Juniper Group Sierra Club
c/o Environmental Center
16 NW Kansas Avenue
Bend, OR 97703

7 April 2022

Doug McKay
ATTN: Leslie Taylor
Heppner Ranger Station
PO Box 7
Heppner OR, 97836

RE: Ellis Integrated Vegetation Project
https://www.fs.usda.gov/project/?project=41350

District Ranger McKay:

The Juniper Group Sierra Club, representing over 2000 members in Eastern Oregon counties, thanks you for the opportunity to comment on the Ellis Integrated Vegetation Project DEIS.

This project is proposed to apply various treatments to over 110,000 acres. This large landscape includes many different vegetation groups and ecosystems, and affects many different wildlife habitats and riparian areas. This is all of concern to us, as we appreciate these natural areas and like to recreate in this project area.

Here are some of our concerns and recommendations.

Evaluation of Alternative 1

Alternative 1, the no action alternative, has been described in some of the expert supporting documents as leading to the fastest recovery of the area as it continues to heal from past management activities. Doing more logging across this landscape as this project is proposing will reset the clock on the natural healing processes. We recommend this no action alternative.

Additional changes to current practices could speed this process. These changes could include:

- Reducing grazing intensity: Fewer cattle grazing on the land will help it heal faster and will improve riparian areas.
- Close more roads: Road closures improve water conditions and reduce wildlife disturbance among other things. More on roads, below.

The more that can be done to not interfere with the natural healing processes, the faster we will be able to enjoy a healthy forest.

Recommendation: Give serious consideration to using this alternative.

Road and Travel Reduction

We applaud your plans to close, decommission, and convert to more seasonal roads in this project area. Roads are generally detrimental to the environment because of effects like these:

- Fragmentation of habitat.
- Increase water runoff.
- Degrade water quality.
- Wildlife disturbance.
- Litter and other pollution brought in by people.
- Avenues for invasive species.
- Increase wildfire risk, added ignition sources from people and vehicles.
- Some people damage vegetation, illegally harvest vegetation, illegally shoot wildlife, and create additional roads or tracks that extend the range of negative effects of roads.
- Roads degrade or take away areas used by non-motorized recreationalists.

We encourage you to make all areas “Properly Functioning” with a road density of <2mi/mi2. (p. 58, DEIS) The lowest road densities provide the greatest chance for the forest to remain healthy.

Road closures must be done with physical barriers. It is well known that signage is mostly ignored (or shot up) my much of the public, and even physical barriers are often surmounted.

We also believe that Relevante Issue #6 is correct, that temporary roads impact soils and aquatic resources. In addition, temporary roads fragment habitat and are the basis for user created tracks. It is best not to create temporary roads, as the scars created remain for years.

Roads also increase the risk of wildfire. Roads bring in more people who are likely to set up camps with fires. Vehicles are also a source of wildfire ignition with hot exhaust pipes and potential for sparks from rocks and dragged chains.

We also appreciate the DEIS comments about how closing roads reduces maintenance costs for the Forest Service.

Recommendation: Close more roads, and use physical barriers.

Need for Change

The DEIS specifies the need for this harvesting project is to increase the health and vigor of the forest. However, work such as this, called thinning or restoration or fuels reduction, is no longer seen as the best way to achieve forest health. (Hanson, 2021, for example)

In the DEIS the need has been specified as both “not within natural range of variability”, and also “historic range of variability” (HRV). This measure has many problems, including:

1. HRV is not an exact measure, it has many weaknesses. It may be used as a guide, but is not definitive for a specific location. See Keane 2009.
2. With climate change, HRV is a guide but needs to be used in conjunction with projections of future conditions. See Keane 2008.

This application of thinning to achieve a certain basal area to match a guessed-at HRV value is a failing stand-in for natural processes that achieve the same thing. The basal area and forest structure that are reached over time through natural processes is not achievable via one pass cutting as it unnaturally opens the canopy, and results in other changes and damages to the ecosystem.

Recommendation: Select the no action alternative.

Hazard Trees

The removal of hazard trees varies considerable between the alternatives.

- Alternative 3 states that danger trees up to 300 feet on either side of a road may be removed.
- Alternative 2, 4, and 5 specify that a danger tree is leaning toward a road and could reach the road if it fell.
- The definition of a danger tree in p. 193 is a hazard tree likely to fail within one and one half the tree length of a road or developed area.

Recommendation: Use the definition on p. 193 for danger tree removal in all alternatives.

Alternative 5 Cutting Large Trees Unacceptable

We oppose the harvest of large trees, all trees greater than or equal to 21 inch DBH.

This protection from the original Eastside Screens was changed with a rushed process in January 2021. The original protection has proven successful over the two decades or more it was in effect, successful in helping to restore the health and diversity of the covered forests.

Large trees, in this case trees >=21” DBH, are important to retain in the forest for many reasons, including these:

- Provide wildlife habitat in the large, three-dimensional structure they create.
- Provide wildlife habitat in the dead branches and cavities that occur as a tree ages.
- Provide wildlife food in seeds, cones, and vegetation.
- Provide wildlife food by creating habitat for insects in the litter produced and in snags and in fallen branches and trees.
- Build soil with the buildup of litter and support for fungi.
- Build soil when fire converts some of the organic matter to minerals that shallow-rooted plants can utilize.
- Slow loss of moisture by providing shade and wind breaks.
- Reduce intensity of fires by retaining more moisture in the soil and litter through shade, and by reducing wind speed which can fan a fire.
- Large trees, of any species, are more fire resistant than small trees.
- Provides cover and security zones for wildlife.
- Provides recreational areas that are preferred by recreationalists.
- Provide sources of nutrients and moisture for small trees that helps them get started; these are Mother Trees. See Simard.
- Large trees in clumps provide habitat and support for each other and smaller trees. See Franklin 2013, p. 76, and Simard.

- Help preserve and protect riparian areas and watersheds.

Further Discussion: Fish and Wildlife Habitat

The Eastside Screens were implemented in 1994 in order to preserve the remaining large and old trees, and to protect ecosystem values such as wildlife and streams habitats. Those protections were recently removed by the highly controversial decision that the Forest Service implemented by the Undersecretary of the Department of Agriculture to remove protections for trees over 21 inches on east side forests. Those protections were not in place long enough to restore the historical amount of large and old trees, and the crucial wildlife habitat they provide to recover from the past century of high-grade logging that removed the largest and oldest trees across many of the forests in eastern Oregon. Large trees are the foundation of old growth and mature forests, and they have a crucial role in supporting biodiversity, wildlife, and clean water. It is important to retain ALL remaining large trees since they are scarce on a landscape that has experienced decades of high grading timber harvest for large old trees. Large, old trees are also important since they are much more tolerant of wildfires.

Large trees are critical for supporting wildlife, water quality, and carbon storage. Large trees remain at a severe scarcity on the landscape and every large old tree on the forest is important to retain, especially given climate and biodiversity loss emergencies in this time of Anthropocene extinctions. These large legacy trees need to be protected, not harvested. Numerous wildlife species depend on large trees and old forests for habitat. These include but are not limited to the American marten, Vaux's swifts, Pileated woodpeckers, Black bears, numerous bird species, and bats.

The DEIS fails to provide evidence that increased harvest of large trees over 21 inches will benefit wildlife or restore ecosystem processes. However, there is a large body of science that shows that increased harvest of large trees results in long-term and irreparable harm to wildlife, ecosystem processes, biodiversity, and water quality. Since the Eastside Screens were implemented in the mid-1990s, the ecological basis for the Screens has not changed since they were implemented. There remains a large deficit of large trees on the landscape in eastern Oregon as well as a relatively low abundance of the wildlife species that the Eastside Screens were designed to protect and maintain.

This level of impact, particularly in mixed conifer forests, old growth areas and connectivity corridors impacts many important functions that old trees provide. These areas are especially important to wildlife species that live almost exclusively in complex multi-layered habitats. Large trees over 21" are important because they support a large variety of wildlife species by providing a multi layered large structural habitat as well as habitat for snag dependent and old growth species. They also assist in the improvement of soil health.

Other treatments such as thinning and prescribed burns in old growth areas need to be carefully applied. We recognize that Native Americans used burning as a method to provide diverse habitats for a wide variety of species. However, prescribed fires can also have impacts on some species that may be in low abundance because of the large scale losses of old trees from a century of timber harvest selecting for old trees. Several important wildlife species include the Northern goshawk and other accipiter hawks, American marten, Pacific fisher, Great gray owls, Black-backed woodpeckers, Three-toed woodpeckers, Pileated woodpeckers, Olive-sided flycatchers, and other species rely on denser forests, mature or old growth mixed conifer forests, and can be negatively impacted by logging. In Eastern Oregon, the largest trees provide key habitats for many wildlife species. Large old trees are essential for reproductive and foraging needs for most of these species. For example, Grand fir is an important tree species for wildlife habitat that provides cavities for denning or nesting. Since Grand fir decays more quickly, it provides essential nutrients for insects such as Carpenter ants that pileated woodpeckers and black bear prey upon.

The application of fuel treatments is also important and can impact important snags and downed woody material. Passovoy and Fule (2006) reported that the loss of large-diameter snags and down wood can take years to decades to recover, as indicated by wildland fire research. Pilliod et al. (2006) also investigated potential unintended negative effects on wildlife and habitats due to thinning and prescribed fire. They stated that species that are associated with large patches of high-density trees and more complex structure may lose habitat through fuel treatments. For example, those wildlife and invertebrate species that depend on down wood, snags, dwarf mistletoe brooms, dense forests with abundant saplings and small poles, and closed-canopy forests for survival and reproduction are likely to be negatively impacted by fuel treatments that alter those habitat components.

Further Discussion: Climate Impacts

We also did not see the issue of impacts of climate change addressed since timber harvest has been documented as the largest source of carbon emissions in Oregon and emits far more carbon than wildfires. Oregon's oldest forests are especially good at capturing and storing carbon and continue to absorb carbon even after tree growth slows. While the timber industry falsely claims that fast-growing young forests are better at absorbing carbon, scientific research shows that old forests store far more carbon. Logging older trees and replacing them with younger ones emits tremendous amounts of CO_2 and creates a "carbon debt" that takes decades or even centuries to repay. Recent research has found that large trees comprise only 3% of trees, yet account for 42% of the above-ground carbon in forests in this region (Mildrexler et al. 2020). Large trees play an outsized role in carbon storage, and so their protection is critical for meeting climate goals and making meaningful strides toward combating climate change.

Mildrexler et al. also reported that "In addition to comprising a substantial portion of forest carbon storage and accumulation, large-diameter trees fulfill a variety of unique ecological roles such as increasing drought-tolerance, reducing flooding from intense precipitation events, altering fire behavior, redistributing soil water, and acting as focal centers of mycorrhizal communication and resource sharing networks (Bull et al., 1997; Brooks et al., 2002; Brown et al., 2004; Luyssaert et al., 2008; Beiler et al., 2015; Lindenmayer and Laurance, 2017). In the United States Pacific Northwest (PNW), carbon dense old growth forests buffer against increasing temperatures by creating microclimates that shelter understory species from rising temperatures (Frey et al., 2016; Davis et al., 2019a). Forests with large-diameter trees often have high tree species richness, and a high proportion of critical habitat for endangered vertebrate species, indicating a strong potential to support biodiversity into the future and promote ecosystem resilience to climate change (Lindenmayer et al., 2014; Buotte et al., 2020)."

Retaining the remaining large trees on the landscape is crucial to providing for climate adaptability, and for protecting and restoring forest ecosystems. Climate change is the international crises of our time, leading to large extinctions of fish and wildlife species over the course of this century. This indifference and irresponsibility of a public land management agency in combating climate change is classic denial.

Instead, this DEIS should evaluate what this project can do to counteract climate change. The most important aspect to combat climate change is carbon sequestration which is accomplished by retaining carbon in the trees, the dead and downed wood, and the soils of the forest. Recent studies have shown that not harvesting trees and retaining large trees is better at carbon sequestration. One study at Oregon State University reported that forests in the western United States should be preserved for their potential to mitigate climate change through carbon sequestration, as well as to enhance biodiversity (Buotte et al. 2019). Not harvesting western forests in key areas is the carbon dioxide equivalent of halting eight years' worth of fossil fuel burning in the western lower 48, which makes public land stewardship a higher societal priority for altering climate change trajectory.

Hutto et al. (2016) reported on the need to develop a more ecologically informed view of severe wildland fire effects. The authors indicated that many plant and animal species use, and have occasionally evolved to depend on, severely burned forest conditions for their persistence. The evidence from their fire history studies indicates that a complex mosaic of severely burned conifer patches was common historically in the West. They also stated that the ecological integrity of forests born of mixed-severity fire will require land managers to accept some severe fire and maintain the integrity of its aftermath. Finally, they stated that public education regarding fire should be improved so that people better understand, and support management designed to maintain ecologically appropriate sizes and distributions of severe fire and the complex early-seral forest conditions it creates.

Gedalof et al. (2005) commented that “fuels treatments alone may not be effective at reducing area burned under extreme climatic conditions and furthermore that anthropogenic climate change may have important implications for forest management.” Essentially, perceived complications with future changes in fire behavior cannot be solved by increasing efforts to treat this particular climate change indicator [wildfires] by installing widespread fuel treatments that do nothing to stop the warming trend and do little to reduce the extent or severity of weather-driven fires. Therefore, vegetation treatments intended to reduce wildfires will ultimately fail because a warming climate and wind events are the major drivers of large wildfires.

Buotte et al. (2019) indicated that the greater frequency and intensity of extreme events such as wildfires have adversely affected terrestrial ecosystems, and although climate change impacts forests in many regions, other regions are expected to have low vulnerability to fires, insects and drought in the future. The authors report that preserving temperate forests in the western United States that have medium to high potential carbon sequestration and low future climate vulnerability could account for about a third of the global mitigation potential previously identified for temperate and boreal forests. Since atmospheric CO_2 has increased 40% since the dawn of the Industrial Age, the global average atmospheric CO_2 concentration on Jan 1, 2019, was 410 parts per million, higher than at any time in at least 800,000 years (and even higher since the study was published). Ultimately, smart public lands management is an opportunity to mitigate the effects of climate-induced ecosystem changes to biodiversity and watersheds. This includes managing to store carbon in large trees.

Further Discussion: Wildfires

Like prescribed low intensity fires, not all medium and high intensity fires are “bad”. There are benefits of high-intensity wildfire because they can create large patches, that are biodiverse, ecologically important, and spatially rare and unique habitats. These areas with wildfires create areas that often have higher species richness and diversity than unburned old forest. Many wildlife species use this forest habitat type and old forest species select it for foraging. Some of the more rare and imperiled species, such as the Black-backed Woodpecker and Buff-breasted Flycatcher, depend on forests that have been burned by wildfires. Other benefits from wildfires are examples of Ponderosa pine and Douglas-fir forests in Idaho at 5-10 years post-fire where aquatic insects emerging from streams were two and a half times greater in high-intensity fire areas than in unburned mature/old forest, while bats were nearly 5 times more abundant in riparian areas with high-intensity fire than in unburned mature/old forest (Malison and Baxter 2010).

Similarly, Raphael et al. (1987) reported that snags in post burned forests supported greater bird species richness and abundance, including woodpeckers and flycatchers, compared to unburned old forest for at least 25 years after high-intensity fires. Schieck and Song (2006) also reported that bird species richness increased for up to 30 years after high-intensity fires, while Haney et al. (2008) reported that by 30 years after high-intensity fire, bird species richness increased 56% compared to pre-fire mature unburned forest. Old growth forest species like the Pacific Fisher benefit from such post-fire habitat for foraging (Hanson 2015). The author stated that fishers used unlogged higher-intensity fire areas at levels comparable to use of unburned dense, mature/old forest.

Large Trees Recommendation

Retain all trees >=21” DBH in the project area. The USFS needs to incorporate a holistic ecosystems plan that prioritizes protecting old and mature forests, wildlife habitat and connectivity, roadless areas, and water quality. The USFS needs to discard the simple focus on misguided silvicultural prescriptions that emphasize a single stratum sparse overstory of Ponderosa pine which disregards impacts on a host of wildlife species.

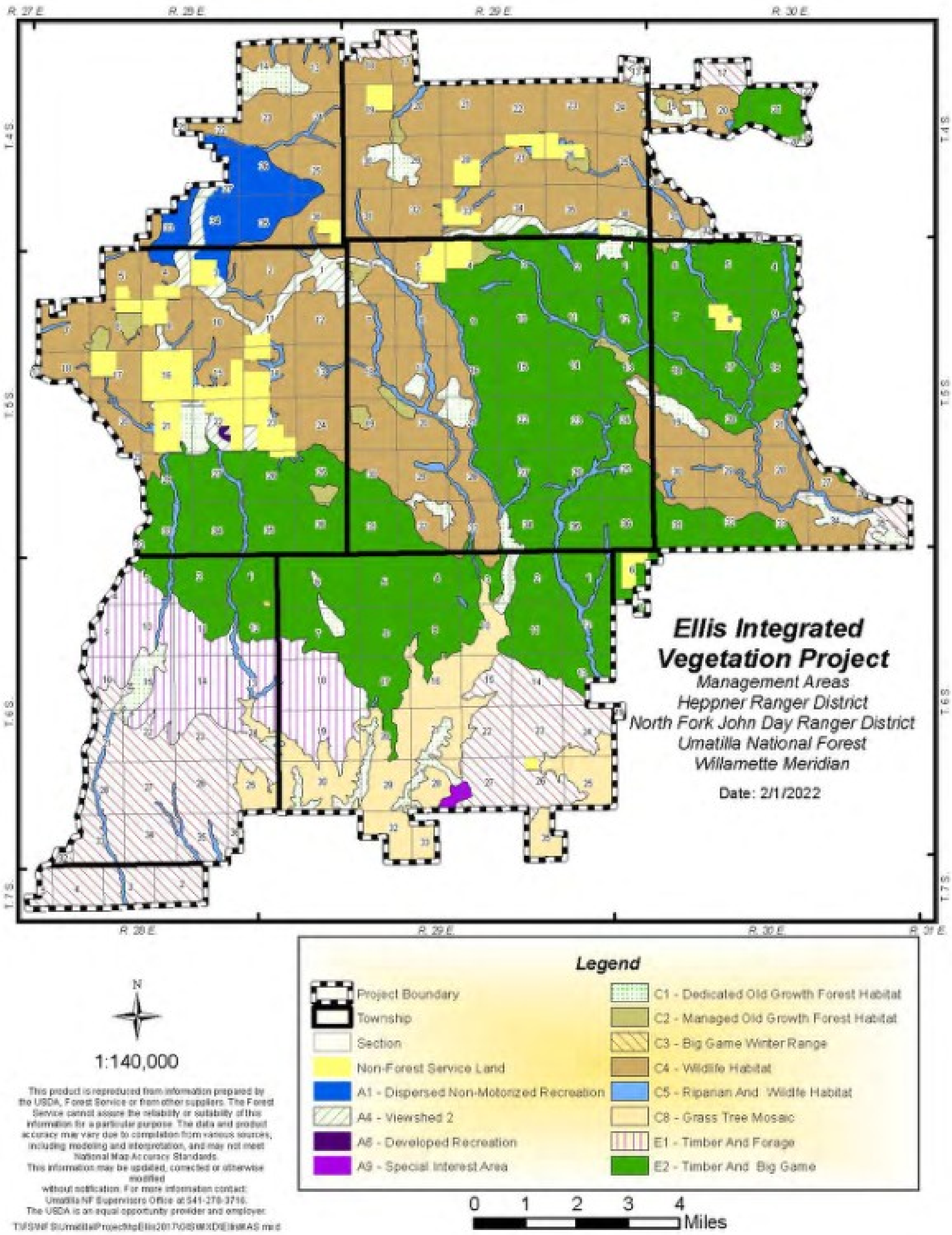
Conclusion

We encourage the Forest Service to consider the concerns we have described above. If an action alternative must be selected, and as alternative 3 appears least disruptive of the natural forest ecosystem, we encourage the Forest Service to adopt this alternative. This also appears to be the alternative that would be least costly, close the most expensive to maintain roads, and provide the most jobs in non-mechanical thinning.

Sincerely,
/s/ Mathieu Federspiel
Executive Committee
Juniper Group Sierra Club
Bend, OR

Appendix 1: Map of Management Areas

As taken from the DEIS. Included here for reference.



Map B-1. Management Areas within the Ellis Integrated Vegetation Project

Literature Cited

Allen, C. D., M. Savage, D. A. Falk, K. F. Suckling, T. W. Swetnam, T. Schulke, P. B. Stacey, P. Morgan, M. Hoffman, and J. T. Klingel. 2002. Ecological restoration of southwestern ponderosa pine ecosystems: a broad perspective. Ecological Applications 12:1418–1433.

Baird, E.J., W. Floyd, I. Van Meerveld and A.E. Anderson. 2012. Road surface erosion. Part 1: Summary of Effects, Processes, and Assessment Procedures. Streamline Watershed Management Bulletin 15. 9 pp.

Beschta, R.L., R.E. Bilby, G.W. Brown, L.B. Holtby and T.D. Hofstra. 1987. Stream temperature and aquatic habitat: fisheries and forestry interactions. pp. 191-232, In: Salo and Cundy, eds.

Bjornn and Reiser. 1991. Habitat requirements of salmonids in streams. In Meehan, W. (Ed). Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19.

Buotte, P.C., B.E. Law, W.J. Ripple, and L.T. Berner. 2019. Carbon sequestration and biodiversity co-benefits of preserving forests in the western USA. Ecological Applications, 2019; DOI: 10.1002/eap.2039.

Carey, H. and M. Schumann. 2003. Modifying wildfire behavior – the effectiveness of fuel treatments, the status of our knowledge. National Community Forestry Center, Southwest Region Working Paper. 26 pp.

Carnefix, G. and C. Frissell. 2009. Aquatic and other environmental impacts of roads: the case for road density as indicator or human disturbance and road-density reduction as restoration target; a concise review. Pacific Rivers Council Science Publication 09-001. 9 pp.

Chapman, D.W. 1988. Critical review of variables used to define effects of fines in redds of large salmonids. Transactions of the American Fisheries Society 117(1): 1-21.

Churchill, D.J., Carnwath, G.C., Larson, A.J., Jeronimo, S.A., 2017. Historical forest structure, composition, and spatial pattern in dry conifer forests of the western Blue Mountains, Oregon. Gen. Tech. Rep. PNWGTR-956. USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon.

Elliot, W.J., P.R. Robichaud, and R.B. Foltz. 2011. Erosion processes and prediction n NW US forests. International Symposium on Erosion and Landscape Evolution. September 18-21, 2011. Anchorage, Alaska. 8 pp.

Everest, F.H., R.L. Beschta, J.S. Scrivener, K.V. Koski, J.R. Sedell and C.J. Cedarholm. 1987. Fine sediment and salmonid production: a paradox. Pp. 98-142, In: J. Colt and R.J.

White, eds. Streamside management: forestry and fishery interactions. Contrib. No. 57. Seattle, WA. Institute of For. Res., Univ. WA.

Franklin, J.F., K.N. Johnson, D.J. Churchill, K. Hagmann, D. Johnson, and J.Johnston, 2013. Restoration of dry forests in eastern Oregon: a field guide. The Nature Conservancy, Portland, OR.

Foltz, R.B., N.S. Copeland, and W.J. Elliot. 2009. Reopening abandoned forest roads in northern Idaho, USA: quantification of runoff, sediment concentration, infiltration, and interrill erosion parameters. J. Environmental Management (Impact Factor: 3.06). 04/2009; 90(8):2542-50.

Forman, R. T. T., D. Sperling, J. A. Bissonette et al. 2003. Road ecology: science and solutions. Washington, DC: Island Press.

Furniss, M.J., T.D. Roelofs, and C.S. Yee. 1991. Road construction and maintenance in Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication 19:297-323.

Gaines, W. L., P. H. Singleton, and R. C. Ross. 2003. Assessing the cumulative effects of linear recreation routes on wildlife habitats on the Okanogan and Wenatchee National Forests. U.S. Department of Agriculture, Forest Service, General Technical Report PNW-GTR-586, Portland, Oregon.

Gedalof, Z., D.L. Peterson and N.J. Mantua. 2005. Atmospheric, climatic, and ecological controls on extreme wildfire years in the Northwestern United States. Ecological Applications 15(1). DOI:10.1890/03-5116.

Haddad, N.M., L.A. Brudvig, J. Clobert, K.F.F. Davies, A. Gonzalez, and others. 2015. Habitat fragmentation and its lasting impact on Earth’s ecosystems. Sci. Adv. 1, e1500052 (2015).

Haney, A., Apfelbaum, S., and Burris, J., 2008. Thirty years of post-fire succession in a southern boreal forest bird community. The American Midland Naturalist 159: 421-433.

Hanson, C., 2015. Use of higher severity fire areas by female Pacific fishers on the Kern Plateau, Sierra Nevada, California, USA. Wildlife Society Bulletin 39: 497-502.

Hanson, Chad T. 2021. *Smokescreen: Debunking wildfire myths to save our forests and our climate.*

Hicks, B.J., J.D. Hall, P.A. Bisson and J.R. Sedell. 1991. Responses of salmonids to habitat changes. Pp. 483-518, In: W.R. Meehan, ed. Influences of forest and rangeland management on salmonid fishes and their habitat. American Fisheries Society Sp. Publ. 19. Bethesda, MD.

Hutto, R. L., R. E. Keane, R. L. Sherriff, C. T. Rota, L. A. Eby, and V. A. Saab. 2016. Toward a more ecologically informed view of severe forest fires. Ecosphere 7(2):e01255. 10.1002/ecs2.1255.

Jackson, W.L. and R. L. Beschta. 1984. Influences of sand delivery on the morphology of sand and gravel channels. Water Resources Bulletin 20(4): 527-533.

Kaufmann, M.R.; Binkley, D.; Fule, P.Z.; Johnson, M.; Stephens, S.L.; Swetnam, T.W. 2007. Defining old growth for fire-adapted forests of the Western United States. Ecology and Society 12.

Keane, Robert E., Lisa M. Holsinger, Russell A. Parsons, Kathy Gray. Climate change effects on historical range and variability of two large landscapes in western Montana, USA. Forest Ecology and Management 254 (2008) 375-389. j.foreco.2007.08.013, August 2007. https://www.fs.fed.us/rm/pubs_other/rmrs_2008_keane_r001.pdf

Keane, Robert E., Paul F. Hessburg, Peter B. Landres, Fred J. Swanson. The use of historical range and variability (HRV) in landscape management. Forest Ecology and Management, j.foreco.2009.05.035, May 2009. https://www.fs.fed.us/rm/pubs_other/rmrs_2009_keane_r001.pdf

Kreutzweiser, D.P., S.S. Capell, and K.P. Good.2005. Effects of fine sediment inputs from a logging road on stream insect communities: A large-scale experimental approach in a Canadian headwater stream
January 2005Aquatic Ecology 39(1):55-66. DOI:10.1007/s10452-004-5066-y.

Lehman, Chadwick P.; Rumble, Mark A.; Rota, Christopher T.; Bird, Benjamin J.; Fogarty, Dillon T.; Millspaugh, Joshua J. 2015. Elk resource selection at parturition sites, Black Hills, South Dakota. Journal of Wildlife Management. 80(3): 465-478.

Lillebo, T. 2012. Restoring eastern Oregon’s dry forests: A practical guide for ecological restoration. Oregon Wild. 18 pp.

Lisle, T.E. 1982. Effects of aggradation and degradation on riffle-pool morphology in natural gravel channels, northwestern California. Water Resources Research. 18:1643-1651.

Luce, B.H. and T.A. Black. 2001. Effects of traffic and ditch maintenance of forest road sediment production. Effects of Traffic and Ditch Maintenance on Forest Road Sediment Production. In Proceedings of the Seventh Federal Interagency Sedimentation Conference, March 25-29, 2001, Reno, Nevada. pp. V67–V74.

Lyon, L. J. 1979. Habitat effectiveness for elk as influenced by roads and cover. Journal of Forestry 79:658-660.

Magee, J.P., T.E. McMahon, and R.F. Thurow. 1996. Variation in spawning habitat of cutthroat trout in a sediment-rich stream basin. Transactions of the American Fisheries Society 125 :768-779.

Malison, R., and Baxter, C., 2010. The fire pulse: wildfire stimulates flux of aquatic prey to terrestrial habitats driving increases in riparian consumers. Canadian Journal of Fisheries and Aquatic Sciences 67: 570-579.

McCorquodale, S., P. Wik, P. Fowler, and T. Owens. 2010. Elk Survival and Mortality Factors in the Blue Mountains of Washington, 2003-2006.Washington Department of Wildlife. Olympia, WA. 65 pp.

McCorquodale, 2013. A brief review of the scientific literature on elk, roads, and traffic. Washington Department of Fish and Wildlife. 26 pp.

Millspaugh, J.J., R.J. Woods, and K.E. Hunt. 2001. Fecal glucocorticoid assays and the physiological stress response in elk. Wildlife Society Bulletin 29:899-907.

Miserendino, L. and Masi, C. (2010). The effects of land use on environmental features and functional organization of macroinvertebrate communities in Patagonian low order streams. Ecological Indicators, 10(2): 311-319.

Mildrexler, D.J., L.T. Berner, B.E. Law, R.A. Birdsey, and W.R. Mooman. 2020. Large Trees Dominate Carbon Storage in Forests East of the Cascade Crest in the United States Pacific Northwest. Front. For. Glob. Change, 05 November 2020 | https://doi.org/10.3389/ffgc.2020.594274.

Oregon Forest Resources Institute. 2013. Wildlife in managed forests: deer and elk. Portland, Oregon. 32 pp.

Passovoy, M.D. and P.Z. Fule. 2006. Snag and woody debris dynamics following severe wildfires in northern Arizona ponderosa pine forests. Forest ecology and management 2006 v.223 no.1-3.

Pilliod, David S.; Bull, Evelyn L.; Hayes, Jane L.; Wales, Barbara C. 2006. Wildlife and invertebrate response to fuel reduction treatments in dry coniferous forests of the Western United States: a synthesis. Gen. Tech. Rep. RMRS-GTR-173. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 34 p.

Proffitt, K.M., J.A. Gude, K.L. Hamlin, and M.A. Messer. 2012. Effects of hunter access and habitat security
on elk habitat selection in landscapes with a public and private land matrix. The Journal of Wildlife Management; DOI: 10.1002/jwmg.491. 11 pp.

Ranglack D., B. Garrott, J Rotella, K. Proffitt, J. Gude, and J. Ganfield. 2014. Security areas for maintaining elk on publicly accessible lands during archery and rifle hunting seasons in southwestern Montana. Montana Fish Wildlife and Parks.

Raphael, M., M. Morrison, and M. Yoder-Williams, M., 1987. Breeding bird populations during twenty-five years of postfire succession in the Sierra Nevada. The Condor 89: 614-626.

Reid, L.M. and T. Dunne. 1984. Sediment production From forest road surfaces. Water Resources Research Vol. 20 (11):1753-1761.

Rowland, M. M., M. J. Wisdom, B. K. Johnson, and J. G. Kie. 2000. Elk distribution and modeling in relation to roads. Journal of Wildlife Management 64:672-684.

Rowland, M.M., M.J. Wisdom, B.K. Johnson, and M.A. Penninger. 2005. Effects of roads on elk: implications for management in forested ecosystems. In: M. Wisdom (ed.) The Starkey Project: A Synthesis of Long-term Studies of Elk and Mule Deer. Transactions of the 2004 North American Wildlife and Natural Resources Conference, Alliance Communications Group, Lawrence, KS. Pp. 42-52.

Schieck, J., and Song, S., 2006. Changes in bird communities throughout succession following fire and harvest in boreal forests of western North America: literature review and metaanalyses. Canadian Journal of Forest Research 36: 1299-1318.

Scrivener, J.C. and M.J. Brownlee. 1989. Effects of forest harvesting on spawning and incubation survival of chum and Coho salmon in Carnation Creek, British Columbia. Canadian Journal of Fisheries and Aquatic Sciences. 46:681-696.

Simard, Suzanne. 2021. *Finding the Mother Tree: Discovering the wisdom of the forest*.

Washington Department of Fish and Wildlife (WDFW) 2005. Living with elk. Adapted from "Living with wildlife in the Pacific Northwest. Russell Link, Wildlife Biologist. 8 pp.

Williams, C.D. 1999. Summary of Scientific Findings on Roads and Aquatic Ecosystems. Primary Research and Analysis. Environmental Consultants, Medford, Or. 17 pp.

Wisdom, M.J., N.J. Cimon, B.K. Johnson, E.O. Garton, and J.W. Thomas. 2005. Spatial Partitioning by Mule Deer and Elk in Relation to Traffic. Pages 53-66 in Wisdom, M. J., technical editor, The Starkey Project: a synthesis of long-term studies of elk and mule deer. Reprinted from the 2004 Transactions of the North American Wildlife and Natural Resources Conference.

Wisdom, M.J., A.A. Ager, H.K. Preisler, N.J. Cimon, and B.K. Johnson. 2006. Effects of Off-Road Recreation on Mule Deer and Elk. Pages 67-80 in Wisdom, M. J., technical editor, The Starkey Project: a synthesis of long-term studies of elk and mule deer. Reprinted from the 2004 Transactions of the North American Wildlife and Natural Resources Conference, Alliance Communications Group, Lawrence, Kansas, USA.