Flat Country Literature Attachments

Agee, J. K., and C. N. Skinner. 2005. Basic principles of forest fuel reduction treatments. Forest Ecology and Management 211:83-96.

- To reduce fire hazard in Western, drier forests, forest managers can use thinning and prescribed fire. These practices are most effective when the following principals are addressed reduction of surface fuels, increasing the height to live crown, decreasing crown density, and retaining large trees of fire-resistant species. Because the BLM plans to conduct thinning while not disclosing how it will utilize prescribed fire over time, it must consider this literature in its analysis.

Amaranthus, M., D. Page-Dumroese, A. Harvey, E. Cazares, and L. Bednar. 1996. Soil compaction and organic matter affect conifer seedling nonmycorrhizal and ectomycorrhizal root tip abundance and diversity. Research Paper PNW-RP-494. USDA Forest Service, Pacific Northwest Research Station. Portland, Oregon, USA.

- Amaranthus et al. found that forest harvest and soil compaction have the potential to effect forest soil productivity. Their findings suggest a loss in the ability of establishing seedings to capture site resources and adapt to changing conditions. The BLM must consider this literature in its analysis given the considerable logging treatments they propose in the project area.

Anthony, R. G. 2013. Effects of riparian thinning on Marbled Murrelets and Northern Spotted Owls. Unpublished report for Department of Fisheries and Wildlife.

- Northern spotted owls have been associated with some riparian reserves. Because the BLM proposes to conduct thinning in riparian areas, it must include this literature in its analysis.

Bellinger, R. G., F. W. Ravlin, and M. L. McManus. 1989. Forest edge effects and their influence on Gypsy Moth (Lepidoptera: Lymantriidae) egg mass distribution. Environmental Entomology 18:840-843.

- The BLM must address the impacts of group selection and road construction edge effects on moth distribution.

Beschta, R. L., J. R. Boyle, C. C. Chambers, W. P. Gibson, S. V. Gregory, J. Grizzel, J. C. Hagar, J. L. Li, W. C. McComb, T. W. Parzybok, M. L. Reiter, G. H. Taylor, and J. E. Warila. 1995. Cumulative effects of forest practices in Oregon. Oregon Department of Forestry. Salem, Oregon, USA.

- In this study researchers examined the cumulative effects of forest management on air resources, soils, water, aquatic biota, and wildlife. Because of the scale of the proposed forest management project, the BLM must analyze this literature.

Bjornn, T. C., and D. W. Reiser. 1991. Habitat requirements of salmonids in streams. Pages 83-118 *in* Meehan, W. R., editor. *Influences of forest and rangeland management on salmonid fishes and their habitats*. American Fisheries Society, Bethesda, Maryland, USA.

- Bjornn and Reiser describe how the composition of in-stream sediment is a useful measure to convey the extent of disturbance and erosion in a drainage. Bjornn and Reiser provide data of how high sediment loads can affect proximal water exchange and oxygen availability that directly influence salmonid incubation and reducing the survival of embryos. Proposed logging and roads create sediment and the sediment can have lethal effects on incubating fish eggs.

Black, S. H. 2005. Logging to control insects: The science and myths behind managing forest insect "pests." A synthesis of independently reviewed research. The Xerces Society for Invertebrate Conservation. Portland, Oregon, USA.

- A review of over three hundred papers on the subject reveals that there is little to no evidence that logging decreases the vulnerability of forests to insect outbreaks. Additionally, though thinning has been touted as a long-term solution to controlling bark beetles, the evidence is mixed as to its effectiveness. Considering the logging proposed in the project area, the BLM should include this analysis in the project impacts.

Bowd, E., S. Banks, C. L. Strong, and D. Lindenmayer. 2019. Long-term impacts of wildfire and logging on forest soils. Nature Geoscience. 12:113-118.

- Soils are a fundamental component of terrestrial ecosystems, and play key roles in biogeochemical cycles and the ecology of microbial, plant and animal communities. Bowd et al. found that disturbances such as logging and fire can negatively impact soil for up to eight decades after the disturbance. Due to the combination of logging and burning proposed for this project the BLM must consider this literature in its analysis.

Butz, R. J., and H. Safford. 2011. A summary of current trends and probable future trends in climate and climate-driven processes for the Klamath National Forest and surrounding lands. Klamath NF climate change trend assessment. USDA Forest Service unpublished report.

- Butz and Safford concluded that Northern California and Southwest Oregon are likely to experience the following: "Total precipitation may remain roughly similar to historical levels, but may shift in seasonality to fall predominantly in mid-winter months. Rising temperatures will increase the percentage of precipitation falling as rain and decrease snowpack considerably, particularly at lower elevations. The area is likely to experience more severe storm events, variable weather, higher and flashier winter and spring runoff events, and increased flooding. Both wet and dry cycles are also likely to last longer and be more extreme, leading to periods of deeper drought as well as periods of more extensive flooding." Because the BLM plans to remove an extensive amount of stabilizing vegetation from the project area, it must analyze this literature.

Churchill, D. J., A. J. Larson, M. C. Dahlgreen, J. F. Franklin, P. F. Hessburg, and J. A. Lutz. 2013a. Restoring forest resilience: From reference spatial patterns to silvicultural prescriptions and monitoring. Forest Ecology and Management 291:442–457.

- In an attempt to understand regeneration of natural forest mosaic patterns, researchers examined the individuals, clumps, and openings (ICO) in mixed conifer forest structures. Resource managers can and should utilize this ICO method to correctly imitate natural forest patterns when managing forests. Because the BLM proposes extensive thinning

and logging in the treatment area, it must include this literature in its analysis in order to ensure best practices are used.

Churchill, D. J., M. C. Dalhgreen, A. J. Larson, and J. F. Franklin. 2013b. The ICO approach to restoring spatial pattern in dry forests: Implementation guide. Version 1.0. Stewardship Forestry and Science. Vashon, Washington, USA.

- In an attempt to understand regeneration of natural forest mosaic patterns, researchers examined the individuals, clumps, and openings (ICO) in mixed conifer forest structures. Resource managers can and should utilize this ICO method to correctly imitate natural forest patterns when managing forests. Because the BLM proposes extensive thinning and logging in the treatment area, it must include this literature in its analysis in order to ensure best practices are used.

Coleman, M., D. Page-Dumroese, J. Archuleta, P. Badger, W. Chung, T. Venn, D. Loeffler, G. Jones and K. McElliot. 2010. Can Portable Pyrolysis Units Make Biomass Utilization Affordable While Using Bio-Char to Enhance Soil Productivity and Sequester Carbon? USDA Forest Service Proceedings RMRS-P-61.

- Coleman et al. provide alternative techniques to combust wood residue from fuels treatment or logging slash. Pyrolyisis (aka biochar) of burn piles would reduce soil damage and carbon emissions. Because the BLM will be burning many hundreds of slash piles with resulting soil damage and carbon emissions, this publication provides a method to mitigate these unwanted effects.

Colombaroli, D., and D. G. Gavin. 2010. Highly episodic fire and erosion regime over the past 2,000 years in the Siskiyou Mountains, Oregon. Proceedings of the National Academy of Sciences 107(44):18909-18914.

- The Bear Grub EA fails to reflect the cumulative impacts associated with the BLM's road system that are detailed in this study.

Copstead, R. L, D. K. Johansen, and J. Moll. 1998. Water/road interaction: Introduction to surface cross drains. USDA Forest Service Technology and Development Program, San Dimas, California, USA.

- This study is directly relevant to the BLM's BMPs for the Bear Grub project.

Countryman, C. M. 1955. Old-growth conversion also converts fire climate. United States Forest Service Fire Control Notes 17:15-19.

- Regenerated fuels after logging are more susceptible to intense fire behavior and severe fire effects than unlogged mature forests, including burned mature forests. The increased susceptibility of plantations to severe fire is due, in part, to warm, windy and dry microclimates compared to what would exist in an unlogged burned forest that possessed more structural diversity, ground shading and barriers to lateral wind movement. Given the BLM's plan to log within the project area, it must include this literature in its analysis.

Courtney, S., J. Blakesley, R. Bigley, M. Cody, J. Dumbacher, R. Fleischer, A. Franklin, J. Franklin, R. Gutierrez, J. Marzluff, and L. Sztukowski. 2004. Scientific evaluation of the status

of the northern spotted owl. U.S. Fish and Wildlife Service. Sustainable Ecosystems Institute, Portland, Oregon, USA.

- The BLM must address the findings of this study prior to downgrading and removing NSO NRF habitat.

DellaSala, D. A., D. M. Olson, S. E. Barth, S. L. Crane, and S. A. Primm. 1995. Forest health: Moving beyond rhetoric to restore healthy landscapes in the inland Northwest. Wildlife Society Bulletin 23(2): 346-356.

- DellaSala et al. explore the appropriate applications of a "historic ranges of variability" approach for thinning activities. They conclude the best approach would include restoration actions that consider regional as well as watershed levels of rare habitat types, and activities that allow sufficient time for recovery of ecosystem processes. Because of its applicability to proposed thinning activities, the BLM should consider this literature in developing the project.

Diller, L. V., K. A. Hamm, D. A. Early, D. W. Lamphear, K. M. Dugger, C. B. Yackulic, C. J. Schwarz, P. C. Carlson, and T. L. McDonald. 2016. Demographic response of northern spotted owls to barred owl removal. Journal of Wildlife Management 80(4):691-707.

- Diller et al. found Barred Owl removal from shared habitat increased Northern Spotted Owl occupancy, increased the rate of population, and in occupied spotted owl sites northern spotted increased productivity when it came to counts of fledged young. In contrast, in habitat where barred owls were not removed Northern spotted owl's rate of population decreased on average, and occupancy declined. The BLM should consider these findings prior to authorizing activities that may facilitate Barred Owl encroachment.

Dugger, K. M., R. G. Anthony, and L. S. Andrews. 2011. Transient dynamics of invasive competition: Barred Owls, Spotted Owls, habitat, and the demons of competition present. Ecological Applications 21(7):2459-2468.

- Maintenance of continuous old growth forest habitat is critical to preservation of the spotted owl. This is especially true when the strong effects of Barred Owl competition with Northern Spotted Owl are present. Due to the extensive logging proposed by the BLM the agency must consider this literature in its analysis.

Eastman, J. C., J. R. G. Townshend, C. O. Justice, R. Sohlberg, and C. J. Tucker. 2002. Roadless Areas and Forest Fires in the Western United States. Paper presented at American Geographical Union Spring Meeting.

- The impacts of logging roads on fire hazard in the Bear Grub planning area are not fully disclosed in the EA. The findings of this paper should be addressed in the EA.

Edwards, P.J., F. Wood, and R. L. Quinlivan. 2016. Effectiveness of Best Management Practices that Have Application to Forest Roads: A Literature Synthesis. Forest Service Northern Research Station General Technical Report NRS-163.

- This reports evaluates effectiveness of BMPs that BLM could be using to abate sediment. Because BLM did not evaluate BMP effectiveness this report would improve analysis and could be used to address uncertainty about logging-related sediment finding its way into streams.

Franklin, J. F., and T. A. Spies. 1986. The ecology of old-growth Douglas Fir forests. Oregon Birds 12(2):79.

- This article explains the characteristics of old growth forests from a scientific perspective. Because BLM is proposing to log trees >32" DBH the analysis would benefit from being informed about scientific standards defining old growth. The concept of "old growth" has been accepted by the scientific community but is missing from the EA and RMP FEIS. Analysis would benefit from the scientific understanding of old growth so impacts can be assessed.

Franklin, J. F. and K. Norman Johnson. 2012. A restoration framework for federal forests in the Pacific Northwest. Journal of Forestry 110(8):429–439.

- This restoration framework relies on thinning to restore dry forests and provides a rational for avoiding group selection clearcuts. The BLM will benefit from learning about a credible restoration framework that was reflected in its earlier dry forest restoration demonstration projects.

Fremier A. K., Kiparsky M., Gmur S., Aycrigg J., Craig R.K., Svancara L.K., Goble D.D., Cosens B., Davis F.W., Scott J.M. 2015. A riparian conservation network for ecological resilience. Biological Conservation 191:29-37.

- Riparian areas provide ecosystem services, habitat, and potential connectivity. Researchers used spatial analysis to look at the viability of a creating Riparian Connectivity Network (RCN) to promote and improve the already exiting benefits of riparian areas of a coalesced network of land protection. The RCN as a conservation strategy is already supported by existing legal and regulatory frameworks. Further, using the RCN for conservation, versus more typical terrestrial land protection corridors better serves government incentives and requirements. Because the BLM proposes thinning in riparian areas, it must disclose how, if at all, it has incorporated RCN into its actions.

Frey, J. K., S. J. Schulze, J. A. Jones, M. G. Betts, A. S. Hadley, and S. L. Johnson. 2016. Spatial models reveal the microclimatic buffering capacity of old-growth forests. American Association for the Advancement of Science. doi: 10.1126/sciadv.1501392.

- BLM is proposing to log in old-growth forests or forests with old growth characteristics. This publication would alert BLM to microclimatic buffering capacity that could be lost with thinning.

Froehlich, H. A., and D. H. McNabb. 1984. Minimizing soil compaction in Pacific Northwest forests. Pages 159-192 *in* E.L. Stone, editor. *Forest Soils and Treatment Impacts*. Paper presented at Sixth North American Soils Conference. Knoxville, Tennessee, USA.

- Froehlich and McNabb propose multiple strategies for minimizing soil compaction during logging operations, such as tilling the compacted soil and designating skid trails. Due to the extensive use of machinery the BLM proposes in the Bear Grub project, it must consider this literature in its analysis.

Frost, E. J., and R. Sweeny. 2000. Fire Regimes, Fire History and Forest Conditions in the Klamath-Siskiyou Region: An Overview and Synthesis of Knowledge. Wildwood Environmental Consulting. Ashland, Oregon, USA.

- If land management agencies are to consider increasing the use of fire in the Klamath-Siskiyou region, then understanding the historic fire regimes, their natural range of variability, and how they may have changed as a result of human activities is essential. Frost and Sweeny explore these elements of fire within the Klamath-Siskiyou region. The BLM plans to conduct some prescribed burning in the project area and therefore should consider this literature when determining the details of their burn plans.

Gaggiotti, O. E. and I. Hanski. 2004. Mechanisms of population extinction. Pages 337-66 *in* I. Hanski and O.E. Gaggiotti, editors. *Ecology, Genetics, and Evolution of Metapopulations*. Elsevier Academic Press, Burlington, Massachusetts, USA.

- The BLM's Bear Grub EA fails to acknowledge the wildlife population dynamics detailed in this study.

Gomez, A., R. F. Powers, M. J. Singer, and W. R. Horwath. 2002. Soil compaction effects on growth of young ponderosa pine following litter removal in California's Sierra Nevada. Soil Science Society of America Journal. 66:1334–1343.

- Gomez et al. found that the effect of soil compaction on tree growth varies considerably based upon soil texture and soil water regime. Given the variability in soil compaction impacts, the BLM must consider this literature to ensure it is using the best management practices based on the soil types within the project area.

Greacen, E.L. and R. Sands. 1980. Compaction of forest soils: A review. Australian Journal of Soil Research. 18(2):163-189.

- Greacen and Sands discuss the impact of logging on soil compaction. Modern harvesting machines apply heavy loads and, for reasons of cost, tend to be kept in operation throughout the year. As a consequence the structure of the soil suffers some damage, often manifested as compaction. Compaction arising from such sources may reduce the growth of the current trees or trees subsequently planted on the site. Due to the extensive use of heavy machinery proposed by the BLM in the Bear Grub project area the agency must include analysis of this literature.

Hann, W. J., J. L. Jones, M. G. Karl, P. F. Hessburg, R. E. Keane, D. G. Long, J. P. Menakis, C. H. McNicoll, S. G. Leonard, R. A. Gravenmier, and B. G. Smith. 1997. Landscape dynamics of the basin. Pages 337-1055 *in* Quigley, T. M., and S. J. Arbelbide, technical editors. *An assessment of ecosystem components in the interior Columbia Basin and portions of the Klamath and Great Basins*. General Technical Report PNW-GTR-40S. USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon, USA.

- As stated in our comments this study is relevant to the BLM's proposed actions.

Harris, L. D. 1984. The Fragmented Forest. University of Chicago Press, Illinois, USA.

- This book explains how removal of forest canopy and other forest management actions have much greater impacts at larger scales. Proposed gap creation logging would contribute to ongoing forest fragmentation discussed in this literature.

Hayward L. S., A. E. Bowles, J. C. Ha, and S. K. Wasser. 2011. Impacts of acute and long-term vehicle exposure on physiology and reproductive success of the northern spotted owl. Ecosphere 2(6):1-20.

- Researchers studied Northern Spotted Owl responses to stress related to OHV use by measuring fecal glucocorticoid metabolites (fGCs), which reflect disturbance; fecal thyroid hormone metabolites (fT3), which reflect nutrition; and the number of offspring fledged within a season. NSO responses to this disturbance were mostly sex- and seasonally-related. Males showed the highest levels of stress in May when they mate and are responsible for feeding their young. In contrast, females' stress was related to their number of young and their nutrition; female NSOs were most stressed when they were without young and had high nutrition. Generally, NSO close to noisy roads fledged significantly fewer young than NSO near quiet roads, indicating that routine traffic exposure may decrease NSO reproductive success over time. Because the BLM proposes to build new roads and yarding corridors in known NSO habitat, it must consider this literature in its analysis.

Hicks, B. J., R. L. Beschta, and R. D. Harr. 1991. Long-term changes in streamflow following logging in western Oregon and associated fisheries implications. Water Resources Bulletin 27(2):217-226.

- This publication may assist BLM in making determinations about possible lowered summer streamflow due to proposed logging and effects on fish.

Higley, J.M., and S. Matthews. 2006. Demographic rates and denning ecology of female Pacific fishers (Martes pennanti) in northwestern California. Preliminary report to U.S. Fish and Wildlife Service. Hoopa, California, USA.

- The Bear Grub EA fails to utilize the best available science regarding Pacific fisher management and populations.

Hindmarch, T. D., and M. L. Reid. 2001. Forest thinning affects reproduction in pine engravers (Coleoptera: Scolytidae) breeding in felled lodgepole pine trees. Environmental Entomology 30(5):919–24.

- Reproduction in bark beetles (*Coleoptera: Scolytidae*) is known to be affected by abiotic factors, especially temperature, and by the quality of individual beetles. Thinning may increase bark beetle reproduction due to higher temperatures associated with thinned forests. Hindmarch and Reid observed greater increases in bark beetle reproduction in thinned stands than in unthinned stands. Because the BLM proposes considerable logging activities in the project area, it must include this analysis in project impacts.

Huff, M. H., R. D. Ottmar, E. Alvarado, R. E. Vihnanek, J. F. Lehmkuhl, P. F. Hessburg, and R. L. Everett. 1995. Historical and current landscapes in eastern Oregon and Washington. Part II: Linking vegetation characteristics to potential fire behavior and related smoke production. USDA Forest Service, Pacific Northwest Research Station. General Technical Report 355. Portland, Oregon, USA.

- Huff et al. modeled fire behavior in different levels of fuel loading in Washington and Oregon and determined that wildfires produce nearly twice the amount of smoke as

prescribed fire for the current period for all river basins analyzed. Because the BLM plans to perform some prescribed burning, it must consider this analysis when deciding the extent of its burning activities.

Keeling E. G., A. Sala, and T. H. DeLuca. 2011. Lack of fire has limited physiological impact on old-growth ponderosa pine in dry montane forests of north-central Idaho. Ecological Applications 21(8):3227-3237.

- The absence of fire in fire-adapted, old-growth areas (specifically ponderosa pine) has typically been thought to be detrimental for stand resilience and function, due to increased competition. However, here, researchers found no difference between unburned areas (for 70+ years) versus stands that had been repeatedly burned. This may indicate that "uneven-aged forests may be more resilient to increased stand density associated with the lack of fire than previously thought." Because the BLM plans to use prescribed burning it should consider this literature in its analysis.

Kellert, S. R. 1993. The Biological Basis for Human Values in Nature. Pages 42-69 *in* S. R. Kellert and E. O. Wilson, editors. *The Biophilia Hypothesis*. Island Press, Washington, D.C., USA.

- BLM mostly addresses physical, vegetative and animal impacts from logging. Kellert identifies human values in nature that will be impacted by proposed logging. This would help BLM describe impacts to the "human environment" as legally required.

Kerr, A. 2012. Ecologically appropriate restoration thinning in the Northwest Forest Plan area: A policy and technical analysis. Oregon Wild, Portland, Oregon, USA.

- Ecological restoration thinning (ERT) can be beneficial for both timber production and healthy ecology. If managers can use a "science-based principles and recommendations in this report, intact mature and old-growth forests can be conserved, degraded forests can be restored to late-successional character, and timber volume can increase from federal public forestlands." Due the extensive logging proposed by the BLM the agency must consider ERT when developing project prescriptions.

Korb, J. E., N. C. Johnson, and W. W. Covington. 2004. Slash pile burning effects on soil biotic and chemical properties and plant establishment: Recommendations for amelioration. Restoration Ecology 12(1):52-62.

- Korb et al. studied mitigation measures to improve vegetation colonization subsequent to pile burning. Because the project may result in many hundreds of burn piles the EA could be improved by implementing mitigations recommended by Korb et al.

Lee, D. E, and M. L. Bond. 2015. Occupancy of California Spotted Owl sites following a large fire in the Sierra Nevada, California. The Condor: Ornithological Applications 17:228–236.

- Researchers used statistics for single-season and multi-state occupancy to estimate the probability of site occupancy in mature forests for Spotted Owls during breeding season after a high-severity forest fire. (Here, researchers used the 2013 Rim Fire to model fire impacts). Researchers found that high-severity fire in mature forest owl habitat did not affect owl pair occupancy. The BLM should consider this literature in its analysis.

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

- Lesmeister et al. found that in the Klamath-Siskiyou region, abstaining from active management in NSO habitat could increase fire resilience and assist in maintaining climate resilience since NSO nesting and roosting habitat also has the potential to function as fire refugia. Because active management strategies can degrade NSO habitat, but may not reduce fire risks, the BLM must ackowledge this literature.

Lohmander, P., and F. Helles. 1987. Windthrow probability as a function of stand characteristics and shelter. Scandinavian Journal of Forest Research 2(1-4):227-238.

- BLM must reduce risk of unanalyzed stand damage that may be acerbated by logging. This publication provides techniques to assess windthrow risk and how to mitigate it.

Luce, C. H.. 1997. Effectiveness of road ripping in restoring infiltration capacity of forest roads. Restoration Ecology 5(3): 265-270.

- The BLM's analysis of the management of temporary logging roads must reflect the findings in this study.

Luce, C. H., and T. A. Black. 1999. Sediment production from forest roads in western Oregon. Water Resources Research 35(8):2561-2570.

- The BLM analysis of sediment production fails to fully incorporate the findings of this paper.

Messier M. S., J. P. A. Shatford, and D. E. Hibbs. 2012. Fire exclusion effects on riparian forest dynamics in southwestern Oregon. Forest Ecology and Management 264:60-71.

- Riparian forest structures, pre-settlers, were developed with fire. Researchers found, using dendro-ecological methods to characterize the pre-settlement disturbance, that fire suppression following European settlement shifted this successional trajectory to a new one, with undesirable consequences. Riparian areas require fire for density reduction in overstory trees, just as upland forests require fire. Because the BLM plans to thin riparian areas it must include this literature in its analysis.

Miller, J. D., C. N. Skinner, H. D. Safford, E. E. Knapp, and C. M. Ramirez. 2012. Trends and causes of severity, size, and number of fires in northwestern California, USA. Ecological Applications 22(1):184-203.

- The study conducted by Miller et al. supports examining unique forest ecology when it comes to fire management, and importantly, supports protection of large diameter trees to prevent high severity fires. Due to the large scale of the Bear Grub project and the extensive proposed logging, the BLM must analyze this literature.

Moore, R. D., and S. M. Wondzell. 2005. Physical hydrology and the effects of forest harvesting in the Pacific Northwest: A review. Journal of the American Water Resources Association 41(4):763-784.

- The RMP FEIS misinterprets this study to dismiss low summer flow impacts from logging. Perry and Jones 2017 is new information that provides conclusive evidence of

decreased summer low flows from logging. There is no disagreement among researchers on depleted low flows.

Morrison, P.H. 2007. Roads and wildfires. Pacific Biodiversity Institute, Winthrop, Washington, USA.

- Large wildfires are frequently correlated with proximity to busy roads. There is a positive correlation between lightning-caused fires and road proximity because fuel availability near roadsides increases flammability. Additionally, fires on public lands can be attributed to human actions more than 90% of the time, frequently occurring near roads. The BLM proposes to construct new roads in the project area. Because of this planned action, it must consider this literature in its analysis.

Odion, D. C., J. Strittholt, H. Jiang, E. Frost, D. DellaSala, and M. Moritz. 2004a. Fire and vegetation dynamics in the western Klamath Mountains. Paper presented at Second Conference on Klamath-Siskiyou Ecology. Cave Junction, Oregon, USA.

- Mixed severity burns are instrumental to maintaining landscape heterogeneity and taxonomic diversity. When areas of even-aged fuels burn, the severity is consistently high without much variation, burning with twice the severity of closed forests. Because the BLM proposes to remove the majority of trees within logging units the agency must consider this literature in its analysis.

Odion, D. C., E. J. Frost, J. R. Strittholt, H. Jiang, D. A. DellaSala, and M. A. Moritz. 2004b. Patterns of fire severity and forest conditions in the western Klamath Mountains, California. Conservation Biology 18(4):927-936.

- A study on the connection between forest conditions and fire severity specific to the Klamath-Siskiyou region found that fuel buildup in the absence of fire did not cause increased fire severity as hypothesized. The Bear Grub project proposes various commercial and non-commercial treatments to decrease fuel loading/fuel structure and reduce the risk of large-scale high-intensity wildfire within the project area. In light of the BLM's desired outcomes the agency must consider this literature in its analysis.

Odion, D. C., C. T. Hanson, D. A. DellaSala, W. L. Baker, and M. L. Bond. 2014. Effects of fire and commercial thinning on future habitat of the northern spotted owl. The Open Ecology Journal 7: 37-51.

- For thinning in Northern Spotted Owl habitat the long-term benefits must outweigh the short-term negative impacts on suitable owl habitat. These long-term benefits may arise in the context of concerns over high-severity fire and reduced timber yields. Researchers examined "whether the fire-reduction benefits accrue faster than the adverse impacts of reduced late-successional habitat from thinning" and found that even if rates of fire increase substantially, long-term benefits of commercial thinning do not clearly outweigh adverse impacts in spotted owl habitat. Thus the requirement long-term benefits clearly outweigh adverse impacts is not attainable. Because the BLM proposes thinning in spotted owl habitat, it must consider this literature in its analysis.

Olson, D., D. A. DellaSala, R. F. Noss, J. R. Strirrholt, J. Kass, M. E. Koopman, and T. F. Allnutt. 2012. Climate change refugia for biodiversity in the Klamath-Siskiyou ecoregion. Natural Areas Journal 32(1):65-74.

- The Klamath-Siskiyou region's current effectiveness at providing a refuge is likely limited for future climate events because of anthropogenic effects. Researchers identified twenty-two highest priority areas, outside of current protection, and proposed reserves for these areas. Areas in the KS like old growth and intact forests on north-facing slopes and in canyon bottoms, lower and middle elevations, wetter coastal mountains, and along elevational gradients are particularly likely to provide safe haven for biodiversity during approaching climatic changes, especially for endemic species with limited mobility and dispersal like plants, invertebrates, and fungi. Due to the region's important function as a refuge for key species the BLM must consider the implications of this study vis-à-vis its proposals that would remove or downgrade forest habitat values.

Perry, D. A. 1995. Self-organizing systems across scales. Trends in Ecology and Evolution 10: 241-244.

- Perry finds that processes such as hydrology and the propagation of disturbance can be strongly self-reinforcing (i.e. the landscape structure supports the process, and vice versa). Hence the picture emerges of a hierarchy of self-organizing systems that span food chains, communities and landscapes/regions. Given the interconnectivity of natural processes the BLM must consider this literature in its large-scale and multi-faceted project to determine unintended or unforeseen impacts.

Perry, D. A., P. F. Hessburg, C. N. Skinner, T. A. Spies, S. L. Stephens, A. H. Taylor, J. F. Franklin, B. McComb, and G. Riegel. 2011. The ecology of mixed severity fire regimes in Washington, Oregon, and Northern California. Forest Ecology and Management 262:703-717.

- Many forests in the west are characterized by mixed-severity fire on a wide moisture gradient, ranging from high elevation areas with high fire severity norms to low elevation areas with low severity norms. These forests are threatened by loss of old, fire resistant trees, increasing homogeneity, increased regional drying, and the loss of understory diversity. As such the risk of insect infestation and fire outbreaks increase. Diversity and protection of closed forest habitats requires land managers to examine these mixed severity forest areas as a whole for ecological restoration. Because the BLM plans to log and thin extensively in the project area it must consider this literature in its analysis.

Quigley, T. M., R. W. Haynes, and W. J. Han. 2001. Estimating ecological integrity in the interior Columbia River basin. Forest Ecology and Management 153:161-178.

- One finding of the Quigley et al. article is that ecological integrity varies inversely with road density. Given the extensive logging road system in this project area the agency must consider this literature in its analysis.

Roland, J. 1993. Large-scale forest fragmentation increases the duration of tent caterpillar outbreak. Oecologia 93:25-30.

- The large-scale forest fragmentation in the Bear Grub planning area from private and BLM logging and road construction must be analyzed and disclosed and acknowledge the findings of this study.

Sapsis, D., and C. Brandow. 1997. Turning plantations into healthy, fire resistant forests: outlook for the Granite Burn. Fire and Resource Assessment Program. California Department of Forestry and Fire Protection, Sacramento, California, USA.

- The BLM's proposal to conduct gap-creation logging requires consideration of these findings.

Smith, M. D. 2005. Recent trends in cumulative impact case law. Paper presented at the National Association of Environmental Professionals Annual Conference. Alexandria, Virginia, USA.

- BLM must assess cumulative impacts. This review paper provides insights for assessing cumulative impacts. For example, BLM needs to assess cumulative impacts in the planning area from past, present and future logging with respect to depleted summer low flows. This cumulative impact was not assessed in EA.

Solé, R., and Goodwin, B. 2000. *Signs of Life: How Complexity Pervades Biology*. Basic Books, New York, New York, USA.

- This study is relevant to the project's effects analysis.

Spies, T., M. Pollock, G. Reeves, and T. Beechie. 2013. Effects of Riparian Thinning on Wood Recruitment: A Scientific Synthesis. Science Review Team Wood Recruitment Subgroup, USDA Forest Service Pacific Northwest Research Station. Portland, Oregon, USA.

- Researchers collected fifteen key points from a study of impacts of thinning in the short and long term for riparian forests and the contribution of large woody debris in such forests. Most critically, they found that accurate assessments of thinning effects require site-specific information. The BLM must analyze this literature and include site-specific information regarding this objective.

St. Clair, B. J. and G. T. Howe. 2007. Genetic maladaptation of coastal Douglas-fir seedlings to future climates. Global Change Biology 13:1441-1454.

- This study identifies the inadequacy of seed stocks for replanting in the face of climate change. This is relevant to analysis because gap creation units may require planting Doug-fir from potentially maladaptive sources. In addition, the analysis would benefit from the use of natural reproduction with thinning that would not use potentially maladaptive seedlings. This issue is not addressed in the EA or the RMP FEIS.

Tilman, D. and C. L. Lehman. 1997. Habitat destruction and species extinctions. Pages 233-49 *in* D. Tilman and P. Karieva, editors. *Spatial ecology: The role of space in population dynamics and interspecific interactions*. Princeton University Press, Princeton, New Jersey, USA.

- The BLM must consider these peer reviewed findings prior to conducting habitat destruction in the Bear Grub project area.

Tilman, D., C. L. Lehman, and K. T. Thomson. 1997. Plant diversity and ecosystem productivity: Theoretical considerations. Proceedings of the National Academy of Sciences 94:1857-1861.

- This paper undermines a number of assumptions relied upon by the BLM in the Bear Grub EA.

Trombulak, S. C., and C. A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14(1):18-30.

- The significant impacts of roads on forest ecology that are detailed in this study necessitate completion of an EIS for this project.

USDA. 2003. Wildfire effects and evaluation project: Umpqua National Forest. USDA Forest Service. Roseburg, Oregon, USA.

- In this report, the Forest Service concluded that the presence of an extensive network of roads in burn areas may have negative ecological impacts post-fire. Roads will remain at a elevated risk for culvert plugging and stream channel crossing failure due to increases in peak runoff flows, increased channel and slope erosion, and increased debris transport within stream channels. Because the BLM proposes to construct new roads it must include this article in its analysis.

Van Wagnendonk, J. W. 1996. Use of a deterministic fire growth models to test fuel treatments. Pages 1155-1165 *in* Centers for Water and Wildland Resources. Sierra Nevada Ecosystem Project, Final Report to Congress, Volume II. University of California, Davis, California, USA.

- The BLM must address these findings prior to logging large trees and planting small trees.

Weatherspoon, P. C., and C. N. Skinner. 1995. An assessment of factors associated with damage to tree crowns from the 1987 wildfires in northern California. Forest Science 41(3):430-451.

- The BLM must address these findings prior to logging large trees and planting small trees.

Wiens, J. D., R. G. Anthony, and E. D. Forsman. 2014. Competitive Interactions and Resource Partitioning between Northern Spotted Owls and Barred Owls in Western Oregon. Wildlife Monographs 85:1-50.

- This monograph provides the scientific basis for increased competition between northern spotted and barred owls. The proposed logging will fragment northern spotted owl habitat and likely increase competition between NSOs and barred owls. Barred owls are replacing spotted owls in the planning area. BLM is charged with NSO recovery so must consider this science in its analysis.

Wilson, E. O. 1984. *Biophilia*. Harvard University Press. Cambridge, Massachusetts, USA.

- The BLM EA mostly addresses physical, vegetative and animal impacts from logging. Wilson identifies human values for nature that will be adversely impacted by proposed logging. This would help BLM describe impacts to the "human environment," as legally required.

Wronski, E. B. 1984. Impacts of tractor thinning operations on the soils and tree roots in a Karri forest, Western Australia. Australian Forestry Research 14:319-332.

- Wronski found that the use of heavy machinery during logging operations has considerable and lasting impacts on soils. Eighteen months after logging, root length density in soil compacted by one or more passes by either vehicle was still only one-sixth

of that in undisturbed soil. Due to the extensive use of heavy machinery proposed by the BLM in the Bear Grub project area the agency must include analysis of this literature.

Zald, H., and C. Dunn. 2018. Severe fire weather and intensive forest management increase fire severity in a multi-ownership landscape. Ecological Applications 28(4): 1068-1080.

- Zald and Dunn analyzed fire severity within the fire perimeter of the Douglas Complex, which burned in Southwestern Oregon in 2013, and found that pre-fire biomass was not a predictor in the severity of burn. Instead, stand age was inversely correlated with burn severity. Because the BLM proposes treatments to lower forest stand ages in the project it must consider this literature in its analysis.

Zielinski, W. J., R. L. Truex, G. A. Schmidt, F. V. Schlexer, K. N. Schmidt, and R. H. Barrett. 2004. Resting habitat selection by fishers in California. Journal of Wildlife Management 68(3): 475-92.

- The Bear Grub EA fails to consider or utilize the best available science regarding Pacific fishers.

Zielinski, W. J., C. Carroll, and J. R. Dunk. 2006. Using landscape suitability models to reconcile conservation planning for two key forest predators. Biological Conservation 133: 409-430.

- The Bear Grub EA fails to consider or utilize the best available science regarding Pacific fishers.