An Evaluation of Projects using Ecological Rationales to Log Mature and Old-Growth Trees on U.S. Federal Lands

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> "*It is generally recognized that silvicultural treatments should follow nature as far as possible. In practice, however, this maxim often has been forgotten or otherwise violated.*"
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> ~Spurr, S. and C. Cline. 1942. Ecological forestry in central New England. Journal of Forestry 40(5): 418-420.

EXECUTIVE SUMMARY

In federal forests of the western U.S., the Forest Service and Bureau of Land Management (BLM) are dramatically accelerating the pace and scale of projects whose stated primary goals are to reduce fuels, restore forests, and/or increase resilience to high intensity wildfire and other disturbances. While broad scientific agreement exists around the need to actively restore dry, frequent-fire (i.e. fire return intervals of 0-35 yrs) forests that have been degraded by over a century of commercial logging and fire suppression, controversy has grown regarding the agencies' focus on commercial logging and conventional silviculture as the primary tools to address these objectives -- particularly if such projects authorize the removal of significant numbers of mature and old-growth trees. In the eastern U.S., mature and old trees are being removed from national forest lands under other purported ecological rationales, such as creating early successional habitat for wildlife.

Due to the current rarity of large/old trees (>150 years in western forests), the numerous essential and irreplaceable roles they play in forest ecosystems (e.g. resilience to disturbance, biodiversity and carbon storage), and the difficulty in replacing them in areas where they are now deficient, the large majority of scientists agree that large/old trees should be retained as part of fuels reduction and forest restoration efforts. Given this broad consensus, to what extent are federal agencies currently retaining large/old trees, as well as adopting other ecologically-based management recommendations in project-level planning? Through detailed evaluations, this report takes an in-depth look at how the Forest Service and BLM are inappropriately using ecological rationales to justify logging of mature/old-growth trees and stands, while also pursuing other specific actions that are inconsistent with widely-accepted, ecologically-based principles on how to reduce wildfire hazard and restore fire-adapted western forests.

This report presents the results of an independent scientific review of eight proposed Forest Service and BLM projects widely distributed across the US, using a set of five key criteria that are both well-established in the scientific literature and agreed upon by a large number of forest ecologists, biologists and other practitioners with specific expertise on these issues. For each criteria, a letter grade was assigned based on the degree to which proposed actions are consistent with principles that are central to implementing ecologically sound forest management on federal lands. As described in detail in this report, all reviewed projects scored poorly (D or F) in terms of meeting these basic ecological criteria. (see summary table below). Key findings and repeated shortcomings identified in project evaluations include:

- Failure to ensure the retention of, or explicit proposals to remove, large/old-growth (>150 years) overstory trees, despite the abundance of evidence and widespread agreement among forest scientists that these trees are now strongly depleted, contribute very little to fire hazard and are critical to protect as part of any effort to increase resiliency and restore degraded forest conditions.
- Inappropriate extrapolation of thinning treatments designed for dry, frequent-fire forests (e.g. ponderosa pine, dry mixed conifer) to moister and/or higher elevation forest types, where reducing tree density will not be restorative and is not likely to be effective at achieving stated ecological goals (e.g. lodgepole pine and subalpine spruce/fir forests in the Rocky Mountains, red fir and moist mixed conifer forests in CA and OR).
- Overreliance on mechanical treatments that focus on removing larger, commercial-sized trees versus small to intermediate-sized understory or subcanopy trees, even though smaller trees are almost always the primary contributors to wildfire hazard within forests proposed for management.
- Failure to substantively analyze and/or downplays the significant impacts of logging-based fuels treatments on at-risk, forest-dependent fish and wildlife species, including many that are formally listed as sensitive, threatened or endangered.

- Plans consistently include significant new road construction and reconstruction, even though roads are known to result in numerous adverse environmental impacts (e.g. elevated wildfire risk, increased erosion, habitat loss/ fragmentation, etc) that often outweigh any potential benefits of reducing fuels and other stated management goals.
- Failure to fully incorporate the use of intentional or prescribed fire into project plans, which is generally necessary in order to realize the potential benefits of mechanical fuel reduction. If not combined with the application of surface fire, thinning treatments alone often increase surface fuel loads and can lead to higher levels of wildfire hazard than if no action is taken.
- Failure to plan for repeated fuel maintenance treatments -- ideally through the use of intentional fire -- in the future and over time, such that the presumed benefits of initial management actions are likely to be quickly reduced or lost.

Instead of protecting large/old trees, focusing efforts on reducing levels of surface and ladder fuels in dry, frequent-fire forests, minimizing adverse impacts to at-risk wildlife, and reintroducing low- and mixed intensity fire as the key to reducing fuels and increasing resilience, land management agencies appear to be doubling down on commercial logging-based approaches to management that will further degrade forests and only worsen many of the significant problems that currently exist across the nation's federal lands.

Summary scores for all eight projects (separating those in western and eastern US) evaluated in this report, using five ecological criteria associated with a science-based approach to forest management.

	ECOLOGICAL EVALUATION CRITERIA					
PROJECT NAME	1. Includes explicit protections for existing mature and/or old-growth trees.	2. Treatments focus on frequent-fire forest type(s) that are likely to be most departed from historic conditions.	3. Treatments focus on reducing surface & ladder fuels (subcanopy trees & shrubs) that most contribute to elevated wildfire hazard.	4. Avoids or at least effectively minimizes actions likely to adversely impact at-risk wildlife.	5. Integrates managed and/or prescribed fire into project planning and addresses need for future/follow-up maintenance treatments.	**FINAL SCORE***
USFS Northern Region						
Gold Butterfly	F (0)	D (1)	D (1)	C (2)	C (2)	6 = D
Hungry Ridge	F (0)	F (0)	D (1)	D (1)	B (3)	5 = D
Bitterroot Front	F (0)	F (0)	C (2)	D (1)	B (3)	6 = D
USFS Rocky Mtn Region						
Lower North-South	F (0)	F (0)	D (1)	I	D (1)	2 = F
USFS Pacific Southwest Region						
North Yuba	D (1)	C (2)	C (2)	D (1)	D (1)	7 = D+
USFS Pacific Northwest Region						
Grasshopper	F (0)	D (1)	D (1)	D (1)	D (1)	4 = D
Oregon BLM						
Last Chance	D (1)	C (2)	D (1)	D (1)	D (1)	6 = D

*Final score is a sum of evaluations across all five criteria, with A=4, B=3, C=2, D=1, F=0; I = incomplete due to lack of necessary information

	ECOLOGICAL EVALUATION CRITERIA					
PROJECT NAME	1. Includes explicit protections for existing mature and/or old-growth trees.	2. Is it ecologically beneficial to log mature and roadless forests to create "early successional habitat"?	3. Do proposed treatments support the restoration of habitats required by at-risk species?	4. Avoids or at least effectively minimizes actions likely to adversely impact at-risk wildlife.	5. Does the project follow goals/objectives of the NF Plan re: biodiversity & ecological services such as carbon sequestration?	**FINAL SCORE***
USFS Eastern Region						
Early Successional Habitat Creation Project	F (0)	F (0)	F (0)	D (1)	F (0)	1 = F

*Final score is a sum of evaluations across all five criteria, with A=4, B=3, C=2, D=1, F=0; I = incomplete due to lack of necessary information

While all eight projects that were evaluated in this review scored poorly across most criteria, the most consistent failing and greatest immediate concern is the continued logging of mature and old-growth trees. Just two of the eight projects (North Yuba, Last Chance) included clear standards regarding large tree retention, and even in these cases, proposed standards only apply in limited settings to the very largest/oldest tree cohort. The remaining six projects that were reviewed included no large/old tree safeguards at all. In the few cases where project documents provided rationales for logging large/old trees, these justifications failed to withstand scientific scrutiny and/or are predicated on an incomplete or inaccurate understanding of the key roles that these trees play in healthy forest ecosystems. For this reason alone, all projects reviewed in this report cannot legitimately be referred to as 'restoration' or 'proactive stewardship'.

		METRICS RELATED TO POTENTIAL FOR ADVERSE ECOLOGICAL IMPACTS				
PROJECT NAME	Acres of planned commercial logging-based treatments	Logging planned in forest stands that meet existing old-growth definitions?	Prescriptions include standards to ensure retention of large/old trees in treatment areas?	Logging in forest types other than those character-ized by frequent, low- to mixed severity fire regime?	Project will result in habitat loss and/or degradation for ESA-listed species?	Degree to which use of prescribed fire is incorpor-ated into project planning & implementation
USFS Northern Region						
Gold Butterfly	5,281	Yes	No	Yes	Yes	Low-Moderate
Hungry Ridge	7,164	Yes	No	Yes	Yes	Moderate
Bitterroot Front	27,477	Yes	No	Yes	Yes	High
USFS Rocky Mtn Region						
Lower North-South	94,575	Unknown	No	Yes	Likely	Moderate
USFS Pacific Southwest Region						
North Yuba	91,025	Yes	Partial; >24 to 40" dbh depending on land use allocation	Yes	Yes	Low-Moderate
USFS Pacific Northwest Region						
Grasshopper	3,858	Yes	No (partial in Riparian Reserves; 24-30" dbh)	Yes	Yes	Low
Oregon BLM						
Last Chance	8.240	Yes	Partial; >36 to 40" dbh depending on land allocation	No	Yes	Low-Moderate

USFS Eastern Region						
Early Successional Habitat Creation Project (Green Mountain NF)	12,000	Up to 160-year-old stands but does not meet Eastern Region OG definition	No	Yes	Yes (state listed in VT)	N/A

The consistently poor scores that arose from this evaluation indicate that many projects recently proposed by the Forest Service and BLM -- particularly those ostensibly designed to restore forests and increase resiliency to fire and other disturbances -- are not following the best available science and are incongruent with an ecologically-based approach to management. Moreover, the projects reviewed in this report do not appear to be atypical cases, but are rather representative of how the Forest Service and BLM are routinely misapplying or ignoring the best available science to approve logging of mature and old-growth trees in the name of hazardous fuels reduction and other purported ecological goals.

While the agencies' stated project goals are appropriate in some settings, the design and implementation of forest restoration on federal lands must quickly become more closely aligned with the principles of ecological science and the detailed existing knowledge of individual forest ecosystems, with particular attention paid to measures that will protect mature and old-growth trees, at-risk fish and wildlife, carbon storage, watershed health and other important values (see table below). Unless significant changes are made to close the gap between the best available science and on-the-ground management, logging-based approaches will continue to degrade the outstanding forest values that exist on America's public lands.

Areas of misalignment between proposed actions in USFS and BLM projects reviewed in this report and an ecologically-based forest management framework. Adjustments listed would bring current projects into better alignment with ecological principles and recommendations applicable to western frequent-fire forests.

Areas of Misalignment with Science	**Adjustments Necessary for Ecologically-Based Management**
Removes significant numbers of large-diameter and old trees	Retains large-diameter and/or old trees wherever possible
Expands roads through new construction, reconstruction and/or addition of non-system roads	Reduces roads using ecological-based criteria for prioritizing restoration, closure and/or removal
Plans treatments across range of different forest types & fire regimes	Focuses active management in lower elevation, warm/dry forests that are most altered and least resilient relative to historic conditions
Focuses on commercial harvest treatments	Focuses on treatments that reduce surface and ladder fuels while retaining existing large overstory trees
Little/no emphasis on old-growth recruitment	Identifies & manages mature trees and stands to facilitate old-growth development wherever there is current deficit
Leads to significant adverse impacts on at-risk species	Designs projects to effectively avoid or at least minimize impacts to at-risk species

Fails to fully incorporate fire as a key ecological process	Commits with resources and planning to prescribed fire and managed wildland fire use for resource benefits
Fails to address need for future forest/fuel maintenance treatments	Identifies and incorporates future maintenance needs to perpetuate and build upon benefits from initial treatments

I. BACKGROUND

After well over a century of management in western U.S. forests that focused primarily on timber production, many federal lands are now in a severely degraded condition. The combination of systemic fire suppression, livestock grazing and commercial logging -- which removed most of the large/old trees that are the 'living backbone' of these forests -- has in many areas led to increased fuel loads, higher densities of small trees, and more frequent insect/disease outbreaks (Hagmann et al. 2021, Stephens et al. 2015, McIntyre et al. 2015). As a result, wildfire size and severity has significantly increased in some areas of the western U.S., particularly the lower elevation, seasonally dry forests (hereafter referred to as 'dry' and/or 'frequent-fire forests') that were historically maintained by frequent (0-35 yrs), low- to mixed-intensity fires (Singleton et al. 2019, Miller et al. 2009, Coop et al. 2022, Williams et al. 2023). Overshadowing historical burn patterns and trends is the fact that climate change is rapidly altering western forests and fire behavior by creating longer fire seasons, more severe and/or prolonged droughts (Parks & Abotzoglou 2020, Abotzoglou & Williams 2016, Westerling et al. 2006), and elevated rates of tree mortality (Fettig et al. 2019, van Mantgem et al. 2009). In sum, the capacity of dry, frequent-fire forests on federal lands to sustain biodiversity, store carbon and provide numerous other critical ecological services is increasingly at risk.

Given this historical context, there is broad agreement that many western forests have been degraded over the past century by ill-informed management, and that ecological restoration in some form and to some degree -- of forest structures and processes as well as fire regimes, watersheds and wildlife habitats -- is appropriate, particularly in the face of multiple increasing stressors (DellaSala et al. 2003, Hessburg et al. 2015, Allen et al. 2002, Brown et al. 2004, Frost 2001). The types of active management treatments that are most often proposed in the context of forest restoration are various methods of mechanical fuels reduction (e.g. silvicultural thinning, selective logging) and prescribed fire (e.g. broadcast burning). The basic premise behind these treatments is that the re-establishment of historic structures (by reducing tree density) and/or ecological processes (by reintroducing fire) will reduce wildfire hazard and improve the general “health” or resiliency of forests that have been degraded by past management (Hessburg et al. 2021, Prichard et al. 2021). However, not all forests are in need of active intervention -- treatments may be warranted in some dry, historically more open forest types that have dramatically changed since European colonization, but cannot be justified ecologically in many others where changes have occurred to a much lesser extent or not at all (Brown et al. 2004, Agee & Skinner 2005, Schoennagel et al. 2017, Noss et al. 2006a-b)

While treating frequent-fire forests to reduce the chances of stand-replacing wildfire may be justified in some places, projects proposed with fuel reduction and resiliency goals often still have persistent, adverse environmental impacts. For example, thinning treatments have been shown to damage soils and their important biota (Jurgensen et al. 1997, Hartmann et al. 2014), elevate rates of erosion (Harvey et al. 1994), facilitate the spread of invasive plants (Nelson et al. 2008) and root pathogens (Slaughter & Rizzo 1999), and increase mortality of residual trees due to mechanical damage and windthrow (Filip 1994, Breece et al. 2008). The potential for undesirable, long-term effects increases dramatically if these projects include specific management actions -- such as the removal of large/old (or too many) trees, construction of roads, and logging on steep slopes or fragile soils -- that are known contributors to forest degradation (Nelson et al. 1995, Frost 2022). Moreover, if projects are overly focused on reducing fuels and tree density, other types of active management that are critical to achieving ecological goals -- such as restoring streams and riparian areas, controlling weeds and livestock, and providing adequate snags and other key wildlife habitats -- may be given too little attention or ignored altogether (Brown et al. 2004, Allen et al. 2002). What's clearly needed but often lacking is an ecologically-based framework and/or set of criteria that can be used to guide the design and implementation of projects that have stated restoration and/or resiliency goals.

As concerns about wildfire grow in the western U.S., the USDA Forest Service and USDI Bureau of Land Management ('the agencies') have increasingly shifted their focus to projects that have fuels reduction, ecological resiliency and/or forest restoration as stated primary goals. In 2022 the Forest Service launched the 'Wildfire Crisis Strategy', a large-scale plan to dramatically increase the pace and scale of fuel treatment levels on federal lands, with the primary goal to "to address wildfire risks to critical infrastructure, protect communities, and make forests more resilient" (USDA Forest Service 2022a-e). The Strategy proposes to implement treatments on up to 50 million acres over 10 years, relying primarily on logging-based thinning and other mechanical treatments as the primary tool to "alter the fuel complex in such a way as to modify fire behavior and thereby minimize the potential negative impacts of future wildfires on ecosystem goods and services, cultural resources, and human communities" (Hoffman et al. 2020, USDA Forest Service 2022b-e). While this shift in management focus may sound like an appropriate change, ***the key question that remains unanswered is whether and to what extent that projects being offered under the Strategy are well-grounded in ecological principles, and are being designed and implemented in such a way that they are most likely to improve forest conditions without exacerbating existing problems or creating new ones***.

At the same time federal land management agencies are dramatically increasing the pace and scale of management explicitly focused on reducing fire hazard and restoring more resilient conditions, a number of scientists are raising serious questions about whether these projects will in fact be ecologically beneficial as the agencies claim (Baker et al. 2023, DellaSala et al. 2022, Bradley et al. 2016, Rhodes & Baker 2008, Schoennagel et al. 2017, Mildrexler et al. 2023). These researchers have argued that despite what may be ecological-sounding goals and objectives, projects that primarily focus on logging-based fuels reduction treatments are actually more likely to degrade forests, watersheds and wildlife habitats rather than restore them. Their primary concern is that the range of adverse consequences associated with mechanical treatments -- especially those that remove mature and old-growth trees -- have often been ignored or underestimated, while the presumed benefits are exaggerated and/or remain unrealized. For example, there is empirical evidence that silvicultural thinning may not be effective at mitigating wildfire hazard, and can even be counterproductive as a landscape fire management tool (DellaSala et al. 2022, Calkin et al. 2023, Law et al. 2023). Given these legitimate concerns, calls for inclusion of 'the best available science' and independent analyses or review of agency plans and decision making are being made repeatedly.

Third-party scientific reviews are often useful when major concerns arise as to the scientific merits of proposed activities, especially when these activities are being implemented across very large areas on public lands (Meffe et al. 1998). In the case of federal forestlands, independent scientific review can help to ensure that management decisions fully consider and employ the best scientific knowledge and judgment available. As expressed in the official position statement on scientific review by the Society for Conservation Biology, "*In controversial policy issues that can be informed by rigorous science, there is no substitute for a penetrating critique...When calls go out for 'the best,' 'credible,' 'rigorous,' or 'objective' science, the most appropriate response is virtually always an independent review of the work...If the science is found wanting, subsequent steps are usually obvious as a result of the review*" (Meffe et al. 1998). In order to help ensure that management practices now being widely applied on federal lands are not undermining critical ecosystem values and services, an independent review of projects that have forest restoration and/or increasing resilience as explicit goals is strongly warranted.

II. INTRODUCTION AND METHODS

In this report, we present the results of an independent scientific review of pending Forest Service and BLM projects that have been proposed to purportedly help restore federal forests and increase their resiliency to wildfire and other disturbances. We evaluated the agency's proposed actions and specific management plans against a set of key criteria that are central to designing and implementing ecologically sound forest restoration and fuel management projects on western federal lands. The five criteria utilized in this review -- discussed in detail in the following section (The Scientific Basis for Criteria.., pp. 9-21) -- were selected because they are both well-established in the scientific literature and agreed upon by a large majority of forest ecologists, biologists and other practitioners with specific expertise on these issues. Taken together, they provide a transparent, science-based framework or yardstick by which to evaluate the ecological efficacy of forest restoration/resiliency projects, programs and policies, both in the design phase as well as during project implementation.

Particular emphasis in this evaluation has been placed on how agency project proposals treat mature and old-growth forests and trees, since older stands as well as large-diameter trees are known to play numerous important ecological roles (e.g. carbon storage, wildlife habitat, water quality, biodiversity, etc.), are generally most resistant to fire, drought and other disturbances, are now rare relative to their historic abundance, and once lost, are very difficult if not impossible to replace (see large/old tree summary, pp. 10-12 and Appendix). Moreover, any continued loss of mature and old trees due to logging and other management actions is inconsistent with President Biden's Executive Order 14072, which directed the Forest Service to develop a cohesive strategy to protect mature and old-growth forests and values across the National Forest System (The White House 2023). In June 2024, the Forest Service released a Draft Environmental Impact Statement that will amend 122 national forest plans (USDA Forest Service 2024). Public comment on this DEIS is scheduled to close on September 20, 2024. An important goal of the analysis is to gain insights into how existing agency projects and management practices may need to be revised or halted in order to ensure the conservation of mature and old-growth forests and trees, while at the same time allowing legitimate opportunities to enhance overall forest resiliency to wildfire, climate change and other stressors.

We reviewed eight projects distributed across six Forest Service regions and one BLM district and assigned a letter grade based on an evaluation of the degree to which these projects were consistent with the set of five ecologically-based criteria for forest management. The grades are intended to serve as a simple and straightforward way for readers to get a relative sense of whether and to what degree individual USFS and BLM projects are meeting the stated goals upon which they are premised (typically specified in the agencies' purpose and need statements; e.g. forest restoration, increasing resiliency, fire hazard reduction, etc.).The grades follow the conventional classroom approach where 'A' and 'B' reflect above average performances, while 'D' and 'F' grades respectively signify inadequate or failing efforts. For example, an 'A' assigned for the criteria #1 related to protection of large/old trees indicates that a project includes clear safeguards to ensure these foundational elements of resilient forests are retained and protected as part of project operations, whereas an 'F' would indicate that no protections are included and that a significant volume of large/old trees are planned for removal as part of the proposed action.

To arrive at a final aggregate score for each project, grades were converted to numeric scores for each criteria on a five point scale (where A=4, B=3, C=2, D=1 and F=0) and then summed scores across all five criteria. Each project was then assigned an aggregate grade according to where the total score lies on the following scale:

F <2.5	>2.5 **D** <7.5	>7.5 **C** <12.5	>12.5 **B** <17.5	**A** >17.5

While there may be additional information or data not included in publicly available documents that could have influenced these scores, we are confident that assigned grades represent a fair and reasoned evaluation of the degree to which projects are consistent with the best available science, are qualitatively accurate, and that small changes to individual scores would not significantly alter larger conclusions.

III. THE SCIENTIFIC BASIS FOR CRITERIA USED TO EVALUATE FOREST MANAGEMENT PROJECTS ON WESTERN FEDERAL LANDS

Projects that have forest restoration and increasing resiliency as explicit management goals must have a strong scientific basis if they are to result in beneficial outcomes for sustaining ecosystems and the numerous services and values they provide. Fortunately, there is emerging common ground around the fundamental elements of an ecologically-based approach to these complex management problems. While there are a number of criteria that have some relevance, the five that were utilized in these project reviews were selected because of a large and consistent body of scientific evidence that strongly supports their adoption as 'best practices' for an ecologically-based approach to forest management. In no particular order, they are articulated in the following questions:

1) Does the project include clear and specific protections for existing mature and/or old-growth trees, which are key foundational elements of fire-resistant and resilient forests?

2) Do proposed treatments focus on frequent-fire forest type(s) that are likely to exhibit the greatest departure from historic conditions (e.g. significantly increased risk of stand-replacing fire), and therefore in most legitimate need of restoration-based management?

3) If reducing wildfire hazard is an element of the project's purpose and need, do treatments focus on reducing surface and ladder fuels (e.g., small / subcanopy trees, shrubs, coarse woody debris) that most contribute to elevated hazard?

4) Is the project designed to avoid, or at the very least effectively minimize adverse impacts to at-risk fish and wildlife species?

5) Does the project integrate managed and/or prescribed fire into project planning, and also address the timing and necessity of future maintenance treatments, absent the return of a natural fire cycle?

The project-specific answers to these questions summarized and critiqued in this report are based upon the information presented in relevant agency planning documents -- Environmental Assessments (EA) or Environmental Impact Statements (EIS) -- as well as supporting specialist reports and other publicly available project files on national forest and BLM district websites.

The scientific basis for selecting and applying each of the five criteria to evaluate the relative ecological merits of forest management projects on western federal lands is summarized below. The discussion of these key criteria, and the reviews based on them, can also be used to inform policymakers about what types of land management actions are most likely to constitute ecologically appropriate forest restoration, resiliency and/or fuels reduction efforts on federal lands.

Criteria #1 -- Protect and Retain Mature and Large/Old Trees

There is overwhelming and widespread consensus among the scientific community that no single ecological criteria is more important in managing federal forests than the need to conserve large and old trees (see Appendix). Protecting large/old trees is regarded as essential because they "form the structural backbone" (Franklin & Johnson 2012, Ellison et al. 2005), "are the key contributor to resistance and resilience in dry forests" (Franklin et al. 2013, Henjum et al. 1994, Johnson et al. 2008), and represent "an ecological cornerstone to which forest restoration strategies can be anchored" (North et al. 2009). A large and broad body of science also makes clear that large trees are critically important because they:

- play a number of ecological roles (e.g. microclimate creation, water storage, nutrient cycling) that differ from those of younger and smaller trees (Franklin et al. 2013, 2018, Lutz et al. 2012);
- provide unique wildlife habitats through the development of structural characteristics such as high overstory crowns, large tree branches, large snags and down logs (Wisdom et al. 2000, Bull et al. 1997, Jones et al. 2017);
- contribute very little to wildfire hazard and are generally more resistant to fire, drought, a changing climate and other stressors compared to smaller trees (Mildrexler et al. 2023, Cannon et al. 2022, Kolb et al. 2007,);
- make outsized contributions to carbon storage and sequestration, thereby helping to mitigate climate change (Law et al. 2022, Mildrexler et al. 2020, Smith et al. 2005);
- are now rare relative to historic conditions due to past and ongoing logging and, once lost, are very difficult if not impossible to replace (Lutz et al. 2018, McIntyre et al. 2015, Lindenmayer et al. 2012)

Based on these reasons, numerous experts across many disciplines have made explicit recommendations that retaining large and old trees is of the utmost importance in any fuels reduction or forest restoration/ resiliency projects that are implemented on western federal lands (see Appendix).

After many decades of intensive logging, most of today's federal forests lack significant populations of large and old trees, such that meeting ecological goals will also require retention of numerous recruitment trees -- most often in the mature age class (i.e. 80-150 yrs). In other words, ***land managers intending to create restored and resilient forest conditions must consider not only the conservation of existing large/old trees wherever they remain, but also the need to allow for the development of mature trees into the larger/older cohort, and to replace existing old trees as they die***. On this point, a set of scientific workshops of the National Commission on Science for Sustainable Forestry concluded that:

> "*To have old growth in the future, it's necessary to identify and protect or restore older forests that are nearing old-growth conditions…If the nation is serious about preserving biodiversity, older forest area must be increased. Such efforts must begin with the existing base of older forests, but it ultimately will be necessary to go well beyond this base to effectively meet biodiversity and human values goals. In every region, the full forest growth and development cycle needs to be integrated into forest restoration plans*." (NCSSF 2008).

Retaining populations of mature trees that are well distributed across the landscape is critical because it will increase the likelihood that the current deficit of large and old trees doesn't worsen, and offers the most effective way to rebuild their distribution and abundance over the near and long term.

Protection of mature and old trees is best accomplished through explicit management guidance that delineates retention requirements for trees that meet certain age or diameter thresholds. In the scientific literature, researchers working in western dry forests have generally used 150 years as the threshold age for defining when a tree attains the 'old' or old-growth stage (Franklin et al. 2013, Johnson et al. 2023, Brown et al. 2004, Kolb et al. 2007, Allen et al. 2002, Henjum et al. 1994, Van Pelt 2008, Addington et al. 2018). This threshold age for old has been widely adopted because: 1) most trees of this age in dry forests exhibit distinctive structural characteristics and play unique ecological roles that differ from those of younger trees (Franklin et al. 2013); and 2) widespread alteration of frequent fire regimes began in many parts of the West about 150 years ago (Hessburg & Agee 2003, Beesley 1996).

When applied to the design of restoration projects, tree retention standards based on age are often considered impractical because of the intensive field sampling needed to determine tree ages. In practice, tree size (i.e., diameter at breast height; dbh), which can generally be correlated to tree age based on species and site class, has often been used as a more easily measurable criterion for identifying old trees and determining retention standards when designing silvicultural treatments. In western forests, large trees are generally defined as being 20 or 21 inches dbh or greater.[1] For example, in their recommendations to Congress, the Eastside Forests Scientific Society Panel (Henjum et al. 1994) proposed a 20" dbh cap to protect all large trees, including those <150 years old, on federal lands in eastern Oregon and Washington. Similarly, the initial 2001 amendment that revised national forest management plans in California's Sierra Nevada region established a 20" dbh limit for tree cutting (USDA Forest Service 2004).[2] For ponderosa pine forests of the Southwest, Allen et al. (2002) recommended retaining "trees larger than 16" dbh and all trees with old-growth morphology regardless of size", because "cutting of larger trees will seldom be ecologically warranted as restoration treatments at this time due to their relative scarcity."

In addition to metrics related to age and diameter, old trees are often identifiable by physical or structural attributes. Documented mature and old tree characters include greater bark thickness and altered color/texture, differences in crown structure and branching patterns (flattened tops, increased crown base height, large limbs), reduced sapwood vs. heartwood content, and increasing decadence (wounds, rots, fire scars, etc; Brown et al. 2019, Van Pelt 2008, Kauffman et al. 2007, Huckaby et al. 2003a). Depending on site productivity, these physical differences (including increased fire resistance) begin to appear around 80 years and become more accentuated with increasing age (Van Pelt 2008). Field guides based on these visual characters are now being used on some federal lands to identify old trees as part of dry forest restoration projects, either in place of or in conjunction with diameter limits (Franklin et al. 2013, Huckaby et al. 2003b, Riling et al. 2019, Urgenson et al. 2017).

Because removing large and old trees is usually counterproductive to achieving restoration, fuel reduction and resilience goals, projects that are included in this review will be evaluated on the basis of this key criteria. There may be instances where commercial-sized trees are in excess of ecological needs, but as explained above, explicit safeguards must be incorporated into project design to ensure that the end result is not simply more degradation. ***The weight of existing scientific evidence is clear that management aimed at reducing fire hazard and restoring forests should retain large/old trees from logging and focus treatments on excess numbers of small. and in some cases, intermediate-sized trees.*** If proposed projects subsidize reducing the density of small trees by removing too many commercial-sized trees, they can no longer legitimately be called 'restoration' -- it would just be timber production, with associated adverse environmental impacts but under a different name. And if federal land managers focus efforts only on those subset of areas where commercial logging may be appropriate, they will likely be neglecting the majority of the restoration need, as well as the areas that may be the highest priority for actions necessary to achieve stated goals (Brown et al. 2004, Noss et al. 2006a-c, Baker et al. 2007, Schoennagel & Nelson 2011, Krofchek et al. 2018, Ager et al. 2010, 2013).

Criteria #2 -- Focus on Dry, Frequent-Fire Forest Types

One of the fundamental tenets of an ecologically-based management approach is to utilize historic disturbance regimes as a guide to help determine where forests have become most altered from historic conditions (Franklin et al. 2018, Attiwill 1994, Palik & D'Amato 2024). In the western U.S., where wildfire is most often the dominant disturbance process, it is generally understood that forests characterized by different fire regimes need different forms of management (Aber et al. 2000, Steel et al.

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[1] Exceptions to the 20-21" dbh large tree standard exist in some forest types, such as 13" dbh for shorter-lived lodgepole pine forests in USFS Region 1 (Greene et al. 2011).
[2] The 2001 Sierra Nevada Forest Plan standard protecting all trees >20" dbh was subsequently changed to 30" dbh in 2004 under the Bush administration.

2015, Noss et al. 2006a-b). Unfortunately, in many cases it is erroneously assumed that western forests in general, or all forests in a specific region or dominated by a particular tree species, have been altered in the same way and/or will benefit from the same type of intervention. In fact, different forest types and landscapes vary greatly in terms of their dominant fire regimes, past management history, and the degree to which they have been altered from their characteristic structure and composition -- and therefore, in the active treatments (if any) that may be needed to increase resiliency (Hessburg et al. 2019, Noss et al. 2006a-b, Gutsell et al. 2001). "*Place is the most significant and most misunderstood element of the decision about where to carry out active restoration. Some forest types are in critical need, whereas others need no treatment at all*." (Brown et al. 2004).

There is widespread agreement in the scientific community that forest restoration should target those forests that are most likely to benefit, and be prioritized in situations where the risks of no action outweigh those of active intervention (Stephens et al. 2021, Schoennagel et al. 2017). In other words, restoration treatments are most warranted in places where past management (e.g. fire suppression, logging, livestock grazing) has resulted in major alterations to ecosystem structure, function, and composition (Agee & Skinner 2005, Noss et al. 2006a-b, Stevens et al. 2016, Brown et al. 2004, Sherriff et al. 2014). Although some areas still support resilient conditions, available evidence is clear that ponderosa pine and dry mixed conifer forests of the western U.S. -- i.e. those forests that were historically shaped by a frequent (0-35 yrs), low- to mixed-severity fire regime -- have been the most degraded in the last ~150 years (Hessburg et al. 2015, Stephens et al. 2013, Schoennagel et al. 2017). Many of these forests, which are usually found at lower elevations and in relatively warm/dry landscape settings, are currently experiencing dramatic changes, including increasing tree mortality and large, high severity fires (Stephens et al. 2018, Fettig et al. 2019, van Mantgem et al. 2009, Young et al. 2017). ***It is these dry, frequent-fire forests that are most likely to benefit from mechanical treatments and/or the intentional use of managed fire***.

In contrast, forest types that are characterized by a more variable, mixed severity fire regime with longer fire return intervals (35-100+ years; USDA Forest Service 2024) are generally less departed from historic conditions and are therefore less obvious candidates for active restoration treatments. A mixed severity fire regime exists where "the typical fire, or combination of fires over time, results in a complex mosaic of patches of differing severity -- including unburned patches, low severity patches (where the fire may have been a low intensity underburn), moderate severity (~2/3 of vegetation is killed), and high severity patches (almost all vegetation is killed"; Agee 2005). Because these fire regimes are much more variable across space and time, it cannot be assumed that relatively high tree densities or an abundance of shade-tolerant species are the result of human influence (Perry et al. 2011, Hessburg et al. 2016, Christensen 1991). While restoration is likely warranted in some mixed severity forests, scientists have recommended that interventions should be more conservative (DellaSala et al. 2013, 2017, Sherriff et al. 2014, Odion et al. 2014, Frost 2001), be based only on locally collected data on forest change (Lindsay & Johnston 2020, Dickinson 2014, Baker 2017), and treat smaller portions of the overall landscape (Perry et al. 2011, Brown et al. 2004, Noss et al. 2006a-b).

Some researchers have expressed concerns that the 'low severity fire model' does not reflect the full range of historic fire behavior and/or is being incorrectly applied to mixed and infrequent-fire forests, often leading to inappropriate mechanical treatments (Baker et al. 2023, Gutsell et al. 2001, Veblen 2003, Brown et al. 2004, Odion et al. 2010, DellaSala et al. 2013, 2022). For example, Schoennagel et al. (2004) warn: "*Ecological restoration and fire mitigation are urgently needed in dry ponderosa pine forests, where previous research supports this management action. However, we are concerned that the model of historical fire effects and 20th-century fire suppression in dry ponderosa pine forests is being applied uncritically, including places where it is inappropriate*." Similarly, Odion et al. (2014) conclude that "[C]urrent attempts to 'restore' forests to open, low-severity fire conditions may not align with historical reference conditions in most mixed-conifer forests of western North America." Because of these concerns, reviews in this report will evaluate if and the extent to which projects are proposing to use silvicultural thinning and other mechanical treatments in forest types where more open canopies and low tree densities are likely not appropriate and run contrary to ecological goals.

Lastly, in the cool, cold and moist forest types that are typified by infrequent (75-100+ yrs), moderate to high severity fires, it is widely understood that manipulation of fuels or stand structure is almost always inappropriate, because fire suppression has had minimal impact on these forests (Clark-Wolf et al. 2023, Franklin & Agee 2003, Brown et al. 2004, Schoennagel et al. 2004). Tree densities and fuel levels are generally within historical ranges or, in the case of previously logged stands, below characteristic levels (Hood et al. 2021, Sibold et al. 2006, Schoennagel et al. 2011, Jaffe et al. 2023). Altering stand structures would also create forests that may be incapable of fulfilling important ecological functions, including provision of wildlife habitat, hydrological regimes and carbon storage (Noss et al. 2006a-b, Aber et al. 2000, Keane et al. 2008). Moreover, most researchers agree that it's highly unlikely fuel reductions can be effective in reducing fire severity in infrequent-fire forests, because most fires burn under extreme weather conditions and fuel loads are not a primary determinant of fire behavior (Bessie & Johnson 1995, Agee 1993, 1997, Kulakowski &Veblen 2007). For these reasons, active treatments attempting to reduce fire hazard and increase resiliency (e.g. via thinning and/or prescribed fire) in infrequent-fire forests are contrary to the best available science, and more likely to further degrade these ecosystems rather than restore them.

Criteria #3 -- Increase Fire Resilience by Reducing Surface and Ladder Fuels while Retaining and Recruiting Large Overstory Trees

While there is a legitimate need to reduce fuel amounts in many western dry, frequent-fire forests that have been degraded by logging, fire suppression and livestock grazing, all 'fuels' are not the same -- what's most important to consider in terms of fire hazard is their size, location and arrangement (Keane et al. 2012, Agee 1993, 1996, 1997), along with the complex physical and ecological attributes of vegetation that also contribute to fire behavior (Loudermilk et al. 2022). Recognizing these important considerations, wildland fuels are generally classified into three primary classes based on their location in the forest: 1) living tree overstory (canopy), 2) small to intermediate-sized understory or subcanopy trees (ladder fuels), and 3) shrubs, down branches, twigs plus other woody and herbaceous biomass on the forest floor (surface fuels; Sandberg et al. 2001, Graham et al. 1994, 2004). Each of these general fuel classes has a very different potential to influence fire behavior and effects.

Surface fuels, often referred to by the Forest Service as 'hazardous fuels', comprise the most flammable fuel type and tend to be the most important drivers of fire behavior (Stephens et al. 2012, Graham et al. 2004). Ladder fuels provide vertical continuity from surface fuels to the crowns of live canopy trees and are often the second-most combustible fuel component (Andrews 1996), whereas canopy or crown fuels (larger live trees) contribute relatively little to wildfire hazard (Stephens et al. 2009, Agee 1993). A fuel reduction project might address any or all of these elements, but depending on which are targeted, the treatment may not be effective at altering the behavior of unwanted wildfires, or the capacity of the forest to sustain itself in the presence of fire (Stephens et al. 2021). In other words, not every fuel treatment will reduce fire hazard, and if improperly designed, some may actually worsen the problems they are attempting to solve (Reinhardt et al. 2008, Banerjee 2020, Vaillant et al. 2009b).

In order to be effective, fuel treatments must be planned and implemented using a set of established, ecological principles that are based on what is currently known about the relationship between different fuel types, forest structure and fire behavior (Agee & Skinner 2005, Agee 1996). These principles, as summarized in Figure 1, include three interrelated steps or objectives: 1) manage surface

Figure 1. Summary of three generally accepted principles that influence fire resilience in western dry forests, and the relative efficacy of various treatment methods to reduce fire hazard and increase resiliency (adapted from Brown et al. 2004, Agee & Skinner 2005). Treatments with highest efficacy in each category are *<u>italicized/underlined</u>* for emphasis.

PRINCIPLE	TREATMENT METHOD	GENERAL EFFICACY
Reduce surface fuels	*<u>Broadcast burning</u>*	High
	Pile burning	Moderate
	Mechanical removal	Variable (rarely accomplished)
	Selectively thin from below	Low to moderate
	Overstory thinning	None to opposite effect
Reduce ladder fuels & increase canopy base height	Broadcast burning	Low to high
	<u>Selectively thin from below</u>	Moderate to high
	Manual pruning	Variable (rarely accomplished)
	Overstory thinning	Low to none or opposite effect
Protect large, overstory trees	*<u>Retain all large trees in treatments</u>*	High
	Retain additional trees to become large	Moderate to high

fuels, 2) manage ladder fuels to increase canopy base height (defined as the distance from the ground surface to lower crowns of live trees), and 3) retain and recruit large trees. Forests that are treated with these principles will generally exhibit characteristics that limit fire spread and intensity as well as reduce tree mortality, particularly under less than extreme fire weather. Depending on initial conditions at any given site, actions may or may not be necessary to address all three of these steps (with the exception of retaining large trees, which is always essential). For example, a dry, multi-storied forest with heavy in-growth of smaller, young trees will likely benefit from surface and ladder fuel reduction, but existing canopy base height among larger trees may already be sufficient to prevent fire from moving up into the overstory (Agee & Skinner 2005) Agee et al. 2000).

The first and often the most important principle for creating fire resiliency is managing surface fuels, which limits the potential energy of a fire and makes it difficult for flames to move vertically into the canopy (Scott & Reinhardt 2001, USDA Forest Service 2003). In forests where surface fuel loads are determined to be excessive, reducing them can generally be accomplished through one of several treatment options -- prescribed fire, pile burning, or mechanical removal. Prescribed fire (i.e. broadcast burning) is widely recognized as the most effective at surface fuel reduction, distantly followed by pile burning (van Wagtendonk 1996, Agee & Skinner 2005, Evans et al. 2011). While theoretically possible, mechanical removal of surface fuels over significant areas is likely to be much less successful, and due to significant practical and economic limitations, very rarely occurs (North et al. 2015b, Woolsey et al. 2024). It is often suggested that silvicultural treatments -- usually some form of selective thinning -- can reduce surface fuels, but numerous studies have shown that thinning alone can also be ineffective or even lead to the opposite result (Weatherspoon 1996, Kalabokidis & Omi 1998, Agee & Skinner 2005, Reinhardt et al. 2008, Banerjee 2020, Taylor et al. 2022). This is usually because the tree tops, limbs and other woody debris generated by thinning (i.e. 'activity fuels') often remain on-site -- which means that fuels are simply moved from one location (understory or subcanopy) to another that is even more fire-prone (ground surface; Fahnestock 1968, Alexander & Yancik 1977, Carlton & Pickford 1982).

The second fire resilience principle applicable to dry forest management is to reduce the potential for canopy torching -- defined as "the movement of a surface fire up into one or more tree crowns" (NWCG 2005). Torching usually occurs due to both high connectivity of fuels between the ground surface and tree canopies (via ladder fuels), and an increased intensity of surface fire behavior, which is commonly associated with 'jackpots' of heavy surface fuels, conducive terrain features, and/or brief wind gusts (Lyderson et al. 2019, Graham et al. 2004). Where surface fuels are relatively low but the potential still remains for a fire to move into the forest canopy, the obvious and most effective way to reduce this risk is by reducing ladder fuels to increase canopy base height (Agee & Skinner 2005). This can be accomplished through prescribed fire that scorches lower tree crowns, manual pruning of branches and lower crowns (rarely accomplished due to prohibitive costs), or the selective removal of small understory to intermediate-sized trees via thinning (Peterson et al. 2005, Agee 1996). Of these options, thinning from below is generally the most effective, but restraint must be used to avoid removing too many and/or larger trees that are either not acting as ladder fuels or contributing very little to fire hazard: "*Thinning from below can most effectively alter fire behavior by increasing crown base height, and changing species composition to fire-adapted species. Such treatments can reduce the severity and intensity of wildfires*." (Graham et al. 1999)

The third and perhaps most important principle in a fire-resilient forest strategy is to retain the larger, more fire-resistant trees in the stand if they are present (Hummel & Agee 2003, Agee & Skinner 2005, Brown et al. 2004, Allen et al. 2002). Mature and old-growth trees, particularly of early seral species such as ponderosa pine, sugar pine, western white pine, Douglas-fir and western larch -- are very fire-resistant because they have few lower limbs, tall/open crowns and thick insulating bark (Peterson and Ryan 1986, Van Pelt 2008). Among all the common fuel treatments, removal of overstory trees via commercial logging is the least justified, often conducted without a sound ecological basis, and is most likely to be counter-productive. This is because large canopy trees alone contribute little if at all to important aspects of fire behavior (e.g. fire intensity, rate of spread and risk of ignition; Stephens et al. 2009, Agee 1993, Agee & Skinner 2005) and overstory trees often help to mitigate fire hazard by maintaining a moister/cooler/less windy microclimate (Loudermilk et al. 2022, Wolf et al. 2021, Russell et al. 2018, Bigelow & North 2012, Rambom & North 2009, Weatherspoon 1996, Ma et al. 2010). Unfortunately, agency project analyses often do not fully evaluate all the complex ways that logging can influence both fuel structure and forest microclimate over time.

There is abundant empirical evidence that removing large overstory trees from western dry forests often leads to an increase rather than a reduction in fire hazard, because doing so tends to: 1) make forest stands warmer, drier, and windier (e.g. more conducive to fire; Davis et al. 2019, Pimont et al. 2011); 2) dry out surface and ladder fuels more completely for a longer period of time (Banerjee 2020, Russell et al. 2018); 3) transfer small-diameter fuels from the canopy to the ground surface, where they are more available for combustion (Weatherspoon 1996); and 4) stimulate vigorous growth of vegetation in the understory, which then increases surface and ladder fuel loads that are the primary cause of our worst fire problems (Coppoletta et al. 2016, Lyderson et al. 2014, Collins & Stephens 2010, Lauvaux et al. 2016, Chiono et al. 2012, Dombeck 2001). So ***while reducing surface fuels and the density of small understory to intermediate-sized trees may be warranted in some dry forests that have been degraded by logging and fire suppression, the presumed fire/fuels benefits of doing so are likely to be lost or outweighed when larger canopy trees -- described by scientists as the "the key contributor to forest resilience" -- are also removed***.

Proponents for removing overstory trees as part of fuel reduction treatments are likely to argue that retaining all large trees will prevent land managers from meeting forest restoration objectives or reducing the risk of stand-replacing wildfires (Abella et al. 2006, Triepke et al. 2011). But in the large majority of cases, ***removal of these trees is not necessary in order to achieve effective modification of fire behavior***. Following the three primary principles summarized here -- treating surface fuels, reducing ladder fuels (e.g. increasing canopy base heights), and retaining large overstory trees -- will generally be sufficient to produce fire-resilient forest conditions in the vast majority of dry, frequent-fire forests.[3] In areas identified as high priorities for treatment, ecologically-informed fuel reduction must strive for the "sweet spot" by removing enough of the small surface and ladder fuels, while retaining some of the medium and all the large trees to maintain a favorable microclimate, suppress understory growth, create fine-scale heterogeneity and provide for important wildlife habitats. In the longer term, additional provisions must also be made to provide for replacement of the existing larger trees as they die. Where large trees are not present, and a thinning prescription is considered, the largest of the small trees should be reserved.

Consistent with this summary about how to improve fire resiliency in frequent-fire forests, many fire/forest scientists and practitioners working across different regions of the western U.S. have all recommended that fuel treatments focus on the removal of small, suppressed and intermediate trees (usually <16" dbh; North et al. 2009a), particularly of fire-sensitive species that are now overly abundant as a result of past logging and fire suppression (Larson & Churchill 2012, 2024, Addington et al. 2018, Johnson et al. 2023, DellaSala & Baker 2020, Frost 2001, Nelson et al. 1995, Henjum et al. 1994, Allen et al. 2002). ***In many areas, simply reducing the density of smaller trees -- while also retaining larger trees -- will be sufficient to significantly reduce fuels, facilitate the reintroduction of low-intensity fire, and restore more resilient forest conditions*** (Franklin et al. 2012, 2013, Brown et al. 2004, Noss et al. 2006a-c, Wales et al. 2007, Mildrexler et al. 2023, Clyatt et al. 2016, Hessburg et al. 2016, DellaSala et al. 2004): "*We suggest modifying current treatments to focus on reducing surface fuels, actively thinning the majority of small trees, and removing only fire-sensitive species in the merchantable, intermediate size class. These changes would retain most of the current carbon-pool levels, reduce future wildfire emissions, and favor stand development of large, fire- resistant trees that can better stabilize carbon stocks*" (North et al. 2009b; see also Stephens et al. 2009).

Criteria #4 -- Avoid, or at the Very Least Minimize, Impacts to At-Risk Species

Forest restoration and fuels reduction treatments that result in substantial changes to the structure, composition and patterning of vegetation will have both short- and long-term effects on fish and wildlife. Many species will likely benefit from ecologically-based treatments (particularly the reintroduction of fire), but some, such as those that depend on an abundance of dead wood and large patches of closed-canopy and/or multi-storied forest, are likely to be adversely affected. The biota of western forest ecosystems has evolved with fire, but the long-term, cumulative loss and degradation of habitat resulting from human activities (principally logging, road building and fire suppression) have drastically reduced populations of some species to the point where any additional decline may threaten their continued persistence (Jones et al. 2017, Pilliod et al. 2006, Zielinski 2014, Williams & Powers 2024). For these reasons, ***the conservation of at-risk species and their habitats must be an essential element of projects that have restoration, fuels reduction or resiliency goals***. While silvicultural thinning and other treatments may be needed in some western forests, these projects must be carefully designed and implemented to avoid adverse impacts to at-risk species that are known to be sensitive to these management activities. All projects that are included in this review will be evaluated based on this key criteria.

[3] Basal area is often used in projects on federal lands to develop targets for silvicultural thinning and other fuel reduction or restoration prescriptions. From an ecological perspective, however, basal area is a poor metric in this context because it does not reflect important attributes of forest structure associated with differences in tree size. Forests that have the same basal area can look very different on the ground, ranging from stands dominated by many dense, small trees with high ladder fuel loads to those with a few very widely spaced large trees that are already fire resilient. For this reason, estimates of tree density by size/diameter class is a much more appropriate way to characterize forest stand conditions and identify site-specific goals for reducing fire hazard and increasing resiliency.

Integrating forest restoration goals with the conservation of sensitive and at-risk species requires coordinated efforts across multiple scales to improve the quantity and quality of potentially suitable habitat (Hessburg et al. 2016, Allen et al. 2002, Wisdom et al. 2000, Rieman et al. 2003). Management actions aimed at restoring forest structure or reducing fuels should not be so aggressive that they subject these species and their habitats to treatments where the long-term benefits do not clearly outweigh the short-term risks (Tempel et al. 2015, Gaines et al. 2010, Zielinski et al. 2013, 2014, Greenwald et al. 2005, North et al. 2012). More specifically, restoration projects and treatment designs can help maintain the habitat needs of special-status species by: 1) avoiding loss and degradation of high quality habitat, especially of those habitats that are most limiting, 2) focusing on improving habitat suitability in areas that currently offer low to moderate suitability, and 3) not managing "down to the minimum" habitat levels that may be allowed under existing standards and guidelines. ***The important point here is that considerable effort should be made to ensure that any logging-based activities be designed and implemented so as not to place species at greater risk.***

In most western landscapes, a large proportion of high-priority forest restoration opportunities can be implemented without adversely affecting habitat for wildlife of special concern (Gaines et al. 2010, Tempel et al. 2014, Stephens et al. 2014). In those cases where significant conflicts do exist, a detailed risk assessment is warranted prior to treating areas that are recognized as critical habitat or likely function as refugia (Noss & Scott 1997, Lehmkuhl et al. 2007, Ager et al. 2012). Such a risk assessment should be based on a multi-scale, spatially explicit and data-driven analysis of existing and potential future habitat conditions for special-status species, as well as the impact that proposed treatment(s) will have on specific habitat attributes (Ager et al. 2013, Rieman et al. 2000, Stevens et al. 2016, Kelsey et al. 2017). For example, responses of northern spotted owls to modification of nesting and roosting habitat are most influenced by relative changes to structural features such as canopy closure, availability of dense clumps of larger trees, and nesting structures such as mistletoe brooms, defective trees, and large snags (USFWS 2011, Lesmeister et al. 2018). The removal of large trees and snags that could serve as nesting structures would likely reduce nesting opportunities for spotted owls, and the simplification of canopy layering can degrade the thermal and protective properties associated with multi-storied stands (Tempel et al. 2014, 2015).

In situations where mature and old forest habitats may need to be mechanically treated, the focus should be on reducing surface and ladder fuels, as opposed to canopy cover, loss of large trees, snags and down wood that are critical habitat features for many species (Hessburg et al. 2016, Weatherspoon et al. 1992). If projects are designed in a strategic and integrated fashion, leaving some relatively dense patches of trees and other vegetation need not compromise efforts to increase resiliency and reduce landscape-scale fire hazard (Ager et al. 2010, Rieman et al. 2000, Finney 2001, Stephens et al. 2014). And in some places, forest conditions other than historic (e.g., higher tree densities) may need to be maintained in order to provide mature and old forest habitats that were previously much more widespread, at least until such time as suitable habitat can be restored in other portions of the landscape (Wisdom et al. 2000, Allen et al. 2002, Brown et al. 2004, Kelsey 2019). For example, the Final Recovery Plan for the Northern Spotted Owl states that recovery “may call for higher levels of dense late-successional and old forest than historically occurred in many dry forest landscapes” (USFWS 2011).

The implementation of ecologically-based forest management also requires special care to protect at-risk aquatic species and their habitats (Frissell & Bayles 1996, Rieman et al. 2003, Rieman & Clayton 1997). Usually the most significant water-related problems with large-scale fuels reduction and restoration projects are from the construction, chronic use and maintenance of roads (Robichaud et al. 2010). Several extensive literature reviews and numerous published studies relevant to this issue have consistently found that increasing road density is strongly correlated with declining aquatic habitat conditions and watershed health (Gucinski et al. 2001, Trombulak & Frissell 2000, Reeves et al. 2018). This is largely because roads increase background rates of erosion and sediment delivery to streams, which in turn results in numerous deleterious changes to these habitats (Katridis 2020, Jones et al. 2000, Hunsaker et al. 2014, Robichaud et al. 2010). "Temporary" roads are a misnomer -- their use may be temporary, but the adverse effects of road building are often long-lasting, and increases in sedimentation are unavoidable even using the most cautious roading methods (Wondzell 2001, Chokhachy et al. 2016, Madej 2000). Roads also increase human-caused fire ignitions (Syphard et al. 2007, Morrison 2007), contribute to habitat fragmentation (Switalski 2020, Collins 2007, Trombulak & Frissell 2000) and facilitate the spread of invasive species (Adhikari et al. 2020, Gelbard & Belnap 2003). Given these concerns, ***projects should attempt to avoid new road construction and reconstruction, and incorporate practices that are known to help minimize the adverse impacts of road-related actions on aquatic and riparian habitats*** -- particularly in those watersheds that are occupied by at-risk species.

Criteria #5 -- Reintroduce Fire as a Key Ecological Process

The overwhelming majority of scientists agree that efforts to restore western dry forests will not succeed without much more extensive use of fire (North et al. 2012 and 2015, Weatherspoon 1996, Friederici 2003, Weatherspoon & Skinner 1996, Brown et al. 2004, Hardy & Arno 1996). In fact, perhaps the single best criteria for evaluating whether a proposed project can legitimately be called "restoration" in western forests is the extent to which the proposed action will successfully restore a more site-appropriate fire regime -- either through a well-planned, long-term program of prescribed burning (van Mantgem et al. 2011, Ryan et al. 2013) and/or where appropriate, managing wildland fires for resource benefit (Stephens et al. 2021, Huffman et al. 2020). Approaches that do not include an explicit and long-term commitment to restore the natural fire regime as a keystone process will fail to merit the adjective 'ecological' (Allen et al. 2002, Silvas-Bellanca 2011).

The primary reasons why the application of managed fire (preferably managed wildfire and where necessary, prescribed fire) must be an essential element of all restoration projects in western landscapes can be summarized as follows:

- Thinning alone often does not reduce and can actually increase surface fuels, and therefore needs to be combined with fire in order to reduce the risk of high intensity wildfires (Stephens et al. 2009, Martinson & Omi 2013, Lydersen et al. 2017);
- Fire is a keystone ecosystem process that regulates numerous functions in western forests (e.g., nutrient cycling, decomposition, snag creation, carbon retention, seed germination, etc) -- and mechanical treatments cannot replace or replicate many of these important ecological effects (Schwilk et al. 2009, Seidl et al. 2016, Keeley & Safford 2016, Silvas-Bellanca 2011);
- Managed wildfire can be applied to a much larger proportion of the landscape than mechanical treatments, and in many areas, fire alone is often sufficient to create more resilient forest conditions (North et al. 2012, Collins & Skinner 2014, Stephens et al. 2016);
- Application of managed wildfire is often more ecologically beneficial, efficient and cost-effective than mechanical treatments at achieving forest restoration goals, and is the best way to align forest conditions with current and future climatic conditions (Boisramé et al. 2017, North et al. 2012, 2021).

For these reasons, ***managed fire should be considered the preferred tool in the design and implementation of forest restoration projects***. Some frequent-fire forests that have been dramatically altered by past logging and fire-suppression, and therefore may need structural manipulation via thinning or other mechanical treatment before fire can be safely reintroduced. But once some degree of structural restoration is achieved, then managed wildfires should be used as the primary method to shape future vegetation patterns through the dynamic interaction between ecosystem structure and process (Allen et al. 2002, North et al. 2009b, 2012).

With respect to the issue of wildfire hazard, thinning and other mechanical treatments alone tend to perpetuate or even increase surface fuel loads -- unless coupled with prescribed burning (Stephens et al. 2009, Martinson & Omi 2013, Lydersen et al. 2017, Prichard et al. 2020). Consequently, numerous studies have shown that wildfires in areas treated with mechanical methods alone often burn at higher severity compared to sites treated with a combination of tree removal and prescribed fire or prescribed fire alone (Cansler et al. 2022, Finney et al. 2005, Prichard & Peterson 2010, Prichard & Kennedy 2014, Taylor et al. 2022, Wimberly et al. 2009, Davis et al. 2024). In contrast, the effectiveness of prescribed fire to remove surface fuels that spread fires and reduce subsequent wildfire severity is well-documented (Kalies & Yocom Kent 2016, Fernandes 2015, Fernandes & Botelho 2003, Vaillant et al. 2009, Hunter & Robles 2020). So if reduction of fire severity is a stated goal, then ***prescribed fire must be incorporated into project design -- either as a stand-alone treatment in areas where it can be safely applied, and/or as an immediate, short-term follow-up activity in frequent-fire forests that are thinned***. As an initial action, application of fire is not incidental to any thinning or mechanical fuel treatments that may be proposed, but rather essential to restoring ecological processes and provides the only tool available to meaningfully influence landscape-scale fuel loads and wildfire behavior (North et al. 2012, 2014, 2015, Barros et al. 2018, Kolden 2019, Vaillant & Reinhardt 2017, Moritz et al. 2014). Where appropriate and necessary, mechanical fuel treatments should be used as a way of re-establishing natural fire regimes, not as a way of perpetuating the outdated and ecologically flawed policy of fire exclusion.

Despite the well-recognized and critical importance of fire to sustaining ecosystems on western federal lands, full suppression still remains the primary approach, with more than 95% of all fires suppressed and rapidly contained (USDA Forest Service 2015b, Kolden 2019). As a result, many forested landscapes are experiencing a "fire deficit" (Haugo et al. 2019, Marlon et al. 2012). Moreover, by suppressing all wildfires, federal land managers are "preferentially selecting for more damaging fires that burn under more extreme conditions" (Dunn et al. 2020) -- increasing the likelihood of the very outcomes that the agencies are purporting to prevent (USDA Forest Service 2022a-e). In short, the weight of scientific evidence and expert opinion are clear that continued aggressive fire suppression is one of the greatest threats to western forests and is counterproductive to building ecological resilience (Calkin et al. 2015, North et al. 2015, Stephens & Ruth 2005, Walker et al. 2018). Managing fire for its ecological benefits must replace the view that every wildfire is a 'catastrophic' event (DellaSala et al. 2004, North et al. 2015). As stated by Reinhardt & Holsinger (2010), "*Fuel treatments can be expected to function best if they are designed to restore forest ecosystems so that fire can play its natural role … [F]ire exclusion is not a sustainable option for forests of the Interior West. If fuel treatments are simply followed by the status quo of continued fire exclusion, then the...inevitable result will be...higher carbon emissions, greater losses to biodiversity, and larger threats to communities and homes*."

Consistent with the principle of restoring key ecological processes, a central goal in promoting resilience in ecosystems that evolved with fire is to facilitate the reintroduction of fire at an ecologically appropriate frequency, scale, and intensity (North & Keeton 2008, Franklin et al. 2018, Franklin et al. 2007). In frequent-fire forests, this means facilitating surface fires with low and mixed severity fire effects, rather than placing a continued emphasis on fire suppression (North et al. 2012, 2014, Calkin et al. 2015, Weatherspoon & Skinner 1996). While the number of acres treated with prescribed fire has increased somewhat on federal forests in recent years, its current use still falls far short of what is needed to reintroduce the functional role of fire to these ecosystems (Kolden 2019, Vaillant & Reinhardt 2017, North et al. 2024, Williams et al. 2024). Reintroducing prescribed burns in areas where frequent fires have been suppressed is essential not only to restore this key ecological process, but also to help these forests adapt to a changing climate:"*Fire has been a strong historical influence on dry western forests and its repeated application under current fuel and climate conditions is likely to build great adaptability into ecosystems than thinning treatments focused on producing a target stand density and diameter distribution*" (North et al. 2021). Only after the proper reintroduction of prescribed fire will conditions exist to allow for natural fire regimes to burn under safe conditions and serve their proper ecological role.

In forest types that are characterized by more infrequent, mixed or high severity fires, fire restoration objectives will often best be accomplished by the management of unplanned ignitions to achieve resource benefits (i.e., wildland fire use; Meyer et al. 2015, Huffman et al. 2020). Both prescribed fires and managed wildfires have been widely and successfully utilized for many years, primarily in western U.S. national parks and wilderness areas (ALRI 2023, Parsons et al. 1986, Keeley et al. 2021) -- similar approaches should be expanded to include a much larger proportion of the federal estate. Where beneficial fire effects cannot yet be accomplished through managed natural ignitions, prescribed fire should match the site-appropriate fire regime as closely as possible. In all cases, the expanded use of managed wildfires will require extensive scientific input and planning across multiple temporal and spatial scales, so that fires occur at the ecologically appropriate frequency, extent and intensity (Meyer 2015, Huffman et al. 2020, Donager et al. 2022, North et al. 2024). Without a clear, committed plan for reintroduction and maintenance of the natural fire regime, the potential benefits of any proposed project focused on fuel reduction or forest restoration will not last long (DellaSala et al. 2017).

Lastly, the ecologically-informed use of managed wildfire needs to dramatically increase not only across larger areas, but also over longer time frames. Fuel treatments, like all vegetation changes, have temporary effects and require repeated measures over time to maintain desired conditions, should wildfires continue to be excluded from these areas (Graham et al. 1999, 2004, Tinkham et al. 2016). In other words, fuels reduction and forest restoration cannot be successfully accomplished by just a single treatment, even where treatment intensity is high (e.g., a large basal area reduction; Hessburg et al. 2016). Current degraded conditions are the consequence of many decades and multiple human interventions; hence, restoration will likely require similar time and effort (Baker et al. 2023, Noss et al. 2006a-b). Some field and simulation studies have shown that it may take as many as 50 to 75 years, or at least two and as many as seven fire treatments or rotations, to restore beneficial fire regimes to stands and landscapes where fire has been excluded (Baker 1994, Baker et al. 2007). Projects that are ecologically informed will explicitly recognize that initial treatments represent only the first step in a series of management actions that will need to occur over a longer period of time in order to restore the ecologically appropriate role of fire and achieve the goal of restoring fire-resilient forests (Stephens et al. 2021, DellaSala et al. 2004)

Once initial restoration treatments are complete, their length of effectiveness is usually a matter of place (e.g., forest type, site productivity, etc; Jain et al. 2012, Evans et al. 2011, Stephens et al. 2012). Where surface and ladder fuels build up quickly, efficacy may be less than a decade (e.g., Brose & Wade 2002, Kalies & Yocom Kent 2016). Observations from montane forests in Yosemite National Park, where managed wildfires have been allowed to burn, indicate that most fires stop at previous fire boundaries that are less than 20 years old (van Wagtendonk 1994, van Wagtendonk et al. 2012). The important point here is that the presumed benefits of initial fuels reduction or restoration work will undoubtedly be lost and, at best, represent a waste of resources if maintenance treatments are not implemented or managed fire is not allowed to burn at ecologically appropriate intervals. Without explicitly recognizing the need to allow for managed wildfires or that future maintenance burning is necessary, subsequent treatments are likely to be both less effective and more expensive (Stephens et al. 2021). It follows then that ***any effective fuel reduction or forest restoration project needs to recognize and incorporate the critical importance of future maintenance treatments, and develop specific plans for them as part of initial project designs*** (while also recognizing those plans would be authorized through separate project decisions in the future).

V. INDIVIDUAL PROJECT EVALUATIONS

The Gold Butterfly Project on the Bitterroot National Forest (Montana)

Examples of old-growth (L) and mature (R, unmarked to right of figure) Douglas-fir trees planned for logging in the Gold Butterfly project, Bitterroot National Forest. Photo credits: Mac Donofrio

LOCATION: The Gold Butterfly project is planned within an area of 55,147 acres located approximately 10 miles east of Corvallis, Montana (Ravalli County) on the Stevensville Ranger District, Bitterroot National Forest.

PURPOSE AND NEED: "The primary objectives of the Gold Butterfly project are to improve landscape resilience to natural disturbances, such as fire, insects, and diseases by modifying forest structure and composition and reducing fuels" (FEIS 2019, ROD 2023).

PROPOSED ACTION: Commercial logging treatments, "including clearcutting lodgepole pine, commercial thinning, improvement cutting, sanitation harvest and other treatments" (5,281 acres); non-commercial treatments, including mechanical fuels treatment, stand improvement thinning and stand-alone prescribed burning (2,084 acres); road construction, "6.4 miles of new permanent road and 17.3 miles of new temporary road needed to remove timber" (ROD 2023).

CURRENT STATUS: Final Supplemental EIS released February 2023 and Record of Decision issued by Bitterroot National Forest in August 2023. This project is currently under litigation (Alliance for Wild Rockies v. U.S. Forest Service Case No. 9:24-cv-00125) and depending on the outcome, implementation may begin soon thereafter.

ECOLOGICAL EVALUATION:

CRITERIA 1: Does the project include clear and specific protections for existing mature and/or old-growth trees, which are key foundational elements of fire-resistant and resilient forests?

The Record of Decision for the Gold Butterfly Project approves commercial logging on 5,281 acres using a variety of 'intermediate harvest' prescriptions that will result in the removal of an undisclosed number of mature and old-growth trees, including from at least 567 acres of stands that are classified by the Bitterroot National Forest as old growth. The proposed action includes no size, diameter or age limits on trees that can be removed in areas that will be commercially logged -- on this issue the Forest Service states that intermediate harvests will "leave most of the large green trees" and those that will be logged "do not contribute to promoting stands that are resilient to insects and disease"(ROD 2023).

As part of the Gold Butterfly project decision, the Forest Service also approved an amendment to the Bitterroot National Forest Plan that effectively allows for removal of large trees (i.e. >21" dbh) in classified old-growth stands down to a minimum of 8 large trees per acre -- which is 47% fewer than the 15 large trees/acre that is specified in the Bitterroot NF Plan. By using a less protective old-growth definition than what is typically required, the Bitterroot NF has weakened a standard previously established to protect old-growth attributes, which in turn allows for increased removal of large/old trees as part of this project. In addition to large trees lost directly due to logging, there is also a significant amount of new road construction and reconstruction planned in and through existing old-growth stands -- which will likely require additional removal of large/old trees and adversely impact the quality of old growth within the Gold Butterfly project area.

In the documentation for this project, the Forest Service presents no analysis or scientific evidence to support its assumption that reducing large trees "down to the minimum" of 8 trees per acre in old-growth stands will not reduce habitat suitability for associated wildlife, or compromise the ecological functions and values of these forests in other ways. The agency's rationale for logging large trees from within existing old-growth stands is that this would "increase their vigor", and in turn "make them more resilient to insects, disease and fire" (FSEIS 2023). However, a large body of scientific evidence shows that an abundance of large/old trees is not the cause of any purported decline in resilience. In fact, large trees are the most fire resistant and have been identified as the "critical backbone" in these forests, and retaining them is widely recognized as a cornerstone to any ecologically-based management plan (see pp. 10-12 and Appendix).

Overall, the Gold Butterfly project appears to move the Bitterroot NF further away from rather than towards the agency's own desired conditions, because it will result in the loss of large/old trees in an area where the current relative proportion of old-growth (approximately 10%; FEIS 2019) is already well below what has been identified as desirable for the national forest as a whole (15-20%; FEIS 2019). And even the Forest Plan's desired goal for maintaining old forest -- which is higher than what exists today in the project area -- is dramatically less than the relative amount that likely occurred here historically. Lesica (1996) estimated that prior to European colonization, old-growth forest conditions occupied between 20-50% of low- and mid-elevation forest types, and 18-37% in mid- to upper-elevations in this region of the Northern Rocky Mountains.

In summary, the Gold Butterfly project conflicts with the general scientific consensus on ecologically-based forest management, because it plans to remove rather than retain many of the mature and old-growth trees that remain in this area of the Bitterroot National Forest. Available scientific evidence is clear that continued loss of large/old trees is counter-productive, if the goal is to "improve forest resilience to natural disturbances" (see pp. 10-12 and Appendix). Unfortunately, the Forest Service failed to analyze to what extent the project's purpose and need could be accomplished by focusing on removal of subcanopy and understory trees, which are those most likely to have increased in abundance due to past management and that most contribute to increased potential for high-intensity disturbance.

GRADE: F

CRITERIA 2: Do proposed treatments focus on frequent-fire forest type(s) that are likely to exhibit the greatest departure from historic conditions, and therefore in legitimate need of restoration-based management?

The Gold Butterfly project area is comprised of several different forest types that range from warm/dry forests dominated by ponderosa pine and Douglas-fir at lower elevations, to cool/moist and cool/wet mixed conifer forest types (with some combination of Douglas-fir, Engelmann spruce, subalpine fir, lodgepole pine and whitebark pine) at mid- to upper elevations. Historically, a large proportion of the warm/dry forests dominated by ponderosa pine were maintained in a relatively open condition by relatively frequent, low- to mixed-intensity fires (Silviculture Specialist Report 2023). Over a century of 'high-grade' logging, fire exclusion and livestock grazing in the project area have altered the structure and composition of warm/dry forests, such that interventions aimed at reducing the density of small to mid-sized trees (along with reintroducing fire) may be ecologically appropriate. However, this same rationale does not apply to the cooler, more mesic forest types also found in the Gold Butterfly project area.

Of the 5,284 acres proposed for commercial logging, at least 2,516 acres (48% of total) are located in the project area's cool/moist forest types. According to the agency's own analysis, "non-uniform, relatively infrequent and stand replacement fires are most common" in these forests, and their "natural development has not been affected by past fire suppression" (Silviculture Specialist Report 2023). Mixed- and high-severity fire regimes like those in the project area, with fire return intervals that range from 60-400 years (USFWS 2023), result in much more variable stand conditions through time. In other words, application of silvicultural principles developed to restore the structure of warm/dry, frequent-fire forests are not appropriate in these other forest types.

Instead of restoring more open stand conditions at lower elevations, the Forest Service claims that the goal of commercial logging in cool/moist forests is to "reduce their vulnerability to possible severe and undesirable effects from wildfire, insects or disease"(ROD 2023). Yet from an ecological perspective, the presence of native insect and disease agents at endemic levels -- which the Forest Service acknowledges is currently the case in the Gold Butterfly project area -- are not a sign of declining "forest health", but rather an integral part of a healthy forest ecosystem (DellaSala et al. 1995) -- "*Maintaining some forest stands at higher densities where* [tree] *mortality may occur is generally part of an ecologically healthy forest*." (Franklin et al. 2013).

Native insect and disease agents -- including dwarf mistletoe, spruce budworm and mountain pine beetle that were identified by the Forest Service as primary concerns in the Gold Butterfly project area -- have been part of these forests for millennia, and carry out numerous important functions as nutrient recyclers, agents of disturbance, members of food chains, and regulators of productivity, structural complexity and genetic diversity within tree species (Clancy 1994, Peters et al. 1996, Black 2005, Black et al. 2010, Six et al. 2014). Even large outbreaks of insects and disease organisms that irregularly reach epidemic levels are known to have numerous beneficial effects (Haack & Byler 1993, Peters et al. 1996, Schowalter 1994). Spruce budworm, for example, may help maintain ecosystem health by selectively killing weaker, genetically inferior trees and thus increasing resistance to future outbreaks (Alfaro et al. 1982).

Moreover, assertions made by the Forest Service that proposed logging will significantly increase resiliency to insect and disease-related disturbances in cool/moist forest types are not strongly supported by available scientific evidence (see review in Black 2005, 2010). Very little empirical research exists to support silvicultural treatments as a way to control insect populations (Muzikai & Liebhold 2000). For example, although thinning has been touted as a long-term solution to reducing bark beetle outbreaks for many decades, the evidence for the efficacy of control is contradictory (Six et al. 2014, Hughes & Drever 2001, Fettig et al. 2007). Once an outbreak has started, there is no evidence that logging can control bark beetles or tree defoliators (Six et al. 2014, Wood et al. 1985). In some cases, logging and thinning may even create conditions that are more favorable for outbreaks of the very insects that managers are trying to control (Hindmarch & Reid 2001, Cronin et al. 2000). In sum, attempting to control native insect and disease agents in cool/moist and wet forest types is not a valid, ecologically-based rationale for the commercial logging that is proposed.

GRADE: D

CRITERIA 3: If reducing wildfire hazard is an element of the project's Purpose & Need, do treatments focus on reducing surface and ladder fuels (e.g., subcanopy trees, shrubs, coarse woody debris) that most contribute to elevated hazard?

Given that the Forest Service has identified increasing resilience of forests to stand-replacing fire as one of the primary goals of the Gold Butterfly project, to what extent do the approved treatments actually focus on altering forest structure and composition in a way that is most likely to reduce wildfire hazard? The project is comprised of three primary treatment types -- commercial logging using a variety of 'intermediate harvest' prescriptions (5,281 acres), non-commercial mechanical treatments (2,081 acres), and prescribed fire -- either as a stand-alone treatment (489 acres) or subsequent to commercially logging (5,281 acres). Among these, the non-commercial and prescribed fire treatments are most likely to be successful at reducing the density of small (subcanopy) trees as well as surface/ladder fuels that are known to most strongly influence wildfire behavior. However, in commercial logging units, a significant volume of large overstory trees will be removed -- which are not a primary contributor to elevated fire hazard. It is a well-established understanding in fire ecology that large, live trees are generally the most resistant and least susceptible to burning, because they are slow to dry out, difficult to ignite and generally do not influence rates of fire spread (Agee & Skinner 2005, Agee 1993, Rothermel 1983).

The agency's rationale that commercial logging "would reduce the risk and potential for a stand replacement fire" runs most contrary to available scientific evidence when applied to the cool/moist and cool/wet forest types in the project area, where 48% of the commercial logging treatments are planned. According to the agency's own analysis, the fire regime in these higher elevation forests is relatively variable and infrequent (every 60-400 yrs), which means they have been little influenced by fire suppression and typically exhibit high fuel loads irrespective of management.

The large majority of fire and forest scientists have concluded that reducing fuels as a means to influence fire behavior is not appropriate in forests with infrequent fire regimes, because fire weather -- rather than fuels -- is the primary influence on the size, timing, and severity of fires (Keeley & Syphard 2019, Noss et al. 2006, Schoennagel et al. 2004, Bessie & Johnson 1995) -- "*Any efforts to manipulate stand structures to reduce fire hazard will not only be of limited effectiveness, but also move systems away from pre-1850 conditions to the detriment of wildlife and watersheds"* (Brown et al. 2004). Based on these key distinctions, there is sufficient evidence to conclude that commercial logging in cool/moist and wet forests of the Gold Butterfly project will likely result in further degrading these forests rather than reducing fire hazard.

GRADE: D

CRITERIA 4: Is the project designed to avoid, or at the very least effectively minimize adverse impacts to at-risk wildlife species?

The Gold Butterfly project area currently includes habitats that support a number of at-risk animal and plant species, including Canada lynx, bull trout, and whitebark pine that are federally listed under the Endangered Species Act. To what extent are planned management actions aligned with the recognized conservation needs of these species -- or at the very least, do they minimize the risks associated with degradation and/or loss of habitat? Here we primarily focus on these three federally-listed species that the Forest Service analyzed in the EIS. In addition these species, grizzly bears and wolverine are known to occur within or in close proximity to the project area. The Forest Service and the US Fish & Wildlife Service did not evaluate the Project's effects on grizzly bear and wolverine. As a result, it is not feasible to accurately assess whether this project avoids or effectively minimizes adverse impacts regarding these two species. Therefore, the score ultimately assigned to this criteria does not fully reflect the Gold Butterfly project's potential to adversely affect grizzly bear and wolverine populations or their habitat.

Bull Trout

Bull trout are a type of char in the salmonid family of fishes that were once widespread in the waters of northwestern North America but now remain only in small, isolated populations (USFWS 2024). According to the Forest Service, bull trout still occur in 10 streams within the project area, and two of these streams have been designated by USFWS as bull trout critical habitat (Fisheries Specialist Report 2023). All three local bull trout populations are known to be in decline, largely due to human-caused degradation of their habitat (Fisheries Specialist Report 2023). The species has very specific requirements at various points in their life cycle, including cold water temperatures, outstanding water quality, deep pools, complex cover and interconnected waterways to accommodate spawning migrations (USFWS 2024, USFWS 2015).

In their Biological Opinion for the Gold Butterfly project, the US Fish & Wildlife Service concluded that the proposed action "is likely to adversely impact bull trout", largely because of increased sediment delivery to streams from road maintenance, construction and log hauling (USFWS 2021). For example in Willow Creek -- one of the primary watersheds in the planning area occupied by bull trout -- the agency's own analysis found that the proposed action will increase sediment delivery in some locations by up to 789% above baseline levels, and that these impacts would last for up to 11 years (Fisheries Specialist Report 2023). Bull trout are known to be highly susceptible to the long-lasting effects of sediment deposition, which can reduce egg survival, delay emergence of incubating fry from stream gravels, reduce growth rates, and cause direct mortality (USFWS 2015).

The Conservation Strategy for bull trout on USFS lands in western Montana (USFWS 2013) calls for reducing roads and stream crossings in and near bull trout habitat, yet Gold Butterfly project activities will do the opposite, exacerbating already degraded conditions in bull trout habitat. The Forest Service fully analyzed and could have selected another alternative (#3) that would forgo new road construction and deliver significantly less sediment to streams over a shorter period of time, so as to give bull trout a better chance at recovery. Because they failed to do so, the agency's decision clearly does not minimize adverse impacts to this imperiled species.

Canada Lynx

Canada Lynx are mid-sized carnivores that can be found in coniferous forests across 14 states in the US, and due to their increasing rarity, have been federally listed as a threatened species since 2000. Although the Bitterroot National Forest is located within what has been identified as a 'secondary area' in the Canada Lynx Conservation Strategy (Interagency Lynx Biology Team 2013), the species was known to occur in the area historically and at the time of listing (Wildlife Specialist Report 2023). In terms of mapped lynx habitat, the Gold Butterfly project would commercially log 940 acres in the mature, multi-storied forest structural stage, which is used as foraging habitat during winter and for denning in the spring.

These changes to forest structure and cover are in turn expected to reduce the abundance of snowshoe hare, which are the lynx' primary prey (Wildlife Specialist Report 2023). In addition, about 2.4 miles of permanent road and 4 miles of temporary road would be constructed within mapped lynx habitat. Although the Fish & Wildlife Service determined that the Gold Butterfly project is "not likely to adversely affect" the regional lynx population as a whole (USFWS 2021), degradation of lynx habitat from the proposed action would reduce the area's conservation value for this species.

<u>Whitebark Pine</u>

The federally threatened whitebark pine (formally listed in 2023) is relatively widespread throughout the Gold Butterfly project area and is known or has the potential to occur on more than 7,300 acres that are proposed for some form of ground-disturbing activity, including up to 3,082 acres where commercial logging will take place. Logging "could damage or destroy some whitebark pine when equipment or logs drive over or fall on seeds or seedlings, or scrape saplings or mature trees" (USFWS 2023). Prescribed fire, which is planned for all acres where commercial logging occurs, can cause mortality to whitebark pine, and new roads constructed through whitebark-containing forest stands would also likely result in some trees being destroyed. The Forest Service claims that specific guidelines incorporated into project design will result in minimal impacts to this species, but an unknown number of whitebark pines will still likely be damaged or lost.

<u>GRADE: C</u>

CRITERIA 5: Does the project integrate managed and/or prescribed fire into project planning, and also address the timing and necessity of future maintenance treatments?

Abundant research has demonstrated that mechanical treatments alone, such as those planned for the Gold Butterfly project, often do not mitigate wildfire hazard, and subsequent reintroduction of fire is critical to effectively reduce surface fuels. (Stephens et al. 2009, Martinson & Omi 2013, Prichard et al. 2021). Given this, to what extent does the Gold Butterfly project promote the reintroduction of beneficial fire through specific actions that help return this key ecological process to the landscape? The selected alternative approves the application of prescribed fire on 5,281 acres subsequent to commercial logging, as well as 489 acres of stand-alone or maintenance prescribed fire use. Taken together, these acres represent ~10% of the 55,147 acre Gold Butterfly project area. While this application of prescribed fire represents a positive step toward the important goal of restoring fire to this landscape, agency documents lack any analysis that explains why additional acreage was not also proposed for burning.

Moreover, research indicates that warm/dry pine-dominated forests similar to those in the Gold Butterfly project area will need follow-up treatment within 10 to 15 years in order to maintain low fuel loads and more open stand conditions that are associated with low-intensity fires (Stephens et al. 2012, Evans et al. 2011). Unfortunately, the Forest Service fails to present a longer-term plan for how fuels reduction and more open stand conditions will be maintained in the future, or when such follow-up treatments should be implemented. Without a long-term plan, one-time reductions in fire hazard and fuel loads are likely to be short-lived and have limited benefits.

<u>GRADE: C</u>

Bitterroot Front Restoration Project, Bitterroot National Forest (Montana)

Old-growth ponderosa pine stand potentially open to commercial logging as part of the Bitterroot Front Restoration Project, Bitterroot National Forest, Montana. Photo credit: Jeff Lonn

LOCATION: The Bitterroot Front Restoration Project (hereafter referred to as BFRP) is planned within a 143,340 acre project area located along the eastern front of the Bitterroot Range from near the community of Florence in the north and extending south to Darby (Ravalli County, MT), on the Stevensville and Darby Districts of the Bitterroot National Forest.

PURPOSE AND NEED: The stated primary purpose of the Bitterroot Front Restoration Project is "to reduce the wildfire risk to the nearby communities, promote forest restoration, and...return the forest to a healthy and resilient ecosystem, which includes high-frequency and low-intensity fire. Additional benefits would include improving vegetation, watershed, wildlife and fish habitat, and transportation resources." (Draft EA 2023)

PROPOSED ACTION:

The proposed action for the BFRP includes a range of different area-based treatments that are identified in Draft EA (2023) as follows: 1) commercial logging using 'intermediate harvest prescriptions' followed by prescribed burning (27,477 acres), 2) non-commercial 'whitebark pine restoration' followed by prescribed burning (35,575 acres), 3) non-commercial 'stand improvement' coupled with prescribed burning (3,163 acres), 4) stand-alone prescribed fire (which also includes pile burning; 54,046 acres), and 5) 'slashing' and prescribed burning (18,019 acres). Other activities without any estimated acreages include "tree planting, meadow restoration, aspen restoration, native revegetation, biological weed control, mastication, herbicide weed control, hazard tree removal, and chipping" (Draft EA 2023). Some of these treatments are likely to overlap on the same areas. For example, a stand may be subject to both commercial logging, mastication or other fuels treatment, followed by prescribed fire. Under the proposed action, mechanical treatments can also occur within inventoried roadless areas, provided that such activities are within 1/4 mile of existing roads.

In addition to the area-based management actions summarized above, the BFRP preferred alternative proposes 1.98 miles of new system (permanent) road construction, 27 miles of temporary road construction and 8.54 miles of existing unofficial roads added to the permanent road system. Potential road improvement or reconstruction actions include road grading, clearing, brushing, resurfacing and hazard tree removal in road corridors. The EA does not specify the methods and locations of roads that would be upgraded or newly constructed, due to its use of 'condition-based management approach' -- which means the Forest Service does not provide locations or boundaries of any proposed management actions. Site-specific locations, prescriptions and details of treatments are to be determined at some unspecified point in the future over the lifespan of the project, well after the NEPA process is completed. Implementation of the proposed action would occur in four phases, over a period of up to twenty years (Draft EA 2023).

CURRENT STATUS: A Draft Environmental Assessment (EA) for the Bitterroot Front project was released by the Bitterroot National Forest in August 2023, selecting the 'action alternative' (relative to 'no action') as the preferred option. A Final EA and Decision Notice are expected in 2024, and implementation may begin soon after. The project is not subject to an objection as it is being authorized under the emergency authority under the Infrastructure Investment and Jobs Act (Section 40807) of Public Law 117-58, passed on November 15, 2021.

ECOLOGICAL EVALUATION:

CRITERIA 1: Does the project include clear and specific protections for existing mature and/or old-growth trees, which are key foundational elements of fire-resistant and resilient forests?

The Draft EA for the Bitterroot Front project proposes commercial logging on up to 27,477 acres, using 'intermediate harvest' prescriptions that will potentially result in the removal of mature and old-growth trees, including from stands that are currently classified by the Bitterroot National Forest as old growth. Given the central importance of this issue to any management plan labeled 'restoration', it is surprising that the amount and location of old growth within the project area are not disclosed, nor is there any information about the abundance and distribution of large/old trees in stands proposed for logging. Of even greater concern is that the proposed action includes no size, diameter, species or age limits on trees that can be removed from stands that will be commercially logged -- on this issue the Forest Service only states that treatments "would be proposed within old-growth stands to increase the stands' resilience to insects, disease, fire and drought" and "will be based on site-specific stand data as well as how that stand fits into the greater landscape" (Draft EA 2023).

In order to remove large-diameter trees from some stands, the proposed action includes an amendment to the Bitterroot National Forest Plan that will apply less protective criteria regarding the definition and management of existing old growth. By adopting the old-growth definitions from Greene et al. (2011), this Forest Plan amendment permits logging of large trees (i.e. >21" dbh) in old-growth stands down to a minimum of eight large trees per acre -- which is 47% fewer than the 15 large trees/acre required by the Forest Plan. The Draft EA claims that "treatment units containing old growth would retain their old growth status" after logging, but the fact remains that the amendment enables the agency to remove trees > 21" dbh that would otherwise be disallowed. Irrespective of which definition or methodology the agency uses to identify old-growth, the primary concern is that the proposed action fails to ensure the retention of large/old trees in treatment units, wherever they occur.

Given that the agency's purported goal -- as repeatedly emphasized in the Draft EA -- is to increase forest resiliency and perpetuate large trees, the proposed action should simply include an upper diameter limit of trees by species that can be removed. The Bitterroot National Forest has previously adopted this general approach on other projects, such as the Como Forest Health Project, where no trees >20" dbh were removed in treatment units that contained old growth (Bitterroot National Forest 2015): "*By retaining trees 20" dbh or larger, we* [USFS] *will retain all the trees that qualify as old growth and provide replacement trees as the older, larger trees age and die*" (Bitterroot National Forest 2016). As they did in this case, the Forest Service can choose to retain larger trees as part of project design and implementation, without the need for a Forest Plan amendment.

In addition to weakening protections for old growth, the proposed amendment would also exempt the BFRP from Forest Plan standards that require "old growth stands be 40 acres or larger" in designated old-growth management areas. In the documentation for this project, the Forest Service presents no analysis or scientific evidence to support its conclusion that eliminating the minimum stand size in old-growth management areas, in addition to reducing large-diameter trees 'down to the minimum' of eight per acre in old growth, will not significantly reduce habitat suitability for at-risk wildlife, or compromise the ecological functions and values of these forests in other ways. This is particularly concerning, given that large trees are now rare relative to their historic abundance, are generally the most fire, insect and drought-resistant cohort, and retaining them is widely recognized as the cornerstone to any ecologically-based management plan (see large/old trees summary, pp. 10-12 and Appendix). While important details are missing from the Draft EA, it's clear that the Bitterroot Front project as proposed will put many large/old trees at risk of loss due to logging.

GRADE: D

CRITERIA 2: Do proposed treatments focus on frequent-fire forest type(s) that are likely to exhibit the greatest departure from historic conditions, and therefore in legitimate need of restoration-based management?

According to data on tree species dominance presented in the Draft EA, the Bitterroot Front project area primarily consists of three forest types: at lower elevations, warm/dry forests dominated by ponderosa pine and, to a lesser extent, Douglas-fir (~43% of forested area), which transition to cool/moist stands containing a mix of lodgepole pine, Douglas-fir, subalpine fir, and Engelmann spruce at mid-elevations (~31%). At the highest elevations are cold forests (~5%) containing a mix of whitebark pine, subalpine larch, subalpine fir and lodgepole pine. If the project area is divided into Habitat Type Groups, defined as "landscape units having similar biophysical characteristics, historical disturbance regimes, stand structure and composition", then 57% of forests are classified as 'warm/dry', 20% are 'cool/moist' and 23% are 'cold' (Vegetation Report 2023).

In the Northern Rockies including the Bitterroot Front project area, relatively frequent, low- to mixed severity fire regimes are largely confined to warm/dry forests where ponderosa pine was historically dominant (Hood et al. 2021, Baker 2009, Fischer & Bradley 1987, Arno et al. 1995, 1997)[4]. As one moves up in elevation into the moister and cooler forest types, mean intervals between fires rapidly increase and mixed- to high-severity fires become dominant (Baker 2009, Stohlgren et al. 2002, Parks et al. 2014). Due to the disproportionate impacts of fire suppression and past timber management, it has been widely recognized that warm/dry forests found at lower elevations are the most departed from historical conditions and in greatest need of restorative management (Noss et al. 2006, Schoennagel et al. 2004, 2011, Brown et al. 2004, Baker et al. 2007). So, to what extent does the proposed action appropriately focus on restoring structure and composition in these frequent-fire forests?

[4] According to analysis conducted as part the Bitterroot Front Draft EA, ~33% of the project area (47,887 acres) supports ponderosa pine and dry Douglas-fir forest types that are associated with a frequent, low and mixed severity fire regime (BFRP Fire & Fuels Report 2023).

Unfortunately, BFRP planning documents include little information about how proposed treatments will be distributed across different forest types and landscape settings. This is in part due to the 'condition-based management' approach that the agency is attempting to use in this case. Rather than describing various resource conditions across the project area and analyzing site-specific information to determine which management actions are appropriate in different areas, the Forest Service is instead seeking to approve a wide range of potential treatments over many thousands of acres, leaving the actual decision of what will be done where until after the project is finalized. Given the lack of site-specific information, it is impossible to fully disclose the potential impacts, because the details and location of each treatment unit is not known and cannot be analyzed in any spatial context. Impacts will vary widely, depending on what specific types of treatment are implemented and where they are located.

The Forest Service claims that the possible impacts from the Bitterroot Front project have been adequately disclosed in the Draft EA because their analysis assumes that the maximum potential treatment area, and thus the maximum impacts, would occur (Draft EA 2023). However, the disclosure of potential impacts is very cursory and not tied to specific areas. Impacts from implementing a management action in one area will be very different from those in another. For example, silvicultural treatments that are specifically designed in relation to the frequent-fire, warm/dry forest type may be applied to cool/moist or even cold forest stands, which would lead to a number of adverse ecological effects that run contrary to the project's stated restoration goals. On this issue, researchers have repeatedly cautioned land managers that the dry pine silviculture model should not be extrapolated to other forest types that are typified by less frequent, mixed- or high-severity fire regimes (Schoennagel et al. 2004, Schoennagel & Nelson 2011, Baker et al. 2007, Odion et al. 2014, Sherriff et al. 2014, Noss et al. 2006).

While it is not possible to specifically determine how much logging is proposed in the different forest types or fire regime groups as part of the BFRP, the Draft EA does make clear that a significant proportion of treatments will occur in forests located above the frequent-fire, warm/dry pine-dominated portion of the landscape. This is problematic from an ecological perspective, because it has been well-established that cool/moist and cold forest types usually burn at relatively long intervals (i.e. 35-200+ yrs) with mixed or high severity fire effects -- which means their structure and composition are often not significantly departed from historic conditions (Baker 2009, Schoennagel et al. 2004, Fire & Fuels Report 2023)[5]. In the context of forest restoration, there is rarely if ever an ecological justification to commercially log cool/moist (and other mid- to high- elevation) forests in the project area (Schoennagel et al. 2004, Brown 2000, Brown et al. 2004, Noss et al. 2006), especially given the large backlog of thinning treatments that exists in the warm/dry zone at lower elevations.

BFRP planning documents do not present any evidence that cool/moist and cold forests have experienced measurable shifts in stand structure or other attributes over recent decades, or that planned commercial logging will effectively increase ecological resiliency. Regarding what management actions will take place in mid- to high-elevation forests, the Forest Service only states that "treatments shall vary across the landscape for diversity, forest health, wildlife habitat, and esthetics", and will employ a wide range of silvicultural prescriptions including "improvement cut and commercial thin, group and single tree selection, seed tree and shelterwood cut or clearcut with reserves" (Vegetation Report 2023). In short, ***the Bitterroot Front project completely lacks any ecological basis for logging-based treatments in cool/moist and cold forests, and in no way can they be considered to "promote forest restoration"*** as the Draft EA suggests. The proposed action would be better aligned with an ecologically-based approach if mechanical treatments were specifically focused on the warm/dry forest zone, where a solid consensus exists that silvicultural interventions are often warranted (Schoennagel & Nelson 2011, Odion et al. 2016, Noss et al. 2006)

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[5] It's noteworthy that the Forest Service's own analysis of relative change in forest composition, structural stage and canopy closure across the Bitterroot Front project area shows that only 22% of existing stands are "strongly departed from historic conditions" (Condition Class III), which the agency typically uses as "an indicator for fuel reduction needs." (Fire & Fuels Report 2023, p. 6)

GRADE: F

CRITERIA 3: If reducing wildfire hazard is an element of the project's Purpose & Need, do treatments focus on reducing surface and ladder fuels (e.g., subcanopy trees, shrubs, down woody debris) that most contribute to elevated risk of high intensity fire?

Given that the Forest Service has identified "reducing the risk of wildfire" and "returning the forest to a healthy and resilient ecosystem" as primary goals of the Bitterroot Front project, to what extent do the proposed treatments actually focus on altering forest structure and composition in a way that is most likely to reduce fire hazard? Of the range of treatments that are part of the BFRP proposed action, stand-alone use of prescribed fire (54,046 acres), 'non-commercial whitebark pine restoration' followed by prescribed burning (35,575 acres), 'slashing' followed by prescribed burning (18,019 acres), and non-commercial 'stand improvement' coupled with prescribed burning (3,163 acres) are most likely to make effective progress toward this goal (Draft EA 2023). This is because these treatments are focused on the surface, ladder and understory fuel components that are known to exert the strongest influence on wildfire behavior (Agee & Skinner 2005, Skinner et al. 2005, Rothermel 1983, Peterson et al. 2005).

In terms of wildfire hazard, the strongest element of this project is the application of landscape-scale prescribed fire as a primary method of fuels reduction, either as a stand-alone treatment or subsequent to other management actions. A large body of published research has clearly shown that understory or broadcast burning is by far the most effective means of reducing surface fuels in dry western forests (North et al. 2012, Stephens et al. 2009, Fernandes 2015, Fernandes & Botelho 2003, Prichard et al. 2010). Widespread application of prescribed fire is also important because it returns this key process to the landscape, the ecological effects of which cannot be replaced or replicated by thinning or other mechanical treatments (Cappoletta et al. 2019, Kolden 2019, Krofcheck et al. 2017). However, it's important to note that the estimate of prescribed fire use in the project area is in no way assured, since the preferred alternative only presents the maximum number of acres where fire may be applied at some point in the future. Moreover, the BFRP Draft EA conspicuously lacks any discussion of how the Bitterroot National Forest plans to dramatically increase the scale of prescribed fire use, and in the case that all eligible acres cannot be burned, which lands should be prioritized and for what reasons.

Due to the agency's reliance on the 'condition-based management' approach, details about how the range of silvicultural treatments will be designed and implemented on-the-ground in the Bitterroot Front project area are lacking in the Draft EA, which makes it difficult to fully evaluate effects on fuels and potential fire behavior. However one positive element of the proposed action is that it apparently includes non-commercial fuels treatments in existing plantations, which often exhibit high fuel loads, are highly combustible and frequently contribute to high intensity wildfire (Kobziar et al. 2009, Thompson et al. 2011, North et al. 2019, York & Russell 2024). As stated in the Draft EA (2023), "Non-commercial thinning treatments would be applied to dense stands of single-aged plantations to alter the species' composition and promote health and vigor in early seral species." Reducing surface/ladder fuels and altering stand structure in overstocked tree plantations is sorely needed, and may help reduce the likelihood that these flammable structures will lead to undesirable wildfire behavior in the future (Stephens et al. 2020, Zald & Dunn 2018, Levine et al. 2022).

In contrast, the most significant shortcoming of this project relevant to wildfire and fuels concerns is the planned removal of many large, overstory trees from differing forest types across the landscape. The BFRP's Fire & Fuels Report (2023) describes very clearly that the primary issue with respect to increased wildfire hazard in the project area is not an overabundance of large-diameter trees, but rather elevated levels of surface and ladder fuels --

> "The lack of fire has increased the density of ***small-diameter*** Douglas-fir and mixed-conifer species. The conifer regeneration and tall shrubs are considered ladder fuels, capable of transitioning a surface fire into the canopy. In addition to increased stand density, there is also

an increased accumulation of downed woody debris in many areas due to past fire suppression...As the frequency of fires lengthened through the 1900s, accumulations of surface and ladder fuels have increased and allowed for stand-replacing wildland fires to become more common." (emphasis added, Fire & Fuels Report, 2023)

The agency's plan to remove many large canopy trees, ostensibly based in part on the rationale of fuels reduction, either ignores or conflicts with available scientific evidence that these trees constitute the least flammable forest fuel type (Graham et al. 2004, Agee & Skinner 2005), generally do not contribute to wildfire spread (Rothermel 1983), and tend to be more resistant to fire, drought and changing climate conditions than smaller/younger trees (Larson et al. 2015, Philips et al. 2003, Carnwath & Nelson 2016, Stevens et al. 2020).

If the agency were to conduct a thorough review of the published scientific literature relevant to this issue, they would find that a large body of evidence strongly supports the conclusion that ***reducing wildfire hazard and increasing resilience in western dry forests does not require widespread cutting of large-diameter trees***. In most cases, favoring early-seral tree species can be achieved by focusing on removal of smaller (subcanopy) trees and reintroducing surface fire -- which is very likely the case for many areas that are being proposed for commercial logging in the BFRP. Clyatt et al. (2016) -- based on a study of tree spatial patterns conducted in the Bitterroot National Forest -- is one of many published studies that make this same basic conclusion:

> "In the context of forest restoration, we recommend that managers take the divisive issue of old tree harvest off the table, and instead focus on thinning young in-growth trees (i.e., those trees that established after Euro-American settlement and disruption of frequent fire regimes) that have established around and among old trees and tree clumps. Focusing harvest on young trees will reduce competition, continuity of crown fuels, and contagion of host-specific tree enemies such as bark beetles, without causing conflict over proposed harvest of any remaining large trees. Such an approach is consistent with current guidelines for restoration and climate change adaptation in dry ponderosa pine and mixed-conifer forests."

GRADE: C

CRITERIA 4: Is the project designed to avoid, or at the very least effectively minimize adverse impacts to at-risk wildlife species?

The Bitterroot Front landscape supports populations of a number of at-risk wildlife species, including several listed under the federal Endangered Species Act, that will be affected by this project. It is perhaps telling that the BFRP will authorize significant modification of forest and aquatic habitats across more than a hundred thousand acres of the Bitterroot National Forest, and yet the conservation of sensitive species is not listed as part of the project's purpose and need. This section evaluates whether and to what degree the Bitterroot Front project's proposed action strikes a reasonable, science-informed balance between active management treatments designed to reduce fire hazard and promote forest restoration, and the risk of irreparable harm to three well-known species in the planning area -- bull trout, fisher and whitebark pine.

Bull Trout

Bull trout, a type of char in the salmonid family of fishes, were once abundant and widespread in the waters of northwestern North America but have declined dramatically over the last century and now remain only in small, isolated populations (USFWS 2015a,b). The species was federally listed as a threatened under the Endangered Species Act in 1998, and has also been designated by the State of

Montana as a 'Species of Greatest Conservation Need' (MT Field Guide 2024). Bull trout have very specific habitat requirements at various points in their life cycle, which include cold water temperatures, complex forms of instream cover (i.e. deep pools, undercut banks, many large logs), clean spawning and rearing substrates, and connected habitats to fulfill migratory life histories (summarized in USFWS 2015a,b). Because many of these essential habitat features are dependent on watershed conditions as a whole, the species is often considered a bioindicator of overall aquatic ecosystem health (Fraley & Shepard 1989, Rieman & McIntyre 1993).

Bull trout populations and their critical habitat are distributed throughout the Bitterroot Front project area. At least 18 streams are known to contain this species, and nine streams have been designated by the USFWS as critical habitat, totaling 29 stream miles in the project area (Watersheds & Aquatics Report 2023). These populations are all in decline, largely as a result of aquatic habitat degradation, but also due to competition with other fish, increasing water temperatures, poor water quality, reduced water flows and other factors (USDA Forest Service 2013, MBTSG 1995). Currently, there are believed to be only ~200 adult fish remaining in the Bitterroot River watershed, which is dramatically below all historic estimates (USDA Forest Service 2013). Although monitoring of these streams is considered "largely inadequate", it is believed that site extirpations continue to exceed new colonizations, particularly in lower elevation streams (USDA Forest Service 2013). Additional impacts associated with the BFRP are likely to worsen the already dire situation for this threatened species.

The proposed action includes a range of ground-disturbing activities in watersheds and near occupied stream reaches that are known to have detrimental effects on bull trout and their habitat. Timber harvest, road construction and log hauling are particularly harmful to this species, because they increase sediment delivery to streams (USFWS 2015a-c, Baxter et al. 2011). Sedimentation negatively affects bull trout by reducing pool depth, altering substrate composition, and destabilizing stream channels (Schälchli 1992, US Forest Service 2013). The most damaging impacts usually occur when logging and road use occur within 300 feet of streams, which also reduces recruitment of large woody debris and increases water temperatures (USFWS 2015c, Rieman & McIntyre 1993). Numerous studies have shown that log-truck traffic substantially increases sediment levels in nearby streams, and the more log-truck use over a longer timeframe, the greater that sediment-related impacts will be (Reid & Dunne 1984, Foltz 1996, Luce & Black 2001, Sheridan et al. 2006, Sugden & Woods 2007).

Although the Forest Service's own documents broadly admit that some adverse effects on bull trout are likely to occur from implementation of this project, the site-specific impacts to particular populations and stream reaches have not been analyzed or disclosed, because the location of proposed actions are not yet known. The lack of site-specific analysis as it relates to bull trout significantly increases the risk that a particular action could lead to loss of local populations and/or long-lasting degradation of critical habitat across the project area. Yet the agency appears to tersely dismiss this concern -- "Although sediment delivery would temporarily increase with the proposed action which would adversely affect some bull trout and bull trout critical habitat, the extent of these effects is limited" and "too small to measure" (Watersheds & Aquatics Report 2023). Without completing a site-specific analysis, there is no way to know if this is in fact the case.

Instead of analyzing site-specific effects, the Forest Service relies on project design features and mitigation measures included as part of the proposed action to conclude that adverse impacts to bull trout and their habitat will be minimal -- "As long as the design features are properly followed [assumed will be 100% compliance], aquatic resources will be sufficiently protected" (Watersheds & Aquatics Report 2023). The Forest Service, however, does not present any empirical evidence or supporting research showing that proposed 'best management practices' will be effective at avoiding adverse impacts to this species, nor does it include a plan that specifies how mitigation measures will be incorporated into project implementation. In addition, some mitigation measures are either vaguely-defined or appear to be non-binding -- which means it is highly uncertain they will be consistently applied under the 'condition-based' management approach the Forest Service has adopted for this project. The last thing these struggling bull trout populations need is more human-caused degradation of habitat, but available evidence suggests that's likely what the outcome of the Bitterroot Front project will be.

Fisher

The fisher, a mid-sized, forest-dwelling carnivore in the weasel family, is classified as a 'Species of Concern' by the State of Montana, as well as a 'Sensitive Species' and 'Management Indicator Species' by all national forests in the Northern Region (western Montana and Idaho). The Northern Rocky Mountain population of fisher is recognized as a population that is isolated and distinct from others in North America, and partly for this reason has been considered for listing under the federal Endangered Species Act (USFWS 2017). In terms of habitat, fishers are typically found in large, connected tracts of mature and old-growth conifer forest, particularly at low to mid-elevations in areas with large trees, dense overhead canopy cover, and structural complexity with abundant snags and down wood (USFWS 2017, Olson et al. 2014, Raley et al. 2012). Forests that have been heavily logged and are dominated by younger stands appear to be significantly less suitable and are often unoccupied by this species (Schwartz et al. 2013, Sauder 2014, Jones & Garton 1994).

Although details regarding the number and distribution of fisher in the Northern Rockies are scant, the Bitterroot Mountains are considered a stronghold for the species in Montana (USFWS 2017, Vinkey 2003). These animals are a remnant of a native population that persisted near the Montana–Idaho border, even after trapping extirpated fishers from most other parts of the region (Vinkey et al. 2006, Schwartz 2007). Individuals have been consistently documented on this portion of the Bitterroot National Forest, particularly in the lower-elevation, heavily forested creek drainages within and adjacent to the Bitterroot Front project area (Inman et al. 2021, Olson et al. 2014). The Forest Service confirms that "fishers have been detected at bait stations in the [Bitterroot Front] project area, but they are uncommon." (Wildlife Report 2023).

The widespread and significant reductions in overstory canopy cover and changes in forest structure that are planned across the Bitterroot Front project area are likely to have significant consequences for fisher, because the species avoids open areas and favors dense forests with large trees and down wood. The adverse impacts of commercial logging on this species are summarized in USWFS (2017): "Timber harvest has significant potential to alter the suitability of a landscape for fisher...The loss or reduction of canopy cover and large trees are two primary habitat effects that can displace individual fisher or result in fisher not using parts of former home ranges." Moreover, "loss of canopy cover due to timber harvest can decrease connectivity among suitable habitat patches, limit fisher movement and potentially reduce gene flow across the Northern Rocky Mountains."

Despite well-established concerns about the potential impacts of logging on fisher, the Forest Service concludes, without presenting any supporting analysis or documentation, that the Bitterroot Front project will have very little or no impact on this at-risk species. The agency's 'no effect' determination is based on vague, unsubstantiated statements that "the project area is likely marginally suitable habitat" and "most of the proposed treatments within fisher habitat would retain large trees" (Wildlife Report 2023). Yet the best currently available data shows that the Bitterroot Front project area includes thousands of acres of suitable fisher habitat (USFWS 2017, see Figure 2), of which a significant acreage is now proposed for commercial logging and/or other modification. And even if proposed treatments were to retain all large trees (which they will not), the agency's own documents show that other important attributes of fisher habitat will be dramatically reduced.

In order to properly evaluate the risks posed to fisher by this project, it is necessary to estimate the degree that key habitat components -- particularly large tree density, canopy cover and structural complexity (large down wood, snags) -- will change due to proposed management actions. Unfortunately, fisher habitat characteristics are not site-specifically analyzed or even discussed in BFRP planning documents. Without this information, it is impossible to conclude that the project will have 'no adverse effect' on fisher, as the Forest Service has done. Moreover, the Draft EA does not address the issue of larger-scale habitat connectivity for this species, which may be particularly relevant in this case because the project area includes a regionally-important movement corridor (see Figure 2). For these reasons, it seems apparent that the Forest Service is attempting to downplay or dismiss concerns about the potential impacts of this project on fisher, and fails to include any actions that would help minimize the potential for adverse consequences on this species.

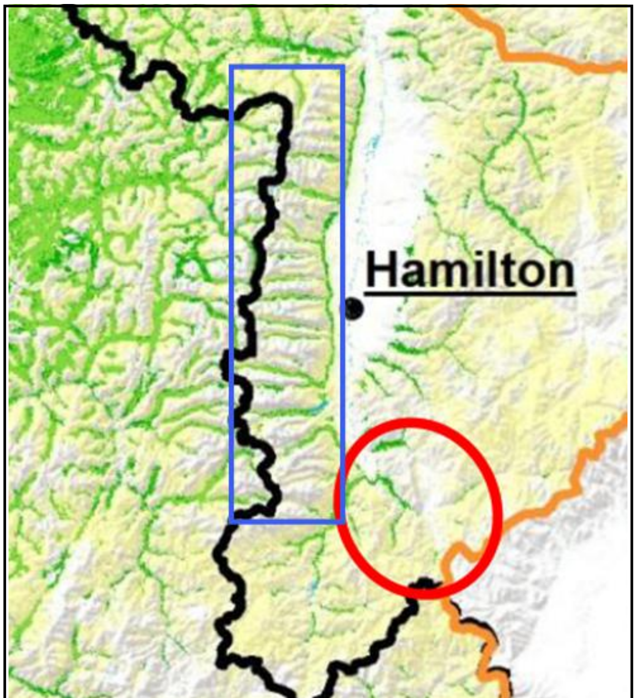

Figure 2. Estimated suitable fisher habitat (in green) overlaid by canopy cover greater than or equal to 40 percent (yellow) in the general vicinity of the Bitterroot Front Restoration Project area (blue rectangle). The red oval depicts a strategically important east-west corridor for fisher movement identified by USFWS within the larger Northern Rocky Mtns region (excerpted from USFWS 2017).

Whitebark Pine

The federally threatened whitebark pine -- formally listed under the Endangered Species Act in 2023 -- is known to occur throughout the mid- to upper elevation forests of the Bitterroot Front project area. According to the Draft EA, there are 9,990 acres of existing whitebark pine habitat and 57,840 acres of potential whitebark pine habitat in the project area (Vegetation Report 2023). The Forest Service has no plans to conduct field surveys to identify where whitebark pines actually occur, and since the project is based on a "condition-based" management approach, it is unknown where various activities will be implemented. Given this lack of information, it is reasonable to conclude that significant potential exists for adverse impacts to this species -- both directly from actions that may damage whitebark pine stands or individual trees, and indirectly through degradation of habitat.

Under the preferred alternative, a number of different ground-disturbing activities may be implemented in whitebark pine habitats, including 'intermediate harvest', 'stand improvement', prescribed burning, 'slashing', tree planting, mastication, hazard tree removal, and chipping (Draft EA 2023). Although the Draft EA states that whitebark pine trees would not intentionally be removed, the agency acknowledges that "there is potential for adverse effects from removal or modification [of trees] during vegetation treatments or from fire treatments", and for this reason the project "is likely to adversely affect whitebark pine" (Draft EA 2023). In an apparent attempt to mitigate these impacts, the proposed action includes up to 54,883 acres of 'whitebark pine restoration', which involves "daylighting" [i.e. thinning] trees and pruning lower branches to reduce blister rust and high-severity wildfire mortality risk." But the Forest Service presents no scientific evidence that these actions are likely to be effective at increasing whitebark pine survival. To the contrary, some researchers have suggested they are either unnecessary or can be deleterious.

Tomback (2021) and Tomback et al. (2022) state that "daylighting" around individual trees as proposed for many thousands of acres in the BFRP has never been tested for effectiveness, which means presumed benefits declared by the agency are at best speculative. According to Robert Keane, noted USFS expert on this species, silvicultural interventions in whitebark pine stands are often unnecessary, and land managers should "let wildfire do the work" (Keane 2017, 2021). Similarly, Six et al. (2021) recommended that "where silvicultural practices are applied [in whitebark pine stands], they should be implemented with caution [because] anthropogenic change is creating or enhancing a number of stressors on forests. To aid forests in adapting to these stressors, we need to move beyond traditional spacing and age class prescriptions and take into account the genetic variability within and among populations, and the impact our actions may have on adaptive potential and forest trajectories." Until greater consensus emerges on where and how silvicultural methods should be applied so as to benefit this species, the very large area of whitebark pine habitat that is planned for mechanical treatments seems ill-advised and unwarranted.

GRADE: D

CRITERIA 5: Does the project integrate managed and/or prescribed fire into project planning, and also address the timing and necessity of future maintenance treatments?

One of the most essential elements of any project that is referred to as 'restoration' is whether the proposed management plan will successfully restore fire, since it is only through this keystone ecological process that fire regimes, stand structures and ecosystem resilience can ultimately be restored or maintained (Coppoletta et al. 2019, Noss et al. 2006). Language from the Draft EA and other project planning documents suggests that the Forest Service recognizes the need to return fire to the Bitterroot Front project area, explicitly stating that a primary goal is to "re-introduce fires as a natural process on the landscape necessary to maintain desired conditions, and move units closer to historical conditions." So, to what extent do the various management activities included in the proposed action align with the goal of reestablishing natural disturbance regimes in the Bitterroot National Forest's fire-dependent ecosystem?

According to the Draft EA, almost all of the area-based treatments that are part of the proposed action are coupled with the use of prescribed fire as a potential element. Stand-alone prescribed fire, which is most likely to be applied to lands with low fuel loading, limited access, and/or steep terrain, may be implemented on up to 54,046 acres throughout the project area. Prescribed fire is also listed as a potential follow-up treatment on lands that will be subject to various silvicultural prescriptions, including 'intermediate harvest (27,477 acres), non-commercial 'whitebark pine restoration' (35,575 acres), non-commercial stand improvement (3,163 acres), and 'slashing' (18,019 acres; Draft EA 2023). If all treatments included in the proposed action that list prescribed fire as part of their description were to be implemented, this would amount to 138,280 acres, or 96% of the Bitterroot Front project area. This level of potential fire application represents a significant commitment by the Forest Service to reintroduce the beneficial role of fire in this portion of the Bitterroot National Forest.

Aside from providing acreage estimates of potential treatment, the BFRP planning documents include very little information about how, where and when the use of prescribed fire may actually be carried out. And there remains some uncertainty about what the Forest Service specifically means when it uses the term 'prescribed fire'. The Draft EA states that "prescribed fire activities covered under the proposed action may include site preparation, low-intensity burns, maintenance burns, mixed severity burns, and pile burning." Pile burning and site preparation are typically used to reduce localized fuel loadings generated by thinning or other mechanical treatments, and do not have the ecological benefits that are associated with broadcast burning (Omi & Martinson 2004, Reinhardt et al. 2008, Hardy & Arno 1996). The Draft EA also states that chipping, slashing and mastication may be used in place of or prior to the use of prescribed fire in some locations. No acreage estimates are provided for any of these treatments, which makes it difficult to evaluate how much they may actually contribute to meeting ecological in addition to fuels reduction goals.

Even if the maximum number of acres proposed for prescribed underburning were to be implemented, this one-time action would not be sufficient to restore a beneficial, low-intensity fire regime to the project area's frequent-fire forests. The BFRP Draft EA (2023) correctly recognizes that some form of ongoing prescribed fire use will be necessary in order to sustain relatively open stand conditions after initial treatments are completed, and suggests that "prescribed maintenance burning would be implemented approximately 10 to 15 years in areas that historically had a frequent fire return interval." The fact that the Forest Service acknowledges the imperative of maintenance fire treatments as part of the Bitterroot Front project is positive, but again, details are lacking that would spell out how maintenance treatments will be incorporated into project implementation.

To address the important question of what will happen when understory vegetation regrows, the Forest Service should present a long-term plan for how maintenance treatments will be planned and implemented, including: 1) a more detailed discussion of when and what type of follow-up treatments will be needed, as well as the potential likelihood that the personnel and funding necessary to carry out future maintenance treatments will be available, 2) a prioritization scheme that would help determine which areas are the highest priority for prescribed fire when fewer acres can be burned than planned in a given year or time period, and 3) the implications in terms of fuel loading and fire hazard if follow-up actions are not fully implemented or are left undone. From an ecological perspective, the long-term objective of restoration in these fire-adapted forests should be to reintroduce fire as the primary disturbance agent in this ecosystem. While the BFRP appears to make significant progress in this regard, some additional planning and commitment of resources would help improve the likelihood of achieving this outcome.

GRADE: B

Hungry Ridge Restoration Project on the Nez Perce-Clearwater National Forest (Idaho)

Forests along the South Fork of the Clearwater River, close to the boundary of the Hungry Ridge project area on the Nez Perce-Clearwater National Forest, Idaho.

LOCATION: The Hungry Ridge Restoration Project (hereafter referred to as HRRP) is planned within an area of ~30,000 acres located approximately 17 miles southeast of Grangeville, Idaho (Idaho County) on the Salmon River Ranger District, Nez Perce-Clearwater National Forest.

PURPOSE AND NEED: "The overall purpose of the HRRP is to manage forest vegetation to restore natural disturbance patterns, improve long-term resilience at the stand and landscape levels; reduce the potential risk to private property and structures, improve watershed conditions and maintain/improve habitat structure, function and diversity." (ROD 2023)

PROPOSED ACTION:
Commercial logging on a total of 7,164 acres, including both 'regeneration' (5,205 acres) and 'intermediate harvest' (1,959 acres). Silvicultural prescriptions for regeneration logging units include seed tree, shelterwood and 'clear cut with reserve trees'. Prescribed burning is planned on 12,372 acres, including 9,495 acres as stand-alone treatment, and up to 4,267 acres in areas proposed for logging to reduce residual activity fuels using a combination of broadcast burning and machine or hand pile/burn. The selected alternative (Alt 2, modified) will also construct ~9 miles of new permanent roads, ~23 miles of new temporary roads and maintain/reconstruct 67 miles of existing roads to facilitate commercial log hauling. Planned logging will take place over 10 years and produce an estimated 173 million board feet of timber.

CURRENT STATUS: Final Supplemental EIS and Draft Record of Decision were released in September 2023. Final ROD is pending and implementation may begin soon after.

ECOLOGICAL EVALUATION:

CRITERIA 1: Does the project include clear and specific protections for existing mature and/or old-growth trees, which are key foundational elements of fire-resistant and resilient forests?

The HRRP Record of Decision approves commercial logging on 7,164 acres that will result in substantial removal of mature and old-growth trees, including from at least 954 acres of stands that meet the Nez Perce-Clearwater National Forest Plan definitions of 'old growth' or 'replacement old growth' (SEIS 2023). Of the 954 acres of old-growth stands to be commercially logged, 'regeneration harvest' (e.g. clearcuts) are planned in 721 acres and 'intermediate harvest' on 233 acres. The selected alternative includes no size, diameter or age limits on trees that can be removed in areas that will be commercially logged. In addition, ~2 miles of new permanent road construction, ~2 miles of new temporary roads, and 7 miles of road reconstruction would occur in forest stands that meet Forest Plan old-growth definitions, resulting in further loss and degradation of these habitats.

Old growth management on the Nez Perce-Clearwater NF is currently guided by the 1987 Forest Plan, which created a specific land allocation (called MA20) to conserve old forests and their associated wildlife. On lands allocated to MA20, the Forest Plan stipulates that at least 50% of each unit shall be comprised of forests that are 150 years or older (OG); the remainder can be 'immature timber' (40-80 yrs) that over time is expected to provide 'replacement old growth' habitat (ROG). According to analysis that appears in the HRRP SEIS, only 20% of the MA20 acres in the project area currently meet the definition of old-growth (Silviculture Specialist Report 2023). The majority of MA20 units are comprised of younger forests (ROG), and an additional 11% fails to meet both OG and ROG standards. Despite the fact that the amount of designated old-growth in the project area is already well below Forest Plan standards, the HRRP plans to reduce levels even further, both inside and outside of MA20 unit boundaries.

The HRRP also plans to commercially log 85 acres of classified old growth located on MA20 lands -- 65 acres with 'intermediate harvest' prescriptions, and 20 acres via regeneration (i.e. clear cut) logging. Because commercial logging in MA20 units would represent a violation of the Nez Perce-Clearwater Forest Plan, the HRRP decision amended this plan so as to allow these actions. The agency's description of 'intermediate harvest' treatments to occur on MA20 lands suggests the focus of removal will be small- to mid-sized trees, but the plan includes no clear, enforceable standards to ensure that large/old legacy trees will not also be logged. In addition, ~3 miles of roads are planned for construction or reconstruction in the project area's MA20 lands, which will also degrade old-growth habitat and ecological values.

Of the four alternatives analyzed in the HRRP EIS, the one selected (Alternative #2, modified) will log the most acres of old growth, remove the largest number of large trees, and have the greatest adverse impacts to mature and old forests. Even if one agrees with the Forest Service, that "the long-term benefits of the proposed action far outweigh the risks of no action", this does not explain why the agency did not select the action alternative (#4) that both addresses the project's purpose and need while also causing significantly less harm to mature and old forest values. In an attempt to justify proposed logging, the agency paints a very distorted, overly optimistic view of project effects -- asserting that after 'intermediate harvest' treatments, old growth characteristics "will remain or even be improved" -- yet presents no data or analysis to support this claim.

In summary, the Hungry Ridge project conflicts with the general consensus on ecologically-based forest management, because it plans to remove rather than retain many of the mature and old-growth trees that remain in this area of the Nez Perce-Clearwater National Forest (Crist et al. 2009, Brown et al. 2004, Hessburg et al. 2015). Available scientific evidence is clear that continued loss of large/old trees is generally counter-productive, given that the agency's stated goal is to "improve long-term resilience at the stand and landscape levels" and "maintain/improve habitat structure, function and diversity" (FEIS 2020; see pp. 10-12 and Appendix). In their comments on this project, the US EPA recommended that large/old trees should be retained in the project area wherever they exist, so as "to provide structure to the forest landscape and an anchor point for establishing species and structural heterogeneity." (US EPA 2018). Removal of more old trees and stands will only further degrade this landscape, and for this reason alone, the Hungry Ridge project cannot legitimately be called 'restoration'.

GRADE: F

CRITERIA 2: Do proposed treatments focus on frequent-fire forest type(s) that are likely to exhibit the greatest departure from historic conditions, and therefore in legitimate need of restoration-based management?

Forests in the Nez Perce-Clearwater NF are some of the most diverse and complex in the Inland Northwest, which is a reflection of the area's wide variation in climate, geology, topography and disturbance regimes. General forest groups and associated tree species in the HRRP area have been identified as: 1) cold (subalpine fir, whitebark pine), 2) moist/cool (Engelmann spruce, grand fir, Douglas-fir, Pacific yew), 3) moderately-dry to moist mixed conifer (grand fir, Douglas-fir, lodgepole pine, western larch), and 4) warm/dry (ponderosa pine, Douglas-fir; South Fork Clearwater Landscape Assessment 1998). Grand fir/mixed conifer (61%,17,896 acres) and lodgepole pine (13%, 3,835 acres) cover types occupy most of the project area, whereas the two relatively warm/dry types (ponderosa pine and Douglas-fir/grand fir) comprise only 0.6% (171 acres) and 13% (3,907 acres; FEIS and Silviculture Specialist Report 2020), respectively.

Most of the HRRP's commercial logging is planned to occur in moderately dry to moist mixed conifer forests that are often dominated by grand fir and Douglas-fir, but logging-based treatments are also planned in moist/cool and cold forests. In their effects analysis, the Forest Service comes to the conclusion that all forest communities in the project area "would benefit [from the proposed action, including commercial logging], because they have adapted to frequent-fire-return intervals." Yet the agency's own analysis shows that ***only a small percentage of lands to be mechanically treated are in fact located within frequent-fire forest types***. Approximately 42% of the project area supports an infrequent (>75 yrs), mixed to high-intensity fire regime, compared to only 8% (2,396 acres) in the frequent (5-25 yrs), low severity regime that is likely to be most altered due to fire exclusion (Silviculture Specialist Report 2020).

Compared to frequent-fire forests dominated by ponderosa pine (and to lesser extent, Douglas-fir), the natural fire regime associated with moist mixed conifer forests is inherently more variable and exhibits a much wider array of fire effects, including infrequent, mixed severity and stand replacement crown fires (Agee 2005, Hessburg et al. 2016, Hopkins et al. 2014, Barrett et al. 2011). This means that moist mixed conifer stands naturally tend to grow more dense, and their structure and composition is less departed from historic conditions relative to warm/dry forests (Arno et al. 2000, Perry et al. 2011). Because of this important difference, many scientists have recommended that forests with mixed severity fire regimes are "less clearly candidates for thinning" (Brown et al. 2004) and should not be the highest priority for restoration-based management (Brown et al. 2004, Frost 2001, Perry et al. 2011, Hessburg et al. 2016, DellaSala & Hanson 2015). Even in cases where some ecologically-based silviculture may be appropriate, a "conservative or cautious approach is warranted" (Brown et al. 2004).

In the case of the Hungry Ridge project, it appears that the Forest Service has inappropriately applied a desired future condition of "open, park-like" structure derived from warm/dry forests to moist mixed conifer and even moist/cool stands that are much more structurally diverse and able to sustainably support much higher densities of large trees. In contrast to the >5,000 acres of 'regeneration' (i.e. clearcut) logging planned as part of the HRRP, an ecologically-based approach to management in forests with mixed severity fire regimes would focus on retaining all large/old trees, while also conserving levels of structural complexity and spatial heterogeneity that are characteristic of these forests (Hessburg et al. 2016, Perry et al. 2011, Hopkins et al. 2014, LeFevre et al. 2020). Unfortunately, the Hungry Ridge project falls far short in this regard.

GRADE: D

CRITERIA 3: If reducing wildfire hazard is an element of the project's Purpose & Need, do treatments focus on reducing surface and ladder fuels (e.g., subcanopy trees, shrubs, down woody debris) that most contribute to elevated risk of high intensity fire?

The HRRP planning documents frequently emphasize that a primary element of the project's purpose of need is to reduce the risk of high intensity fire, and the agency's analysis concludes that of the four alternatives considered, the proposed action will most successfully reduce fuels and the potential for large, high intensity wildfire (FEIS 2020). However, this review of HRRP planning documents reveals a glaring disconnect between the specific character of the 'fuels problem' that the agency consistently describes, and the commercial logging treatments that are actually being proposed.

According to the Forest Service analysis, the primary, unintended outcome of fire exclusion is that it has "created dense understories and midstories of live and ladder fuels" and "allowed encroachment of shade-tolerant species *into the understory*, increasing the risk of stand-replacing fires by creation of ladder fuels and accumulations of ground fuels." (ROD 2023, emphasis added). In other words, the primary concern in terms of altered forest structure and fire hazard in these forests is the cohort of suppressed, small to intermediate-sized trees that can act as ladder fuels and have become more abundant since effective fire suppression began 75-100 years ago. It follows that a legitimate restoration-based approach to forest management in this area would focus on reducing the density of these smaller, shade-tolerant trees (Larson & Churchill 2024, Fiedler et al. 2010). But instead, the large majority of treatments (73%) approved in the HRRP are for 'regeneration' (i.e. clearcut) logging that will remove all or almost all dominant overstory trees.

It is nonsensical how the Forest Service can present the existing problem in one way (excessive levels of small trees and surface/ladder fuels), but then select an action alternative that will instead remove significant numbers of large, overstory trees that are known to be most resistant to fire, are rare relative to their historic abundance, and the key to ecological resiliency (see criteria #1, pp. 10-12 and Appendix). The proposed action will even clearcut 721 acres of existing old-growth stands, "where root disease is concentrated, in areas at risk from insects, and/or areas suitable for restoration of early seral species" (Silviculture Specialist Report 2023). After logging, these areas will be replanted with conifers and eventually converted to relatively uniform, even-aged tree plantations that are known to be highly vulnerable to high intensity fire and other disturbances (Zald & Dunn 2018, Levine et al. 2022, Naficy et al. 2010) -- which is directly contrary to the agency's stated purpose and need to create greater resilience.

The Forest Service should have developed and analyzed an alternative that focused on reducing the density of suppressed, small to intermediate-sized trees, which it claims are the primary fuels and forest health issue in the project area. While it is well-established that 'thinning from below' (i.e. selective removal of smaller trees from below the canopy) can be ecologically appropriate and help to reduce fire hazard in forests where frequent fire has long been excluded, the same is definitely not the case for the overstory tree removal and regeneration logging that is proposed here. In sum, the Hungry Ridge project is falsely presented as 'restoration', when in fact the commercial logging of mature and old-growth canopy trees is likely to only further degrade forests in this biologically diverse area of the Nez Perce-Clearwater National Forest.

GRADE: F

CRITERIA 4: Is the project designed to avoid, or at the very least effectively minimize adverse impacts to at-risk wildlife species?

The Hungry Ridge project area includes a diversity of forest habitats that support a wide range of wildlife species, including a number that are recognized as sensitive, at-risk or formally 'threatened' under the Endangered Species Act. The Forest Service did conduct effects analyses relating to a number of at-risk species, but the action alternative that was selected (#2, modified) includes the most commercial logging and the fewest fish and wildlife protections. As a general pattern, project planning documents often downplay the potential for adverse impacts, by suggesting that effects will be short-term, temporary and negligible, and that the project will improve fish and wildlife habitat in the long term. The following species summaries provide the most concerning examples where the proposed action fails to minimize adverse impacts to at-risk wildlife, which is widely recognized as a necessary element of any ecologically-based, restoration approach.

American Goshawk

The American Goshawk (formerly northern goshawk; *Accipiter atricapillus* ssp. *atricapillus*) is a relatively rare, mid-sized raptor associated with closed-canopy conifer forests in mountainous areas extending across much of the western US (Anderson et al. 2005). Individual goshawk pairs typically inhabit homes ranges up to ~5,000 acres in size that include mature and old growth stands with complex structure that are required for nesting (Austin 1993, Kennedy 2003). One of the greatest threats to the species in the western US is logging, which can destroy nesting sites and reduce canopy cover to the point that birds permanently abandon affected areas (Reynolds et al. 2006, Boyce et al. 2006, Crocker-Bedford 1990). Largely because of their close association with mature and old-growth forests, the goshawk was designated as both a Management Indicator and Sensitive Species in the Nez Perce-Clearwater National Forest Plan.

American goshawks have been documented throughout the HRRP area, including at least several active nesting territories (FEIS and Wildlife Specialist Report 2020). According to the Forest Service, planned "regeneration logging would eliminate nesting habitat by reducing forest canopy and stand structure", and... "intermediate harvest significantly reduces habitat quality because key elements of structural diversity such as large trees, snags and down logs would be lost" (ROD 2023). The selected alternative is expected to remove approximately 3% of nesting and 30% of foraging habitat in the project area, including 94 acres of nesting stands classified as MA20 (designated old growth; FEIS 2020). The net result of these actions would be that "individual goshawks would move away from [i.e. abandon] areas of active treatment" (ROD 2023).

Impacts of planned logging to goshawks and this and other old forest-dependent species will be even more significant, because closed-canopy forests will be fragmented into smaller stands or patches, which is known to reduce habitat quality (McGrath 1997, Greenwald et al. 2005, Boyce et al. 2006). Other than acknowledging that logging "will add to forest fragmentation levels in the project area", the Forest Service did not directly analyze these impacts on goshawks, for example by looking at changes to the size and configuration of habitat patches within each occupied territory as well as across the larger landscape. Instead, the FEIS and ROD repeatedly downplay adverse effects to goshawks, by suggesting that logging will "improve tree health" and "potentially contribute to less fire risks." It is therefore apparent that the project did not attempt to avoid or minimize risks to this species.

Fisher

The fisher is a reclusive, forest-dwelling carnivorous mammal in the weasel (Mustelid) family whose current distribution includes forested ecoregions across several western states. In terms of habitat, fishers are typically found in large, connected tracts of mature and old-growth conifer forest, particularly at low to mid-elevations in areas with relatively dense overhead canopy cover, structural complexity and abundant down wood (USFWS 2017, Olson et al. 2014). Forests that have been heavily logged and are dominated by younger stands appear to be significantly less suitable and are often unoccupied (Schwartz et al. 2013, Jones & Garton 1994). The fisher was designated as both a Sensitive and Management Indicator Species in the Nez Perce-Clearwater Forest Plan. Individual animals have been consistently documented on this national forest, including within the Hungry Ridge project area, but their local population levels and trends are not known (USFWS 2017, Raley et al. 2012, Sauder 2014).

Logging planned as part of the HRRP will significantly reduce the amount and quality of fisher habitat. Regeneration logging would eliminate over 5,000 acres of mature and old forest that likely provide suitable habitat, and another ~2,000 acres would be degraded by intermediate harvest that reduces both canopy cover (down to ~35%) and structural attributes (snags, down logs, etc) that are important for this species. In the Wildlife Specialist Report for HRRP, the Forest Service acknowledged the ways in which logging will destroy and degrade fisher habitat, admitted that it takes 100-150 years after logging for suitable fisher habitat to return, and determined that forest openings would increase from 5% now to 26% after logging (Wildlife Specialist Report 2020).

Instead of seeking a way to mitigate the adverse, long-lasting impacts to fisher resulting from the proposed action (e.g., by reducing or eliminating the acres of regeneration logging), the ROD discussed only those ways logging would "provide more habitat for species needing early-seral forests" and "improve overall habitat quality" (ROD 2023), and does not even mention the potential harmful consequences for fisher that will likely persist for the next 100 years or more. By mostly ignoring and/or downplaying the long-lasting adverse impacts to fisher, American Goshawk and other wildlife that are dependent upon on older forests, the HRRP fails to demonstrate that it minimizes harm to these at-risk species.

<u>Snake River Steelhead and Bull Trout</u>

Streams in the Hungry Ridge project area provide valuable aquatic habitats that are occupied by three fish species that are protected as 'threatened' under the federal Endangered Species Act -- bull trout, Snake River steelhead and spring Chinook salmon. The two largest watersheds in the HRRP -- Mill and Johns Creeks -- are of particular importance and have been designated as critical habitat for steelhead and bull trout. Mill, Johns and all other creeks in the Hungry Ridge project area flow directly into the South Fork Clearwater River, which is also used by these fish and has been designated critical habitat. Very low numbers of steelhead in the South Fork Clearwater Basin have lead the National Marine Fisheries Service (NMFS) to recently classify this population as "high risk and non-viable" (NMFS 2020).

All watersheds in the Hungry Ridge project area have been heavily degraded by past management activities and currently exhibit elevated levels of sediment, which in turn has adverse impacts on aquatic habitat utilized by ESA-protected fish. Higher amounts of fine sediment in streams can decrease food production, simplify stream channels, eliminate hiding cover, bury spawning gravels and reduce reproduction success (see review in NMFS 2020). Sediment delivery from the area's extensive road system has been identified as one if not the most problematic issue preventing recovery of listed fish populations in the South Fork Clearwater watershed. Five primary watersheds within the Hungry Ridge project area currently fail to meet Forest Plan requirements for fish habitat conditions (FEIS 2020), and the South Fork Clearwater River is currently listed as water quality impaired for temperature and sediment under section 303(d) of the Clean Water Act (NMFS 2020).

Analyses of this issue conducted by both the Forest Service and NMFS agree that sediment loading into streams of the area will worsen with implementation of the Hungry Ridge project, primarily as a result of log hauling (estimated at >37,000 log truck loads over 10 yrs), road construction and culvert replacement (FEIS 2020, NMFS 2020). In several watersheds, proposed activities will cause near-term sedimentation to approach or even exceed Forest Plan guidelines (FEIS 2020). This additional sediment deposition "will further decrease ecologic function, as the baseline condition is already highly impaired." (NMFS 2020). Given these impacts, NMFS determined that HRRP "is likely to adversely affect the Snake River steelhead trout and Columbia River bull trout and their designated critical habitat." (NMFS 2020).

Notwithstanding these concerns, the Forest Service claims that adverse impacts predicted to occur from logging and road use "will be more than offset by the long-term improvements associated with the replacement of stream crossings and the habitat enhancement from stream restoration work." (FEIS 2020). In other words, the agency's rationale is that additional short-term habitat degradation is acceptable, so long as beneficial actions to be implemented elsewhere in the project area eventually result in an "upward trend " in habitat quality. The Forest Service, however, did not provide site-specific empirical data or other scientific evidence that clearly supports this determination. The Forest Service should address the need to restore degraded stream conditions proactively and independent of logging and other management actions that are expected to result in further harms.

Due to their concerns about the potential for adverse impacts to water quality and fisheries from the HRRP, the US EPA recommended that the Nez Perce-Clearwater NF select an action alternative that would avoid or at least minimize new road construction, and for this reason they endorsed Alternative 4 as most preferable (US EPA 2018). The Forest Service's own analysis confirmed that Alternative 4 would result in the least adverse impacts to project watersheds, primarily because fewer new roads mean a smaller increase in sediment delivered to streams (FEIS 2020). Instead of following the EPA's recommendation on this issue, the Forest Service approved alternative #2, which is likely to result in the greatest harm to fish species protected under the Endangered Species Act.

Whitebark Pine

The federally threatened whitebark pine (formally listed in 2022) is known to occur as individual trees and potentially scattered groves in the upper elevation forests of the Hungry Ridge project area. Over 1,000 acres of potential habitat for whitebark pine have been identified by the USFWS (2023), and of these, 367 acres (36%) are planned to be clearcut as part of the HRRP. Field surveys in planned logging units have not been conducted, but it is "reasonable to assume that whitebark pine occur within harvest units" (USWFS 2023). As discussed under evaluation criteria #2 (see pp. 12-14), it is unclear why the Forest Service even finds it appropriate to commercially log stands that include whitebark pine as part of a 'restoration' project, given that these forests are not likely to be significantly altered in terms stand structure and wildfire hazard compared to historic conditions.

To minimize impacts, USFWS has directed the Forest Service to avoid logging clumps of trees that include whitebark pine, and where possible, protect potential whitebark pine habitat identified during implementation. Even with these mitigation measures, the Hungry Ridge project "has the potential to adversely affect" whitebark pine by compacting soils, causing physical damage..and making them more susceptible to white pine blister rust and mountain pine beetle" (USFWS 2023). Heavy equipment used during logging and road construction has significant potential to compact soils near whitebark pine trees, adversely affecting recruitment, growth and survival -- and these effects can last for years or even decades (USFWS 2023). There will also be adverse effects to individual trees "that endure physical damage from timber harvest, road construction and prescribed fire." (USFWS 2023).

GRADE: F

CRITERIA 5: Does the project integrate managed and/or prescribed fire into project planning, and also address the timing and necessity of future maintenance treatments?

The Hungry Ridge project includes plans for prescribed burning on 12,372 acres, including 9,495 acres without logging, and up to 4,267 acres in logged areas to reduce down woody debris generated by logging (i.e. 'activity fuels'). Taken together, these acres represent ~41% of the Hungry Ridge project area. This level of prescribed fire application, particularly the 9,495 acres of stand-alone burning, is a positive step toward more ecologically-based management. However, any one-time application of prescribed fire will likely not be sufficient to restore this process to its essential role in the ecosystem --

especially if the Forest Service does not develop a plan that would allow wildland fires to be managed for resource benefits. The HRRP FEIS correctly acknowledges that "fuel treatments, like all vegetation changes, have temporary effects and require repeated measures, such as prescribed burning, to maintain desired fuel conditions." (Fire/Fuels Specialist Report 2020). Depending on site-specific productivity and other factors, the agency estimates that initial fuel treatments may remain effective for up to 20 years, but "as the vegetation grows, they will become less effective."

To address the important question of what will happen when understory vegetation regrows, the Forest Service should have developed a long-term plan for maintaining the more open stand conditions this project would create. Such a plan would include: 1) a discussion of when and what type of follow-up treatments will be needed, 2) how areas that are not being treated in this project will be addressed in the future, 3) the potential likelihood that the personnel and funding necessary to carry out future maintenance treatments will be available when needed, and 4) the implications in terms of fuel loading and fire hazard if follow-up actions are not fully implemented or are left undone (particularly in warm/dry and moderately dry frequent-fire forest types). From an ecological perspective, the long-term objective of restoration in these fire-adapted forests should be, to the maximum extent practicable, restore the role of fire as the primary disturbance agent. Unfortunately, the Forest Service does not analyze or discuss the contribution that the Hungry Ridge project could make toward this potential outcome.

GRADE: B

Lower North-South Vegetation Management Project, Pike-San Isabel National Forest (Colorado)

Old-growth Douglas-fir (left) and high-elevation Engelmann spruce-subalpine fir forest (right) located in the Lower North-South project area, Pike-San Isabel National Forests, Colorado. Photo credits: Deanna Meyer

LOCATION: The Lower North-South Vegetation Management Project (hereafter 'LNS project') is being planned within a 261,096 acre project area (228,238 acres on federal land) on the South Platte Ranger District of the Pike-San Isabel National Forest in the foothills of the Colorado Front Range, approximately 30 miles west and southwest of Denver, Colorado.

PURPOSE AND NEED:
To "move the vegetation in the project area towards a more resilient condition and structure consistent with a fire-adapted ecosystem", "reduce the likelihood of large-scale, high intensity wildfires and improve resiliency of the forest to insects and disease, while providing for diverse wildlife habitats, recreational opportunities, and sustainable watershed conditions" (Pike-San Isabel NF 2024).

PROPOSED ACTION:

The preliminary proposed action includes a range of different area-based treatments that are identified as: 1) commercial logging using ground-based harvest systems (62,186 acres), 2) commercial logging on steep terrain (35-60% slopes) using aerial/tethered or cable harvest systems (15,307 acres), 3) a combination of logging-based mechanical (17,082 acres) and manual (mastication, hand) treatments (1,491 acres) in inventoried roadless areas, 4) manual treatments (mastication) in shrublands (19,537 acres) and 4) riparian areas (998 acres). "[O]penings of various sizes [i.e., patch clearcuts] would be created in all vegetation classes", either by enlarging existing openings (up to 40 acres in size) and/or by creating new openings (up to 20 acres). An undetermined number and total mileage of 'temporary roads' would be constructed to facilitate commercial logging, including in inventoried roadless areas.

In addition to logging-based treatments, other management activities planned within the project area footprint include 'thinning without product removal', 'pile burning' 'jackpot burning' and 'underburning' (e.g. prescribed fire). An undisclosed number and mileage of fuel breaks would also be created "in strategic locations for fire control opportunities in a variety of forest types." Because the Forest Service is proposing to use a 'condition-based management approach', site-specific locations, prescriptions and details of treatments are to be determined at some unspecified point in the future, well after the NEPA process is completed. No information is provided regarding the amount of timber to be produced over the estimated 20 years when the LNS project will be implemented.

CURRENT STATUS:

Public scoping for this project was released by the South Platte District Ranger in October 2023 and reinitiated in February 2024, accompanied by an updated description of the project's preliminary proposed action and purpose and need (Pike-San Isabel NF 2024). Planning is ongoing and an Environmental Assessment is expected to be released as soon some time in 2024, followed by a final decision in 2025.

ECOLOGICAL EVALUATION:

CRITERIA 1: Does the project include clear and specific protections for existing mature and/or old-growth trees, which are key foundational elements of fire-resistant and resilient forests?

As currently proposed, the Lower North-South Project is one of if not the largest commercial logging project in the history of the national forests in Colorado. The preliminary proposed action includes roughly 94,575 acres of commercial logging across a wide range of forest types, using both uneven- and even-aged logging. Thus far, the Forest Service has presented very little information for evaluating the extent to which mature/old trees and old-growth stands will be affected. The Forest Service suggests that uneven-aged silvicultural prescriptions are "intended to result in the retention and development of large trees", but there is no specific language in the proposed action that would ensure the retention of large/old trees. In fact, removal of some unknown volume of large/old trees appears highly likely, because the Forest Service has presented no size, species, diameter or age limits on trees that can be logged.

In both ponderosa pine/Douglas-fir and dry mixed conifer forests, the project plans to employ commercial logging to create a wide range of tree densities in different areas, with goals presented in terms of stand basal area. Most of the proposed stand-level basal area targets are quite low, and would result in the conversion of existing forests into very open woodlands with less than 40% canopy cover. For example in the ponderosa pine/Douglas-fir forest type, basal area could be reduced to as low as 20-40 ft^2/acre in many landscape settings, and the average target would be only 30-50 ft^2/acre (Pike-San Isabel NF 2024). In order to create these very open stands with low basal areas, it is almost assured that at least some of the larger, older trees that currently occupy these sites would have to be removed. In addition to the overall reduction in tree density, logging treatments will also create an unknown number and distribution of 'openings' (e.g. patch clearcuts) in different forest types up to 40 acres in size. An additional, likely significant number of large/old trees may also be removed in these areas, as well as on lands where the construction of temporary roads will be used to access and transport commercial timber.

The specific effects of the proposed action on large/old trees are highly uncertain, because the Forest Service has not disclosed how much tree removal will occur in the mature and large/old tree cohorts, or where logging will occur in relation to the location of existing old-growth stands. On this issue, the Forest Service only states that "old trees are important structural components that would be retained throughout the landscape to provide ecological and wildlife benefit and structural complexity" (Pike-San Isabel NF 2024). But what specifically does 'throughout the landscape' mean? Is there a minimum number of large/old trees that will be retained in logging units? If so, are any large/old trees that exist above this minimum available for logging? On what ecological basis is it appropriate to remove any large/old trees from the project area? The Forest Service does not present information that would allow reviewers to answer these critical questions.

Loss of large/old trees as part of the LNS project is ecologically inappropriate because this landscape almost assuredly exhibits a significant deficit of large trees and old forest stands relative to the historic range of variability. As stated in the preliminary proposed action, "current forest conditions are the combined result of intense historic landscape-scale logging" (Pike-San Isabel NF 2024), which removed the vast majority of large/old trees that were once widely distributed throughout the more easily accessible lower and mid-elevations forests of the Colorado Front Range (Huckaby et al. 2001, 2003a-b, Kaufmann et al. 2000, 2003, Veblen & Donnegan 2005, Veblen & Lorenz 1991, Addington et al. 2018, Baker 2009). Yet despite the current rarity of large/old trees in this landscape and their known importance in sustaining numerous ecological functions such as fire resilience, critical wildlife habitat and carbon storage, the preliminary plan proposes to reduce them even further, but now under the auspices of fuels reduction and increasing resiliency. Such actions would be in direct conflict with the agency's own dry forest management framework for the Colorado Front Range, which recommends that "*treatments should remove overrepresented* [tree] *age and size classes (usually trees 50 to 120 years old)* ***while retaining old trees*** *(>150 years old)...If old trees occur in groups, the groups should be retained*" (emphasis added, Addington et al. 2018).

As discussed in numerous places throughout this report, the vast majority of forest and fire scientists and the relevant peer-reviewed scientific literature overwhelmingly agree that removal of large, old trees is rarely ecologically appropriate in western forests, and is more likely to contribute to further degradation rather than restoration of forest structure, function or composition (see criteria #1 and #3, pp. 10-12 and 14-17). Given that large/old trees are the "foundational backbone" of forests that are resilient to fire and other disturbances, their planned removal over many thousands of acres in the LNS project runs contrary to the agency's stated objectives. Instead, what the Forest Service should do in its forthcoming Environmental Assessment is analyze to what extent the project's purpose and need can be accomplished by focusing on removal of subcanopy and intermediate-sized trees in dry forest types, which are those most likely to have increased in abundance due to past management and most contribute to increased potential for high-intensity disturbances.

GRADE: F

CRITERIA 2: Do proposed treatments focus on frequent-fire forest type(s) that are likely to exhibit the greatest departure from historic conditions, and therefore in legitimate need of restoration-based management?

Spanning over 250,000 acres and including a wide range of elevations, climatic environments and landscape settings, the LNS project area supports a wide diversity of forest types that strongly differ in terms of their characteristic structure, composition and natural disturbance regimes. As described previously in this report (criteria #2, pp. 12-14), inherent differences among forest types have major implications for the type of forest management that is likely to be appropriate, because ecologically-based management generally seeks to mimic or emulate the way in which natural disturbance shapes landscape and stand structures (Drever et al. 2006, Franklin et al. 2007, Perera & Buse 2004, Seymour & Hunter 1999). In the LNS project area, relatively frequent-fire forests are identified by the Forest Service as ponderosa pine/Douglas-fir and dry mixed conifer types, of which a significant acreage are being proposed for active management. But much of the commercial logging will also occur in cooler and more mesic forest types that "do not appear to be considerably departed from historical conditions" (Pike-San Isabel NF 2024) -- for which there is likely little or no ecological justification.

Question: Are mechanical fuel treatments ecologically appropriate and potentially effective in reducing wildfire hazard in relatively cool/moist, higher elevation forests of the Rocky Mountains? (excerpted from Schoennagel et al. 2004)

- Infrequent, high-severity, stand-replacing fires dominate the historical and contemporary fire regime in these forests.
- Dense trees and abundant ladder fuels are natural in [higher-elevation] forests and do not represent abnormal fuel accumulations.
- Fire suppression has had minimal influence on the size, severity, and frequency of high-elevation fires.
- Climatic variation, through its effects on the moisture content of live fuels and larger dead fuels, is the predominant influence on fire frequency and severity. Variation in fuels, as measured by stand age and density, typically have only minimal influence on fire behavior.
- Fuel reduction projects probably will not substantially reduce the frequency, size or severity of wildfires under extreme weather conditions [i.e., when most fires burn in this zone]

Based on this understanding --

"*We expect fuel reduction treatments in higher-elevation forests to be generally unsuccessful in reducing fire frequency, severity and size, given the overriding importance of extreme climate in controlling fire regimes in this zone. Thinning also will not restore subalpine forests, because they were dense historically and have not changed significantly in response to fire suppression. Moreover, these efforts may create new ecological problems by moving the forest structure outside the historic range of variability*."

The preliminary proposed action for the LNS project does not break out planned logging and other management actions by forest type or landscape setting, but it does describe plans to conduct logging-based treatments -- likely across many thousands of acres -- in mesic mixed conifer, lodgepole pine, Engelmann spruce-subalpine fir, aspen, and riparian forest types (Pike-San Isabel NF 2024). For several of these forest types, the Forest Service acknowledges that existing conditions are currently operating within the historic range of variability, because these communities typically support relatively high tree densities with complex, closed-canopy structures created by infrequent (i.e., >100 yrs), high severity fires that are primarily driven by weather (e.g. drought/aridity, high winds), not by fuels (Schoennagel & Nelson 2011, Schoennagel et al. 2004, 2007, 2017, Agee 1997, Noss et al. 2006a-b, Bessie & Johnson 1995, Baker 2003, Sibold & Veblen 2006; see adjacent text box). For example in Engelmann spruce-subalpine fir forests, the Forest Service states that "these areas are prone to high intensity and severity fires that occur infrequently during dry periods", and "are less departed from historical fire regimes" (Pike-San Isabel NF 2024). In practice, what this means is that ***these higher elevation forest types do not need active restoration and will not be made more resilient by proposed logging-based treatments***.

The LNS project proposes to use commercial logging on many thousands of acres of cool and/or moist, infrequent-fire forests as a means "to move the vegetation in the project area to be more resilient to disturbances and alter stand structure to better mimic natural patterns" (Pike-San Isabel NF 2024). These treatments will create numerous openings up to 40 acres in size, remove large/old trees, reduce tree density and canopy cover. Yet the agency has presented no scientific evidence to support claims that these actions will in fact reduce increase resilience or significantly modify fire behavior in forests that are currently operating within the normal range of variation. In fact, contrary to agency assertions, ***the large majority of scientific evidence suggests that commercial logging in cool, moist and/or high-elevation forests like those of the Lower North-South project area will not significantly alter fire behavior, is incongruent with natural disturbance regimes, and is therefore more likely to result in further degradation*** (DellaSala et al. 2004, Agee 1993, Agee 1996, Agee & Skinner 2005, Brown et al. 2004, Noss et al. 2006a-b, Schoennagel & Nelson 2011, Schoennagel et al. 2004, 2011, 2017, Sherriff et al. 2001, 2014; see text box).

The Forest Service suggests that logging treatments in higher elevations forests may be warranted for "firefighter safety and suppression effectiveness", because "wildfire should be managed where feasible" (Pike-San Isabel NF 2024). But again, the agency has not incorporated the best available science on fire and fuel dynamics in these ecosystems, which finds that there is no consistent relationship between fire intensity and fuel abundance (Schoennagel et al. 2004, 2011, Sibold et al. 2006, Sibold & Veblen 2006, Baker 2003, 2009, Sherriff et al. 2001, Kulakowski & Veblen 2007). For example, Bessie & Johnson (1995) found little variation in fuel loads in subalpine forests of different ages, and even where variation in fuels did occur, it was not the primary influence on the size and severity of subsequent wildfires. A number of studies conducted in North American boreal forests, which are similar to Rocky Mountain subalpine forests in terms of forest structure and fire regime, have found fuel reduction treatments do not consistently reduce fire behavior, especially under drought/extreme weather (Thompson et al. 2020, Boyd et al. 2023, Beverly et al. 2023). The strong probability is that any fire in cool/moist forest types of the Colorado Front Range is likely to be a crown fire under very dry and/or extreme fire weather conditions, which means any fuels reduction measures are likely to be ineffective (see text box, p. 51).

In summary, while there may be a scientific basis for thinning small to intermediate-sized trees in some dry ponderosa pine-dominated forests in the LNS project area, ***proposed logging in higher elevation moist and cool/wet forest types lacks any ecological justification and conflicts with the best available science -- in no way can these actions be considered to "promote resilience" or "conserve biodiversity" as the agency suggests***. In fact, the even-aged logging prescriptions that are proposed across in cool/moist forest types are just as if not more likely to increase wildfire hazard and reduce resiliency, because they often lead to: 1) higher levels of surface fuels as a result of logging, 2) drier/warmer/windier microclimates that are more favorable to fire, 3) increased light availability in the understory that often triggers growth of understory vegetation, and 4) removal of large/old trees that are known to be the most resistant to fire (see discussion of these issues under criteria #2 and #3, pp. 12-17). A more effective way to reduce the risk of wildfire in these higher elevation forests is to reduce the large network of open roads, which are known to significantly elevate the probability of human-caused ignitions (Narayanaraj & Wimberly 2012, Molina et al. 2019, Syphard et al. 2007).

GRADE: F

CRITERIA 3: If reducing wildfire hazard is an element of the project's Purpose & Need, do treatments focus on reducing surface and ladder fuels (e.g., subcanopy trees, shrubs, down woody debris) that most contribute to elevated risk of high intensity fire?

Given that the purpose and need for the LNS project is centered around the goals of "moving the vegetation toward a more resilient condition" and "reducing the likelihood of large-scale, high intensity wildfires", to what extent is the preliminary proposed action consistent with ecological principles for creating fire-resilient forests? (see criteria #3 pp. 14-17). Among planned treatments, the non-commercial and prescribed fire treatments in ponderosa pine and dry mixed conifer stands are most likely to be effective at reducing the density of small (subcanopy) trees, shrubs and other surface/ladder fuels that are known to most strongly influence wildfire behavior. Prescribed fire (i.e. broadcast burning) is widely recognized as the most effective means of reducing surface fuels in western dry forests (North et al. 2012, Stephens et al. 2009, Fernandes 2015, Prichard et al. 2010) and although the LNS project purports to utilize this tool, the preliminary proposed action does not present acreage estimates or descriptions about how, where and when the use of prescribed fire may actually be carried out. There is also some uncertainty about what the Forest Service means when it uses the term 'prescribed fire', since the proposed action states that pile burning may be used rather than broadcast burning. Pile burning is typically used to reduce localized fuel loadings generated by thinning or other mechanical treatments, and does not have the same ecological or surface fuel reduction benefits that are associated with broadcast burning (Omi & Martinson 2004, Reinhardt et al. 2008, Hardy & Arno 1996). The lack of important information regarding prescribed fire use make it difficult to evaluate how much the proposed action may actually contribute to meeting fuels reduction goals.

Similarly, important details are also lacking regarding how various mechanical and manual treatments will be designed and implemented, which makes it difficult to fully evaluate effects on fuels and potential fire behavior. While the Forest Service generically states that "[r]emoval would be focused on small-diameter trees and ladder fuels", several significant concerns remain: 1) no prohibition on removal of large overstory trees, which generally contribute very little to increased fire spread or intensity, 2) the potential for increased surface and ladder fuels to develop in created openings (up to 40 acres in size), 3) the lack of any ecological justification for the use of logging in higher elevation infrequent-fire forest types, and 4) the lack of a clear plan for reducing surface fuels generated by aerial-based logging systems, particularly in inventoried roadless areas.

Given that the most important factor with respect to wildfire hazard in western dry forests is elevated surface and ladder fuels, the Forest Service does not rationally explain why it is necessary to also remove large canopy trees across thousands of acres in order to reduce the risk of wildfire or increase resiliency. Removal of large overstory trees is generally not necessary or effective at reducing wildfire hazard, because large green trees are generally the most resistant to fire, drought and other disturbances (Larson et al. 2015, Philips et al. 2003, Stevens et al. 2020), constitute the least flammable fuel type (Graham et al. 2004, Agee & Skinner 2005), usually contribute very little to wildfire spread (Rothermel 1983) or the surface and ladder fuels that most influence fire behavior (Agee 1993, Agee & Skinner 2005). For these reasons, retaining all large-diameter trees is recognized as one of the primary principles of how to create more fire-resilient forests (Agee 1996, Agee & Skinner 2005, Brown et al. 2004, also see criteria #3, pp. 14-17). Even the Forest Service's own framework for dry forest restoration in the Colorado Front Range recommends that treatments should *"aim to increase the ratio of old to young trees through removal of young trees and retention of old trees... If old trees occur in groups, the groups should be retained*" (Addington et al. 2018).

The Forest Service also does not address how creating large openings (e.g. clearcuts 20-40 acres in size) will influence fuels and potential fire behavior, or explain why openings of this size are ecologically appropriate in this landscape. In fact, the large majority of studies in lower montane forests of the Colorado Front Range have shown that historically, openings were either controlled by persistent biophysical features that do not support tree cover (e.g. thin, rocky soils, steep slopes), or were transient, relatively small (<50 meters long) and created by localized disturbances like windthrow and insect/disease agents (Addington et al. 2018, Brown et al. 2015, 1999, Kaufmann et al. 2000, Williams & Baker 2012, Baker 2009, Dickinson 2014a-b). A study by Dickinson (2014b), part of which was conducted in ponderosa pine/Douglas-fir forests not far from the LNS project area, found that the current landscape has fewer small openings (less than 50 meters long) relative to historical conditions, but is basically unchanged with regard to larger openings. The author concluded that "[F]orest restoration treatments should focus on recreating <u>***small***</u> openings (<50 m) by breaking up large contiguous forest canopy patches within the context of local site conditions (emphasis added)" -- which is incongruent with the 20 to 40 acre-sized openings proposed as part of the LNS project (Platt & Schoennagel 2009).

Even if large openings were historically more abundant, there is little evidence to suggest that logging to create large openings will be effective at reducing fire hazard or creating more resilient forest conditions. In fact, the opposite effect may be more likely. Research has shown that increased light availability in large openings, together with ground disturbance from logging, can lead to rapid establishment and dense growth of woody shrubs and small trees, which in turn leads to higher surface fuel loads that are more likely to burn at higher severity compared to older forests (Levine et al. 2022, Kobziar et al. 2009, Thompson et al. 2011, Zald & Dunn 2018, Collins et al. 2019, Stephens et al. 2020, Wayman & North 2007). Large openings also tend to create warmer/windier/ drier conditions that are conducive to wildfire spread and growth (Platt et al. 2006, Chen et al. 1999, Ma et al. 2010, Russell et al. 2018, Bigelow & North 2012, Countryman 1956) -- which is directly contrary to the agency's stated purpose to create greater resilience to fire. The LNS proposed action fails not only to explain why large openings are ecologically appropriate, but also the potential increase in wildfire hazard from increasing density of shrub and small trees.

The Forest Service should develop and analyze an action alternative for the LNS project that focuses exclusively on reducing the density of suppressed, small to intermediate-sized trees and shrubs from dry forest types (ponderosa pine/Douglas-fir, dry mixed conifer), which are the primary fuels and fire hazard issue in the area. While it is well-established that 'thinning from below' (i.e. selective removal of smaller trees from below the canopy) can be ecologically appropriate and help to reduce fire hazard in dry forests where frequent fire has long been excluded, the same is definitely not the case for large overstory tree removal. Even with the limited information that the Forest Service has presented to date, it's clear that this project paints a misleadingly positive impression of the effects of planned logging on fire behavior, when in fact the commercial logging of large canopy trees is more likely exacerbate wildfire hazard and otherwise degrade forests across this portion of the Pike-San Isabel National Forest.

GRADE: D

CRITERIA 4: Is the project designed to avoid, or at the very least effectively minimize adverse impacts to at-risk wildlife species?

The LNS project has the potential to impact habitat for a wide variety of wildlife species, including several that have been designated as sensitive, at-risk or formally listed as threatened or endangered. The agency's preliminary proposed action does not specifically address the potential impacts on wildlife, only stating that "vegetation management would be employed to achieve various wildlife habitat improvement objectives throughout the LNS landscape" (Pike-San Isabel NF 2024). Given the current lack of information on potential wildlife-related effects, this review is currently unable to fully evaluate the project based on this criteria. In lieu of this, we identify several species associated with forested habitats that likely occur in the project area and for which significant efforts should be made to analyze and avoid/minimize adverse impacts. Avoiding harm to these species is in keeping with the Forest Service's own regional framework for dry forest restoration in the Colorado Front Range, which recommends that "[r]*estoration efforts should focus on areas where restoration will protect, maintain, or expand terrestrial and aquatic habitats, especially for threatened, endangered, and uncommon animal and plant species*" (Addington et al. 2018).

Mexican Spotted Owl

The Mexican spotted owl (MSO) has been listed as a threatened species under the federal Endangered Species Act since 1993, and is also formally recognized as threatened by the State of Colorado and south of the border in Mexico (USFWS 2024, NatureServe 2024). The species occurs in disjunct forested mountains and canyons that are widely scattered across the southwestern U.S. (portions of CO, AZ, UT, NM, TX) and Mexico (USFWS 2012, 2013). The primary threat to the species has been identified as loss and degradation of habitat due to commercial logging, urban and suburban development, agriculture development, livestock grazing, mining and high intensity wildfire (USFWS 2012, 1993). Although data on population trends are limited, available evidence suggests MSO numbers and distribution have declined in the recent past, and these declines are expected to continue (Seamans et al. 1999, Stacey & Peery 2002, Gutiérrez et al. 2003, Lanier & Blakesley 2016). Only about 2,100 owls are thought to still exist north of the border, and far fewer in Mexico (USFWS 2012, 2013).

The MSO is considered to be a 'habitat specialist' in that roosting and nesting habitats occur primarily in late-successional forests with complex structure (and less commonly, in rocky canyons). Nesting habitat is typically comprised of mature or old-growth stands that are multi-storied, include large trees and exhibit high canopy closure (USFWS 2012, Danzer 2005, Fletcher & Hollis 1994, Ganey & Dick 1995, Johnson 1997). The species is known to forage in a broader array of habitats than they use for nesting/roosting, but most commonly in Douglas-fir forests (USFWS 2012). Ganey & Balda (1994) found that MSOs generally foraged more than expected in unlogged forests and less so in selectively logged forests. Many MSO prey species, including woodrats, also tend to be more abundant in late-successional forests than in other habitats (USFWS 2012, Ward 2001). In 2004, the USFWS designated 8.6 million acres of federal lands in Arizona, Colorado, New Mexico and Utah as critical habitat for the Mexican spotted owl. The LNS project area on the Pike-San Isabel National Forest is located within the MSO recovery plan's Southern Rocky Mountains Ecological Management Unit, and includes Critical Habitat Unit SRM C-2 (USFWS 2004). Although survey data are limited, active owl nest sites are known to exist in the project area (see Figure 3, this page).

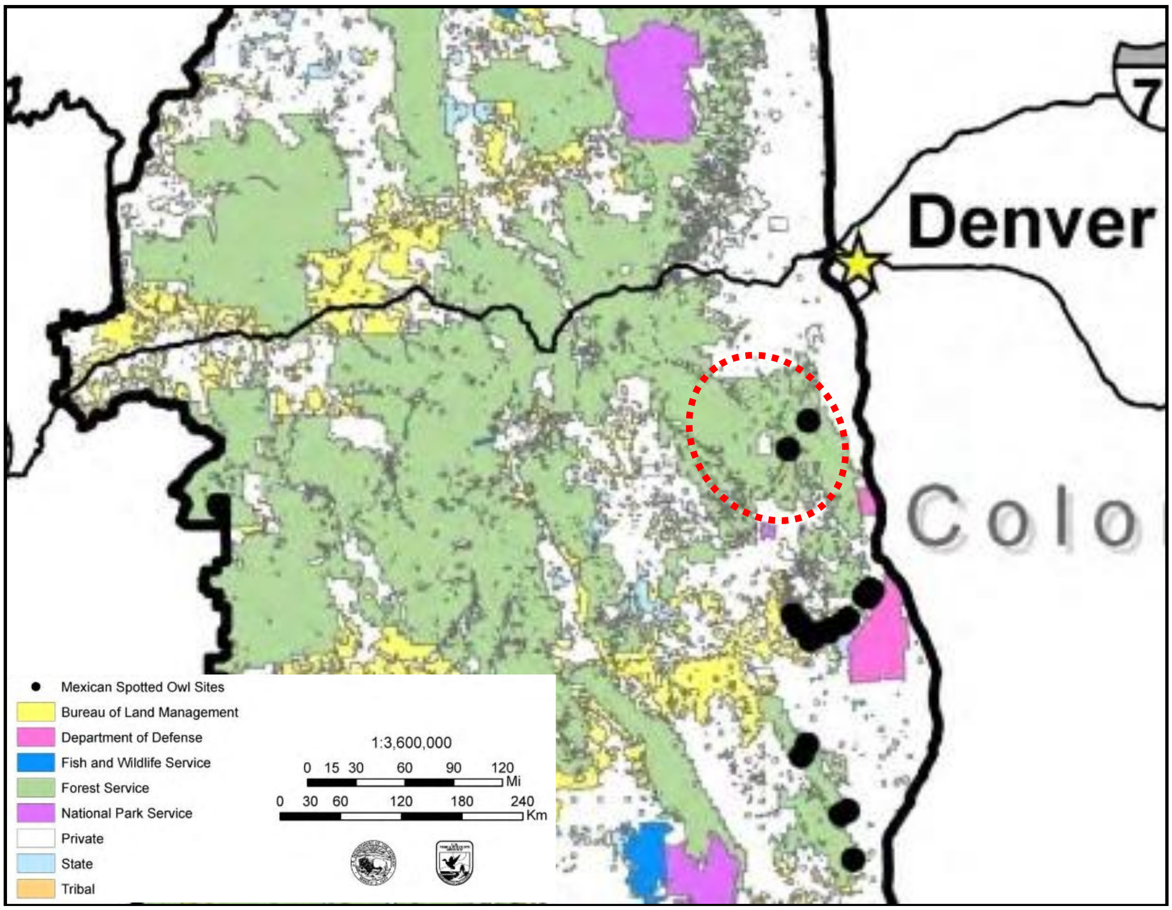

Figure 3. Map of a portion of the Southern Rocky Mountains Ecological Management Unit for the Mexican spotted owl in Colorado, relative to known MSO nest sites (solid black circles) and the generalized location of the LNS project area (dashed red oval) on the Pike-San Isabel National Forest. The US Fish & Wildlife Service notes that the "lack of mapped MSO sites within potential owl habitat is an artifact of a lack of data and does not necessarily indicate absence of owl sites." (from USFWS 2012).

Based on the preliminary proposed action, it appears that the LNS project plans to conduct commercial logging within MSO nesting/roosting habitat, and potentially within designated critical habitat as well. While light thinning of small-diameter trees from below the canopy and reintroduction of low intensity fire may not be harmful to this species in some areas, proposed commercial logging is likely to remove and/or greatly reduce important elements of MSO habitat, such as large trees, overstory cover, multi-storied canopies, snags and down logs. Such treatments should be significantly constrained in MSO habitat, and avoided altogether in MSO Protected Activity Centers (PACs), which are 600-acre core areas that surround nest sites. Relatively dense, multi-storied stands -- even when located in atypical settings --

are known to provide habitat that is important to owls, both as areas to hunt prey and as roosting sites (USFWS 2012, Fletcher & Hollis 1994, Ganey & Dick 1995).

The US Fish & Wildlife Service's 2012 recovery plan recognized that logging-based fuel reduction projects may represent "a significant risk to the MSO population", particularly when implemented across large areas as is proposed in the LNS project (USFWS 2012, Ganey et al. 1999). As a result of this concern, the recovery plan recommends that fuels reduction and forest restoration treatments should be located primarily outside of suitable MSO habitat, or at the very least "limited in spatial extent and treatment intensity": Recognizing the need to retain some dry forests with higher tree densities and more complex structure for this species, the FWS has emphasized that "[m]uch of the work needed to reduce fire risk can be achieved by treating areas around owl habitat" (USFWS 2012):

> "Available studies suggest that at least some kinds of mechanical [fuel reduction] treatments may negatively affect spotted owls. Some treatments may have beneficial or neutral effects, but we do not know which types and intensities of treatments may be beneficial, neutral, or harmful. *Lacking such information, managers should proceed cautiously in terms of treatment intensity and extent. That is, initial treatments should be limited in spatial extent and treatment intensity, and should be aimed at balancing reduced fire risk with maintaining the mature forest structure that seems to be favored by Mexican spotted owls*. And all treatments in owl habitat should be linked to rigorous monitoring of owl response, to allow us to evaluate the effects of different types of treatments in an adaptive management context" (emphasis added, USFWS 2012).

In summary, ***because logging-based treatments have significant potential to adversely affect this threatened species, every attempt should be made to avoid impacts up front, as part of project design***.

In addition, parts of the LNS project area that are not in PACs likely represent what the MSO recovery plan describes as recovery habitat -- defined as "ponderosa pine-Gambel oak, mixed-conifer, and riparian forest that either currently is, or has the potential for becoming, nesting/roosting habitat or does or could provide foraging, dispersal, or wintering habitats" (USFWS 2012). The recovery plan recommends that "[t]reatments in [recovery] habitat, if any occur, must be light; i.e., it must not reduce or eliminate the possibility of the treated land and surrounding area becoming future nesting/roosting habitat for MSO." These areas "should be managed to replace nesting/roosting habitat lost due to disturbance (e.g. fire) or senescence and to provide additional nesting/roosting habitat to facilitate recovery of the owl" (USFWS 2012). Given these important considerations, a strategy that avoids adverse impacts on MSO habitat must be fully incorporated into the design, planning and implementation of LNS treatment units, and should be presented together with a discussion of how these actions are in compliance with the recovery plan for this threatened species.

Preble's Meadow Jumping Mouse

The Preble's meadow jumping mouse (*Zapus hudsonius preblei*) is a small rodent in the jumping mouse family (Dipodidae) whose entire distribution is restricted to 11 counties extending from southeastern Wyoming to south-central Colorado (USFWS 2018). The subspecies is closely associated with dense, well-developed riparian habitats with adjacent, relatively undisturbed grassland communities that represent a very small percentage of their overall range (USFWS 2018). Habitat loss and degradation resulting from development, flood control, agricultural activities and other human land uses led to the subspecies being listed as threatened under the federal Endangered Species Act, and also by the State of Colorado, in 1998 (USFWS 2018). The USFWS later designated critical habitat for the Preble's mouse in 2003, and revised critical habitat for the subspecies in 2009 (USFWS 2009). Designated critical habitat includes approximately 411 miles of rivers and streams and 34,935 acres of lands in Colorado (USFWS 2009). Critical Habitat Unit 10 for the Preble's meadow jumping mouse is located within the Lower North-South project area and includes parts of Bear, West Bear, Gunbarrel, Sugar, Eagle and Long Hollow Creeks. There is also some critical habitat along the South Platte River (USFWS 2009, 2014).

The preliminary proposed action for the LNS project plans to conduct a range of logging-based treatments within at least 998 acres of riparian areas, including "thinning of encroaching vegetation", "broadcast burning", "removal of coniferous and decadent vegetation", "reducing fuels", "enhancing aspen", "staking and transplanting willows" and "restoring disturbed areas" (Pike-San Isabel NF 2024). The specific locations of these proposed treatments have not been disclosed, but it is expected that some areas may overlap with habitat that is suitable and/or currently occupied by the Preble's meadow jumping mouse. If this is the case, then there is significant potential for adverse impacts to this subspecies. Any type of mechanical treatments in Preble's mouse habitat are likely to conflict with recommendations made by the USFWS (2018). The Preble's mouse recovery plan calls for protection of critical riparian habitat areas from human-caused disturbances on federal lands, and land management agencies to "remove or minimize threats to Preble's mouse on federal lands" (USFWS 2018). From an ecological perspective, it would be prudent to avoid most if not all mechanical treatments in riparian areas that are potentially important to this threatened taxon.

American Goshawk

The American goshawk (*Accipiter atricapillus* ssp. *atricapillus;* differentiated from the northern goshawk in 2023), a mid-sized, forest-dwelling bird of prey in the Accipiter family, is another at-risk species with significant potential to be adversely affected by the LNS project. The species is a USFS Sensitive Species in the Rocky Mountain Region, and there is evidence this regional population may be in decline (Greenwald et al. 2005, Wickersham 2016, Brodhead et al. 2023, Smith & Keinath 2004, Patla 2004). As top-level predators, goshawks have relatively large spatial requirements, occur at relatively low densities, and depend on extensive areas of mature and old-growth forests (Kennedy 2003, Anderson et al. 2004, 2005). On the west slope of the Rocky Mountains, they occupy montane forest types ranging from ponderosa pine/dry mixed conifer up to the Engelmann spruce-subalpine fir zone (Wickersham 2016, Beck et al. 2011). Nest stands consistently have more large trees, greater canopy cover (>60%), and more open understories as compared to surrounding forest (Hargis et al. 1994, Anderson et al. 2004, Graham et al. 1999, Ferland 2006, Wright et al. 2022)

The primary threat facing the Rocky Mountain goshawk population, as is the case throughout the species' range in the western US, is habitat loss and degradation resulting from forest management, wildfire and fire suppression -- all of which can remove the dense canopies, large nesting trees, snags and down logs that goshawks require (Anderson et al. 2004, 2005, Mahon & Doyle 2005, Patla 2005, Iverson et al. 1996, Beier & Drennan 1997). In a study that identified specific roost locations on the Lassen National Forest in CA, no goshawk roosts were found within areas where timber harvest had occurred during the past 20 years (Rickman et al. 2005) -- indicating projects that reduce canopy cover (<40%) are particularly detrimental (Rodriguez et al. 2016, Squires et al. 2020). In addition, individuals are vulnerable to nest tree abandonment due to human disturbances, including those associated with roads and land management activities (Morrison et al. 2011). Based on available observation data, goshawks appear to be widely distributed in the Pike-San Isabel National Forest and the LNS project area likely includes numerous active nest sites (see: https://ebird.org/species/norgos/US-CO).

The LNS preliminary proposed action does not mention goshawk or what actions the Forest Service may take to ensure that this species is not harmed. Current USFS management standards and guidelines for goshawks typically focus on protecting habitat around nest sites during project implementation. Goshawk protected activity centers (PACs) -- areas that surround known goshawk breeding territories -- are designated based on recent documented nest sites, location(s) of alternative nests, and location of territorial birds (Reynolds et al. 1992). It is unknown to what extent any goshawk PACs as well as other suitable habitat overlap with areas that are planned for commercial logging and/or other area-based treatments in the project. This species requires relatively large areas of forest with high canopy cover, which proposed logging will reduce, potentially below minimum threshold levels necessary for site occupancy (Greenwald et al. 2005, Anderson et al. 2005, Crocker-Bedford 1990, Rodriguez et al. 2016, Tuten 2008, Patla 2005). In addition, large snags, down logs and other habitat attributes important to goshawks and their prey will also likely be significantly reduced. It remains to be seen whether or to what extent the LNS project will comply with widely accepted measures that are deemed necessary in order to avoid adverse impacts to this at-risk species.

GRADE: I (incomplete -- necessary information not available, such that scoring is not currently possible for this criteria)

CRITERIA 5: Does the project integrate managed and/or prescribed fire into project planning, and also address the timing and necessity of future maintenance treatments?

General language in the LNS preliminary proposed action suggests that the Forest Service recognizes the importance of utilizing fire as a tool in this landscape, but provides very little information on the specifics and extent to which this will actually be accomplished. The following statements summarize what the preliminary proposed action has to say about the use of prescribed fire in the LNS project area:

> "Prescribed fire would be used to both remove concentration of slash and other fuels, as well as to further thin the remaining forest to help create forest conditions more typical of historical wildfire, insects, and disease patterns."
>
> "Prescribed fire would be used in forest stands where it could effectively meet management action objectives...If an initial stand-alone prescribed fire management action was not feasible and/or would not meet objectives, stands would receive an initial vegetation management action to achieve target conditions for stand density, tree species composition, and reduce ladder fuels. In these areas, prescribed fire would be applied following vegetation management actions to reduce surface and ladder fuels and re-introduce fire into treated stands under acceptable conditions to reduce the severity of potential wildfire impacts and facilitate conditions for more frequent, low- to moderate-severity fires to occur" (Pike-San Isabel NF 2024).

Aside from these very general statements, no other information is provided about how, where, when and under what conditions the use of prescribed fire may actually be carried out as part of this project.

Modeling analysis of fuel treatment effectiveness and relative costs in the LNS project area found that compared to mechanical treatments, prescribed fire alone is a much more cost-effective means of reducing fire hazard at the landscape scale (Mueller et al. 2023). Based on both ecological and economic benefits, prescribed fire-only treatments should be prioritized as the first option where they can be safely and effectively implemented. Where can fire-only treatments be utilized and across how many acres? How will determinations be made about where broadcast burning will occur, as opposed pile burning, mastication, or other fuel abatement methods? The Forest Service has yet to provide information relevant to answering any of these questions. Considering the central importance of and strong scientific support for returning the beneficial effects of fire to dry forest landscapes (Addington et al. 2020), the Forest Service must present a clear, well-developed plan for how this will be accomplished in the forthcoming Environmental Assessment. From an ecological perspective, the long-term objective of management in these fire-adapted forests should be to reintroduce fire as the primary disturbance agent at the frequency, scale and intensity appropriate for these ecosystems. Based on available information, ***it appears that the Lower North-South project has not yet made a clear commitment to restoring the beneficial effects of fire at the scale and level of detail that is needed in order to achieve project objectives***.

GRADE: D

Last Chance Forest Management Project on Medford District BLM, Grants Pass Field Office (Oregon)

Large/old trees within units proposed for commercial logging as part of the Last Chance project, Medford District BLM. Photo credits: George Sexton

LOCATION: The Last Chance Forest Management Project (hereafter referred to as LCP) is planned within an area of mixed public-private ownership totaling 56,888 acres (of which 32,272 acres are BLM land), located approximately 20 miles north of the city of Grants Pass, Oregon (Douglas, Jackson and Josephine Counties) on federal lands administered by the Grants Pass Field Office, Medford District BLM.

PURPOSE AND NEED:
The stated purposes of the Last Chance Project include the following: "Reduce fire risk and insect/disease outbreaks", "[r]educe stand susceptibility to disturbances and promote desired species composition", "[r]educe the risk of stand-replacing wildfire" and "accelerate or improve the development of northern spotted owl habitat" (USDI BLM 2024; hereafter Draft EA).

PROPOSED ACTION:
The preliminary proposed action (Alternative #2) calls for a range of silvicultural treatments that are identified individually by the BLM as 'variable retention harvest' (786 acres), 'selection harvest' (5,948 acres), 'commercial thinning' (1,506 acres), and non-commercial 'hazardous fuels reduction' which either does (8,240 acres) or does not (3,446 acres) overlap with commercial logging units. Selection harvest and commercial thinning prescriptions would include a combination of single tree selection thinning, group

selection (to create 'gap' openings) and 'skips' (i.e. small unthinned clumps of trees). Created openings (i.e. patch clearcuts) would range in size from one up to four acres each, and generally be applied to between 10 and 30 percent of each treatment unit, depending on land use allocation (LUA). Untreated 'skips' would be retained on a minimum of 5 to 10 percent of the treatment unit acres (depending on LUA), but otherwise do not have designated size or acre requirements. Post-logging, overall average canopy cover is expected to range from below 30 to 60 percent (or average relative stand density of 30 +/- 10%). In 'variable retention' logging units, anywhere from five to 30 percent of live pre-logging conifer cover would be retained, in spatial patterns ranging from small aggregated groups to individual trees. Most of the logging will utilize either ground-based (5,080 acres) or cable (2,590 acres) yarding systems.

Together with proposed quarry expansion plus road and landing construction, all proposed ground-disturbing activities would impact a total area of 11,686 acres, or ~36% of all BLM lands in the project area (Draft EA). 7,607 of these acres are located on lands identified in the Medford District's Resource Management Plan as 'Harvest Land Base', and the remainder (~35% of total) are in 'Late-Successional Reserve' (950 acres), 'Riparian Reserve' (2,082 acres), and 'District-Designated Reserve' (1,047 acres). Alternative #2 also includes 253 miles of road renovation, 29 miles of new road construction, and re-entry/expansion of 14 existing rock quarries. Of the 253 miles of road renovation proposed, ~16 miles would need extensive renovation, including widening, rerouting, major drainage improvements and surface upgrades. In addition, previously decommissioned roads and/or roads placed in a long-term closure are proposed to be reconstructed for the project. Planned logging will be divided into at least three separate timber sales and implemented over a period of several years beginning as early as 2025 (USFWS 2023, Draft EA).

CURRENT STATUS: A Draft Environmental Assessment was released by Medford District BLM in July 2024, followed by a Final EA and initial Decision Notice (for Paul's Payoff timber sale; September 2024). Timber sales associated with project approval are included in Medford BLM's planned FY 2025 schedule.

ECOLOGICAL EVALUATION:

CRITERIA 1: Does the project include clear and specific protections for existing mature and/or old-growth trees, which are key foundational elements of fire-resistant and resilient forests?

As described in Medford BLM's Draft EA (USDI BLM 2024), the Last Chance proposed action is planning 8,240 acres of commercial logging, using a combination of 'selection harvest' (5,948 acres), 'variable retention harvest' (786 acres) and 'commercial thinning' (1,506 acres) prescriptions. The BLM generically claims that treatments "will promote and retain large trees" within areas to be logged, but review of planned prescriptions shows that the BLM would retain only the largest/oldest trees that meet very narrow criteria (if they exist at all), which vary slightly between land use allocations (described below). In addition, any existing large/old trees would also be removed on more than 478 acres in order to construct new roads, landings, cable yarding corridors, and to expand rock quarries (USFWS 2023).

In the Moderate-Intensity Timber Area LUA (57 acres), only those Douglas-fir and pines that are both > 40" diameter at breast height (dbh) and that BLM identifies as having been established prior to 1850 (i.e. ≥174 years old) would be protected from logging. On other lands designated as Low-Intensity Timber Area, Uneven-Aged Timber Area, Late-Successional Reserve and Riparian Reserve, the large tree standard is the same as described above, except the minimum diameter requirement for retention is >36" dbh instead of 40" dbh, and all hardwood trees (madrone, oak) ≥24" dbh are also protected. It's unclear from available documents what tree retention standard would be applied to lands identified as District-Designated Reserves, which are not generally available for timber harvest (USDI BLM 2016).

The BLM's proposed standards, as summarized above, set a very low bar for retaining large/old trees as part of proposed logging treatments. Given the highly variable stand structure, age and site conditions that are associated with mixed conifer forests in the planning area, it's very likely that many if not most existing mature and old-growth trees will not meet both the diameter and age criteria that would be necessary to qualify for retention. For example, slower-growing trees older than 174 years of age are often less than 36-40" dbh (particularly on thin soils or steep slopes), and trees growing on productive sites may be >36" diameter but less than 174 years old (Black et al. 2008). Even more important, many trees that are relatively large (e.g. 20-40" dbh) and/or old (~120-174 years) and that play numerous critical ecological roles in these forests will also be logged -- which flies in the face of previous expert recommendation that all trees ≥150 years should be retained on BLM lands in southwest Oregon (Franklin & Johnson 2010; see criteria #1 pp. 10-12 and Appendix). The Draft EA did not disclose the specific timber volume or percentage of large/old trees that would be removed in the LCP under the proposed action, but clearly the potential exists for this to be ecologically harmful and very significant.

Moreover, the preliminary action for the LCP does not specify how silvicultural prescriptions will be implemented in treatment units where few or no trees exist that meet both the strict tree size and age criteria necessary for retention. If few or no such trees qualify (a scenario that may be common), then it appears likely prescriptions will allow removal of the largest/oldest trees that remain in these stands -- which would be plainly antithetical to an ecologically-based management approach that seeks to reduce fire hazard, increase resiliency and maintain wildlife habitat. It's also unclear how the BLM would even implement the proposed tree retention standard, since its very unlikely the agency will be determining the age of all trees in units that are >36-40" dbh, to see if they are also >174 years old. In addition to large trees lost directly due to logging, there is a also a large amount of new road construction and reconstruction planned, which the BLM acknowledges will require removal of large/old trees and adversely impact forests within the Last Chance project area ("In areas of permanent road construction, large trees may be removed"; Draft EA).

Any additional loss of large/old trees as part of the LNS project is ecologically inappropriate because the project area already exhibits a significant deficit of large trees and old forest stands relative to historic conditions due to past logging. According to the Draft EA, more than 65% of BLM lands in the Last Chance project area (21,184 acres) have been commercially logged since 1950, most of which was conducted using clearcutting or overstory removal (>20,000 acres). And even this large percentage is assuredly an underestimate of past impacts, since considerable logging is known to have occurred in the area prior to 1950. Only ~10% of forest stands in the project area are currently classified as "late seral closed canopy", which is significantly below the historic range of variability for this landscape (Draft EA). Of the remaining late-successional forests, the proposed action will log 851 acres, or 16% of the older stands that still remain (Draft EA). In summary -- despite the current rarity of large/old trees in this area and their known importance in sustaining numerous ecological functions such as fire resilience, critical wildlife habitat and carbon storage, the Last Chance project plans to reduce them further under the auspices of "risk reduction", "creating desired species composition" and "improving the development of spotted owl habitat."

The removal of large/old trees as part of the LCP is most glaringly inconsistent with ecologically-based management on the lands that are proposed for logging within Late Successional Reserves (LSR; 291 acres) and Riparian Reserves (RR; 1,297 acres). While the BLM's Resource Management Plan allows for some fuels reduction activities to take place in LSRs and RRs, the primary management objective on these lands is to maintain "a network of large blocks of older, structurally complex and multi-layered conifer forest" (USDI BLM 2016) [6]. Given this goal***, it is difficult to understand how removing any mature and old-growth trees from LSR and RR lands represents a legitimate action****,* especially given that large/old trees are: 1) now rare relative to their historic abundance, 2) generally do not contribute to elevated fire hazard, 3) provide numerous key ecological functions and services (including fire resistance)

[6] The primary management objectives of Riparian Reserves are to "maintain and restore riparian functions, maintain water quality, and contribute toward the conservation and recovery of ESA-listed fish species (USDI BLM 2016) -- all of which are benefited by and dependent upon the retention and recruitment of large-diameter trees.

that are not provided by smaller trees, and 4) once lost, are very difficult and take well over a century to replace (Franklin et al. 2013, see pp. 10-12 and Appendix).

GRADE: D

CRITERIA 2: Do proposed treatments focus on frequent-fire forest type(s) that are likely to exhibit the greatest departure from historic conditions, and therefore in legitimate need of restoration-based management?

The Last Chance project area is located in the 'Inland Siskiyou' ecological subregion within Oregon's portion of the Klamath Mountains, and includes elevations ranging from ~1,600 to 5,000 feet (Thorson et al. 2003, ODFW 2016). Forests in this area support a very diverse range of coniferous (Douglas-fir, ponderosa pine, sugar pine, incense cedar, white fir, western hemlock), hardwood deciduous (big leaf maple, California black oak, Oregon white oak) and broadleaf evergreen (madrone, canyon live oak, chinquapin) tree species that vary and intermix at fine spatial scales (Frost & Sweeney 2000, Atzet et al. 1996, Franklin & Johnson 2010). The Draft EA for the LCP describes the diversity of forest types in the project area in terms of Plant Association Groups (PAGs), which are loosely associated with differences in slope, aspect, elevation and soil types (Atzet et al. 1996). Relatively warm/dry slopes with south and west aspects tend to be dominated by pines, oaks and madrone, while more mesic northern and eastern slopes, as well as productive soils and valley bottom settings support higher cover of white fir, western hemlock, maple and chinquapin (Draft EA 2024). Commercial logging is proposed to occur to varying degrees in all ten of the different forest types identified in the project area, with most in the Douglas-fir-Dry (1,977 acres), White Fir-Intermediate (1,588 acres), Western Hemlock-Dry (1,558 acres) and Douglas-fir Moist (1,358 acres) PAGs.

Often collectively referred to as 'Siskiyou mixed conifer', this general forest type historically was characterized by highly variable, low and (mostly) mixed severity fires that maintained a complex, patchy and fine-grained mosaic of multi-aged forest stands across the landscape (Skinner et al. 2006, Sensenig et al. 2013, Metlen et al. 2018, Frost 2001, Frost & Sweeney 2000). The Draft EA states that "[b]efore fire suppression and intensive management practices of the twentieth century, the project area was characterized by high frequency (0-35 yrs), low severity fires." In contrast, the majority of available scientific evidence recognizes these forests are primarily associated with a mixed- rather than a low-severity fire regime (Perry et al. 2011, Hessburg et al. 2016, Halofsky et al. 2011, Lesmeister et al. 2019, Thompson & Spies 2009, Estes et al. 2017, Odion et al. 2014a). In mixed-severity forests, fire behavior varies considerably and typically includes a range of low, moderate and high severity effects, as determined by the complex interplay of weather, topography, stand structure, fuel loads and moisture levels (Beatty & Taylor 2001, Lesmeister et al. 2019, Agee 2005, Taylor & Skinner 2003, Perry et al. 2011). Shortcomings in the proposed action reflect the BLM's inaccurate portrayal of natural disturbance dynamics in the project area.

According to the principles of ecological forestry, silvicultural prescriptions should mimic or emulate the variation in natural disturbance patterns as they shift along a continuum from warm/dry to cool/mesic forests that are found in more productive biophysical settings (e.g., lower slopes, deeper soils, north and east aspects; Franklin et al. 2018, 2007, Hessburg et al. 2016). For example, on south slopes at lower elevations, dry pine and Douglas-fir forests historically tended to burn more frequently and create more open stands, whereas cooler, more productive sites dominated by western hemlock or white fir supported higher tree densities, more complex structure, and often functioned over time as 'fire refugia' (Lesmeister et al. 2021, Downing et al. 2021, Blomdahl et al. 2019). Unfortunately, the Last Chance project fails to consider these important differences in stand dynamics as the basis for designing appropriate management. Instead, differences in treatment intensity and logging-based prescriptions are exclusively tied to land use allocations, which have little or no ecological relevance to the actual landscape on the ground.

The best available science indicates that large portions of the forested landscape in the Last Chance project area have likely missed one to several mixed-intensity fires since effective fire suppression began over a hundred years ago (Frost 2001, Hessburg et al. 2016, Metlen et al. 2021). In addition, commercial logging over many decades has also dramatically altered forest structure and increased fire hazard, by removing most of the large, fire-resistant trees and creating conditions conducive to the recruitment and survival of many smaller, young trees (Odion et al. 2004, Perry et al. 2011, Naficy et al. 2010). Based on this context and currently available information, it is reasonable to conclude that the BLM's Last Chance Project is appropriately focused on forests that are associated with a relatively frequent mixed-severity fire regime, and therefore likely to be departed from the more resilient conditions that existed in this landscape historically.

GRADE: C

CRITERIA 3: If reducing wildfire hazard is an element of the project's Purpose & Need, do treatments focus on reducing surface and ladder fuels (e.g., subcanopy trees, shrubs, down woody debris) that most contribute to elevated risk of high intensity fire?

Given that the BLM has identified "reducing the risk of stand-replacing wildfire" as one of the primary goals of the Last Chance Project, to what extent do the proposed treatments actually focus on altering forest structure and composition in a way that is most likely to reduce uncharacteristic fire behavior? Proposed commercial logging is comprised of three primary treatment types -- 'selection harvest' (5,948 acres), 'variable retention harvest' (786 acres) and 'commercial thinning' (1,506 acres). All of these acres will be subject to some type of follow-up hazardous fuels reduction (hereafter HFR) after logging.[7] An additional 3,446 acres are proposed as stand-alone fuels maintenance treatments, which will occur "as funding and personnel permit" in stands that have been previously treated for hazardous fuels in order to maintain the current condition. Unfortunately, the BLM does not specify how much, where or which of the various HFR treatments would be employed within treatment units of the project area, only stating they "could include slashing, machine piling, hand piling, hand pile burning, chipping, lop and scatter, biomass removal, and/or understory burning" (Draft EA).

HFR treatments are typically designed to reduce understory fuel levels, which includes both surface (i.e. on the forest floor) and ladder (small trees and shrubs) fuels that are known to exert the strongest influence on wildfire behavior (Agee & Skinner 2005, Stephens et al. 2009, Rothermel 1983). HFR is particularly important after logging, because all of the tree branches, tops, and other flammable biomass left on site (i.e. 'activity fuels') leads to higher post-logging fuel loads on the ground (Ottmar 2019, Koski & Fischer 1979, Bennett 1960). Studies have shown that fire hazard is often elevated in logged areas, particularly where HFR has not been conducted (Donato et al. 2006, Stone et al. 2008), and such areas are predisposed to burn at high intensity in subsequent wildfires (Thompson et al. 2011, Thompson & Spies 2010, Weatherspoon & Skinner 1995).

While the BLM does propose to conduct HFR on lands after logging is conducted, very little information is presented regarding how, where, when and to what extent such actions will actually be carried out. In terms of standards and requirements for HFR treatments, the Draft EA only states the following:

> "*Adjacent to values and along access routes, activity fuel loads would be reduced to result in expected flame lengths less than 4 feet under typical fire weather conditions within 1-2 years following completion of harvest. In areas not adjacent to values or access routes, the depth of*

[7] The Last Chance Draft EA defines hazardous fuels reduction (HFR) as one of two things -- 1) in logged areas, non-commercial actions "that are needed to reduce the amount or depth of residual activity fuels" generated by logging, and 2) on other lands, HFR treatments are "designed to treat understory vegetation (less than 8 inches dbh) to reduce surface and ladder fuels".

activity fuels would be reduced to less than 18 inches in height by lop and scatter within 1 year of harvest."

The BLM does not specifically define or identify areas that are "adjacent to values and along access routes", so it's unknown what portion of the project area this proposed standard applies. On other lands not adjacent to values or access routes (also not identified), the agency will only treat activity fuels to a depth of 18 inches in height by 'lop and scatter' -- which represents a very significant surface fuel load that may very well be higher than what currently exists in these stands.

Other important information about proposed fuels reduction work is missing from the Draft EA -- How much prescribed underburning will take place in the project area, either as a stand-alone treatment and/or in areas that are proposed for logging? How much machine and hand pile burning will take place, and in what areas? How long can it be expected that surface fuel loads will remain elevated after 'lop and scatter', and how does this compare to other fuel reduction methods? The BLM does not provide answers to these questions, which are important because the range of HFR methods proposed by the BLM (i.e., chipping, slashing, lop and scatter, machine and pile burning, etc.) have very different ecological effects, are not equivalent in terms of their purported fuel reduction benefits, and are likely to have long-term consequences regarding forest resiliency.

An additional, potentially even more significant increase in fire hazard is likely to result from forest openings (i.e., patch clearcuts) that will be created by proposed logging. By removing all canopy trees from stands up to 4 acres in size, logging-based treatments will create openings that cover between 10 and 30% of each unit, leading to an equivalent clearcut area of ~1,908 acres (Draft EA). The BLM does not explain why openings of up to 4 acres in size are ecologically appropriate in this specific landscape, and in fact, the agency's own review of spatial patterns in similar forests of southwest Oregon found that under an active disturbance regime, "gap sizes were typically less than 2 acres and generally less than 1 acre" (Draft EA). Creating larger openings, as is proposed across over 1,000 acres, will not only move the forest further outside the historic range of variability but also unnecessarily increase fire hazard. After logging, the BLM states that these openings will be actively replanted and eventually converted into densely stocked patches of young conifers (target density according to Draft EA is 150 trees/acre). Young, even-aged stands, even if relatively small, are known to be highly vulnerable to fire because they contribute to both surface and ladder fuel loads (Levine et al. 2022, Kobziar et al. 2009, Thompson et al. 2011, Zald & Dunn 2018).

Moreover, research has shown that the increased light availability in canopy gaps of this size, together with ground disturbance from logging, often leads to rapid establishment and growth of woody shrubs and (non-planted) trees, which can also contribute to increased surface fire intensity and facilitate the movement of fire from the forest floor into the canopy (Nagel & Taylor 2005, Coppoletta et al. 2016, Lutz et al. 2017, Jaffe et al. 2021, Wayman & North 2007). The BLM acknowledges that these actions will increase wildfire hazard: "In areas thinned to open canopy conditions (e.g., <40 percent canopy cover), regeneration of a diverse understory is expected and could contribute toward more rapid live fuel loading accumulation... and increase rates of surface fire spread"(Draft EA, Appendix D). Yet the Draft EA lacks any plan for mitigating the effect of increased shrub and tree growth in created openings on wildfire hazard.

Lastly, removal of some undetermined but significant volume of larger (e.g. >20" dbh) mature and old-growth trees, which are part of all proposed logging-based treatments across 8,240 acres of the Last Chance project area, will also reduce rather than increase resiliency to wildfire, and runs contrary to the agency's stated purpose and need. It is a well-established understanding in the fire ecology of western, seasonally dry forests that of all fuel types that may be present, living large/old trees are the most resistant and least susceptible to burning, because they are slow to dry out, difficult to ignite and generally do not influence rates of fire spread (Agee & Skinner 2005, Agee 1993, Rothermel 1983, Miller et al. 2012). As described earlier in this report (see criteria #3, pp. 7-9 and Appendix), retention of large-diameter trees is one of the primary, well-established principles for how to create fire-resilient forests (Agee & Skinner 2005, Agee 1996, Brown et al. 2004). Not only do large overstory trees contribute little to fuel loads and fire hazard, but research has shown that they help to moderate fire behavior and effects through their influence on forest structure and microclimate.

Numerous studies conducted in mixed conifer and Douglas-fir/hardwood forests in the Klamath-Siskiyou region (e.g. analogous to those in this project area) have found that stands dominated by large/old trees tend to burn less intensely than open stands that are the supposed goal of BLM's logging-based treatments (Lesmeister 2019, Thompson & Spies 2009, Raymond & Peterson 2005a-b, Odion et al. 2004, Taylor & Skinner 1998, Halofsky et al. 2011, Alexander et al. 2006). Researchers have long recognized that in forests dominated by large trees, the overstory canopy creates shade, cooler temperatures and reduced air flow that allows fuels to retain higher moisture content longer into the fire season (Kitzberger et al. 2012, Frey et al. 2016). As summarized by Lesmeister et al. (2021), "*Converting older, closed-canopy forests into more open forests does in no way assure a dampening effect on wildfire severity, due in part to the complex changes in the microclimate of forest stands after thinning. Recently disturbed forests have higher and more variable short-wave radiation, temperature and wind speed, all of which can increase fire severity*." The BLM's own rudimentary analysis on this issue reveals that implementation of Alternative #2 will in fact increase fire hazard by "converting mature structure to the early successional stage", "increasing surface wind gusts" and "delaying promotion of large fire-resistant trees." (Draft EA).

Interestingly, the Last Chance EA does present an alternative (#3) that would retain all large trees (>20" dbh) while also including the full range of hazardous fuel reduction treatments that are part of other action alternatives. Consistent with the evidence presented in this report, the BLM's analysis confirms that widespread removal of large trees will significantly increase wildfire hazard. Under Alternative #2 -- where large trees will be removed across thousands of acres -- 51% of treated stands will exhibit moderate to high fire hazard after logging, compared to only 14% when all large trees are retained under Alternative #3 (Draft EA). Given that "reducing the risk of stand-replacing wildfire and stand susceptibility to disturbances" is a primary goal of the Last Chance project, the agency's own site-specific evaluation shows that Alternative #3 (which retains all large trees) is clearly the more effective option. Yet the Draft EA makes it relatively clear that Alternative #2 is the preferred alternative -- even though it runs contrary to the BLM's purported project objective (fire risk reduction).

If the BLM is actually concerned with reducing fire hazard and restoring forest structure, this project would not remove large/old trees and create openings, but rather focus on the cohort of smaller, subcanopy and understory trees that have become much more abundant since the onset of widespread logging and fire suppression. As recognized by USFWS (2023) in their assessment of this project, "[The] *best available information suggests that managing for the protection of large trees can be accomplished while still reducing potential fire intensity through surface and ladder fuel reduction*" (Stephens et al. 2009, Martinson & Omi 2013, Prichard et al. 2020). BLM projects that are based on a "thinning from below" approach to fuels reduction and forest restoration (similar to Alternative #3) have been successfully implemented in similar forest settings of southwest Oregon (USDI BLM 2015, Reilly 2012, Franklin & Johnson 2010). Unfortunately, the Medford District has decided to instead focus on removal of larger trees, using silvicultural treatments that are more likely to increase rather than reduce the risk of high severity wildfire in the Last Chance project area.

GRADE: D

CRITERIA 4: Is the project designed to avoid, or at the very least effectively minimize adverse impacts to at-risk wildlife species?

The Last Chance Project area is known or suspected to support a number of at-risk wildlife species that are associated with mature and old-growth forest habitats, and of these, the most well-studied is the Northern Spotted Owl (hereafter NSO). This section will evaluate whether and to what extent the Last Chance Project balances the need to conserve this threatened species and its habitat with the desired goals of reducing fuels and wildfire risk. The information presented here on potential impacts to NSO is mostly taken from the U.S. Fish & Wildlife Service Biological Opinion, which after a detailed analysis, concluded that this project as currently proposed is "likely to adversely affect NSO and their critical habitat" (USFWS 2023).

<u>Northern Spotted Owl</u>

The northern spotted owl (*Strix occidentalis caurina*) has been federally listed under the Endangered Species Act since 1990 as Threatened throughout its range “due to loss and adverse modification of habitat as a result of timber harvesting” (USFWS 1990). Since the time of its ESA listing, the NSO has continued to decline across large portions of its geographic range, which extends from the Washington-Canada border to Marin County, California. The biggest ongoing threats to spotted owls are: 1) loss of habitat due to timber harvest and/or severe wildfire, and 2) competition with non-native barred owls. The documented steep annual rate of population decline (5.3% per year) indicates that extinction risk for this species has increased significantly since the time of federal listing (Franklin et al. 2021, USFWS 2023).

Spotted owls depend on multi-storied, structurally complex forests that are dominated by large trees and high densities of down and standing coarse wood for nesting and foraging (USDA 2023). Habitats that contain these attributes are considered high quality Nesting-Roosting (NR) habitats (USDA 2023). Spotted owls also rely on stands with lesser amounts of these features for foraging and dispersal across the landscape (F habitat). As described below, proposed treatments in the Last Chance project are planned within forest stands classified as either NR or F habitat. The potential for adverse impacts to NSO from these treatments in the Last Chance project also vary depending on habitat type and land use allocation, as well as site-specific effects to known NSO nesting territories and designated critical habitat.

Within the Last Chance project area, 19,343 acres of BLM lands have been designated as NSO Critical Habitat (USFWS 2023, Draft EA). In their evaluation of potential impacts to NSO on these lands, the BLM determined that proposed logging treatments would eliminate 3,420 acres of NRF habitat and 2,501 acres of dispersal habitat (of which 232 acres of NRF and 50 acres of dispersal occur in Late-Successional Reserves[8]). On top of this, an additional 2,668 acres of NRF and 1,801 acres of dispersal habitats would be modified (e.g. downgraded to lower quality habitat; Draft EA). ***<u>Taken together, proposed logging actions would result in a 16% net decrease in available NRF habitat and 20% decrease in dispersal habitat on federal lands in the project area</u>*** (Draft EA).

In terms of site-specific impacts, there are 33 known NSO home ranges that are completely contained within the Last Chance project area (USFWS 2023). Of these 33, the US Fish & Wildlife Service determined that implementation of the Last Chance Project (Alternative #2) is "likely to adversely affect" 27 (82%) territories, including all six that are known to be currently occupied. The adverse impacts are a result of logging prescriptions that "*reduce habitat features that are known to be important to NSOs, specifically the density of tall/large trees, legacy stand structures (e.g. large snags/down logs), overstory canopy cover and the density/number of canopy layers...These treatments, primarily large tree removal, are expected to result in mostly unusable NRF habitat within the affected stands for decades post-treatment, and have the potential to reduce the overall carrying capacity of the project area*" (USFWS 2023). Even greater cause for concern is the fact that proposed logging will reduce the amount

[8] Late-Successional Reserve (LSR) management direction, as set forth in BLM's Resource Management Plan (2016), makes clear that any BLM actions should not decrease the amount or quality of existing NSO NR habitat, and only proceed if they can reasonably be expected to improve NSO habitat conditions -- “*Any commercial treatments within the LSR are to occur in stands that currently do not function as NSO nesting-roosting habitat and are expected to improve spotted owl nesting conditions across the landscape in the future. In stands that are not NSO NR habitat, limit such silvicultural treatments to those that do not preclude or delay by 20 years or more the development of NSO nesting-roosting habitat in the stand and in adjacent stands, as compared to development without treatment* (USDI BLM 2016).

of NRF habitat below minimum threshold levels in two of the six occupied NSO territories, and across four additional core use areas. Research has shown that when less than 40% of an overall home range, and/or less than 50% of the 0.5 mile core use area supports suitable NRF habitat, then spotted owl occupancy, survival and reproductive rates all significantly decline (Bart & Forsman 1992, Bart 1995, Dugger et al. 2005).

On top of the direct habitat loss and degradation that is expected to result from logging, the Last Chance project also has the potential to adversely affect NSO by increasing competitive interactions between NSO and barred owls -- now considered one of the greatest threats to NSO survival (USFWS 2011). Wherever the two owl species are found together, the barred owl has a competitive advantage because barreds are more aggressive than NSO and can utilize a wider array of habitats and prey species for food (Irwin et al. 2020, Wiens et al. 2014, Hamer et al. 200). In locations where spotted and barred owl home ranges overlap, NSO often experience reduced fitness and survival, and over time can be completely excluded from previously occupied, high-quality habitat (Mangan et al. 2019, Sovern et al. 2014, Hamer et al. 2007).

Recent spotted owl surveys have found that barred owls are prevalent across the Last Chance project area and that occupancy of spotted owl nest sites continues to decline, likely due to widespread barred owl occupation (Lesmeister et al. 2021, Franklin et al. 2021, Dugger et al. 2023). NSO biologists believe (with supporting empirical evidence) that the amount and quality of old forest habitat may be an important factor determining how spotted owls fare in the face of competition from barred owls (Franklin et al. 2021). Based on this evidence, it is reasonable to conclude that the combination of NSO habitat loss and degradation caused by the logging in the Last Chance Project is likely to increase the barred owl's competitive advantage, and thereby result in adverse impacts to NSO that are greater than the effects of habitat loss alone (USFWS 2023).

The BLM asserts in the Draft EA for the Last Chance project that proposed actions may have short-term adverse impacts to NSO, but these impacts will be more than offset by future benefits to the species, because treatments will increase resiliency of stands to withstand fire and hasten the development of NSO nesting-roosting habitat over time. However, a number of studies that have explored the tradeoffs between short-term impacts from mechanical treatments and long-term benefits to NSO habitat do not support this conclusion (Odion et al. 2014b, Peery et al. 2017, Lesmeister et al. 2018, 2019, Tempel et al. 2015, Dunk et al. 2019, Dow et al. 2016, Wood et al. 2018). Moreover, accepting this tradeoff between loss of NSO habitat due to planned logging versus potential loss due to wildfire makes sense *only if it is reasonably certain that the project will in fact reduce wildfire hazard in a manner that still retains essential habitat characteristics for NSO*. As described previously (see previous section and also criteria #3, pp. 14-17), the preferred alternative as currently proposed has significant potential to increase rather than reduce fuel loading and the probability of high intensity fire.

The BLM's Medford District is fully capable of designing an action alternative for the Last Chance Project that would both produce commercial timber and have fewer adverse impacts to the northern spotted owl and their critical habitat (see specifically Franklin & Johnson 2010). But based on the information currently available, it appears the agency has chosen to focus more on producing timber rather than minimizing risks to NSO and other species that are closely associated with the area's remaining large trees and late-successional forests. From an ecologically-based perspective, a more conservative approach to forest management in the Last Chance project is clearly warranted (similar to Alternative #3), so as to more effectively mitigate the risks of logging-based treatments on this declining species.

GRADE: D

CRITERIA 5: Does the project integrate managed and/or prescribed fire into project planning, and also address the timing and necessity of future maintenance treatments?

A large body of scientific research has demonstrated that silvicultural thinning and other mechanical treatments alone often do not mitigate wildfire hazard (Safford et al. 2012, Taylor et al. 2022, Barnett et al. 2016), and that prescribed burning is necessary in order to effectively reduce surface fuel loads and increase forest resiliency to subsequent fire (Stephens et al. 2009, Martinson & Omi 2013, Ritchie et al. 2007, Fernandes 2015, Davis et al. 2024). As currently presented in the Draft EA, 'hazardous fuels reduction' following timber harvest will occur on 8,240 acres. On these acres, the BLM states that "a fuels specialist will prescribe the appropriate method of treatment", and that "underburning ***may be used*** in treatment units to reduce fire hazard" (emphasis added, Draft EA). No acreage estimates are presented as to how much prescribed fire will be applied, or in which cases the use of fire will be chosen over other fuel treatment methods that are proposed (i.e. lop and scatter, slashing, machine and hand pile burning, chipping and biomass removal).

The Last Chance proposed action also includes 3,446 acres of stand-alone 'hazardous fuels reduction' maintenance treatments, which will be implemented in stands where tree and brush densities have increased since initial fuels treatments were implemented over the last 20 years. "Without frequent maintenance [e.g. every 15-30 years], understory fuels would re-grow, vegetation would also die, and surface and ladder fuels would re-accumulate" -- leading to an increase in fire hazard. The BLM recognizes the need for maintenance treatments, and is taking at least some steps to incorporate these actions into project planning -- but it is again unclear to what extent the agency will utilize prescribed fire rather than some other, less ecologically beneficial method of fuels abatement. And although it is acknowledged that maintenance treatments are essential to reducing fire hazard in the project area, apparently these actions will occur only to the extent that future "funding and personnel permit" (Draft EA). Even more problematic is that the preferred alternative (#2) would create the greatest need for future maintenance treatments -- because "more open conditions would require more frequent maintenance" -- and yet the Draft EA fails to present any plan describing how the BLM will ensure these essential actions will in fact be carried out.

Even with the limited information presented in the Draft EA, it is apparent that the fuels management treatments included as part of the Last Chance project fall far short of the actions that would be necessary to substantively increase resiliency of the project area to wildfire, or help to restore low-intensity fire as a keystone ecological process in this landscape. While a significant portion of BLM lands in the project area will be subject to some form of hazardous fuels reduction, of these acres, it's likely that only a very small (undisclosed) proportion will involve the application of prescribed fire. Given 1) the apparent lack of prescribed burning that is being proposed, 2) the absence of a long-term plan for future stand maintenance that is based on additional fire use, and 3) a commitment to ensure that adequate funding and resources will be available to carry out future maintenance necessary to achieve desired outcomes, it's very unlikely that the Last Chance project can successfully meet its stated goals to "promote forest resiliency" and "reduce the risk of stand-replacing wildfire".

GRADE: D

Grasshopper Restoration Project, Mount Hood National Forest (Oregon)

Old-growth Pacific silver fir (left) and Douglas-fir trees located in variable density thinning units #150 (left) and #208 (right) of the Grasshopper Restoration Project, Mount Hood National Forest, Oregon. Photo credits: BARK

LOCATION: The Grasshopper Restoration Project (hereafter referred to as GRP) is planned within a 5,360 acre project area that extends from near the crest of the Cascades to the foothills of the Eastern Cascades on the Mount Hood National Forest (Barlow Ranger District) in the White River watershed, Hood River and Wasco Counties, Oregon.

PURPOSE AND NEED: The stated primary purposes of the Grasshopper Restoration Project are "to improve the health and vigor of forested stands,...reduce risks associated with high-intensity wildfires, restore the landscape to conditions more consistent with natural disturbance regimes, structure and species compositions"...and "enhance, restore, and protect wildlife habitat." (Final EA 2022 and Decision Notice 2023)

PROPOSED ACTION:

The proposed action for the Grasshopper project (Alternative #1 in the Final EA) plans commercial logging in late-successional forest stands using 'Variable Density Thinning' (VDT) prescriptions on 3,503 acres, 'sapling' (pre-commercial) thinning in stands less than 40 years old on 1,422 acres, and 'intermediate' commercial thinning in stands 40-80 years old on 355 acres. VDT prescriptions include no restrictions based on stand age and forest type, or explicit retention standards for trees of any species, size (diameter) or age, and will create canopy gaps where all trees may be removed in areas up to two acres. In terms of land use allocations, commercial logging is planned on 272 acres of inventoried roadless areas (10-14" dbh limit), 541 acres of late-successional reserves (of which 325 acres are commercial logging), and 556 acres of riparian reserves (including 463 acres in older stands). Overstory canopy cover will be reduced down to 40-50% in treated portions of riparian reserves, and trees up to 30" and 24" dbh can be removed from 'moist' and 'dry' riparian reserves, respectively.

Other management activities planned within the project area footprint, but without any specific location or acreage estimates, include construction of fuelbreaks along roads and ridges, prescribed underburning, mastication, pruning, machine and hand pile burning (Final EA 2022). Approximately 17 miles of temporary roads would be constructed to access proposed treatment units, but the EA does not specify the locations of these new roads, which will only be determined during project implementation. Road maintenance, reconstruction and other improvements may also occur on any roads located within the planning area. The Grasshopper DN also approves exemptions from the Mt. Hood NF Plan allowing greater disturbance of vegetation and watersheds. Implementation of the proposed action would generate approximately 19.5 million board feet of timber (Final EA 2022).

CURRENT STATUS: A Final Environmental Assessment (EA) for the Grasshopper Restoration Project was released by the Mt Hood National Forest in September 2022, selecting 'Alternative #1' as the preferred alternative. In January 2023, a Final Decision Notice was issued by the Barlow/Hood River District Ranger, authorizing the selected alternative for implementation. This project is currently under litigation (Oregon Wild v. U.S. Forest Service Case No. 3:23-cv-00935-SB) and depending on the outcome, implementation may begin soon thereafter.

ECOLOGICAL EVALUATION:

CRITERIA 1: Does the project include clear and specific protections for existing mature and/or old-growth trees, which are key foundational elements of fire-resistant and resilient forests?

The Decision Notice for the Grasshopper Restoration Project approves commercial logging using 'variable density thinning' (VDT) prescriptions on 3,503 acres, the large majority of which will occur in late-successional forests. VDT employs commercial logging as a means to create a wide range of tree densities in different areas, presented in terms of stand basal area. In order to achieve the prescribed range of basal areas in VDT logging units, many of the large, old trees that make up these forest stands will be removed -- including from approximately 500 acres that meet the Mt. Hood National Forest's definition for old growth. Removal of some unknown volume of large/old trees is essentially assured, because the proposed action includes no size, species, diameter or age limits on trees that can be logged. In addition to the overall reduction in tree density, VDT prescriptions will also create an unknown number and distribution of 'gaps' -- canopy openings or patch clearcuts where essentially all trees are removed -- up to two acres in size. An additional, likely significant number of large/old trees may also be removed in these areas.

Beyond these broad indications, the specific effects of the proposed action on large/old trees in the Grasshopper project area are highly uncertain, because the Forest Service did not disclose how much tree removal will occur in the mature and large/old tree cohorts, or where logging will occur in relation to the location of existing old-growth stands. On this issue, the Forest Service only states that "The acres of late seral and mature stand classes would remain very similar after treatment, due to the fact that stands would retain the majority of the large overstory trees." But what specifically does 'the majority' mean? Will the logging in various units remove 40% of large overstory trees? 20%? The Forest Service does not present any information that would allow reviewers to answer this important question. While important details are not disclosed in Final EA, what's clear is that the Grasshopper project as authorized will inappropriately place many remaining large/old trees at risk of loss due to logging.

The Grasshopper project also proposes VDT logging in 556 acres of Riparian Reserves established by the Northwest Forest Plan, including 463 acres of forest stands that are identified as late-successional. As part of the selected alternative, trees up to 30" diameter at breast height (dbh) will be removed from Riparian Reserves located within the 'moist' forest zone, and trees up to 24" dbh can be logged in 'dry' Riparian Reserves. The EA and supporting documents fail to provide a compelling ecological justification for any removing large trees from Riparian Reserves, which are known to play numerous important roles in both aquatic and terrestrial habitats. In fact, logging of trees of these sizes runs contrary to the agency's own analysis. The White River Watershed Analysis, a document intended to guide management of the national forest lands that include the Grasshopper project area, recommended that timber harvest in Riparian Reserves should not remove trees larger than 15" dbh (USDA Forest Service 1995). The Grasshopper EA fails to explain why this recommendation should not apply to this project, and why removal of trees up to 30" dbh is ecologically appropriate as part of the management and restoration of Riparian Reserves.

Additional loss of large/old trees as part of the Grasshopper project strongly conflicts with an ecologically-based approach to management, because the project area already exhibits a significant deficit of large trees and old forest stands relative to historic conditions -- primarily due to past logging (USDA Forest Service 1995). According to Forest Service data, approximately ~60% of the project area (3,156 acres) has been commercially logged since 1950. And even this large percentage is assuredly an underestimate of impacts since, according to the Forest Service, considerable logging is known to have occurred in this area prior to 1950 (Vegetation Report 2022). According to the Grasshopper EA, only ~3% of forest stands in the project area are classified as "late seral" and 11% of stands are considered to be older than 160 years in age -- "There are isolated stands with larger trees, but these are infrequent and represent a small portion of the project area." (Vegetation Report 2022). Despite the recognized rarity of large/old trees in this area and their known importance in sustaining numerous ecological functions such as fire resilience, critical wildlife habitat and carbon storage, the Grasshopper project plans to reduce them further, but now under the auspices of "restoration".

As discussed throughout this report, the vast majority of forest and fire scientists and the relevant peer-reviewed scientific literature widely agree that removal of large, old trees is rarely ecologically appropriate in western forests, particularly as part of projects with forest restoration goals. Given that large/old trees are the "foundational backbone" of forests that are resilient to fire and other disturbances, their planned removal in the Grasshopper project runs contrary to the agency's stated objectives to reduce wildfire hazard and "restore the landscape to conditions more consistent with natural disturbance regimes, structure and species compositions." Unfortunately, the Forest Service failed to analyze to what extent the project's purpose and need could be accomplished by focusing on removal of subcanopy and understory trees, which are those most likely to have increased in abundance due to past management and most contribute to increased potential for high-intensity disturbances.

GRADE: F

CRITERIA 2: Do proposed treatments focus on frequent-fire forest type(s) that are likely to exhibit the greatest departure from historic conditions, and therefore in legitimate need of restoration-based management?

The Grasshopper project area encompasses a broad moisture and elevation gradient, and as a result includes an incredible diversity of forests that have both Eastern and Western Cascade characteristics. The Forest Service recognizes three broad vegetative zones in the Grasshopper area (Crest, Transition and Eastside). In the eastern portion of the planning area at the lowest elevations are warm/dry forests -- dominated by ponderosa pine, Douglas-fir and Oregon white oak -- that historically burned frequently (<35 yrs) at low to mixed severity (Fire Regime Groups I and IIIA; see Figure 4, p. 72). To the west and increasing in elevation, forests transition from dry to moist, productive mixed conifer types that include various combinations of western larch, ponderosa pine, grand fir, Douglas-fir, western white pine, lodgepole pine, western red cedar and western hemlock. These transitional forests, which comprise most of the project area, are characterized by relatively infrequent (50-200 yrs) mixed severity fires (FRGs IIIB and IIIC). At the highest elevations, the westernmost Crest zone supports cool/moist forests dominated by mountain hemlock and Pacific silver fir. Fires in this forest type tend to burn infrequently (100-200 yrs) and at high severity, often in stand replacement events during periods of drought and/or extreme fire weather (FRGs IVC and V).

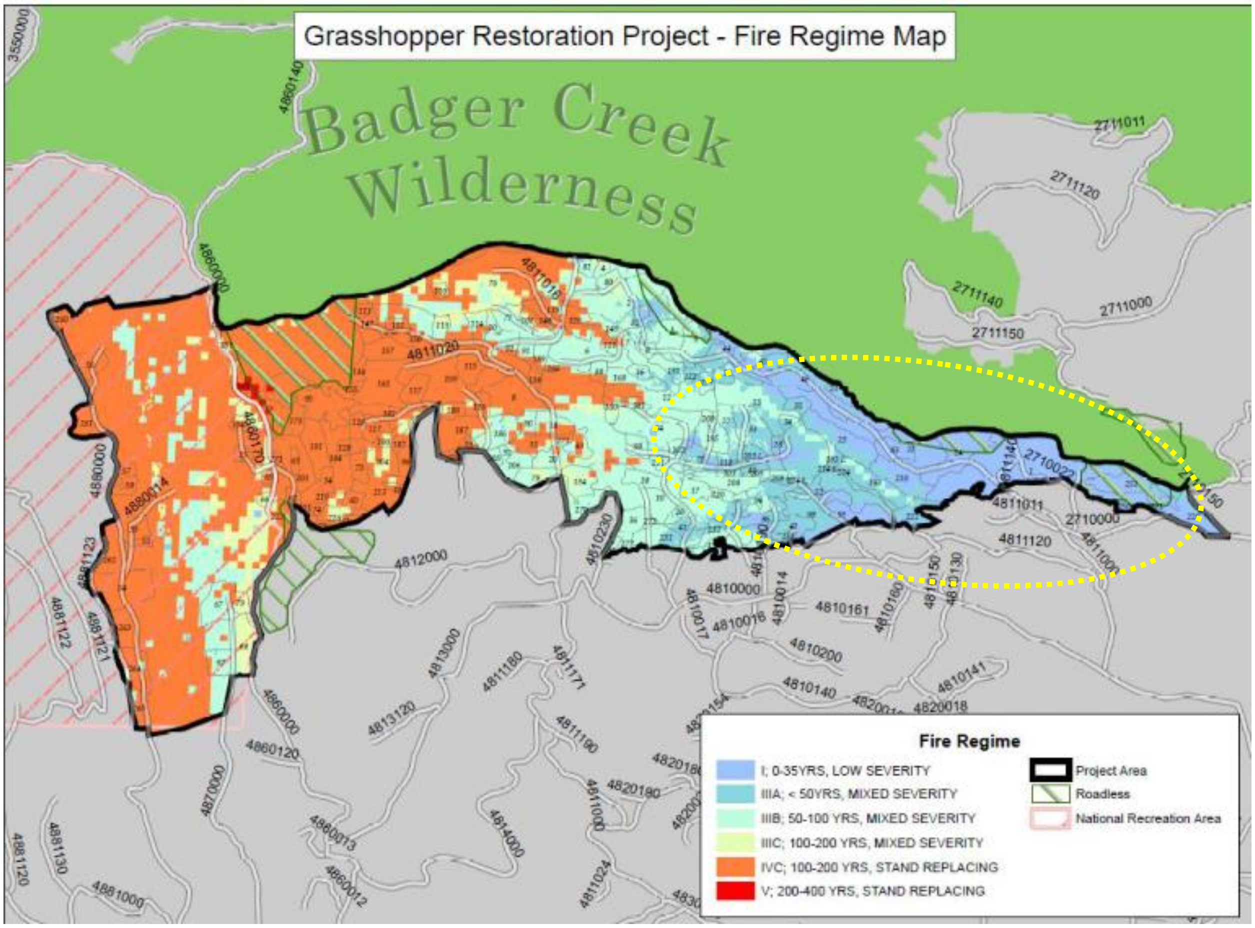

Figure 4. Map of Fire Regime Groups associated with different forest types and proposed treatment units (numbered polygons) in the Grasshopper project area. Note that frequent-fire regimes (I and IIIA; darker blue, circled in yellow) are restricted to warm/dry settings at lower elevations in the easternmost portion of the planning area, yet a large portion of the planned logging will occur in infrequent-fire forests (light blue and red colors; from Fuels Specialist Report 2022).

As discussed under evaluation criteria #2 at the beginning of this report (pp. 12-14), inherent differences among forest types in terms of structure, composition and natural disturbance regime have major implications for the type of forest management that is likely to be ecologically appropriate (or not). Interventions to restore more resilient forest conditions are most often warranted, and therefore should be the highest priority, in the warm/dry frequent-fire forests found at lower elevations in the eastern 1/3 of the project area. As recognized in the Grasshopper EA, this zone is where "the exclusion of fire and past forest management actions have resulted in the most departure from natural conditions" (Fuels Report 2022). Yet the majority of proposed logging is planned to occur in the moist and cool/wet forest types, which the agency acknowledges are not significantly departed from historic conditions and where disturbances "are operating within the range of normal." (Fuels Report 2022). ***Applying "the principles of fire resistance for dry forests" to these higher elevation forests, particularly in late-successional stands, lacks ecological justification and is more likely to lead to further degradation rather than restoration***.

The Grasshopper project's proposed action plans to use VDT logging prescriptions on approximately 2,050 acres of the 3,700 acres of moist/infrequent-fire forests as a means "to reduce risks associated with high severity fires"(Final EA 2022). These VDT treatments will remove large/old trees, create gaps (e.g. patch clearcuts) up to two acres in size and reduce average canopy cover below 50% (Fuels Specialist Report 2022). In their brief discussion of this issue, the agency presents no scientific evidence in support of claims that these actions will in fact reduce fire hazard or significantly modify fire behavior in late-successional, moist/infrequent-fire forests that are currently operating within the normal range of variation. The EA cited several published studies conducted in much drier, frequent-fire forests from other regions of the western U.S. that are not directly applicable to the western portion of the Grasshopper project area. And contrary to agency assertions, ***the large majority of scientific evidence suggests that commercial logging in moist, high-elevation forests like those of the Grasshopper project area is not likely to reduce fire hazard*** (DellaSala et al. 2004, Agee 1993, Agee & Skinner 2005, Brown et al. 2004, Allen et al. 2002, Noss et al. 2006a, Schoennagel et al. 2017). Even the Forest Service admits that after logging, "heavier surface fuels, with a shrub and tree understory and dense canopy cover would remain." in treatment areas and "single and group tree torching with passive crown fire remains possible." (Fuels Report 2022).

In summary, while there may be a scientific basis for lightly thinning small to intermediate-sized trees in dry forests of the eastern portion of the Grasshopper project area, ***those same treatments are not ecologically appropriate in higher elevation moist and cool/wet forests -- in no way can they be considered to promote forest restoration as the agency asserts***. Moreover, the VDT prescriptions that are proposed across ~3,503 acres are just as if not more likely to increase fire hazard and reduce fire resiliency on these lands, because they often lead to: 1) higher levels of surface fuels as a result of logging, 2) drier/warmer/windier microclimates that are more favorable to fire, 3) increased light availability in the understory that often triggers growth of understory vegetation (ladder fuels), and 4) removal of large/old trees that are known to be the most resistant to fire (see discussion of these issues under summaries of criteria #2 and #3, pp. 12-17). If the Forest Service wanted to reduce the risk of wildfire in these higher elevation forests, the agency should have considered reducing the large network of open roads, which are known to significantly elevate the risk of human-caused ignitions (Narayanaraj & Wimberly 2012, Molina et al. 2019, Syphard et al. 2007).

GRADE: D

CRITERIA 3: If reducing wildfire hazard is an element of the project's Purpose & Need, do treatments focus on reducing surface and ladder fuels (e.g., subcanopy trees, shrubs, down woody debris) that most contribute to elevated risk of high intensity fire?

Given that the Forest Service has identified reducing the risk of high severity fire as one of the primary goals of the Grasshopper project, to what extent do the approved treatments actually focus on altering forest structure and composition in a way that is most likely to reduce wildfire hazard? The project is comprised of three primary treatment types -- commercial logging using 'variable density thinning' prescriptions (3,503 acres), 'sapling' (pre-commercial) thinning in stands less than 40 years old on 1,422 acres, and 'intermediate' commercial thinning in stands 40-80 years old on 355 acres.
Among these, the 'sapling' and 'intermediate' treatments are most likely to be successful at reducing the density of small (subcanopy) trees, as well as surface/ladder fuels that are known to most strongly influence wildfire behavior. However, in VDT logging units, a significant volume of large overstory trees will be removed -- which are not a primary contributor to elevated fire hazard. It is a well-established understanding in fire ecology that large, live trees are generally the most resistant and least susceptible to burning, because they are slow to dry out, difficult to ignite and generally do not influence rates of fire spread (Agee & Skinner 2005, Agee 1993, Rothermel 1983).

While the EA makes numerous general assertions about how thinning treatments "were planned using principles of fire safe forests" (Fuels Report 2022) and will significantly reduce fire hazard, the Forest Service does not describe these treatments in sufficient detail that allows for an evaluation of the degree to which they are likely to lead to proposed outcomes. For example, the Forest Service describes variable density thinning as a treatment where "selected trees of all sizes down to saplings (i.e., 3" or less in diameter) would be removed. The focus would be on leaving the largest most vigorous, healthiest trees, and favoring shade intolerant, more fire tolerant species" (Vegetation Report 2022). Nowhere else in the EA or supporting documents is VDT more specifically defined in a way that would allow an estimation of resulting stand structures and potential fuel profiles (surface and ladder fuels). Numerous other important information about the effects of planned actions are also missing from the Grasshopper EA. How much prescribed underburning will take place in the project area, either as a stand-alone treatment and/or in areas that are proposed for logging? How much pile burning will take place, and in what areas? Specifically how will the agency reduce 'activity fuels' that are generated as a result of planned logging, and to what levels? The Forest Service does not provide answers to these important questions.

What the GRP's Fuels Report (2022) does describe very clearly is that the primary issue with respect to increased wildfire hazard in the project area is not an overabundance of large-diameter overstory trees, but rather elevated levels of surface and ladder fuels --

> "*Surface fuel loadings have increased as a result of missed disturbances. The fuels have accumulated to loadings above what would be considered normal in historical context... including higher components of brush and shrubs*."
>
> "*Higher levels of trees and brush in the understory lead to an increase in ladder fuels. Ladder fuels provide vertical continuity in the spread of fires. As fires move through the continuous surface fuels, with higher flame lengths and higher spread rates, the brush and trees provide a transition for surface fires to potentially become crown fires*."
>
> "*Attributes of a fire adapted landscape that are departed from historic conditions include an abundance of ladder fuels, an increased density of trees, brush and shrubs, as well as an accumulation of dead and down surface fuels. All these attributes lead to an increase in the vertical and horizontal continuity of fuels*."

Given that the most important factor with respect to wildfire hazard in the project area are elevated surface and ladder fuels, the Forest Service does not rationally explain why it is necessary to also remove large canopy trees across thousands of acres in order to reduce the risk of wildfire.

Plans for widespread logging of large-diameter trees in VDT units across more than 3,500 acres conflicts with the large, established body of scientific evidence that finds these trees constitute the least flammable forest fuel type (Graham et al. 2004, Agee & Skinner 2005), generally do not contribute to wildfire spread (Rothermel 1983), and tend to be more resistant to fire, drought and changing climate conditions than smaller/younger trees (Larson et al. 2015, Philips et al. 2003, Carnwath & Nelson 2016, Stevens et al. 2020). The predominant view on this issue was summarized in DellaSala et al. (2004): "*Removal of large, old trees is not ecologically justified and does not reduce fire risks. Such trees contribute to the resistance and resilience of the forest ecosystems of which they are a part. Large, old trees of fire-resistant species are the ones most likely to survive a wildfire and subsequently serve as biological legacies and seed sources for ecosystem recovery*." For these reasons, retaining all large-diameter trees is recognized as one of the primary principles of how to create more fire-resilient forests (Agee 1996, Agee & Skinner 2005, Brown et al. 2004, also see criteria #3, pp. 8-11) -- principles that the Grasshopper EA cites and describes (Fuels Specialist Report 2022), but then fails to follow.

Variable density thinning treatments in the preferred alternative will also create an undisclosed number and acreage of 'gaps' or openings (e.g. patch clearcuts) up to two acres in size throughout the project area (Final EA 2022). In the very brief discussion of gap creation included in project documents, the agency states that these openings "would be managed as an even-age system" and replanted with conifers (Vegetation Report 2022). Young, even-aged stands, even if relatively small, are known to be highly vulnerable to fire because they contribute to both surface and ladder fuel loads, and as a result, often increase fire hazard (Levine et al. 2022, Kobziar et al. 2009, Thompson et al. 2011, Zald & Dunn 2018). Moreover, research has shown that the increased light availability in canopy gaps of this size, together with ground disturbance from logging, can lead to rapid establishment and growth of woody shrubs and (non-planted) trees, which in turn leads to higher surface fuel loads (Collins et al. 2019, Stephens et al. 2020, Kauffman & Martin 1991). Under wildfire conditions, dense patches of shrubs and small trees often exacerbate surface fire intensity, and can also facilitate the movement of fire from the forest floor into the canopy (Nagel & Taylor 2005, Coppoletta et al. 2016, Lutz et al. 2017, Jaffe et al. 2021) -- ***both of which run contrary to the agency's stated purpose and need for this project.***

The Forest Service should have developed and analyzed an alternative that focused on reducing the density of suppressed, small to intermediate-sized trees in lower elevation warm/dry forests, which are described as the primary fuels and fire hazard issue in the project area. While it is well-established that 'thinning from below' (i.e. selective removal of smaller trees from below the canopy) can be ecologically appropriate and help to reduce fire hazard in dry forests where frequent fire has long been excluded, the same is definitely not the case for large overstory tree removal, particularly in the moist and cool/wet forest types that is proposed here. Even with the limited information that the Forest Service has presented, it's clear that the Grasshopper project paints a misleadingly positive impression of the effects of planned logging on fire behavior, when in fact the commercial logging of mature and old-growth canopy trees is likely to only exacerbate wildfire hazard and otherwise degrade forests in this biologically diverse area of the Mt. Hood National Forest.

GRADE: D

CRITERIA 4: Is the project designed to avoid, or at the very least effectively minimize adverse impacts to at-risk wildlife species?

The Grasshopper project area is known or suspected to support a number of at-risk wildlife species that are associated with mature and old-growth forest habitats, and of these, the most well-studied (and likely most imperiled) is the Northern Spotted Owl (hereafter NSO). This section will evaluate whether and to what extent the Grasshopper project balances the need to conserve this threatened species and its habitat with the desired goals of reducing fuels and wildfire risk. The information presented here on potential impacts to NSO is largely taken from the Grasshopper Project Wildlife Report (2023), which concluded that this project as currently proposed is "likely to adversely affect NSO and their critical habitat."

Northern Spotted Owl

The northern spotted owl (*Strix occidentalis caurina*) has been federally listed under the Endangered Species Act since 1990 as Threatened throughout its range "due to loss and adverse modification of habitat as a result of timber harvesting" (USFWS 1990). Since the time of its ESA listing, the NSO has continued to decline across large portions of its geographic range, which extends from the Washington-Canada border to Marin County, California. The biggest ongoing threats to spotted owls are: 1) loss of habitat due to timber harvest and/or severe wildfire, and 2) competition with non-native barred owls. The documented steep annual rate of population decline (5.3% per year) indicates that extinction risk for this species has increased significantly since the time of federal listing (Franklin et al. 2021, USFWS 2011).

Spotted owls depend on multi-storied, structurally complex late-successional forests for nesting, roosting and foraging (USFWS 2011). Nesting and roosting habitat consists of forest stands with moderate to high canopy cover (60% to over 80%) that are multi-layered with a high density of large-diameter overstory trees, large snags and down logs (USFWS 2011). Spotted owls also rely on stands with lesser amounts of these features (and at least 40% canopy cover) for foraging and dispersal across the landscape (F habitat). Combined, USFWS considers nesting, roosting, and foraging (NRF) habitat to be "suitable habitat" for northern spotted owls (USFWS 2011). Northern spotted owl habitat also includes dispersal habitat (D), which supports the species' "transience and colonization phase" as juveniles move away from their parents post-fledging. The Grasshopper Project area currently supports thousands of acres of suitable northern spotted owl habitat, including 4,428 acres of designated critical habitat -- by definition an ecologically critical area -- within the East Cascades North Critical Habitat Unit (specifically the ECN 7 subunit; Wildlife Report 2023). Seven historic NSO home ranges are known to overlap with the Grasshopper project area, and one NSO pair has been recently documented in the Boulder Creek drainage in the western part of the project area (Wildlife Report 2023).

Commercial logging included as part of the Grasshopper project's proposed action would downgrade[9] 1,234 acres of suitable NSO habitat to dispersal-only habitat (839 acres of which are designated as critical habitat), reduce the quality of an additional 1,773 acres of suitable habitat (1,181 acres are critical), and remove 610 acres of dispersal habitat (all of which are within designated critical habitat, see Figure 5). In addition, Alternative #1 would reduce suitable habitat in three spotted owl core areas and all seven home ranges. In two of the core areas, suitable habitat would be reduced to or nearly to the lowest threshold needed by spotted owls (Buchanan et al. 1995, Buchanan & Irwin 1998). Similarly, in four of the home ranges, suitable habitat would be reduced to or nearly to the lowest threshold. The Forest Service further determined that fuel treatments will adversely affect the spotted owl due to impacts on prey species, and road construction will also eliminate suitable NRF habitat (Wildlife

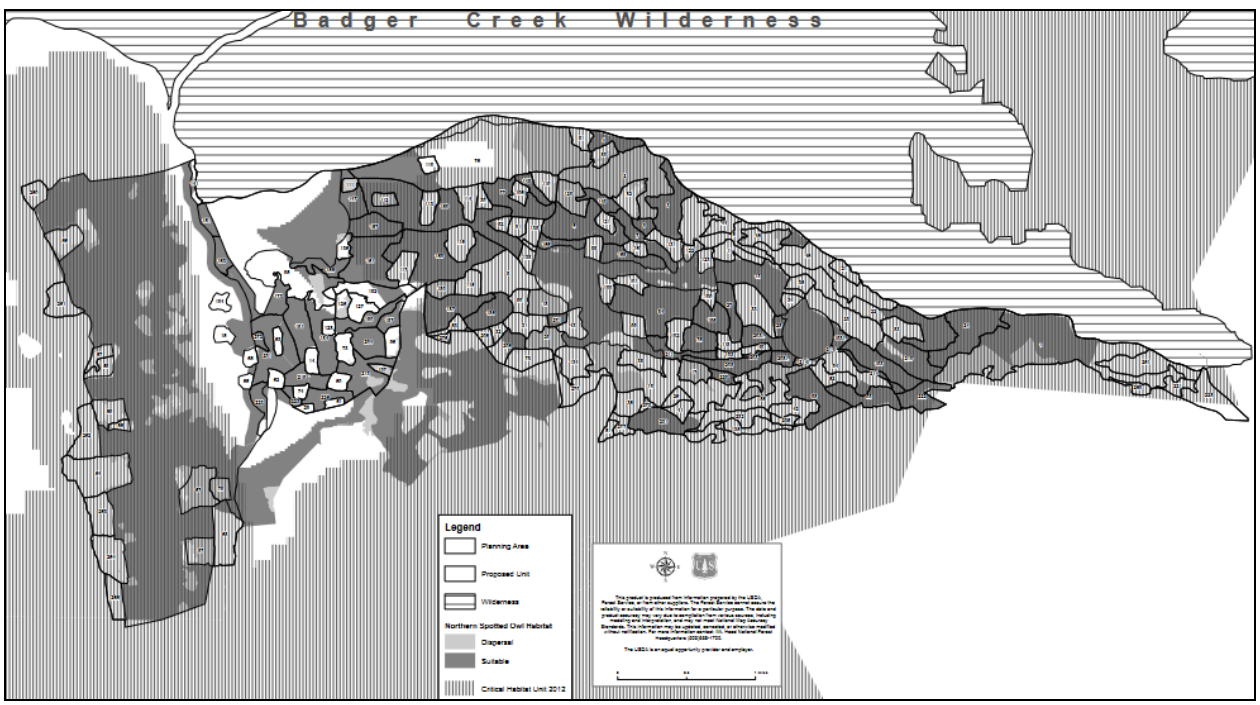

Figure 5. Map of Grasshopper Restoration Project treatment units (numbers in outlined polygons) in relation to existing suitable (dark gray), dispersal (light gray) and critical habitat (vertical hashmarks) for northern spotted owls. From Final Grasshopper Environmental Assessment (2022).

[9] "Downgrade" generally means to convert nesting or roosting habitat for northern spotted owls to foraging or dispersal habitat, while "remove" means to eliminate all habitat function for the species, including foraging and dispersal.

Report 2023). Under the proposed action, the highest basal area that may be retained in VDT units after logging is 150 square feet/acre, which is far below the 240 square feet/acre that spotted owls need for nesting and roosting (USFWS 2011). These treatments are expected to delay the attainment of late seral forest conditions needed by spotted owls for 75 to 100 years (Wildlife Report 2023). Given these numerous and significant impacts, it is difficult to understand why the Forest Service did not consider an alternative based around thinning prescriptions that would retain more canopy cover and other important NSO habitat features.

The effects analysis for NSO in the Grasshopper EA is misleading because it claims that much of the suitable spotted owl habitat to be logged will thereafter still meet the 'suitable habitat' definition, and therefore "the function of that habitat would be maintained" (Wildlife Report 2023). However, it is inescapable that logging will cause a long-term loss of NSO habitat function, because the key elements of NSO habitat such as large trees and snags, canopy cover and down logs will be significantly reduced. VDT prescriptions will decrease canopy cover to as low as 40%, remove large/old trees >20" dbh and dramatically reduce long-term recruitment of snag habitat. Tables 8 and 9 of the Wildlife Report (2023) show that logging results in fewer large snags for the next 100 years compared to the no action alternative. What will most likely be left after logging are conditions that barely meet the minimum criteria used that define suitable NSO habitat. "Managing down to the minimum" in this way is known to dramatically increase risks to species like the spotted owl, whose populations are already small, habitat restricted, and subject to numerous interacting stressors (Forsman et al. 2011, Lesmeister et al. 2018, Wan et al. 2018).

On top of the direct habitat loss and degradation that is expected to result from logging, the Grasshopper project also is likely to adversely affect NSO by increasing competitive interactions between spotted owls and barred owls, which are now considered one of the greatest threats to NSO survival (Long & Wolf 2019). Wherever the two owl species are found together, the barred owl has a competitive advantage because it's more aggressive and can utilize a wider array of habitats and prey species (Irwin et al. 2020, Wiens et al. 2014, Hamer et al. 2001). In locations where spotted and barred owl home ranges overlap, NSO often experience reduced fitness and survival, and over time can be completely excluded from previously occupied habitat (Mangan et al. 2019, Sovern et al. 2014, Hamer et al. 2007). Tens of thousands of acres old forest owl habitat (which was in short supply before the barred owl arrived) are now occupied and defended by barred owls to the exclusion of spotted owls (Olson et al. 2004, 2010, Carrete et al. 2005, Dugger et al. 2011).

Recent studies have shown that rates of spotted owl extirpation due to displacement by barred owls are highest in areas with low levels of old growth habitat in nesting areas, and high levels of forest fragmentation (Anthony & Andrews 2012, Olson et al. 2010, Sovern et al. 2014, Dugger et al. 2016). Similarly, Forsman et al. (2011) found that recent recruitment of spotted owls across the landscape was higher in areas where the amount of suitable habitat was generally highest. In fragmented landscapes, barred owls have a survival advantage relative to spotted owls, but that advantage diminishes in landscapes with a higher proportion of older forest (Wiens et al. 2014, Wiens 2012). In other words, conservation of existing mature and old-growth forest (e.g. existing NSO suitable habitat) is likely to be critical for persistence of the species, because spotted owls are able to compete better with barred owls under these conditions. In the Final Recovery Plan for the Northern Spotted Owl, the US Fish & Wildlife Service (USFWS 2011) recognized the importance of reducing competition with barred owls by recommending protection of "substantially all of the older and more structurally complex multi-layered conifer forest", including existing old forests located outside of late-successional reserves. Despite the importance of this issue, the Grasshopper EA failed to adequately evaluate the impact that reducing suitable NSO habitat via logging as proposed will have on adverse competitive interactions between spotted owls and barred owls.

Although the Forest Service acknowledges that the Grasshopper project is 'likely to adversely affect' spotted owls and their critical habitat, the agency concludes in the Final EA that these impacts will be more than offset by future benefits to the species, because treatments will increase the ability of residual stands to withstand fire. However, a number of studies that have explored the tradeoffs between short-term impacts of logging-based fuels reduction and long-term benefits to NSO habitat do not support this conclusion (Odion et al. 2014, Peery et al. 2017, Lesmeister et al. 2018, 2019, Tempel et al. 2015, Dunk et al. 2019, Dow et al. 2016, Lehmkuhl et al. 2015, TWS 2010, Raphael et al. 2013, Ganey et al. 2017, Wood et al. 2018). Moreover, accepting the tradeoff between loss of NSO habitat due to planned logging versus potential loss due to wildfire makes sense *only if it is reasonably certain that the project will in fact reduce wildfire hazard*, and the agency has not presented any analysis that substantiates this claim. In fact, as described elsewhere in this project review, (also see evaluation criteria #3, pp. 14-17), the preferred alternative as currently proposed has significant potential to increase rather than reduce fuel loading and the probability of high intensity fire, particularly in the moist, more productive forest types found in the western portion of the project area.

The Mt. Hood National Forest is fully capable of designing an action alternative for the Grasshopper Project that would address the purpose and need while also avoiding adverse impacts to the northern spotted owl and their critical habitat. But based on the information currently available, it appears the agency has chosen to focus more on producing timber rather than minimizing risks to NSO and other species that are closely associated with the area's remaining large trees and late-successional forests. Clearly, a more cautious approach to forest management in the Grasshopper project area is warranted so as to more effectively mitigate the risks of logging-based treatments on this declining species.

GRADE: D

CRITERIA 5: Does the project integrate managed and/or prescribed fire into project planning, and also address the timing and necessity of future maintenance treatments?

One of the most essential elements of any project that is referred to as 'restoration' is whether proposed management will successfully restore fire, at the intensity, frequency and scale appropriate for a specific forest type -- since it is only through this keystone ecological process that fire regimes, stand structures and ecosystem resilience can ultimately be restored or maintained (Coppoletta et al. 2019, Noss et al. 2006a-b). General language in the Grasshopper project planning documents suggests that the Forest Service recognizes the need "to return fire to the ecosystem" and "put fire back onto the landscape", particularly in the dry, frequent-fire forest of the project area (Fuels Report 2022). Given this recognition, to what extent does the Grasshopper project promote the reintroduction of beneficial fire through specific actions that help return this key ecological process?

There are two fuel treatments included as part of the selected alternative to reduce risks associated with wildfire: 1) establishment of fuel breaks, and 2) prescribed burning. The following statements summarize the entirety of what the Grasshopper EA has to say about the use of prescribed fire in the project area:

> "[Prescribed burning] activities would take place within the footprint of areas proposed for silvicultural treatment. This treatment would occur in stands that can support underburning without thinning activities and within stands where thinning activities have occurred."
>
> "Underburning would be used following pre-treatments such as thinning, masticating, pruning, or pile burning to further reduce the surface fuels. The use of underburning helps maintain the desired vegetation conditions and enhance the overall health and resiliency of the stand."

Aside from these very general statements, no other information is provided about how, where and when the use of prescribed fire may actually be carried out as part of this project. Which proposed treatment units will be broadcast burned after logging? If prescribed fire is to be applied to areas as a stand-alone treatment (e.g. without thinning or tree removal), where will this occur, in which forest types and across how many acres? How will determinations be made about where broadcast burning will occur, as opposed to mastication, pile burning or other fuel abatement methods? Unfortunately, the Forest Service fails to provide information relevant to answering any of these questions. Considering the importance of and strong scientific support for returning the beneficial effects of fire to landscapes such as the Grasshopper project area, the Forest Service should have presented a clear, well-developed plan for how this will be accomplished and it has not done so. Generic suggestions that prescribed fire may be used in some areas at some time after logging is completed represent a lack of commitment to this important issue.

Furthermore, numerous studies have demonstrated that thinning, prescribed fire, and other wildfire-reduction measures must be integrated and planned simultaneously across the landscape and over time in order to be effective (Brown et al. 2004; Perry et al. 2004, Hessburg et al. 2016). Some language in the Grasshopper EA acknowledges that planned one-time treatments will not by themselves be sufficient to achieve project objectives: "Maintenance actions would be essential to sustain the effectiveness of the fuels reduction treatments" and "It may take one or more uses of prescribed fire before the landscape has returned to its historic condition" (Fuels Report 2022). While the Forest Service recognizes that fire-adapted forests in the Grasshopper project area will need follow-up use of prescribed fire in order to maintain low fuel loads (particularly in lower elevation, warm/dry forests), the proposed action fails to present a longer-term plan for how, where and when this maintenance work should take place. Without a clear plan and a commitment of investment for implementation, the one-time reductions in fuel loads that may be created by this project will be short-lived and have very limited benefits.

To address the important question of what will happen when understory vegetation regrows, the Forest Service should present a long-term plan for how future maintenance treatments will be designed and implemented, including: 1) a detailed discussion of where, when and what type of follow-up treatments will be needed, as well as the potential likelihood that the personnel and funding necessary to carry out maintenance treatments will be available, 2) a prioritization scheme that would help determine which areas are the highest priority for prescribed fire when fewer acres can be burned than planned in a given year or time period, and 3) the implications in terms of fuel loading and fire hazard if follow-up actions are not fully implemented or are left undone. From an ecological perspective, the long-term objective of restoration in these forests should be to reintroduce fire as the primary disturbance agent at the frequency, scale and intensity appropriate for these ecosystems. Unfortunately, the Grasshopper project falls far short of making a clear commitment and laying out a plan for restoring the beneficial effects of fire at the scale and level of detail that is needed in order to achieve project objectives.

GRADE: D

North Yuba Landscape Resilience Project, Tahoe National Forest (Northern California)

North Fork of the Yuba River (L) and large, old-growth sugar pine (R) located within the North Yuba Landscape Resilience project area, Tahoe National Forest.

LOCATION: The North Yuba Landscape Resilience Project (hereafter referred to as NYLRP) is planned within the ~275,000 acre project area (210,000 acres of USFS lands) of the North Yuba River watershed, which extends from New Bullards Bar Reservoir (Yuba County) east to the crest of the northern Sierra Nevada (Sierra County, CA), within the Yuba River District, Tahoe National Forest.

PURPOSE AND NEED: The stated purposes of the North Yuba Project are to "improve and restore forest health and resilience, reduce the risk of high-severity wildfire, protect and secure water supplies, protect communities from the effects of high-severity wildfire, and maintain, enhance, and restore important terrestrial, riparian, and aquatic habitats" (ROD 2023).

PROPOSED ACTION:

The NYLRP Record of Decision approves a range of area-based silvicultural treatments that are identified as follows: 1) 'variable density thinning' ("a form of uneven-aged management designed to produce a mosaic of individual trees, clumps and 1-3 acre openings"; 83,115 acres), 2) 'thinning from below' (which "focuses on removing trees from the lower canopy"; 4,270 acres), 3) stand-alone use of prescribed fire (10,850 acres), 4) 'overstory sanitation and stand improvement' ("removal of mistletoe-infected overstory trees from red fir stands"; 3,640 acres), and 5) strategic tree planting in created openings (423 acres). Details of silvicultural treatment vary slightly by forest type and management emphasis area such as California spotted owl and northern goshawk Protected Activity Centers, Home

Range Core Areas and Inventoried Roadless Areas. Similar treatments involving commercial removal of conifers are also planned within 2,560 acres of 'unique habitats' (aspen stands, meadows and fens). The total of all proposed area-based treatments, most of which include commercial logging, is 145,735 acres (~69% of all USFS lands in the project area).

An additional set of vegetation and fuel reduction treatments are planned within 600 feet from the edge of areas identified as 'infrastructure buffers' (6,198 acres), 'road access corridors' (600' on either side of road; 18,347 acres), 'WUI defense zones' (8,747 acres) and 'fuel breaks' (4,651 acres) that together encompass almost 20% of National Forest lands in the North Yuba project area (37,943 acres total). These treatments would "focus on thinning trees to attain an average spacing of half to one and a half crown widths between residual tree crowns and creation of gaps"(FEIS 2023). Live conifers up to 30" dbh (and on some acres, up to 40" dbh) would be removed for commercial sale, and residual biomass treated using machine piling, mastication, chipping, hand piling/burning or other methods. Total commercial timber volume to be produced over the life of the project is estimated at 773 million board feet (FEIS 2023).

In order for these treatments to be implemented across the project area, an undisclosed but likely very large number of Forest Service system roads would be maintained or upgraded to meet USFS transportation standards. Potential road improvement or reconstruction actions include road grading, clearing, brushing, resurfacing and hazard tree removal in road corridors. In addition, a significant but also undisclosed amount of new 'temporary roads' would be constructed. The Forest Service did not specify the mileage, methods and locations of roads that would be either upgraded or newly constructed, due to its use of 'condition-based management' -- whereby the agency waits until after it issues a project decision to collect the site-specific information necessary to design management actions.

CURRENT STATUS: A Final EIS for this project was released by the Tahoe National Forest in April 2023, selecting Alternative 2 as the proposed action. The Project is relying on multiple, separate decisions over a ~10-year time frame to implement the actions analyzed in the FEIS. The first Record of Decision was issued July 2023 in the first two sub-project areas (Galloway and Rattlesnake-Skinner) covering ~26,000 acres. Implementation is expected to begin in 2024.

ECOLOGICAL EVALUATION:

CRITERIA 1: Does the project include clear and specific protections for existing mature and/or old-growth trees, which are key foundational elements of fire-resistant and resilient forests?

The proposed action (Alternative 2) for the North Yuba project includes a range of mechanical treatments that will potentially result in the removal of large trees across more than 100,000 acres of the Tahoe National Forest. Requirements for retention of large trees vary depending on land use allocation and for specific management areas, from a minimum standard of 24" diameter at breast height (dbh) in inventoried roadless areas, to 30" dbh in spotted owl Protected Activity Centers located outside infrastructure buffers, to a high of 40" dbh in areas of general forest. This project is one of if not the most expansive proposal to log green forests in the history of the Pacific Southwest Region (R5), and is the first under the direction of the Sierra Nevada Forest Plan Amendment to allow widespread logging of trees larger than the 30" dbh diameter limit established in 2004 (USDA Forest Service 2004).

Instead of focusing on the need to reduce the density of small to mid-sized conifers less than ~21" dbh and smaller in size -- the trees that numerous recognized experts have identified as most important to remove from Sierra Nevada forests (Franklin et al. 1997, Allen et al. 2002, Noss et al. 2006a, b, McIntyre et al. 2015, Stephens et al. 2015, Knapp et al. 2013) -- the NYLRP decision approves logging of large/old trees up to 40" dbh across thousands of acres, including in created openings up to 3 acres in size. Logging of trees larger than 30" dbh can occur only because the selected action alternative (Alternative 2) incorporates a Forest Plan amendment that allows for removal of trees up to 39.9" dbh for "restoration and resilience purposes" (FEIS 2023, Appendix B). Although the FEIS suggests that trees >30"dbh subject to logging will be shade-tolerant species (i.e. white fir, Douglas-fir, incense cedar) that are considered to be more abundant in contemporary compared to historic forests, the Forest Plan amendment that will allow for removal of very large trees does not explicitly require that they all be shade-tolerant species (FEIS 2023, Appendix B).

The FEIS does not specify where logging of these very large trees will occur, but estimates that the total acreage where 30-40" dbh trees are most likely to be removed is ~5% of the total treatment area, or 5,800 acres (FEIS 2023, Appendix E). Within these stands, removal of trees in the 30- to 40-inch-diameter class "would range from 5 to 12 per acre, with an average of 7 trees per acre removal." (Silviculture Report 2023). If these estimates are extrapolated across the project area, then well over 40,000 trees larger than 30" dbh are likely to be logged. In addition to the significant loss of very large trees, variable density thinning "may remove a similar number of trees per acre in the 24- to 30-inch-diameter class" (Silviculture Report 2023). The proposed action will also remove trees up to 24" dbh from over 4,200 acres located within two Inventoried Roadless Areas (IRA). Removing trees of this size class from IRAs runs contrary to direction set forth in the 2001 Roadless Area Conservation Rule, which only allows for removal of "generally small diameter timber" (i.e. less than 12") when necessary to reduce the risk of high severity wildfire effects (USDA Forest Service 2000).

Additional vegetation treatments planned for ~38,000 acres within "infrastructure buffers, road access corridors, WUI defense zones and fuel breaks" will also result in significant loss of large trees, as will road improvements, new road reconstruction, log landings and cable yarding corridors. Large trees that are determined to pose a safety hazard in the field or that hinder "equipment operability" will also be removed on an ad-hoc basis as part of project implementation (FEIS 2023, Appendix B). Yet the magnitude and significance of these cumulative impacts on large trees, combined with the planned loss of large trees in area-based treatments described above, are not fully analyzed or disclosed in the FEIS. The condition-based management approach adopted by the NYLRP effectively allows the agency to interpret the intent of the proposed action during implementation, with little to no disclosure or specificity of what actions will be taken on-the-ground.

Despite the likelihood of significant adverse impacts, the Forest Service fails to present any ecologically-based analysis demonstrating that removal of large/old trees across so many acres is necessary in order to move the North Yuba landscape toward greater resilience to wildfire and other disturbances. The FEIS states that the upper diameter logging limit of 39.9 inches "is based on recent science" (FEIS 2023, Appendix E) and that large tree removals will generically be "beneficial", but it fails to evaluate or discuss the abundance of published research and science-based recommendations that find widespread removal of large trees is not appropriate in a restoration-oriented project (see pp. 10-12 and Appendix). As summarized by Franklin & Johnson (2008), "*Silvicultural activities that focus on removing dominant trees will not reduce potential fire intensities and stand mortality, nor will they contribute to creation of forest structure and composition characteristic of older forest*."

The widespread removal of large trees proposed in this project directly conflicts with the agency's own admission that "larger conifers are in deficit across the Landscape", due to past logging and wildfire (FEIS 2023, documented in McGarigal et al. 2018, 2020). ***The best opportunity to increase the proportion of large trees and move toward forest conditions that are more resilient to fire, disease and other stressors is to retain existing large, fire-resistant trees during treatment operations*** -- unfortunately, the selected alternative for the North Yuba project falls far short in this regard.

GRADE: D

CRITERIA 2: Do proposed treatments focus on frequent-fire forest type(s) that are likely to exhibit the greatest departure from historic conditions, and therefore in legitimate need of restoration-based management?

There is surprisingly little baseline information in the North Yuba analysis documents needed to assess the range of forest types and conditions that currently exist in the project area, and that will be affected by the proposed action. Elevations in the North Yuba River watershed vary from ~2,500 feet near New Bullards Bar Reservoir to over 8,000 feet near and along the Sierra Crest at the eastern boundary (FEIS 2023). The wide diversity of elevations, complex landforms and climatic conditions in turn gives rise to a variety of forest types, each of which can be differentiated in terms of structural and compositional attributes, fire ecology, and degree of departure from historic conditions. On this topic, the FEIS states only that the landscape "contains low-elevation mixed conifer and hardwoods, transitioning to pine-dominated and red fir mixed conifer at higher elevations." (FEIS 2023).

Ecologically-based forest management is guided by the principle that silvicultural treatments should focus on those areas of the landscape that have been most altered in terms of structure and composition, and seek to actively restore more resilient conditions similar to those that existed historically (Palik & D'Amato 2023, North et al. 2021, Franklin et al. 2018, 2007). Primarily due to fire suppression and widespread logging, the most altered forests in the North Yuba watershed are the relatively dry, pine-dominated mixed conifer forests mostly found at elevations below ~5,000 feet elevation (McGarigal et al. 2018,2020). According to the FEIS, there are approximately 159,000 acres of mixed conifer forest in the project area, and of these, the proposed action would conduct logging-based treatments on 93,578 acres (59% of total treatment area; FEIS 2023). The remaining 35,390 acres planned for mechanical treatments will occur in forest types other than mixed conifer, where the presumed benefits of logging-based interventions are less clear and the potential ecological downsides are often more significant (Brown et al. 2004, Perry et al. 2011, Noss et al. 2006a, Hessburg et al. 2016, DellaSala & Hanson 2015).

Outside of the mixed conifer zone, much of the area proposed for logging in the NYLRP is located within mid- to upper-montane forests dominated by red fir (*Abies magnifica*). The FEIS states that 8,833 acres of red fir forest will be logged, of which 3,640 acres are 'overstory sanitation and stand improvement cuts' (FEIS 2023). Compared to the drier, more fire-prone mixed conifer forests found at lower elevations, the red fir zone historically burned at moderately long intervals with high variability (15-130 years; van der Water & Safford 2011, Safford & van der Water 2014), often with mixed or even high severity fire effects (Meyer et al. 2019, van Wagtendonk et al. 2018), and generally supported higher tree densities (Safford & Stevens 2017, North et al. 2002) -- which means their structure and composition are significantly less departed from historic conditions (Malleck et al. 2013, Meyer & North 2019, Miller & Safford 2012). Because of these important differences***, there is little if any ecological justification to remove large, commercial-sized trees from red fir (and other high elevation) forests*** (Merriam et al. 2022, Meyer et al. 2019), especially given the large backlog of needed thinning treatments that exists in the mixed conifer zone at lower elevations.

Regarding this issue, the Forest Service has presented no evidence that the current structure and composition of red fir forests in the planning area are significantly departed from historic conditions, that proposed treatments in the red fir zone are a legitimate priority for reducing wildfire hazard, and that proposed actions can be effective in creating more disturbance-resilient stands. Ecologically, the fact that some large overstory red firs in proposed units may show evidence of dwarf mistletoe infection (as described in the FEIS) is not a legitimate reason to remove them, since mistletoe is known to make numerous important contributions to forest structure and wildlife habitat (Hedwall & Mathiasen 2006, Griebel et al. 2017, Parker et al. 2017, Mathiason et al. 2004), removing some infected trees may not reduce mistletoe levels in treated stands (Muir & Geils 2002, Mehl et al. n/d, Roth & Barrett 1985) and "it is uncertain whether mistletoe is more abundant in the project area than it was in the past" (Silviculture Report 2023). Moreover, since the Forest Service's proposed reason for logging residual large red fir is due to mistletoe, the project should fell and leave the large tree boles in regenerating stands, which are very likely lacking large coarse woody debris and structural complexity due to past even-aged logging.

GRADE: C

CRITERIA 3: If reducing wildfire hazard is an element of the project's Purpose & Need, do treatments focus on reducing surface and ladder fuels (e.g., subcanopy trees, shrubs, down woody debris) that most contribute to elevated risk of high intensity fire?

A large body of published research has clearly shown that reducing surface and ladder fuels is the most effective action that can be taken to reduce wildfire hazard and the potential for high intensity fire (North 2012, North et al. 2009a, Stephens et al. 2018, 2009, Collins et al. 2011, Kelsey 2019). Given this consensus understanding, to what extent does the selected alternative for the North Yuba project focus on reducing these specific fuel types? Of the range of treatments proposed, 'thinning from below' (4,270 acres), stand-alone use of prescribed fire (10,850 acres) and fuel reduction focused around road corridors, WUI defense zones, fuelbreaks and infrastructure buffers (37,943 acres total) are most likely to make effective progress toward this goal. But by far the largest number of acres in this project (83,115 ac) will be treated with variable density thinning (VDT) prescriptions, where potential changes to surface/ladder fuels and associated fire effects are much less clear.

Details relating to how VDT treatments will be designed and implemented on-the-ground in the North Yuba project area are surprisingly lacking in the FEIS and initial Record of Decision, which makes it difficult to fully evaluate effects on fuels and potential fire behavior. While the FEIS generically states that "thinning treatments would focus on reducing stand density mostly in the lower-diameter classes", several potential concerns and uncertainties about the fuels/fire effects of VDT treatments remain: 1) removal of large overstory trees, which generally contribute very little to increased fire spread or intensity, 2) whether and to what extent thinning or other fuels work will occur in the many overstocked tree plantations that exist across the project area, 3) the potential for increased surface and ladder fuels to develop in created 1-3 acre openings, and 4) the lack of a clear plan for reducing surface fuels generated by aerial-based logging systems within inventoried roadless areas.

As discussed elsewhere in this review, removal of very large overstory trees is generally not necessary or effective at reducing wildfire hazard, because large green trees are generally the most fire resistant, are least susceptible to burning, and usually contribute very little to the surface and ladder fuels that most influence fire behavior (Agee 1993, Agee & Skinner 2005, Rothermel 1983). Consistent with this, numerous research studies conducted in Sierra mixed conifer forests have concluded that the target of most fuels reduction and restoration work should be reducing the density of small understory to intermediate-sized (subcanopy) conifers that create a connection or 'ladder' between the surface fuelbed and the forest overstory (North et al. 2009a, North et al. 2012, Stephens et al. 2021, Evans et al. 2011, Noss et al. 2006a-b).

On this issue, Stephens et al. (2018) suggested that "current harvesting practices that have restoration as an objective should focus *on large-tree retention* while reducing basal area in smaller and medium size classes and lowering surface fuels" (emphasis added). Similarly, North et al. (2009b) concluded that "significant increases in wildfire resistance can be achieved by thinning only smaller ladder fuels and fire-sensitive intermediate trees", without reducing the number of large trees of all species. The key point is that ***achieving the North Yuba project's stated purpose and need to reduce wildfire hazard would not be prevented or constrained if the plan to log large trees >30" dbh was completely removed from the proposed alternative***.

Instead of logging very large, fire-resistant trees that do not significantly contribute to wildfire concerns, this project should focus on reducing fuel loads and increasing heterogeneity across the thousands of acres of uniformly dense, overstocked tree plantations that exist across the planning area. Young planted conifer stands are known to be highly vulnerable to fire (Weatherspoon 1996), and can also increase the potential for spread of high severity fire into adjacent older forests (Levine et al. 2022, Kobziar et al. 2009, Zald & Dunn 2018). Unfortunately, the FEIS does not specifically discuss the current condition of plantations in the planning area, and if or how the selected alternative will actively reduce fuels in these stands via pre-commercial thinning or other methods.

Variable density thinning treatments in the preferred alternative will also create 3,323 acres of 1- to 3-acre openings throughout the project area (FEIS 2023). Research has shown that the increased light availability in large canopy gaps, together with ground disturbance from logging, can lead to rapid establishment and growth of woody shrubs (e.g. *Ceanothus*, *Arctostaphylos*), which in turn leads to higher surface fuel loads (Wilkin et al. 2017, Collins et al. 2019, Stephens et al. 2020, Kauffman & Martin 1991, Wayman & North 2007). Under wildfire conditions, dense patches of shrubs often exacerbate surface fire intensity, and can also facilitate the movement of fire from the forest floor into the canopy (Nagel & Taylor 2005, Coppoletta et al. 2016, Lutz et al. 2017, Jaffe et al. 2021) -- both of which run contrary to the agency's stated purpose and need for this project. The Forest Service fails to address this potential outcome in the FEIS, and lacks a clear plan for mitigating the effect of increased shrub growth in created openings on wildfire hazard.

Lastly, the selected alternative proposes to remove trees up to 24" dbh across ~4,200 acres in two Inventoried Roadless Areas (IRA), purportedly to reduce undesirable wildfire effects. The FEIS and project documents claim that this logging is consistent with the 2001 Roadless Area Conservation Rule (RACR), but removal of larger trees, as discussed above, is usually not necessary to mitigate fire hazard. Moreover, the aerial logging systems (helicopter or skyline) that will be employed in IRAs often generate large amounts of activity fuels, because tree limbs, tops and other woody debris are generally not transported off-site. The FEIS for the RACR makes clear that to legitimately reduce fire hazard in IRAs, "*land managers must deal primarily with the fine fuels on the surface of the forest floor and with the smaller diameter trees growing in the understory of a forest*" (USDA Forest Service 2000). Despite the RACR's clear language, there are no requirements in the FEIS or ROD to ensure that increased surface fuels created by aerial-based logging systems will be effectively reduced on treated acres within roadless areas.

GRADE: C

CRITERIA 4: Is the project designed to avoid, or at the very least effectively minimize adverse impacts to at-risk wildlife species?

The North Yuba landscape supports populations of a number of at-risk wildlife species that are dependent on mature and old-growth forest habitats, including the California spotted owl (CSO), American goshawk and Pacific marten. It is perhaps telling that the North Yuba project allows significant modification to old forest habitats across many thousands of acres of the Tahoe National Forest, and yet conservation of sensitive species associated with this increasingly rare habitat type is not listed as part of the project's purpose and need. This section will evaluate whether and to what degree the North Yuba project's proposed action strikes a reasonable, science-informed balance between active management treatments designed to reduce fire hazard, and the risk of irreparable harm to three well-known species that are dependent on old forest habitats in the planning area.

California Spotted Owl (CSO)

The California spotted owl (*Strix occidentalis occidentalis*) has been proposed for federal listing as threatened under the Endangered Species Act, but a final rule has not yet been published (88 FR 11600, February 23, 2023). Prior to this proposed listing, CSO was on the USFS Region 5 Forester's Sensitive Species List for the Tahoe National Forest and it is a Management Indicator Species on all National Forests in the Sierra Nevada region (USDA Forest Service 2019). The CSO is closely associated with Sierra mixed conifer, ponderosa pine, red fir and montane hardwood forest types that are dominated by large trees (>24" dbh, but usually more than 30") with high structural diversity and moderate to high levels of canopy cover (>40%), particularly in nesting stands (USFWS 2022, USDA Forest Service 2019). Medium (40 to 70%) and high (>70%) canopy cover have been positively correlated with CSO occupancy, survival, and productivity (Tempel et al. 2016, Stephens et al. 2014, Blakesley et al. 2005).

Existing management strategies for the CSO are largely centered around the identification and maintenance of CSO protected activity centers (PACs) and home range core areas (HRCAs). PACs encompass the best available 300 acres of habitat that surround recent documented nest sites, repeatedly used roost sites or a territorial owl activity center detected on National Forest lands (USDA Forest Service 2004). HRCAs are areas that encompass ~1,000 acres of the best available contiguous CSO habitat within 1.5 miles of a PAC. Desired conditions within HRCAs include maintaining large habitat blocks of multi-storied forest that supports high canopy cover (>50%), large trees (>24" dbh), very large snags (>45" dbh) and down logs (USDA Forest Service 2019). Currently there are 77 CSO PACs (~24,000 acres) and 83 HRCAs or territories (~46,250 acres) that either fully or partially overlap with the North Yuba project area, and a significant proportion of these areas are already significantly deficient in high quality (e.g. large tree-dominated) habitat (Wildlife BE 2023). Outside of PACs and HRCAs, there are an additional 22,300 acres of CSO high quality habitat and 59,300 acres of moderate- to low-quality habitat on National Forests lands in the project area (Wildlife BE 2023).

The proposed action for the NYLRP calls for significant logging of large trees (20-40" dbh) from both CSO PACs (5,926 acres) and HRCAs (6,550 acres) located throughout the project area (FEIS 2023; see Figure 6). Widespread removal of large trees from these critical areas will reduce overstory canopy cover down to or below minimum threshold levels, and shift the focus away from reducing surface and ladder fuels that are the primary influence on fire hazard and habitat resilience. Despite the recognized importance of abundant large trees as an essential component of CSO habitat, the Forest Service does not present any science that supports the logging of 30" dbh trees from CSO PACs, or trees up to 40" dbh in HRCAs. Outside PACs and HRCAs, an additional 21,400 acres of the 'highest quality' CSO habitat and 75,700 acres of 'best available' CSO habitat are also planned for mechanical treatments that may remove large trees (primarily due to variable density thinning; FEIS 2023).

The extensive area of spotted owl habitat proposed for large-tree logging carries with it significant potential for long-lasting, negative consequences for this species, and can largely be attributed to the fact that the proposed action does not adhere to a number of key management recommendations that are part of the Forest Service's own regional CSO conservation strategy (hereafter CSO strategy; USDA Forest Service 2019). The most egregious discrepancies include the following:

- The CSO strategy recommends that all trees greater than 30" dbh should be retained in CSO territories, whereas the North Yuba project allows removal of trees up to 30" in PACs and 40" dbh in HRCAs;
- Contrary to the CSO strategy, logging treatments do not ensure retention of the highest quality nesting and roosting CSO habitat in the project area. Some PACs and HRCAs will continue to be degraded, even where the amount of CSO habitat is already less than minimum desired levels.
- The proposed action is inconsistent with the recommendation in the CSO strategy that actions should "minimize near-term effects" of any resiliency treatments, and the agency should design treatments "to primarily reduce surface and ladder fuels and minimize impacts to overstory canopy" (USDA Forest Service 2019).

Although the Forest Service claims to have adopted the CSO strategy as part of the NYLRP (FEIS 2023), these important differences between the selected alternative and the strategy demonstrate otherwise, and are likely to significantly increase risks to CSOs and their habitat on the Tahoe National Forest.

The Forest Service claims in the planning documents that the North Yuba project will be generally beneficial to the local CSO population, because the species is "seemingly unaffected by forest management activities that have occurred in the past" and "the larger landscape benefits are expected to far outweigh any potential smaller scale site-level or PAC-level costs" (Wildlife BE 2023). However the agency offers no substantive evidence to support these statements. In fact, the published studies that have investigated this issue have documented negative impacts to CSOs from large-scale mechanical treatments (Keane et al. 2017, Seamans & Gutierrez 2007, Tempel et al. 2016). The agency's own researchers have found that the negative impacts to CSO from thinning treatments that remove trees >24"

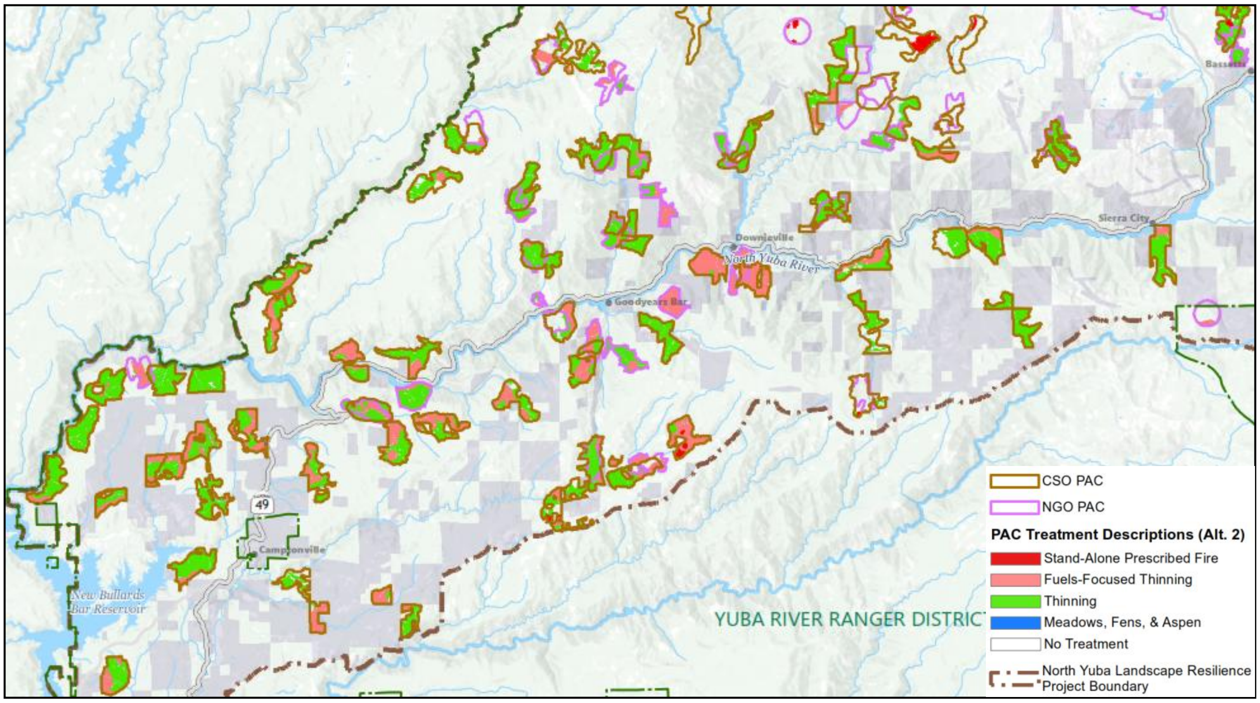

Figure 6. Map of polygons delineating both CA spotted owl and goshawk Protected Activity Centers (PACs) in the western portion of the North Yuba project area, identified by those that will be impacted by different types of commercial thinning (green, pink), stand-alone prescribed fire (red) or no treatment (no color) under the selected alternative Private lands (shaded gray) are not included within the NYLRP (excerpted from Wildlife BE 2023).

dbh are even greater than those associated with severe wildfire (Jones et al. 2021) -- "*To minimize the effects of fuel reduction and forest restoration on* [CA] *spotted owls and other old-forest species,* ***it is essential*** *that large, old trees be maintained*" (emphasis added, Jones et al. 2018). Unfortunately, these findings appear to have been ignored or dismissed by the agency's planners and decision makers.

To sum up this review regarding the CSO, the North Yuba project far exceeds the scale and intensity of any previous plan for logging-based treatments that have yet been implemented within the range of the CSO. At a minimum, the project will significantly increase levels of uncertainty regarding the status and persistence of this species across the Tahoe National Forest. The worst case scenario is that adverse short-term impacts from large-tree logging in PACs, HRCAs and other existing high-quality habitat will jeopardize the viability of CSO in this landscape, at a time when observed declines in the larger CSO population continue across the Sierra Nevada (USFWS 2022). The Forest Service fully analyzed but decided against selecting an alternative (#3) that addresses fire/fuels concerns while also complying with recommendations in the CSO strategy, as described above. Clearly, a more cautious approach to forest management in the North Yuba project is necessary in order to effectively mitigate the risks of logging-based treatments on this declining species.

Pacific Marten

Pacific marten (*Martes caurina* ssp. *sierrae*), a mid-sized carnivorous mammal in the weasel family, is another forest-dependent species with significant potential to be adversely impacted by the North Yuba project. The State of California lists the marten as a "Species of Special Concern" at moderate risk of extinction, and it has been designated as both a Sensitive Species and Management Indicator Species across all seven national forests in the Sierra Nevada region (USDA Forest Service 2004). Martens are closely associated with late-successional conifer forests exhibiting a dense, multi-storied canopy, abundant large trees, snags and dead-wood structures that provide prey resources, resting structures, and escape cover to avoid predators (Zielinski 2014). In the Sierra Nevada including the Tahoe National Forest, marten generally occur above 6,000 feet elevation, in forest types dominated by white/red fir, lodgepole pine, subalpine conifer, and higher elevation Sierran mixed conifer (Freel 1991, Spencer et al. 1983). Both camera trap and tracking surveys have recently confirmed the presence of martens in the North Yuba project area (Wildlife BE 2023).

The widespread and significant reductions in overstory canopy cover and changes in forest structure that are planned across this landscape will have significant consequences for Pacific marten, because the species avoids open areas and favors dense forests with large trees (Zielinski 2014, Buskirk & Ruggiero 1994). Research has consistently shown that marten populations decline and can be extirpated in areas where canopy cover is managed below 65-75% (Hargis et al. 1999; Potvin et al. 2000; Moriarty et al. 2011, 2016). While the Wildlife BE (2023) appropriately recognizes that "the largest potential threat to marten and their habitat resulting from forest management is the effect of forest thinning", the potential impacts from the proposed action are not sufficiently analyzed or disclosed. In order to properly evaluate the risks posed to marten by this project, it's necessary to estimate the degree that key components of marten habitat -- canopy cover, structural complexity, large down wood and snag density -- will change due to proposed treatments. Unfortunately, changes to these habitat characteristics are not quantified or discussed in any detail in the NYLRP planning documents.

The selected alternative (#2) includes 4,836 acres of variable density thinning in high-quality marten habitat across the project area, using either a 30- or 40-inch dbh upper diameter limit (FEIS 2023, Wildlife BE 2023). These actions have the potential for large negative effects to marten over thousands of acres -- yet the Forest Service dismisses these impacts as "minimal", since "only 14% of the project area is suitable for marten" (Wildlife BE 2023). It appears that the agency is attempting to downplay the NYLRP's impact on this species, since 14% of the project area amounts to roughly 29,400 acres -- not a small or inconsequential area. As part of thinning in high-quality marten habitat, large to very large (up to 40" dbh) trees will be removed to create canopy openings of 1-3 acres in size (Wildlife BE 2023). Up to 15% of the project area would be treated using this approach (FEIS 2023). Despite these significant and widespread impacts to high-quality marten habitat and the known vulnerability of this species, no protection measures are included in the project's design that would help to ensure marten persistence.

American Goshawk

The American goshawk (*Accipiter atricapillus* ssp. *atricapillus;* reclassified and renamed from the northern goshawk in 2023), a mid-sized, forest-dwelling bird of prey in the Accipiter family, is another at-risk species with significant potential to be adversely affected by the North Yuba project. The CA Department of Fish & Wildlife has listed the goshawk as a "Species of Special Concern" since 1978, and it has also been designated a Sensitive Species across all national forests in the state (Remsen 1978, CDFG 1992, USDA Forest Service 2004). As top-level predators, goshawks have relatively large spatial requirements, occur at relatively low densities, and depend almost entirely on extensive areas of mature and old-growth forests (Kennedy 2003, Anderson et al. 2005). On the west slope of the Sierra Nevada, they occupy montane forest types ranging from dry mixed conifer up to red fir and lodgepole pine (Keane 1999). Nest stands consistently have more large trees, greater canopy cover (>60%), and more open understories as compared to surrounding forest (Saunders 1982, Hall 1984, Hargis et al. 1994, Keane 1999, Maurer 2000).

American goshawk populations in California are poorly understood, but recent estimates for goshawks state-wide are only ~1,000 breeding territories. (Shuford et al. 2008). The primary threats facing the species are habitat loss and degradation from wildfires, fire suppression and vegetation treatment projects, all of which can remove the dense canopies, large nesting trees, snags and downed logs that goshawks require (Austin 1993, Hargis et al. 1994, Iverson et al. 1996, Beier & Drennan 1997). In a study that identified specific roost locations on the Lassen National Forest (just north of the North Yuba project area), no goshawk roosts were within areas where timber harvest had occurred during the past 20 years (Rickman et al. 2005) -- indicating projects that remove large trees and canopy cover are particularly harmful to goshawks (Rodriguez et al. 2016). Chronic human disturbances associated with roads and land management activities are also a known risk factor (Morrison et al. 2011).

Current management standards and guidelines for goshawks focus on protecting habitat around nest sites during project implementation. Goshawk protected activity centers (PACs) are areas that surround known goshawk breeding territories detected on National Forest system lands. PACs are designated based on recent documented nest sites, location(s) of alternative nests, and location of territorial birds, and require protection of the best available 200 acres of forested habitat in the largest contiguous patches possible (USDA Forest Service 2004). Currently there are 43 goshawk PACs (~9,200 acres) that are wholly or partially within the North Yuba project area -- 21% of these PACs have less than 50% of high-quality habitat, and ~half are no more than 25% of high-quality (Wildlife BE 2023). Based on this information, it's likely that existing habitat conditions for goshawks are already poor and may become even more marginal with implementation of this project.

The NYLRP's selected alternative (#2) incorporates an amendment to the Tahoe National Forest Plan that allows logging-based treatments to occur within essentially all goshawk PACs in the project area (ROD 2023; see map on page 39). Large trees up to 30" dbh can be removed from PACs, except for those overlapping inventoried roadless areas, where the upper diameter limit is 24" dbh. For PACs in infrastructure buffers, road corridors, WUI defense zones and fuelbreaks, average canopy cover may be reduced below 50%, which is likely less than the minimum threshold levels necessary for goshawk site occupancy (Greenwald et al. 2005, Anderson et al. 2005, Crocker-Bedford 1990, Rodriguez et al. 2016, Tuten 2008). In addition, large snags, down logs and other habitat attributes important to goshawks will also be significantly reduced (Wildlife BE 2023). Neighboring districts on this national forest are also treating goshawk PACs mechanically, and there is no mention of how all these treatments to goshawk PACs at once affects goshawk viability across the Tahoe National Forest.

The Forest Service broadly claims that all treatments in PACs will result in the maintenance or even improvement of highest quality NGO habitat, "because thinning would increase the quadratic mean diameter (i.e. average tree size) in the treated stands." (Wildlife BE 2023). But average tree size does not represent or correlate to the many important habitat attributes (canopy cover, abundance of large trees, snags, down logs, etc) that will be reduced by planned logging. Moreover, the agency's dismissive conclusion contradicts a number of published studies that found forest thinning treatments can degrade goshawk habitat and result in reduced site occupancy (Bruggeman et al. 2023, Byholm et al. 2020, Blakey et al. 2020a, Rodriguez et al. 2016). According to goshawk researcher Rodney Siegel, "*Treatments to reduce risk of high-severity fire, including forest thinning, reduce goshawk foraging and roosting habitat quality if they decrease canopy cover and fragment late-seral forest*" (Phys.org 2019, Blakely et al. 2020a). Mechanical treatments outside of goshawk PACs also have significant potential to negatively impact this species, because PACs alone are incapable of maintaining habitat conditions necessary for long-term population persistence (Blakey et al. 2020b, Saga & Selås 2012, Rickman et al. 2005, McGrath 1997).

Given the massive scale of the proposed action and the significant, recognizable threats associated with planned treatments as summarized above, it appears that the NYLRP has failed to strike a reasonable balance between active management treatments designed to reduce wildfire hazard, and the risk of irreparable harm to special-status species that depend on old forest habitats. No single project yet proposed by the Forest Service in the Pacific Southwest region has a footprint this extensive (210,000 acres), or as much potential for significant, long-term impacts to these species. To some extent, the Forest Service acknowledges the likelihood of these impacts by recognizing Alternative #3 (which would result in less impact to essential habitats of spotted owl, goshawk and marten) as the “environmentally preferred alternative” that would “most benefit the ecological landscape”(ROD 2023). But the Forest Service chose Alt. #2 and rejected Alt. #3, and by doing so, has opted to take excessive, unnecessary and perhaps irreversible risks with this region's outstanding wildlife resources.

GRADE: D

CRITERIA 5: Does the project integrate managed and/or prescribed fire into project planning, and also address the timing and necessity of future maintenance treatments?

A large body of scientific research has demonstrated that the restoration of a beneficial fire regime, either through prescribed burning or managing unintentional ignitions for resource benefit, is necessary to effectively increase resilience in Sierra Nevada forests (Coppoletta et al. 2019, Kelsey 2019, DellaSala et al. 2017, Noss et al. 2006a, North et al. 2012, Krofcheck et al. 2017). The reintroduction of fire is not incidental to the logging that is proposed, but rather ***essential*** to achieving the agency's desired outcomes. Regarding this issue, the FEIS (2023) appropriately recognizes "there is a need to mitigate historic fire suppression and climate change impacts by bringing overly dense forests back to a resilient state and encouraging a more natural fire return interval." Unfortunately, the proposed action and alternatives fail to promote and approve the use of prescribed fire (underburning or broadcast burning) over a significant portion of the North Yuba landscape.

Among the 145,735 acres that are proposed for treatment in this project, only 10,850 acres (~7% of the treatment area) are proposed for stand-alone prescribed fire (FEIS 2023). Despite recognizing that forests in the project area are fire-dependent and that fire suppression has led to undesirable conditions, the proposed action relies almost entirely on logging to achieve project goals, and does very little to actually increase the application of beneficial fire at the proper frequency and intensity. This deficiency represents an extreme loss of opportunity, since implementing broadcast burning over a majority of the project area would greatly improve the ecological basis for the project. On this issue, the Forest Service claims that stand-alone underburning will not likely lead to desirable outcomes, because prescribed fire "does not significantly reduce basal area or alter the species composition to achieve desired heterogeneity" (FEIS 2023). But fire is essential for reducing surface fuels, recycling nutrients, stimulating seed germination, creating large snags, controlling tree pathogens, and numerous other ecological processes associated with forest resiliency that cannot be replicated by mechanical treatments (Coppoletta et al. 2019, North et al. 2012, 2007, Allen et al. 2002, Silvas-Bellanca 2011).

An equally if not more egregious deficiency in the NYLRP is the failure to disclose if and to what extent prescribed fire will be applied as a follow-up treatment in areas where thinning or other mechanical fuels reduction are planned. In its 'Response to Comments' section of the NYLRP documents, the Forest Service makes some attempt to assure reviewers that "The broader intent of the project is to re-introduce fire on as much of the landscape as possible, potentially 80-90% of the roughly 145,000 acres proposed for treatment under the preferred alternative" (FEIS Appendix E). However, this statement of 'potential intent' is buried in an appendix and not incorporated directly into the description of the preferred alternative presented in the FEIS, nor in the subsequent (first) Record of Decision. The decision document and FEIS are the official, forward-facing documents that will direct implementation of this project in the future. ***Neither of these planning documents clearly articulate the expectation, let alone assurance, that prescribed fire will be applied on up to 90% of the treatment areas (~130,500 acres).***

The Record of Decision (ROD) is the critical summary document that identifies the actions the Forest Service plans to implement to meet the purpose and need of the project. Certainly, the first North Yuba ROD (2023) offers a detailed summary of the thousands of acres of logging and various other silvicultural treatments that are being approved in the first two sub-project areas (Galloway and Rattlesnake-Skinner). This summary, however, makes absolutely no mention of the prescribed fire that would also (supposedly) be permitted on up to 90% of the treated area (i.e. 24,300 acres). Similarly, the FEIS includes a summary table characterizing treatments across the entire 210,000-acre landscape (FEIS, p. 2-39, Table 2-10), and again, makes no mention of applying prescribed fire on up to 90% of the treatment area (~132,000 acres). Either the Forest Service has not formally included follow-up prescribed fire use as an essential element of the selected alternative, or the agency is downplaying its importance for some unknown reason -- perhaps because these actions are discretionary, and/or the resources necessary for implementation are not assured.

In summary regarding the issue of integrating fire use into project planning, the NYLRP falls short because it: 1) fails to recognize that the project's primary goals of increased forest resilience cannot be achieved unless a beneficial fire regime is ultimately established across the project area, 2) does not unambiguously disclose the amount and locations of stand-alone and follow-up prescribed fire use that will be implemented as part of the selected alternative, 3) fails to demonstrate or provide a strategy for ensuring that adequate funding and resources will be available to apply prescribed fire at the increased scale necessary to achieve desired outcomes, and 4) lacks a prioritization scheme that would help determine which areas are the highest priority for prescribed fire when fewer acres can be burned than planned in a given year or time period. While the Forest Service does generally acknowledge the need to restore the beneficial role of fire to this landscape, the NYLRP does not make a clear commitment or lay out a long-term plan for doing so.

GRADE: D

Early Successional Habitat Creation Project, Green Mountain National Forest (Vermont)

prepared by Rick Enser

A clearcut recently logged as part of the Early Successional Habitat Creation Project, Green Mountain National Forest. Photo credit: Standing Trees

LOCATION: The Early Successional Habitat Creation (ESHC) project is located within the Manchester Ranger District, Green Mountain National Forest. Bennington, Rutland, Windham and Windsor Counties, Vermont.

PURPOSE AND NEED: "Increase the regenerating age class (0-9 years old) of forested stands on up to 15,000 acres over a 15-year period to provide habitat for neotropical migrant passerine birds (or perching birds) and other wildlife species requiring early successional habitats."

PROPOSED ACTION: Even-aged regeneration (clearcut with reserves, patch cuts, and shelterwood) on approximately 80 percent (12,000 acres) of total acres logged. Uneven-aged treatments (group selection, and group selection with improvements) to create temporary openings on approximately 20 percent (3,000 acres) of total acres logged. Up to 25 miles of new roads will be constructed to facilitate logging, and up to nine miles of existing system roads will be reconstructed, for a total of 33 miles.

CURRENT STATUS: A Finding of No Significant Impact and Final Record of Decision were issued by the Green Mountain National Forest in June 2019. Implementation of this project is ongoing.

ECOLOGICAL EVALUATION:

CRITERIA 1: Does the project include clear and specific protections for existing mature and/or old-growth trees, which are key foundational elements of resilient forests and are in significant deficit in New England?

The majority of the 399 forest stands identified for logging in this project are composed of Northern hardwood forest in mid-late successional age classes, ranging from 80 to 160+ years old. Forest-wide, the Forest Service has identified only 737 acres that meet the definition of old-growth in the 2006 GMNF Forest Plan.[10] While these acres are not targeted for logging, there are no specific protections outlined for old-growth trees, and it is possible that the project includes logging of stands that meet the Region 9 old-growth definition that was presented as part of the national mature and old-growth inventory finalized in April 2024.[11]

The EA states the purpose of the project is designed to address Goal 2 of the Green Mountain Forest Plan "which promotes management activities that maintain and restore the quality, amount, and distribution of habitats to produce viable and sustainable populations of native and desirable non-native plants and animals"[12]. This statement is incredibly broad. The more specific direction is that the outdated forest plan calls for a significant reduction in mature forests generally,[13] and specifically of northern hardwoods,[14] up to or possibly exceeding those that are 250 years old[15] -- setting back the clock on this forest's recovery from intensive logging in the 1800s.

GRADE: F

CRITERIA 2: Is it ecologically beneficial to log mature and roadless forests to create "early successional habitat"?

The short answer is no. This project would log stands up to 160 years of age,[16] and within Inventoried Roadless Areas.[17] Proposed logging is detrimental and not justified when only 0.3% of forested stands in the Northeast US are over the age of 150 years.[18] Historically, old-growth forests comprised a significant proportion of Northeastern forests. Roadless areas provide important blocks of unfragmented habitat that benefit water quality, as well as numerous fish and wildlife species such as Cerulean Warbler, Black-throated Blue Warbler, and American marten (listed as endangered by the State of Vermont). Following intensive logging in the 18th and 19th centuries, forests in the eastern U.S. are finally recovering. Left to grow, mature forests will become old growth, which provide critical ecological benefits including carbon storage and sequestration, and habitat for wildlife that depend on old forest conditions and watershed health.

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[10] "Telephone Gap Integrated Resource Project: Preliminary Environmental Assessment for 30-day Comment" at 38.
[11] FS-1215a, April 2024 (revised). "Mature and Old-Growth Forests: Definition, Identification, and Initial Inventory on Lands Managed by the Forest Service and Bureau of Land Management in Fulfillment of Section 2(b) of Executive Order No. 14072."
[12] GMNF 2006 Forest Plan at 10.
[13] GMNF 2006 Forest Plan at 11.
[14] Ibid.
[15] GMNF 2006 Forest Plan at 12.
[16] See ESHC Project map folder entitled "Stand Age Class Maps." Available at: https://usfs-public.app.box.com/v/PinyonPublic/folder/164800716914
[17] See "Forest Plan Revision and RACR Roadless Areas." Available for download at: https://usfs-public.app.box.com/v/PinyonPublic/file/970643072970
[18] Kellett et al 2023 Forest clearing to create early-succsional habitats: Questionable benefits, significant costs. Frontiers in Forests and Global Change. https://doi.org/10.3389/ffgc.2022.1073677

Further, the Forest Service overstates the amount of early seral forest that is ecologically appropriate on the GMNF, while also significantly underestimating the amount of existing early successional habitat that currently exists across the national forest. Prior to European colonization, patches of early successional habitat were created in Northeastern forests by periodic natural disturbances including wind and ice storms, fire, floods, insects/disease, beaver activity, and other agents. Models of forest development in the Northeast generally predict that patches of 0 to15-year-old forest would comprise no more than two percent under historic natural disturbance regimes[19], and generally in patches of less than one acre, although the percentage of early seral habitat could be temporarily greater (4-5%) following more widespread and severe disturbances such as hurricanes. The ESHC project proposal states that the existing amount of 0- to 9-year-old forest stands in the Manchester Ranger District is less than one percent, and that management actions are needed in order to increase this amount to somewhere between five and 15 percent, based on the 2006 Green Mountain Forest Plan objectives.

Regarding this issue, there are several issues of concern: First, the percent of forest in the 0-9 year-old class is almost certainly higher than what the Forest Service has reported, because the agency calculated the amount of early seral habitat based only on areas that have been 'regenerated' through even-aged logging. Openings created by group selection as well as application of other logging prescriptions are not counted. Nor does the Forest Service count, or provide any data on early seral forests created through natural disturbances such as windstorms, ice storms, hurricanes etc. Second, the 0-9 year-old age class is only measured within GMNF boundaries, and does not account for any early successional habitat resulting from natural processes or other forest clearing activities located immediately outside of or adjacent to the national forest. About 13 percent of the forested area in the Northeast is currently in the seedling-sapling tree size class, a decline of >50% over the last 40 years, but still several times higher than estimated pre-settlement values.[20] Importantly, the EA for this project acknowledges that this project is not necessary:

> *"Most changes in habitat conditions on National Forest System lands within the project area for Alternative A (No Action) would take place through natural processes such as wind and ice storms, fire, beaver activity, floods, insects and disease, and natural forest succession."*

GRADE: F

CRITERIA 3: Do proposed treatments support the restoration of habitats required by at-risk species?

Clearcutting to create wildlife habitat has been employed by Federal and State wildlife agencies for decades to benefit common game animals. The ESHC Project proposal states "regenerating forest stands 0 to 9 years old provide important early successional habitat for a number of wildlife species. These include species such as ruffed grouse, woodcock, wild turkey, deer, bear, bobcat, and snowshoe hare." The proposal also says that "the management goals of our partners are also important considerations for the project purpose." The agency's primary partner in this project is The Ruffed Grouse Society, the mission of which is "to improve land for the ruffed grouse and American woodcock, two gamebird species that require early successional habitat." A second partner, The Mennen Environmental Foundation, "is interested in maximizing neotropical migrant passerine diversity". Both organizations have also contributed at least $80,000 toward implementation of the project.[21]

The ESHC proposal states that "the focus of this project is to provide early successional habitat for neotropical migrant passerine birds…. such as the eastern bluebird, chestnut-sided warbler, common

[19] Lorimer and White 2003
[20] Kellett et. al., 2023
[21] "Early Successional Habitat Creation Project in Vermont." Available at: https://ruffedgrousesociety.org/early-successional-habitat-creation-project-in-vermont/

yellowthroat, song sparrow, and American goldfinch." However, these birds are among the most common species in the region and are far from imperiled. All the species cited in the ESHC proposal as potential beneficiaries of the project are identified by NatureServe (2024), the authoritative source of North American biodiversity data, as "secure", or "at very low risk of extinction or collapse due to a very extensive range, abundant populations or occurrences, and little to no concern from decline or threats."[22] Thus, the proposed logging proposals do not support the restoration of habitats required by at-risk species.

Moreover, the size of planned clearcuts well exceeds those that would be created by natural disturbances. Habitat fragmentation is particularly impactful to forest interior birds, including the cerulean warbler, black-throated blue warbler and wood thrush -- three Neotropical migrants identified in the Vermont Wildlife Action Plan as Species of Greatest Conservation Need, but not recognized as Sensitive Species in the ESHC EA. In addition, the American marten, a carnvirous mammal in the weasel family that is known to be dependent on large tracts of older forest and a state-listed endangered species in Vermont, was not considered in the EA.

GRADE: F

CRITERIA 4: Is the project designed to avoid, or at the very least effectively minimize, adverse impacts to at-risk species?

The ESHC project recognizes four federally listed threatened and endangered species known to occur on or near the Green Mountain National Forest. The gray wolf is considered "historic" (not present) and the presence of Canada lynx is considered "unlikely." According to the project EA, the Indiana bat would be affected, but not "adversely" affected, and the Northern long-eared bat might also be affected, but the project "would not cause prohibited take" as defined by the Endangered Species Act. The proposal also identifies 20 Regional Forester Sensitive species, "identified by the Forest Service for which population viability is a concern." The EA states that the project "would have no impact on sensitive species with a low likelihood of occurrence (8 species), and there may be an adverse impact to individual species with a moderate (11) or high (1) likelihood of occurrence in the analysis area, but proposed activities are not likely to cause a trend towards federal listing or loss of viability."

However, the EA fails to take a hard look at potential adverse impacts to one of only two known populations of American marten in Vermont, which is formally listed as endangered by the state.[23] Martens depend on large blocks of unfragmented forest, and generally select older forest stands that are structurally complex. When mature and old-growth forests are lost or degraded, marten populations decline. A 2022 study analyzing marten populations in Maine found that "even partial harvest activities can diminish the canopy cover, structural complexity and overall basal area [that marten] require."[24] And "Marten…showed lower initial occupancy probability in areas of increasingly disturbed forest and had both higher extinction rates and lower colonization rates in these areas."

The ESHC EA erroneously concludes, "In the short- and long-term, effects to habitat conditions for threatened, endangered, and sensitive wildlife species, and effects to individual animals, would be negligible. Since potential effects would occur only in the physical locations of the proposed activities, the spatial extent of the direct and indirect effects analysis *is the stands in which proposed activities would occur"* [emphasis added]. In other words, no analysis was conducted in the retained forests that would surround the created openings. Patch cuts and clearcuts will create large openings, from 5 to 30

[22] https://explorer.natureserve.org/
[23] https://vtfishandwildlife.com/learn-more/vermont-critters/mammals/american-marten#:~:text=Marten%20were%20legally%20classified%20as,marten%20population%20in%20the%20state.
[24] Evans, B.E. and A. Mortelliti, "Effects of forest disturbance, snow depth, and intraguild dynamics on American marten and fisher occupancy in Maine, USA." *Ecosphere* (2022) 13(4): e4027. https://doi.org/10.1002/ecs2.4027.

acres that will result in increased wind damage to surrounding trees, higher temperature extremes, greater opportunities for colonization by invasive species, and increased predation and brood parasitism on forest interior birds. These impacts may extend into retained forest for several hundred meters so that the actual zone of impact of each logging unit is far greater than the deforested area.

GRADE: D

CRITERIA 5: Does the project follow the goals and objectives of the Green Mountain National Forest Plan regarding forest biodiversity and other ecological services including carbon

The 2006 Green Mountain National Forest Plan was approved without recognition of the Forest's contribution to carbon sequestration and storage, biodiversity conservation, or substantive analysis of the detrimental impacts of logging on these important ecological services. In fact, the terms *carbon sequestration* and *carbon storage* do not appear in the document; and the term *biodiversity* appears only once in the glossary. Forest Service staff were queried several times during the scoping process for the ESHC project about preparing an updated Forest Plan, or at minimum an amendment to address these important issues -- they responded that they lack appropriate funding. In summary, logging treatments are being designed and implemented in order to create early successional habitat for common birds and game species that were historically less abundant on the GMNF, at the expense of Neotropical migrants and a range of at-risk plants and animals that require relatively large, unfragmented patches of mature and old forest.

GRADE: F

APPENDIX

Quoted excerpts from the scientific literature and recognized forest/fire experts on the critical importance of conserving large/old trees as part of fuels reduction, restoration and resiliency efforts in the fire-adapted forests of the western U.S.

"*Maintaining the fire-resistant, large-tree component of the forest is essential in active management schemes...Removal of large, pre-settlement trees is apt to undermine credibility of restoration efforts while degrading wildlife habitat and exacerbating fire risk.*" ~Brown et al. 2004

"*Retention of old live trees, large snags, and large logs in* [dry forest] *restoration treatments is critical*." ~Noss et al. 2006a

"*Ecological restoration should protect the largest and oldest trees from cutting and crown fires, focusing treatments on excess numbers of small young trees...cutting of larger trees will seldom be ecologically warranted as 'restoration' treatments at this time due to their relative scarcity. Following this guideline would significantly reduce hazards of stand-replacing fires in most cases and also favor the development of future old- growth forest conditions*." ~Allen et al. 2002

"*Removing large fire-tolerant trees like western larch, ponderosa, western white pine, and sugar pine can reduce forest resilience to wildfire and climate change*." ~Hessburg et al. 2022

"*Most research reveals that broadly conserving large and old fire-resistant trees and replacing those that were removed or killed by harvest, drought, insects, pathogens, and wildfires provides a strong backbone of resilient structure and habitat to seasonally dry pine and mixed-conifer ecosystems*." ~Hessburg et al. 2021

"*Old-growth trees, especially large old-growth trees of all species, definitely qualify as 'ecological keystones' given their central roles in ecosystem function, wildlife habitat, resilience as live trees and as large persistent snags and logs after death. In general, we recommend retaining trees of all species older than about 150 years of age as part of dry forest restoration projects – even if they are within the crown of an old ponderosa pine tree."* ~Franklin et al. 2013

"*To minimize the effects of fuel reduction and forest restoration on spotted owls and other old-forest species, it is essential that large, old trees be maintained. When large, old trees are maintained and recruited, fuel reduction and forest restoration can benefit both old-forest species, forest ecosystem resilience, and people in a changing climate*." ~Jones et al. 2017

"*A critical step in large old tree management is to stop felling them where they persist and begin restoring populations where they have been depleted*." ~Lindenmayer et al. 2014

"*Removal of pre-settlement era trees (old) trees is not necessary to restore fire-resilient forest structure, spatial pattern and ecological process.*" ~Franklin & Johnson 2012

"*Cut no trees of any species older than 150 years or with a diameter of 20 inches or greater. It is essential to conserve as many of the mature trees of Eastside forests as possible in the short term to sustain these forests in the long term...they are "living examples of our long-term objectives*." ~Henjum et al. 1994

"*When managing for old forest conditions and to increase fire resiliency in drier forest types, legacy/large/old trees provide the foundation or "living backbone" from which to build restoration actions*." ~Franklin et al. 2013

"*Cutting larger trees in a stand is likely to create future problems and should not be done if long-term landscape health is the primary objective*." ~Perry et al. 2004

"*Silvicultural activities that focus on removing dominant trees will not reduce potential fire intensities and stand mortality, nor will they contribute to creation of forest structure and composition characteristic of older forest*." ~Franklin et al. 2008

"Protecting the remaining old trees from logging, unnatural stand-replacing fire and uncharacteristic levels of insect and disease attack are perhaps the most needed conservation measures."
~Noss et al. 2006b

"*In management aimed at accelerating the recovery of old-growth structures, protection of all pre-Euro-American trees is needed to ensure that this restoration truly leads to old forests*." ~Baker et al. 2007

"*Widely distributed large, old trees provide a critical backbone to dry pine and dry to moist mixed conifer forest landscapes*." ~Ellison et al. 2005

"*This result [less mortality in stands w/larger trees] highlights the importance of retaining the largest, most fire-resistant trees in forest restoration and wildfire hazard treatments if the goal is forest persistence*." ~Brodie et al. 2024

"*Large diameter trees, which are often old (>150 years), fulfill an array of ecosystem functions and services: They are fire resistant due to thick bark and high crown bases, store most of the above-ground carbon, contribute disproportionately to seed production, and produce large quantities of leaf litter to carry surface fires. Large, old trees develop decadence -- dead tops, heart rot, cavities, and complex branches and crown architecture -- features that make them especially valuable as wildlife habitats*."
~Larson & Churchill 2024

"*In the context of forest restoration, we recommend that managers take the divisive issue of old tree harvest off the table, and instead focus on thinning young in-growth trees (i.e., those trees that established after Euro-American settlement) that have established around and among old trees and tree clumps. Focusing harvest on young trees will reduce competition, continuity of crown fuels, and contagion of host-specific tree enemies such as bark beetles, without causing conflict over proposed harvest of any remaining large trees. Such an approach is consistent with current guidelines for restoration and climate change adaptation in dry ponderosa pine and mixed-conifer forests*."
~Clyatt et al. 2016

"*A logical starting point for increasing the presence of large old early-seral trees would be to protect early seral trees over a minimum size or estimated age...and* [where lacking] *develop future cohorts of large/old trees at fire resistant densities*." ~Hessburg et al. 2016

"*Because wildlife habitat of large-diameter trees takes a long time to develop, extra efforts to conserve existing large trees in the short term may be needed as continued loss may occur due to harvest on private lands, wildfire, and insect activity...Attention should be given to protecting existing large-diameter and old trees (especially fire-resistant species) because they are difficult to replace*." ~Wales et al. 2007

"*Old-growth trees and the habitat they provide require centuries to replace, and it is thus reasonable to give such trees and other scarce habitats special attention as a part of restoration efforts, even if it requires departures from the historic range of variability to perpetuate them*." ~Noss et al. 2006c

"*The key ingredient in all management to produce, conserve, or protect dry old forest is the retention of sufficient numbers of large ponderosa pine, western larch, and (in some cases) Douglas-fir*." ~USFWS 2011

"*Logging older tree remnants in younger stands undergoing harvest should cease. When retained, large trees provide extraordinarily valuable wildlife habitat and help create stands that are more resistant and resilient to wildfire*." ~Johnson et al. 2023

"*The starting point and highest priority should be to retain older trees within these* [dry] *forests and enhance their survival by reducing surrounding competition and ladder fuels...Old trees and their derivative snags and down logs are core structural elements of natural dry forest ecosystems...An ecologically-based approach to forest management requires conserving these keystone ecological features, including old-growth forests and trees, wherever they are found.*" ~Johnson et al. 2023

"*Retaining and enhancing the survival of existing older trees is a high priority objective in restoration, because it is the older trees that are the structural keystone of these dry forests, including having the greatest resistance to fire*." ~Franklin et al. 2018

"*Leave all pre-settlement trees* [in forest restoration projects]...*Pre-settlement trees are the slowest variable to restore in the system, and they represent centuries worth of genetic and structural diversity*." ~Moore et al. 1999

"*Old trees* [defined as trees >150 years old] *are rare on the landscape, are a living testimony of past disturbance and climate change, provide unique wildlife habitat, sequester carbon over centuries, and provide spiritual inspiration to many people*." ~Kolb et al. 2007

"[Do] *not thin mature and old groups of trees except to remove young trees within these groups to reduce ladder fuel*." ~Reynolds et al. 2013

"*Enhancing forest resilience does not necessitate widespread cutting of any large-diameter tree species. Favoring early-seral species can be achieved with a focus on smaller trees and restoring surface fire, while retaining the existing large tree population*." ~Mildrexler et al. 2023

"*Given their current deficit in mixed-conifer forest and the time necessary for their renewal, protect large trees and snags from harvest...Stand treatments that significantly reduce the proportion of small trees and increase the proportion of large trees compared to current stand conditions will improve forest resilience*." ~North et al. 2009

"*In general, removal of large, old trees is not ecologically justified and does not reduce fire risks. Such trees contribute to the resistance and resilience of the forest ecosystems of which they are a part. Large, old trees of fire-resistant species are the ones most likely to survive a wildfire and subsequently serve as biological legacies and seed sources for ecosystem recovery...For all practical purposes, they are impossible to replace*." ~DellaSala et al. 2004

"*Restoration treatments aim to increase the ratio of old to young trees through removal of young trees and retention of old trees...Treatments should remove overrepresented age and size classes (usually trees 50 to 120 years old) while retaining old trees (>150 years old). The eventual goal is to increase the* *amount of basal area in old, large ponderosa pine trees compared to current conditions...If old trees occur in groups, the groups should be retained*." ~Addington et al. 2018

"*Large-diameter, decadent trees are particularly important features for retention because they provide critical habitat for many organisms, are most likely to survive intense wildfire and will otherwise be absent from managed stands*." ~Franklin et al. 1997

"*Because old trees and old-growth conditions are rare in most frequent-fire forests of western North America, it is imperative to conserve and manage them where they exist*." ~Fiedler et al. 2007

"Large trees in dry forests disproportionately support biodiversity, moderate micro-climates, store most of the above-ground live carbon, and provide essential resistance and resilience to wildfires...Large trees take time to regrow after disturbances and need protection from logging." ~Baker et al. 2023

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SECTION IV - INDIVIDUAL PROJECT EVALUATIONS

GOLD BUTTERFLY PROJECT, BITTERROOT NF

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APPENDIX

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Rick Enser retired to Vermont in 2007 following a 28-year career directing the Rhode Island Natural Heritage Program, the state's biodiversity inventory and conservation program. He has taught courses in ecology, endangered species, conservation biology and biodiversity at the University of Rhode Island, Rhode Island School of Design, and for the Native Plant Trust's certificate program. He currently serves as the principal consulting conservation biologist with Conservation Cooperative, based in Hartland, Vermont.