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Submitted Via Online Portal: https://cara.fs2c.usda.gov/Public//CommentInput?Project=64745

Elizabeth Berger Acting Regional Forester Pacific Northwest Region, U.S Forest Service 1220 SE 3rd Avenue Portland, OR 97204

Re: Notice of Intent to Prepare an Environmental Impact Statement—Forest Plan Amendment for Planning and Management of Northwest Forests Within the Range of the Northern Spotted Owl

Ms. Berger:

Central Oregon LandWatch provides these scoping comments in response to the Notice of Intent ("NOI") to prepare an Environmental Impact Statement ("EIS") to amend the Northwest Forest Plan ("NWFP") which was published in the Federal Register on December 18, 2023.

Central Oregon LandWatch ("LandWatch") is a conservation organization which has advocated for preservation of natural resources in Central Oregon for over 30 years. With over 950 members in Central Oregon, LandWatch has a long history of protecting the forests and streams in and around the Deschutes National Forest and other lands managed under the NWFP. LandWatch's members and supporters live in Central Oregon, including on lands adjoining the Deschutes National Forest, and recreate in the Crescent, Fort Rock and Sisters Ranger Districts. They hunt, fish, take photographs, view wildlife, hike, drive, and engage in other recreational activities on National Forest lands, generally, and on lands within the boundary of the NWFP area specifically.

LandWatch's comments are focused on the NWFP area east of the Cascade crest and primarily within the Deschutes National Forest, an extremely varied landscape ranging in elevation from 10,358 feet to 2,900 feet, and encompassing a broad spectrum of wildlife, plant groups and fire regimes.

The NOI describes a need to change the NWFP around five focus areas and places a consistent emphasis on seeking updated plan direction that further recognizes the differences between forests on the west and east side of the Cascades, and particularly as management relates to wildfire. Within that context, considering the current framing of vegetation management projects under the NWFP east side of the Cascades is important to determining whether existing implementation of the NWFP is meeting the overall purpose of the 1994 NWFP, and how it might be improved.





Recent forest management projects on the Deschutes National Forest are often framed in terms of "forest restoration," with a narrow purpose and need centered on addressing fuel loading and mitigating the perceived threat of extreme wildfire behavior.¹ The over-reliance on fuels-centric projects, however, is leading to an artificial ceiling on forest restoration efforts, the misapplication of treatments in the context of place, and increasing controversy in the Central Oregon region related to the management of National Forest lands.

Fire is a key driver in Central Oregon forests having shaped forest structure, process, pattern, and composition for millennia. There is little controversy in whether a lack of fire in forest communities that historically experienced frequent, lower severity fires-such as lower elevation ponderosa pine and dry-mixed coniferous forests-has fundamentally transformed and contributed to the degradation of many of these forest ecosystems (Brown, Agee, Franklin 2004; Noss et al 2006; Haugo et al 2015). While public perceptions can often be that too much of our forests are burning in the modern era, western forests continue to be in a fire deficit (Parks et al. 2015; Hessburg et al 2021) and modern fire suppression efforts effectively put out 97-98 percent of all fire starts (Dombeck et al. 2004; North et al. 2015; Hessburg et al 2021). The 2 percent of fires that escape suppression efforts are most often driven by extreme fire weather and account for 97 percent of all firefighting costs and area burned (Calkin et al. 2005; Hessburg et al 2021).

Changes in fire frequency and extent are just one of a suite of factors that have profoundly influenced forest ecosystems east of the Cascades. The transformation and degradation of lower elevation pine dominated forests and watersheds has primarily been driven by logging of large fire-resistant trees², extensive road building, fire exclusion, and livestock grazing (Brown, Agee, & Franklin 2004; Stine et al. 2014). The combination of these "drivers of degradation" have culminated in dramatic impacts to forest ecosystems, playing a leading role in the biodiversity crisis and the loss or near loss of multiple keystone species. Though the challenges related to addressing these drivers of degradation are large, each is fundamentally a resource management decision that can be changed, mitigated, or prohibited all together.

While there is broad consensus that some ponderosa pine and dry-mixed coniferous forests under the NWFP are in a degraded state, defining the purpose and need for restoration is not without controversy; the when, where, why, and how to restore forest ecosystems east of the Cascades continues to be highly debated in scientific, public, and policy forums. The Forest Service's often narrow focus on reducing fuels to restore forest condition fails to address the full suite of factors that have fundamentally changed disturbance regimes and degraded forests. Further, a fuels-centric approach has significant tradeoffs for fish and wildlife, plant community pattern and composition, and is unlikely to meaningfully influence the 2 percent of fires that burn the majority of forested acres.

<u>Management Project</u>. ² Despite the ecological impacts, large tree logging continues to occur on the Deschutes National Forest: <u>Group</u> sounds alarm over plan to cut big, old trees near Bend - OPB



¹ Examples include: Green Ridge Landscape Restoration; Cougar Rock Restoration Project; West Bend Vegetation



In updating the NWFP, LandWatch urges the Forest Service to consider establishing forest plan standards and other sideboards that help re-calibrate forest management and restoration projects east of the Cascades—especially where projects propose to address large-scale risks such as wildfire—and embrace a more balanced forest management framework that centers on the concepts of ecological restoration and addressing fundamental drivers of degradation. This framework should address large tree logging, road networks, the reintroduction of keystone species such as beaver, and livestock grazing in addition to and in balance with addressing fire exclusion.

The United Nations Convention on Biodiversity has defined ecological restoration as:

the process of managing or assisting the recovery of an ecosystem that has been degraded, damaged or destroyed as a means of sustaining ecosystem resilience and conserving biodiversity. Degradation is characterized by a decline or loss of biodiversity or ecosystem functions. Degradation and restoration are context-specific and refer to both the state of ecosystems and to ecosystem processes.³

Similarly, Stine et al. (2014) defined ecological restoration as:

the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Ecological restoration focuses on re-establishing the composition, structure, pattern, and ecological processes necessary to facilitate terrestrial and aquatic ecosystem sustainability, resilience, and health under current and future conditions.

Recalibrating forest management to lead with ecological restoration and implementing projects that fundamentally address the drivers of forest degradation is necessary to facilitate terrestrial and aquatic ecosystem resilience and health under current and future conditions. Further, by taking a more cautious and balanced approach to fuels management, ecological restoration efforts can better address ecological concerns related to forest ecosystem structure, process, pattern, and composition, improve forest resiliency in the face of climate change, and decrease the level of controversy around federally managed public forests.

The current fuels-centric approach to forest management east of the Cascades fails to lead with ecological integrity and resilience.

In amending the NWFP, LandWatch urges the Forest Service to consider how to support a more balanced approach to forest management and restoration that builds upon and furthers the core tenets and purpose of the 1994 plan. To that end, our comments focus on strengthening key management standards and sideboards around three themes: 1) ensuring that risk-reduction efforts do not further degrade and impact ecological integrity, wildlife habitats, and other key forest values; 2) improving our understanding of treatment outcomes; and 3) building and restoring public trust in forest management.

³ Ecosystem restoration: short-term action plan (cbd.int)





I. Fire and Climate Resistance and Resilience

The Federal Register Notice ("FRN") makes clear that the Forest Service seeks to adopt additional forest plan direction to differentiate forest management on the east side of the Cascade crest, especially as it relates to wildfire (See FRN at 87396; 87397). While we agree that additional clarity could improve implementation of the NWFP east of the Cascades, we strongly recommend the Forest Service consider and adopt stronger protections for wildlife habitat and more clarity around the process and implementation of Standards & Guidelines ("S&Gs") intended to reduce the risk of large-scale disturbance east of the Cascades.

a. Clarify Management Direction for Areas Where Risk of Large-Scale Disturbance Has Been Identified

East of the Cascades, the NWFP includes flexibility for managers to implement additional management treatments and activities within Late Successional Reserves ("LSR"), and outside of plantations or younger stands when treatments are "beneficial to the creation and maintenance of later successional forest conditions" (USDA 1994a at 6). Specifically, the guidelines to reduce risks of large-scale disturbance east of the Cascades in Oregon state:

While risk-reduction efforts should generally be focused on young stands, activities in older stands may be appropriate if: (1) the proposed management activities will clearly result in greater assurance of long-term maintenance of habitat, (2) the activities are clearly needed to reduce risks, and (3) the activities will not prevent the Late-Successional Reserves from playing an effective role in the objectives for which they were established.

(USDA 1994b at C-12).

LandWatch recommends the Forest Service provide additional clarity on how the risk of largescale disturbance is determined, and what management actions are allowed when a determination has been made that a proposed project area is at risk from a large-scale disturbance. For example, the EIS should outline a consistent, science-based approach for determining the level of risk from large-scale disturbance; a process to balance forest values and assess whether apparent risk warrants additional management flexibility in LSR, including by providing explicit ecological thresholds to assist managers in determining if "activities are clearly needed to reduce risks"; and outline what management activities are permitted when a large-scale disturbance risk determination is made.

Fuels-centric forest management aimed at reducing risk, whether that be to communities, large trees, or other values, has inherent tradeoffs. Ensuring the Forest Service is utilizing a science-based approach to determine whether increased flexibility is required is paramount to reducing negative impacts, better balancing trade-offs between the known impacts of vegetation





management actions and perceived risks from disturbance events, and supporting positive ecological outcomes.

b. Standards to Protect the Ecological Integrity of Forests Under All Management Scenarios

The Forest Service should establish new forest plan standards that protect the ecological integrity of the forest, including key wildlife habitat, under all management scenarios. For example, the Forest Service should develop and adopt a standard that protects all large (≥ 21 inches DBH), mature, and old growth trees. Large trees, regardless of species and age, provide critical wildlife habitat (both alive and dead), store the majority of forest carbon, are in a deficit east of the Cascades, and are generally the most fire-resistant trees on the landscape. Logging large trees as part of risk reduction efforts conflicts with the purpose of the original NWFP, exacerbates large tree structure scarcity problems, and provides little if any benefit to reducing the risk of large-scale disturbance events. Further, protecting large trees will reduce the controversy and contentious tradeoffs that surround large tree logging, both within the Forest Service and more broadly among the public, streamlining silviculture prescriptions for LSR stands and improving the public's trust in the Forest Service.

c. Standards & Guidelines for Suppression Activities

The existing NWFP has no S&Gs for management during fire suppression. Given the FRN's focus on refining and updating management guidance to address wildfire concerns—especially east of the cascades—the amendment should provide additional clarity around what actions are allowed during suppression activities in mature and old growth forests.

For example, additional clarity is needed around how, when and whether the Forest Service builds fuel breaks as part of suppression activities. The Forest Service should consider S&Gs that clearly define when and where fuel breaks are appropriate. Where fuel breaks are deemed necessary to suppression efforts, new S&Gs that provide clarity around how they are implemented will greatly reduce negative outcomes. For example, S&Gs around the development of gappy, patchy, clumpy fuel breaks, shaded fuel breaks where all large trees are retained, and a stepwise process for developing fuel breaks during active suppression, where treatments are implemented incrementally through time, would all mitigate the potential ecological impacts of suppression activities.

S&Gs for suppression activities will assist the Forest Service in fully meeting the original purpose of the NWFP, including conserving and mitigating impacts to mature and old-growth ecosystems, habitat for the NSO and other species, and riparian areas and waters.

d. Standards & Guidelines for Prescribed Understory Burning

In projects that propose to remove young, small trees to address concerns related to fuels and large-scale disturbance, the focus should be on restoring periodic surface fire. In amending the NWFP, new S&Gs should require understory burning to be the primary focus of projects





proposing to remove small understory trees. Whether it is the only treatment, or implemented shortly after science-based thinning, carefully applied understory burning provides important ecological benefits, creating landscape heterogeneity, reducing surface and ladder fuels, lowering stand densities, improving drought resistance of surviving trees, and may be the most appropriate treatment in riparian areas that historically experienced frequent fire (Knapp & Keeley, 2006; van Mantgem et al. 2016; Mildrexler et al 2023; Kauffman et al. 1997; Agee 1999; Everett et al. 2003; Brown, Agee, Franklin 2004).

II. Mature and Old Growth Forest Management

a. Standards to Protect Large, Mature, and Old Growth Trees and Forest Types

The EIS should consider and adopt a standard that protects all large, mature, and old growth trees across the entire NWFP area. As discussed above, this should include the protection of large trees in areas the Forest Service has determined to be at risk of large-scale disturbance.

The best available science is clear that protecting mature and old growth trees and forest conditions is essential to mitigating the impacts of climate change (Hudiburg et al. 2009; Mildrexler et al. 2020; Law et al. 2018; Law et al. 2022), protecting and providing clean and cool water for fish, wildlife, and growing communities, and for providing refuge for wildlife and people alike (Brandt et al. 2014). In fact, two of the architects of the original NWFP have called for an end to all logging of mature and old growth trees within the NWFP planning area.⁴ As the FRN states "[p]rotecting and enhancing biodiversity of mature and old growth ecosystems is a central tenet of the NWFP, and the 2012 Planning Rule's focus on ecosystem integrity emphasizes this priority. Mature and old growth ecosystems are critical components of biodiversity and provide carbon storage" FR at 87396. In considering management east of the Cascades, this central tenet must lead the development of all management actions, and the retention of all large trees should be part of all projects.

As discussed above, protecting mature and old growth trees on forests east of the Cascades does not prevent the Forest Service from implementing projects to address fuel concerns in forests where frequent fire was historically common. Large trees are not driving concerns related to fuel loading or the risk of large-scale disturbance. Removing small trees can achieve fuels management objectives without the logging of large trees.

b. Late Successional Reserves

The Forest Service should consider how best to adjust the reserve system to ensure plants and animals have room to migrate, as well as to facilitate ecological processes and functions. This should include considering how increasing the size and spatial arrangement of reserves across the landscape could improve ecosystem connectivity and improve the ability of wildlife to adapt to changing climate conditions.

⁴ <u>Guest View: Protect older natural forests in the western Cascades (registerguard.com)</u> (Last access January 29, 2024)





c. Provide for Retention of Old-Growth Fragments

The NWFP already outlines an S&G for matrix that "provides for the retention of old-growth fragments in watersheds where little remains" (USDA 1994b at C-44). In addition to establishing a standard to protect all large trees, including mature and old growth, the existing S&G for retaining old-growth fragments should be further emphasized within project planning. This will help ensure not only individual trees are protected, but so are the few remaining old-growth stands on our National Forest. As the current S&G states:

Isolated remnant old-growth patches are ecologically significant in functioning as refugia for a host of old-growth associated species, particularly those with limited dispersal capabilities that are not able to migrate across large landscapes of younger stands. These include, but are not limited to, many species of fungi, lichens, bryophytes, arthropods, and vascular plants, and will likely include vertebrate species such as small mammals and amphibians, and various bird species.

(USDA 1994b at C-44). Protecting these remaining stands across all land use allocations should be a required frame for all vegetation management projects.

III. Wildlife Habitat Protections

a. Standard to Protect All Mature and Old Growth Trees

As discussed in the previous two sections, the Forest Service should consider and ultimately adopt a new standard that protects all large, mature, and old growth trees within the NWFP area.

East of the Cascade Crest, retention of all species of large trees is critical to maintaining large tree structure and providing habitat for NSO and other wildlife. In conducting watershed analyses under the 1994 NWFP, the Forest Service has recognized the broad benefits of retaining large trees to NSO, mule deer and other wildlife, as well as their resistance to wildfire induced mortality (USFS 2017). Oregon and Washington forests have lost a substantial proportion of forests supporting large trees and recruitment of these structural elements of wildlife habitat is slow; maintaining forest biodiversity in part depends on retaining existing and restoring older forest habitat for wildlife species (Bell et al. 2021).

b. End All Salvage Logging

The science is clear that there is no ecological reason to conduct salvage logging operations (Noss et al. 2006; Brown, Agee, Franklin 2004). The Forest Service should consider and adopt an alternative that ends all salvage logging, including on forests east of the Cascades.

c. Aquatic Conservation Strategy





The Aquatic Conservation Strategy ("ACS") is a key pillar of the 1994 NWFP, and generally, the ACS should be retained as is. However, the Forest Service should consider expanding the ACS to emphasize and encourage restoration of riparian areas.

For example, the Forest Service should consider adopting additional standards around developing comprehensive riparian restoration plans that address the drivers of riparian degradation, including reestablishing floodplain connectivity, reducing road densities and road crossings, reintroducing beaver, and increasing the recovery of riparian shade and large wood through plantings. As part, the Forest Service should encourage more analysis of stream side conditions and develop and emphasize riparian restoration projects that do not include timber harvest. Further, more emphasis on the restoration of non-salmon bearing streams would improve forest resiliency and support overall biological diversity.

Additionally, the Forest Service should consider standards for expanded buffers for all activities within burned and unburned riparian reserves, consistent with findings in the Metolius Watershed Analysis (USFS 2004).

d. Landscape Heterogeneity

The FRN states that "[i]n the drier portions of the NWFP area, more than a century of fire exclusion and other management practices have resulted in overly dense and homogenous forest conditions that heightens the risk of large, high-severity fire" (FR at 87395). Under the NWFP, recent projects implemented east of the Cascades to address conditions caused by fire exclusion are leading to homogenous, park-like forest conditions across large swaths of the Deschutes National Forest. In the context of implementing prescribed burns and scienced-based thinning of small trees, the Forest Service should adopt additional standards that ensure projects create heterogeneity on the landscape, such as a gappy, patchy, clumpy distribution of trees and understory plant communities following treatment. As part, wildlife habitat attributes, like hiding cover, are preserved, and balanced against other project needs.

e. NSO Dispersal Habitat

The Forest Service should develop and implement science-based minimum canopy cover standards for NSO dispersal habitats, especially on forests east of the Cascades. Where minimum canopy cover standards are not being met, a plan for attaining cover standards should be developed. As part of this, the Forest Service should develop a connectivity strategy to move NSO in a north-south continuum between NRF habitats (USFS 2017). The connectivity strategy should require identification of stands to be left untreated to facilitate NSO dispersal as well as providing security and predator avoidance (USFS 2017).

As discussed further in the section below, the Forest Service should implement a robust effectiveness monitoring program to assess the efficacy of its management actions across the





forest, and especially within dispersal habitat. Understanding the outcomes of past vegetation management projects on the integrity of dispersal habitat will help inform best practices for meeting wildlife habitat objectives in the future.

f. Road Density

The Forest Service should adopt lower road density standards for LSRs, Riparian Reserves, and key wildlife habitats to limit the direct impact of roads, road construction and maintenance, and human disturbance via recreation and road system use. Reducing road densities, especially within riparian areas and at stream crossings, has been consistently recommended in the Forest Service's watershed analyses under the NWFP (USFS 2004; USFS 2017). Yet road densities remain high across much of the Deschutes National Forest.

g. Other Wildlife

To fully meet the NWFP's original intent of conserving habitat for the NSO *and other species*, the plan should incorporate additional S&Gs for protecting other key wildlife habitats, especially in the context of planning risk reduction projects. These should include, but not be limited to ungulates, carnivores, reptiles, amphibians, and invertebrate species.

Mule deer are a good example of a species the Forest Service should develop additional S&Gs for. Over the past decade, mule deer populations east of the Cascades have experienced declines of greater than 50% in some areas, and forest management practices have been identified as a concern for regional populations. Particularly relevant here are findings from the Deschutes Collaborative Forest Partnership's ("DCFP") 10-Year Monitoring Report related to forest restoration treatments and their impacts to deer and elk habitat. In that report, the DCFP states that "[p]ost-treatment monitoring data show that deer hiding and thermal cover have declined on DCFP project areas, particularly on the Sisters Area Fuels Reduction (SAFR), Melvin Butte, and West Bend projects. Similarly, elk habitat has been significantly decreased in the Ryan Ranch Key Elk Habitat Area on the West Bend project. These findings were not unexpected but, combined with recent research showing dramatic declines in mule deer populations in Central Oregon, they may make elk and deer habitat a higher priority for the DCFP in coming years" (Caligiuri et al. 2020).

IV. Effectiveness Monitoring

The Forest Service should consider and adopt new forest plan standards that require effectiveness monitoring for a percentage of all treated stands within a watershed to better understand the outcomes of management. For example, the Forest Service should adopt a standard that requires 15-20% of all treated stands within a watershed to be monitored for the duration of the plan. In addition, effectiveness monitoring should be triggered when a fire occurs within a watershed. Effectiveness monitoring is paramount to assessing whether treatments are attaining project goals, especially as it relates to wildlife habitat and risk reduction. An effectiveness monitoring program must be carefully developed and include a defined framework,



with clear process for establishing a monitoring plan, implementation, and inter-disciplinary team review.

As part of an effectiveness monitoring program, the Forest Service must consider and specify how it will sustain monitoring efforts through time, including how efforts will be staffed and funded. Additionally, the Forest Service should consider what role citizen groups can play in assisting in effectiveness monitoring efforts. With the right-side boards in place, citizen-led monitoring can assist the Forest Service in achieving its monitoring goals at a lower cost, while also improving public and agency relationships, and providing sustained institutional knowledge for an agency that sees high turnover in staff at the forest level.

The original NWFP was heavy on the promise of monitoring, but in practice, often failed to deliver. In amending the NWFP the agency should recalibrate its monitoring goals and provide the support needed to follow through.

V. Public Trust

Amending the NWFP provides the Forest Service an opportunity to improve public trust and transparency in how our National Forests are managed. The recent trend of transitioning S&Gs from standards to guidelines has caused significant concern and increased uncertainty around forest management outcomes, eroding public trust in the Forest Service as an institution. Maintaining and building upon standards, especially for wildlife and ecological integrity, can provide the public with assurances about project outcomes and transparency regarding what actions are, and are not permissible. Forest plan standards are a cornerstone to public trust with the Forest Service; further eroding standards will only lead to more conflict and increased public mistrust of the Forest Service.

VI. Tribal Consultation

LandWatch acknowledges that Central Oregon, including those lands managed by the Forest Service, are the original homeland of the Wasq'u (Wasco) and Tana'ma (Warm Springs) Tribes. The Klamath and Molalla tribe—among others—also frequent this area, as did the Nama (Paiute), who were eventually forcibly relocated to the Warm Springs Reservation. What we now know as Central Oregon are the ceded lands of the Warm Springs Tribes, where they retain the right to hunt, fish and gather.

The Forest Service must consult early and often with Tribal governments to ensure that indigenous people's interests and knowledge are brought forward in the planning process and that land use allocations do not conflict with landscapes of cultural significance or rights on ceded lands.

VII. Conclusion

Thank you for considering these comments. Please retain Central Oregon LandWatch on your list of interested public for this project.





Sincerely,

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Jeremy Austin Wild Lands & Water Program Director Central Oregon LandWatch 2843 NW Lolo Dr St. 200 Bend, OR 97703

Cc:

Ben Gordon, Executive Director Central Oregon LandWatch <u>ben@colw.org</u>





REFERENCES

Agee, J.K., 1999, April. A coarse-filter strategy. In *Forum for Applied Research and Public Policy* (Vol. 14, No. 1, p. 15). University of Tennessee, Energy, Environment and Resources Center.

Bell, D.M., Acker, S.A., Gregory, M.J., Davis, R.J. and Garcia, B.A., 2021. Quantifying regional trends in large live tree and snag availability in support of forest management. Forest Ecology and Management, 479, p.118554.

Brown, R.T., Agee, J.K. and Franklin, J.F., 2004. Forest restoration and fire: principles in the context of place. *Conservation biology*, *18*(4), pp.903-912.

Caligiuri, P., Dean, A., Ferriel, J., Fisher, M., Gregg, M., Gritzner, J., Turner, L. 2020. Deschutes Collaborative Forest Project: A Decade of Learning, 10-Year Monitoring Report. Retrieved from Bend, OR p 7

Calkin, D.E., Gebert, K.M., Jones, J.G. and Neilson, R.P., 2005. Forest Service large fire area burned and suppression expenditure trends, 1970–2002. *Journal of Forestry*, *103*(4), pp.179-183.

Dombeck, M.P., Williams, J.E. and Wood, C.A., 2004. Wildfire policy and public lands: integrating scientific understanding with social concerns across landscapes. *Conservation biology*, *18*(4), pp.883-889.

Everett, R., Schellhaas, R., Ohlson, P., Spurbeck, D. and Keenum, D., 2003. Continuity in fire disturbance between riparian and adjacent sideslope Douglas-fir forests. *Forest Ecology and Management*, *175*(1-3), pp.31-47.

Haugo, R., Zanger, C., DeMeo, T., Ringo, C., Shlisky, A., Blankenship, K., Simpson, M., Mellen-McLean, K., Kertis, J. and Stern, M., 2015. A new approach to evaluate forest structure restoration needs across Oregon and Washington, USA. *Forest Ecology and Management*, *335*, pp.37-50.

Hessburg, P.F., Prichard, S.J., Hagmann, R.K., Povak, N.A. and Lake, F.K., 2021. Wildfire and climate change adaptation of western North American forests: a case for intentional management. *Ecological applications*, *31*(8), p.e02432.

Hudiburg, T., Law, B., Turner, D.P., Campbell, J., Donato, D. and Duane, M., 2009. Carbon dynamics of Oregon and Northern California forests and potential land-based carbon storage. Ecological applications, 19(1), pp.163-180.

Kauffman, J.B., Beschta, R.L., Otting, N. and Lytjen, D., 1997. An ecological perspective of riparian and stream restoration in the western United States. *Fisheries*, *22*(5), pp.12-24.





Knapp, E.E. and Keeley, J.E., 2006. Heterogeneity in fire severity within early season and late season prescribed burns in a mixed-conifer forest. *International Journal of Wildland Fire*, 15(1), pp.37-45.

Law, B.E., Hudiburg, T.W., Berner, L.T., Kent, J.J., Buotte, P.C. and Harmon, M.E., 2018. Land use strategies to mitigate climate change in carbon dense temperate forests. Proceedings of the National Academy of Sciences, 115(14), pp.3663-3668.

Law, B.E., Moomaw, W.R., Hudiburg, T.W., Schlesinger, W.H., Sterman, J.D. and Woodwell, G.M., 2022. Creating Strategic Reserves to Protect Forest Carbon and Reduce Biodiversity Losses in the United States. Land, 11(5), p.721.

Mildrexler, D.J., Berner, L.T., Law, B.E., Birdsey, R.A. and 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, p.127.

Mildrexler, D.J., Berner, L.T., Law, B.E., Birdsey, R.A. and Moomaw, W.R., 2023. Protect large trees for climate mitigation, biodiversity, and forest resilience. *Conservation Science and Practice*, p.e12944.

North, M. P., S. L. Stephens, B. M. Collins, J. K. Agee, G. Aplet, J. F. Franklin, and P. Z. Fule. 2015. Reform forest fire management. *Science*, *349*(6254), pp.1280-1281.

Noss, R.F., Franklin, J.F., Baker, W.L., Schoennagel, T. and Moyle, P.B., 2006. Managing fireprone forests in the western United States. *Frontiers in Ecology and the Environment*, 4(9), pp.481-487.

Parks, S.A., Miller, C., Parisien, M.A., Holsinger, L.M., Dobrowski, S.Z. and Abatzoglou, J., 2015. Wildland fire deficit and surplus in the western United States, 1984–2012. *Ecosphere*, *6*(12), pp.1-13.

Patric Brandt, David J. Abson, Dominick A. DellaSala, Robert Feller & Henrik von Wehrden, *Multifunctionality and biodiversity: Ecosystem services in temperate rainforests of the Pacific Northwest, USA*, 169 BIODIVERSITY CONS. 362 (2014).

Stine, P., Hessburg, P.F., Spies, T.A., Kramer, M.G., Fettig, C.J., Hansen, A.J., Lehmkuhl, J.F., O'Hara, K.L., Polivka, K.M., Singleton, P.H. and Charnley, S., 2014. *Ecology and Management of Moist Mixed-conifer Forests in Eastern Oregon and Washington: A Synthesis of the Relevant Biophysical Science and Implications for Future Land Management*. United States Department of Agriculture, Forest Service, Pacific Northwest Research Station.

van Mantgem, P.J., Caprio, A.C., Stephenson, N.L. and Das, A.J., 2016. Does prescribed fire promote resistance to drought in low elevation forests of the Sierra Nevada, California, USA?. *Fire ecology*, *12*, pp.13-25.





USDA. 1994a. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Norther Spotted Owl. Portland, Oregon.

USDA. 1994b. Standards and Guidelines for Management of Habitat for Late Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. Attachment A to the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl. Portland, Oregon.

USFS. 2004. Metolius Watershed Analysis Update. Sisters Ranger District, Deschutes National Forest. Sisters, Oregon.

USFS. 2017. Lower Metolius Watershed Analysis. Sisters Ranger District, Deschutes National Forest. Sisters, Oregon.

