logging allowances in moist LSRs but fails to take a hard look at the effect of salvage logging on northern spotted owls in a post-fire landscape.[124] Spotted owls can use and benefit from the ecological diversity created by fires.[125] Even in severely burned landscapes, key habitat elements can remain, including standing dead trees for perching and residual live trees.[126] Salvage logging removes these structural components and can simplify post-fire landscapes, reducing their ecological value. Rockweit et al. (2024) recently found that post-fire salvage logging within an owl's core use area likely negatively affects survival.[127] The DEIS fails to take a hard look at the compounding harm of salvage logging on spotted owls on post-fire landscapes, or the ability of the LSRs to fulfill their primary purpose of maintaining and developing late-successional forest conditions.

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[119] FEMAT 1993 at IV-28, IV-39.
[120] DEIS at 2-14 (FORSTW-LSR-MOI-STD-01-B).
[121] DEIS at 2-16 (FORSTW-LSR-MOI-GDL-01-B/D).
[122] USFWS (2011), III-42.
[123] Hamer et al. (2007).
[124] DEIS at 2-15 (FORSTW-LSR-MOI-STD-02-B/D).
[125] Hanson et al. (2009).
[126] Hanson et al. (2009); Rockweit et al. (2024).
[127] Rockweit et al. (2024).

With allowances for increased thinning and salvage logging, and management practices that promote early seral characteristics within LSRs, the proposed amendments risk undermining the integrity of the reserve network. The Forest Service has not demonstrated that these changes are necessary to achieve the fundamental purpose of LSRs of maintaining and developing late-successional forest conditions for species that depend on them.

3. Dry LSR Management.

The DEIS proposes a substantial increase in active management within dry LSRs, with a stated goal of improving ecological resilience and reducing wildfire risk. Alternative B introduces a new plan objective to treat one-third of dry forests across the NWFP area within 15 years—approximately 527,000 to 643,000 acres per decade—using ecological forestry methods while retaining older trees and promoting the development of future old-growth forests.[128]

Alternative B also includes a new standard limiting the harvest of trees over 150 years old across all land use allocations, including LSRs.[129] However, exceptions are permitted for tribal co-stewardship and cultural uses, restoration of unique ecosystems, and wildfire risk reduction near communities and infrastructure.[130] Alternative B additionally permits limited fuel management salvage in dry LSRs when it aligns with restoration goals, fire resilience, wildlife needs, and local community interests.[131] Salvage operations must retain a high number of large snags and all live trees, though further exceptions apply near critical infrastructure and along system roads.[132]

Beyond dry LSRs, the DEIS outlines broader fire resilience objectives across all land use allocations. These include treating 2.65 million acres per decade through various fuel treatments and using prescribed and managed wildfire on 1.75 million acres per decade.[133] The plan also expands the strategic use of wildland fire to mitigate wildfire intensity and severity while supporting cultural burning practices and ecosystem regeneration.[134]

While these provisions aim to increase forest resilience, the DEIS fails to consider research indicating that large-scale thinning and salvage logging in dry LSRs may have limited effectiveness and significant ecological trade-offs. The DEIS assumes mechanical thinning will meaningfully reduce fire severity but does not engage with research that challenges this premise. Hanson et al. (2009) observed lower rates of high-severity fire in mature and old-growth forests than commonly assumed and reported old-forest

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[128] DEIS at 2-18.
[129] DEIS at 2-18 (FORSTW-ALL-DRY-STD-01-B).
[130] DEIS at 2-18 (FORSTW-ALL-DRY-OBJ-01-B).
[131] DEIS at 2-20 (FORSTW-ALL-DRY-GDL-03-B).
[132] DEIS at 2-11–2-13.
[133] DEIS at 2-20 (FIRE-ALL-OBJ-01-B, FIRE-ALL-OBJ-02-B).
[134] DEIS at 2-21 (FIRE-ALL-PMA-B).

recruitment occurring at 5.5 to 10.9 times the rate of loss to high-severity fire. Law et al. (2023) further question the efficacy of landscape-scale thinning for wildfire resilience, finding that only about 1% of treated areas experience wildfire annually, which calls into question the effectiveness of large-scale fuel reduction as a primary fire mitigation strategy and highlights the tradeoffs it entails. The Forest Service must at least grapple with these studies before undertaking such broad-scale management changes with significant ecological impacts.

The DEIS also overlooks recent research examining how wildfire affects northern spotted owl habitat, even though this species is a key indicator of late-successional forest health. A systematic review and meta-analysis by Lee et al. (2018) found no evidence that mixed-severity fire is a primary driver of northern spotted owl population declines. Instead, owls demonstrated a preference for foraging in low- and moderate-severity burned forests, and mixed-severity fire appeared to offer ecological benefits by increasing prey abundance. Far from rendering landscapes purely destructive, the studies indicated that burned forests often retain essential habitat features for northern spotted owls.[135] More recently, Rockweit et al. (2024) found no measurable population-level effects of wildfire on northern spotted owls from 1987 to 2018, though individual owls exhibited greater sensitivity to fire severity within their core use areas.[136] These findings suggest that while certain high-severity burns may harm individual owls, the broader assumption that wildfire poses a principal threat to the species is not strongly supported by empirical data.

Mature and old-growth forests with complex structures and dense canopies can serve as natural fire refugia, mitigating fire impacts even under increasingly frequent wildfire conditions. Northern spotted owls typically select habitats with large trees and extensive canopy cover—traits commonly associated with old-growth forests. Lesmeister et al. (2019) found that these nesting and roosting habitats burned at lower severity during high-fire conditions than surrounding forest types, suggesting that protecting large blocks of structurally complex older forests may help buffer ecosystems against climate-driven increases in fire severity. Similarly, Lesmeister et al. (2021) synthesized data from 472 large wildfires over a 30-year period and reported that interior nesting forests for northern spotted owls consistently burned at lower severity than adjacent non-nesting forests across most fire regimes. Bradley et al. (2016) likewise found that forests with higher levels of protection burned at lower severity despite having more biomass and fuels, based on an analysis of 1,500 fires spanning 9.5 million hectares of pine and mixed-conifer forests. Together, these studies underscore the potential role of intact older forests—particularly in remote areas of dry LSRs—as natural fire refugia, suggesting that maintaining their structural complexity may enhance fire resilience and provide wildlife an important refuge during increasing wildfire activity.

[135] Lee et al. (2018).
[136] Rockweit et al. (2024).

Further research not considered in the DEIS highlights ecological trade-offs associated with large-scale mechanical thinning, suggesting these treatments may have unintended adverse impacts that the DEIS has not thoroughly analyzed. Expanding road networks to facilitate logging operations can also contribute to habitat fragmentation, further degrading ecological integrity. DellaSala et al. (2022a) caution that mechanical thinning operations in dry forests can result in the removal of fire-resistant live trees and snags, which are critical structural elements for wildlife habitat and carbon storage.

The intense scientific debate over how best to manage dry LSRs underscores the need for a more comprehensive evaluation of trade-offs. While some research supports targeted thinning to protect communities and reduce fire spread in the wildland-urban interface, other studies suggest that maintaining complex forest structure may enhance natural fire resilience in remote areas. The DEIS does not fully engage with this body of literature or even acknowledge the scientific debate, raising questions about whether its proposed management framework sufficiently accounts for the potential ecological costs and uncertainties associated with large-scale thinning and salvage logging in dry forests. A more thorough assessment of ecological trade-offs would help clarify whether the proposed scale and intensity of thinning and salvage logging in dry LSRs will be as effective as assumed and whether it sufficiently balances wildfire risk reduction with habitat conservation and climate resilience. The Forest Service must at least take a "hard look" and grapple with these issues.

Finally, the DEIS fails to quantify precise logging targets under each alternative, providing only broad ranges rather than specific, measurable objectives. This lack of specificity undermines NEPA's fundamental purpose of ensuring agencies identify, consider, and disclose to the public relevant environmental information early in the process before decisions are made and actions taken. Without clearly articulated harvest targets, the public is denied the transparent, data-driven scientific analysis that NEPA requires. This lack of specificity is especially concerning given that research indicates spotted owls are most productive in drier mature forests, where they are more able to persist against competitive pressure from barred owls.[137] A more thorough assessment of ecological trade-offs is needed to clarify whether the proposed scale and intensity of thinning and salvage logging in dry LSRs will be as effective as assumed and whether it sufficiently balances wildfire risk reduction with habitat conservation and climate resilience. The Forest Service must at least take a "hard look" and grapple with these issues.

G. Matrix Lands Management.

Alternative B eliminates substantive restrictions on logging in Matrix stands up to 120 years old (established after 1905), with projected logging of 81,000 acres per decade explicitly "to bolster timber production," with even more ambitious goals under Alternative

[137] Hamer & Verschuyl (2009); Irwin et al. (2008).

D.[138] This scale of harvest—over 126 square miles of forest per decade under Alternative B and over 250 under Alternative D—represents a significant departure from the NWFP's balanced approach to Matrix management.[139] The DEIS fails to adequately analyze how this intensive logging will affect the recruitment of future old-growth stands, which was an essential component of the NWFP's long-term conservation strategy.

The DEIS also fails to meaningfully distinguish between different stand histories when authorizing Matrix harvest. Stands under 120 years old often exhibit key late-successional forest attributes—such as multiple canopy layers, abundant snags, and downed wood—particularly if they regenerated naturally rather than through plantation-style management.[140] Research consistently finds that natural forests develop greater structural complexity over time, including diverse age classes, spatial heterogeneity, and a higher density of large-diameter trees—attributes often lacking in intensively managed plantations.[141] These structural differences are not just aesthetic but are critical for wildlife habitat, as natural stands provide more suitable conditions for species dependent on late-successional forests, such as the northern spotted owl.[142] Plantation forests, by contrast, tend to be more uniform in age and species composition, often lacking the complex habitat features necessary to support diverse wildlife communities.[143] By treating all stands below 120 years old as categorically open to harvest, the DEIS bypasses any deeper assessment of whether some of those stands supply critical habitat or exhibit late-successional characteristics, undermining the NWFP's conservation framework.

Even more concerning, the DEIS permits discretionary logging in Matrix stands up to 200 years old (established between 1825 and 1905) under the broad exception for "reducing the risk of fire."[144] This vague justification effectively eliminates the recruitment of additional old growth, as virtually any stand could be logged under this rationale. Compounding this problem, the DEIS's approach of hardcoding establishment dates (*e.g.,* 1905) rather than using stand age ensures permanent exclusion of forests from protection in the Matrix, accelerating habitat loss.[145] Under this framework, stand acreage eligible for harvest arguably will increase over time as older stands are lost to wildfire, disease, or insect outbreaks and replaced by newly maturing stands. As stands established after 1905 would not be able to mature into protection as stands can under the current NWFP

[138] DEIS at 2-17.
[139] DEIS at 2-17, 3-33.
[140] Swanson et al. (2011).
[141] Franklin et al. (2002).
[142] USFWS (2011), III-16, G-2.
[143] Lindenmayer & Franklin (2002); Brockerhoff et al. (2008).
[144] DEIS at 3-25.
[145] DEIS at 2-5.

structure, this hardcoding approach would effectively ensure a "rolling brown-out" scenario where protected habitat steadily decreases over time.

By preventing newly maturing forests from receiving protection as they develop late-successional characteristics, the amendment would arguably result in the total amount of protected habitat steadily declining due to natural disturbances and climate change impacts, without any mechanism for replacement. The Forest Service has not explained what, if any, changed circumstances in the field required this radical departure from established paradigms that have been in place for over three decades. As such, the Forest Service has not provided the "hard look" NEPA requires or the reasoned explanation for this change required by the APA.

E. Climate Change and Carbon Accounting.

As the Intergovernmental Panel on Climate Change recently stressed in its Sixth Assessment Report, addressing the most up-to-date physical understanding on climate systems and climate change, it is unequivocal that human influence is warming the climate at an unprecedented rate.[146] Global temperatures have increased 1.1 degrees Celsius over the last century due, in large part, to unsustainable energy use and land use patterns, including forestry. In 2019, atmospheric CO2 concentrations were higher than at any time in the past two-million years, with these historic highs undoubtedly caused by greenhouse gas emissions from human activities. "US net greenhouse gas emissions remain substantial and would have to decline by more than 6% per year on average, reaching net-zero emissions around midcentury, to meet current national mitigation targets and international temperature goals; by comparison, US greenhouse gas emissions decreased by less than 1% per year on average between 2005 and 2019."[147]

This rapid change in global temperature has ushered in unprecedented weather and climate extremes in every region across the globe, which has led to devasting impacts to both people and ecological communities. The following is a list of just a few highlighted in the IPCC's report:

- "In all regions increases in extreme heat events have resulted in human mortality and morbidity;"
- "Climate change has reduced food security and affected water security;"
- "Economic damages from climate change have been detected in climate-exposed sectors, such as agriculture, forestry, fishery, energy, and tourism. Individual livelihoods have been affected through, for example, destruction of homes and infrastructure, and loss of property and income, human health and food security;"

[146] IPCC (2023a); IPCC (2023b).
[147] USGCRP (2023).

- "Hot extremes have intensified in cities. Urban infrastructure, including transportation, water, sanitation and energy systems have been compromised by extreme and slow-onset events;" and
- "Climate change has caused substantial damages, and increasingly irreversible losses, in terrestrial, freshwater, cryospheric, and coastal and open ocean ecosystems. Hundreds of local losses of species have been driven by increases in the magnitude of heat extremes with mass mortality events recorded on land and in the ocean. Impacts on some ecosystems are approaching irreversibility."[148]

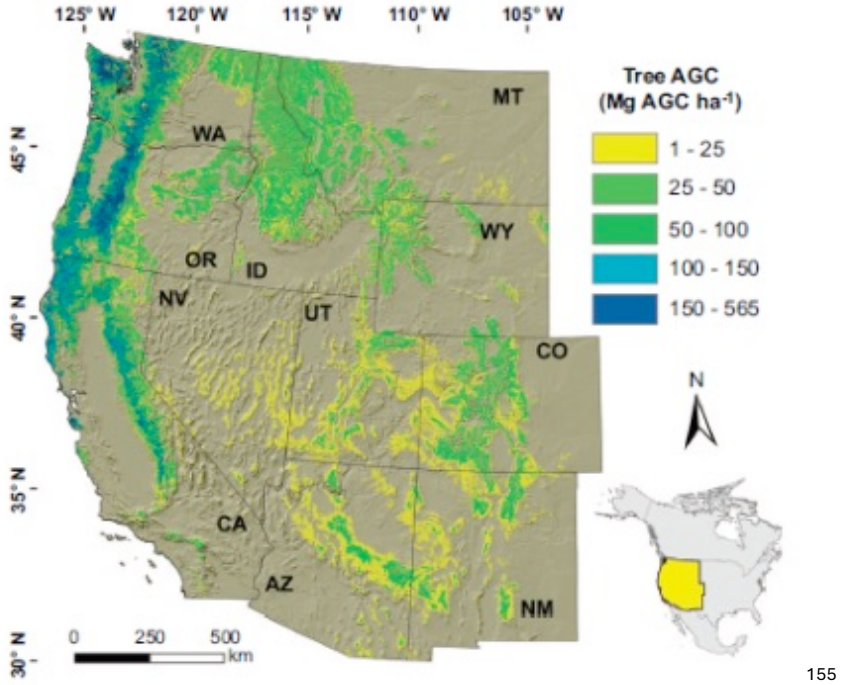
These impacts will not abate absent swift, decisive action to address this crisis. While some future changes are unavoidable and/or irreversible due the already significant accumulation of CO2 in the atmosphere and associated warming, rapid and sustained greenhouse gas emissions reductions are necessary to circumvent the worst potential climate change impacts. With approximately 3.3 to 3.6 billion people living in regions highly vulnerable to climate change and climatic hazards, and the United States already experiencing a billion-dollar weather or climate disaster every three weeks, rapid action is imperative.

Forests play a critical role in combating climate change by capturing carbon dioxide and storing carbon within soils and forest biomass. Forests account for 92% of all terrestrial biomass globally and store approximately 400 gigatons of carbon, or 45% of the total organic carbon on land, in their biomass and soils.[149] On average, forests remove the equivalent of about 30% of the carbon dioxide emitted through fossil fuel emissions.[150] Temperate forests play an inordinately important role in moderating climate change, with 44% of annual forest carbon dioxide capture attributed to temperate forests.[151] Temperate forests of the United States are the largest category of land sinks in the country, consistently offsetting about 14% of the nation's CO2 emissions.[152]

Forests in the NWFP area are globally unique in their capacity to capture and store immense amounts of carbon. The Forest Service acknowledges, yet understates, these forests' importance for mitigating climate change, noting in the DEIS that "[f]orests in the Pacific Northwest can affect the rate of global climate change through the uptake and storage of carbon in living and dead materials, aboveground biomass, and soils." The region's unique combination of long-lived tree species, such as Douglas-fir, western hemlock, and western redcedar, and climate, with mild fall and winter conditions following by long, dry summers, facilitates the development of forests characterized by big trees and

[148] *See also* Ripple et al. (2022); Ripple et al. (2024).
[149] Law et al. (2022).
[150] Mildrexler et al. (2023); Law et al. (2022).
[151] Mildrexler et al. (2023).
[152] Mildrexler et al. (2020).

complex forest conditions that support large amounts of biomass—an ideal combination for the capture and storage of large amounts of carbon.[153] It is not surprising, then, that the five National Forests with the highest mean tree carbon density in the United States—the Suislaw, Olympic, Gifford Pinchot, Mt. Baker Snoqualmie, and Willamette—are all within the NWFP area.[154]



[155]

Managing forests in the NWFP area under conditions that preserve and encourage carbon storage is imperative considering their national and global role in addressing the climate crisis. Intensive timber harvest, particularly harvest focused on large, high-biomass trees in late-successional forests, in the twentieth century contributed to a negative net carbon balance on these forests. It was only with the development and implementation of the NWFP that these forests returned to being a net carbon sink—with carbon uptake from the atmosphere exceeding emissions from harvest, wood product use and decomposition, and wildfire.[156] As Krankina 2012 documents, "the NWFP has led to a considerable increase in [carbon] stores on federal forest lands within the first decade of plan implementation and this trend can be expected to continue for several decades into the future"—that is, "*if the limits on timber harvest set under the NWFP are maintained*."

Despite the Forest Service acknowledging these forests' important role in mitigating climate change, it provides scant analysis of the project's climate impacts. The Forest

[153] Smithwick et al. (2002).
[154] Law et al. (2023).
[155] Berner et al. (2017) (depicting above ground carbon stores).
[156] Krankina et al. (2012); Krankina et al. (2014); Law & Waring (2015); Hudiburg et al. (2019).

Service makes no attempt to quantify, or even estimate, the project's greenhouse gas emissions and impacts to carbon stores, compare how the alternatives would impact carbon stores, and evaluate if the project would significantly impact the environment, as required by NEPA.

1. The DEIS Fails to Take a Hard Look at the Project's Climate Impacts.

NEPA requires the Forest Service take a "hard look" at the direct, indirect, and cumulative effects of proposed agency action. NEPA's hard look standard requires agencies to provide "quantified or detailed information" and "[g]eneral statements about possible effects and some risk do not constitute a hard look absent a justification regarding why more definitive information could not be provided.'" *See Klamath-Siskiyou Wildlands Ctr. v. Bureau of Land Mgmt.*, 387 F.3d 989, 993–97 (9th Cir. 2004); *Ocean Advocates v. U.S. Army Corps of Eng'rs*, 402 F.3d 846, 865 (9th Cir. 2004). The fact that an agency may not be able to define, with precision, a project's incremental or specific impacts does not absolve the agency from its obligation to provide high quality information and accurate scientific analysis. *350 Montana v. Haaland*, 50 F.4th 1254, 1272 (9th Cir. 2022). The agency must still grapple with the issue, providing the information that is known and employing a "methodology that satisfies NEPA and the [Administrative Procedure Act]" in evaluating a project's impacts on the environment. *Id*.

Evaluating a project's impacts on climate change is required by statute, caselaw, and CEQ guidance. 42 U.S.C. § 4332; *Center for Biological Diversity v. U.S. Forest Service*, 687 F. Supp. 3d 1053, 1073 (D. Mont. 2023); National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change, 88 Fed. Reg. 1196, 1197 (Jan. 9, 2023); *see also* CEQ, Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews (Aug. 2016). Notably, NEPA expressly calls on agencies to provide for intergenerational equity, stating that it is intended to "fulfill the responsibilities of each generation as trustee of the environment for succeeding generations." 42 U.S.C. § 4331(b)(1). Because climate change poses long-term, intergenerational impacts, agencies applying NEPA must account for both how climate change might alter a project's environmental consequences and how the proposed project might exacerbate or mitigate climate change. *See, e.g., Mid States Coal. for Progress v. Surface Transp. Bd.*, 345 F.3d 520, 550 (8th Cir. 2003). Such evaluation is particularly important where, as here, "adaptation to and mitigation of climate change" is cited as a principal motivation for a federal action.[157]

The Forest Service's analysis of effects on carbon stewardship falls far short of this mark. The analysis is exceedingly vague, noting that "[f]uels treatments that would be implemented under the action alternatives all involve a tradeoff between emissions

[157] DEIS at ES-1.

resulting from treatment activities, loss or conversation of carbon stored within the biomass that is removed, improved growth potential of remaining trees due [*sic*] decreased competition for resources, and the potential carbon saved from release by wildland fire associated with the decreased fire risk."[158] The Forest Service then concludes it is "infeasible to develop reliable, quantified estimates of the potential long-term changes in greenhouse gas emissions or carbon sequestration that may result from different types of treatments in different types of landscapes." The sum of its analysis is, ultimately, that "across alternatives, varying levels of treatments would be expected, broadly, to have different effects on carbon." While this statement is, technically, true—the alternatives would be expected to have different effects on carbon—it is not a "hard look."

Contrary to the Forest Service's contention, it is feasible to compare the varying effects the alternatives would have on carbon stores. The DEIS overlooks the substantial body of scientific literature on carbon emissions involved in the very "tradeoff" the Forest Service identifies—specifically those from wildfire versus timber harvest intended to decrease fire risk. Recent advances in the scientific understanding of wildfire demonstrates that the percentage of a stand combusted in a wildfire—of both low and high severity fires—is significantly less than previously assumed.[159] This, along with an evolved understanding of the dynamics of carbon release from timber harvest, demonstrates that timber harvest reduces natural forest carbon sinks significantly more than wildfire.

Campbell et al. (2012), for example, evaluates how fuel treatments, wildfire, and their interactions affect forest carbon stocks across a wide range of spatial and temporal scales. The authors were interested in how fuel-reduction treatments affect carbon stocks, and particularly in investigating the common assumption that short-term losses in forest biomass associated with fuel-reduction treatments are more than made up for by reducing future wildfire emissions. The authors ultimately concluded that, across a range of treatment intensities, protecting one unit of carbon from wildfire combustion came at the cost of removing approximately three units of carbon in treatments. These results were based on simulations of fires in Oregon semiarid ponderosa pine forests, such as the dry forests in the Northwest Forest Plan area.

One of the reasons for this is that Campbell et al. (2012) and other have shown that forests do not "burn to the ground"—with affected stands fully combusted—during wildfires, a previously widely held assumption. The reality is only a small portion of fuels in any given stand combust in wildfires—low, medium, and severe intensity fires.[160] Rather than entire stands burning to the ground, it is only fine surface fuels and surface char that

[158] DEIS at 3-92.

[159] Campbell et al. (2012); Gray et al. (2014); Stenzel et al. (2019); Bartowitz et al. (2022); DelaSalla et al. (2022b); Harmon et al. (2022); Law et al. (2022); Moomaw et al. (2023).

[160] Campbell et al. (2012); Stenzel et al. (2019); Bartowitz et al. (2022); Harmon et al. (2022); Law et al. (2022).

releases carbon immediately during fires.[161] As Campbell et al. (2012) notes, "[e]ven under the most extreme fuel-moisture conditions, the water content of live wood frequently prohibits combustion beyond surface char; this is evident in retention of even the smallest canopy branches after high-severity burns." This is captured in the following image from Stenzel et al. (2019):

FIGURE 2 Post-fire forest landscapes following different, varying severity fires in Oregon. (a) Ponderosa pine—low severity patch 4 years after the 2003 B&B Complex mixed severity fire (28,640 ha; photo by G. Meigs), (b) Mixed conifer—moderate severity patch 4 years after the 2003 B&B complex (photo by G. Meigs), (c) Ponderosa pine—high-severity patch 2 years after the 2002 Eyerly mixed severity fire (photo by T. Hudiburg) and (d) Ponderosa pine—high-severity patch 5 years after the 2002 Eyerly fire (photo by B.E. Law) [Colour figure can be viewed at wileyonlinelibrary.com]

Stenzel et al. (2019) highlights that even for trees that do suffer mortality during wildfires, it is wrong to equate mortality with combustion, as dead snags and downed wood release carbon over decades to centuries, not immediately. Law et al. (2022a), summing up some of this research on wildfire carbon emissions, notes:

> While moderate to high severity fire can kill trees, most of the carbon remains in the forest as dead wood that will take decades to centuries to decompose. Less than 10% of ecosystem carbon enters the atmosphere as carbon dioxide in PNW forest fires. Recent field studies of combustion rates in California's large megafires show that carbon emissions were very low at the landscape-level (0.6 to 1.8%) because larger trees with low combustion rates were the majority of biomass, and high severity fire patches were less than half of the burn area. These findings are consistent with field studies on Oregon's East Cascades wildfires and the large Biscuit Fire in southern Oregon.[162]

[161] Campbell et al. (2012); Stenzel et al. (2019); Harmon et al. (2022).

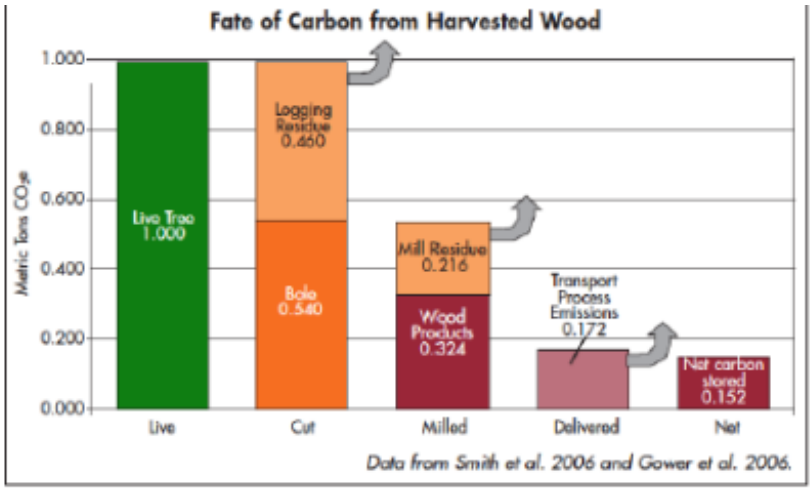
[162] Law et al. (2022a) (discussing Campbell et al. (2012); Law & Waring (2015); Stenzel et al. (2019); Harmon et al. (2022)).

While wildfire emissions have been overestimated, the opposite is true for carbon emissions associated with timber harvest.[163] Many past studies have erroneously assumed harvest fuel treatments benefit natural carbon sinks—that harvested wood is saved from fire and stored in long-term wood products, which only release carbon over decades to centuries as these products decay.

In reality, much of the carbon from harvesting is released almost immediately or within a short period, with very little stored in long-term wood products. Wood harvest results in immediate (burning residue on-site or mill residue), fast (short-lived products like paper), decadal (long-lived products like wood), and long-term (buildings/land fill) carbon release.[164] Law et al. (2022a) describes the carbon dynamics of harvest as follows:

> Approximately half of the aboveground carbon is removed and taken to the mills (as wood) while the other half remains behind in slash piles (leaves, bark, branches, etc.) and in the dead belowground roots. The slash is burned on-site and the carbon is immediately emitted to the atmosphere. The roots decompose over the next few decades, emitting carbon to the atmosphere. The carbon taken to the mill as wood is processed into short- and long-term wood products (red line), that decay over years to centuries, eventually returning the carbon to the atmosphere. Estimates comparing carbon benefits of wood products to alternative materials have been found to overestimate the benefit by factors of between 2- and 100-fold by not counting the full life cycle carbon and the shorter durability of wood relative to alternative materials.[165]

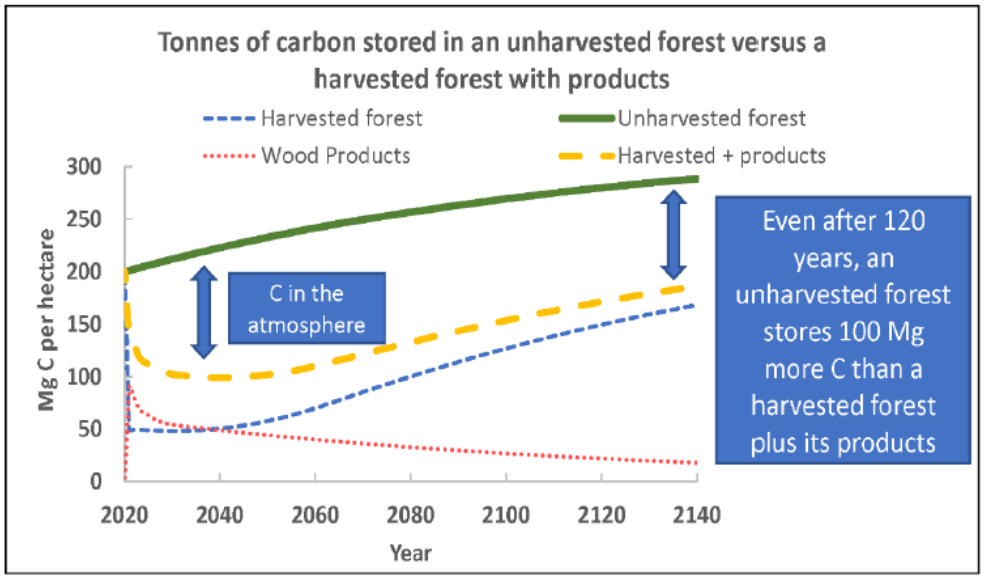
The following chart captures this dynamic:



[163] Harmon (2019).
[164] Hudiburg et al. (2019).
[165] Law et al. (2022a) (US Strategic Reserves, not the Oregon-specific study); *see also* Hudiburg et al. (2019).

In other words, the majority of a harvested tree's stored carbon is lost immediately or within a short time after harvest, with only a small percentage stored in long-term wood products. This is particularly true for forest thinning for wildfire risk reduction, which is often focused on removing smaller-diameter trees. As Bartowitz et al. (2022) notes, "little to no long-term wood products would be created from the smaller-diameter trees removed from these types of thinning" as "[t]hese smaller-diameter trees will most likely be used in short term wood products such as paper."

It has also been assumed that any carbon loss from harvest and wood product decay is balanced out by carbon sequestration by new growth, at least over a couple decades. Yet that has also been shown to be incorrect. Not only is there a short-term carbon loss, but a long-term one as well, as the following chart from Law et al. (2022a) shows:



Based on the above, there is little question that the project, particularly Alternatives B and D, will have detrimental impacts to carbon stores in the NWFP area. These alternatives include increased harvest in 312,000 to 964,000 acres of dry forest over the next 15 years and 10% to 20% of young stands within the next decade, and opening significant new stands for treatment by reclassifying mature forests as young stands subject to treatment, as discussed further below. This will significantly impact carbon stores and removal in the NWFP area, and NEPA requires the Forest Service take a hard look at these impacts.

2. The DEIS Fails to Account for Critical Factors Affecting Carbon Storage.

The DEIS also overlooks several factors critical to the project's impacts on carbon stores. The DEIS acknowledges the importance of mature and old growth forests, and large trees broadly, in storing carbon, recognizing that the action alternatives provide plan

direction to protect stands in moist Matrix established before 1825 and substantially limit treatments in stands established between 1825 and 1905, and that forests in that age class store large amounts of carbon. Despite this, the DEIS completely overlooks the impact that increased harvest of older tress would have on carbon stores. Alternatives B and D propose increasing the age for allowable harvest in moist LSRs from 80 to 120 years, which opens 824,000 acres of previously protected mature forest to treatment, as well as the creation of early seral habitat in moist LSRs.[166] Alternatives B and D would also significantly increase harvest in dry LSRs, including harvest of older trees, through treatment goals.

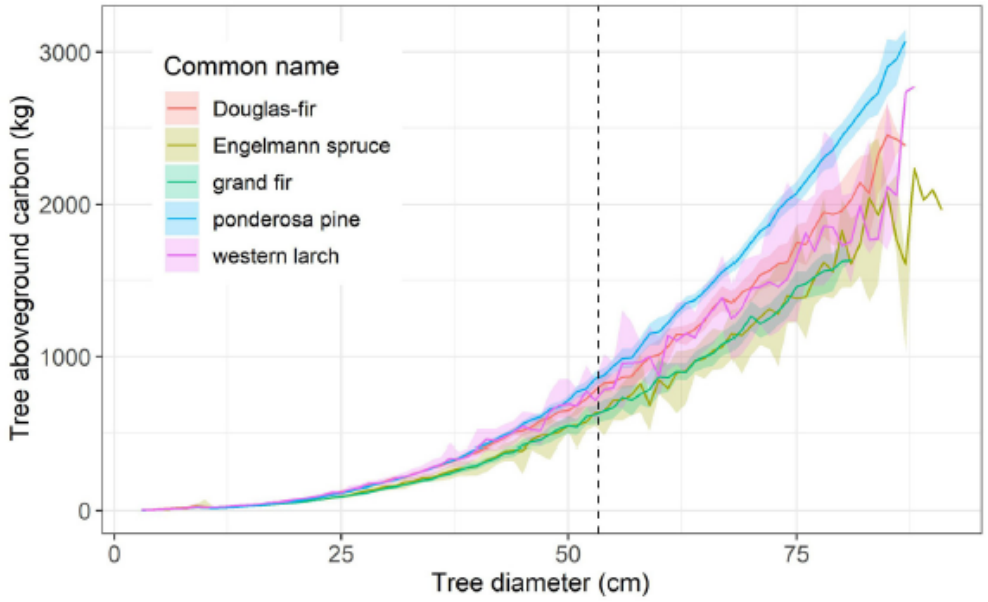
These changes, which are not acknowledged in the DEIS carbon stewardship effects analysis, will have significant impacts on carbon stores in the NWFP area. Numerous studies show that large trees—those over 80 years old—play an inordinately large role in removing carbon from the atmosphere and storing it in biomass. While large trees comprise a small fraction of trees, they store most of the carbon found in aboveground biomass both globally and across the western United States specifically.[167] As Mildrexler et al. (2023) notes, "studies have found that about half the aboveground carbon is concentrated in" one to five percent of all trees, namely large, older trees.

Mildrexler et al. (2020) specifically evaluated carbon content of large trees on the east side of the Cascades, in the type of dry forest where Alternatives B and D propose the greatest reduction in protection for mature stands and the greatest increased harvest in such stands. The study found that while trees over 20 inches in diameter at breast height (DBH), which equates to around 80 years old, comprised just 2 to 3.7 percent of all trees in the study areas, they held 33 to 46 percent of all aboveground carbon. Not only that; the study also found that "[o]nce trees attain large stature, each additional DBH increment results in a significant addition to the tree's total carbon stores, whereas small-diameter trees must effectively ramp up to size before the relationship between DBH and [above ground carbon] results in significant carbon gain." Large trees are not only important carbon stores in life, but also in death, provided they remain on the landscape, as they create large-diameter snags and downed wood that continues to store carbon for decades.[168]

[166] DEIS at 2-14, 2-16.

[167] Besnard et al. (2017); Birdsey et al. (2023); Buotte et al. (2020); Lutz et al. (2018); Stenzel et al. (2019); Mildrexler et al. (2020); Mildrexler et al. (2023).

[168] Mildrexler et al. (2023).



Opening LSR stands to harvest, as proposed in Alternatives B and D, has significant implications for forest carbon stores.[169] As Mildrexler et al. (2023) states:

> Thinning also has an inherent carbon cost that increases as larger trees are harvested, thereby putting thinning of larger trees in conflict with carbon goals because it takes so long to replace the harvested biomass (James et al., 2018; Law & Harmon, 2011). The underlying principle for these losses is the negative relationship between harvest intensity and forest carbon stocks whereby as harvest intensity increases, forest carbon stocks decrease and emissions increase (Hudiburg et al., 2009; Mitchell et al., 2009; Simard et al., 2020). Claims that carbon stores will be "stabilized" by increasing harvest of large-diameter trees that store and accumulate the most carbon (Johnston et al., 2021) are inconsistent with basic science on thinning (Zhou et al., 2013) and the carbon cycle (Campbell et al., 2012; Law et al., 2018). These claims ignore the large amounts of CO2 rapidly released to the atmosphere following harvest (Hudiburg et al., 2019), and that large trees cannot be replaced in short timeframes. It can take centuries to reaccumulate forest carbon stocks reduced by harvest of large trees (Birdsey et al., 2006).

The Forest Service must account for this in the DEIS.

The DEIS also fails to analyze the impact of road construction on carbon stores. Table 3-16 outlines the magnitude of treatments considered under the action alternatives, including treating one-third of dry forests over the next 15 years under Alternative B and 20% of stands younger than 120 years in moist matrix under alternative D, among other

[169] Bartowitz et al. (2022).

things. While the Forest Service will be able to use some existing roads, there is little doubt new roads will need to be constructed to accommodate this significant increase in forest treatments. Additionally, changing the harvest age limits, as outlined above, will open previously untreatable stands to treatment. Road construction will be required to access and conduct treatments in these newly opened stands.

Finally, the DEIS overlooks carbon storage impacts from salvage logging. The four alternatives each include different permissions and prohibitions on salvage logging.[170] As discussed at length above, only a small portion of forest carbon is emitted during wildfires, with the majority remaining on-site in live trees, dead snags, and downed trees. Even carbon from dead snags and downed trees is emitted over decades to centuries, not immediately. As a result, salvage logging significantly impacts carbon stores, removing post-fire carbon and expediting its release. The DEIS must analyze how the project alternatives differing approaches to salvage logging impacts carbon stores.

3. The Forest Service Must Use Science-Based Methodology to Evaluate the Significance of Carbon Impacts.

As noted above, the Forest Service must take a "hard look" at the project's impacts on climate change and carbon stores. While the Forest Service has some discretion in how to approach this analysis, it must apply some "methodology that satisfies NEPA and the [Administrative Procedure Act]." *350 Montana*, 50 F.4th at 1272. It is insufficient to explain how the project could impact carbon emissions "only in general terms," as this does not satisfy the hard look NEPA requires. *Center for Biological Diversity*, 687 F. Supp. 3d at 1073. The Forest Service must apply a two-step process that, first, analyzes how the project will impact carbon emissions, and second, applies "articulated criteria for significance" assessing the project's contribution to global warming. *Id.*; *350 Montana*, 50 F.4th at 1266.

The Forest Service's analysis in the DEIS falls far short of both these requirements. The Forest Service simply states the acreage impacted by each alternative and notes the various alternatives involve "tradeoffs."[171] The Forest Service makes no attempt at articulating any criteria for significance or analyzing the alternatives' contributions to global warming.

The Forest Service must draw on the best available science on emissions from timber harvest and wildfire outlined above to take a hard look at the project's impacts on carbon stores. This must include a life-cycle assessment of forest sector emissions that accounts for forest-to-landfill forest sector emissions.[172] As Moomaw et al. (2020) notes, Hudiburg et al. (2019) provides "an accurate, transparent, and transferable accounting

[170] DEIS at 2-15, 2-17, 2-20, 2-23
[171] DEIS at 3-92 to 3-93.
[172] Hudiburg et al. (2019).

method." The Forest Service must utilize this or an equivalent methodology for analyzing the project's impacts on carbon stores.

Once the Forest Service has fulfilled this lowest common denominator of quantifying the project's emissions and comparing emissions from the four alternatives, it must meaningfully analyze the project's climate change impacts. This requires assessing the project's contribution to global warming in light of remaining national and global carbon budgets and applying tools such as the Social Cost of Greenhouse Gases to describe the actual economic, ecologic, and human costs of the project at national and global scales.

F. Cumulative Effects

NEPA requires adequate disclosure of the cumulative effects of the proposed action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. 36 C.F.R. § 220.4(f); CEQ, *Considering Cumulative Effects Under the National Environmental Policy Act* (Jan. 1997) ("*Considering Cumulative Effects*"). Agencies must "give a sufficiently detailed catalogue of past, present, and future projects, and provide adequate analysis about how these projects, and differences between the projects, are thought to have impacted the environment." *Klamath-Siskiyou Wildlands Ctr. v. U.S. Bureau of Land Mgmt.*, 387 F.3d 989, 993–94 (9th Cir. 2004); *Considering Cumulative Effects*. Some "quantified or detailed information" is required; general statements about possible effects "do not constitute a hard look absent a justification regarding why more definitive information could not be provided." *Kern v. U.S. Bureau of Land Mgmt.*, 284 F.3d 1062, 1075 (9th Cir. 2002); *see also Neighbors of Cuddy Mountain*, 137 F.3d 1372, 1379 (9th Cir. 1998).

The DEIS's cumulative effects discussion, Section 3.9, lacks any quantified or detailed information. Instead, the analysis rests on vague statements about potential effects. For example, the cumulative effects analysis for biological resources is a mere two paragraphs.[173] The Forest Service's substantive analysis is condensed into just two sentences, which provide no more than that (1) while timber harvest and other management activities on non-Forest Service lands may impact species, forest resiliency and restoration activities will benefit them, and (2) activities on non-Forest Service lands that support species will complement conservation efforts on Forest Service lands.[174] To allow for meaningful public comment and decisionmaking, the cumulative effects discussion must provide far more detail on the nature and degree of cumulative effects. The Forest Service's cumulative impacts analyses for other resource classes are similarly cursory and do not provide the "hard look" NEPA requires.

The cumulative effects analysis is also incomplete and overly vague as to past, present, and reasonably foreseeable future projects in the NWFP area. The list of activities

[173] DEIS at 3-162.
[174] DEIS at 3-162.

that could impact biological resources includes a broad reference to "private timber lands that emphasize timber production."[175] As discussed in more depth above, private timber lands in the NWFP area are often heavily harvested, altering, removing, and fragmenting habitat for listed species and other wildlife in the plan area. The Forest Service must identify timber harvest projects and other land management activities on non-Forest Service lands throughout the NWFP area, provide information on their nature, size, and impacts, and analyze the amendment's cumulative effects when added to those projects' impacts.

The cumulative effects analysis similarly overlooks the 2016 withdraw of BLM lands from the NWFP. The NWFP was created as a joint-agency effort for management of BLM and Forest Service lands, with the plan's reserve system and management structure predicated on these lands being managed jointly under the NWFP. The DEIS must evaluate the amendment's impacts against the backdrop of the withdrawal of BLM lands from the NWFP, and BLM's subsequent management of those lands outside the NWFP.

Finally, the cumulative effects discussion overlooks any comparison of the cumulative impacts of the various alternatives.

III. CONCLUSION

The signed groups ask that the Forest Service address the legal deficiencies outlined above and comply with all applicable laws to ensure its amendment honors the NWFP's legacy and meets the needs of both nature and communities.

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[175] DEIS at 3-162.

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Literature Cited

Bartowitz, K.J., Walsh, E.S., Stenzel, J.E., Kolden, C.A., & Hudiburg, T.W. (2022). **Forest carbon emission sources are not equal: Putting fire, harvest, and fossil fuel emissions in context.** *Frontiers in Forests and Global Change, 5*, 867112. https://doi.org/10.3389/ffgc.2022.867112

Baumbusch, R.C. (2023). *Foraging Ecology of Barred Owls where they are Outcompeting the Threatened Northern Spotted Owl*. Doctoral dissertation, Oregon State University.

Bell, S., (July 25, 2021). **Seeing the Forest for the (Burnt) Trees: How Salvage Logging in Oregon is Perpetuating Outdated Extractive Approaches to Federal Forestland Management.** *Yale School of the Environment* blog. Permalink: https://highplainsstewardship.com/seeing-the-forest-for-the-burnt-trees-how-salvage-logging-in-oregon-is-perpetuating-outdated-extractive-approaches-to-federal-forestland-management-shannon-bell/

Berner, L.T., Law, B.E., Meddens, A.J.H., Hicke, J.A., (2017). **Tree mortality from fires, bark beetles, and timber harvest during a hot and dry decade in the western United States (2003–2012).** *Environmental Research Letters,* 12 065005. https://doi.org/10.1088/1748-9326/aa6f94

Besnard, S., Carvalhais, N., Arain, M.A., Black, A., de Bruin S., Buchmann N., Cescatti, A., Chen, J., Clevers, J.G.P.W., Desai, A.R., Gough C.M., Havrankova, K., Herold, M., Hörtnagl, L.J., Jung, M., Knohl, A., Kruijt, B., Krupkova, L., Law, B.E., Lindroth, A., Noormets, A., Roupsard, O., Steinbrecher, R., Varlagin, A., Vincke, C., and Reichstein, M. (2017). **Quantifying the Effect of Forest Age in Annual Net Forest Carbon balance.** *Environmental Research Letters,* 13 124018. https://doi.org/10.1088/1748-9326/aaeaeb

Betts, M.G., Northrup, J.M., Guerrero, J.A.B., Adrean, L.J., Nelson, S.K., Fisher, J.L., Gerber, B.D., Garcia-Heras, M.S., Yang, Z., Roby, D.D., Rivers, J.W., (2020). **Squeezed by a habitat split: Warm ocean conditions and old-forest loss interact to reduce long-term occupancy of a threatened seabird.** *Conservation Letters,* 13: e12745. https://doi.org/10.1111/conl.12745

Birdsey, R.A., DellaSala, D.A., Walker, W.S., Gorelik, S.R., Rose, G., Ramirez, C.E., (2023). **Assessing carbon stocks and accumulation potential of mature forests and larger trees in U.S. federal lands.** *Frontiers in Forests and Global Change,* 5:1074508. https://doi.org/10.3389/ffgc.2022.1074508

Bond, M.L., Lee, D.E., Siegel, R.B., & Ward, J.P., (2022). **Forest Management, Barred Owls, and Wildfire in Northern Spotted Owl Territories.** *Journal of Wildlife Management, 86* (3), 487–99. https://doi.org/10.1002/jwmg.22153

Bradley, C.M., Hanson, C.T., & DellaSala, D.A., (2016). **Does Increased Forest Protection Correspond to Higher Fire Severity in Frequent-Fire Forests of the Western United States?** *Ecosphere, 7* (10), e01492.https://doi.org/10.1002/ecs2.1492

Brockerhoff, E. G., Jactel, H., Parrotta, J. A., Quine, C. P., & Sayer, J., (2008). **Plantation forests and biodiversity: Oxymoron or opportunity?** *Biodiversity and Conservation*, 17(5), 925–51. https://dx.doi.org/10.1007/s10531-008-9380-x

Buotte, P.C., Law, B.E., Ripple, W.J., Berner, L.T., (2020). **Carbon sequestration and biodiversity co-benefits of preserving forests in the western United States.** *Ecological Applications*, 30(2):e02039. https://doi.org/10.1002/eap.2039

Burger, A.E., Masselink, M.M., Tillmanns, A.R., Szabo, A.R., Farnholtz, M., Krkosek, M.J., (2004). **Effects of Habitat Fragmentation and Forest Edges on Predators of Marbled Murrelets and Other Forest Birds on Southwest Vancouver Island.** *Proc. Species at Risk 2004 Pathways to Recovery Conference, Mar. 2–4, Victoria B.C.* https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=e1954a1c4b01ea25554d3905056b3db24e7459ae.

Burger, A.E., Page, R.E., (2007). **The need for biological realism in habitat modeling: a reinterpretation of Zharikov et al. (2006)**. *Landscape Ecology,* 22:1273–1281. https://doi.org/10.1007/s10980-007-9114-6

Burger, A.E., Manley, I.A., Silvergieter, M.P., Lank, D.B., Jordan, K.M., Bloxton, T.D., Raphael, M.G., (2009). **Re-Use of Nest Sites by Marbled Murrelets (*Brachyramphus marmoratus)* in British Columbia**. *Northwestern Naturalist*, 90: 217–226. https://research.fs.usda.gov/treesearch/36171

Campbell, J.L., Harmon, M.E., Mitchell, S.R., (2012). **Can fuel-reduction treatments really increase forest carbon storage in the western US by reducing future fire emissions?** *Frontiers in Ecology and the Environment,* 10(2): 83–90. https://doi.org/10.1890/110057

Clark, D.A.; Anthony, R.G.; Andrews, L.S., (2013). **Relationship between wildfire, salvage logging, and occupancy of nesting territories by northern spotted owls.** *Journal of Wildlife Management*. 77(4): 672–688. https://doi.org/10.1002/jwmg.523

Collier, C.J., (2024). **Fire Severity Mediates Marten and Fisher Occurrence: Impacts of the Dixie Fire on a Carnivore Community.** *California Polytechnic University, Humboldt theses and projects*. 730. https://digitalcommons.humboldt.edu/etd/730

DellaSala, D.A., R. Baker, D. Heiken, C.A. Frissell, J.R. Karr, S.K. Nelson, B.R. Noon, D. Olson, and J. Strittholt (2015). **Building on Two Decades of Ecosystem Management**

and Biodiversity Conservation under the Northwest Forest Plan, USA. *Forest Ecology and Management, 355*, 22–34. https://doi.org/10.3390/f6093326

DellaSala, D.A., Baker, B.C., Hanson, C.T., Ruediger, L., Baker, W., (2022a). **Have western USA fire suppression and megafire active management approaches become a contemporary Sisyphus**? *Biol. Conserv. 268*, 109499. https://doi.org/10.1016/j.biocon.2022.109499.

DellaSala D.A., Mackey B., Norman P., Campbell C., Comer P.J., Kormos C.F., Keith, H., Rogers, B. (2022b). **Mature and old-growth forests contribute to large-scale conservation targets in the conterminous United States.** *Frontiers in Forests and Global Change,* 5:979528. https://doi.org/10.3389/ffgc.2022.979528

Divoky, G.J. & Horton, M., (1995). **Chapter 7: Breeding and Natal Dispersal, Nest Habitat Loss and Implications for Marbled Murrelet Populations.** In: Ralph, C. John; Hunt, George L., Jr.; Raphael, Martin G.; Piatt, John F., Technical Editors. 1995. *Ecology and conservation of the Marbled Murrelet*. Gen. Tech. Rep. PSW-GTR-152. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; pp 83–88. https://research.fs.usda.gov/treesearch/27889

Dugger, K.M., Anthony, R.G., & Andrews, L.S. (2011). **Transient dynamics of invasive competition: Barred Owls, Spotted Owls, habitat, and the demons of competition present.** *Ecological Applications, 21*(7), 2459–2468. https://doi.org/10.1890/10–2142.1

Dugger, K.M., Forsman, E.D., Franklin, A.B., Davis, R.J., White, G.C., Schwarz, C.J., Burnham, K.P., Nichols, J.D., Hines, J.E., Yackulic, C.B., Doherty, P.F. Jr., Bailey, L., Clark, D.A., Ackers, S.H., Andrews, L.S., Augustine, B., Biswell, B.L., Blakesley, J., Carlson, P.C., Clement, M.J., Diller, L.V., Glenn, E.M., Green, A., Gremel, S.A., Herter, D.R., Higley, J.M., Hobson, J., Horn, R.B., Huyvaert, K.P., McCafferty, C., McDonald, T., McDonnell, K., Olson, G.S., Reid, J.A., Rockweit, J., Ruiz, V., Saenz, J., & Sovern, S.G. (2016). **The effects of habitat, climate, and Barred Owls on long-term demography of Northern Spotted Owls**. *The Condor, 118*(1), 57–116. https://doi.org/10.1650/CONDOR-15–24.1

Dunham, J., Hirsch, C., Gordon, S., Flitcroft, R., Chelgren, N., Snyder, M., Hockman-Wert, D., Reeves, G., Andersen, H., Anderson, S., Battaglin, W., Black, T., Brown, J., Claeson, S., Hay, L., Heaston, E., Luce, C., Nelson, N., Penn, C., & Raggon, M. (2023). **Northwest Forest Plan—the first 25 years (1994–2018): Watershed Condition Status and Trends**. General Technical Report PNW-GTR-1010. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. https://doi.org/10.2737/PNW-GTR-1010

Franklin, J.F., Spies, T.A., Van Pelt, R., Carey, A.B., Thornburgh, D.A., Berg, D.R., Lindenmayer, D.B., Harmon, M.E., Keeton, W.S., Shaw, D.C., Bible, K., & Chen, J., (2002). **Disturbances and structural development of natural forest ecosystems with**

silvicultural implications, using Douglas-fir forests as an example. *Forest Ecology and Management*, 155(1–3), 399–423. https://doi.org/10.1016/S0378-1127(01)00575-8

Franklin, A.B., Dugger, K.M., Lesmeister, D.B., Davis, R.J., & Wiens, J.D., (2021). **Range-wide declines of northern spotted owl populations in the Pacific Northwest: A meta-analysis.** Biological Conservation, 259, 109168. https://doi.org/10.1016/j.biocon.2021.109168

Forest Ecosystem Management Assessment Team (FEMAT), (1993). **Forest Ecosystem Management: An Ecological, Economic, and Social Assessment: Report of the Forest Ecosystem Management Assessment Team**. Portland, OR: U.S. Department of Agriculture, Forest Service; U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service; U.S. Department of the Interior, Bureau of Land Management, Fish and Wildlife Service, National Park Service; Environmental Protection Agency. https://www.fs.usda.gov/r6/reo/library/downloads/documents/FEMAT-1993-Report.pdf

Fountain, E.D., Kulzer, P.J., Golightly, R.T., Rivers, J.W., Pearson, S.F., Raphael, M.G., Betts, M.G., Nelson, S.K., Roby, D.D., Kryshak, N.F., Schneider, S., Peery, M.Z., (2023). **Characterizing the Diet of a Threatened Seabird, the Marbled Murrelet *Brachyramphus Marmoratus*, Using High-Throughput Sequencing**. *Marine Ornithology*, 51: 145–55. https://research.fs.usda.gov/treesearch/67058

Gray, A.N., Thomas R. Whittier, T.R., (2014). **Carbon stocks and changes on Pacific Northwest national forests and the role of disturbance, management, and growth.** *Forest Ecology and Management,* 328, 167–178. https://doi.org/10.1016/j.foreco.2014.05.015

Hamer, T.E., Forsman, E.D., & Glenn, E.M. (2007). **Home Range Attributes and Habitat Selection of Barred Owls and Spotted Owls in an Area of Sympatry.** *The Condor,* 109, 750-768. https://doi.org/10.1650/0010-5422(2007)109[750:HRAAHS]2.0.CO;2

Hamer, T., & Verschuyl, J. (2009). **Factors affecting spotted owl persistence in Northwest Washington: A 20 year retrospective.** Final Technical Report Submitted to Seattle City Light. Hamer Environmental, L.P., Mount Vernon, WA.

Hanson, C.T., Odion, D.C., & DellaSala, D.A. (2009). **Overestimation of Fire Risk in the Northern Spotted Owl Recovery Plan.** *Conservation Biology*, 23 (6), 1314–19. https://doi.org/10.1111/j.1523-1739.2009.01274.x

Harmon, M.E., (2019). **Have product substitution carbon benefits been overestimated? A sensitivity analysis of key assumptions.** *Environmental Research Letters,* 14 065008. https://doi.org/10.1088/1748-9326/ab1e95

Harmon, M.E., Hanson, C.T., DellaSala, D.A. (2022). **Combustion of Aboveground Wood from Live Trees in Megafires, CA, USA.** *Forests,* 13, 391. https://doi.org/10.3390/f13030391

Hudiburg, T.W., Law, B.E., Moomaw W.R., Harmon, M.E., Stenzel, J.E., (2019). **Meeting GHG reduction targets requires accounting for all forest sector emissions.** *Environmental Research Letters,* 14 095005. https://doi.org/10.1088/1748-9326/ab28bb

Irwin, L.L., Fleming, T.L. & Beebe, J., (2004). **Are Spotted Owl Populations Sustainable in Fire-Prone Forests?**, *Journal of Sustainable Forestry, 18*:4, 1–28, https://doi.org/10.1300/J091v18n04_01

Intergovernmental Panel on Climate Change (IPCC) (2023a). *Climate Change 2021: The Physical Science Basis: Working Group I* Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press; 2023. https://doi.org/10.1017/9781009157896

Intergovernmental Panel on Climate Change (IPCC) (2023b). Summary for Policymakers. In: *Climate Change 2021 – The Physical Science Basis: Working Group I Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press; 2023:3–32. https://doi.org/10.1017/9781009157896.001

Johnson, K.N., Franklin, J.F., & Reeves, G.H. (2023). **The Making of the Northwest Forest Plan: The Wild Science of Saving Old Growth Ecosystems.** *Oregon State University Press*.

Krankina, O.N, Harmon, M.E., Schnekenburger, F., Sierra, C.A., (2012). **Carbon balance on federal forest lands of Western Oregon and Washington: The impact of the Northwest Forest Plan.** *Forest Ecology and Management*, 286, 171–182. https://doi.org/10.1016/j.foreco.2012.08.028.

Krankina, O.N., Acker, S.A., & Harmon, M.E. (2014). **High-biomass forests of the Pacific Northwest: Who manages them and how much is protected?** *Environmental Management*, 54 (6), 112–121. https://doi.org/10.1007/s00267-014-0336-1

Larson, A.J., Lutz, J.A., Donato, D.C., Freund, J.A., Swanson, M.E., HilleRisLambers, J., Sprugel, D.G., & Franklin, J.F. (2015). **Spatial aspects of tree mortality strongly differ between young and old-growth forests.** *Ecology, 96*(11):2855–2861. https://doi.org/10.1890/15-0628.1

Law, B.E. & Waring, R.H., (2015). **Carbon implications of current and future effects of drought, fire and management on Pacific Northwest forests.** *Forest Ecology and Management,* Volume 355, 4–14. https://doi.org/10.1016/j.foreco.2014.11.023

Law, B.E., Hudiburg, T.W., Berner, L.T., Kent, J.J., Buotte, P.C., Harmon, M.E., (2018). **Land use strategies to mitigate climate change in carbon dense temperate forests.** *Proceedings of the National Academy of Sciences, U.S.A.* 115 (14) 3663–3668. https://doi.org/10.1073/pnas.1720064115

Law, B.E., Berner, L.T., Buotte, P.C., Mildrexler, D.J., Ripple, W.J., (2021). **Strategic Forest Reserves can protect biodiversity in the western United States and mitigate climate change.** *Communications Earth & Environment*, 2, 254. https://doi.org/10.1038/s43247-021-00326-0

Law, B.E., Moomaw, W.R., Hudiburg, T.W., Schlesinger, W.H., Sterman, J.D., Woodwell, G.M., (2022a). **Creating Strategic Reserves to Protect Forest Carbon and Reduce Biodiversity Losses in the United States.** *Land,* 11, 721. https://doi.org/10.3390/land11050721

Law, B.E., Berner, L.T., Mildrexler, D.J., Bloemers, R.O, Ripple, W.J., (2022b). **Strategic reserves in Oregon's forests for biodiversity, water, and carbon to mitigate and adapt to climate change.** *Frontiers in Forests and Global Change,* 5:1028401. https://doi.org/10.3389/ffgc.2022.1028401

Law, B.E., Berner, L.T., Wolf, C., Ripple, W.J., Trammell, E.J., Birdsey, R.A. (2023). **Southern Alaska's forest landscape integrity, habitat, and carbon are critical for meeting climate and conservation goals**. AGU Advances, 4, e2023AV000965. https://doi.org/10.1029/2023AV000965

Lee, D.E. (2018). **Spotted Owls and Forest Fire: A Systematic Review and Meta-Analysis of the Evidence.** *Ecosphere, 9* (7), e02354. https://doi.org/10.1002/ecs2.2354

Lesmeister, D.B., Nielsen-Pincus, N., Singleton, P.H., & Davis, R.J. (2019). **Mixed-Severity Wildfire and Habitat of an Old-Forest Obligate.** *Forest Ecology and Management, 440*, 40–50. https://doi.org/10.1016/j.foreco.2019.03.031

Lesmeister, D.B., Davis, R.J., Singleton, P.H., & Spies, T.A. (2021). **Northern Spotted Owl Nesting Forests as Fire Refugia: A 30-Year Synthesis of Large Wildfires.** *Forest Ecology and Management, 482*, 118898. https://doi.org/10.1016/j.foreco.2020.118898

Lindenmayer, D.B. & Franklin, J.F. (2002). *Conserving forest biodiversity: a comprehensive multiscaled approach*. Island Press, Washington, D.C. ISBN 1-55963-934-2.

Long, L.L., & Wolfe, J.D. (2019). **Review of the Effects of Barred Owls on Spotted Owls.** *Journal of Wildlife Management*, 83(6):1281–1296. https://doi.org/10.1002/jwmg.21715

Lorenz, T.J., Raphael, M.G., Bloxton, T.D. Jr., (2016). **Marine Habitat Selection by Marbled Murrelets (Brachyramphus marmoratus) during the Breeding Season**. *PLoS ONE* 11(9): e0162670. https://doi.org/10.1371/journal.pone.0162670

Lorenz, T.J., Raphael, M.G., Young, R.D., Lynch, D., Nelson, S.K., & McIver, W.R. (2021). **Status and trend of nesting habitat for the marbled murrelet under the Northwest Forest Plan, 1993 to 2017.** U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. https://www.fs.usda.gov/pnw/pubs/pnw_gtr1051.pdf

Lutz, J.A., Furniss, T.J., Johnson, D.J., Davies, S.J., Allen, D., Alonso, A., Anderson-Teixeira, K.J., Andrade, A., Baltzer, J., Becker, K.M.L., Blomdahl, E.M., Bourg, N.A., Bunyavejchewin, S., Burslem, D.F.R.P., Cansler, C.A., Cao, K., Cao, M., Cárdenas, D., Chang, L.W., Chao, K.J., Chao, W.C., Chiang, J.M., Chu, C., Chuyong, G.B., Clay, K., Condit, R., Cordell, S., Dattaraja, H.S., Duque, A., Ewango, C.E.N., Fischer, G.A., Fletcher, C., Freund, J.A., Giardina, C., Germain, S.J., Gilbert, G.S., Hao, Z., Hart, T., Hau, B.C.H., He, F., Hector, A., Howe, R.W., Hsieh, C.F., Hu, Y.H., Hubbell, S.P., Inman-Narahari, F.M., Itoh, A., Janík, D., Kassim, A.R., Kenfack, D., Korte, L., Král, K., Larson, A.J., Li, Y., Lin, Y., Liu, S., Lum, S., Ma, K., Makana, J.R., Malhi, Y., McMahon, S.M., McShea, W.J., Memiaghe, H.R., Mi, X., Morecroft, M., Musili, P.M., Myers, J.A., Novotny, V., de Oliveira, A., Ong, P., Orwig, D.A., Ostertag, R., Parker, G.G., Patankar, R., Phillips, R.P., Reynolds, G., Sack, L., Song, G.Z.M., Su, S.H., Sukumar, R., Sun, I.F., Suresh, H.S., Swanson, M.E., Tan, S., Thomas, D.W., Thompson, J., Uriarte, M., Valencia, R., Vicentini, A., Vrška, T., Wang, X., Weiblen, G.D., Wolf, A., Wu, S.H., Xu, H., Yamakura, T., Yap, S., & Zimmerman, J.K. (2018). **Global importance of large-diameter trees.** *Global Ecology and Biogeography, 27*(7), 849–864. https://doi.org/10.1111/geb.12747

Malt, J. M. (2007). **The influence of habitat fragmentation on Marbled Murrelet (Brachyramphus marmoratus) habitat quality in southwestern British Columbia.** Thesis. Simon Fraser University. Burnaby, British Columbia, Canada.

Malt, J.M., Lank, D.B., (2007). **Temporal dynamics of edge effects on nest predation risk for the marbled murrelet.** *Biological Conservation,* 140, pp 160–173. https://doi.org/10.1016/j.biocon.2007.08.011

Malt, J.M., Lank, D.B., (2009). **Marbled Murrelet nest predation risk in managed forest landscapes: dynamic fragmentation effects at multiple scales.** *Ecological Applications*, 19(5), pp. 1274–1287. https://doi.org/10.1890/08-0598.1

Martin, M.E., Delheimer, M.S., Gabriel, M.W., Wengert, G.M., & Moriarty, K.M. (2022). **Combined field and clinical methods clarify mortality causes and survival patterns of Pacific martens.** *The Journal of Wildlife Management*. https://doi.org/10.1002/jwmg.22131

Marzluff, J.M., Millspaugh, J.J., Hurvitz, P.M., Handcock, M.S. (2004). **Relating Resources to a Probabilistic Measure of Space Use: Forest Fragments and Steller's Jays.** *Ecology,* 85, 1411–1427. https://doi.org/10.1890/03-0114

Meyer, C.B., Miller, S.L., Ralph, C.J., (2002). **Multi-scale landscape and seascape patterns associated with marbled murrelet nesting areas on the U.S. west coast.** *Landscape Ecology,* 17, pp 95–115. https://doi.org/10.1023/A:1016574928706

Mildrexler, D.J., Berner, L.T., Law, B.E., Birdsey, R.A., Moomaw, W.R., (2020). **Large Trees Dominate Carbon Storage in Forests East of the Cascade Crest in the United States Pacific Northwest.** *Frontiers in Forests and Global Change,* 3:594274. https://doi.org/10.3389/ffgc.2020.594274

Mildrexler, D.J., Logan T. Berner, Beverly E. Law, Richard A. Birdsey, William R. Moomaw (2023). **Protect large trees for climate mitigation, biodiversity, and forest resilience.** *Conservation Science and Practice,* 5:e12944. https://doi.org/10.1111/csp2.12944.

Miller, S.L., Raphael, M.G., Falxa, G.A., Strong, C., Baldwin, J., Bloxton, T., Galleher, B.M., Lance, M., Lynch, D., Pearson, S.F., Ralph, C.J., & Young, R.D. (2012). **Recent Population Decline of the Marbled Murrelet in the Pacific Northwest.** *The Condor,* 114(4):771–781. https://www.jstor.org/stable/10.1525/cond.2012.110084

Moomaw, W.R., Law, B.E., & Goetz, S.J., (2020). **Focus on the role of forests and soils in meeting climate change mitigation goals: summary.** *Environmental Research Letters, 15,* 045009. https://doi.org/10.1088/1748-9326/ab6b38

Moomaw, W.R. & Law, B.E., (2023). **A call to reduce the carbon costs of forest harvest.** *Nature,* 620, 44–45. https://doi.org/10.1038/d41586-023-02238-9

Moriarty, K.M., Epps, C.W., & Zielinski, W.J., (2016). **Forest Thinning Changes Movement Patterns and Habitat Use by Pacific Marten.** *The Journal of Wildlife Management,* 80(4), 621–633. https://doi.org/10.1002/jwmg.1060

Nelson, S.K. & Hamer, T.E., (1995). **Chapter 5: Nesting Biology and Behavior of the Marbled Murrelet.** In: Ralph, C.J., Hunt, G.L. Jr., Raphael, M.G., Piatt, J.F.; Ecology and conservation of the Marbled Murrelet; Gen. Tech. Rep. PSW-GTR-152. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture. https://doi.org/10.2737/PSW-GTR-152

Nelson, S.K. & Wilson, A.K., (2002). **Marbled Murrelet Habitat Characteristics on State Land in Western Oregon.** Oregon Cooperative Fish and Wildlife Research Unit Oregon State University, Department of Fisheries and Wildlife, Final Report, Submitted to Oregon Department of Forestry Oregon Department of Fish and Wildlife, U.S. Fish and Wildlife Service, National Council for Air and Stream Improvement.

Norris, D.R., Arcese, P., Preikshot, D., Bertram, D.F., Kyser, T.K., (2007). **Diet Reconstruction and Historic Populations Dynamics in a Threatened Seabird**. *Journal of Applied Ecology*, 44: 875–884. https://doi.org/10.1111/j.1365-2664.2007.01329.x

Oregon Department of Fish and Wildlife (ODFW), (2018a). *Status review of the Marbled Murrelet (Brachyramphus marmoratus) in Oregon and evaluation of criteria to reclassify the species from threatened to endangered under the Oregon Endangered Species Act*. Report prepared for the Oregon Fish and Wildlife Commission, January 2018. Salem, Oregon. https://perma.cc/EL28-G7SD

Oregon Department of Fish and Wildlife (ODFW), (2018b). *Background and Basis for the Commission's Decision to Reclassify the Marbled Murrelet as Endangered Under the Oregon Endangered Species Act*. https://perma.cc/T5K3-MQAB

Oregon Department of Fish and Wildlife (ODFW), (2021). *Biological Assessment of the Marbled Murrelet (Brachyramphus marmoratus) in Oregon and Evaluation of Criteria to Reclassify the Species from Threatened to Endangered under the Oregon Endangered Species Act*. https://perma.cc/8UAD-4GH2

Raphael, M.G., Evans-Mack, D., Marzluff, J.M., & Luginbuhl, J.M., (2002). **Effects of forest fragmentation on populations of the marbled murrelet.** *Studies in Avian Biology*. 25: 221–235.

Raphael, M.G., Shirk, A.J., Falxa, G.A., & Pearson, S.F., (2015). **Habitat Associations of Marbled Murrelets During the Nesting Season in Nearshore Waters Along the Washington to California Coast**. *Journal of Marine Systems*. 146: 17–25. https://doi.org/10.1016/j.jmarsys.2014.06.010

Raphael, M.G., Falxa, G.A., Burger, A.E., (2018). **Chapter 5: Marbled Murrelet**. In: Spies, T.A.; Stine, P.A.; Gravenmier, R.; Long, J.W.; Reilly, M.J., tech. coords. 2018. Synthesis of science to inform land management within the Northwest Forest Plan area. Gen. Techn. Rep. PNW-GTR-966. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 301–370. https://doi.org/10.2737/PNW-GTR-966

Ripple, W.J., Wolf, C., Gregg, J.W., Levin, K., Rockström, J., Newsome, T.M., Betts, M.G., Huq, S., Law, B.E., Kemp, L., Kalmus, P., Lenton, T.M., (2022). **World Scientists' Warning of a Climate Emergency 2022.** *BioScience*, 72, 1149–1155. https://doi.org/10.1093/biosci/biac083

Ripple, W.J., Wolf, C., Gregg, J.W., Rockström, J., Mann, M.E., Oreskes, N., Lenton, T.M., Rahmstorf, S., Newsome, T.M., Chi Xu, Svenning, J.C., Pereira, C.C., Law, B.E., Crowther,

T.W., (2024). **The 2024 state of the climate report: Perilous times on planet Earth.** *BioScience*, 74, 812–824. https://doi.org/10.1093/biosci/biae087

Rockweit, J.T., Jenkins, J.M., Hines, J.E., Nichols, J.D., Dugger, K.M., Franklin, A.B., Carlson, P.C., Kendall, W.L., Lesmeister, D.B., McCafferty, C., Ackers, S.H., Andrews, L.S., Bailey, L.L., Burgher, J., Burnham, K.P., Chestnut, T., Conner, M.M., Davis, R.J., Dilione, K.E., Forsman, E.D., Glenn, E.M., Gremel, S.A., Hamm, K.A., Herter, D.R., Higley, J.M., Horn, R.B., Lamphear, D.W., McDonald, T.L., Reid, J.A., Schwarz, C.J., Simon, D.C., Sovern, S.G., Swingle, J.K., Wiens, J.D., Wise, H., & Yackulic, C.B. (2022). **Range-wide sources of variation in reproductive rates of northern spotted owls.** *Ecological Applications, 33*(1), e2726. https://doi.org/10.1002/eap.2726

Rockweit, J.T., Lesmeister, D.B., & Forsman, E.D. (2024). **Changing Fire Regimes and Nuanced Impacts on a Critically Imperiled Species.** *Biological Conservation, 286*, 110237. https://doi.org/10.1016/j.biocon.2024.110237

Smithwick, E.A.H., Harmon, M.E., Remillard, S.M., Acker, S.A., Franklin, J.F., (2002). **Potential Upper Bounds of Carbon Stores in Forests of the Pacific Northwest.** *Ecological Society of America,* 12, 1303–1317. https://doi.org/10.1890/1051-0761(2002)012[1303:PUBOCS]2.0.CO;2

Sovern, S.G., Forsman, E.D., Olson, G.S., Biswell, B.L., Taylor, M., & Anthony, R.G. (2014). **Barred Owls and Landscape Attributes Influence Territory Occupancy of Northern Spotted Owls**. *Journal of Wildlife Management, 78*(8):1436-1443. https://doi.org/10.1002/jwmg.793

Sovern, S.G., Forsman, E.D., & Anthony, R.G. (2015). **Roosting Habitat Use and Selection by Northern Spotted Owls During Natal Dispersal.** *Journal of Wildlife Management, 79* (6), 957–65. https://doi.org/10.1002/jwmg.922

Sovern, S.G., Lesmeister, D.B., Dugger, K.M., Pruett, M.S., Davis, R.J., & Jenkins, J.M. (2019). **Activity Center Selection by Northern Spotted Owls.** *Journal of Wildlife Management, 83*(3):714–27. https://doi.org/10.1002/jwmg.21632

Spies, T.A., Stine, P.A., Gravenmier, R., Long, J.W., & Reilly, M.J. (Eds.). (2018). **Synthesis of science to inform land management within the Northwest Forest Plan area, Volume 1.** *U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station*. General Technical Report PNW-GTR-966 Vol. 1. https://doi.org/10.2737/PNW-GTR-966 https://www.fs.usda.gov/pnw/pubs/pnw_gtr966.pdf

Stenzel, J.E., Bartowitz, K.J., Hartman, M.D., Lutz, J.A., Kolden, C.A., Smith, A.M.S., Law, B.E., Swanson, M.E., Larson, A.J., Parton, W.J., Hudiburg T.W., (2019). **Fixing a snag in carbon emissions estimates from wildfires.** *Global Change Biology,* 25, 3985–3994. https://doi.org/10.1111/gcb.14716

Strong, C.S., (2020). **Marbled Murrelet Population Monitoring at Se in Conservation Zone 4 During 2019. Results from Southern Oregon and Northern California.** *Annual Report to the U.S. Fish and Wildlife Service; Cooperative Agreements, No. F16AC00554 and F18AC00326.*

Strong, C.S., (2024). **Marbled Murrelet Population Monitoring at Se in Conservation Zone 4 During 2023. Results from Southern Oregon and Northern California.** *Annual Report to the U.S. Fish and Wildlife Service; Cooperative Agreements no. F22AC02293 and F22AC03383.*

Swanson, M.E., Franklin, J.F., Beschta, R.L., Crisafulli, C.M., DellaSala, D.A., Hutto, R.L., Lindenmayer, D.B., & Swanson, F.J. (2011). **The forgotten stage of forest succession: early-successional ecosystems on forest sites.** *Frontiers in Ecology and the Environment*, 9 (2), 117–125. https://doi.org/10.1890/090157

Thompson, S.A., Sydeman, W.J., Santora, J.A., Black, B.A., Suryan, R.M., Calambokidis, J., Peterson, W.T., & Bograd, S.J. (2012). **Linking predators to seasonality of upwelling: Using food web indicators and path analysis to infer trophic connections.** *Progress in Oceanography, 101*, 106–120. https://doi.org/10.1016/j.pocean.2012.02.001

U.S. Department of Agriculture (USDA), (2013). **From Trees to Seas—Marbled Murrelet Numbers Are Down.** Forest Service, Pacific Northwest Research Station: *Science Findings* 157. Portland, OR. Dec. 2013. https://research.fs.usda.gov/treesearch/45196

U.S. Department of Agriculture (USDA), (2015). **Northwest Forest Plan—The First 20 Years (1994–2013): Status and Trends of Late-Successional and Old-Growth Forests.** U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. https://www.fs.usda.gov/pnw/pubs/pnw_gtr911.pdf

U.S. Department of Agriculture (USDA), (2019). **Inside Their Hidden World: Tracking the Elusive Marbled Murrelet**. *Science Findings,* 213. https://www.fs.usda.gov/pnw/sciencef/scifi213.pdf

U.S. Fish and Wildlife Service (USFWS), (2011). *Revised Recovery Plan for the Northern Spotted Owl (Strix occidentalis caurina)*. June 28, 2011. Portland, Oregon. https://www.fws.gov/media/revised-recovery-plan-northern-spotted-owl-strix-occidentalis-caurina

U.S. Fish and Wildlife Service (USFWS), (2023a). *Special Status Assessment Report for the Coastal Marten (Martes caurina), Version 2.2*. February 2023. Arcata, CA. https://www.fws.gov/media/species-status-assessment-coastal-marten-martes-caurina-version-22

U.S. Fish and Wildlife Service (USFWS), (2023b). *Transmittal of Biological Opinion and Conclusion of Formal and Informal Consultation for the South Fork Sacramento Safety and Forest Restoration Project, Shasta-Trinity National Forest, California*. FWS Ref. No. 2022-0087135. November 20, 2023.

U.S. Fish and Wildlife Service (USFWS), (2024). *Marbled Murrelet (Brachyramphus marmoratus) CA, OR, WA DPS 5-Year Review: Summary and Evaluation*. Lacey, WA. https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/18327.pdf

U.S. Global Change Research Program (USGCRP), (2023). *Fifth National Climate Assessment: Impacts, Risks, and Adaptation in the United States*. Washington, DC: U.S. Government Printing Office. https://www.globalchange.gov/nca5

Valente, J.J., Nelson, S.K., Rivers, J.W., Roby, D.D., Betts, M.G., (2021). **Experimental evidence that social information affects habitat selection in Marbled Murrelets,** *Ornithology*, 138:2, pp 1–13. https://doi.org/10.1093/ornithology/ukaa086

van Rooyen, J.C., Malt, J.M., Lank, D.B., (2011). **Relating Microclimate to Epiphyte Availability: Edge Effects on Nesting Habitat Availability for the Marbled Murrelet**. Northwest Scientific Association, Northwest Science, 85(4):549–561. https://www.bioone.org/doi/full/10.3955/046.085.0405

Volkmann, L.A. & Hodges, K.E., (2021). **Post-fire movements of Pacific marten (Martes caurina) depend on the severity of landscape change.** *Movement Ecology,* 9:49, 1-19. https://doi.org/10.1186/s40462-021-00286-2

Wengert, G.M., Higley, J.M., Gabriel, M.W., Rustigian-Romsos, H., Spencer, W.D., Clifford, D.L., & Thompson, C., (2021). **Distribution of trespass cannabis cultivation and its risk to sensitive forest predators in California and Southern Oregon.** *PLoS ONE,* 16(9): e0256273. https://doi.org/10.1371/journal.pone.0256273

Wiens, J.D., Anthony, R.G. and Forsman, E.D. (2014), **Competitive interactions and resource partitioning between northern spotted owls and barred owls in western Oregon.** *Wild. Mon.* 185: 1–50. https://doi.org/10.1002/wmon.1009

Wilson, T.M. & Forsman, E.D., (2013). **Thinning effects on Spotted Owl prey and other forest-dwelling small mammals.** In P.D. Anderson & K.L. Ronnenberg (Eds.), *Density management in the 21st century: West Side Story* (pp. 79–90). *U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station*. PNW-GTR-880. https://doi.org/10.2737/PNW-GTR-880

Yackulic, C.B., Bailey, L.L., Dugger, K.M., Davis, R.J., Franklin, A.B., Forsman, E.D., Ackers, S.H., Andrews, L.S., Diller, L.V., Gremel, S.A., Hamm, K.A., Herter, D.R., Higley, J.M.,

Horn, R.B., McCafferty, C., Reid, J.A., Rockweit, J.T., & Sovern, S.G. (2019). **The past and future roles of competition and habitat in the range-wide occupancy dynamics of Northern Spotted Owls.** *Ecological Applications, 29*(3), e01861. https://doi.org/10.1002/eap.1861

Yen, P.P.W., Huettmann, F., Cooke, F., (2004). **A Large-Scale Model for the At-Sea Distribution and Abundance of Marbled Murrelets (*Brachyramphus marmoratus)* During the Breeding Season in Coastal British Columbia, Canada.** *Ecological Modelling,* 171: 395–413. https://doi.org/10.1016/j.ecolmodel.2003.07.006

Zald, H.S.J. & Dunn, C.J. (2018). **Severe fire weather and intensive forest management increase fire severity in a multi-owner landscape.** *Ecological Applications, 28*(4), 1068–1080. https://doi.org/10.1002/eap.1710