Blue Mountains Biodiversity Project
Addendum to timber sale comments and objections
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The following is a collection of summaries and descriptions of independent science on a variety of ecological issues related to timber sales on National Forests in our region. These studies highlight the ecological degradation and destruction caused by logging and roads to soils, wildlife and their habitats, fish, water quality, and carbon storage.

In recent years, numerous studies have raised alarms regarding habitat loss, climate change, and decline of fauna and biodiversity across the planet. Warnings have been sounded by scientists regarding the declining bird populations we are seeing, and the projections of far greater losses to come. For example, the Rosenberg et al. (2019) study *Decline of the North American Avifauna* reported a *"staggering decline of bird populations, and found "wide-spread population declines of birds over the past half-century, resulting in the cumulative loss of billions of breeding individuals across a wide range of species and habitats. They show that declines are not restricted to rare and threatened species—those once considered common and wide-spread are also diminished. These results have major implications for ecosystem integrity, the conservation of wildlife more broadly, and policies associated with the protection of birds and native ecosystems on which they depend."*

Given the urgent need to address the biodiversity and climate crises, which includes species and habitats in the Blue Mountains, the agency needs to focus on protecting wildlife, clean water, high-quality habitat, and ecosystem integrity. Birds are an integral part of forested ecosystems on the Blue Mountains, and are not adequately considered in FS planning. These structural components and forest types include: mixed-conifer forests, fir dominant or codominant forests, and mature and late old structure forests.

The following is a summary of birds in the Blue Mountains of Oregon and SE Washington rely on mature and old forests, mixed-conifer forests, and fir-dominant or co-dominant forests. For additional detail and citation information, please see the detailed notes and spreadsheet that compliments this section. These documents include additional detail about BBS population trends, Langham et al. (2015) climate threat determinations, and habitat descriptions from Csuti et al (1997), Thomas et al. (1979), Miller (personal communication), and Marshall et al. (2006).

Association with mature and old forests, mixed-conifer forests, and fir dominant or co-dominant forests: Many of the birds that are associated with mature forests, old growth forests, mixed-conifer forests, and/or Grand fir or Doug fir during a key portion of their life history. These include:

Birds that rely on mixed-conifer forests, mature and old forests, and Grand fir: Birds that rely on mixed-conifer forests, mature and old forests, and Grand fir for at least part of their life histories (such as reproduction and feeding) include: Harlequin duck; Bufflehead; Barrow's goldeneye; Hooded merganser; Wood duck; Red crossbill; White-winged crossbill; Brown creeper; Vaux's swift; Evening grosbeak; Pine grosbeak; Hermit thrush; Swainson's thrush; Varied thrush; Pine siskin; Cordilleran flycatcher; Golden-crowned kinglet; Ruby-crowned kinglet; Black-capped chickadee; Chestnut-backed chickadee; Mountain chickadee; MacGillivray's warbler; Townsend's warbler; Yellow-rumped warbler; Mountain bluebird; Calliope hummingbird; Rufous hummingbird; Red-breasted nuthatch; American three-toed woodpecker; Black-backed woodpecker; Downy woodpecker, Hairy woodpecker, Lewis' woodpecker; Pileated woodpecker, Williamson's sapsucker; American kestrel, Winter Wren, Western Tanager, Hammond's flycatcher, Boreal owl; Flammulated owl; Great grey owl; Long-eared owl; Northern saw-whet owl;

Northern pygmy owl, Bald eagle; Golden eagle; Osprey; Merlin, Peregrine falcon, and Northern goshawk. (Marshall et al. 2003; Csuti et al. 1997; Thomas 1979; Miller 2020 personal communications).

Birds that have also seen declining populations according to the BBS, and/or are considered climate endangered or climate threatened by Langham et al. (2015) include Bufflehead; Barrow's goldeneye; Hooded merganser; Wood duck; Red crossbill; Brown creeper; Vaux's swift; Pileated woodpecker; American three-toed woodpecker; Black-backed woodpecker; Lewis' woodpecker; Williamson's sapsucker; Great grey owl; Boreal owl; Long-eared owl; Flammulated owl; Northern saw-whet owl; Bald eagles; Golden eagles; and Osprey

Langham et al. 2015 *Conservation Status of North American Birds in the Face of Future Climate Change* identified 314 birds at risk of losing more than half of their current geographic ranges under climate change scenarios. In addition, 126 of these are not expected to see gains in their geographic ranges. The authors note: *"Our results demonstrate the need to include climate sensitivity into current conservation planning and to develop adaptive management strategies that accommodate shrinking and shifting geographic ranges. The persistence of many North American birds will depend on their ability to colonize climatically suitable areas outside of current ranges and management actions that target climate adaptation."* The authors also note: "*We suggest that the 126 species in this category be considered by conservation entities for immediate monitoring beyond existing programs such as BBS and CBC."*

The habitat requirements of birds imperiled by declining populations and/or climate change are regularly ignored or downplayed by the Forest Service (FS). The Forest Service cannot protect the viability of these species without analyzing the effects of this proposal on their habitats, ranges, connectivity, and needed forest components and structures.

Thomas (1979) also highlights several wildlife species that rely on mixed-conifer, mature and old forests, and Grand fir for at least part of their life histories (such as reproduction and feeding) include: Canada lynx, bobcat, Snowshoe hare, White-tailed deer, Northern flying squirrel, numerous bats, Rubber boa, Malheur shrew, Vagrant shrew, Dusky shrew, Heather vole, Long-tailed vole, Gapper red-backed vole, Black bear, Short-tailed weasel, Jumping mouse, and mule deer.

Through the lens of species presence and evolutionary history

Mixed-severity fires (including high severity fires) create habitat that is necessary for species within the ONF and eastern Oregon, suggesting that high severity fires are natural and historically present, as well as necessary. High severity fires create important habitat that is very high in biodiversity, and may be rare compared to historic norms.

The evolutionary history and very existence of Black-backed woodpeckers suggests that large high-severity fires must regularly occur within their range. We are concerned that current fire suppression efforts (including thinning) through the region will continue to exclude high-severity wildfires 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)."*

"The degree to which the black-backed woodpecker is restricted to burned forest conditions in the intermountain west is truly remarkable. Although this species has been detected outside burned forest conditions, particularly in unburned, beetle-killed forests, the numbers therein are small, and nest success therein is substantially lower than in burned forests (Saab et al. 2005). Neither Powell (2000) nor Morrissey et al. (2008), for example, found any black-backed woodpeckers in surveys of mountain pine beetle-infested mixed-conifer forests even though they located northern flickers and three-toed, hairy, downy, and pileated woodpeckers. Similarly, a regionwide bird survey across a series of unburned, beetle-infested conifer forests within the Forest Service Northern Region (Cilimburg et al. 2006) yielded only two black-backed woodpecker detections (0.46 % of 433 point counts). This is less than one-tenth of the frequency of detection in forests burned 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., fire morel [Morchella angusticeps]; jewel beetle, Buprestidae; blackbacked 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."

"…[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.*** *Because plant and animal adaptations can serve as reliable sources of information about what constitutes a natural fire regime, it might be wise to supplement traditional historical methods with careful consideration of information related to plant and animal adaptations when attempting to restore what are thought to be natural 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*

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The Integrated Scientific Assessment for Ecosystem Management in the Interior Columbia Basin and Portions of the Klamath and Great Basin (Quigley et al. 1996) includes summaries of their finding. The "Highlighted Findings" note that **there has been a 27 percent decline in multi-story old forest structures** (Chapter 8, Findings, pg. 181). Given the extensive portion of forests that have already been logged on the landscape, mature and old forests (and the trees, snags, and logs within them) often provide some of the last high-quality wildlife habitat and connectivity corridors in and adjacent to timber sale areas.

Young and mature fir are also needed for future recruitment of old and large fir. Bull et al. 1997 highlights the importance of large fir with cavities, as well as the importance and rarity of the multilayer stands that produce this habitat, notes:*"**In northeastern Oregon, grand fir and western larch make up most of the hollow trees used by wildlife.** Bull et al. 1997 goes on to note that "[l]arge, hollow trees are uncommon in managed landscapes and typically are found only in late- and old-seral stands of grand fir and western redcedar. Although isolated hollow trees in young stands have significant value to wildlife, these young stands cannot reproduce this type of structure for at least 150 to 200 years. **The late-seral, multilayer stands that produce hollow trees comprise less than 3 percent of the forested landscape in the interior Columbia River basin**."*

The Forest Service Region 6's Response to Blue Mountains Biodiversity Project's Freedom of Information Act request (2016-FS-R6-001106-F) included the "Eastside Screens Enclosure; Recent Science Findings and Practical Experience: Implications for the Eastside Screens September 2015". This Enclosure also recognizes the importance and rarity of large hollow firs. The Enclosure noted (emphases added): *"Implementation of the Screens has substantial species management implications. For example, the white-headed woodpecker, Lewis's woodpecker and several species of bats are Regional Forester's Sensitive Species that rely on large snags and defective trees for part of their life history. **Large, defective grand fir trees and snags provide critical roosting and denning habitat for black bears, Vaux's swifts, pileated woodpeckers, American marten, and bats** (Bull et al., 1997). **These legacy trees, especially large, hollow grand fir, are rare on the landscape and have declined from historical conditions on the eastside of Oregon and Washington".** The enclosure also states: "These findings reinforce the importance of retaining and recruiting large, old trees in dry, mesic and moist mixed conifer forests on the eastside of the Region. It is critical that silvicultural prescriptions provide for **large** snags and defective trees in adequate numbers through time….**large, hollow grand firs take 150 to 200 years to develop (Bull et al. 1997): adequate numbers of smaller trees need to be left to allow for the processes that create replacement hollow trees."***

Logging and riparian forests:

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".*

The August 2017 "Science Findings" from the PNW Research Station discussed the importance of snags and wildfire, and found that many more snags are needed than current regulations or standards provide for.

Riparian forests are disproportionately used by wildlife and birds, and so these findings are particularly relevant to Riparian Reserves. The following quotes are from August 2017 "Science Findings" from the PNW Research Station:

- *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.*

- *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.*

Prescribed fire:

We also have concerns about prescribed fire, particularly landscape-scale prescribed fire in sensitive or remote areas (including RHCAs) that historically burned with mixed severity, including high severity. The FS also does not seem to account for the dynamic nature and natural variability and complexity of the landscape, or for fire refugia. Also, prescribed fires should not take place in the spring, as the potential to harm nesting birds, butterflies, and other species who are nesting or reproducing at that time is high.

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 logging and because of 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 timber sales. 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)."*
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> *"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…."*
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> *"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"*
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> *"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"*
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> *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)."*
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> *"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)."*

Forested streams:

Biodiversity in headwater systems can be significant, but is not well characterized and may be underestimated (Pearl et al. 2009). For example, stream-associated amphibians require clear, cold water and species such as Columbia spotted frogs and tailed frogs would benefit from the 300' buffers or larger protective riparian buffers. (Corn & Bury 1989, Cushman 2006, Olson & Weaver 2007, Pearl et al. 2009, Semlisch & Bodie 2003, Welsch and Olliver 1998). Corn and Bury (1989) found that amphibian diversity decreased in lower order streams adjacent to logging. Semlisch and Bodie (2003) found that riparian-associated amphibians utilized and depended upon large areas of upland terrestrial habitat (approximately 300 meters for most amphibians), and so require core habitats well beyond the traditional buffers afforded to the headwater riparian areas (Semlisch and Bodie 2003, Olson et al. 2007). Cushman (2006) suggested management strategies include headwater areas and/or patches that are prioritized for core habitats and maintain connectivity between some watershed areas (Cushman 2006). In general, amphibians in headwater areas may not receive sufficient protections in relation to land management projects (Corn & Bury 1989, Janisch et al. 2011, Semlisch & Bodie 2003). The FS is unfortunately going in the opposite direction, and attempting to decrease or altogether eliminate (such as in small streams) the already buffer protections under Forest Plan standards.

Because forests within RHCAs have been somewhat more protected in the last few decades, these forests often have comparatively more mature and old forests and high-quality wildlife habitat compared to upland forests. As a result, they are providing even greater and disproportionately important wildlife habitat to fauna that rely on mature and old forests, multi-story canopies, denser forests, and fir dominated or co-dominated forests. Riparian forests often encompass these types of forests, but unfortunately riparian forests have become increasingly targeted for logging in recent years. Logging in mixed-conifer forests within and adjacent to riparian corridors will negatively impact wildlife. For example, Northern goshawk and other accipiter hawks, American marten, Great gray owls, Black-backed woodpeckers, Three-toed woodpeckers, Pileated woodpeckers, Olive-sided flycatchers, and other species that rely on denser forests, mature or old growth mixed conifer forests, and/or will be negatively affected by logging in riparian corridors. The Forest Service's narrow focus on the logging also ignores mycorrhizal networks, sharing resources among trees; windthrow; or other situations in which nearby trees and tree cohorts benefit each other and promote biodiversity.

Riparian corridors provide particularly important habitat that is used at disproportionately high rates by many species of wildlife. The negative ecological impacts associated with logging in mature and old mixed-conifer forests, multi-story and complex habitat are particularly concerning in relation to riparian forests and the streams they protect. Streams and riparian forests are impacted by what occurs in the uplands as well as within riparian corridors, and can be affected by actions in neighboring creeks and waterbodies. We are concerned about the effects to streams and riparian corridors from upland logging and roading, in addition to being very concerned about such activities within RHCAs.

Crucial wildlife habitat such as snags and downed wood are vitally important, particularly in RHCAs as they see disproportionally high wildlife use and serve as connectivity corridors. Unfortunately, the FS increasingly sees this key wildlife habitat as "fuels" and logs such habitat or destroys it as part of the collateral damage of logging. In addition, managed stands have fewer snags than unmanaged stands (Cline 1997).

In addition, we are concerned that the combined effects of logging and prescribed fire can also be severe for sapling recruitment. In addition, logging down to very low basal areas, followed by prescribed burning, may end up with severely open canopies-- especially if burns run larger or hotter than intended. Opening up forest canopies to a low basal area can cause forests to be substantially drier and hotter, and cause habitat loss for species that rely on multi-layered and dense canopies. Shrubs may extensively colonize such open areas, making it difficult for forests to recover from logging. Also missing from the FS's cumulative effects analyses are the past and possibly ongoing/future effects from fire lines, backburns, and other fire suppression efforts. We are also extremely concerned about the potential severe impacts associated with logging within fire lines and ember reduction zones, and the lack of adequate analyses surrounding these activities.

Overview of water quality and aquatic species concerns:

Aquatic and riparian ecosystems are especially vulnerable to negative impacts of logging, both from logging within RHCAs and from upslope logging. The Forest Service, in the vast majority of their many sales, fails to adequately disclose, analyze, or avoid the negative effects that logging would have on these ecosystems and the cumulative impacts of ongoing threats (roads, livestock grazing, fragmentation, climate change, logging, invasive species, etc.). The agency cherry-picks science and scientific interpretations that bolsters their desired outcome of logging within riparian corridors, while ignoring or severely downplaying science that did not align with the agency's assumptions or conclusions.

The agency's proposals for logging in riparian corridors (RHCAs) and heavy upslope logging (including in important wildlife areas such as marten source habitat areas) flies in the face of widespread scientific consensus to increase core habitats and connectivity in response to climate change (Heller and Zavaleta 2009). The agency needs to consider how existing conditions and proposed logging would potentially exacerbate possible negative impacts from climate change. The Forest Service has an extreme and disproportional emphasis on logging and fails to consider the importance of less risky and more effects strategies with regard to climate change that do not focus on logging.

Managed watersheds with logging associated roads have worse stream habitat conditions. 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 effect on the relationship between road density and the condition of stream habitat (Al-Chockhachy et al 2010b)."***

Logging can be associated with changes in macroinvertebrate community structure or metrics (Flaspohler et al. 2002, Kreutzweiser et al. 2005), increases in stream temperatures (Guenther et al. 2012) and alterations in nutrient cycling and leaf litter decomposition rates (Lecerf and Richardson 2010). Flaspohler et al. (2002) noted that changes to biota associated with selective logging were found decades after logging. For example, the USFS's Draft Forest Plan Revision for the Blue Mountains (vol. 2 pg. 48) noted: *"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 evidence of deterioration showed up at different spatial scales within the watershed".*

Headwater streams and non-fish bearing streams are particularly at risk and need more, not less, protection. In order to protect downstream fish bearing reaches, headwater streams need at least as much protection as larger downstream reaches (Rhodes et al., 1994; 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. Headwater streams and small intermittent streams do not have buffer widths that are sufficient to protect water quality and stream habitats. Wider buffers are needed in order to prevent excess fine sediments and nutrients entering waterways. (Freeman et al. 2007; Gomi et al. 2005; Nieber et al. 2011; Sweeney and Newbold 2014). Negative impacts to upstream reaches, such as higher temperatures, increased sediment loading, down-cutting, and altered hydrographs also negatively affect downstream reaches.

Importance of riparian forests for amphibians, birds, wildlife, and general biodiversity:

Current logging proposals negatively impact riparian habitats, water quality, and fish would be directly and negatively impacted by logging. **Approximately 75% of eastside terrestrial species depend upon riparian habitats for their life cycle needs or use these habitats more than others (Henjum et al. 1994).** Mixed-conifer forests dominated or co-dominated by Grand fir support important wildlife habitat, and are crucial for regional biodiversity. The FS regularly fails to adequately protect or consider the importance of multistory forests for wildlife species and their habitat needs.

Water quality:

The most common water quality impairment in National Forest System lands is stream temperature. Elevated stream temperatures are known to negatively impact fish stocks on National Forest lands in the Blue Mountains, including anadromous fish, and listed and at-risk fish such as Bull trout. Water quality standards for temperature, sediment, and other water quality parameters are not being met on hundreds of miles of streams on these National Forest lands. TMDLs and WQRPs have not been developed in a timely fashion for many 303(d) listed basins. BMPs have not been adequately re-evaluated or adjusted to assure compliance with water quality parameters such as temperature. WQRPs plans and TMDLs often do not adequately deal with forest management activities, and monitoring is not always followed through on and lacks public transparency.

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 (BMFPR), Vol. 1 pg. 272). This baseline figure from the BMFPR is almost certainly an underestimate-- the large volume of recent data submissions in 2019 from the Forest Service to ODEQ reflect even more widespread problems with stream temperature violations across the landscape. The agency's 2018 data submissions were the first effort by the Forest Service to share a substantial portion of their data with ODEQ in over a decade.

Monitoring and baseline information:

The Forest Service has repeatedly demonstrated that it does not have the ability to collect, organize, store, analyze, or share data and monitoring information in an effective or consistent manner. The following are a few examples of issues with monitoring data and information:

- The Forest Service lacks the will or internal organization to share data with outside agencies, such as Oregon Department of Environmental Quality, on a regular basis. Until BMBP wrote letters to Forest Supervisors and ODEQ staff calling attention to this issue, the USFS had not shared the vast majority of their water quality data with ODEQ for over a decade. After we highlighted this issue during the last ODEQ 'call for data' in 2018, the Forest Service shared large amounts of data with ODEQ, finally. However, based on stream temperature data that BMBP received through FOIA, the Forest Service still has not provided ODEQ with existing stream temperature data for some streams, including streams in violation of water quality standards. BMBP had to appeal the first FOIA response we received from the Forest Service in order to finally get the bulk of these data.

- Unwilling to be transparent with the public. The Forest Service has repeatedly made it difficult to obtain water quality information.

- Unable to properly organize data storage or coordinate data sharing among key staff members. For example, water temperature data does not generally seem to be housed in a central location in most instances. Submission of existing data into the centralized database is voluntary for staff members in charge of such data. Once it became clear that the Forest Service was planning to (finally) submit some of their data to ODEQ during the ODEQ 'call for data', it became clear that the Forest Service did not have an adequate internal system or protocol for data storage or organization. Much of this data was housed with individuals who were not required submit it to the centralized database for eventual submission to ODEQ.

- The Forest Service often does not have accurate or consistent water quality data in NEPA documents. We have documented this issue for numerous streams. For a few examples, please see our exhibit with our letter to the Malheur National Forest requesting an SEIS for the Camp Lick timber sale.

- The Forest Service does not conduct an adequate or statistically robust number of site visits to determine BMP and PDC effectiveness in timber sales. This only happens for a handful (or less) of timber sale sites on each forest per year. While the Forest Service claims that BMP monitoring is effective, in reality the agency does not have enough data to make this determination.

- The Forest Service is unable to follow through with monitoring plans and efforts (for example, stream temperature monitoring promises made and broken)

- The agency lacks an appropriate framework for adaptive management. In many cases, the agency lacks baseline data, which is a key component of an adaptive management framework. This is particularly true of data regarding population trends for fish and wildlife.

- When designing monitoring goals, the agency will often narrowly focus on monitoring parameters relative to 'fuels', silvicultural questions, tree species composition, or some other aspect of measuring trees or wood. The Forest Service rarely focuses substantial or widespread effort to systematically or responsibly collect data on and monitor issues such as: water quality response to logging in a before/after upstream/downstream design; wildlife or fish response to logging or grazing; soil compaction; etc.

- Lack of follow-through with long-term monitoring plans and promises, such as those for stream temperature monitoring in the Big Mosquito sale in the Malheur NF.

The monitoring that the Forest Service is narrowly focused on parameters that miss the mark for actually looking for indicators of ecosystem response, or potential effects to wildlife, birds, water quality, riparian habitats, in stream habitats, etc. The primary threats and stressors to special-status and at-risk riparian and aquatic species on National Forests in eastern Oregon are logging, roads, and livestock grazing. These activities result in increased fine sediment inputs to streams, warming stream temperature, increased diurnal stream temperature fluctuations, stream bank instability, soil compaction and erosion, fish passage barriers, and other widespread problems.

Logging increases surface runoff and overland flow, which delivers warmer water and excess sediments into streams quickly, and can alter peak flows and increase stream temperatures. In addition, increased surface runoff and faster delivery of water into streams also means that less water becomes groundwater. This decreases groundwater storage, groundwater flows, and hyporheic flows. (Coutant 1999; Croke and Hairsine 2006; Jones and Grant 1996). Protecting groundwater storage, groundwater flows, and hyporheic flows associated with intermittent streams is crucial for protecting temperatures in larger downstream perennial streams. Cold water inputs from intermittent streams to downstream reaches are essential providing cold water refugia for special-status and imperiled aquatic organisms, including ESA-listed fish (Caissie, 2006; Ebersole et al. 2015; Groom 2011; Groom 2011; Jones and Grant, 1996; Pollock et al. 2009). Patches of cold water refugia are crucial for fish. Shallow groundwater patterns can be important for influencing stream temperatures, (Poole et al. 2008) and so are likely vulnerable to upslope logging (Caissie 2006). In research in eastern Oregon, Ebersole 2015 found that dry streams supplied cold water to downstream reaches at confluence sites. Such cold water refugia habitats are important for fish, which were observed at these locations.

Logging, including upland logging, can cause decreases in summer baseflows in the long-term. Decreased canopy cover due to logging can cause more snow to accumulate in these more open areas, which alters the timing and magnitude of runoff from snow melt. This can also cause changes to peak flows (Harr and Coffin 1992). Should proposed logging be implemented, it would create more open canopies, which will then increase solar radiation inputs, and as a result may increase the amount of early snow melt. This, in turn, may further alter peak flows and groundwater recharge and the hyporheic cold water delivery downstream, including to perennial streams. (Caissie 2006; Harr and Coffin 1992).

Logging also alters microclimates, creating hotter, drier, and windier conditions that stretch beyond forests directly affected and into adjacent forests, sometimes for distances of hundreds of feet. Such microclimate edge affects could extend into the entirety of riparian buffers, especially in smaller headwater streams. (Chen et al. 1992; Chen et al. 1995; Brosofske et al. 1999)

Given the research done by Ebersole and others cited above, it is very likely that logging within RHCAs, including the agency's frequent proposals for no setback for small and intermittent streams and violations of PACFISH/INFISH requirements, and is likely to threaten the cold-water temperatures and refugia in streams that are important for ESA-listed and sensitive Bull trout, salmonids, and other aquatic species.

Stream temperatures:

Logging within RHCAs has well-documented and negative effects on stream temperatures, including increased water temperatures. For example, 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. Pollock et al. 2009 found that stream temperature was more closely associated with degree of logging within catchments than with streamside vegetation.

Small streams are particularly vulnerable to increases in temperature, even with limited selective logging. There is evidence to suggest that ***wider*** buffer widths may be necessary to protect stream temperatures, particularly in intermittent and headwater streams, and particularly when logging within 100' of streams. Logging within RHCAs, removing shade, road-related impacts, and degrading hyporheic flow can increase stream temperatures in small intermittent streams. Parameters that influence stream temperatures include, stream shade, overland flow, groundwater and hyporheic flows, and groundwater storage. Alteration of these parameters can increase stream temperatures, especially in small streams. Logging alters these parameters, and degrades the ability of these parameters to support cold water, and is likely to increase stream temperatures. (Caissie 2006; Davies and Nelson 1994; DeWalle 2010; Kiffney et al. 2003; Groom et al. 2011 201; Jones et al. 2006; Sweeney 2013; Pollock et al. 2009; Wigington et al. 2006; Poole et al. 2008; Poole and Berman 2001; Ebersole et al. 2015).

Also, logging within RHCAs or forest wetlands can magnify water quality and hydrology impacts from upland logging. (Hicks et al. 1991; Moore and Wondzell 2005). Janisch et al. (2011 and 2012) and Buttle et al. (2009) found that wetlands associated with headwater and low order streams are more common and influential on stream hydrology and water quality than previously realized. Many of the wetlands associated with first order streams are small and fall below the size requirements for protection in relation to timber sales. Janisch et al.(2012) found streams in headwater catchments with wetlands had larger and more consistent increases in temperature in relation to adjacent logging than did the catchments that did not contain wetlands. The authors found that in streams with wetlands present in their catchments tended to have streams with finer sediments in their substrates.

Even in situations where logging within RHCAs is limited to thinning of smaller diameter trees, logging may compromise the ability of the RHCA buffer to protect streams or ameliorate the negative impacts from upland logging, including increased stream temperatures and the delivery of sediment and nutrients into waterways.

Watershed hydrology and excess fine sediments:

Logging often increases surface runoff and overland flow, potentially delivering warmer water (and excess sediments) into streams more quickly and with a greater volume. This, in turn, can also cause erosion and alter stream morphology, and potentially affect stream temperatures.

In their final decisions on timber sales, the Forest Service regularly ignores decades of scientific consensus, research, and expert opinion regarding riparian buffers, including their own. For example, the FS noted that: "[r]esearch has shown that effective vegetated filter strips need to be at least 200 to 300 feet wide to effectively capture sediment mobilizing by overland flow from outside the riparian management area" (Draft Blue Mountains Forest Plan Revision vol. 2 pg. 52). The FS is clearly not adhering to the requirements or the intent of PACFISH/INFISH in the Baker City Project. The FS regularly ignores ample and well-documented evidence regarding the negative impacts logging and associated activities have on RMOs such as stream temperatures, fine sediments, LWD, pool frequency, and others, as well as peak and base flows, watershed hydrology, and other parameters.

Roads outside of RHCAs can also harm stream water quality. Road networks act as artificial stream channels, greatly increasing the magnitude and timing of peak flows and potentially carrying sediment into streams. Transport can occur through a variety of mechanisms, including roadside ditches, culverts, erosion, and gullies. Small and large landslides increase in frequency in association with roads, providing another mechanism by which fine sediments can be carried into streams—even if these roads and events occur outside of RHCAs. Further, the Forest Service admits that it does not have funding in place to repair fish barriers.

For example, the Tiger-Mill Scoping Notice of Proposed Action does a more transparent job of acknowledging the complex nature of these dynamics: *"Depending on the nature, extent and timing of disturbances, changes in vegetative structure can reduce rainfall interception, water infiltration, and evapotranspiration, which can increase the amount of surface runoff and streamflow, respectively, and can also alter the timing of that flow. Increases in runoff and streamflow can lead to a decrease in water quality from non-point source pollutants through increased nutrient and sediment loads because hillslope erosion transported into streams, as well as increased streambank and streambed scour."*

Similarly, from the Upper Touchet Hydrology Report: *"The relationship between created openings in forested landscapes and changes in water yield and peak flows has been documented by numerous studies. Changes in forested stand and canopy density caused by harvest, fire, or insect and disease can change the distribution of the snow pack, increase the rate of melt of the snow pack, and cause the timing of the melt to be earlier. These factors may lead to changes in peakflows. In addition, reduction of stocking density reduces the overall vegetative use of water, increasing the amount of water available for runoff. Changes in water yield and in peak flows have the potential to destabilize channels, causing increased erosion and* *sedimentation in channels. Changes in these parameters would be of concern for aquatic habitat and biota, downstream water users, and for channel morphology."*

The Mill Creek DEA: *"Equivalent Harvest Area (EHA) Water yield is particularly affected by changes in the water budget, which includes changes to precipitation, evaporation, and transpiration from vegetation, infiltration, and runoff. Changes in water yield can influence bank erosion, stream temperatures, stream form, and habitat for fish. Resulting channel incision can reduce connection to floodplains and therefore reduce potential water retention across a valley section. EHA is an assessment required by the Ochoco National Forest Land and Resource Management Plan (Forest Plan) to determine the effects to peak flow from timber harvest activities and forest vegetative Mill Creek Dry Forest Restoration, Watershed and Fisheries Effects Analysis 3 conditions within a watershed. EHA is based on the principle that removing vegetation changes hydrologic response characteristics such as runoff, overland flow, peak flow, snow accumulation, timing, and total water yield. Excessive changes in these hydrologic response characteristics can lead to poor riparian conditions such as erosion, lateral scour, channel degradation, aggradation and/or incision resulting in poor water quality."*

Excess fine sediments generated by road related erosion or harvest related soil compaction may be carried farther across the landscape because of decreases in water infiltration or runoff rates over damaged soils, which in turn can cause an increase in the distance of overland flow transporting the sediments. Thus, the sediments generated by management activity can reach streams (Croke and Hairsine 2006, Nietch et al. 2005, Wemple et al. 2000). In addition, improper road drainage can cause gullies, landslides, and other erosional features, which in turn lead to sediment generation, increased runoff, and more direct and rapid transport of runoff and sediment to streams (Croke and Hairsine 2006, Wemple et al. 2000). Furthermore, the distance of travel required for sediments to enter streams may be shortened by the artificial extension of stream networks by roads and culverts (Croke and Hairsine 2006, Wemple et al. 1996). Increases in the efficiency of delivery of water and sediment to streams due to road networks and changes to soil infiltration and groundwater inputs can affect the timing, magnitude, duration, and frequency of sediment inputs. Roads increase peak flows by intercepting surface and subsurface flow, and diverting it into culverts and ditches that drain into streams (Wemple et al. 1996). Instream sediment dynamics such as timing and placement of fine sediment deposition, embeddedness, and scour are affected by stream power and flow regimes (Moore and Wondzell 2005, Wood and Armitage 1997).

Studies have found selective logging may be associated with increases of instream fine sediments (Kreutzweiser et al. 2005, Miserendino and Masi 2010). Upslope logging, particularly on steep slopes above streams, can increase fine sediment inputs into streams, contribute to stream temperature increases, cause increased variability in water quality and aquatic habitat parameters, and alter stream morphology and watershed hydrology. Additionally, logging on thin soils, ash soils, and rain-on-snow zones greatly increase the risk of soil damage, erosion, and excess fine sediments in streams. Zhang et al (2009) found long-term impacts to macroinvertebrate communities and streambed substrates. These impacts lasted for up to 40 years due to excess fine sediments associated with logging. Effects, such as changes to sediment loading and stream morphology, may not show up for many years after logging. (Beechie 2001; Beechie et al. 2005; Benda and Dunne 1997; Kelsey 1982; Madej and Ozaki 1996).

Ashy soils typically hold more moisture than sandy or poor soils. As a result, they are often associated with mixed-conifer forests. Because RHCAs, steep slopes, and mixed-conifer forests on ashy soils are targeted for logging, and would be at risk of soil damage, compaction, and displacement, should this proposal be implemented. In a recent Forest Service timber sale, the Upper Touchet FEA (pg. 47) notes that the "[e]ffects of ashy soil displacement and compaction by ground-based and cable activities on soil productivity is immediate and will persist on the landscape for up to 20 years or more (Giest, 1989)." The Upper Touchet FEA states: *"Ashy soils have low bearing strength and are susceptible to increased soil displacement and compaction by logging activities. When non-mixed ashy soils are disturbed, erosion is greater due to fine* *particle size and lack of cohesiveness between ash particles. The FEA also notes that "[a]sh cap soils cover about 80 percent of all the units in the project area".*

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. 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. 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.

BMPs are largely subjective and voluntary, and it cannot be assumed that they will be implemented to their fullest possible extent. The protective measures intended by BMPs may or may not be applied in most situations, and lack any strong mechanism of enforcement. There is no guarantee or enforcement mechanism to ensure that they will be properly applies.

Large woody debris (LWD):

We are very concerned that logging, especially within RHCAs, will negatively affect the availability of future large wood recruitment for LWD in streams. Wood recruitment and delivery is a crucial cornerstone of ecological integrity for streams, essential for the viability of many native and ESA-listed aquatic species, and a driving force of recovery for stream morphology. Hyporheic flows and groundwater storage and movement depend in part on wood and future large wood recruitment, and are important for maintaining cold water in perennial streams. Groundwater movement and storage is interconnected with a number of complex watershed processes and forest components, and may be negatively impacted by soil compaction and other negative effects from logging.

Aquatic ecosystems include complex and interdependent interactions. The loss of snags and downed wood along streams negatively affects stream morphology, including pools. The reduction of smaller wood for streams, as well as future recruitment for these components, is already occurring through logging in many timber sales across the landscape.

It is important to highlight that small intermittent streams, as well as perennial streams, would also be negatively affected by logging and the loss of wood for streams, and that those effects are felt downstream. Small streams are crucial to maintaining cold water for downstream perennial waterways, and to creating and ensuring cold water refugia for fish. (Benda et al. 2005; Caissie 2006; Kaufmann and Faustin 2011)

Special status and at-risk fish and aquatic species:

The Forest Service manages much of the land that encompasses core and critical habitats for spawning and rearing for numerous listed fish species. Spawning and rearing habitat quality is a limiting factor in the continued viability of these species, due in part to the widespread problems with high stream temperatures and excess fine sediments across National Forests in eastern Oregon (Middle Fork IMW Working Group 2017).

High stream temperatures are already a limiting factor for at-risk and special status aquatic species in many areas. Threatened fish stocks are struggling due to high stream temperatures and increased fine sediments. Stream temperature increases, especially in areas that are already in violation of state and Forest Plan stream temperature standards, are especially dangerous to ESA-listed Threatened Bull trout and steelhead populations. The increased stream temperatures that result from the proposed logging and roading in timber sales across the region exacerbate the already dire situation for water quality and imperiled aquatic species across eastside Forests.

Even localized increases at the subwatershed or reach scale can jeopardize already ESA-listed fish—especially if the problem is repeated in multiple stream reaches across the landscape. At-risk aquatic species such as Bull trout are already suffering from fragmented and small populations. Creating additional negative impacts across the landscape as a result of logging extremely risky at best. Small and isolated populations make for fragile populations (that are subject to declines due to localized events, genetic drift, and other factors). Reiman 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 in cases where the management actions resulted in long-term benefits in later years. The negative effects on water quality parameters such as stream temperature from proposed logging within this sale and from ongoing logging throughout the region are already putting Bull trout and Steelhead at risk.

Logging may pose a greater risk to aquatic species than wildfire, even high-severity wildfire. For example, the USFS proposed Forest Plan Revision (2014) vol 2. pg 60 notes that Redband trout will recolonize a stream relatively rapidly after experiencing severe fire: ***"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".***

In addition, the Olson 2000 thesis noted: *"Gresswell (1999) notes that local extirpation of fishes is often patchy in the case of extensive high severity fires, and that recolonization is rapid."*

Logging in uplands and logging in riparian corridors pose clear and serious risks to imperiled and at-risk aquatic and riparian species. We are also extremely concerned that widespread upslope logging and roading activities will negatively affect imperiled aquatic species such as Bull trout.

Fish, amphibians, and macroinvertebrate communities may be negatively impacted by excess fine sediment inputs resulting from logging and roads (Bryce et al. 2010, Nietch et al. 2005). Increases in fine sediment loading can cause simplification of 6 complex habitats and channel structure either through settling on or scouring out the streambed (Cover et al. 2008, Nietch et al. 2005). As a result, habitats such as pools, riffles, and side channels required by stream organisms for egg laying, resting, hiding, and rearing of young may be degraded or eliminated (Bryce et al. 2010, USEPA 2006). In addition, excess fine sediment loading, particularly in combination with the alteration of flow regimes and hydrologic processes, may negatively impact stream channel stability, limit hyporheic exchange, and alter groundwater inputs, potentially degrading conditions for stream organisms by further increasing sediment loading, decreasing necessary physical habitat, and altering stream water volume which can affect temperature and dissolved oxygen, and limit resources (Croke and Hairsine 2006, Moore and Wondzell 2005, Nietch et al. 2005, USEPA 2006). Fine sediment inputs exceeding natural background levels may bury and smother fish and amphibian eggs or young, decrease dissolved oxygen (DO) levels, interfere with behaviors such as mating, feeding and predator avoidance, cause shifts in macroinvertebrate community structures, and increase macroinvertebrate drift rates (Bryce et al. 2010, Nietch et al. 2005, USEPA 2006). For example, Coho salmon egg survival and fry emergence were negatively correlated with embedded fines of greater than 10%. In addition, when fines exceeded 20%, average survival decreases dramatically (Cederholm 1980). Macroinvertebrate drift rates increased significantly when exposed to suspended sediment concentrations of 8 mg/L for 5 hours, though ephemeroptera and plecoptera drift more rapidly upon exposure to sediments compared to those not exposed to sediments. Some ephemeroptera species, when exposed to concentrations of suspended sediments greater than 29mg/L for 30 days, 7 will disappear entirely. Longer exposure durations and smaller particle sizes caused increased rates of drift (IDEQ 2003).

Dynamics between stream temperatures and sensitive aquatic species may be far more complex, and often more delicate, than agencies are taking into account—including for ESA-listed species. The study *Key findings for Stream Temperature Variability: Why It Matters To Salmon* by Steele and Beckman (2014) found that: *"Commonly used degree-day accumulation model is not sufficient to predict how organisms respond to stream temperatures. Changes in how the degree days are delivered have the potential to alter the timing of life history transitions in Chinook salmon and other organisms. Emerging from the gravel a few days earlier or later could directly affect their survival due to changes in available food resources, competition for feeding grounds, or strong currents".*

Also, evidence suggests that current BMPs and/or Project Design Criteria may not be sufficiently protective of sensitive aquatic species such as Bull trout. For example, the Fish and Wildlife Service Final Rule for Bull trout (Department of the Interior Fish and Wildlife Service 50 CFR part 17 2010) states that: *"Special management considerations or protection that may be needed include the implementation of best management practices specifically designed to reduce these impacts in streams with bull trout, particularly in spawning and rearing habitat. Such best management practices could require measures to ensure that road stream crossings do not impede fish migration or occur in or near spawning/rearing areas, or increase road surface drainage into streams."*

We are concerned that logging within RHCAs will negatively affect sensitive, at-risk, special-status, and imperiled riparian and aquatic species and their habitats, including Bull trout and Redband trout. We are also concerned about other at-risk, special-status aquatic species within timber sales. We are concerned that special-status aquatic species may be present but unrecognized in many sale areas, and thereby be affected by logging and associated activities.

The Forest Service must take responsibility for their part in the continued viability of fish that use key habitats on national forest lands, rather than downplaying and refusing to acknowledge the impacts from Forest Service Management, including logging, grazing, and roading. Logging on National Forests continues to cause ongoing negative affects to anadromous and resident fish populations that have important consequences for long-term trends and continued viability. Logging greatly exacerbates these negative impacts to ESA-listed species, harm ESA-listed aquatic and riparian species, jeopardize their recoveries, cause downward trends in their populations, result in local extirpations or extinctions, and losses of viability.

Climate change and aquatic resources:

Logging within RHCAs 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 serious 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.”*

Bull trout may lose over 90% of their habitat within the next 50 years due to increased stream temperatures as a result of climate change. Bull trout require very cold headwater streams for spawning, and so are likely to be disproportionately affected by stream temperature increases due to climate change. Recent projections of the loss of suitable habitat for bull trout in the Columbia Basin range from 22% to 92% (ISAB 2007). The US Fish and Wildlife Service notes that: “[g]lobal climate change threatens bull trout throughout its range in the coterminous United States…..With a warming climate, thermally suitable bull trout spawning and rearing areas are predicted to shrink during warm seasons, in some cases very dramatically, becoming even more isolated from one another under moderate climate change scenarios….Climate change will likely interact with other stressors, such as habitat loss and fragmentation; invasions of nonnative fish; diseases and parasites; predators and competitors; and flow alteration, rendering some current spawning, rearing, and migratory habitats marginal or wholly unsuitable.”

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 that are associated with LOS, mixed-conifer forests, denser forests, etc. 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.

The agency repeatedly fails to adequately consider the importance of carbon sequestration and storage, or to include the best available science on this issue. Intact, unmanaged forests sequester the most carbon. Logging is the largest source of carbon emissions in Oregon. (Law et al. 2018). The Forest Service fails to analyze how logging in sales across the region would further increase carbon emissions, or to consider alternatives that instead prioritize carbon sequestration. Reducing CO2 emissions is the most effective way to combat climate-driven wildfires—not more logging, which increases carbon emissions.

Roads:

There is overwhelming evidence based on peer-reviewed science, discussed throughout these comments, that logging, roading, and other activities proposed in the project harm water quality and imperiled aquatic species.

Road densities across the region are at levels recognized as harmful to water quality and to aquatic habitats, as well as to terrestrial and avian species that are sensitive to forest fragmentation and road-related disturbances. Note: “temporary” roads are not temporary, and the FS loses credibility and public trust every time the agency attempts to claim otherwise, despite evidence and common sense. ESA-listed fish and aquatic species continue to be jeopardized and face downward population trends as a result of high road densities across eastside forests. As a result, it is all the more important NOT to build or rebuild roads in the few areas that aren't already overburdened with a high density of roads, and to work to reduce road densities.

The bloated road networks on National Forests lands threaten the long-term viability of imperiled and ESA-listed fish such as MCR steelhead and Bull trout, and other imperiled or sensitive aquatic species. The Forest Service notes (USFS 2015) that "*[t]he most important road related environmental issue is the effects of roads on aquatic resources in general, and specifically Threatened, Endangered and Sensitive aquatic species (bull trout, mid-Columbia steelhead, and Columbia spotted frog).*"

Increased road densities have been correlated with low population levels and declines in bull trout and other aquatic species that rely on clean, cold waters (USFWS 2010). Of particular concern are roads that interact with stream channels. Such roads are likely to have disproportionately negative effects on water quality and sensitive fish (USFS 2018). Sedimentation from roads is known to be one of the largest contributors for degradation to water quality as well as a source of degradation to fish habitat and spawning areas. Roads in disrepair create safety issues and conflicts with protection for natural resources, especially for those such as water quality, aquatic species, and functioning wetland processes.

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."*

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 have implicated roads as a primary factor in altering watershed hydrology and/or declines in fish stocks, and 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; Carnefix and Frissell 2009; DellaSala et al. 2011; Frissell and Carnefix 2007; Rieman and Clayton 1997, Rieman et al. 2000, Thurow et al. 2001; Public Lands Initiative/Trout Unlimited 2004; Western Native Trout Campaign 2001; Quigley and Arbelbide 1997)

The effects of roads and stream sediments on stream integrity and aquatic habitats affect Bull trout, Steelhead, and other fish are well recognized. 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 also recognizes the ecological threats posed by roads to fish and water quality: *"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."*

The NOAA 5-Year Review of Snake River Salmonids notes the synergistic negative effects of both logging and roads occurring in watersheds: *"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.*"

Other National Forests acknowledge the risks that roads and high road densities have on fish and water quality, not only when limited to roads directly within the RHCAs. For example, in the Upper Touchet sale on the Umatilla NF, the FEA states: "Road density is used as an indicator of potential for affects to hydrologic function (extension of the stream network) and water quality (sediment delivery to surface waters). Stream crossings are used as an indicator of the degree of connectivity between the road system and the drainage network. To the degree that roads are connected to the drainage network the risk of road sediment reaching surface waters is increased, the drainage network is lengthened and the potential for precipitation to drain more quickly, with less residence time in the watershed is increased. Roads have the potential to intercept surface and subsurface water, reducing infiltration and increasing the delivery of water to channels. Roads which are hydrologically connected are a risk to water quality. Sedimentation may be increased by surface erosion from roads and the ability of road drainage to route sediment to channels."

Also from the Upper Touchet DEA: *"Roads have the potential to intercept surface and subsurface water, reducing infiltration and speeding the delivery of water to channels. Sedimentation may be increased by surface erosion from roads and the ability of road drainage to route sediment to channels. Road density alone does not indicate slope position, another critical factor. Valley bottom roads have the most direct effect on streams and riparian areas because of accelerated erosion and loss of streamside shade. Mid-slope roads intercept subsurface runoff, extend channel networks and accelerate erosion, and ridge top roads can influence watershed hydrology by channeling flow into small headwater swales, which may accelerate channel development. McCammon (1993) assigned three watershed risk classes based on road density (mi/mi2) to assess the potential of road impacts to adversely affecting hydrologic function and water quality: low (< 3), moderate (3.1-4.5) and high (> 4.5). The Upper North Fork Touchet SWS road density is 1.4 mi/mi2."*

Another example the USFS's Draft EA for the Mill Creek sale in the Ochoco NF*: "Roads are a major source of erosion and stream sedimentation on forested lands. Roads can increase erosion rates and turbidity three orders of magnitude greater than the undisturbed forest condition (Megahan 1974). Sediment eroded from the road prism can be delivered to a forest stream, resulting in increased turbidity, sediment loads, and degraded habitat for fish. Research has shown that roads have the greatest effect on erosion relative to other forest management practices (Megahan and King 2004)."*

We are also concerned about the massive amount of felling and logging of large trees as "danger" trees, and for construction of roads and haul related corridors for timber sales in the region. Felling of trees for "temporary" roads, skyline logging or cable-assisted corridors, and other similar actions may result in excessive and widespread logging of large trees. Allowing large trees to be sold in these circumstances incentivizes cutting them, and inappropriately sidesteps environmental analyses and public transparency. We have similar concerns about logging within fuel breaks and ember reduction zones. Will fuel breaks be treated similarly to roads or haul routes, and result in the felling of large trees in and adjacent to the fuel break?

BMBP's recent post-logging field surveys in Forests in Eastern Oregon, such as the Malheur NF, suggest that the felling of large and old trees in relation to hazard trees and clearing road beds, skid trails, haul corridors, etc. can be very extensive. The pictures below are of recent felling of large and mature or old Ponderosa pine trees, most of which were felled as "hazard" trees or for road, haul, skid trails, or cable corridors in the Big Mosquito and Camp Lick timber sales. Dozens of large mature and old Ponderosa pines were felled in the Big Mosquito sale. Logging in the Camp Lick sale has only just begun, and already BMBP found legacy Ponderosa pines felled as part of either "hazard" tree felling or "temporary" road and other road-related work. The FS confirmed that many of the trees depicted in the pictures below were sold at the mill.

Big Mosquito sale (Malheur NF)

Camp Lick sale in 2021 (Malheur NF)

The Forest Service often builds or rebuilds "temporary" roads (that have impacts for decades or centuries on the landscape), as well as rebuilds "existing temporary roads" to access logging units. Roads that the agency terms "temporary" are not in reality "temporary". This is made evident by the repeated re-use of 'existing roadbeds' and the use of 'existing disturbance areas' for creating roads with each new timber sale. The Forest Service continues to repeatedly re-use these areas of permanent disturbance on the landscape as roads in current timber sales (and the USFS regularly uses these roads as reasons for disqualifying areas for IRAs or Potential Wilderness). Yet the USFS repeatedly claims that these roads won't actually continue to exist beyond each new timber sale's completion. These roads remain as scars on the landscape and show signs of erosion, compaction, or other impacts for years if not decades to come. "Temporary" roads which were not decommissioned or recontoured are ubiquitous on the landscape. They are also not well-documented or monitored, and they are often not included in road density calculations.

Road densities that exceed standards are a regular problem in watersheds and across eastside forests. Existing road density in many areas of, for example, the Wallowa-Whitman 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 mile. The widespread, chronic negative impacts to watersheds and streams caused by the bloated, unsustainable, and badly managed road network across public lands must be addressed by the agency.

Furthermore, the Wallowa-Whitman National Forest has not yet completed Travel Planning as required by the 2005 Final Rule for Travel Management. The Wallowa-Whitman National Forest currently has existing road densities at levels that are recognized as threats to water quality, fish, and watershed health, and exceed Forest Plan standards for road density in many watersheds, including those designated for prioritizing the protection of water quality and fish. Wilderness and Roadless areas occupy a small percentage of National Forests in the Blue Mountains, and the excessive road density outside of these areas has serious and ongoing negative ecological consequences for the majority of watersheds on these forests. Wilderness areas, for example, occupy approximately 17.1 percent of the combined area of the Malheur and Wallowa Whitman National Forests, and only four percent of Oregon's total land area.

The bloated and sprawling road systems on National Forest lands, including the Malheur and Wallowa-Whitman National Forests, are fiscally burdensome as well as ecologically harmful. In discussing budget shortfalls, the Forest Service notes, for example, that on the Wallowa-Whitman National Forest, it would take approximately $64 million dollars to bring the entire road system back up to standard, and approximately $6.8 million dollars to keep it that way (US Forest Service (2015). Malheur National Forest Forest-Wide Travel Analysis. Pg. 28.)

Across Oregon and Washington, the USFS manages approximately 90,000 miles of roads. The agency notes that it is "a challenge to maintain all roads to proper safety and environmental standards to increased use, aging infrastructure, and decreasing budgets. Many roads, built between 1950 and 1990, have exceeded their designated lifespan and require costly repairs. Unmaintained roads and infrastructure can impact water quality and wildlife habitat, especially fish-bearing streams. Backlog maintenance projects top $1.2 billion, and funds available for road maintenance are only about 15% of what is needed to fully maintain the current road system." (US Forest Service. Webpage. Accessed at: https://www.fs.usda.gov/detail/r6/landmanagement/?cid=fseprd485439])

The Wallowa-Whitman has 4,633 miles of open roads and 4,486 miles of closed roads for a total of 9,119 miles of existing roads. One could drive from the northwestern tip of Washington state to the farthest northeastern tip of Maine, down to Miami, Florida, over to San Diego, California, and back up to the northwestern tip of Washington state, and still not have traveled as many road miles as are contained within the Wallowa-Whitman National Forests. The USFS notes that "of the 90,000 miles of Forest Service roads in Oregon and Washington, about 2/3 of those are currently open and maintained for both public and administrative uses." The USFS estimates that approximately 12% of the overall road network is "likely not needed", with many of these unneeded roads already being "closed or stored", and only about 20% or 2,000 miles being currently open to the public. (US Forest Service. Travel Analysis Report. Wallowa-Whitman National Forest. Table 3, page 19. Accessed online at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd486098.pdf)

We are also extremely concerned about road-related fish passage barriers, which are an enormous problem for fish across the region. True restoration would focus on issues such as culvert repair and other fish passage barrier removals.

A timber sale case: the Baker City Watershed sale in the Wallow Whitman National Forest:

The Baker City Watershed sale relies heavily on the Harley et al. 2020 study and, by extension, the Olson 2000 master's thesis, to justify commercial logging within Riparian Habitat Conservation Area buffers. These studies were based on fire scar analyses. The Forest Service claims that these studies show that low intensity frequent fire dominated the landscape, and so are planning to log and burn based on these assumptions.

In response to BMBP's draft EA comment that full RHCA buffers are needed to protect streams ecosystems and that the agency's attempt to lump forests in RHCAs with those in uplands for the purposes of logging is harmful and misguided—the Forest Service's response states: *"Thanks for the comment about RHCA management.....Baker City Watershed has a rich scientific history of dendroecological and fire reconstruction work that has been published and referenced in the analysis (Harley et al, 2020). These dry forests adapted with low severity fire and this disturbance has been disrupted by fire suppression and management is needed to make it resilient/resistant to climate change, droughts and wildfire for the high values of municipal water."*

However, in large and ecologically significant portions of the Baker City Watershed project area, including areas targeted for logging, the data from the scientific research that the agency references do *not* support the conclusion that these forests were all "dry" or that they all had low severity fire regimes. For example, data from the Olson 2000 master's thesis is accessible for public review along with the thesis, and these data tell a different story.

The Olson 2000 research mapped fire years for "every year there was clear evidence of fire scarring" (Olson 2000 Appendix E. pp. 181- 237), and show data from 1428 through 1972. In our review of the Olson 2000 maps, we note that there are substantial portions of the Baker City Watershed project area that had no evidence of any fire, including the headwaters/upper watersheds of Mill, Marble, and Salmon Creeks. These areas are currently targeted for logging, including extensive planned logging within RHCAs. However, the Olson fire maps show a distinct absence of fire, and so suggest that these areas have infrequent (and likely high severity) fire with long return intervals, and have been acting as fire refugia for centuries. Many of these areas appear to have never been logged or only very minimally logged, and some are within or adjacent to Inventoried Roadless Areas. These areas, if left unlogged, can serve as crucial climate refugia. Such forests provide important habitat for species that rely on mature and old forests, and dense and complex canopy forests, and will be instrumental for providing habitat and connectivity in a changing climate. These forests are also essential for providing clean, cold water. It would a tragedy to log these legacy forests that have provided fire refugia and crucial habitat for centuries.

We want to note some finer scale detail from those maps that we observed. ***Olson 2000 data shows <u>no evidence of fire</u> in the upper portions of Mill, Marble, and Salmon watersheds:***

- There appears to be no evidence of fire scars shown on the maps for the upper portions of high elevation watersheds such as the Mill, Marble, and Salmon watersheds. Also there looks to be little to no logging in at least a portion of these areas (see BMBP's field survey sheets), meaning these mature and old forests have likely been acting as fire refugia, perhaps since 1428 or before. The lack of fire scars suggests that these forests are likely to have experienced infrequent, high severity fires historically.
- The maps also show no evidence of fire for these more incised, steep watersheds between 1428-1529 (~100 years).
- Between 1529 and 1645, there are only isolated incidents of evidence of fire scars at single sites in these watersheds, with the exception of 1581 when there was a second location that had "probable" fire evidence. So, between 1428 and 1646 there was no evidence of more than one isolated small fire until 1646 for the three watersheds (~218 years), with the exception of the "probable" other single location.
- Mill Creek had only isolated evidence of fire scars at single sites, with two exceptions, one with 2 sites showing evidence and the other with five (in 1783 and the other in 1828, respectively). So, aside from single isolated locations showing evidence of fire scarring within Mill Creek, there was no evidence of fire in Mill Creek between 1428 and 1782 (352 years); between 1784 and 1827 (43 years); or between 1829 and 1972 (143 years).

Several of the locations in the Olson 2000 that show repeated fire included those along the mid and lower portions of Mill and Marble creeks appear to have very isolated and small-scale fire activity, possibly suggesting only extremely small fires such as those related to lighting strikes that burn less than one acre. I.e., it is likely that those locations are attracting repeated fire strikes at the same ridge tops and topographic high points.

We also note that the Harley et al. 2020 paper only sampled riparian plots at lower elevations in the Baker plots. The Harley et al. 2020 study notes: "At Dugout, we sampled riparian plots along the major streams throughout the extent of the upland plots. However, at Baker ***we only sampled riparian plots at low elevation along the major streams*** (below 1770 m) ***because visible fire scars did not occur at high elevations at this site."*** (Emphasis ours). Wouldn't those higher elevation sites with no apparent/visible fire scars indicate either fire refugia/no fire and/or stand replacement fire in those areas—contrary to how the agency has characterized them and based their plans for logging?

The Harley et al. 2020 paper goes on to state: "*All the riparian plots were installed more than 46 m and downslope from existing upland plots (range 49 - 939 m, mean = 316 m; Heyerdahl et al 2001)* ***where fire scars were visible on either lie or dead trees and within the riparian buffer.****"* (Emphasis ours). It would seem that the targeted selection of sampling plots within areas where both upland and riparian forests showed clear signs of fire scars potentially skew the results and/or bias the conclusions about widespread low intensity fire. I.e., if it was a randomized selection, would there not be more potential evidence for infrequent and high severity fires within the study area?

The only data collected in higher elevation riparian areas was from the Olson 2000 study, which—again--shows no evidence of fire in significant portions of higher elevation areas within the Baker City Watershed timber sale project area. The authors of the Harley paper stated that they left out possible sites in riparian areas at higher elevation because no visible fire scars were not present. Of course, this biases their findings towards detecting low severity fire regimes, because they left out the very areas that lacked fire scars which would suggest infrequent and/or high severity fires.

The Harley et al. 2020 study also states: "As elevation increases and terrain becomes more dissected at Baker, ***longer and more variable fire intervals also occurred. This is likely a result of forest composition changes related to both topography and elevational changes in temperature, as well as aspect controls***

on varying insolation levels (Olson 2000); Heyerdahl et al. 2001). ***When forests occur within interaction zones of climate and topography, such that riparian forests contain greater variety in vegetation composition relative to upslope forests, then fire intervals differ, suggesting that forest composition is important as landscape dissection increases.*** Compared with Dugout, ***riparian valleys at Baker are more incised and therefore receive less insolation, resulting in a north-facing slope and riparian forest composition that is more mesic compared with adjacent south-facing upslope forests.***" (Emphasis ours).

We note that the authors found longer and more variable fire intervals DESPITE sampling at only lower elevation locations along major streams.

In addition, an overwhelming majority of sample sites in both the Dugout and Baker locations are predominantly on south or west facing slopes. The predominance of south or west facing slopes in the Harley et al. 2020 paper study may also have skewed the results towards more frequent and lower intensity fire being more common in riparian forests (and similar to uplands). If one is looking for statistical differences between riparian and uplands—then predominately choosing sample sites most likely to burn more frequently may dampen any statistical signals one might have found with a more robust sampling protocol. Any possible statistical signal from a small sample size with this composition is likely to be muted or overwhelmed by the larger number of sites that are drier, at lower elevations, and have more gentle and open topography. This is especially the case as the Harley study has an extremely small proportion of sample sites in locations that would be more likely to be more moist and have longer fire intervals (i.e., north, northeast, or east facing slopes; higher elevations; and more incised valleys and gulches).

- The Baker study area plots have a total of 35 upland sites. Twenty of those appear to be primarily on south-facing slopes. Of the 15 sites that have more of a northern or eastern slope orientation, five appear to also include strong southern or western influences, as they are somewhat northwest or southeast facing. Of the 35 upslope sites in the Baker study area, only 10 appear to be clearly on slopes that have a strong north, northeast, or east orientation.

- In the Dugout study area, there appear to be a total of approximately 75 upland sites. Only 12 of those sites appear to be on slopes with strong and predominant north, northeastern, or eastern facing. Of these, four are on ridgetops.

- Riparian sites are almost entirely situated all on the larger order streams within the study area, which tend to be less incised and more open. Only eight suites were situated on smaller tributaries, and only one of these sites faces N/NE.

Figure from the Harley paper:

Eastern Oregon riparian versus upland fires Int. J. Wildland Fire 603

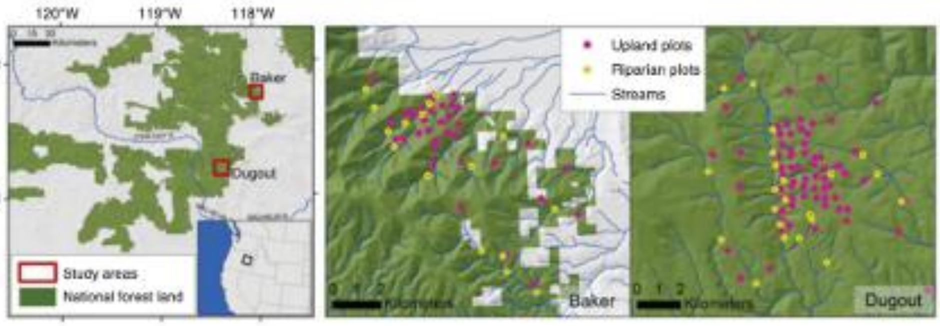


Fig. 1. Location of Baker and Dugout study areas and riparian and upland plots in the Blue Mountains of eastern Oregon, USA. Most of the riparian plots were sampled for this study and most of the upland plots were sampled for an existing study (Heyerdahl *et al.* 2001).

The Harley paper also states: *"[i]n the two study sites in the Blue Mountains of eastern Oregon during the period 1650–1900,* ***historical fires burned more frequently in upland forests compared with adjacent, downslope riparian forests.*** *However, the difference between riparian and upland fire intervals at both Baker (5 years) and Dugout (3 years) was not statistically significant (P . 0.10) and* ***likely not ecologically relevant."*** (Emphases added)

Lack of statistical significance does not necessarily mean lack of data patterns or trends. Lack of statistical significance can be due to a variety of factors, including small sample size. In this instance, the sample size for sites representing north/northeast facing sites was an even smaller proportion of an already small sample size, and seems to have constituted far less than half of the sample sites. While statistically significant differences were not found between upland and riparian forests, there was a clear trend pointing to a difference between the two-- even with the small data sets in this one study. Choices and/or limitations in statistical analyses can also mute variation and complexity, especially when working with small sample sizes, large elevation gradients, and other confounding factors. The Forest Service's conclusion that all the forests within the Baker City Watershed project area are dry forests with historically low intensity and frequent fire regimes contradicts the data trends-- including the reality of very long fire intervals in large portions of the project area, such as the higher and mid elevation portions.

The Harley et al. 2020 authors also dismissed any ecological importance in the data trend of more frequent fire in uplands compared to the riparian areas (see quote from Harley et al. 2020 above). However, the authors provide no evidence to support this claim, and do not attempt to substantiate their declaration that this very important data trend would lack ecological importance.

The Harley et al. 2020 paper notes that an average of five trees (range 2 - 9 trees) were sampled per hectare by removing fire-scared partial cross-sections. These cross sections were sanded and looked at with a microscope, and were used to assign calendar years to tree rings through cross dating and against existing ring-width chronologies. This small sample size of trees at each plot then means that the study's already small sample size in riparian forests, especially in the Baker location, is an even smaller sample size for areas most likely to have infrequent and/or stand replacement fire. If the smaller end of the sample range was present at the more northern/eastern slopes and/or in the higher elevations and more incised valleys– then this is potentially only a couple of handfuls of samples in these locations.

Also, evidence of fire at a specific location(s) does not necessarily mean that the fire was widespread, or part of a larger fire regime. For example, lightning strikes may result in only a very small area burning, sometimes even one to several trees. Lightning can and does tend to strike certain ridges and areas repeatedly, also an important factor to consider. In addition, a relatively few trees were sampled at any sample site, potentially leaving room for misinterpretation of fire scars. I.e., some small fires may have been from lightning strikes (not widespread low intensity fires). It could also be the case that some of these fire scars were the result of high severity fire mosaic patterns that include low intensity fire within the fire perimeter.

The Harley et al. 2020 authors also state that for smaller fire years that *"[s]maller fires were likely characterized by a mosaic of varied fuel dryness across the study area. Hence, fuel moisture levels may have varied enough within and between riparian forests and upslope forests, resulting in smaller fires and greater variations in burn severity."* This suggests that there was at least some mixed or high severity fire within riparian zones. High severity fire has specific dynamics and processes that are crucial for certain species and for the ecological integrity of forests that evolved with it. Managing the mixed-conifer forests-- especially those on north/northeast/east facing slopes and at higher elevations-- for a frequent and low-severity fire regime artificially homogenizes them, and degrades or entirely destroys the wildlife habitat and connectivity they provide, as well as greatly impairs their ability to support clean and cold water for fish and people.

The Baker City Watershed project's Watershed Report notes that "[m]ost of the project area (63 percent) was dominated by high frequency and low severity fires that occurred every 10 to 25 years (Harley et al, 2020)." However—what of the other 37 percent of the project area? This is over one-third of the landscape, with apparently infrequent and moderate and/or high severity fire—an issue the FS seems to be entirely ignoring.

The existing riparian data that the Forest Service discussed as "*a rich scientific history of dendroecological and fire reconstruction work that has been published and referenced in the analysis (Harley et al, 2020)"* are data from the Harley et al. 2020 study and the Olson 2000 master's thesis. The Heyerdahl et al. 2001 paper contained very few riparian sample sites. The Harley 2020 study states: *"Most of the riparian plots were sampled for this study and most of the upland plots were sampled for an existing study (Heyerdahl et al. 2001)."* The actual data from both the Olson and Harley studies suggest that the topographically and ecologically diverse areas within the Baker City Watershed project area are actually more varied in terms of fire intensity and frequency than the FS claims in the FEA. The statistical conclusions of the Harley et al. 2020 paper are based on analyses of sample sites that are more likely to have frequent and low severity fires (lower elevation, west and/or south facing locations, gentle and open topography, etc.). Areas with less frequent and higher intensity fire were sampled in only a handful of locations, or excluded entirely (as with higher elevation sites at Baker in the Harley paper). These sampling biases, as well as the lumping in of data from higher elevations, steep and incised valleys, and N/NE/E facing slopes with data from lower elevations, open topography, and S/SW/W facing slopes-- may have overwhelmed any possible statistical signals of variation, and skewed results towards overgeneralizations of frequent and low severity fire regimes. Lumping all forests in the area together as "*dry forests adapted with low severity fire"* reflects the agency's failure to take a hard look at the data, and the potential limitations of sampling, methodology, and analyses. The data from the Olson thesis fire maps clearly reflects very, very long fire return intervals (and/or stand replacement fire) in the upper and mid elevations of the project area.

As mentioned above, the Olson 2000 maps suggest that there are substantial portions of the Baker City Watershed project area that had no evidence of any fire, including in higher elevation areas such as the headwaters/upper watersheds of Mill, Marble, and Salmon Creeks. These areas are currently targeted for logging, including extensive planned logging within RHCAs. However, the Olson fire maps suggest that these areas have infrequent (and likely high severity) fire with long return intervals and have been acting as fire refugia for centuries. Many of these areas appear to have never been logged or only very minimally logged, and some are within or adjacent to Inventoried Roadless Areas.

A few specific examples include the riparian areas (RHCAs) adjacent to Goodrich Lake and Goodrich Creek, slated for DFPZ logging. These areas contain mature and old forests, road work that would negatively impact streams and forests if they are to be reopened, and are adjacent to Twin Mountains IRA. The agency is proposing to build numerous "temporary" roads directly adjacent to Little Marble Creek, and likely to negatively impact the creek and forest habitats. ("Temporary" are not temporary and the agency loses public trust attempting to claim otherwise). Further, the Baker City Watershed sale landslide risk maps show moderate landslide risk overlap with proposed logging adjacent to Goodrich Lake and Goodrich Creek (and within the Twin Mountain IRA); along Little Mill Creek (also within the Twin Mountain IRA); along Rock Creek (which supports Bull trout and is partly within Twin Mountain IRA); and skyline and ground based commercial logging within the RHCA along Little Marble Creek. There is a high landslide risk area along Rock Creek that overlaps with a steep skyline logging sale unit, directly above a section that supports Bull trout.

Given the landslide risks, we are extremely concerned about negative effects on water quality and stream ecosystems, if planned logging is implemented. Again, many of these areas show no evidence of fire, or only very infrequent and isolated fire, in the Olson 2000 fire maps. In addition, many of these areas have had no or minimal past logging. They are currently providing some of the only high-quality habitat and connectivity in the area, especially for species dependent on mature and old forests, particularly denser and multi-story forests. They have served as fire refugia for decades if not centuries, and, if allowed to, they will become crucial for species habitat and movement in a changing climate. They should not be logged.

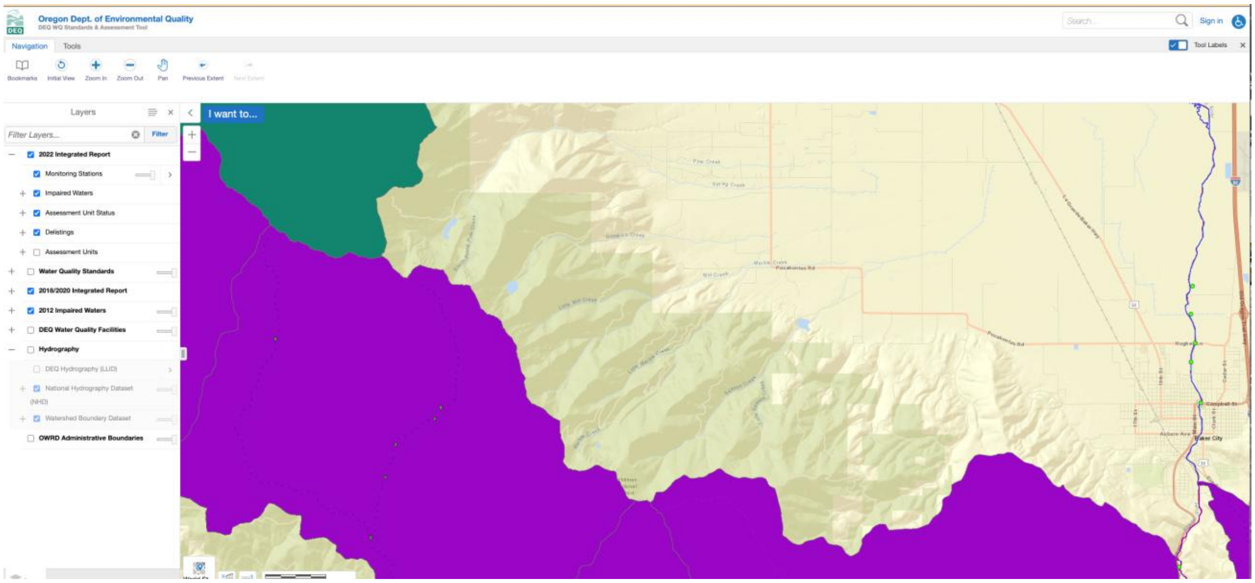
More from the Baker City Watershed timber sale case study: ODEQ and stream monitoring:

Baker City Watershed Report notes that: "Elk Creek and its watershed are the only waterbody listed as being 303(d) water quality impaired (DEQ, 2022) in the project." However, the Baker City Watershed analyses note that numerous streams within the project area are not meeting water quality standards. Normally, such violations would lead to these streams being listed on ODEQ's 303d list.

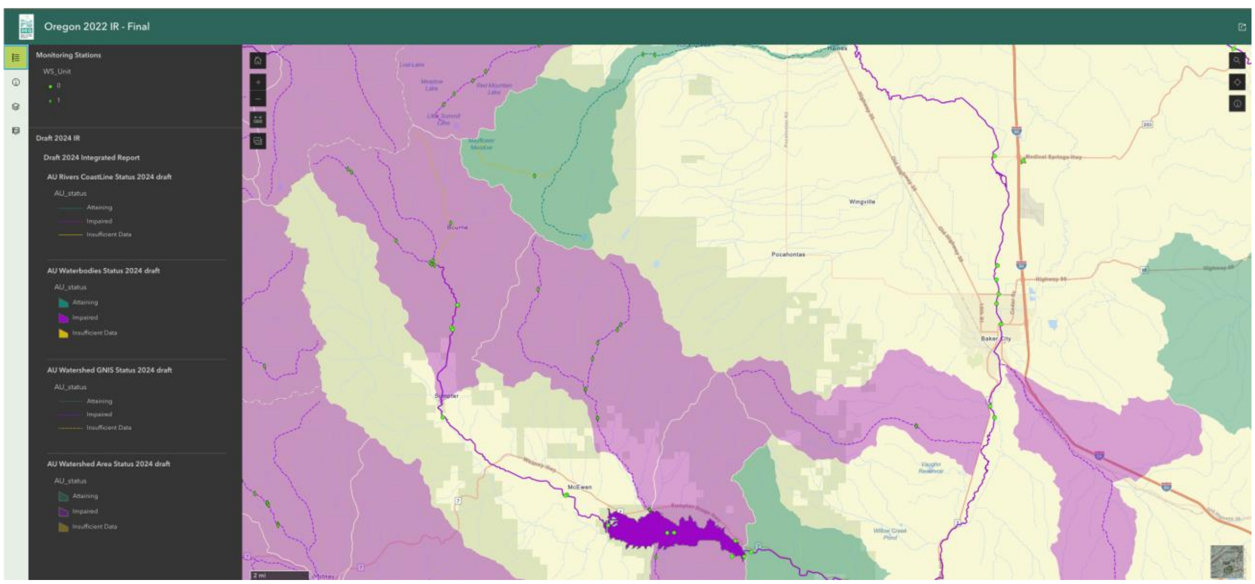
Has the Forest Service shared stream temperature data for creeks within the project area? Did the Forest Service share all of their stream temperature data for streams within the project area with ODEQ?

The Forest Service response to BMBP's questions on this issue stated that the "USFS sure does provide its water temperature data to DEQ as we update our regional database." The agency also noted that "[b]eing transparent and sharing our data with DEQ is important to us." However, we will note that "as we update our regional databases" is an entirely optional exercise, with no internal requirements within the Forest Service for staff to enter existing stream temperature data into the regional databases. Our through and extensive reviews of ODEQ's list of waterbodies that are either impaired or meeting water quality criteria have exactly zero information on the majority of the streams within the Baker City Watershed sale area, including streams that the agency has information about as reflected in the Aquatics Report. This includes Mill, Little Mill, Marble, Little Marble, Salmon, and others. It appears that, unfortunately, the Forest Service possesses water quality data for these streams—many of which are not meeting water quality standards—but has in fact *not* shared those data with ODEQ. Please clarify if we are incorrect about this issue.

Note the absence of any water quality information from streams within the project area on the ODEQ maps below—despite those maps reflecting data for surrounding watersheds.



https://hdcgcx2.deq.state.or.us/Html5Viewer211/?viewer=wqsa



https://geo.maps.arcgis.com/apps/instant/sidebar/index.html?appid=7d13b19e01a44f1dbfd12903576e6d29

According to the Decision Notice (pg. 35), 13 out of 22 stream monitoring sites (just over half of monitoring sites) are meeting ODEQ temperature criteria in the project area. "Based on recent stream temperature monitoring, most of the streams (13 of 22 sites) are meeting the DEQ temperature criteria throughout the project area (see Table 10)……The uppermost site in California Gulch did not meet water temperature standards. Lower reaches of Marble, Little Marble, Salmon, Little Salmon, and some of the sites in the middle sections of Elk Creek exceeded temperature standards (see Table 10). Of these sites, Little Marble, Marble, Salmon, Little Salmon were very close to the water temperature standard, within one degree of the 7DADM. Little Mill had a 7DADM that exceeded the standard by 1.4 ºC, California Gulch's headwaters exceeded by 4.7ºC and Elk exceeded by 4.3ºC." The Decision Notice goes on to state that "California Gulch had the upper site that was warmer and the probe was likely placed in a water column that did not have much groundwater or surface water inputs and was impacted by the summer air temperatures. The sampling for Elk Creek was from 1996 data collection efforts and had very different max temperature charts compared with the 2020 measurement, suggesting this data was collected prior to the use of solar shields. The Draft EA also noted that “California Gulch would likely have heightened water temperatures because of past mining and impacts associated with the lack of proper reclamation. Exceedances that were observed in 2020 in Little Mill, Marble, Little Marble, Salmon and Little Salmon Creeks may continue to have exceedances in years with low snowpack and early season increases on air temperature.”

When streams are impaired and, as a consequence, included on the 303d list—the agency is then required to ensure that actions such as logging and road-related activities do not raise stream temperatures by more than 0.1 degree Celsius. However, if the FS has not shared stream temperature data with ODEQ then the USFS is improperly sidestepping such requirements, and sidestepping key regulatory oversight as well as the creation of TMDLs and restoration plans to bring streams back into compliance with CWA standards.

We are concerned that the Forest Service has repeatedly and systematically failed to share water quality data with ODEQ. Until BMBP wrote letters to Forest Supervisors and ODEQ staff calling attention to this issue in 2018, the National Forests in eastern Oregon had not shared the vast majority of their water quality data with ODEQ for over a decade. After we highlighted this issue during the last ODEQ ‘call for data’ in 2018, the Forest Service shared large amounts of data with ODEQ, finally. However, based on stream temperature data that BMBP received through FOIA, the Forest Service still has not provided ODEQ with existing stream temperature data for many streams, including streams in violation of water quality standards.

The Forest Service has a legal responsibility to uphold state water quality standards on the federal lands they manage. Their directives include adhering to ‘adaptive management’ practices. We are very concerned that the USFS is not upholding water quality standards and not adequately tracking or sharing the results of their water quality monitoring with the public or ODEQ, and that they have failed to create a framework for adaptive management. For example, the Forest Service lacks data or evidence showing that recent logging activity and current logging proposals will not adversely affect or further degrade water quality, including in streams that are already in violation of state water quality standards for temperature or sediment. The USFS, despite our persistent inquiries, has not been able to provide us with examples of or data from any upstream/downstream and before/after monitoring from logging projects in priority watersheds, including logging projects taking place within Riparian Habitat Conservation Areas. It seems that there *may* have been one or two projects that might have had such a targeted monitoring design, but the USFS has not been able to provide us with a location, name of stream, or any data. None of the dozens of USFS staff or specialists I’ve talked with have been able to say for sure if such monitoring has taken place, or tell me a location or stream where it will take place in the near future. The USFS does conduct subwatershed and watershed scale water temperature monitoring—these monitoring data often reflect high stream temperatures that are in violation of state water quality standards. The necessary follow-up work to figure out what is causing these widespread water quality issues and violations is lacking.

Monitoring and accurate inclusion of water quality data into Oregon’s Integrated Database are key components for ensuring that water quality standards are being upheld, and for protecting the viability of aquatic species, including ESA-listed species. Given the widespread logging on public lands across eastern Oregon, including the increasingly common practices of commercial and non-commercial logging within streamside RHCAs, inclusion of accurate water quality data in ODEQ’s Integrated database is key for examining and assessing landscape scale data and for implementing adaptive management strategies.

In addition, we are concerned that the USFS is increasingly attempting to use streamside shade as a proxy for attainment of stream temperature standards. However, one has only to look briefly at NEPA documents to understand that data on the percent of shade in a streamside corridor is a poor substitution for water temperature data. For example, in the Aquatics Report of the Camp Lick timber sale on the Malheur National Forest, 25 out of the 31 stream reaches that the USFS surveyed for shade met fish habitat objectives. Yet, only 6 out of 25 of the reaches with stream temperature data met the USFS's fish habitat objectives in those streams (Camp Lick Aquatics Report pages 17-19). Clearly, using stream shade as a proxy for stream temperature in these eastside forests is not appropriate. While we understand that stream shade is an important driver of water temperatures, it is not the only one. Many factors influence stream temperatures, as we've discussed and provided scientific references for in numerous portions of these comments.

The Forest Service's reponse to BMBP's comments on this issue was as follows: "What is neat about NEPA is that each project area is very different and the existing conditions help specialists paint the existing and desired conditions. Camp/Lick has abundant non-forest low gradient riparian areas that were incised, lacked the historic riparian vegetation, lacked beaver, had many miles of railroad grade and the stream was a large heat sink that negatively influenced water temperature patterns. Shade was very low on those reaches, but was high in the tributaries where stream temperatures were not as far departed from state standards. In the Baker City Watershed, these streams do not have non-forest low gradient areas, other than Elk Creek that has limited RHCA thinning."

The Forest Service has entirely missed the point that shade is often not a reliable predictor of stream temperature. The streams in Camp Lick where these data were collected were well shaded, including upstream through to headwater areas. These streams would not have met shade standards if they lacked riparian vegetation. Very similar examples/issues exist showing that shade standards can be reliably met while and stream temperatures standards are NOT met, in additional examples such as the Ragged Ruby and Big Mosquito sales. Similarly to Camp Lick, it sounds like issues such as mining piles and ground disturbance is a widespread issue in the Baker City Watershed sale. The Forest Service continuing to use shade as a surrogate for water temperature is a risky strategy that threatens to miss the widespread issues with excessively high stream temperatures that are generally present throughout National Forests in the Blue Mountains.

The Baker City Watershed analyses do not give clear data summaries of the USFS's available data. For example, are there additional water temperature data from recent years? Do they reflect higher temperatures than the years that were included for public review?

The Baker City Watershed timber sale case study, continued:

The FEA effects determinations for Bull trout and Bull trout critical habitat are *"Not Likely to Adversely Affect" and No Effect. The Aquatics Report notes that "Bull trout occupy approximately 2.18 miles of habitat within the project area, which represents approximately 0.3 percent of available habitat on the Wallowa Whitman National Forest."* What is the cumulative impact with other past, current, and foreseeable sales and other management activities on available habitat for Bull trout across the WWNF? Across the Blue Mountains? While this project may affect a small percent of available Bull trout habitat across the Forest, what is the sum of all the recent, current, and reasonably foreseeable projects across the Forest?

The effects determination for Redband trout is "May Impact Individuals or Habitat". The Decision Notice (pg. 48) states: *"Because both action alternatives impact less than 1% of suitable redband trout habitat in relation to the distribution throughout the Wallowa Whitman National Forest, the overall direct, indirect, and cumulative effects would result in a small negative trend of habitat in the short term. The effect on habitat would be insignificant at the scale of the Forest. As such, the implementation of the project may impact individuals or habitat but would not likely contribute toward federal listing or cause a loss of* *viability to the population or species at the Forest scale. Over the long term, proposed actions would result in a beneficial impact in habitat conditions for redband trout in the project area."*

Again, the Forest Service is ignoring the cumulative impacts of this combined with other projects on Bull trout habitat across the Forest. The agency is disingenuously using an improper scale of analysis, and then not bothering to even look at the actual cumulative impacts within the scale they have chosen.

In the Forest Service's response to BMBP's comments, the agency states that *"[a]ccording to the Forest Service Manual, cumulative effects determinations are to be done at the project level scale. Therefore, the cumulative effects found on page 37 only focus on effects in the same spatial area as the effects of the project.* ***Viability determinations for a species do occur at the Forest level.*** *.....The short-term impact to less than 1% of suitable redband trout habitat on the Wallowa Whitman would be insignificant at the scale of the Forest."*

If viability is determined at the scale of the Forest, how can the agency expect to make such a determination if they utterly fail to look at other projects affecting viability at the scale of the Forest?

What about the cumulative effects for other special status, imperiled, and at-risk species in the project area—do they all have similar lack of cumulative analyses?

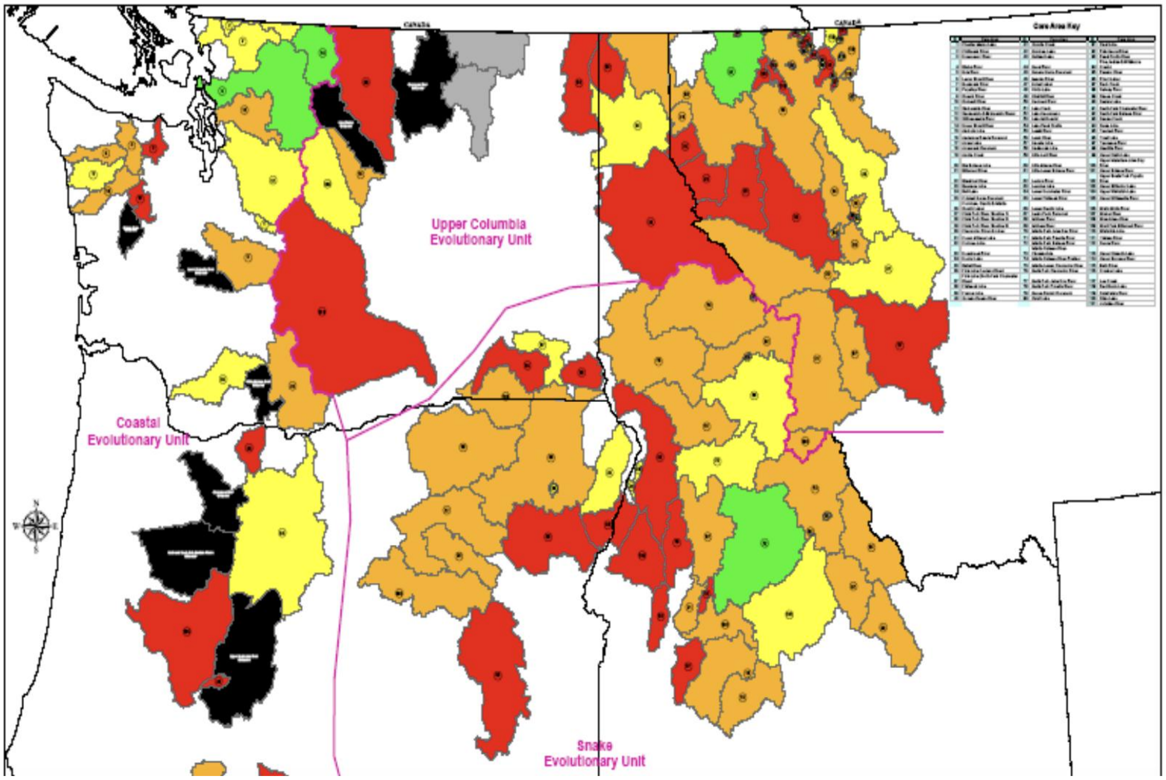
The Aquatics Report also notes: *"Redband trout are present in all fish bearing streams in the aquatic project area (Figure 2), however their population abundance is unknown."* The lack of baseline data is a serious issue for Redband trout and other species in the project area. Adaptive management is impossible without adequate baseline data.

We also note that for some streams, such as Mill Creek, there is a lack of sufficient baseline data for Bull trout populations. The Aquatics Report note: *"The population size of bull trout within the Mill Creek tributary is unknown as evidence of their presence has only been made through eDNA and no individuals have been observed."*We are very concerned that the Baker City Watershed sale will cause downward population trends for Bull trout, and threaten their continued.

USFWS has characterized Bull trout populations within the Baker City Watershed project are characterized as at high risk (see figure below). Even in areas with comparatively high numbers, current population numbers are still low when compared to historic norms and to numbers needed for successful recovery. The USFWS 2010 Bull Trout Final Rule notes that "Over 30 years of research into wildlife population sizes required for long-term viability (avoiding extinction) suggests that a minimum number of 5,000 individuals (rather than 50 or 500) may be needed in light of rapidly changing environmental conditions, such as accelerated climate change (Traill *et al.* 2009, p. 3)."

Figure below from the USFWS 2008 Bull Trout 5-yr Review: Summary and Evaluation:

Figure 5. Map of Core Areas by Risk Category (red=high risk; orange=at risk; yellow=potential risk; green=low risk; gray=unknown risk; black=likely extirpated).



Additional discussion on forest ecology, wildfire, logging, and prescribed burning:

Several studies suggests that numerous species are more negatively affected by thinning than by wildfire. Example include Olive-sided flycatchers, lynx, Pacific fisher, Spotted owls, flying squirrels, and other species. 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."

The Forest Service claims that Douglas and 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.

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:

> *"There is widespread concern that fire exclusion has led to an unprecedented threat of uncharacteristically severe fires in ponderosa pine (Pinus ponderosa Dougl. ex. Laws) and mixed-conifer forests of western North America. These extensive montane forests are considered to be adapted to a low/moderate-severity fire regime that maintained stands of relatively old trees.* ***However, there is increasing recognition from landscape-scale assessments that, prior to any significant effects of fire exclusion, fires and forest structure were more variable in these forests. Biota in these forests are also dependent on the resources made available by higher-severity fire."***

They also noted: *"... most forests appear to have been characterized by mixed-severity fire that included ecologically significant amounts of weather-driven, high-severity fire."*

> *"....paleoecological studies also support mixed-severity fire regimes for the ponderosa pine and mixed-conifer forests. These studies have found charcoal depositions from major fire episodes in ponderosa pine and interior Douglas-fir forests occurring for millennia in the northern Rockies (central Idaho: [100,101]), Klamath [102], Sierra Nevada [103], eastern Oregon Cascades [104], and southwestern USA [105–107*]. ***These major episodes are generally interpreted as large, severe fire events [101– 107].***
>
> ***"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"***
>
> *"The majority of the evidence did not support the low/moderate-severity fire hypothesis, but, instead, supported the alternate hypothesis that mixed-severity fire shaped these forest landscapes. This finding applies to Pacific states ponderosa pine, Jeffrey pine, and California mixed-conifer*

forests, as well as ponderosa pine and mixed-conifer forests in the eastern Cascades, Rockies and southwestern USA, where low/moderate-severity regimes have often been applied."

"In addition, patch sizes of high severity fire in the central Rockies have not increased [58]. Our assessment of high-severity rotations based upon existing literature also revealed a generally lower incidence of high-severity fire in these forests in recent decades…"

"Based on direct observations of fire behavior, high winds (generally 10 m open wind speeds .32–35 kilometers/hr) may subject virtually any conifer forest, regardless of fuel density, to crown fire [108]. Thus, empirical data call into question a major premise of the low/moderate-severity fire regime: that ponderosa pine and mixed-conifer forests may be completely resistant to crown fire. Fire intensity increases with winds, and at winds of .30 km/hr spot fires may be ignited over 1 km ahead of the fire front [109]. The coalescing of separate spot fires with the fire front can further energize wind-driven fire [110,111]. Severe droughts also intensify fires by reducing fuel moisture to extremely low levels, allowing crown fire under less windy conditions [108,112]. Severe drought years throughout much of western North America occurred from 1856 to 1865, 1870 to 1877 and 1890 to 1896 [113]. The extensive high-severity fires of 1910 (the Big Burn in Idaho and Montana), when large areas of drier forests burned at high severity prior to fire exclusion–much of it in ponderosa pine–illustrate how fire behavior that is rare temporally due to extreme climate and weather can dominate in space [1]. Many fire episodes in the charcoal records that exceed modern fires undoubtedly involve combinations of extreme wind, drought, and mass fire."

"The importance of multiple lines of evidence has been stressed in determining whether mixed-severity fire regimes applied historically [122]. ***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"***

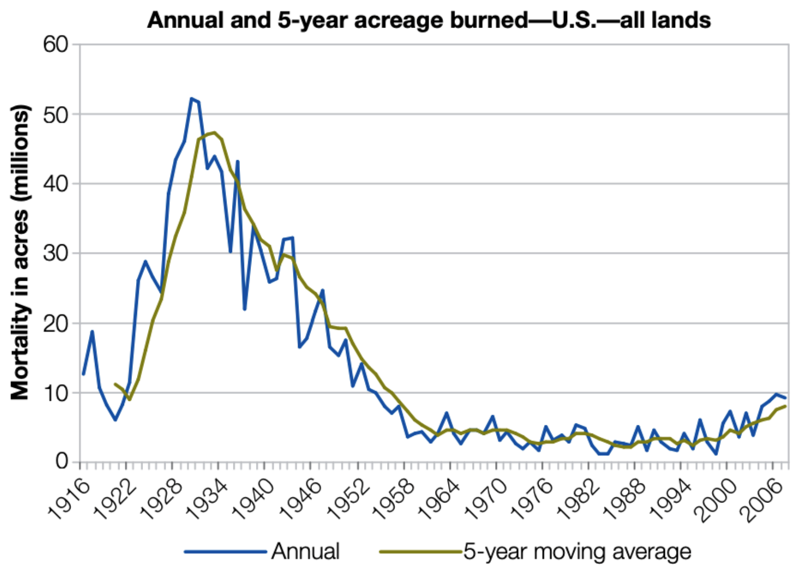
"To improve clarity in communication, we propose that ''low/ moderate-severity'' be applied to those regimes where, as the term implies, high-severity fire is absent. These circumstances appear to be quite rare in the ponderosa pine and mixed-conifer forests of western North America. Therefore, a fire regime with a high-severity component of any amount should not be classified as low/moderate-severity"

"Our findings suggest a need to recognize mixed-severity fire regimes (Table 2) as the predominant fire regime for most of the ponderosa pine and mixed-conifer forests of western North America"

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.

In addition, data from the USFS National Report on Sustainable Forests (2010) shows that fire extent was much more prevalent historically across the US. (However, this is likely to change or be changing in the era of large, climate change driven fires):

Figure 16-1. Total acreage burned.



Source: USDA Forest Service, Forest Health Protection

In addition, Hessberg et al. (2007) found that historically mixed-conifer forests were dominated by dense forests. Many of the mixed conifer forests in the region 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.

High intensity wildfires produce unique ecological conditions compared to low intensity fires. High intensity fires are historically natural, and unique, and are integral to the biodiversity of flora and fauna in the region. Favoring lower severity fires across the region in management activities may create unnatural ecological situations that are deleterious to the wildlife, ecological processes, and biodiversity of the area. An example of the importance of post-fire areas occurring after high intensity fires include the findings of Donato et al. (2008):

- *"[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."

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). Their research has 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 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). Palaeoecological 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."

Independent science related to Forest Service rationales of fire management for current logging practices:

The Forest Service claims that Douglas and 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.

A 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. riparian corridors 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 investigated the relationship between protected status and fire severity using the Random Forests algorithm applied to 1500 fires affecting 9.5 million hectares between 1984 and 2014 in pine (Pinus ponderosa, Pinus jeffreyi) and mixed-conifer forests of western United States, accounting for key topographic and climate variables.* ***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."***

In addition, recent research suggests that Grand fir forests are more fire resistant than generally assumed by the agency. Moris et al. 2022 found:

> *"The grand fir forest type had severity values at the same level of forest types dominated by fire-resister species despite grand fir was classified as a fire-avoider species. ... In many ponderosa pine forests maintained historically by a high frequency, low-severity fire regime, the transition towards denser forests dominated by Douglas-fir and grand fir would explain why ponderosa pine and Douglas-fir still compose a significant proportion of basal area in the grand fir forest type, and many maintain large, old, fire-resistant ponderosa pine trees (Johnston et al. 2021; Merschel et al. 2021). Therefore, the particular structure and composition of these "recent" grand fir forests (e.g., Merschel et al. 2014), with an important presence of large-diameter trees of fire-resistant species, may provide latent fire resistance (Larson et al. 2013)."*

We note that the Forest Service does not have a legal mandate to manage forests for historical range of variability (HRV) for tree species composition and structure. They are, however, responsible for ensuring the viability of the full compliment of native species, as well as species such as Bull trout and other ESA-listed species. We are very concerned that the FS is myopically focused on shifting tree species composition and structure, rather than on protecting values such as native species and water quality. We are concerned about issues such as the likely loss of snags, downed wood, and other key wildlife habitat. We are also concerned that the FS's answer to native diseases or pests that serve ecological functions is ecologically destructive logging (i.e., in relation to mistletoe, laminated root rot, native bark beetles, etc.).

Further, we are very concerned that the FS has systematically overlooked evidence that mixed-severity fire regimes are more widespread than generally acknowledged by the agency. For example, Baker et al. 2023 discuss in their abstract:

> *"The structure and fire regime of pre-industrial (historical) dry forests over ~26 million ha of the western USA is of growing importance because wildfires are increasing and spilling over into communities. Management is guided by current conditions relative to the historical range of variability (HRV). Two models of HRV, with different implications, have been debated since the 1990s in a complex series of papers, replies, and rebuttals. The "low-severity" model is that dry forests were relatively uniform, low in tree density, and dominated by low- to moderate-severity fires; the "mixed-severity" model is that dry forests were heterogeneous, with both low and high tree densities and a mixture of fire severities. Here, we simply rebut evidence in the low-severity model's latest review, including its 37 critiques of the mixed-severity model. A central finding of high-severity fire recently exceeding its historical rates was not supported by evidence in the review itself. A large body of published evidence supporting the mixed-severity model was omitted. These included numerous direct observations by early scientists, early forest atlases, early newspaper accounts, early oblique and aerial photographs, seven paleo-charcoal reconstructions, ≥18 tree-ring reconstructions, 15 land survey reconstructions, and analysis of forest inventory data. Our rebuttal shows that evidence omitted in the review left a falsification of the scientific record, with significant land management implications. The low-severity model is rejected and mixed-severity model is supported by the corrected body of scientific evidence."*

Limitations of fire scar analysis in determining fire return intervals:

Much of the logging taking place in eastside forests is being justified by the Forest Service through claims that forests—including mixed conifer forests and those on steep slopes, at mid and high elevations, and adjacent to streams—burned more frequently and at lower severities than previously understood. There are a handful of studies that back up this claim, almost all using fire scar analyses.

We want to highlight that fire scar analysis has important limitations. We are concerned that some of the ecologically significant implications regarding the limitations with fire scar analyses are being ignored by the Forest Service—with potentially very unfortunate and negative ramifications. We are concerned that the fire scar analyses may be artificially inflating the frequency of fire regimes because small localized fires are overrepresented and/or conflated with fire return intervals (rather than recognized as often very localized, sometimes tiny events). For example, an isolated lighting strike that burns a handful of trees, sometimes repeatedly on the same ridge in different years, does not a fire return interval make.

Use of composite fire intervals tend to shorten the time between fires and give a false interpretation of the past fire history. For example, personal communications from George Wuerthner, in our communication regarding limitations of fire scar analyses used in research with similar methodology, include:

> *"Take a hypothetical situation: Let's say you have a 1000 acre study area. You note a fire someplace in that 1000 acres every single year over a hundred year period. However, for argument's sake, each of those fires burns less than a single acre. So you have a total of 100 fires and a fire interval of 1 year. I.e. the fire scar history suggests there is a fire every year. But because each fire is less than an acre, you have only burned 100 acres in a hundred years or only 10% of the 1000 acre study site. Even at a fire every year, it would require 1000 years to get to the fire rotation.*
>
> *This is why it's important to note how large the fire is. You can do this in a number of ways including using air photos, fire atlas, or Government Land Office survey notes as Baker has done.*
>
> *Using fire scars, the best way to do this is to only include fires that burn a significant amount of the study area. In other words, again using the 1000 acres. You would ignore all the fires that are only recorded at one or even a few sights and assume they are small fires of no consequence. After all we are trying to get to the notion of how important fire was in any area and the kind of fire that burned. The only fires you would include would be the years when the majority of the study sites burned, preferably across much of the 1000 acres. You could also note the occurrence of even-aged stands across large areas that might indicate regrowth after a stand replacement blaze. That would give you the real fire rotation."*

Similarly, personal communications from William Baker, in our communication regarding limitations of fire scar analyses used in research with similar methodology (and so are also relevant here), include:

> *"There are no estimates of historical fire rotations, the essential rate parameter of historical fires. Composite fire interval estimates are done within each site, not across sites, which is OK. But, there is little correction to remove small fires, so their MFRI is close to a mean CFI-all fires in the Baker (2017) terminology. Using Baker (2017 Table 2), to estimate fire rotation, for mean CFI--all fires, we would multiply MFRI by 2.44. For the range of MFRIs in their Table 1, which is 10.6-21.2 years, the estimated range of historical fire rotations would then be 25.9 to 51.7 years.*
>
> *Based on these fire rotations, these were not frequent-fire forests with fire rotations < 25 years that would have kept fuel loads generally reduced, since fuels can recover within about 10-20 years usually. Instead, historically there would have been ample time for fuels to fully recover between fires, including plenty of fully regrown shrubs, many small trees, lots of small wood, some larger wood etc. and some stands with higher tree density. It is important to estimate fire rotations because it is well accepted now in the scientific fire community that the MFRI used in Johnston et al. does not estimate historical rates of burning and should not be used to guide restoration programs (Baker 2017). See the quotes in this paper from well fire historians that make this very clear.*
>
> *Also, in the intro Johnston et al. suggest fire regimes would have been mixed severity, but then they did no reconstruction of fire severity, which of course is essential where fires where historically mixed in severity. The paper doesn't say so explicitly, but seems to assume that all fires were low-severity, and the final paragraphs even imply that higher-severity fires did not occur. Of course, what would be expected is that in moister forests, more of the fires that occurred would be higher-severity, including substantial patches of high-severity fire, whereas in ponderosa of course more of the fires would have been low-severity, with fewer that were higher-severity, as has been shown nearly everywhere that fire severities have been reconstructed in these kinds of forests. Showing,*

as they do, that MFRI did not differ between dry and moist forests has little meaning, since it is not the occurrence of fires, but instead fire size and fire severity that would be expected to differ. They have no data on the essential fire-severity parameter of historical fire regimes in ponderosa pine and mixed-conifer forests in their study areas, and certainly cannot conclude that historical fire regimes would have been similar in these two types of forest.

Also, their historical basal area estimates are based on just extant (live) historical trees, not dead trees present on the forest floor. Although fires may have been suppressed, there are many other sources of continuing tree mortality that could have killed and even removed many of the smaller trees present in the late-1800s (e.g., bark beetles, drought, competition, root rots etc.). They did not compare their basal area estimates to early historical reports, such as Munger 1917 to see whether extant live historical trees even approximately estimate basal area, tree density, and tree diameter distributions in the late-1800s to early 1900s. It is well known that smaller trees present in the late-1800s would likely have burned, died from competition or other mortality agents, and decomposed since then, particularly in moister forests. Since logging is often aimed at smaller trees, and they have no validation at all that smaller trees are correctly reconstructed by using just extant live trees that happen to still be present, this study does not provide a sufficiently sound basis for any restoration logging program."

Most structures are lost to grass fires, and most fires are caused by human fire ignitions:

Many large climate driven wildfires are in grasslands, and the majority of homes lost in recent large fires were a result of grassfires. In addition, most fires are started by human caused ignitions.

Radeloff et al. 2023 found that most homes that burned in the US were destroyed by grass and shrub fire, not forest fire. This dynamic highlights the realities of climate-driven wildfire and lack of efficacy in logging to control fire behavior. Reporting from CNN about the study notes: "*Over the last three decades, the number of US homes destroyed by wildfire has more than doubled as fires burn bigger and badder, a recent study found. Most of those homes were burned not by forest fires, but by fires racing through grass and shrubs."… "The West is most at risk, the study found, where more than two-thirds of the homes burned over the last 30 years were located. Of those, nearly 80% were burned in grass and shrub fires."*

We also want to note that recent research found that the majority of fire ignitions that cross jurisdictional boundaries start on private lands, not public, and that most fires are started by human activity. OSU Newsroom coverage discussed the Downing et al. 2022 study: *"The study area covered almost 141 million acres across 11 states and included 74 national forests"*… "*Of all ignitions that crossed jurisdictional boundaries, a little more than 60% originated on private property, and 28% ignited on national forests. Most of the fires started due to human activity."*

In the Balch et al. 2024 study *The fastest-growing and most destructive fires in the US (2001 to 2020)*, the authors also found that most fast fires were in grasslands, and that fast fires were largely driven by climate change, high winds, low wind friction, and human ignitions. These findings highlight the outdated nature and ineffectiveness of the FS's primary focus on logging in mature and old forests to reduce fire risk.

"The most destructive and deadly wildfires in US history were also fast. Using satellite data, we analyzed the daily growth rates of more than 60,000 fires from 2001 to 2020 across the contiguous US. Nearly half of the ecoregions experienced destructive fast fires that grew more than 1620 hectares in 1 day. These fires accounted for 78% of structures destroyed and 61% of suppression costs ($18.9 billion). From 2001 to

2020, the average peak daily growth rate for these fires more than doubled (+249% relative to 2001) in the Western US. Nearly 3 million structures were within 4 kilometers of a fast fire during this period across the US. Given recent devastating wildfires, understanding fast fires is crucial for improving firefighting strategies and community preparedness."

They also found that the *"[t]op 20 fastest-growing fires across the CONUS from 2001 to 2020. Summary statistics describe the top 20 fastest fires from FIRED linked to their associated incident command system summary report (44). The top 20 fastest fires accrued an estimated $398 million in suppression costs alone, exposed 264,338 properties (within 4 km of a fire perimeter), and destroyed >9000 structures. Of the 20 fastest fires, 16 occurred primarily in grassland vegetation types (>50% grassland in burned area)."*

In their closing summary, the authors note: *"Fires may be growing faster due to warming trends, vegetation transitions to more flammable fuels, or the co-occurrence of high winds with increasing human-related ignitions. Climate driven increases in burned area has been well documented in the US (57), as well as an observed tripling of fire frequency in the 2000s relative to the prior two decades (21). Many fast fires occur during downslope wind events coincident with anomalously dry autumn conditions, which increased both in frequency (25%) and in the area they burned (140%) from 1992 to 2020 (58). Juang et al. found that the increase in Western US forest fire area since the mid-1980s was driven almost exclusively by increasing sizes of the largest fires (59). The mechanism is a function of geometric growth: Larger fires tend to grow faster than smaller fires because longer firelines have greater potential for spread. It is also known that invasive grasses can drive increases in size (23), occurrence, and frequency (24). Because grassfueled fires are some of the fastest (table S3), it may then follow that where vegetation transitions have occurred, for example, from forest or shrubland to invasive grassland (60), fire speed may have also increased. Further, we know that there is a relationship between human ignitions and higher winds (11, 61), because lightning generally does not occur under high-wind conditions due to the constraints surrounding their associated storms (61). Across the US, there has been a steady increase (9%) in the percentage of wildfires started by humans since 1992 (62). It has yet to be tested whether the co-occurrence of windy conditions and human-related ignitions, such as downed power lines, is increasing. People start nearly all the wildfires that threaten our homes (3), making understanding of the ignition, climatic, and fuel drivers of fast fires an important area of future work."*

The Forest Service repeatedly fails to acknowledge that logging and "fuel reduction" does little to nothing to stop climate change related wildfires, which are overwhelmingly driven by drought, heat, and wind—and that most wildfire threatening structures are grassfires. Logging in the backcountry will not make communities safer—working near communities, home hardening, and emergency preparedness are far more effective in keeping people safe. Please also see the research of Dr. Jack Cohen, a Forest Service researcher who has done decades of work on the topic of home hardening.

We are also concerned that repeated building and reopening roads will further increase human access across these numerous and widespread timber sales, especially in the backcountry. This, in turn, increases the risk of human-caused ignitions. Home hardening is the most effective strategy for keeping communities safe.

Cumulative impacts and foreseeable actions:

Most timber sales plan widespread prescribed fire after logging as part of their timber sales. However, we note that the Forest Service generally does not analyze the cumulative impacts of repeated burning every

10 years across these timber sales, repeatedly. Clearly, plans for repeated future burning are in the foreseeable future, and are clear intended by the Forest Service.

Such 10-year cycles of burning would require repeated road maintenance and access. What is the over-arching plan with road access for such repeated management for this and other sales? Does the Forest Service intend to maintain the bloated and expensive road network that exists, which the FS has admitted it does not have the funding to maintain or fix? And which the agency has admitted are causing detrimental impacts to fish and water quality, as well as negative impacts to species such as elk and other animals sensitive to roads?

Also, prescribed fire is not the same as wildfire. Prescribed burns can and do cause ecologically important damage to crucial wildlife habitat, particularly if done in ecologically inappropriate areas such as fire and climate refugia. We are also concerned about the loss of snags and downed logs, and note that prescribed burns do not necessarily mimic the same dynamics as wildfire. In addition, timing of prescribed burns, such as those done in spring, potentially interrupts delicate life cycle rhythms of wildlife, such as egg laying and hatching and can harm insects, butterflies, nesting birds, and other species. and that prescribed fire can cause lasting, long-term negative reductions in snags, logs, and dead wood habitats (Arkle and Pilliod, 2010; Pilliod et al. 2006).

Another concern we have that much of the prescribed burning in many timber sale areas are comprised of burning slash, including slash piles. Such burning can severely damage soils, and often supports some of the highest concentrations of invasive weeds on Forests. In the Baker City Watershed sale, for example, the Forest Service notes that prescribed fire units would include jackpot burning, which involves "*burning of slash concentrations to reduce excess slash generated in harvest and/or non-commercial thinning units. Generally, jackpot burning is used to burn pockets of slash within a unit or to ignite specific targets within the unit without spread through the remainder of the unit. Jackpot burning would be accomplished through hand ignition techniques.*" (USFS 2024 Baker City Watershed FEA).

The Forest Service is also conducting logging and burning in sensitive habitats such as streamside riparian corridors. Given that riparian corridors are disproportionately relied upon by many species for connectivity, key habitat, thermal refugia and shade, and other parameters provided by these often denser, complex forests—what effect will repeated logging and burning have on the species that rely on riparian corridors for at least part of their life cycles?

The efficacy of "fuels reduction":

Large severe fires are climate driven, and are expected to increase as a result of climate change. Fuels reduction activates have little to no impact on large, climate-driven fires. While logging and burning forests sometimes correlates to reduced fire severity or altered fire behavior— this is only true for fire events that are not weather and climate driven, and only for a very short period of time before these logged and burned areas start to grow back and "fuels reduction treatments" are no longer effective. Forests often grow back more densely and homogenously than before they were logged, creating an even more flammable situation. Heavy, industrial-scale logging increases fire risk.

There is a very short window of time that "treatments" will be effective, usually ~10-15 years. "Treated" (logged) areas having a vanishingly small chance of encountering a wildfire during that 10-15 year window of time (Rhodes and Baker 2008).

The short-term and temporary nature of the perceived fuels reduction benefits from most sales are not likely to result in meaningful changes to fire intensity, size, or severity. Most timber sales designed to reduce fuels note that perceived benefits are estimated to affect fire behavior for approximately 10-20 years. If the estimated effectiveness is only approximately 10-20 years, then the justification for logging 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."*

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)."*

DellaSala et al. 2022 highlight the often-overlooked negative environmental impacts of logging and thinning in the name of fire suppression:

> "*Active Management Approach (MFAMA) in an attempt to contain wildfires increasingly influenced by top down climate forcings. Wildfire suppression activities aimed at stopping or slowing fires include expansive dozerlines, chemical retardants and igniters, backburns, and cutting trees (live and dead), including within roadless and wilderness areas. MFAMA involves logging of large, fire-resistant live trees and snags; mastication of beneficial shrubs; degradation of wildlife habitat, including endangered species habitat; aquatic impacts from an expansive road system; and logging-related carbon emissions. Such impacts are routinely dismissed with minimal environmental review and defiance of the precautionary principle in environmental planning. Placing restrictive bounds on these activities, deemed increasingly ineffective in a change climate, is urgently needed to overcome their contributions to the global biodiversity and climate crises. We urge land managers and decision makers to address the root cause of recent fire increases by reducing greenhouse gas emissions across all sectors, reforming industrial forestry and fire suppression practices, protecting carbon stores in large trees and recently burned forests, working with wildfire for ecosystem benefits using minimum suppression tactics when fire is not threatening towns, and surgical application of thinning and prescribed fire nearest homes."*

Baker et al. 2023 determined that nature-based solutions that emphasize natural disturbances are a viable and important strategy:

> *"Natural disturbances, unlike mechanical treatments, select survivors that are more likely to be genetically adapted to survive future disturbances and climate change, while perpetuating ecosystem services. Natural disturbances also could ecologically restore forest heterogeneity, better maintain carbon storage, and reduce management needs. A fully developed disturbance-*

based NbS could more effectively adapt dry forests to climate change within ~30–40 years if active management is reprioritized to protect the built environment and communities near public forests."

Noss et al. 2006 also highlighted the paradigm shift needed for true restoration:

"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)."

"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 (Figure 4) 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."

Climate change:

Forests are important for carbon storage and for carbon sinks—they store carbon in both the soils and the vegetation, and are important for mitigating the impacts of climate change. Harvesting wood "represents the majority of [carbon] losses from US forests...." (Harris et al., 2016). Additionally, (Achat et al., 2015) has estimated that intensive biomass harvests could constitute an important source of carbon transfer from forests to the atmosphere. Pacific Northwest forests hold live tree biomass equivalent or larger than tropical forests. (Law and Waring, 2015). "Alterations in forest management can contribute to increasing the land sink and decreasing emissions by keeping carbon in high biomass forests, extending harvest cycles, reforestation, and afforestation." (Law et al., 2018). The FS omits an honest carbon accounting of the carbon outputs of their logging in individual sales and across the region.

Buotte et al. 2020 published an article prioritizing forest lands for preservation based on "carbon priority ranking with measures of biodiversity." This is important information that the Forest Service should consider in its analysis. The researchers mapped "high carbon priority forests in the western US exhibit features of older, intact forest with high structural diversity[], including carbon density and tree species richness." Here is the map from that article:

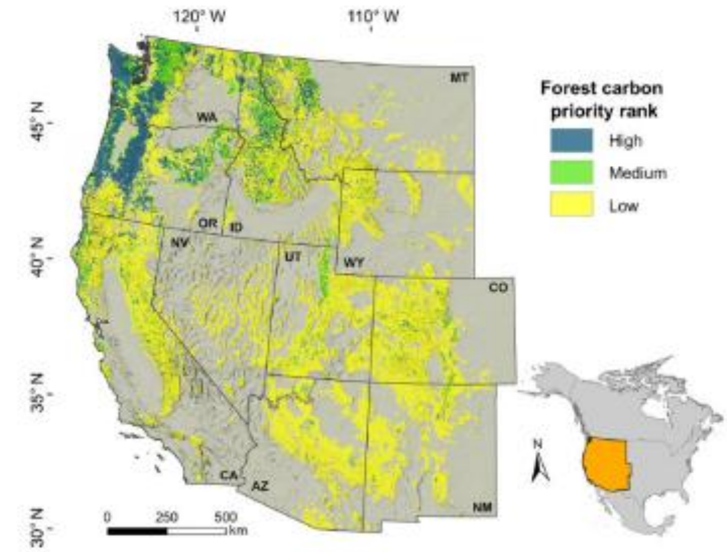


Fig. 1. Forested land in the western conterminous United States classified into priority for preservation to mitigate climate change based on the spatial co-occurrence of low vulnerability to drought and fire and low, medium, and high potential carbon sequestration. WA, Washington; ID, Idaho; MT, Montana; OR, Oregon; CA, California; NV, Nevada; UT, Utah; CO, Colorado; AZ, Arizona; NM, New Mexico.

Over the last several decades, forest managers in North America have used concepts of historical range of variability, natural range of variability, and ecological sustainability to set goals and inform management decisions. An underlying premise in these approaches is that by maintaining forest conditions within the range of presettlement conditions, managers are most likely to sustainably maintain forests into the future. We argue that although we have important lessons to learn from the past, we cannot rely on past forest conditions to provide us with adequate targets for current and future management. This reality must be considered in policy, planning, and management. Climate variability, both naturally caused and anthropogenic, as well as modern land-use practices and stressors, create novel environmental conditions never before experienced by ecosystems. Under such conditions, historical ecology suggests that we manage for species persistence within large ecoregions.

Large trees are especially important for carbon storage. On National Forest lands east of the Cascade Crest in Oregon and Washington, large trees equal to or over 21" in diameter at breast height comprise only ~3% of trees-- yet store ~42% of the carbon. (Mildrexler et al. 2020). Despite their importance, the Forest Service is repeatedly targeting large trees and mature and old forests for logging.

(Mildrexler, et al., 2020) state:

- *Large-diameter trees store disproportionally massive amounts of carbon and are a major driver of carbon cycle dynamics in forests worldwide.*
- *We examined the proportion of large-diameter trees on National Forest lands east of the Cascade Mountains crest in Oregon and Washington, their contribution to overall aboveground carbon (AGC) storage, and the potential reduction in carbon stocks resulting from widespread harvest. We analyzed forest inventory data collected on 3,335 plots and found that large trees play a major role in the accumulated carbon stock of these forests. Tree AGC (kg) increases sharply with tree diameter at breast height (DBH; cm) among five dominant tree species. Large trees accounted for 2.0 to 3.7% of all stems (DBH ≥ 1" or 2.54 cm) among five tree species; but held 33 to 46% of the total AGC stored by each species. Pooled across the five dominant species, large trees accounted for 3% of the 636,520 trees occurring on the inventory plots but stored 42% of the total AGC. A recently proposed large-scale vegetation management project that involved widespread harvest of*

large trees, mostly grand fir, would have removed ~44% of the AGC stored in these large-diameter trees, and released a large amount of carbon dioxide into the atmosphere.

- *Given the urgency of keeping additional carbon out of the atmosphere and continuing carbon accumulation from the atmosphere to protect the climate system, it would be prudent to continue protecting ecosystems with large trees for their carbon stores, and also for their co-benefits of habitat for biodiversity, resilience to drought and fire, and microclimate buffering under future climate extremes.*

Given that large trees over 20" dbh are still rare on the landscape compared to historic norms, logging these trees only hurts carbon storage, as well as key wildlife habitat that is still at a deficit in the region, and biodiversity. Large trees are also essential to watershed health and stream, and logging large trees will negatively affect stream habitats and water quality. Logging large trees over 21" dbh will not make communities safer from wildfire, and will not make a meaningful difference in the FS achieving their tree species composition/forest conversion goals. It will however, negatively affect carbon storage and wildlife habitat in meaningful and harmful ways. Logging, particularly the logging of large trees, does not address the primary problems and sources of ecological degradation on the landscape—too many roads and roads that are harming water quality and wildlife, excess fine sediment and high stream temperatures, and invasives species.

Law et al. 2022 highlights the need for a paradigm shift for managing forests on public lands:

> *"The recent Intergovernmental Panel on Climate Change report on impacts, mitigation, and adaptation found, and member countries agreed, that maintaining the resilience of biodiversity and ecosystem services at a global scale is "fundamental" for climate mitigation and adaptation, and requires "effective and equitable conservation of approximately 30 to 50% of Earth's land, freshwater and ocean areas, including current near-natural ecosystems." Our key message is that many of the current and proposed forest management actions in the United States are not consistent with climate goals, and that preserving 30 to 50% of lands for their carbon, biodiversity and water is feasible, effective, and necessary for achieving them."*

The FS fails to consider how climate change is already, and is expected to be even more in the future, influencing forest ecology. This has vast ramifications as to whether or not the forests in timber sales will respond as the FS assumes. Global warming and its consequences are effectively irreversible which implicates certain legal consequences under NEPA and NFMA and ESA (e.g., 40 CFR § 1502.16; 16 USC §1604(g); 36 CFR §219.12; ESA Section 7; 50 CFR §§402.9, 402.14). All net carbon emissions from logging represent "irretrievable and irreversible commitments of resources." The Committee of Scientists, 1999 recognize the importance of forests for their contribution to global climate regulation. Also, the 2012 Planning Rule recognizes, in its definition of Ecosystem services, the "Benefits people obtain from ecosystems, including: (2) Regulating services, such as long term storage of carbon; climate regulation..."

Climate change science suggests that logging for sequestration of carbon, logging to reduce wild fire, and other manipulation of forest stands does not offer benefits to climate. Rather, increases in carbon emissions from soil disturbance and drying out of forest floors are the result. The FS can best address climate change through minimizing development of forest stands, especially stands that have not been previously logged, by allowing natural processes to function. Furthermore, any supposedly carbon sequestration from logging are usually more than offset by carbon release from ground disturbing activities and from the burning of fossil fuels to accomplish the timber sale, even when couched in the language of restoration. Reducing fossil fuel use is vital. Everything from travel planning to monitoring would have an important impact in that realm.

There is scientific certainty that climate change has reset the deck for future ecological conditions. For example, (Sallabanks, et al., 2001): (L)ong-term evolutionary potentials can be met only by accounting for potential future changes in conditions. ...Impending changes in regional climates ...have the capacity for causing great shifts in composition of ecological communities.

We also want to highlight several recent studies and articles have been published in relation to climate change and forests, including papers on forest reserve strategies that include the Blue Mountains:

- 2022: DellaSala et al. Have western USA fire suppression and megafire active management approaches become a contemporary Sisyphus?
- 2022: Ripple et al. World Scientists' Warning of a Climate Emergency
- Dec 2022: Law et al. Strategic reserves in Oregon's forests for biodiversity, water and carbon to mitigate and adapt to climate change. *Front. Forests & Global Change* link
- Aug 2022: Law & Schlesinger. Why mature and old forests are so important for climate mitigation and adaptation. *The Hill* link
- Jul 2022: Law. Boreal and Temperate Forests. In: The Climate Book by Greta Thunberg. link
- May 2022: Law et al. Creating Strategic Reserves to protect forest carbon and reduce biodiversity loss in the United States. *Land* link
- Dec 2021: Law et al. Strategic Forest Reserves can protect biodiversity and mitigate climate change in the western US. *Nature Comm Earth & Environ*. link
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