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July 11th, 2019

Regional Forester
Objection Reviewing Officer
Pacific Northwest Region
USDA Forest Service, Attn. 1570 Objections
PO Box 3623
Portland, OR 97208-3623
Email: objections-pnw-regional-office@fs.fed.us

RE: Addendum to Blue Mountains Biodiversity Project's Objection to the Rattlesnake Vegetation Management Project: A Summary of Science

Dear Forest Service Official,

I am submitting this summary of scientific information along with copies of scientific studies as an addendum to the objection to the Rattlesnake project Environmental Assessment that Karen Coulter submitted on behalf of Blue Mountains Biodiversity Project. I have sent the summary with citations via email and via certified return receipt postal delivery, and included copies of the scientific studies on CD via postal delivery. If you have any questions, please contact me at 510-715-6238 or paula@bluemountainsbiodiversityproject.org or at 510-715-6238.

Sincerely,

Paula Elizabeth Hood

Paula Hood, Co-Director
Blue Mountains Biodiversity Project

Summary of scientific information and citations:

Western conifer forests have evolved with fire and are adapted to it, and in fact need fire, including high-severity fires. Wildfires, including high-severity fires, create important habitats, lessen the severity and frequency of disease and insect outbreaks, and facilitate seed germination in some plant species. Post-fire forests are one of the most biodiverse and important habitats, and are home to many at-risk, sensitive, and listed species. Post-fire areas are rich in snags (standing dead trees) used for nesting and foraging by many species, including woodpeckers. Fires also stimulate the growth of many species of native wildflowers, certain berries and fungi (such as Morels), and provide habitats for small mammals and forage for deer and elk. Post-fire habitats are among the most important for wildlife, and are unfortunately very rare compared to historic proportions because of continued fire-suppression and post-fire logging.

In studies of the structures left by high-intensity burns, ecologists have found biodiversity equal to, or surpassing, the biodiversity found in old-growth forest. Dr. Richard Hutto, one of the nation's top ornithologists, found that: "Besides the growing body of evidence that large, infrequent events are ecologically significant and not out of the range of natural variation, an evolutionary perspective also yields some insight into the 'naturalness' of severely burned forests… The dramatic positive response of so many plant and animal species to severe fire and the absence of such responses to low-severity fire in conifer forests throughout the U.S. West argue strongly against the idea that severe fire is unnatural. The biological uniqueness associated with severe fires could emerge only from a long evolutionary history between a severe-fire environment and the organisms that have become relatively restricted in distribution to such fires. The retention of those unique qualities associated with severely burned forest should, therefore, be of highest importance in management circles". The current science points to post-fire replanting hindering natural recovery as well as potentially setting forests on an unnatural trajectory, and asserts that there are no ecological benefits to salvage logging.

Donato et al. (2009) found that "high-intensity re-burn [high-intensity fire occurring 15 years after a previous high-intensity fire] had the highest plant species richness and total plant cover, relative to high-intensity fire alone [no re-burn] and unburned mature/old forest; and the high-intensity fire re-burn area had over 1,000 seedlings/saplings per hectare of natural conifer regeneration". An example of the importance of post-fire areas occurring after high intensity fires include these Donato et al. (2009) findings: "[S]evere fires are typically expected to be deleterious to forest flora and development; however, these results indicate that in systems characterized by highly variable natural disturbances (e.g. mixed-severity fire regime), native biota possess functional traits lending resilience to recurrent severe fire. Compound disturbance resulted in a distinct early seral assemblage (i.e. interval- dependent fire effects), thus contributing to the landscape heterogeneity inherent to mixed-severity fire regimes. Process-oriented ecosystem management incorporating variable natural disturbances, including 'extreme' events such as SI severe fires, would likely perpetuate a diversity of habitats and successional pathways on the landscape."

The August 2017 "Science Findings" from the PNW Research Station note that mixed-severity fire, including high-severity fire is necessary for many species:

- In dry forests, a mixed-severity fire that kills trees is an important but underappreciated strategy for providing enough snags for cavity-dependent species. Low-severity prescribed fires may not provide enough snags for these species.
- Suitable snags are limited, such that snag availability drives landscape-level habitat selection by some species. For example, white-headed woodpeckers selected severely burned patches for nesting, which was initially puzzling because this species does not characteristically forage in burns.
- Within burns used by at-risk woodpeckers, the majority (86 to 96 percent) of seemingly suitable trees contained unsuitably hard wood; wood hardness limits nest site availability for these declining species.
  - This suggests that past studies that did not measure wood hardness counted many sites as available to cavity-excavating birds when actually they were unsuitable. "By not accounting for wood hardness, managers may be overestimating the amount of suitable habitat for cavity-excavating bird species, some of which are at risk," Lorenz says.

> "Based on their results, Lorenz and her colleagues see the critical role that mixed-severity fires play in providing enough snags for cavity-dependent species. Low-severity prescribed fires often do not kill trees and create snags for the birds. "I think humans find low-severity fires a more palatable idea. Unfortunately or fortunately, these birds are all attracted to high-severity

> burns," Lorenz says. "The devastating fires that we sometimes have in the West almost always attract these species of birds in relatively large numbers." Many studies have shown that a severely burned forest is a natural part of western forest ecosystems. Snags from these fires attract insects that love to burrow beneath charcoal bark. And where there are insects, there are birds that love eating these insects. Lorenz and her colleagues stress that providing snags that woodpeckers can excavate is crucial for forest ecosystem health in the Pacific Northwest, where more than 50 wildlife species use woodpecker-excavated cavities for nesting or roosting."
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> "Currently, the best solution we can recommend is to provide large numbers of snags for the birds, which can be difficult without fire," According to the researchers' calculations, if one of every 20 snags (approximately 4 percent) has suitable wood, and there are five to seven species of woodpeckers nesting in a given patch, approximately 100 snags may be needed each year for nesting sites alone. This does not account for other nuances, like the fact that most species are territorial and will not tolerate close neighbors while nesting, or the fact that species like the black-backed woodpecker need more foraging options. Overall, more snags are needed than other studies have previously recommended."

Protected Forests with Little or No Logging Are Not More Likely to Experience Higher Severity Wildfire. A recent study from Bradley et al. (2016) challenges USFS assumptions about the fire risk associated with more protected areas—those area that have been less-managed or less-logged, but may still have experienced some degree of fire exclusion (such as Wilderness areas. RHCAs have also, of course, seen much more protection than upland areas). The authors state:

> "There is a widespread view among land managers and others that the protected status of many forestlands in the western United States corresponds with higher fire severity levels due to historical restrictions on logging that contribute to greater amounts of biomass and fuel loading in less intensively managed areas, particularly after decades of fire suppression. This view has led to recent proposals—both administrative and legislative—to reduce or eliminate forest protections and increase some forms of logging based on the belief that restrictions on active management have increased fire severity.
>
> **"We found forests with higher levels of protection had lower severity values even though they are generally identified as having the highest overall levels of biomass and fuel loading. Our results suggest a need to reconsider current overly simplistic assumptions about the relationship between forest protection and fire severity in fire management and policy"**
>
> **"Protected forests burn at lower severities: We found no evidence to support the prevailing forest/fire management hypothesis that higher levels of forest protections are associated with more severe fires based on the RF and linear mixed-effects modeling approaches. On the contrary, using over three decades of fire severity data from relatively frequent-fire pine and mixed-conifer forests throughout the western United States, we found support for the opposite conclusion—burn severity tended to be higher in areas with lower levels of protection status (more intense management), after accounting for topographic and climatic conditions in all three model runs. Thus, we rejected the prevailing forest management view that areas with higher protection levels burn most severely during wildfires."**

Efficacy: Logging is Not Practical or Cost Effective, and Does Not Make Communities Safer

The short-term and temporary nature of the perceived fuels reduction benefits from most logging project are not likely to result in meaningful changes to fire intensity, size, or severity. Most projects designed to reduce fuels note that perceived benefits are estimated to affect fire behavior for approximately 20 years. If the estimated effectiveness is only approximately 20 years, then the justification for this project is even more tenuous. For example, Rhodes and Baker (2008) found that: "[u]sing extensive fire records for western US Forest Service lands, we estimate fuel treatments have a mean probability of 2.0-7.9% of encountering moderate-or high-severity fire during an assumed 20-year period of reduced fuels."

Campbell and Agar 2013 noted: "First, there is the issue of relative versus absolute area subject to wildfire. As discussed earlier, even small changes in treatment rate can dramatically influence the amount of area impacted by a wildfire, but wildfire is simply not that common to begin with. Among fire-prone forests of the western US, the combination of wildfire starts and suppression efforts result in current average burn probabilities ofless than 170 (Campbell et al., 2012; Rhodes and Baker, 2008). In our simulations, where extreme-weather wildfires were ignited once every 20 years, a 95% reduction in burned area amounted to only 200 ha across our 2000 ha landscape (see Fig. 4). Simply put, even when treatment is presumed efficient and effective, there is not that much to affect."

Current forest management is unnecessarily putting firefighters at risk by focusing on remote areas, contrary to peer-reviewed science or common sense. Gibbons et al. (2010) found that defensible space work within 40 meters [about 131 feet] of individual homes effectively protects homes from wildland fire, even intense fire. The authors concluded that the current management practice of thinning broad zones in wildland areas hundreds, or thousands, of meters away from homes is ineffective and diverts resources away from actual home protection, which must be focused immediately adjacent to individual structures in order to protect them. In addition, other studies note that the vast majority of homes burned in wildland fires are burned by slow-moving, low intensity fire, and defensible space within 100-200 feet of individual homes [reducing brush and small trees, and limbing up larger trees, while also reducing the combustibility of the home itself] effectively protects homes from fires, even when they are more intense (Cohen 2000, Cohen and Stratton 2008).

Cohen and Stratton 2008: "Our post-burn examination revealed that the residential destruction did not result from a high intensity wildfire engulfing homes. With minor exception (6 homes), the wildfire primarily initiated residential burning from firebrands igniting homes directly and/or producing spot fires that spread through surface fuels to homes. Once initiated, home destruction largely resulted from local residential fire conditions. The ignition vulnerable homes (e.g., flammable wood roofing, surface fuels in contact with wood siding, heavy pine litter in roof gutters), burning in close proximity to one another continued the fire spread through the residential area without the wildfire as a factor."

Gibbons et al. 2012 study: "All fuel treatments were more effective if undertaken closer to houses. For example, 15% fewer houses were destroyed if prescribed burning occurred at the observed minimum distance from houses (0.5 km) rather than the observed mean distance from houses (8.5 km). Our results imply that a shift in emphasis away from broad-scale fuel-reduction to intensive fuel treatments close to property will more effectively mitigate impacts from wildfires on peri-urban communities."

Scott et al. 2016 study: "Results suggest that treating USFS land does little to reduce overall wildland urban interface (WUI) exposure across the landscape. A treatment scenario that focused on treating defensible space near homes was by far the most efficient at reducing WUI exposure, including exposure transmitted from USFS lands."

Syphard et al. 2014: "Structures were more likely to survive a fire with defensible space immediately adjacent to them. The most effective treatment distance varied between 5 and 20 m (16–58 ft) from the structure, but distances larger than 30 m (100 ft) did not provide additional protection, even for structures located on steep slopes. The most effective actions were reducing woody cover up to 40% immediately adjacent to structures and ensuring that vegetation does not overhang or touch the structure. …..The best long-term solution will involve a suite of prevention measures that include defensible space as well as building design approach, community education and proactive land use planning that limits exposure to fire."

Hutto et al. 2016 note, in relation to climate change, that increased efforts towards fuels reduction would be an untenable emphasis: "Any perceived problem with future changes in fire behavior cannot be solved by redoubling our effort to treat this particular climate change symptom 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 (Gedalof et al. 2005). Therefore, fuel management efforts to reduce undesirable effects of wildfires outside the xeric ponderosa pine forest types could be more strategically directed toward creating fire-safe communities….Fuel treatment efforts more distant from human communities may carry the negative ecological consequences we outlined earlier and do little to stop or mitigate the effects of fires that are increasingly weather driven (Rhodes and Baker 2008, Franklin et al. 2014, Moritz et al. 2014, Odion et al. 2014)."

In terms of possible future reentry of forests for logging under the guise of 'fuels reduction'—what is the USFS's plan for the many thousands of acres of logged areas? Will re-entries be planned across the landscape if wildfire or prescribed fire does not burn the area within 10-35 years? If treatments are only good for 10-15 years, then either re-entry will be needed or logging is a very costly and short-term endeavor that is not effective. It is not feasible to thin the entire landscape every 10-35 years, and if we could accomplish such a misguided feat, it would likely have unacceptable ecological impacts and not be economically viable.

Logging Harms Many At-Risk and Sensitive Wildlife Species

Growing scientific evidence shows that numerous species are at much lower risk from wildfire than previously thought, and some of these species may be more negatively affected by thinning than by wildfire. Example include Olive-sided flycatchers, Canadian lynx, and others (Hanson 2015; Moriarty et al. 2016; Manning et al. 2012; Robertson and Hutto 2007). For example, Robertson and Hutto (2007) provide evidence for the harmful effects of thinning to some species in their study Is selectively harvested forest an ecological trap for Olive-sided flycatcher? The authors state that: "Human activities that closely mimic the appearance but not the fundamental quality of natural habitats could attract animals to settle whether or not these habitats are suitable for their survival or reproduction. We examined habitat selection behavior and nest success of Olive-sided Flycatchers (Contopus cooperi) in a naturally occurring burned forest and an anthropogenically created habitat type—selectively harvested forest. Olive-sided Fly- catcher density and nestling provisioning rates were greater in the selectively harvested landscape, whereas estimated nest success in selectively harvested forest was roughly half that found in naturally burned forest. Reduced nest success was probably a result of the relatively high abundance of nest predators found in the artificially disturbed forest. **These results are consistent with the hypothesis that selectively harvested forest can act as an ''ecological trap'' by attracting Olive-sided Flycatchers to a relatively poor-quality habitat type. This highlights the importance of considering animal behavior in biodiversity conservation."**

Large trees are essential for wildlife habitat for numerous species, regardless of the age of trees. The USFS categorizes trees less than 150 years old are "young", and argues that they do not have to adhere to current Forest Plan prohibitions on logging large trees if they are "young". To determine if large trees are less than 150 years old, the USFS uses the Van Pelt guidelines. However, the Van Pelt guidelines are wholly inadequate for determining the age of Grand fir, as they do not contain guidance that can be used in the field to reliably identify Grand fir older than 150 years. It is large trees that are necessary for wildlife habitat, and those are in extreme deficit across the region due to logging—regardless of age. The Ursus Environmental Assessment on the Deschutes NF discusses the inadequacies of the Van Pelt guidelines for determining age (USFS pg. 77): "A size or a diameter limit was chosen as the best metric to measure effect on trees that are old or large on the landscape. Other considerations were made, such as using Van Pelt's guide to identify old grand (white) fir, but due to the characteristics of white/grand fir it was determined to not be an accurate metric. Bark on white/grand fir never develops the thickness of its fire-tolerant associates. The transformation that many trees experience from young gray bark to increasingly more colorful mature bark does not occur with white/grand fir. Even in giant old trees, bark characteristics reveal little about age. Like Douglas fir and western larch, white/grand fir is an opportunist, and has epimoric branch formation. As the stand matures and conditions change around a tree, light penetration may allow new branches to grow where they had been previously lost. Crown condition, tree form, and bark fissures are not an accurate way to tell age. Other than size, there is little else on white/grand fir that indicates age." The Forest Service claims that Grand firs and other less fire-resistant trees are present in larger numbers and higher densities across the landscape than they were historically, as a consequence of fire suppression. However, the Forest Service abuses this rationale by applying it overly broadly and aggressively, and uses it as an excuse to extensively log old growth and mature forests– including in ecologically inappropriate areas such as forests with ample evidence of historic mixed-conifer and high-density forests, on north and east facing slopes; deep gulches and narrow valleys; forests on soils that hold more nutrients and moisture (such as ash soils); and other areas that show historic evidence of supporting mixed-conifer forests in general and Grand fir in particular. The Forest Service is using flawed assumptions that lack adequate scientific backing in order to log in ecologically inappropriate and sensitive areas, and to large trees across many thousands of acres—despite the documented deficit in large trees across the landscape and their importance to wildlife.

Furthermore, fire suppression efforts of the past were highly unlikely to have been widespread or effective in remote areas such as those within the project area until recent decades. The 100+ year timeframe the FEA puts forth for fire exclusion is an extreme overestimate. Heyerdahl et al. (2002) note that fire suppression was not effective until recent decades: **"…active re suppression by land-management agencies because these efforts were probably not effective until the 1940s–50s when surplus military aircraft became available".**

Pilliod et al. 2006 examined potential unintended negative effects on wildlife and habitats due to thinning and prescribed fire. We are concerned that similar negative effects on wildlife and habitats will occur in the widespread logging in riparian corridors. For example, we are concerned about possible losses of snags and dead wood (both in direct response to the project and decreased future recruitment), negative effects on density-and closed canopy-dependent species, negative effects on alpha and beta biodiversity, declines in mammal populations, and other unintended negative effects on the flora and fauna and habitats in the project area. Highlights from their study include:

"Large-scale prescribed fires and thinning are still experimental tools in ecological restoration (box 1), and unanticipated effects on biodiversity, wildlife and invertebrate populations, and ecosystem function may yet be discovered (Allen and others 2002; Carey and Schumann 2003)."

"Species that prefer closed-canopy forests or dense understory, and species that are closely associated with those habitat elements that may be removed or consumed by fuel reductions, will likely be negatively affected by fuel reductions. Some habitat loss may persist for only a few months or a few years, such as understory vegetation and litter that recover quickly. The loss of large-diameter snags and down wood, which are important habitat elements for many wildlife and invertebrate species, may take decades to recover…."

"Wildlife and invertebrate species that depend on down wood, snags, dwarf mistletoe (Arceuthobium spp.) brooms, dense forests with abundant saplings and small poles, and closed-canopy forests for survival and reproduction are likely to be detrimentally affected by fuel treatments that alter these habitat elements"

"Implementation of any thinning or prescribed burning is likely to result in loss of snags, future snags, and down wood that are important stand attributes of healthy forests and critical components of wildlife and invertebrate habitat"

Loss of large-diameter snags and down wood can take years to decades to recover, as indicated by wildland fire research (Passovoy and Fule 2006)."

"There is a great need for long-term observational and preferably experimental studies on the effects of a range of fuel reduction treatments at multiple spatial scales (stand or larger)."

Numerous studies have found negative impacts on wildlife habitats from thinning in riparian areas, even when snags removal is not intended. For example, Pollock et al. (2012) found that selective logging may cause riparian forests to develop characteristics outside of normal late seral conditions in reference stands. Pollock and Beechie (2014) study found that:

"Because far more vertebrate species utilize large deadwood rather than large live trees, allowing riparian forests to naturally develop may result in the most rapid and sustained development of structural features important to most terrestrial and aquatic species".

Through an Evolutionary Lens

Mixed-severity fires (including high severity fires) create habitat that is necessary for species within eastern Oregon, suggesting that high severity fires are natural and historically present. High severity fires create important habitat that is very high in biodiversity, and is rare compared to historic norms. The evolutionary history and very existence of native species such as Black-backed woodpeckers suggests that large high-severity fires must regularly occur within their range. We are concerned that current fire suppression efforts through the region will continue to exclude high-severity wildfires (and continue despite project implementation) and threaten the viability of Black-backed woodpeckers and other species that depend on high-severity wildfire.

Hutto et al. (2008) noted that:

> **"Without embracing an evolutionary perspective, we run the risk of creating restoration targets that do not mimic evolutionarily meaningful historical conditions, and that bear little resemblance to the conditions needed to maintain populations of native species**, as mandated by law (e.g., National Forest Management Act of 1976)." "…[T]he patterns of distribution and abundance for several other bird species (black-backed woodpecker [Picoides arcticus], buff-breasted flycatcher [Empidonax fulvifrons], Lewis' woodpecker [Melanerpes lewis], northern hawk owl [Surnia ulula], and Kirtland's warbler [Dendroica kirtlandii]) suggest that severe fire has been an important component of the fire regimes with which they evolved. **Patterns of habitat use by the latter species indicate that severe fires are important components not only of higher-elevation and high-latitude conifer forest types, which are known to be dominated by such fires, but also of mid-elevation and even low-elevation conifer forest types that are not normally assumed to have had high-severity fire as an integral part of their natural fire regimes.**

In addition, two lines of evidence suggest that it is the more severe fires that are needed to create conditions most suitable for this fire specialist: (1) not only is the black-backed woodpecker restricted to burned forests, but its distribution within burned forests is also relatively restricted to the more severely burned conditions (Kotliar et al. 2002, Smucker et al. 2005, Russell et al. 2007, Hutto 2008); (2) black-backed woodpecker nest sites occur in locations that harbor significantly larger and more numerous trees than occur around randomly selected sites within a burn (Saab and Dudley 1998, Kotliar et al. 2002, Russell et al. 2007). **Such nesting locations would be difficult to find in forests maintained as low-density, open, park-like stands due to frequent, low-severity fire.**

How could a species evolve to depend on a condition that occurs only infrequently? The answer lies with the distribution and abundance of such fires across space and time. **The return interval for severe fire in one location may be several hundred years, but black-backed woodpecker populations persist in a particular re for >6 yr (Saab et al. 2007), so the probability of a severe fire occurring somewhere within an entire watershed in any given 6-year window is very high.** Thus, when viewed on a landscape scale, it becomes easy to imagine that a sufficiently mobile plant or animal species (e.g., re morel [Morchella angusticeps]; jewel beetle, Buprestidae; black-backed woodpecker) could become specialized to use a burned forest condition that is ephemeral on a local scale but always present somewhere in the larger landscape."

Fire Regimes and Forest Structure

Multiple convergent lines of evidence suggest that mixed-severity fire, which included large patches of high-severity fire, dominated most western forested landscapes. In addition, many forests were more dense than commonly recognized by agencies such as the Forest Service. For example, Odion et al. (2014) noted, based on extensive literature review of landscape-scale evidence of historical fire severity patters in Ponderosa pine and mixed conifer forests: "… **most forests appear to have been characterized by mixed-severity fire that included ecologically significant amounts of weather-driven, high-severity fire."**

"**Our results illustrate broad evidence of mixed-severity fire regimes in ponderosa pine and mixed-conifer forests of western North America. Prior to settlement and fire exclusion, these forests historically exhibited much greater structural and successional diversity than implied by the low/moderate-severity model"**

"Our findings suggest a need to recognize mixed-severity fire regimes as the predominant fire regime for most of the ponderosa pine and mixed-conifer forests of western North America"

"The high-severity fire rotations […] do not support the hypothesis that low/moderate-severity fire regimes were predominant in the majority of ponderosa pine and mixed-conifer forests of western North America. In all the large, forest landscapes for which data covering at least 70 years exist, high-severity fire rotations ranged from about 217 to 849 years [57], and were mostly 200–500 years. This is generally less than potential tree lifespans. For combined moderate- and high-severity fires in the eastern Cascades, rotations were 115–128 years"

Evidence that mixed-severity fires are still within historic range of variability in the west is also provided by the research of Pierce and Meyer (2008). They examined the size and frequency of fire-related debris flows within alluvial fans in Idaho dating back approximately 2,000 years. They found that evidence of small frequent fires historically coincided with multi-decadal climatic cycles of greater moister or drought, and that larger fires corresponded to drought cycles. Today's high severity fires were found to be within natural range of variability.

The extent and influence of fire was much more prevalent than today across the US (USFS National Report on Sustainable Forests, 2010). Historically, mixed-conifer forests were dominated by dense forests (Hessberg et al. 2007). Many of the mixed conifer forests in the west are closed canopy forests that are highly interwoven complex ecosystems that provide high quality habitat for numerous species such as goshawk, marten, Pileated, Lewis woodpecker, and others. Much peer-reviewed scientific research on mixed- conifer forests has suggested that thinning is likely not needed, effective, nor ecologically beneficial in moist mixed-conifer forest to prevent fire, does not mimic the complex natural fire regime (Noss et al, 2006; Lindenmayer et al. 2009) and threatens to increase fire risk (Lindenmayer et al. 2009). The moist, mixed forest type is fragile and vulnerable to the chronic negative impacts of industrial commercial logging. Mature and old-growth moist mixed conifer stands have dense, moist interiors and little wind, which inhibit the spread of wildfire (Lindenmayer et al. 2009; Morrison and Smith, 2005; Rhodes, 2007). Large fires are climatically driven and fuels reduction treatments can be insignificant to prevent fire spread under these conditions. However, the post-fire habitat is significantly degraded by the logging that happens in the name of fuels reduction prior to the fire.

Much peer-reviewed scientific research on mixed-conifer forests has suggested that thinning is likely not needed, effective, nor ecologically beneficial (Noss et al, 2006; Lindenmayer et al. 2009) and threatens to increase fire risk (Lindenmayer et al. 2009). Large fires are climatically driven and fuels reduction treatments can be insignificant to prevent fire spread under these conditions. Weather conditions such as drought and wind are the primary drivers of fire behavior, and generally override on-the-ground forest conditions. Large wildfires are not generally influenced by previous fuels reduction measures. Post-fire habitat is significantly degraded by the logging that happens in the name of fuels reduction prior to the fire.

Lydersen et al. (2014): "Our results suggest that wildfire burning under extreme weather conditions, as is often the case with fires that escape initial attack, can produce large areas of high-severity fire even in fuels-reduced forests with restored fire regimes." They also note: "Our study suggests that even fire-restored forests may not be resistant to high-intensity wildfire that escapes suppression during extreme weather conditions."

Noss et al. (2006) note:"[f]ire exclusion has had little effect on fuels or forest structure in forests characterized by high severity (stand replacement) fire. High severity fires are relatively infrequent, occurring at intervals of one to many centuries, whereas active fire exclusion, especially in remote forests, began only decades ago. Because fuel structures or tree densities are usually within the historical range of variability, active restoration is ecologically inappropriate in these forests."

Dillion et al. 2011: "Using 1,024 fires from the Northwest (4,311,871 ha) and 497 fires from the Southwest (1,434,670 ha), we examined the relative influence of fine-scale topography and coarse-scale weather and climate on burn severity (the degree of change from before the fire to one year after) using the Random Forest machine learning algorithm. Together, topography, climate, and weather explained severe fire occurrence with classification accuracies ranging from 68% to 84%. Topographic variables were relatively more important predictors of severe fire occurrence than either climate or weather variables. Predictability of severe fire was consistently lower during years with widespread fires, suggesting that local control exerted by topography may be overwhelmed by regional climatic controls when fires burn in dry conditions. Annually, area burned severely was strongly correlated with area burned in all ecoregions (Pearson's correlation 0.86–0.97; p , 0.001), while the proportion of area burned severely was significantly correlated with area burned only in two ecoregions (p 0.037). During our short time series, only ecoregions in the Southwest showed evidence of a significant increase (p □ 0.036) in annual area burned and area burned severely, and annual proportion burned severely increased in just one of the three Southwest ecoregions."

Hanson et al. 2009 noted that:"…it is typical for a high percentage of total burned area (i.e., > 90%) to accrue from the small percentage of wildfires (i.e., < 5%) that are large and infrequent (Moritz et al. 2005)."

Noss et al. 2006 noted: "One barrier to better use of ecological science is that individuals involved in developing fire policies and practices have tended to be specialists in fire and fuel management, not ecologists, conservation biologists, or other broadly trained scientists. It is not surprising, therefore, that current forest law does not adequately incorporate ecological considerations in its implementation and tends to promote a narrow definition of restoration that focuses almost exclusively on fuels (DellaSala et al. 2004; Schoennagel et al. 2004)."

Noss et al. 2006 also noted: "True ecological restoration requires the maintenance of ecological processes, native species composition, and forest structure at both stand and landscape scales. Because forests are highly variable over space and time, few universal principles exist for integrating insights from ecology and conservation biology into fire management policies. Nevertheless, one fundamental principle is that managed forests should not only support the desired fire regime but also viable populations of native species in functional networks of habitat (Hessberg et al. 2005). A common-sense conservation goal is to achieve forests that are low maintenance and require minimal repeated treatment. With time, in a landscape of sufficient size, the right end of the restoration continuum could be reached, where natural fire maintains the system in the desired state. Indeed, wildland fire use is the cheapest and most ecologically appropriate policy for many forests. We envision a future where fire is seen by land managers and the public as the key to healthy forests, but where each forest and each patch of the forest mosaic is recognized for its individuality and managed accordingly. Above all, a guiding principle of forest management should be a precautionary approach that avoids ecological harm."

Zald et al. 2018: Zald et al. 2018 found that industrial forest lands burned more severely than older forests on federal BLM lands. "….[I]n the landscape we studied, intensive plantation forestry appears to have a greater impact on fire severity than decades of fire exclusion. Second, higher fire severity in plantations potentially flips the perceived risk and hazard in multi-owner landscapes, because higher severity fire on intensively managed private lands implies they are the greater source of risk than older forests on federal lands. These older forests likely now experience higher fire severity than historically due to decades of fire exclusion, yet in comparison to intensively managed plantations, the effects of decades of fire exclusion in older forests appear to be less important than increased severity in young intensively managed plantations on private industrial lands."

"… [W]e found **daily fire weather was the most important predictor of fire severity**, followed by stand age and ownership, followed by topographic features. **Estimates of pre-fire forest biomass were not an important predictor of fire severity**" and "Our findings suggest intensive plantation forestry characterized by young forests and spatially homogenized fuels, rather than pre-fire biomass, were significant drivers of wildfire severity."

Williams and Baker have published several studies suggesting that forests in eastern Oregon were considerably more dense than estimates commonly asserted by agencies (Baker 2012; Williams and Baker 2012; and Baker and Williams 2015). There studies have received criticism by some, such as Fule et al. (2014). However, Williams and Baker (2014) provided in-depth responses to these criticisms and clear rationales and defense of their methods; their response was peer-reviewed and published. Their work should not be discounted; rather, it should be considered part of the ongoing conversation and part of the scientific controversy involved in these discussions. Williams and Baker (2014) note: "Government wildland fire policies and restoration programmes in dry western US forests are based on the hypothesis that high- severity fire was rare in historical fire regimes, modern fire severity is unnaturally high and restoration efforts should focus primarily on thinning forests to eliminate high-severity fire. Using General Land Office (GLO) survey data over large dry-forest landscapes, we showed that the proportion of historical forest affected by high-severity fire was not insignificant, fire severity has not increased as a proportion of total fire area and large areas of dense forest were present historically….. In response, Fulé et al. …suggest that our inferences are unsupported and land management based on our research could be damaging to native ecosystems. Here, we show that the concerns of FE are unfounded. Their criticism comes from misquoting W&B, mistaking W&B's methods, misusing evidence (e.g. from Aldo Leopold) and missing substantial available evidence. We also update corroboration for the extensive historical high-severity fire shown by W&B. We suggest that restoration programmes are misdirected in seeking to reduce all high-severity fire in dry forests, given findings from spatially extensive GLO data and other sources."

The authors respond to criticism of their paper point by point, and then include the following concluding notes: "The best possible historical baseline for dry forests is likely to come from systematically combining all sources. Past studies that supported the past incomplete historical baseline, which suggested that low-severity fire primarily maintained historical dry forests, were often spatially limited, incomplete samples of larger landscapes. Tree-ring methods can reconstruct to fine scales back to the late 1800s, but are difficult to complete across large landscapes (but see Heyerdahl et al., 2001). Palaeo-ecological reconstructions can provide key temporal evidence, but are also difficult to replicate across large landscapes. GLO data, in contrast, can be used to develop reconstructions across hundred of thousands to millions of hectares. New findings from GLO data have challenged past findings about the nature of the historical baseline in dry forests, but it is the role of science to continually test past findings. Refining the historical baseline should help avoid misuse of evidence, false narratives, and misdirected restoration and provide a sound scientific foundation for predicting the effects of climatic change on wildfire and forests."

Mature unlogged forests sequester more carbon than logged forests, including thinned forests. (Campbell et al. 2011; Law and Waring 2015; Mtchell et al. 2009; and Reinhardt and Holsinger 2010). The USFS must accurately analyze carbon sequestration, and should seek to sequester the greatest amount of carbon.

Campbell et al. 2011: "Results suggest that the protection of one unit of C from wildfire combustion comes at the cost of removing three units of C in fuel treatments."

Law and Harmon 2011: "Thinning forests to reduce potential carbon losses due to wildfire is in direct conflict with carbon sequestration goals, and, if implemented, would result in a net emission of CO2 to the atmosphere because the amount of carbon removed to change fire behavior is often far larger than that saved by changing fire behavior, and more area has to be harvested than will ultimately burn over the period of effectiveness of the thinning treatment."

Law and Waring 2015: "By accounting for more of the benefits and costs involved in reducing the risk of crown fires, modifying storage in long- and short-term products, and in substituting wood products for fossil fuel (biomass), we find that thinning existing forests to reduce crown-fire risk increases net carbon emissions to the atmosphere for many decades… "

Quote from Mitchell et al. 2009: "Reducing the fraction by which C is lost in a wildfire requires the removal of a much greater amount of C, since most of the C stored in forest biomass (stem wood, branches, coarse woody debris) remains unconsumed even by high-severity wildfires. For this reason, all of the fuel reduction treatments simulated for the west Cascades and Coast Range ecosystems as well as most of the treatments simulated for the east Cascades resulted in a reduced mean stand C storage. "

Reinhardt and Holsinger 2010: "Although wildfire emissions were reduced by fuel treatment, the fuel treatments themselves produced [carbon] emissions, and the untreated stands stored more carbon than the treated stands even after wildfire. … Our results show generally long recovery times."

Logging is the largest source of carbon emissions in the state of Oregon (Law et al. 2018). The USFS must adequately analyze greenhouse gas emissions released by their logging projects, including the rattlesnake project.

Logging practices release more carbon than if these forests were left to grow and recover naturally. The BMFPR should have included carbon emissions from logging. The USFS need to disclose and include in its environmental analyses that: forests with the highest carbon storage are unmanaged old growth forests; it is ineffective and inappropriate to encourage rotation-style forestry. The USFS needs to end destructive forest practices on public lands that contribute to greenhouse gases and exacerbate climate change. This includes many fire suppression and selective logging practices. Prioritize the preservation of clean, cold water through addressing excessive roading, destructive logging, and livestock grazing damage. True restoration measures, such as removal of fish passage barriers, should be implemented.

Carbon Emissions & Inadequate Climate Change Effects Analysis: Thinning decreases carbon storage compared to unmanaged forests. Beverly E. Law, Professor of Global Change Biology & Terrestrial Systems Science Oregon State University, recently gave a presentation on wildfire risks and management effects. Main points of her presentation included the following:

- "Thinning does not reduce fire occurrence; it can reduce severity, spread"
- "Thinning reduces carbon stocks and sequestration, 100+ years to recoup carbon loss"
- "No guarantees fire will occur during period of thinning effectiveness"
- "No treatment increases carbon stocks. Carbon debt is not sequestered in next century"
- "Thinning for crown fire risk reduction increased net C emissions"
- "Amount of biomass combusted in high-severity crown fire is greater than low- severity surface fire, but difference is small"
- "Low likelihood treated forests will be exposed to fire while effective (~20 yrs)"
- "Thinning larger area to decrease probability of high-severity fire ensures decreased carbon stock and net carbon balance over treated area"
- "Not important to suppress all fires - contributes to landscape heterogeneity" The presentation can be accessed at: https://docs.google.com/viewer?a=v&pid=sites&srcid=Zm9yZXN0Y2Mub3JnfGZmY2N8Z3g6M2Y wMjZiNDJhMTcxZmI4Yg

We are concerned about the potential negative effects of logging in riparian corridors on numerous bird species, especially those likely to be vulnerable to climate change. Many birds that are threatened by climate change-driven range shifts are also threatened by logging and other practices on the Malheur NF and other NFs in eastern Oregon. Bird species that rely on denser forests and complex canopy structure are also suffering widespread habitat loss due to logging that targets mature mixed-conifer forests—these provide needed complexity and forest density. Logging in riparian corridors may have disproportionately negative effects on climate- endangered and climate-threatened birds because riparian corridors currently provide some of the best remaining habitat. This includes species such as: Boreal owl; Northern pygmy owl; Northern saw-whet owl; Pine grosbeak; Vaux's swift; Hermit thrush; Three-toed woodpecker; Varied thrush; Evening grosbeak; Hammond's flycatcher; Townsend's warbler; Cordilleran flycatcher; Winter wren; Hairy woodpecker; Great gray owl; and Pine siskin (Csuti et al 1997; Langham et al. 2015).

Logging in riparian corridors is likely to decrease connectivity, especially connectivity in mixed-conifer areas that currently serve as important corridors and are among the last remaining areas that can provide connectivity for species. Commercial logging, in order to be viable, is likely to further incentivize removal of a greater number of trees, and further exacerbate an already concerning situation.

Increasing connectivity is the most commonly recommended strategy for preserving biodiversity in the face of climate change, according to a review of 22 years of scientific recommendations (Heller and Zavaleta 2009). Increasing connectivity includes actions such as removing barriers to species dispersal, locating reserves near each other, and reforestation. Other commonly recommended connectivity-related actions include creating "ecological reserve networks [i.e.,] large reserves, connected by small reserves, stepping stones"; "protecting the "full range of bioclimatic variation"; increasing the number and size of reserves; and creating and managing buffer zones around reserves (Heller and Zavaleta 2009). Large blocks of habitat that are well-connected to each other are important for the long-term survival for many species in the face of climate change.

It is essential that we preserve core habitats and connectivity corridors because these areas are very important for maintaining genetic diversity, facilitating movement and migration, and providing for range and habitat needs. Connectivity corridors also allow for species to colonize new areas or recolonize after disturbances, which will help species adapt to shifts in geographic range due to climate change. Many species are already facing threats to their viability due to fragmentation and a lack of connectivity; climate change threatens to severely exacerbate risks to their continued survival by further fragmenting habitats.

Logging in riparian corridors is likely to exacerbate some of the negative effects of climate change on riparian and stream ecosystems. Stream temperature is a primary concern. Actions that minimize increased water temperatures are important for maintaining cold water refugia. The Independent Scientific Advisory Board (2007) states:

"Adequate protection or restoration of riparian buffers along streams is the most effective method of providing summer shade. This action will be most effective in headwater tributaries where shading is crucial for maintaining cool water temperatures. Expanding efforts to protect riparian areas from grazing, logging, development, or other activities that could impact riparian vegetation will help reduce water temperature increases. It will be especially important to ensure that this type of protection is afforded to potential thermal refugia. Removing barriers to fish passage into thermal refugia also should be a high priority."

Salmon face serous threats to their continued existence due to climate change, and are predicted to suffer significant habitat loss**.** The Independent Scientific Advisory Board (2007) notes that according to some research predictions:

"[T]emperature increases alone will render 2% to 7% of current trout habitat in the Pacific Northwest unsuitable by 2030, 5%-20% by 2060, and 8% to 33% by 2090. Salmon habitat may be more severely affected, in part because these fishes can only occupy areas below barriers and are thus restricted to lower, hence warmer, elevations within the region. Salmon habitat loss would be most severe in Oregon and Idaho with potential losses exceeding 40% by 2090**."**

Commercial logging in riparian corridors would likely exacerbate stream temperature issues. Even localized temperature increases may have negative effects on struggling fish populations, especially when repeated in numerous streams across the landscape. Past and current logging, grazing, and roads have increased stream temperatures to ecologically and legally unacceptable extremes. There is little evidence to support that USFS proposals to log in riparian corridors and to focus on tree species composition in riparian corridors is an appropriate response or will ameliorate stream temperature problems. High stream temperatures, as well as increased fine sediment in many areas, are likely the pressing risks to fish viability and stream ecosystems. The synergistic effects of climate change, high temperatures, and increased fine sediments warrant actions such as protecting shade, ecosystem integrity, and terrestrial and aquatic connectivity. Wildfire is far less of a threat to these parameters than widespread logging in riparian corridors.

Hicks et al. (1991) found base flows increased for 8 to 9 years after clearcut logging because rainfall is not intercepted, evaporated, and transpired by trees. Instead, most rainfall becomes surface, subsurface, or groundwater flow once the trees are removed, and therefore contributes to base flow increases. However, the author found that base flow rates declined to lower than normal volumes in areas of hardwood riparian re-growth for the following 18 of 19 years in their study. This was thought to be due to uptake and ET of stream water by the hardwoods, which had a greater effect on lowering streamflow than conifers. Base flow rates in areas without hardwood re-growth continued to be higher than expected 16 years after logging. The authors predicted base flow rates would return to normal in approximately 40 to 60 years. In addition, Jones & Grant (1996) found that watersheds with drier conditions and more intense summer droughts were more sensitive to the effects of logging and roads on increased peak flows. Logging to increase base flows has been widely cautioned against, and is unpredictable and unlikely to increase base flows during the lowest flow periods or for the long-term. In combination with climate change, unintended negative effects may have severe consequences.

Historical documents

The following are the main summary points gleaned from research BMBP did on historic documents dated from the early to mid 1900s. Clumps of higher density forests are natural and documented in early historical accounts—even within Ponderosa pine forests. A more in-depth discussion on historical documents and copies of the studies are included in our addendum to this objection.

- Grand fir and other non-Ponderosa pine species were historically well-represented on the landscape. Historical accounts of mixed conifer stands include descriptions of fir being the most abundant and dominant species in those forest types; Douglas fir and smaller percentages of Western larch were also described. Early seral species were not the dominant or most abundant components of these stands in the majority of historical accounts. Mixed conifer forests comprised large percentages of the forested landscapes in Eastern Oregon. In some watersheds, close to half of the forests were mixed conifer stands. Percentages vary according to historical document and geographic area.

- Ponderosa pine forests also contained a substantial percentage of other tree species, including Grand fir. Pure Ponderosa pine stands were rare.

- Grand fir was targeted for removal as per regional direction to foresters working on National Forests. Current estimates of Grand fir density and volume may be erroneously based on anecdotal observations that occurred after substantial proportions of fir were already removed across the landscape.

- Extensive overgrazing during the turn of the century may have created artificially open forest stands in some areas.

AQUATICS:

Scientific controversy regarding logging and vegetation "management" within riparian corridors: A large body of scientific research shows that logging near streams can have long-term and devastating consequences for stream ecological integrity and water quality. Logging in riparian corridors can cause degradation of water quality such as stream temperature increases, changes to stream temperature patterns, increased fine sediment inputs, stream bank instability, and other problems. The USFS has ignored and downplayed the well-documented negative affects and ecological risks associated with logging within streamside corridors. Even non-commercial thinning in riparian corridors is, at best, a large scale and ecologically risky experiment in which little is known about the outcome. Risks are considerable, and the outcome can have unintended negative consequences. Rieman et al. (2001) noted that: **"…vulnerable aquatic species could be impacted in the short term in ways from which they could not easily recover, even if long-term benefits eventually became evident in later years"** (USFS Forest Plan Revision (2014)).

More than 1,240 stream miles on National Forest lands in the Blue Mountains are listed as not meeting water quality criteria. The most common water quality impairment on National Forest lands is stream temperature (Draft EIS for the Blue Mountains Forest Plan Revision, Vol. 1 pg. 272). The USFS has data showing streams that are almost certainly violating state temperature standards but that ODEQ does not have data for, so this figure (based on ODEQ's past Integrated Databases) is almost certainly a severe underestimate. This important baseline of conditions, as included in the BMFPR analyses, is inaccurate. Many streams are violating the state temperature standards by substantial margins, including those in mid and high-elevation forested streams that support ESA-listed species such as Mid-Columbia River steelhead and Bull trout, and are Designated Critical Habitat—but are not included in the state's Integrated Database or the 303d list. It is not uncommon for these streams to be over 70 degrees Fahrenheit.

When sensitive or at-risk aquatic species have already fragmented populations, low numbers, and are currently limited by high stream temperatures, creating widespread situations in which their populations cannot easily recover from management effects in miles of streams is extremely risky at best. Logging poses a greater risk to aquatic species than wildfire, even high-severity wildfire. The USFS proposed Forest Plan Revision (2014) vol 2. pg 60: **"Redband trout and bull trout have been shown to recolonize severely burned drainages within two years, provided the drainages were physically accessible (i.e., no culvert barriers, and provided that other fish in unburned areas were close enough to discover and move back into the recently burned habitat"**

Allowing for "short term" negative impacts for perceived long-term benefits is a very risky and highly subjective strategy. Localized and short-term impacts can be devastating to small or struggling populations of aquatic species. For example, Reiman et al. (2001) noted in relation to accelerated restoration schedules that: **"…vulnerable aquatic species could be impacted in the short term in ways from which they could not easily recover, even if long-term benefits eventually became evident in later years"** (also cited in the USFS proposed Forest Plan Revision (2014)). When at-risk aquatic species have already fragmented and small populations and are currently limited by water quality impairments such as high stream temperatures, cumulatively creating widespread situations in which their populations cannot easily recover from management effects across miles of streams is extremely risky at best.

Some studies have found selective logging may be associated with increases of instream fine sediments (Kreutzweiser et al. 2005, Miserendino and Masi 2010), changes in macroinvertebrate community structure or metrics (Flaspohler et al. 2002, Kreutzweiser et al. 2005), alterations in nutrient cycling and leaf litter decomposition rates (Lecerf and Richardson 2010), and increases in stream temperatures (Guenther et al. 2012). Flaspohler et al. (2002) noted that changes to biota associated with selective logging were found decades after logging. While these studies did not take place in eastern Oregon, they strongly suggest that alterations caused by logging within riparian buffer zones may result in significant changes in water quality parameters and stream biota in many areas; these results are likely tied to dynamics that may be common to many forested streams to varying degrees.

A large number of scientific studies have implicated roads as a driving or primary factor in altering watershed hydrology and/or declines in fish stocks (Bader 2000; Bradley et al. 2002; Carnefix and Frissell 2009; DellaSala et al. 2011; Frissell and Carnefix 2007; Public Lands Initiative 2004; Reiman and Clayton 1997; Reiman et al. 2000; Thurow et al. 2001; Public Lands Initiative/Trout Unlimited 2004; Quigley and Arbelbide 1997; Western Native Trout Campaign 2001), especially in combination with other impacts such as livestock grazing (Al- Chockhachy et al. 2010b).

By logging in and adjacent to riparian corridors areas, threats to water quality from roads are exacerbated. Roads are a primary if not *the* primary threat to water quality in public forests. Logging projects make this problem worse through increased maintenance and use of roads adjacent to and crossing streams and riparian corridors, and through building "temporary" roads and skid trails. In many instances, projects claim to reduce road density but instead the actual road density (existing road density) is increased rather than reduced. Road-related activities in timber sales create lasting effects from "temporary" roads, skid trails, landings, re-opened roads, and closed and decommissioned roads, and increased erosion. Actual on the ground impacts are often not accurately considered. Road density, even for "temporary" use, should not be allowed to increase in areas already exceeding road density standards and existing biological thresholds, especially not in riparian corridors and subwatersheds with sensitive or at-risk aquatic species. Effects from roads are almost never "temporary", and may last for many decades; this can include negative affects on water quality.

Fish stocks are stronger and better distributed in areas of little or no management and low road densities, even in fire suppressed areas, and even if severe fires occur. Numerous studies and reports show that many benefits are gained by leaving forests unroaded, and to their own ecological processes (including processes involving fire, insects, and disease). (Bader 2000, Bradley et al. 2002, DellaSala et al. 2011, Frissell and Carnefix 2007, Public Lands Initiative 2004, Reiman and Clayton 1997, Reiman et al. 2000, Thurow et al. 2001, Public Lands Initiative/Trout Unlimited 2004, Western Native Trout Campaign 2001).

Stream temperature and sediment

High stream temperatures are already a limiting factor for fish in many areas, as well as the most common water quality problem. Threatened fish stocks are already struggling due to high stream temperatures and increased fine sediments in many areas. Stream temperature increases, especially in areas that are already in violation of state and Forest Plan stream temperature standards. Even if temperature increases aren't detected at larger watershed scales, localized increases at the subwatershed or reach scale can be very important for already Threatened fish stocks—especially if the problem is repeated in multiple stream reaches across the landscape.

There has been little direct monitoring or studies done regarding the effects of logging in riparian corridors on stream temperature in relation to current silvicultural prescriptions. It is well documented that heavy logging within riparian areas will significantly raise stream temperatures, often drastically, as well as negatively impact other water quality parameters (such as fine sediment). There is little reason to conclude that removing some trees from the riparian corridors will not have an intermediate negative affect on stream temperatures—likely resulting in an increase in stream temperatures, though not as great as the increases seen in clear cut scenarios. Given that many streams are already in violation of water quality standards for temperature, and that stream temperatures already exceed optimal ranges for fish in many streams– even minimal increases in stream temperatures may pose additional severe threats to fish viability.

Guenther et al. (2012) found increases in stream temperature in relation to selective logging. The Guenther study found increases in bed temperatures and in stream daily maximum temperatures in relation to 50% removal of basal area in both upland and riparian areas. Increases in daily maximum temperatures varied within the harvest area from 1.6 to 3 degrees Celsius.

Logging or thinning within riparian corridors will cause fine sediment production and allow for sediment delivery into streams, and potentially contribute to stream temperature increases, increased variability in waters quality and aquatic habitat parameters, alterations to stream hydrology, and other negative impacts. Furthermore, headwater streams and non-fish bearing streams need more, not less, protection. Negative impacts to upstream reaches, such as higher temperatures, increased sediment loading, down-cutting, and altered hydrographs also negatively affect downstream reaches. In order to protect downstream fish bearing reaches, headwater streams need at least as much protection than larger downstream reaches (Rhodes et al., 1994; Moyle et al., 1996; Erman et al., 1996; Espinosa et al., 1997). Both Erman et al., (1996) and Rhodes et al., (1994) concluded, based on review of available information, that intermittent and non-fish-bearing streams should receive stream buffers significantly larger than those afforded by PACFISH/ INFISH. In addition, Best Management Practices (BMPs) may need to be specially designed to ensure protection of Bull trout (USFWS 2010).

In addition, effects of logging (including thinning) can be hard to detect despite being persistent, long-lasting, and negative. For example, the Draft Forest Plan Revision for the Blue Mountains (vol. 2 pg. 48): "Timber harvest can influence aquatic ecological condition via such activities as removal of trees in the riparian zone, removal of upslope trees, and associated understory or slash burning (Hicks et al. 1991). These activities can affect wood recruitment, stream temperatures, erosion potential, stream flow regime, and nutrient runoff, among others (Hicks et al. 1991). Effects of harvest are likely to be different at different scales. Hemstad and Newman (2006) found few effects of harvest at the site or reach scale, but **found that harvest five to eight years earlier resulted in losses of habitat quality and species diversity at the scale of a stream segment (larger than a reach) or at the subwatershed level. Those losses were revealed in terms of increases in bank instability and fine sediment throughout the watershed and increased water temperatures and sediment problems throughout the channel segment. The cumulative effects of widespread harvest within a single drainage in a short period of time resulted in deterioration of the aquatic and riparian habitats, but evidence of effects lagged harvest by several years and different evidences of deterioration showed up at different spatial scales within the watershed".**

The effects of sediments and roads on stream integrity and aquatic habitats affect Bull trout, Steelhead, and other fish. From the Federal Registrar, Department of the Interior Fish and Wildlife Service 50 CFR part 17 (2010) Final Rule for Revised Designation of Critical Habitat for Bull Trout states:

“Sedimentation negatively affects bull trout embryo survival and juvenile bull trout rearing densities (Shepard et al. 1984, p. 6; Pratt 1992, p. 6). An assessment of the interior Columbia Basin ecosystem revealed that increasing road densities were associated with declines in four nonanadromous salmonid species (bull trout, Yellowstone cutthroat trout (Oncorhyncus clarkii bouvieri), westslope cutthroat trout (O. c. lewisi), and redband trout (O. mykiss spp.)) within the Columbia River basin, likely through a variety of factors associated with roads. Bull trout were less likely to use highly roaded basins for spawning and rearing and, if present in such areas, were likely to be at lower population levels (Quigley and Arbelbide 1997, p. 1183). These activities can directly and immediately threaten the integrity of the essential physical or biological features described in PCEs 1 through 6.”

Timber harvest, grazing, and the synergistic impacts of the two activities combined have significant negative impacts on aquatic habitats. From NOAA 5-Year Review of Snake River Salmonids:

“Information from the [PACFISH Biological Opinion Monitoring Program] PIBO monitoring program indicates that unmanaged or reference reaches (streams in watersheds with little or no impact from road building grazing, timber harvest, and mining) on Federal lands in the Interior Columbia basin (including the Snake River basin) are in better condition than managed streams (Al- Chockhachy et al. 2010b). In particular, managed watersheds with high road densities or livestock grazing tend to have stream reaches with worse habitat conditions than streams in reference watersheds. When roads and grazing both occur in the same watershed, the presence of grazing has an additional significant negative ffect on the relationship between road density and the condition of stream habitat (Al-Chockhachy et al 2010b).”

Carnefix and Frissell (2009) discussed impacts from roads, and show that significant negative impacts to sensitive aquatic species are present at road densities greater than one mile per square mile: “Multiple, convergent lines of empirical evidence summarized herein support two robust conclusions: 1) no truly “safe” threshold for road density exists, but rather negative impacts begin to accrue and be expressed with incursion of the very first road segment; and 2) highly significant impacts (e.g., threats of extirpation of sensitive species) are already apparent at road densities on the order of 0.6 km per square km (1 mile per square mile) or less. Therefore, restoration strategies prioritized to reduce road densities in areas of high aquatic resource value from low-to-moderately-low levels to zero-to-low densities (e.g., 1 mile per square mile, lower if attainable) are likely to be most efficient and effective in terms of both economic cost and ecological benefit. By strong inference from these empirical studies of systems and species sensitive to humans’ environmental impact, with limited exceptions, investments that only reduce high road density to moderate road density are unlikely to produce any but small incremental improvements in abundance, and will not result in robust populations of sensitive species.”

For example, the existing road density on the Malheur National Forest is well above the 2-miles/square mile NOAA (1996) threshold for watersheds to be considered “properly functioning”. NOAA (1996) notes: properly functioning: 2 miles/sq mile; at risk 2-3 mi/sq mi; not properly functioning >3mi/sq mi.

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