Flathead-Lolo-Bitterroot Citizen Task Force
Friends of the Bitterroot • Friends of the Clearwater
WildEarth Guardians • Wilderness Watch
Western Watersheds Project

Amanda Milburn, Revision Team Leader
Lolo National Forest
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Sent electronically to*: amanda.milburn@usda.gov*

Part A- Comments on the Draft Assessment

Introduction

These comments are submitted on behalf of the Flathead-Lolo-Bitterroot Citizen Task Force, Friends of the Bitterroot, Friends of the Clearwater, WildEarth Guardians, Wilderness Watch and Western Watersheds Project.

The Draft Assessment (DA) is lacking in substantive data because the Lolo National Forest (LNF) has been neglectful in performing the required Monitoring and Evaluation. Inadequate information is presented on key issues. Moreover, much of the science cited in the DA is outdated when newer sources are available. These comments all carry equal weight.

Distinctive roles and contributions

Distinctive roles and contributions are a required section of a forest plan. *"The 2012 planning* rule (36 CFR 219.7(1(ii)) *and associated handbook* (FSH 1909.12.22.32) *require that revised plans describe the plan area's distinctive roles and contributions within the broader landscape. This content describes roles for which the plan area is best suited, considering the Agency's mission, the unit's unique capabilities, and the resources and management of other lands in the vicinity."*

For example, in 2004 the Forest Service identified the Western Montana Planning Zone which encompassed the Flathead, Lolo and Bitterroot National Forests in recognition that these three forests share a common landscape, watersheds and wildlife and fish populations.

FSH 1909.12.22.32 emphasizes the importance of properly identifying distinctive roles and contributions, *"Once described, the plan area's roles and contributions within the broader landscape can serve as a focused foundation or context that should be a unifying concept helping <u>to define the vision for the plan area within the broader landscape</u>. This description is important because it is a <u>source of motivation or reasons behind desired conditions (emphasis added)</u>.…*

"The description of the plan area's distinctive roles and contribution within the broader landscape must not be a list of all the roles of the plan area. Rather, it should reflect those things that are truly unique and distinctive" (emphasis added).

Unfortunately, in the DA the LNF fails to adequately identify the Forest's distinctive roles and contributions. Rather it presents a list of 'common themes' it heard in workshops held in February 2023. In reviewing the workshop notes filed on the website we saw many detailed and nuanced observations of what is unique and of value to participants and users of the national forest, which are not reflected in the laundry list provided in this important section. For example, access to the full spectrum of recreation is placed at the top of the list. This is not distinctive to the Lolo but occur on every forest in Montana, Region 1, and across the country. Similarly, the 'emphases' on economic opportunities that you 'heard' are not only not distinctive, but also not strongly emphasized in the workshop notes.

Sandwiched between recreation and resource extraction is a relatively short underwhelming statement, *"Participants expressed an interest in providing for ecological health and biological elements on the landscape such as supporting the diversity of plants and animals, healthy vegetation and restoration of fire-adapted ecosystems given the influences of climate change, carbon sequestration, habitat connectivity, clean water, and healthy streams."* Not only does this fail to value and reflect the more nuanced and sophisticated conservation values of many of the public participants, it fails to grasp the opportunities presented in the 2012 planning rule to develop a Lolo National Forest Land and Resource Management Plan that could meet the challenges of the times and carry it beyond the foreseeable future.

Whether inadvertent or intentional the structure of this required section of the plan demonstrates a preference if not a prejudice for 'Multiple use' (§ 219.10) over other sections of the 2012-planning rule, specifically Sustainability (§ 219.8) and Diversity of plant and animal communities (§ 219.9). This is inconsistent with the intent of the 2012-planning rule that emphasizes (§ 219.8) "(a) *Ecological sustainability.* (1) *Ecosystem Integrity. The plan must include plan components, including standards or guidelines, to maintain or restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds in the plan area, including plan components to maintain or restore structure, function, composition, and connectivity*…". Section 219.10 clearly states, *"While meeting the requirements of § 219.8 and 219.9, the plan must provide for ecosystem services and multiple uses, including outdoor recreation, range, timber, watershed, wildlife, and fish, within Forest Service authority and the inherent capability of the plan area…"* Connectivity is a prominent thread in planning for sustainability, diversity of plant and animal communities and even in multiple use and other sections. We are concerned that not helping to educate the public on the 2012 planning rule will lead to confusion and unnecessary resistance by those publics fearful of losing the familiar.

The DA of the LNF's distinctive roles and contributions misses the mark by characterizing the forest as a public playground and economic opportunity. We put forth that the LNF's most distinctive role and contribution is as a regionally significant connectivity hub. The LNF covers eight geographical areas that span over 2,250,000 of acres of national forests. It borders the Kootenai, Clearwater, Bitterroot, Flathead, and Lewis and Clark National Forests as well as tribal lands. It includes portions of three grizzly bear recovery areas, the Northern Continental Divide (NCDE), the Cabinet-Yaak (CYE) and the Bitterroot Ecosystem (BE). The Conservation

Strategy for Grizzly Bear in the Northern Continental Divide Ecosystem places a unique responsibility on the LNF to manage the Ninemile Demographic Connectivity Area, one of only two such areas in the NCDE. Petty Creek, south of the Clark Fork River is a logical extension of the DCA and an opportunity to include in the forest plan revision. The Ninemile is a unique area. The community is known to support conservation easements for wildlife habitat and connectivity. Interagency and NGO cooperation has invested millions in restoring Ninemile Creek damaged by mining. NGO's have invested millions in securing 52 acres at the confluence of Ninemile and the Clark Fork River to facilitate grizzly bear passage under I-90. Such extra-community cooperation dedicated to conservation and wildlife values goes beyond the Ninemile and deserves to be considered a distinctive role and contribution of the LNF.

The LNF bridges the Bitterroot, Clearwater, Blackfoot, and Clark Fork River valleys, each experiencing the pressures of housing and infrastructure development and human population growth. Missoula is a major population and commerce center where a complex of highways and railroads converge, all but eliminating opportunities for safe wildlife passage through this once rich and diverse habitat. Loss of this habitat enhances the importance of surrounding forest lands and maintenance or improvement of intact habitat in Rattlesnake, Rock Creek, Lolo, Patty, Fish, Ninemile and Petty creeks.

The LNF contains about 147,893 acres of designated wilderness, 223,915 acres recommended for wilderness designation, and 758,000 acres (34%) of inventoried roadless areas as well as other lands that offer administrative protections such as research natural, botanical areas and wild and scenic rivers found eligible and suitable for inclusion. Some of these are listed in Section 1.5.3 Distinctive Roles by Geographic Area, but reporting and formatting is not consistent. We noticed this assessment drew from the 2006 Proposed Land Management Plan Geographic Area descriptions.

However, while the 2006 draft plan included the percentage of each geographic area "within designated wilderness, recommended wilderness or other primitive settings", this helpful information was 'scrubbed' from your assessment. For example, the Greater Missoula Geographic Area, the most developed and populated GA includes 59 percent in designated, recommended or other primitive settings. Please report percentage of "protected and primitive areas as a distinctive role and contribution by geographic area in Section 1.5.3, and the LNF in general. In the interest of accuracy and consistency with the 2012-planning rule this information deserves to be highlighted, not scrubbed. With this in mind we expect to see a science-based connectivity plan developed during this process.

We strongly encourage you to reconsider and reframe the LNF's distinctive roles and contributions in light and context of its geographic position as a connectivity hub. We provide more detail on this later in our comments. We would be happy to help you rewrite this section since it is foundational to development of components throughout the forest plan.

To begin, it's helpful to place the Assessment and lists of Potential Species of Conservation Concern in the context of the 2012 Planning Rule. The Planning Rule sets out the sequence of steps for the process of Forest Plan Revision and highlights the stages for which the Forest Service is to provide opportunities for public involvement. The Planning Rule states:

> The process for developing or revising a plan includes: Assessment, preliminary identification of the need to change the plan based on the assessment, development of a proposed plan, consideration of the environmental effects of the proposal, providing an opportunity to comment on the proposed plan, providing an opportunity to object before the proposal is approved, and, finally, approval of the plan or plan revision. A new plan or plan revision requires preparation of an environmental impact statement.
>
> …In the assessment for plan development or revision, the responsible official shall identify and evaluate existing information relevant to the plan area for …potential species of conservation concern present in the plan area;

We appreciate the Forest Service is soliciting comments on the DA in response to the Planning Rule mandate to "provide opportunities to the public for participating in the assessment process" and also recognize the value of the roundtable discussions held on the Assessment. Before commenting on the DA, we note that the next step the Forest Service will take is the "preliminary identification of the <u>need to change the plan **based on the assessment**</u>…" (emphases added). We take this as meaning a need to change from the current Forest Plan, adopted in 1986. Implicit in that reasoning includes the Forest Service determining what of the current plan is working, and what isn't.

Under 1.2 Purpose of the Assessment the DA identifies, "a responsive process that informs integrated resources management and allows the Forest Service to adapt to changing conditions, including climate change, and improve management based on new information **and monitoring**." (Emphasis added.) The DA goes on to state:

> …the environmental and regulatory context for the Lolo National Forest has changed in ways that were not foreseen or addressed in the planning efforts conducted in 1986. Broad changes that have altered the context of forest planning, and that present both challenges and opportunities for management include:
> …New information related to managing ecosystem and socioeconomic sustainability provided by best available scientific information **and monitoring.**

(Emphasis added.) In 1.8 Public Engagement, Cooperation, and Coordination the DA identifies "broad outcomes …desired from public engagement:" including "Maintain and build relationships that carry forward to plan implementation **and monitoring**." (Emphasis added.)

The previous planning rule (1982) required the Forest Service to include programmatic monitoring in the 1986 (current) forest plan, and such monitoring was explicitly designed to assess how that forest plan was working and address—similar to the current process—the need to change via amendment or revision. So we find it extremely frustrating and in fact a barrier to public participation at this revision stage, that the DA makes scant mention of the results of programmatic monitoring and how it has informed the Forest Service as it contemplates a "need to change" the forest plan. It's as if the Forest Service is attempting to erase the history of 1986 Forest Plan implementation during this revision process, lowering agency credibility and public confidence in the Forest Service. Most mention of programmatic monitoring in the DA cites the 2021 Biennial Monitoring and Evaluation Report, which covers very little of the duration of the

1986 forest plan. This ignores the Planning Rule mandate that the Assessment: “Identify and consider relevant existing information contained in governmental or non-governmental assessments, plans, monitoring reports, studies, and other sources of relevant information.”

Therefore, we must remind you of previous commitments the 1986 forest plan made, and request that you explicitly discuss the results of the monitoring of these items from 1986 until the present day in the final Assessment, especially given that your next step will be identifying the Need to Change from the 1986 plan:

Table V.1

TABLE OF FOREST MONITORING REQUIREMENTS

MONI-TORING ITEM	SUBJECT	ACTIVITY, PRACTICE, OR EFFECT TO BE MEASURED	DATA SOURCE	1/ EXPECTED PRECI-SION	2/ EXPECTED RELIA-BILITY	3/ FREQUENCY OF MEASUREMENTS	REPORTING PERIOD	VARIABILITY (±) WHICH WOULD INITIATE FURTHER EVALUATION
1-1	WILDLIFE	Elk productivity—total time of human disturbance created by timber management activities.	Timber sale & postsale inspection reports. Miles of open road. The following Montana Dept. of Fish, Wildlife, & Parks information: bull elk harvest rates; hunting season length; & elk populations.	Mod.	Mod.	30% of sales >2 MMBF Annually	5 years	On roads with yearlong closures, timber management disturbance occurring more than 4 years out of 10 years.
1-2		Elk productivity—cover/forage ratios.	Stand exams, aerial photos, reforestation surveys, EA, project files, miles of open road, bull elk harvest rates, hunting season length, & elk populations.	High	Mod.	100% of sales >2 MMBF Annually.	5 years	Any cover/forage ratio below 40/60 in a minimum analysis area of 4,000 acres.
1-3		Monitor effectiveness of old-growth habitat areas that are harvested.	Stand exams and aerial photos.	High	High	100% of timber sales sold	5 years	20% degradation in short run and 10% degradation in long run.
1-4		Postsale snag densities.	Field transects.	High	Low	10% of timber sales sold	5 years	30% or more of transects fail to meet Forest snag prescriptions.
1-5		Acres of threatened and endangered habitat improvement.	Management Attainment Report.	Mod.	High	100% of sales >2 MMBF Annually	5 years	Forest must accomplish 75% of habitat improvements programmed for a 5-year period with at least 50% accomplishment every year.
1-6	WILDLIFE (con't)	Treated acres of big-game winter range.	Management Attainment Report.	Mod.	Mod.	100% of sales >2 MMBF Annually	5 years	Forest must accomplish 75% of habitat improvements programmed for a 5-year period with at least 50% accomplishment every year.
2-1	AQUATIC ENVIRON-MENT AND FISHERIES HABITAT	Improvement of fish habitat.	Management Attainment Report.	Mod.	High	100% sampling Annually	5 years	Forest must accomplish 75% of habitat improvements programmed for a 5-year period with at least 50% accomplishment every year.
2-2		Validation of aquatic habitat quality and fish population assumptions used to predict effects of management activities and an evaluation of actual effects.	Evaluation of the following indicators: aquatic insect density or diversity; fish populations; intergravel sediment accumulations; channel structure changes; and streambank vegetation changes.	High	Mod.	20% sampling Annually	Annual	A decline in aquatic habitat/fish population for more than 1 year.
2-3		Assessment of riparian activities on riparian dependent resources.	Field review of riparian activities and evaluation of stream and lake surveys.	Mod.	Mod.	20% sampling Annually	Annual	Visible or measurable decline in aquatic habitat/fish population for more than 1 year.
3-1	TIMBER	Insure management practices minimize hazards from flood, wind, wildfire, erosion, and other natural physical forces.	EA, project file and field reviews.	Mod.	Mod.	100% project sampling Annually	Annual	Anticipated problem identified in interdisciplinary team review of timber sale.

3-2		Insure establishment of vegetation on temporary roads within 10 years.	EA, project file, timber sale contract, and field reviews.	High	High	1 project/ District Annually	Annual	Departure from management standard to scarify and seed all temporary roads.
3-3		Assure silvicultural prescriptions meet multiple use goals.	EA, project file and field reviews.	High	High	1 project/ District Annually	Annual	Departure from management direction.
3-4		Assure silvicultural prescriptions are not primarily chosen on basis of greatest dollar return or greatest timber output.	EA, project file.	Low	Low	1 project/ District Annually	2 years	Departure from management direction.
3-5		Assure silvicultural prescriptions consider residual trees and adjacent stands.	EA, project file and field reviews.	Low	Low	1 project/ District Annually	Annual	Departure from management direction.
3-6		Assure silvicultural prescriptions are practical.	EA, project file and field reviews.	Mod.	Mod.	1 project/ District Annually	Annual	Departure from management direction.
3-7		Assure silvicultural prescriptions meet legal size limits.	EA, project file and field reviews.	Mod.	Mod.	100% project sampling Annually	Annual	Departure from management standard restricting clearcuts to less than 40 acres.
3-8	TIMBER (con't)	Assure selected sale alternative provides for plant/animal community diversity.	EA, project file, stand exams, regeneration surveys, and field reviews.	High	High	1 project/ District Annually	5 years	Departure from management direction.
3-9		Assure harvest on unsuitable lands will meet other resource needs.	EA, project file and field reviews.	High	High	1 project/ District Annually	Annual	Departure from management direction.
3-10		Assure timber sold does not exceed allowable sale quantity for 10-yr. period.	Timber Sale Accomplishment Report	High	High	100% sampling Annually	Annual	Departure from 10-year allowable sale quantity.
3-11		Assure restocking within 5 years.	Reforestation accomplishments reported in Timber Stand Data Base.	High	High	100 Percent Sample Annually	Annual	Development of regeneration backlog.
3-12		Assure silvicultural treatments (harvest, thinning, etc.) are planned and accomplished as projected in Forest Plan.	Silvicultural prescriptions, Timber Stand Data Base.	High	High	100 Percent Sample Annually	Annual	Departure from 10 year output schedule.
3-13		Insure harvest by even-age management is compatible with other resource values.	EA, project file and field reviews.	Mod.	Mod.	1 project/ District Annually	Annual	Departure from management direction.
3-14		Assure harvest will not promote disease and insect increases.	EA, project files and stand files.	Mod.	High	1 project/ District Annually	Annual	Increases in insect/disease problems following logging.

3-16	TIMBER (con't)	Review timber suitability of lands classified as unsuitable.	Forest Plan Data Base	High	High	100% project Sampling Annually, 100% Forestwide in 10-year period	10 years	Classification of lands as suitable.
4-1	WATER AND SOIL	Validation of sediment and water yield assumptions used in plan. (For "R-1/R-4" or current sediment yield model)	Flow measurements and sediment sampling of streams representative of Forest Plan land classes.	Low	Mod.-Low	12-16x/year 100% sampling of hydrol types types Annually	Annual	30% variability from sediment yields used in the model.
4-2		Monitor for compliance with existing State and Federal water quality statutes.	Flow measurements and water quality sampling in streams representative of Forest Plan land classes.	Low	Mod.	12-16x/year 100% sampling of hydrol types Annually	Annual	Activities not meeting State and Federal water quality standards, or leading to long-term degradation of aquatic environment.
4-3		Monitor the effect of soil disturbance/displacement on land productivity.	Measurements of soil compaction, soil displacement, and biomass left on site.	Mod.	Mod.	1 sale/ District Annually	Annual	Movement or compaction of soils reducing productivity more than 20%.
5-1	RECREATION	Limit off-road vehicle damage.	Field observaton of identified areas.	Mod.-Low	Mod.-Low	Ongoing	2 years	When use conflicts with management goals of area.
5-2		Provide opportunities for a wide spectrum of recreation activities.	RIM Use Records, Recreation Opportunity Guide, MDFWP Hunter Information, Travel Plan Trail Assessment, and Limits of Acceptable Change.	Mod.-Low	Mod.-Low	100% sampling	Annual	± 25% of target projected in Recreation Opportunity Inventory.
5-3	RECREATION (con't)	Compare changes in acres and distribution of Roadless lands with plan projections.	Forest Data Base, 5-Year Sale Program, Timber Stand Data Base, Management Attainment Reports, RARE II, Updated Roadless Inventory.	High	High	100% sampling Annually	5 years	Changes different from what was projected.
6-1	RANGE	Livestock forage available (AUM's).	Range analyses and allotment mgt. plans.	High	High	100% sampling Annually	Annual	± 10%
6-2		Assure range allotment management plans are compatible with Forest Plan direction.	Range Analysis and Utilization Reports.	High	High	1 plan/ District Annually	Annual	Departure from management direction.
7-1	ROADS	Assure open road densities are in accordance with Forest Plan direction.	Forest Travel Plan, Transportation System.	High	High	100% sampling Annually	2 years	Greater than 20% annually or 10% on a 5-year average.
7-2		Review of road construction.	Construction contracts and constructed roads.	Mod.	Mod.	1 project/ District per year.	Annual	Road construction resulted in unacceptable resource damage or beyond construction tolerances.
7-3		Review of road design and construction standards.	Road design packages and timber sale reviews.	High	High	1 sale per District per year.	Annual	Designs beyond the limits of the standards.
7-4		Monitor road density deviations from those projected in plan.	EA, project files, Transportation Inventory System, Project Transportation Plans.	Mod.	Mod.	100% sampling Annually	Annual	Departure from management direction.

8-1	MINERALS	Review of Forest Service projects that may have an effect on minerals activities. Review of mining activities affecting surface land management.	Monthly mineral progress report, operating plans, leases, and permits.	High	High	100% sampling Annually	Annual	Any adverse effect of Forest Service project on mineral activities, or any departure from approved operating plans, leases, and permits.
9-1	ECONOMICS	Verification of unit costs used in FORPLAN.	Timber sale appraisals and contracts, and the accounting system.	High	High	100% sampling Annually	Annual	In general, ±25% variation would trigger need to rerun FORPLAN.
10-1	VISUAL QUALITY	Monitor project and activity compliance with visual quality objectives.	Special use, EA project files, and field reviews.	High	High-Mod.	2 sales/ District Annually	Annual	Failure to meet intended VQO.
11-1	FIRE	Assure prescribed fire meets air quality guidelines and standards.	Burning treatment plans and local air quality offices.	High	High	100% sampling Annually	Annual	Burning without required permit.
11-2		Assure accomplishment of fuel treatment targets.	Management Attainment Reports.	High	High	100% sampling Annually	Annual	Less than 75% of Forest Plan Projections.
11-3		Evaluate impact of wildfire losses on management area targets.	Incident Fire Reports.	High	High	100% sampling Annually	10 year	Wildfire losses 100% above PARS prediction by MA for decade.

V-12

The DA also fails to tap into the wealth of scientific literature and other information the public has taken great pains to assemble and provide to the Forest Service during NEPA and other processes of project development during the decades of 1986 forest plan implementation. Why wouldn't this Assessment phase consider, for example, the information submitted by FOC and other members of the public during the Wildfire Adapted Missoula comment and objection processes? The answer is of course—it very much should. As the Planning Rule mandates of the Assessment: "Identify and consider …other sources of relevant information" including "private information …if publicly available or voluntarily provided."

Assessment Bias

In 2006 the Ninth Circuit U.S. Court of Appeals noted:

> We have noticed a disturbing trend in the [Forest Service's] recent timber-harvesting and timber-sale activities…It has not escaped our notice that the [Forest Service] has a substantial financial interest in the harvesting of timber in the National Forest. We regret to say that in this case, like the others just cited, the [Forest Service] appears to have been more interested in harvesting timber than in complying with our environmental laws."

(*Earth Island Institute v. United States Forest Service* 442 F.3d 1147 (2006).) Under 3.10.1 Timber Suitability, Production, and Harvest the DA states:

> Timber production is the purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use (36 CFR 219.19). …Lands that are suitable for timber production are lands that meet the following criteria, per the National Forest Management Act of 1976:
>
> • Timber production is a primary or secondary use of the land,
>
> • Timber production is anticipated to continue after desired conditions have been achieved,
>
> • A flow of timber can be planned and scheduled on a reasonably predictable basis,

- Regeneration of the stand is intended, and
- Timber production is compatible with the desired conditions or objectives for the land.

We note that the term "desired conditions" does not appear in the National Forest Management Act of 1976, nor do those other clauses appear anything like how the DA cited. The DA's misrepresentation of the law at this phase serves to remind the public of the agency's extreme bias towards logging. Likewise, the DA continues: "Timber harvest is also used to move vegetation towards desired conditions and meet other resource objectives such as improving watershed condition, improving wildlife habitat, and reducing wildfire risk." The Forest Service cannot cite scientific studies supporting any such claims that logging has holistically improved habitat or watershed conditions on the Lolo National Forest, nor as we discuss in a later section, reduced wildfire risk.

The DA also makes false and misleading statements promoting the alleged benefits of logging: *"Timber harvest is a tool used to achieve multiple resource objectives (including) reducing insect or disease hazard and impacts, improving wildlife habitat, increasing tree growth, improving timber productivity, and reducing fuel complexes, fire hazard and associated risk, and altering forest structure and composition to improve forest resistance, resilience, and ecological sustainability."* Based on its decades of conducting logging on the Lolo National Forest, one might expect the Forest Service to be able to cite scientific studies or monitoring results to support such claims, but the DA does not because the scientific support isn't there. We are concerned that such extreme bias will eventually lead to the Forest Service including a very narrow and limited range of alternatives to its Proposed Action in the revision Environmental Impact Statement, excluding ones that prioritize conservation and climate values above industrial resource extraction.

Scientific Integrity

In multiple subsections, the 2012 Planning Rule requires that the Forest Service **identify the best scientific information, use it in preparation of the Assessment, and explain how that science was used**:

> § 219.3 Role of science in planning. The responsible official shall use the best available scientific information to inform the planning process required by this subpart. In doing so, the responsible official shall determine what information is the most accurate, reliable, and relevant to the issues being considered. The responsible official shall document how the best available scientific information was used to inform the assessment, the plan decision, and the monitoring program as required in §§ 219.6(a)(3) and 219.14(a)(4). Such documentation must: Identify what information was determined to be the best available scientific information, explain the basis for that determination, and explain how the information was applied to the issues considered.
>
> § 219.6 Assessment. (b) *Content of the assessment for plan development or revision.* In the assessment for plan development or revision, the responsible official shall identify

> and evaluate existing information relevant to the plan area for the following: (5) Threatened, endangered, proposed and candidate species, and potential species of conservation concern present in the plan area;
>
> (3) Document the assessment in a report available to the public. The report should document information needs relevant to the topics of paragraph (b) of this section. Document in the report how the best available scientific information was used to inform the assessment (§ 219.3). Include the report in the planning record (§ 219.14).

Science Consistency Review

The Forest Service must meet the challenge of objectively and transparently weighing available scientific information to determine best available science. Recognizing the problems this raises, Ruggiero, 2007 (a scientist from the research branch of the Forest Service) identified a fundamental need to demonstrate the proper use of scientific information in order to overcome doubts over decisionmaking integrity. Ruggiero, 2007 and Sullivan et al., 2006 comment on scientific integrity, and also the use and misuse of science.

In considering the role of science and other topics during the planning process, we believe it's imperative that the Forest Service use Committee of Scientists, 1999 (Sustaining the People's Lands. Recommendations for Stewardship of the National Forests and Grasslands into the Next Century. March 15, 1999). The Committee of Scientists (1999) recommend "independent scientific review of proposed conservation strategies…" The Committee of Scientists report was initiated as part of the original NFMA planning rule revision in the 1990s, as explained in its Synopsis:

> In December 1997, Secretary of Agriculture Dan Glickman convened an interdisciplinary Committee of Scientists to review and evaluate the Forest Service's planning process for land and resource management and to identify changes that might be needed to the planning regulations.

Committee of Scientists (1999) was cited multiple times in the USDA's responses to comments on the 2012 Planning Rule.

Fortunately, there are well-known and well-documented USDA/Forest Service sources that serve as guides for conducting a rigorous and healthy debate about science. The documents, "USDA-Objectivity of Regulatory Information" and "USDA-Objectivity of Scientific Research Information" are instructional on this topic, both stating:

> If agency-sponsored peer review is employed to help satisfy the objectivity standard, the review process should meet the general criteria for competent and credible peer review recommended by OMB. OMB recommends that (a) peer reviewers be selected primarily on the basis of necessary technical expertise, (b) peer reviewers be expected to disclose to agencies prior technical/policy positions they may have taken on issues at hand, (c) peer reviewers be expected to disclose to agencies their sources of personal and institutional

funding (private or public sector), and (d) peer reviews be conducted in an open and rigorous manner.

Additionally, the process known as "Science Consistency Review" was designed by the Forest Service (Guldin et al. 2003; also *see* Guldin et al. 2003b.) Guldin et al. 2003:

> ...outlines a process called the science consistency review, which can be used to evaluate the use of scientific information in land management decisions. Developed with specific reference to land management decisions in the U.S. Department of Agriculture Forest Service, the process involves assembling a team of reviewers under a review administrator to constructively criticize draft analysis and decision documents. Reviews are then forwarded to the responsible official, whose team of technical experts may revise the draft documents in response to reviewer concerns. The process is designed to proceed iteratively until reviewers are satisfied that key elements are **consistent with available scientific information**.

(Emphasis added.) In other words, the Forest Service may **cite** "best available science" in preparing the revised forest plan, but it's another matter entirely whether or not the plan **is consistent with** the science being cited. Guldin et al., 2003 suggest the review seek answers to these four questions:

> 1. Has applicable and available scientific information been considered?
>
> 2. Is the scientific information interpreted reasonably and accurately?
>
> 3. Are the uncertainties associated with the scientific information acknowledged and documented?
>
> 4. Have the relevant management consequences, including risks and uncertainties, been identified and documented?

Similarly, independent scientific review team Hayes, et al., 2011 conducted a "Science Review of the United States Forest Service Draft Environmental Impact Statement for National Forest System Land Management" (the Planning Rule). The reviewers considered the following three questions:

> 1. Does the information accurately reflect the current peer-reviewed scientific literature and understanding? If not, what is missing or incorrectly presented?
>
> 2. Based on the current peer-reviewed scientific literature and understanding: does the documentation on environmental effects adequately respond to levels of uncertainty and limitations? If not, please describe what is missing or incorrect, and how the documentation can be improved.
>
> 3. What, if any, differing viewpoints should be included that are not mentioned in the DEIS regarding the effects of alternatives on climate change, restoration and resilience,

> watershed and water protection, diversity of plants and animal communities, sustainable use of public lands to support vibrant communities, forest threats, and monitoring.

Given the importance and potentially controversial nature of the revised forest plan, it is incumbent upon the Forest Service to undertake the Science Consistency Review process as early as possible. Nie and Schembra, 2014 recommend that agencies solicit independent feedback on it use of science:

> The 1997 (Tongass National Forest) Plan was written using an innovative process whereby scientists within the Pacific Northwest Research Station (an independent research arm of the USFS) were assembled into risk assessment panels "to assist decisionmakers in interpreting and understanding the available technical information and to predict levels of risk for wildlife and fish, old growth ecosystems, and local socioeconomic conditions resulting from different management approaches." In this case, "science consistency checks" were used as a type of audit to ensure that the policy and management branch writing the Tongass Plan could not misrepresent or selectively use information in ways not supported by the best available science. The process, at the very least, facilitated the consideration of best available science when writing the Tongass Plan, even if parts of the Tongass Plan were based on factors going beyond science.

And in response to an appeal of its 1997 revised Forest Plan, the Black Hills National Forest was directed by the Forest Service Washington Office to re-evaluate their revised Forest Plan for its ability to meet diversity and viability requirements set in existing laws, and correct any deficiencies. In doing so, Forest Service biologists "interviewed accredited scientific experts to obtain information on Region 2 sensitive species for use during the Phase I Amendment" in order to remedy deficiencies in the revised forest plan. (USDA Forest Service 2000b.)

Similarly, the Boise National Forest consulted with an independent scientist to review portions of their "Wildlife Conservation Strategy" proposed to amend its revised forest plan. And a Science Consistency Review was undertaken by the Forest Service in the process of designing the Sierra Nevada Forest Plan Amendments.

Everest et al., 1997 participated in a science consistency review. They state:

> The authors participated as scientists on the Tongass Land Management Planning Team, and were asked to assure that credible, value-neutral, scientific information was developed independently without reference to management decisions. They examined how scientific information was used in making management decisions relative to the Tongass land management plan and examined and evaluated whether the decisions were consistent with the available information. They also displayed the likely levels of risk to resources and society associated with various management options.
>
> The authors developed and used a set of criteria to evaluate the way in which managers used scientific information in formulating decisions:

> A. A management decision was considered to be consistent with available scientific information if the following three conditions were met:
>
> 1. All relevant scientific information made available to managers was considered in the decision.
>
> 2. Scientific information was understood and correctly interpreted.
>
> 3. Resource risks associated with decisions were acknowledged and documented.
>
> All three criteria had to be met before a decision could receive a summary rating of being consistent, in our assessment, with available scientific information.
>
> B. A management decision was considered to be inconsistent with available scientific information if any of the following circumstances occurred:
>
> 1. Managers misrepresented or reinterpreted information in ways not supported by the original information.
>
> 2. Managers selectively used information such that a different decision was reached than would have been made if all available information had been used.
>
> 3. Decisions were stated and documented in such a way that implementation effects could not be predicted.
>
> 4. Projected consequences of management actions were not consistent with scientific information.
>
> Failure to meet any of these criteria resulted in a summary rating of being inconsistent, in our assessment, with available scientific information.

Station Director of the Pacific Northwest Research Station Thomas J. Mills states in the Preface of Everest, et al., 1997:

> Any reasoned decision about the management of natural resources must be based on a sound foundation of scientific information. The complexity of natural systems and their importance to people depending on them demand this. Scientists …should determine whether the decision is consistent with the science information.

Everest et al., 1997 described their participation:

> We joined the planning team as full members but maintained separate and distinct roles from National Forest System members. We worked in cooperation with other resource experts from the Forest Service, state and other Federal agencies, and universities to assemble the most complete base of information ever developed for Forest planning in the Tongass National Forest. We were asked to assure that credible, value-neutral,

> scientific information was developed independently without reference to management decisions. Emphasis was placed on acquisition, assessment, and synthesis of available information. **We displayed options and the likely levels of risk to resources and society associated with various decisions.** (Emphasis added.)

Everest et al., 1997 recognize that *"All policy decisions concerning the use of natural resources contain some level of risk to resources as a result of long-term implementation. Potential risks associated with decisions can be numerous and might affect, for example, community stability, wildlife viability, or long-term sustainability of resources."*

The Forest Service must acknowledge the levels of risk to resources and issues evaluated, associated with alternatives. In effect the Forest Service will be analyzing the tradeoffs involved with the potential adoption of any alternatives considered.

In evaluating risks, Everest et al., 1997 further state:

> When making decisions, managers strive to **balance the array of risks** associated with their decisions with the values of goods and services flowing to society from National Forest lands. Such management decisions almost always include compromises for one or more resources. **The appropriate level of risk to accept in management of the National Forests is a policy decision** determined by managers. It is not an issue that can be answered by the scientific method.

(Emphases added.) To emphasize, FOC asks the Forest Service to objectively: **evaluate the risks of the alternatives; disclose the tradeoffs; and most importantly, provide a window into the way these policy decisions are made by utilizing a process the agency has frequently employed—the Science Consistency Review**.

We don't believe the Forest Service can comply with the 2012 Planning Rule and NEPA in revising the forest plan without conducting an independent peer review such as the Science Consistency Review.

The use of largely qualitative, subjective terminology would obstruct the public's ability to evaluate agency integrity as policy decisions are made, which would render the final decision highly arbitrary. The Forest Service has employed several such terms in recent decades (e.g., "forest health", "ecosystem management") mostly to serve its active management/resource extraction agenda. The latest is "resilient", as in, the Forest Service wants to increase the forest's resilience to (some stressor). Asaro et al. (2023) recognize, *"Forest health is a difficult concept to define using terms such as integrity, resilience, or balance, which are problematic because they do not provide objective, scale-independent criteria that can easily be assessed quantitatively and applied consistently across forest ecosystems."*

Data reliability, modeling and analytic validity

In his 2000 book, *Reading Statistics and Research* Schuyler Huck explores basic scientific ideas on the accuracy and reliability of data, plus the validity of measurements and their conceptualization. First, in discussing the notion of reliability Huck, 2000 states:

> The basic idea of reliability is summed up by the word consistency. Researchers can and do evaluate the reliability of their instruments from different perspectives, but the basic question that cuts across these various perspectives (and techniques) is always the same: "To what extent can we say the data are consistent?" …(T)he notion of consistency is at the heart of the matter in each case.
> …(R)eliability is conceptually and computationally connected to the data produced by the use of a measuring instrument, not to the measuring instrument as it sits on the shelf.

Since "an instrument's data must be reliable if they are valid" (*Id.*) this means data input to models must accurately measure that aspect of the world it is claimed to measure, or else the data is invalid for input into that model. Also, Beck and Suring, 2011 *"remind practitioners that if available data are poor quality or fail to adequately describe variables critical to the habitat requirements of a species, then only poor quality outputs will result. Thus, obtaining quality input data is paramount in modeling activities."* And Larson et al. 2011 state: *"Although the presence of sampling error in habitat attribute data gathered in the field is well known, the measurement error associated with remotely sensed data and other GIS databases may not be as widely appreciated."*

The 2019 Draft Resource Management Plan and Environmental Impact Statement (Volume II) for the BLM Missoula Field Office discloses:

> The disadvantage of remotely sensed data is that it usually has a certain degree of error. Bitterroot/Lolo National Forest VMap data (Ahl and Brown 2017) concluded, based on a comparison to 4.404 ground-surveyed data points, that the accuracy for canopy closure was 84 percent, whereas the accuracy for cover type was 71 percent, and the accuracy for size class was only 62 percent. The low level of accuracy for size class is of particular concern since many forest planning wildlife issues focus of on the availability of certain tree size classes.

During litigation of a timber sale on the Kootenai National Forest (CV-02-200-M-LBE, Federal Defendants Response to Motion for Preliminary Injunction), the Forest Service criticized a report provided by plaintiffs, stating "(Its) purported 'statistical analysis' reports no confidence intervals, standard deviations or standard errors in association with its conclusions."

Huck (2000) states, the issue of "standard deviations or standard errors" that the Forest Service raised in the context of that litigation relates to the reliability of the data, which in turn depends upon how well-trained the data-gatherers are with their measuring tools and measuring methodology. In other words, different measurements of the same phenomenon must result in numbers that are very similar to result in small "standard deviations or standard errors" and thus high reliability coefficients, which in turn provide the public and decisionmakers with an idea of how confident they can be in the conclusions drawn from the data.

A Forest Service forest plan monitoring and evaluation report (USDA Forest Service, 2000c) is an example of the agency acknowledging problems of data that is old and incomplete, leading to the limitation of models the Forest Service typically uses for wildlife analyses for old-growth wildlife habitats:

> Habitat modeling based on the timber stand database has its limitations: the data are, on average, 15 years old; canopy closure estimates are inaccurate; and data do not exist for the abundance or distribution of snags or down woody material…

In that case, the Forest Service expert believed the data were unreliable, so the usefulness or applicability of the model—its validity—was limited.

So the next level of scientific integrity is the notion of "validity." In other words, even if data the Forest Service inputs to its models are reliable, a question still remains concerning validity of analysis and modeling methodology. In other words, are the models scientifically appropriate for the uses for which the Forest Service is utilizing them? As Huck, (2000) explains, the degree of "content validity," or accuracy of the model or methodology, is established by utilizing other experts. This, in turn, demonstrates the absolute necessity for utilizing the scientific peer review process.

In the Clear Creek Integrated Restoration Project FEIS, the Nez Perce-Clearwater National Forests defined "model" as "a theoretical projection in detail of a possible system of natural resource relationships. A simulation based on an empirical calculation to set potential or outputs of a proposed action or actions." From www.thefreedictionary.com:

> Empirical – 1. a. Relying on or **derived from observation or experiment**: empirical results that supported the hypothesis. b. Verifiable or provable by means of observation or experiment: empirical laws. 2. Guided by practical experience and not theory, especially in medicine. (Emphasis added.)

This implies that models are somewhat "theoretical" in nature, and furthermore the Forest Service implies that they are based in observation or experiment which support the hypotheses of the models. That would be required, because as Verbyla and Litaitis (1989) assert, "Any approach to ecological modelling has little merit if the predictions cannot be, or are not, assessed for their accuracy using independent data." This corresponds directly to the concept of "**validity**" as discussed by Huck, 2000: "…a measuring instrument is valid to the extent that it measures what it purports to measure."

So the Lolo National Forest must publicly evaluate the validity of the models for the purposes for which they are to be used to inform forest plan revision. Also, Huck (2000) explains that "content validity," or accuracy of the model or methodology is established by utilizing other experts. This again demonstrates the necessity for utilizing independent peer review.

Larson et al. 2011 state:

> Habitat models are developed to satisfy a variety of objectives. ...A basic objective of most habitat models is to predict some aspect of a wildlife population (e.g., presence, density, survival), so assessing predictive ability is a critical component of model validation. **This requires wildlife-use data that are independent of those from which the model was developed.** ...It is informative not only to evaluate model predictions with new observations from the original study site but also to evaluate predictions in new geographic areas. (Internal citations omitted, emphasis added).

The U.S. Department of Agriculture document, "USDA-Objectivity of Statistical and Financial Information" is also instructional on this topic.

USDA Forest Service 1994b states "It is important to realize that all models greatly simplify complex processes and that the numbers generated by these models should be interpreted in light of field observations and professional judgement." (III-77.)

Beck and Suring, 2011 developed several criteria for rating modeling frameworks—that is, evaluating their validity. They state:

> Developers of frameworks have consistently attained scientific credibility through published manuscripts describing the development or applications of models developed within their frameworks, but a major weakness for many frameworks continues to be a lack of validation. Model validation is critical so that models developed within any framework can be used with confidence. Therefore, we recommend that models be validated through independent field study or by reserving some data used in model development.

Larson et al. 2011 state:

> (T)he scale at which land management objectives are most relevant, often the landscape, is also the most relevant scale at which to evaluate model performance. Model validity, however, is currently limited by a lack of information about the spatial components of wildlife habitat (e.g., minimum patch size) and relationships between habitat quality and landscape indices (Li et al. 2000).

The Committee of Scientists (1999) state:

> To ensure the development of scientifically credible conservation strategies, the Committee recommends a process that includes (1) scientific involvement in the selection of focal species, in the development of measures of species viability and ecological integrity, and in the definition of key elements of conservation strategies; (2) **independent scientific review of proposed conservation strategies before plans are published**; (3) **scientific involvement** in designing monitoring protocols and adaptive management; and (4) **a national scientific committee** to advise the Chief of the Forest Service on scientific issues in assessment and planning.

(Emphases added.) Ruggiero, 2007 stated, *"Independence and objectivity are key ingredients of scientific credibility, especially in research organizations that are part of a natural resource management agency like the Forest Service. Credibility, in turn, is essential to the utility of scientific information in socio-political processes."* So there is a fundamental need to demonstrate the proper use of scientific information, in order to overcome issues of decisionmaking integrity that arise from bureaucratic rigidity and political pressure.

Sullivan et al., 2006 also discuss the dangers of the "Politicization of Science":

> Many nonscientists and scientists believe that science is being increasingly politicized. Articles in newspapers (e.g., Broad and Glanz 2003) and professional newsletters document frequent instances in which the process and products of science are interfered with for political or ideological reasons. In these cases, the soundness of science, as judged by those interfering, turns on the extent to which the evidence supports a particular policy stance or goal. ...Politicization is especially problematic for scientists supervised by administrators who may not feel the need to follow the same rules of scientific rigor and transparency that are required of their scientists.

Ruggiero, 2007 points out the distinction between the Forest Service's scientific research branch and its management branch:

> The Forest Service is comprised of three major branches: the National Forest System (managers and policy makers for National Forests and National Grasslands), Research and Development (scientists chartered to address issues in natural resource management for numerous information users, including the public), and State and Private Forestry (responsible for providing assistance to private and state landowners). This article is directed toward the first two branches.
>
> The relationship between the National Forest System and the Forest Service Research and Development (Research) branches is somewhat hampered by confusion over the respective roles of scientists (researchers) and managers (policy makers and those that implement management policy). For example, some managers believe that scientists can enhance a given policy position or management action by advocating for it. This neglects the importance of scientific credibility and the difference between advocating for one's research versus advocating for or against a given policy. Similarly, some scientists believe the best way to increase funding for research is to support management policies or actions. But, as a very astute forest supervisor once told me, "Everyone has a hired gun…they are not credible…and we need you guys [Forest Service Research] to be credible."

Ruggiero, 2007 discusses the risk to scientific integrity if that separation is not maintained—that is, if politics overly influences the uses of scientific research:

> This separation also serves to keep conducting science separate from formulating policy and the political ramifications of that process. The wisdom here is that science cannot be

> credible if it is politicized. Science should not be influenced by managers, and scientists should not establish policy. This logic keeps scientific research "independent" while ensuring that policy makers are free to consider factors other than scientific understandings. Thus, science simply informs decision making by land managers. As the new forest planning regulations clearly state, those responsible for land management decisions must consider the best available science and document how this science was applied (Federal Register 70(3), January 5, 2005; Section 219.11(4); p. 1059).

Darimont, et al., 2018 advocate for more government transparency:

> Increased scrutiny could pressure governments to present wildlife data and policies crafted by incorporating key components of science: transparent methods, reliable estimates (and their associated uncertainties), and intelligible decisions emerging from both of them. Minimally, **if it is accepted that governments may always draw on politics, new oversight by scientists would allow clearer demarcation between where the population data begin and end in policy formation** (Creel et al. 2016*b*; Mitchell et al. 2016). Undeniably, social dimensions of management …will remain important.

(Emphasis added.) In a news release accompanying the release of that paper, the lead author states:

> In a post-truth world, **qualified scientists at arm's length now have the opportunity and responsibility to scrutinize government wildlife policies and the data underlying them.** Such scrutiny could support transparent, adaptive, and ultimately trustworthy policy that could be generated and defended by governments.

Ecosystem Drivers and Stressors

Ecosystem Drivers-

Habitat and Species Connectivity

The 2012 Planning Rule requires explicit consideration of ecological connectivity during forest plan revisions, and a fundamental precursor to this is understanding the status of ecosystem connectivity in a planning area (Williamson et al. 2020). (DA page 141). *"To better understand the state of ecosystem connectivity on the Lolo National Forest, we employed a coarse-filter modeling process developed by stakeholders during the Custer-Gallatin Forest Plan revision process."* Why? The Lolo National Forest has its own unique characteristics and geography and there is no need to apply an approach developed by "stakeholders" on the Custer-Gallatin process.

The Lolo-Bitterroot region is **'Connectivity Central'** for wildlife (see Figure 1). Grizzly bears have been documented on all districts on the Forest (DA page 155) and the entire Forest is within the Occupied and May be Present map by the U.S. Fish & Wildlife Service (2022).

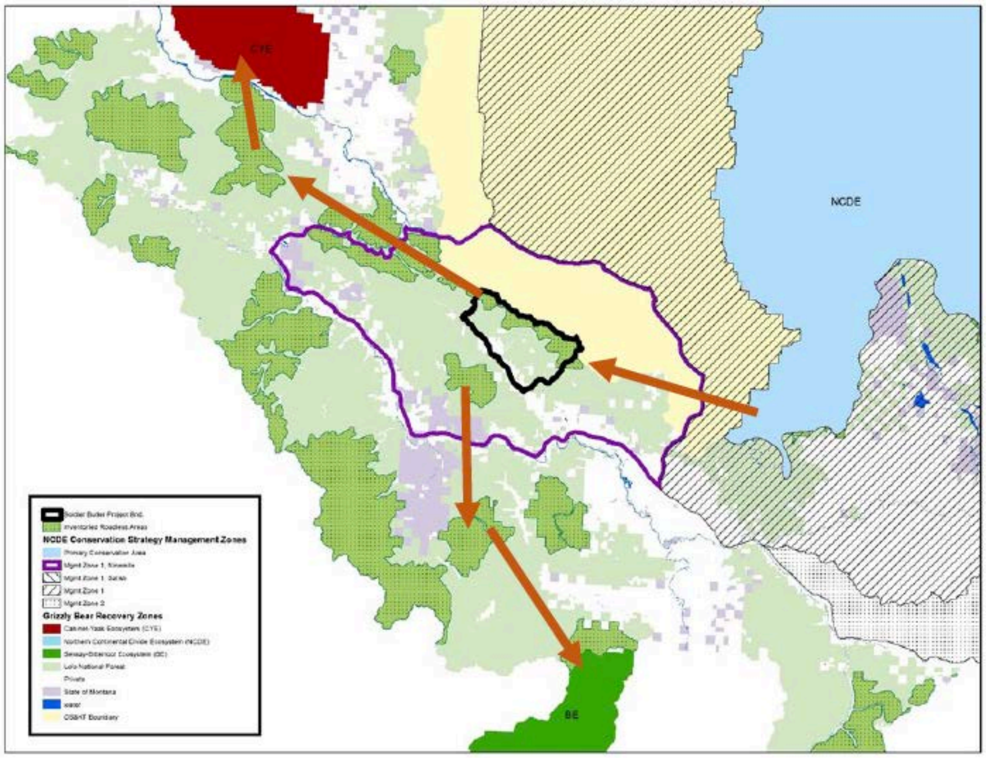

Figure 1. The Ninemile Demographic Connectivity Area designated to link the NCDE, CYE and BEs. U.S. Forest Service map.

The Lolo National Forest has lands in three different Grizzly Bear Recovery Areas and is critically located between the Northern Continental Divide, Greater Bitterroot and Cabinet-Yaak Ecosystems. The western half of the Bitterroot National Forest is part of the vast central Idaho wildlands complex which is the largest assemblage of wildlands in the lower 48. It connects this ecosystem to the rest of the Northern Rockies through the Sapphire and Pintler Mountain Ranges including a key linkage for grizzly bears to and from the Greater Yellowstone Ecosystem.

The long-term survival of grizzly bears (*Ursus arctos*) in the northern Rockies is dependent on connecting isolated populations with areas of protected habitats between the designated Grizzly Bear Recovery Areas (Allendorf et al. 2019) and linking the populations into a metapopulation would significantly reduce extinction risk (Boyce et al. 2001; Servheen et al. 2001; Craighead and Vyse 1996).

Originally referred to as biological corridors, in 1990 the U.S. 9th Circuit Court of Appeals in *Marble Mountain Audubon v. Rice.* (U.S. 9th Circuit Court of Appeals. D.C. No. CV-89-1701-EJG) recognized the legal requirement to protect these areas, describing them as *"...avenues along which wide-ranging animals can travel, plants can propagate, genetic interchange can occur, populations can move in response to environmental changes and natural disasters, and threatened species can be replenished from other areas."*

Connectivity is a component of the National Forest Planning Rule of 2012 and a Demographic Connectivity Area was designated in the Ninemile area of the Lolo National Forest as part of the NCDE Grizzly Bear Conservation Strategy in 2018. As grizzly bears reoccupy native habitat in the Northern Rockies there is a need to designate additional Demographic Connectivity and Restoration Areas as part of National Forest management plan revisions or amendments.

The Executive Office of the President, Council on Environmental Quality released a memorandum to all federal departments and agencies on March 21, 2023 titled *Guidance for Federal Departments and Agencies on Ecological Connectivity and Wildlife Corridors. Among its many goals and guidance are:*

- •Assessments that may indicate natural and human-induced risk or threat level to components of connectivity
- •Identification of existing barriers or blockages to connectivity that could be removed
- •Removing, modifying, or avoiding the installation of barriers to wildlife movement along migratory routes

The threats in the roaded matrix which are existing barriers and blockages that cause excessive displacement must be mitigated through restoration as the cumulative impacts of multiple small and persistent threats increases extinction risk within a 100-year timeline, far shorter than previously thought (Kimmel et al. 2022). Within connectivity areas, Open Motorized Route Density should be limited to 1mi/mi^2 which will require targeted road closures and decommissioning. Within the roaded matrix lands, road decommissioning should be focused on increasing secure core area size, to connect isolated secure core areas and to better represent different habitat types and seasonal food sources within secure core.

These standards would also be very important to other wildlife including elk, lynx and native plants. For example, elk require security habitat at least 0.6 miles from a road. Damschen et al. (2006) showed that *"habitat patches connected by corridors retain more native plant species than do isolated patches, that this difference increases over time, and that corridors do not promote invasion by exotic species. Our results support the use of corridors in biodiversity conservation."*

The DA ecological connectivity analysis is completely inadequate. What about forest roads? The current status and trend for connectivity is unacceptable and impaired due primarily to the transportation network (road and motorized trail density) but is also impacted by timber harvest that reduces cover and recreation pressures.

The Draft Montana Statewide Grizzly Bear Management Plan (MTFWP 2022) states, *"Two Demographic Connectivity Areas (DCAs) are intended to provide sufficient security for female grizzly bear occupancy, potentially providing a demographic "stepping stone" from the NCDE to the CYE (via the Salish DCA) and to the Bitterroot Ecosystem (via the Ninemile DCA)."* Also, *"…in order for grizzly bear recovery to occur in the Bitterroot area, additional demographic connectivity from other populations, particularly for female bears who are unlikely to travel as widely as males, will be required."*

The Ninemile Demographic Connectivity Area needs to connect all the way to the CYE and BE as shown in Figures 2 and 3. The Lolo National Forest also contains a large part of the identified Cabinet-Bitterroot Connectivity Area along the Northern Bitterroot Divide.

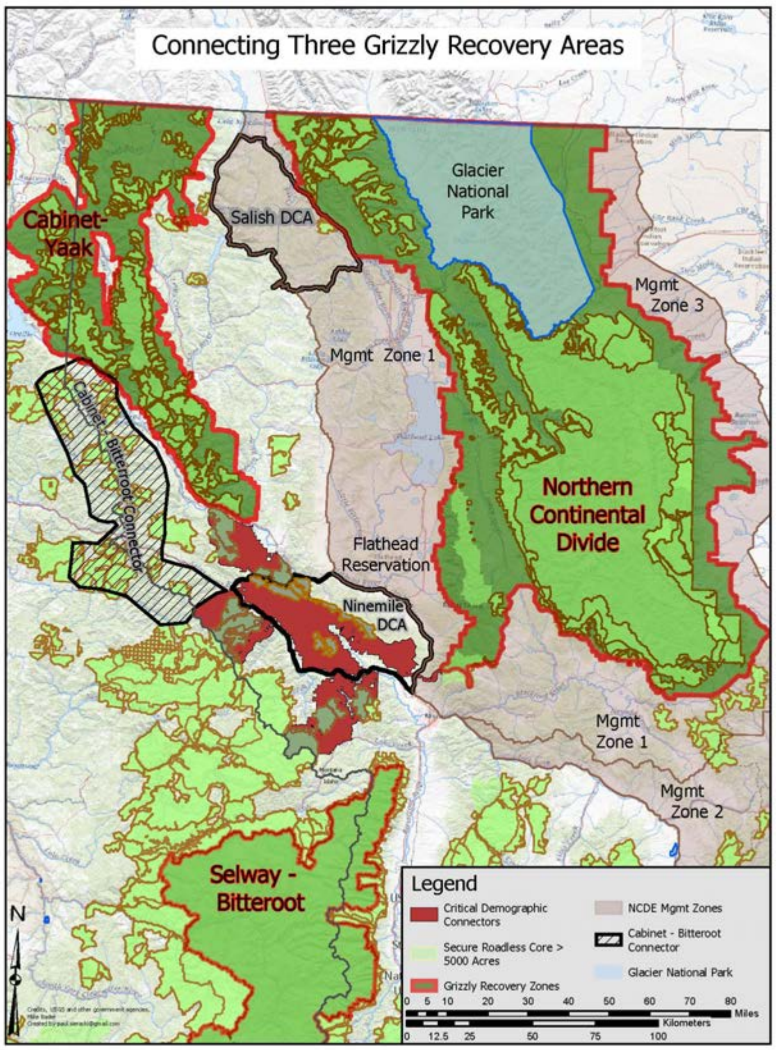

Figure 2. The Lolo National Forest is geographically located to provide connectivity on a landscape scale.

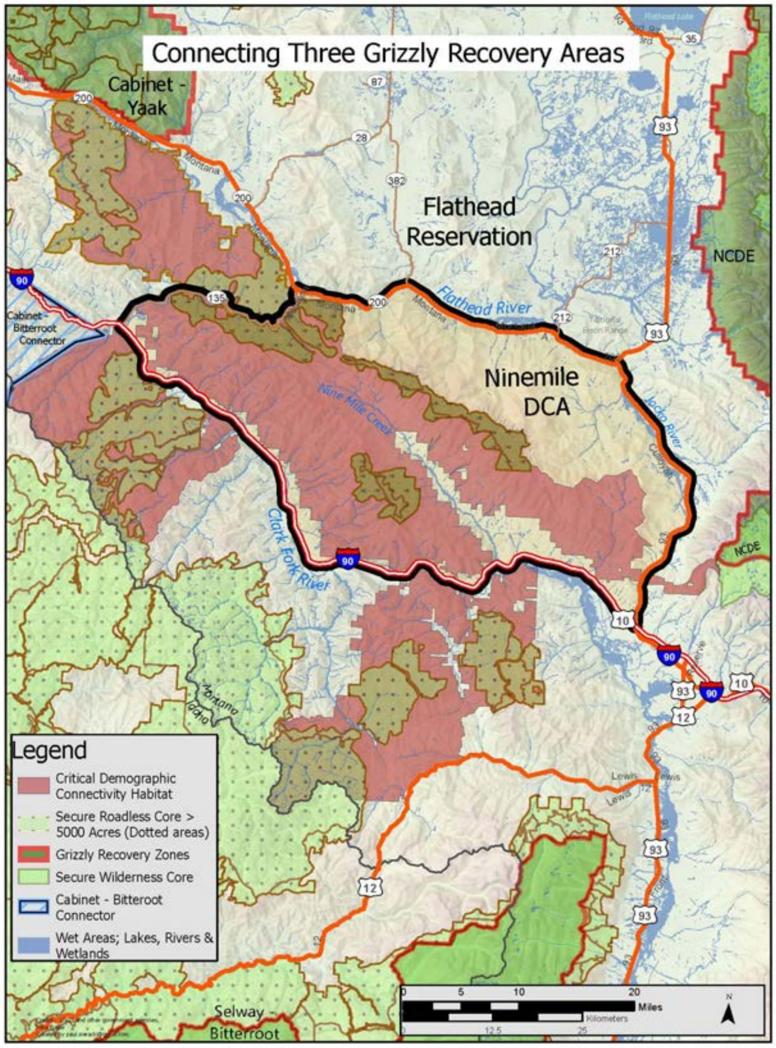

Figure 3. Closeup of the Ninemile Demographic Connectivity Area on the Lolo National Forest.

Many models show that linking isolated populations with connective habitat can extend the probability of persistence for grizzly bears (Boyce et al. 2001). Servheen, et al. (2001) wrote: "Boyce, et al. (2001) have demonstrated the value of multiple populations with some dispersal between them to the survival of the grizzly bear in the Northern Rockies." Newmark, et al. (2023) found that linking Glacier and Yellowstone National Parks would extend medium to large species persistence time by 4.3X.

Connectivity areas are not just linear corridors on a map. Connectivity is measured by landscape permeability or the ability of animals to move across the landscape with minimal disturbance and mortality risk. All of the lands between the Recovery Areas have potential value as connective habitat.

Bader and Sieracki (2022) outline prerequisites for the demographic model of connectivity:

(1) "Denning Habitat and Secure Core within Dispersal Distances—. The availability of denning habitats within secure core areas is a fundamental requirement of the demographic model. These are areas where females can survive and raise offspring who become a source of dispersals.

We suggest Bear Management Units (BMUs) be identified within key connectivity habitats with standards to maintain all currently secure core habitat. Standards based upon scientific data maintained 68% of a BMU in secure core habitat (USFS 1995). The secure core areas should not shift as this disrupts female Grizzly Bears who learn that areas are secure and pass a significant portion of the maternal home range to their female offspring so that sudden shifts in security conditions would not be conducive to the demographic model.

In connectivity habitats, the larger secure areas should be spatially distributed within known dispersal distances for female Grizzly Bears (Mattson et al. 1996). From the dispersal information in Graves et al. (2014), Proctor et al. (2004) and McLellan and Hovey (2001) secure core areas from 0-10km apart might work for 64% and 74% of dispersing females, respectively with 0 representing females who do not disperse from their home ranges, while core from 20-30km apart might work for 22% and 19% of dispersing females, respectively. How Grizzly Bears might best move between and within secure core awaits a future analysis based on habitat quality, least-cost path analysis and circuit theory, as in Proctor et al. (2015).

(2) Highway Passage Structures—. Highway and rail transportation corridors are zones that fragment Grizzly Bear populations into isolated demographic units (Proctor et al. 2002). The two biggest obstacles to female Grizzly Bear dispersal in the study area are the Interstate 90 corridor and US Highway 93 from Whitefish to Darby, Montana. While a female grizzly with cubs south of I-90 has been documented (Jonkel 2021) the big issue is the number of dispersing bears and the number that choose to disperse plus the limited number of crossing structures where bears can safely cross highways. These are essential to successful demographic dispersion of Grizzly Bears into historic habitats (Ford et al. 2017). Having "multiple shots on goal" would provide a higher likelihood of success.

It is notable that Kasworm (2023) has documented a one-way movement of a female grizzly approx. 70km from the Cabinet-Yaak to the NCDE which indicates that female dispersals may not be as restricted as presented in the DA.

The DA indicates that connective habitats will have lower population density. This is a self-fulfilling prophecy as the Lolo National Forest has proposed very large logging projects (> 16 mmbf) with dozens of miles of permanent and temporary roads in the heart of identified connectivity areas. This would certainly suppress the possibilities of successful demographic residential occupancy and genetic interchange and critically, natural immigration into the greater Bitterroot ecosystem.

The DA fails to account for denning habitats outside the Recovery Zones and within connective habitats. Bader and Sieracki (2022) mapped denning habitats in all areas of Montana west of the

Continental Divide and found sufficient habitats to support residential occupancy by female grizzly bears and their cubs to provide "demographic connectivity" and "stepping stones" of secure habitats to facilitate natural immigration to the Bitterroot ecosystem and the Cabinet-Yaak.

Its intuitive that grizzly bears would exist at lower densities outside the core recovery zones that have large National Parks, designated Wilderness and Inventoried Roadless Areas. Bader (2000b) was cited in the 2007 Grizzly Bear Management Plan for Western Montana as one of the papers used for its preparation. It was predicted that grizzly bear density in connectivity areas would be lower than what it is in core recovery zones due to low area/perimeter ratios resulting in more edge effects, lower habitat security and expected higher mortality rates due to roads and large areas of private lands.

However, 23 years later many of these factors are being mitigated through programs that increase public acceptance for having grizzly bears on the landscape. Education on coexistence and conflict prevention including sanitation and securing attractants using facilities or electric fencing and reducing open road densities on public and private lands improve security and lower mortality risk. Conservation easements and outright purchases are being accomplished by the State of Montana, land trusts and other entities.

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Wildland Fire

The Lolo National Forest, as all the forests in the Northern Rockies, have evolved and adapted with wildfire for thousands of years. Fire is a primary ecosystem driver and shaper that maintains evolutionary processes and biological diversity. As stated in the DA it serves numerous ecological functions, driving species structure and composition, carbon and nutrient recycling, snag and tree cavity creation, and stimulating seeding and sprouting of vegetation (page 28). Fire-burned areas are also important wildlife habitat[1]. There is a need to change the approach in practice and messaging around wildland fire, including post-fire response. It is not a catastrophe; it is a natural process with many benefits. The emphasis on fuels reduction should focus on defense of structures and communities not landscape logging.

The historical fire regime is a classification of the role fire would play in the absence of human intervention but for this assessment included the use of fire by indigenous people. The classification includes historical fire frequency and severity. Table 2 shows six fire frequency

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[1] Hutto, Richard 2008. The ecological importance of severe wildfires: Some like it hot. Ecological Applications. December 2008. Vol. 18, No. 8.

classes on 3,243,752 acres covering all ownerships across the Lolo National Forest, including 982,000 acres (30 percent) non-forest land. Since the Lolo NF covers 2,257,793 acres in eight geographic areas (Table 2), it makes it difficult to pair the fire frequency class with public lands managed by the Lolo NF. In addition, non-forest lands are mostly on lower elevation valley bottoms, where vegetation is more typically dry ponderosa pine associated with the very frequent and frequent historical fire regimes. This could represent closer to 40 percent of non-forest lands and skews the data displayed in Table 2. So instead of very infrequent and frequent fire regimes being 1,445,212 acres, using some crude math and a multiplier of 0.4 instead of 0.3, these fire frequency classes are closer to 865,000 acres of the forest. This makes data displayed in Table 2 highly suspect if not useless, and not worth trying to make sense of Table 3.

This is another subject we see the need to correct and supplement the Assessment record because of the Forest Service's failure to objectively weigh facts and best available science.

The Forest Service's dysfunctional relationship with wildland fire is reflected in the vast sums of money spent annually in fighting fires, implementing "fuel reduction" and "fire risk" mitigation actions while accomplishing very little in measurable outcomes other than the taxpayer money spent. Much of the dysfunctionality stems from the agency's absurd pretense of being in control of natural processes such as fire, fomented in part to justify its existence. And the Forest Service furthers this pretense of control to justify its extreme bias toward logging, as discussed above. Until this systemic dysfunction is properly addressed, the agency will continue to wreak havoc upon the integrity of the ecosystems it's charged with conserving. Another symptom of this dysfunction is the Forest Service's failure to monitor the outcomes of its activities (also discussed above), which results in lack of awareness of its failures and also evasion of accountability.

A *Missoulian* article from October 6, 2017 ("Experts: More logging and thinning to battle wildfires might just burn taxpayer dollars") is one of many messages to the Forest Service indicating the public is aware of its dysfunction. It notes that "…several wildfire experts say the simplistic notion that fuel reduction will somehow stop wildfires or reduce their severity is deeply flawed. And at worst, it could waste taxpayer dollars." But the agency is not listening.

In his July 23, 2007 opinion (Guest column: Sensible fire policy easy to implement), scientist David Bayles states, *"Clear policy is needed because large fires cannot be avoided. Large fires are driven by climate and weather, and we can no more control them than we can control earthquakes, hurricanes and tornadoes, volcanoes or floods. The illusion that we can control large fires stems from our success at controlling small ones. … Protecting lives and property primarily requires implementing "firewise" techniques within a few yards of human habitations, and developing site-specific firefighter access. Distant forest "thinning" will not protect lives or property."* Still, the agency refuses to hear.

The premise that thinning and other mechanical treatments adequately replicate the effects of wildland fire is contradicted by science (e.g., Rhodes and Baker 2008, McRae et al 2001, and Rhodes 2007).

It makes no scientific sense to replace dense conifer forests with clearcuts and densely packed little trees–in the name of reducing severe fire behavior. Atchley et al., 2021 note that denser forest actually slows fire spread. They also state:

> Wind entrainment associated with large, sparse canopy patches resulted in both mean and localised wind speeds and faster fire spread. Furthermore, the turbulent wind conditions in large openings resulted in a disproportional increase in TKE [Turbulence Kinetic Energy] and crosswinds that maintain fire line width.

The following perspective of two co-authors (a former Forest Service researcher and a Missoula County Commissioner) illustrates why the DA's implication of wildlands as a fire risk to communities is wrong:

> …research has shown that home ignitions during extreme wildfires result from conditions local to a home. A home's ignition vulnerabilities in relation to nearby burning materials within 100 feet principally determine home ignitions. … Although an intense wildfire can loft firebrands more than one-half mile to start fires, the minuscule local conditions where the burning embers land and accumulate determine ignitions… Thus, community wildfire risk should be defined as a home ignition problem, not a wildfire control problem. (Cohen and Strohmaier, undated.)
>
> The fire protection for homeowners implied by the DA is pretty much imaginary. Responsibility for reducing risk of fire burning private structures ought to and does rest squarely on the shoulders of the owners of those structures—not on U.S. taxpayers.

We present to the revision team Baker et al. (2023), which is new scientific information pertaining to fire. The Abstract states:

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

body of scientific evidence. (Emphasis added.)

So follow the money. Baker et al., 2023 point out that many research scientists who are funded by or work for the Forest Service promote the “low severity fire model” to perpetuate the myth that logging will prevent forests from being “destroyed” by the fire regime on the Lolo National Forest: mostly mixed- and high-severity fires. The oft-called “emergency situation” is a smokescreen for expedited logging. Since fire cannot be entirely removed from a landscape featuring mixed- and high-severity fires, actions taken in the Home Ignition Zone of the privately owned structures are the real key for structure survival.

Fire Refugia

“Fire refugia” is a term referring to more isolated locations disturbed less frequently or less severely by wildfire than the surrounding landscape matrix. (Camp et al., 1997; Meddens et al., 2018.)[2,3] The study of fire refugia and the science has been evolving for three decades or more. Ecologically, fire refugia “provide habitat for individuals or populations in which they can survive fire, in which they can persist in the postfire environment, and from which they can disperse into the higher-severity landscape.” (Meddens et al. 2018.) To date, the Forest Service has no management strategy that recognizes—let alone conserves—fire refugia. This is a problem during wildfire suppression operations as well as fuels reduction project planning when units might target fire refugia that could play an important role on the landscape. There is a need to change our understanding of fire refugia. They need to recognized, understood and considered if not avoided in management. There is a need to include fire refugia in the final assessment and the forest plan revision given the emphasis on wildland fire on the landscape and in policy.

In a study of fire refugia in central Washington, Kolden et al. (2017)[4] found that, “almost all of the plots burned, but half of the plots persisted in their pre-fire forest structure successional state, suggests that definitions of fire refugia focused on the maintenance of forest structure or canopy thresholds may reveal a higher proportion of refugia that are persistent through multiple fires.”

Fire refugia are more likely than their surroundings to exhibit old-growth habitat characteristics. Camp et al. 1997 say “Before Euro-American settlement, late-successional species and compositions were found within fire refugia-stands that burned less frequently than the surrounding matrix ...by virtue of topographic position, soil type, or a combination of environmental conditions and vegetation attributes.” The latter “include areas adjacent to stream confluences, on perched water tables, and within valley bottoms and headwalls, especially at higher elevations (higher total precipitation) and on northerly aspects (more terrain shading, less insolation and thus reduced evapotranspiration).” There is a need for change to incorporate fire refugia into any pre, post, and active fire-fighting strategies.

The DA completely omitted any mention of the well-documented uncertainty of the strategy using logging to reduce future fire behavior, especially logging of mature forests, which serve as fire refugia. It is increasingly understood and accepted that reducing fuels does not consistently

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[2] Camp et.al 1997, Predicting late-successional fire refugia pre-dating European settlement in the Wenatchee Mountains - In: Forest Ecology and Management July 1997.pdf.

[3] Meddens et.al. 2018. Fire Refugia: What are they and why do they matter for global change. In *BioScience* XX: 1–11. Published by Oxford University Press on behalf of American Institute of Biological Sciences 2018. This work is written by (a) US Government employee(s) and is in the public domain in the US. doi:10.1093/biosci/biy103

[4] Kolden et.al. 2017. Fire Effects on Historical Wildfire Refugia in Contemporary Wildfires. In *Forests* 2017.

prevent large fires and does not reduce the outcome of these fires. *See* Lydersen et al. 2014.

Former Forest Service Deputy Chief James Furnish weighs in:

> For a long time, we have heard that the problem is in the forests, and that we must ramp the pace and scale of work in these forests. The proponents ask for our continued faith that scaling is possible, even though they have been at it for nearly 30 years and most of our home and community loss happens in grasslands and shrublands.
>
> Let us begin by citing the large Jasper Fire, in SD's Black Hills National Forest, circa 2000. Jasper Fire burned almost 90,000 acres of intensively managed Ponderosa pine forest, about 10 percent of the entire national forest. Human caused, it was ignited on a hot, dry, windy July day – quite typical of weather in peak burning periods nowadays. Suppression efforts were immediate and used every tool in the agency's tool box… to no avail. Notably, the burned terrain exemplifies what we consider the best way to reduce fire intensity, if not fireproof, a forest. This mature forest of small saw timber had been previously thinned to create an open stand intended to limit the likelihood of a crown fire. Yet, the fire crowned anyway and raced across the land at great speed, defying control efforts. Much of the area remains barren 20 years later, while the Forest Service slowly replants the area.
>
> We cite this example, because it represents precisely what agencies posit as the solution to our current crisis: 1) aggressively reduce fuel loading through forest thinning on a massive scale of tens if not hundreds of millions of acres (at a cost of several $ billion, and then do it again), while trying to 2) come up with sensible answers about how to utilize the finer woody material that has little or no economic value; and 3) rapidly expanding the use of prescribed fire to reduce fire severity. These solutions are predicated on the highly unlikely (less than 1%) probability that fire will occur exactly where preemptive treatments occurred before their benefits expire. These treatments are not durable over time and space, and only work if weather conditions are favorable, and fire fighters are present to extinguish the blaze.
>
> To be blunt, the ineffectiveness of current practices has led many scientists to suggest, based on peer reviewed science and field research as opposed to modeling, that agency "fire dogma" needs to be revisited. The call for a true paradigm shift is occurring both within and outside the agency. Several truths have emerged:
>
> 1) Fires burn in ways that do not "destroy", but rather reset and restore forests that evolved with fire in ways that enhance biodiversity.
> 2) Forest carbon does not "go up in smoke" – careful study shows that more than 90 percent remains in dead and live trees, as well as soil, because only the fine material burned.
> 3) The biggest trees in the forest are the most likely to survive fire, and thinning efforts that remove mature and older trees are counter-productive. We are seeing more cumulative fire mortality in thinned forests, than in natural forests that burn.
> 4) Thinning and other vegetation removal increases carbon losses more than fire itself and, if scaled up, would release substantial amounts of carbon at a time when we must

do all we can to keep carbon in our forests.
5) If reducing home loss is our goal, experts are telling us that the condition of the structure itself and vegetation immediately adjacent to the home are the primary drivers of home ignition and loss, and that the condition of vegetation more than 100 feet from the home has nothing to do with the ignitability or likelihood a home will burn.
6) Large, wind-driven fires defy suppression efforts and many costly techniques simply waste money and do more damage. Weather changes douse big fires, people do not. (Furnish 2022).

And Downing et al. 2022 state, "Focusing on minimizing damages to high-value assets may be more effective than excluding fire from multijurisdictional landscapes."

In his opinion piece in the *Missoulian*, biologist and fire ecologist Hutto (2022) echoes those points. Also see DellaSala (2022). Yet as the DA reveals, the Forest Service keeps spewing the same propaganda implying that logging is needed to protect homeowners and communities:

- Timber harvest is also used to move vegetation towards desired conditions and meet other resource objectives such as …reducing wildfire risk.
- …vegetation management remains an extremely effective tool for achieving desired vegetation conditions in key areas such as the wildland urban interface
- … wildland-urban interface …describes an area within or adjacent to private and public property where mitigation actions can prevent damage or loss from wildfire.

Large fires are driven by several conditions that completely overwhelm fuels. (Meyer and Pierce 2007). Because weather is often the greatest driving factor of a forest fire, and because the strength and direction of the wildfire is often determined by topography, fuels reduction projects cannot guarantee fires of less severity. (Rhodes, 2007; Carey and Schumann, 2003.)

The DA implies a need to adapt a fire-prone ecosystem to the presence of human development, however we firmly believe the emphasis must be the opposite—assisting human communities to adapt to the fire-prone ecosystems into which they've been built. It is folly to mainly rely upon firefighting and "fuel treatments" rather than face the inevitability of wildland fire.

See Powell 2019 (noting that severe fires are likely inevitable and unstoppable). See also Schoennagel et al., 2017 (explaining, "[o]ur key message is that wildfire policy and management require a new paradigm that hinges on the critical need to adapt to inevitably more fire in the West in the coming decades").

It is well-established that structures are best protected from fire by "home hardening" and judicious removal of fuels within the surrounding 100-200 ft. radius. (Syphard et al. 2014; Cohen, 2000.) The Forest Service fails to face the fact that addressing the home ignition zone will do more to protect property than "thinning" and other logging and "fuel reduction" activities.

The nine-part Wildfire Research Fact Sheet Series was produced by the National Fire Protection Association (NFPA)'s Firewise USA® program, as part of the NFPA/USDA Forest Service cooperative agreement and with research provided by the Insurance Institute for Business and Home Safety (IBHS). They are a product of the research done by the IBHS lab in South Carolina, covering a wide range of issues. This Firewise approach also begs the question—why hasn't the Lolo National Forest already implemented an aggressive outreach and education program to assist homeowners living in and near wildland areas?

"Only treating fuels in the immediate vicinity of the homes themselves can reduce risk to homes, not backcountry fuel reductions projects that divert scarce resources away from true home protection." DellaSala et al. 2015 (Chapter 13), p. 384 (citing Cohen, 2000; Gibbons et al. 2012; Calkin et al. 2013; Syphard et al, 2014).

Finney and Cohen, 2003, state:

> Research findings indicate that a home's characteristics and the characteristics of a home's immediate surroundings within 30 meters principally determine the potential for wildland-urban fire destruction. This area, which includes the home and its immediate surroundings, is termed the home ignition zone. The home ignition zone implies that activities to reduce the potential for wildland-urban fire destruction can address the necessary factors that determine ignitions and can be done sufficiently to reduce the likelihood of ignition. Wildland fuel reduction outside and adjacent to a home ignition zone might reduce the potential flame and firebrand exposure to the home ignition zone (i.e., within 30 m of the home). However, the factors contributing to home ignition within this zone have not been mitigated. Given a wildfire, wildland fuel management alone (i.e., outside the home ignition zone) is not sufficient nor does it substitute for mitigations within the home ignition zone. ...(I)t is questionable whether wildland fuel reduction activities are necessary and sufficient for mitigating structure loss in wildland urban fires.
>
> …(W)ildland fuel management changes the … probability of a fire reaching a given location. It also changes the distribution of fire behaviors and ecological effects experienced at each location because of the way fuel treatments alter local and spatial fire behaviors (Finney 2001). **The probability that a structure burns, however, has been shown to depend exclusively on the properties of the structure and its immediate surroundings (Cohen 2000a).** (Emphasis added.)

Finney and Cohen (2003) point out:

> Although the conceptual basis of fuel management is well supported by ecological and fire behavior research in some vegetation types, the promise of fuel management has lately become loaded with the expectation of a diffuse array of benefits. Presumed benefits range from restoring forest structure and function, bringing fire behavior closer to ecological precedents, reducing suppression costs and acres burned, and preventing losses of ecological and urban values. For any of these benefits to be realized from fuel management, a supporting analysis must be developed to physically relate cause and effect, essentially evaluating how the benefit is physically derived from the management action

> (i.e. fuel management). Without such an analysis, the results of fuel management can fail to yield the expected return, potentially leading to recriminations and abandonment of a legitimate and generally useful approach to wildland fire management.

In response to those authors' call to "evaluat(e) how the benefit is physically derived from the management action" the Assessment needs to take a hard look at the Forest Service's actions and evaluations of the actual efficacy of its actions.

Finney and Cohen, 2003 recognize: "To reduce expected loss from home ignition, it is necessary and **often sufficient to manage fuels only within the home ignition zone** …**and abide by fire resistant home construction standards**…" (Emphasis added).

Cohen, 1999a recognizes "the imperative to separate the problem of the wildland fire threat to homes from the problem of ecosystem sustainability due to changes in wildland fuels."

The DA must consider how logging impacts on the rate of fire spread, therefore invoking safety issues. Graham, et al., 1999a point out that fire modeling indicates:

> For example, the 20-foot wind speed[5] must exceed 50 miles per hour for midflame wind speeds to reach 5 miles per hour within a dense Stand (0.1 adjustment factor). In contrast, in an open stand (0.3 adjustment factor), the same midflame wind speeds would occur at only a 16-mile-per-hour wind at 20 feet.

Good graphics are found in interagency "Living with Fire" publications. One booklet spans many regions and provides graphics showing that an open pine forest can burn at 150 acres per hour while dense conifer forest can burn at 15 acres per hour with 20 mph. wind speeds. Another includes a graphic showing "dense confer reproduction" can burn at 650 acres per hour with 20 mph winds, second only to grass and brush fires.

We support government actions that facilitate cultural change towards private landowners taking the primary responsibility for mitigating the safety and property risks from fire, by implementing firewise activities around their property. Again, the best available science supports such a prioritization. (Kulakowski, 2013; Cohen, 1999a) Also, see Firewise Landscaping as recommended by Utah State University, and the Firewise USA website by the National Fire Protection Association for examples of educational materials.

Similarly, scientific information rejects the agency's claims to be using thinning, logging, and other "fuel reduction" to enhance "resiliency" of the forest landscape. A recent article in Phys.org reports on results of a study by DellaSala and Hanson, 2019:

> They found no significant trend in the size of large high-severity burn patches between 1984 and 2015, disputing the prevailing belief that increasing megafires are setting back post-fire forest regeneration. "This is the most extensive study ever conducted on the high-severity fire component of large fires, and our results demonstrate that there is no need for

[5] Velocity of the wind 20 feet above the vegetation, in this case tree tops.

> massive forest thinning and salvage logging before or after a forest fire," says Dr. Dominick A. DellaSala, lead author of the study and Chief Scientist at the Geos Institute. "The perceived megafire problem is being overblown. After a fire, conditions are ideal for forest re-establishment, even in the interior of the largest severely burned patches. We found conditions for forest growth in interior patches were possible over 1000 feet from the nearest low/moderately burned patch where seed sources are most likely."

DellaSala, et al. (1995) state:

> Scientific evidence does not support the hypothesis that intensive salvage, thinning, and other logging activities reduce the risk of catastrophic fires if applied at landscape scales ... At very local scales, the removal of fuels through salvage and thinning may hinder some fires. However, applying such measures at landscape scales removes natural fire breaks such as moist pockets of late-seral and riparian forests that dampen the spread and intensity of fire and has little effect on controlling fire spread, particularly during regional droughts. ... Bessie and Johnson (1995) found that surface fire intensity and crown fire initiation were strongly related to weather conditions and only weakly related to fuel loads in subalpine forest in the southern Canadian Rockies . . . Observations of large forest fires during regional droughts such as the Yellowstone fires in 1988 (Turner, et al. 1994) and the inland northwest fires of 1994 . . . raise serious doubts about the effectiveness of intensive fuel reductions as “fire-proofing” measures.

The DA also does not evaluate scientific information indicating that past logging and thinning practices increase risk of intense fire behavior. For example, agency researchers themselves have long since recognized that logging, especially the extensive and homogeneous “regeneration” logging, actually increase fire severity where the fire might otherwise have been severe. Stone et al. (2008), a technical report based on a presentation in 2004 (Proceedings of the Second International Symposium on Fire Economics, Planning, and Policy: A Global Perspective), discuss a study of a forested area southeast of Missoula, Montana affected by the Cooney Ridge fire complex. The scientists found fire severely and uniformly burned a watershed which had been extensively and homogeneously logged, in contrast to an adjacent watershed with higher fuel loads but greater heterogeneity which experienced mosaic of burn severities. They conclude, “Harvesting timber does not translate simply into reducing fire risk.” Similar results have been repeatedly found in other published science.

Cohen and Butler (2005) state:

> Realizing that wildland fires are inevitable should urge us to recognize that excluding wildfire does not eliminate fire, it unintentionally selects for only those occurrences that defy our suppression capability—the extreme wildfires that are continuous over extensive areas. If we wish to avoid these extensive wildfires and restore fire to a more normal ecological condition, **our only choice is to allow fire occurrence under conditions other than extremes. Our choices become ones of compatibility with the inevitable fire occurrences rather than ones of attempted exclusion.** (Emphasis added.)

Several other direct and indirect effects of fire suppression are also omitted from evaluation in the DA. For example, Ingalsbee, 2004 describes the direct, indirect, and cumulative environmental impacts of firefighting:

> Constructing firelines by handcrews or heavy equipment results in a number of direct environmental impacts: it kills and removes vegetation; displaces, compacts, and erodes soil; and degrades water quality. When dozerlines are cut into roadless areas they also create long-term visual scars that can ruin the wilderness experience of roadless area recreationists. Site-specific impacts of firelines may be highly significant, especially for interior-dwelling wildlife species sensitive to fragmentation and edge effects.
>
> ...Another component of fire suppression involves tree cutting and vegetation removal. Both small-diameter understory and large-diameter overstory trees are felled to construct firelines, helispots, and safety zones.
>
> ...A host of different toxic chemical fire retardants are used during fire suppression operations. Concentrated doses of retardant in aquatic habitats can immediately kill fish, or lead to algae blooms that kill fish over time. Some retardants degrade into cyanide at levels deadly to amphibians. When dumped on the ground, the fertilizer in retardant can stimulate the growth of invasive weeds that can enter remote sites from seeds transported inadvertently by suppression crews and their equipment.
>
> ...One of the many paradoxes of fire suppression is that it involves a considerable amount of human-caused fire reintroduction under the philosophy of "fighting fire with fire." The most routine form of suppression firing, "burnout," occurs along nearly every linear foot of perimeter fireline. Another form of suppression firing, "backfiring," occurs when firefighters ignite a high-intensity fire near a wildfire's flaming edge, with or without a secured containment line. In the "kill zone" between a burnout/backfire and the wildfire edge, radiant heat intensity can reach peak levels, causing extreme severity effects and high mortality of wildlife by entrapping them between two high-intensity flame fronts.
>
> ...Firelines, especially dozerlines, can become new "ghost" roads that enable unauthorized or illegal OHV users to drive into roadless areas. These OHVs create further soil and noise disturbance, can spread garbage and invasive weeds, and increase the risk of accidental human-caused fires.
>
> ...Roads that have been blockaded, decommissioned, or obliterated in order to protect wildlife or other natural resource values are often reopened for firefighter vehicle access or use as firelines.
>
> ...Both vegetation removal and soil disturbance by wildfire and suppression activities can create ideal conditions for the spread of invasive weeds, which can significantly alter the native species composition of ecosystems, and in some cases can change the natural fire regime to a more fire-prone condition. Firefighters and their vehicles can be vectors for transporting invasive weed seeds deep into previously uninfested wildlands.
>
> ...Natural meadows are attractive sites for locating firelines, helispots, safety zones, and fire

> camps, but these suppression activities can cause significant, long-term damage to meadow habitats.

Although the DA shows a glimmer of recognition of the important role wildland fire plays in maintaining the integrity and biodiversity on the Lolo National Forest, it doesn't delve deeply into the science. Therefore we further supplement the Assessment record.

DellaSala, et al. (2018) is a synopsis of current scientific literature summarizing some of the latest science around top-line wildfire issues, including areas of scientific agreement, disagreement, and ways to coexist with wildfire.

Tingley et al., 2016 note the diversity of habitats following a fire is related to the diversity of burn severities: *"(W)ithin the decade following fire, different burn severities represent unique habitats whose bird communities show differentiation over time… Snags are also critical resources for many bird species after fire. Increasing densities of many bird species after fire—primarily wood excavators, aerial insectivores, and secondary cavity nesters—can be directly tied to snag densities…"*

Similarly, Hutto and Patterson, 2016 state, *"the variety of burned-forest conditions required by fire-dependent bird species cannot be created through the application of relatively uniform low-severity prescribed fires, through land management practices that serve to reduce fire severity or through post-fire salvage logging, which removes the dead trees required by most disturbance-dependent bird species."*

Hutto et al., 2016 urge "a more ecologically informed view of severe forest fires":

> Public land managers face significant challenges balancing the threats posed by severe fire with legal mandates to conserve wildlife habitat for plant and animal species that are positively associated with recently burned forests. Nevertheless, land managers who wish to maintain biodiversity must find a way to embrace a fire-use plan that allows for the presence of all fire severities in places where a historical mixed-severity fire regime creates conditions needed by native species while protecting homes and lives at the same time. This balancing act can be best performed by managing fire along a continuum that spans from aggressive prevention and suppression near designated human settlement areas to active "ecological fire management" (Ingalsbee 2015) in places farther removed from such areas. This could not only save considerable dollars in fire-fighting by restricting such activity to near settlements (Ingalsbee and Raja 2015), but it would serve to retain (in the absence of salvage logging, of course) the ecologically important disturbance process over most of our public land while at the same time reducing the potential for firefighter fatalities (Moritz et al. 2014). Severe fire is not ecologically appropriate everywhere, of course, but the potential ecological costs associated with prefire fuels reduction, fire suppression, and postfire harvest activity in forests born of mixed-severity fire need to considered much more seriously if we want to maintain those species and processes that occur only where dense, mature forests are periodically allowed to burn severely, as they have for millennia.

Agency biologists on the Western Montana Level I Bull Trout Team (Riggers, et al. 2001) state:

> (T)he real risk to fisheries is not the direct effects of fire itself, but rather the existing condition of our watersheds, fish communities, and stream networks, and the impacts we impart as a result of fighting fires. Therefore, attempting to reduce fire risk as a way to reduce risks to native fish populations is really subverting the issue. If we are sincere about wanting to reduce risks to fisheries associated with future fires, we ought to be removing barriers, reducing road densities, reducing exotic fish populations, and re-assessing how we fight fires. At the same time, we should recognize the vital role that fires play in stream systems, and attempt to get to a point where we can let fire play a more natural role in these ecosystems.

Those biologists emphasize, *"the importance of wildfire, including large-scale, intense wildfire, in creating and maintaining stream systems and stream habitat. …(I)n most cases, proposed projects that involve large-scale thinning, construction of large fuel breaks, or salvage logging as tools to reduce fuel loading with the intent of reducing negative effects to watersheds and the aquatic system are largely unsubstantiated."*

Kauffman (2004) suggests that current Forest Service fire suppression policies are catastrophic. They encourage recognition of the benefits of wildland fire:

> Large wild fires occurring in forests, grasslands and chaparral in the last few years have aroused much public concern. Many have described these events as "catastrophes" that must be prevented through aggressive increases in forest thinning. **Yet the real catastrophes are not the fires themselves but those land uses, in concert with fire suppression policies that have resulted in dramatic alterations to ecosystem structure and composition**. The first step in the restoration of biological diversity (forest health) of western landscapes must be to implement changes in those factors that have resulted in the current state of wildland ecosystems. Restoration entails much more than simple structural modifications achieved through mechanical means. **Restoration should be undertaken at landscape scales and must allow for the occurrence of dominant ecosystem processes, such as the natural fire regimes achieved through natural and/or prescribed fires at appropriate temporal and spatial scales.** (Emphases added.)

Noss et al. (2006) state:

> Forest landscapes that have been affected by a major natural disturbance, such as a severe wildfire or wind storm, are commonly viewed as devastated. Such perspectives are usually far from ecological reality. Overall species diversity, measured as number of species–at least of higher plants and vertebrates – is often highest following a natural stand replacement disturbance and before redevelopment of closed-canopy forest (Lindenmayer and Franklin 2002). Important reasons for this include an abundance of biological legacies, such as living organisms and dead tree structures, the migration and establishment of additional organisms adapted to the disturbed, early-successional environment, availability of nutrients, and temporary release of other plants from dominance by trees. Currently, early-successional forests (naturally disturbed areas with a full array of legacies, i.e. not

> subject to post-fire logging) and forests experiencing natural regeneration (i.e. not seeded or planted), are among the most scarce habitat conditions in many regions.

High-severity fire is ecologically important. (Bond et al. 2012.) Snag forest habitat "is one of the most ecologically important and biodiverse forest habitat types in western U.S. conifer forests" (Lindenmayer and Franklin 2002, Noss et al. 2006, Hutto 2008). (Hanson 2010.)

The philosophy driving the Forest Service strategy to replicate the natural range of variability is that emulation of the results of disturbance processes would conserve biological diversity. McRae et al. (2001) provide a scientific review summarizing empirical evidence revealing several significant differences between logging and wildfire. Also, Naficy et al. 2010 found a significant distinction between fire-excluded ponderosa pine forests of the northern Rocky Mountains logged prior to 1960 and paired fire-excluded, unlogged counterparts:

> We document that fire-excluded ponderosa pine forests of the northern Rocky Mountains logged prior to 1960 have much higher average stand density, greater homogeneity of stand structure, more standing dead trees and increased abundance of fire-intolerant trees than paired fire-excluded, unlogged counterparts. Notably, the magnitude of the interactive effect of fire exclusion and historical logging substantially exceeds the effects of fire exclusion alone. These differences suggest that historically logged sites are more prone to severe wildfires and insect outbreaks than unlogged, fire-excluded forests and should be considered a high priority for fuels reduction treatments. Furthermore, we propose that ponderosa pine forests with these distinct management histories likely require distinct restoration approaches. We also highlight potential long-term risks of mechanical stand manipulation in unlogged forests and emphasize the need for a long-term view of fuels management.

Bradley et al. 2016 studied the fundamental premise that mechanical fuel reduction will reduce fire risk. This study "found forests with higher levels of protection had lower severity values even though they are generally identified as having the highest overall levels of biomass and fuel loading." In fact, the study's results suggest the opposite: "(B)urn severity tended to be higher in areas with lower levels of protection status (more intense management), after accounting for topographic and climatic conditions in all three model runs. Thus, we rejected the prevailing forest management view that areas with higher protection levels burn most severely during wildfires." The study goes on to discuss other findings:

> An extension of the prevailing forest/fire management hypothesis is that biomass and fuels increase with increasing time after fire (due to suppression), leading to such intense fires that the most long-unburned forests will experience predominantly severe fire behavior (e.g., see USDA Forest Service 2004, Agee and Skinner 2005, Spies et al. 2006, Miller et al. 2009b, Miller and Safford 2012, Stephens et al. 2013, Lydersen et al. 2014, Dennison et al. 2014, Hessburg 2016). However, this was not the case for the most long-unburned forests in two ecoregions in which this question has been previously investigated—the Sierra Nevada of California and the Klamath-Siskiyou of northern California and southwest Oregon. In these ecoregions, the most long-unburned forests experienced mostly low/moderate-severity fire (Odion et al. 2004, Odion and Hanson

> 2006, Miller et al. 2012, van Wagtendonk et al. 2012). Some of these researchers have hypothesized that as forests mature, the overstory canopy results in cooling shade that allows surface fuels to stay moister longer into fire season (Odion and Hanson 2006, 2008). This effect may also lead to a reduction in pyrogenic native shrubs and other understory vegetation that can carry fire, due to insufficient sunlight reaching the understory (Odion et al. 2004, 2010).

From a news release announcing the results of the Bradley et al. 2016 study:

> "We were surprised to see how significant the differences were between protected areas managed for biodiversity and unprotected areas, which our data show burned more severely," said lead author Curtis Bradley, with the Center for Biological Diversity.
>
> The study focused on forests with relatively frequent fire regimes, ponderosa pine and mixed-conifer forest types; used multiple statistical models; and accounted for effects of climate, topography and regional differences to ensure the findings were robust.
>
> "The belief that restrictions on logging have increased fire severity did not bear out in the study," said Dr. Chad Hanson, an ecologist with the John Muir Project. "In fact, the findings suggest the opposite. The most intense fires are occurring on private forest lands, while lands with little to no logging experience fires with relatively lower intensity."
>
> "Our findings demonstrate that increased logging may actually increase fire severity," said Dr. Dominick A. DellaSala, chief scientist of Geos Institute. "Instead, decision-makers concerned about fire should target proven fire-risk reduction measures nearest homes and keep firefighters out of harm's way by focusing fire suppression actions near towns, not in the back country."

Zald and Dunne, 2018 found: "…intensive plantation forestry characterized by young forests and spatially homogenized fuels, rather than pre-fire biomass, were significant drivers of wildfire severity."

Wales, et al. 2007 modeled various potential outcomes of fire and fuel management scenarios on the structure of forested habitats in northeast Oregon. They projected that the **natural disturbance scenario resulted in the highest amounts of all types of medium and large tree forests combined** and best emulated the Natural Range of Variability for medium and large tree forests by potential vegetation type after several decades. Restoring the natural disturbances regimes and processes is the key to restoring forest structure and functionality similar to historical conditions.

In his testimony before Congress, DellaSala, 2017 discusses *"…how proposals that call for increased logging and decreased environmental review in response to wildfires and insect outbreaks are not science driven, in many cases may make problems worse, and will not stem rising wildfire suppression costs"* and *"what we know about forest fires and beetle outbreaks in relation to climate change, limitations of thinning and other forms of logging in relation to* *wildfire and insect management" and gives "recommendations for moving forward based on best available science."*

The Forest Service presents a rather schizophrenic perspective; grudgingly acknowledging fire as well as native insects and other natural tree pathogens as fundamental natural processes yet still characterizing them as threats to the ecosystem. Again, the agency needs such phantom "threats" in order to justify replacing these natural processes with vegetation manipulation "treatments" and "prescriptions." But the scientific support for assuming that ecosystems can be restored or continuously maintained by intensive, landscape-scale manipulative actions is lacking.

Churchill, 2011 points out:

> Over time, stand development processes and biophysical variation, along with low and mixed-severity disturbances, **break up these large patches into a finer quilt of patch types**. **These new patterns then constrain future fires**. Landscape pattern is thus generated from a blend of finer scale, feedback loops of vegetation and disturbance and broad scale events that are driven by extreme climatic events. (Emphases added.)

There has been extensive research in forests about the ecological benefits of mixed-severity fire, which includes patches of high-severity fire, over the past two decades. In 2015 science and academic publishers Elsevier published a 400-page book, *The Ecological Importance of Mixed-Severity Fires: Nature's Phoenix* which synthesizes published, peer-reviewed science investigating the value of mixed- and high-severity fires for biodiversity (DellaSala and Hanson, 2015). The book includes research documenting the benefits of high-intensity wildfire patches for wildlife species, as well as a discussion of mechanical "thinning" and its inability to reduce the chances of a fire burning in a given area, or alter the intensity of a fire, should one begin under high fire weather conditions, because overwhelmingly weather, not vegetation, drives fire behavior (DellaSala and Hanson, 2015, Ch. 13, pp. 382-384).

"Only treating fuels in the immediate vicinity of the homes themselves can reduce risk to homes, not backcountry fuel reductions projects that divert scarce resources away from true home protection." DellaSala et al. 2015 (Chapter 13), p. 384 (citing Cohen, 2000; Gibbons et al. 2012; Calkin et al. 2013; Syphard et al, 2014).

Another frequently invoked Forest Service bogeyman is the effect of fire suppression, especially as pertaining to the drier forest types in western Montana. This bogeyman has also largely been debunked. Baker (2015) for example states: *"Programs to generally reduce fire severity in dry forests are not supported and have significant adverse ecological impacts, including reducing habitat for native species dependent on early-successional burned patches and decreasing landscape heterogeneity that confers resilience to climatic change. …Dry forests were historically renewed, and will continue to be renewed, by sudden, dramatic, high-intensity fires after centuries of stability and lower-intensity fires."* Also, *"The evidence presented here shows that efforts to generally lower fire severity in dry forests for ecological restoration are not supported."* (Id.)

In his book, "Fire Ecology in Rocky Mountain Landscapes" William Baker writes: *"...a prescribed fire regime that is too frequent can reduce species diversity (Laughlin and Grace 2006) and favor invasive species (M.A. Moritz and Odion 2004). Fire that is entirely low severity in ecosystems that historically experience some high-severity fire may not favor germination of fire-dependent species (M.A. Moritiz and Odion 2004) or provide habitat key animals (Smucker, Hutto, and Steele 2005)."*

Baker estimates the high severity fire rotation to be 135 - 280 years for lodgepole pine forests. (Page 162.) And on pp. 457-458:

> Fire rotation has been estimated as about 275 years in the Rockies as a whole since 1980 and about 247 years in the northern Rockies over the last century, and both figures are near the middle between the low (140 years) and high (328 years) estimates for fire rotation for the Rockies under the HRV (chap. 10). These estimates suggest that since EuroAmerican settlement, fire control and other activities may have reduced fire somewhat in particular places, but a general syndrome of fire exclusion is lacking. Fire exclusion also does not accurately characterize the effects of land users on fire or match the pattern of change in area burned at the state level over the last century (fig. 10.9). In contrast, fluctuation in drought linked to atmospheric conditions appear to match many state-level patterns in burned area over the last century. Land uses that also match fluctuations include logging, livestock grazing, roads and development, which have generally increased flammability and ignition at a time when the climate is warming and more fire is coming.

The agency also promotes the premise that tree mortality from native insect activity and other agents of tree mortality are "stressors" on the ecosystem. Again, this is not supported by science. Meigs, et al., 2016 found *"that insects generally reduce the severity of subsequent wildfires. ... By dampening subsequent burn severity, native insects could buffer rather than exacerbate fire regime changes expected due to land use and climate change. In light of these findings, we recommend a precautionary approach when designing and implementing forest management policies intended to reduce wildfire hazard and increase resilience to global change."* [Also *see* Black, 2005; Black, et al., 2010; DellaSala (undated); Kulakowski (2013); Hanson et al., 2010; Hart et al., 2015.] Also see Rhoades et al., 2012, who state: *"While much remains to be learned about the current outbreak of mountain pine beetles, researchers are already finding that* ***beetles may impart a characteristic critically lacking in many pine forests today: structural complexity and species diversity****."* (Emphasis added.)

Ultimately the DA reflects an overriding bias favoring vegetation manipulation and resource extraction via "management" needed to achieve some selected static conditions, along the way neglecting the ecological processes driving these ecosystems. Essentially the Forest Service would be rigging the outcome of plan revision since "desired conditions" would only be achievable by resource extractive activities. But since desired conditions must be maintained through repeated management/manipulation the management paradigm would forever conflict with <u>natural processes</u>—the real drivers of the ecosystem.

In sum, much of what "needs to change" is the Forest Service orientation to wildland fire. The agency needs an enlightened view of the wildland fire issue and needs a huge dose of humility so it can admit its role as **the** major stressor of ecosystems on the LNF.

Aquatic Systems

The current condition of aquatic, wetland and riparian ecosystem integrity, watersheds and hydrology and water quality including primary indicators of aquatic ecosystem health on the LNF is unacceptable and requires specific management direction to promote desired conditions. Desired conditions are those conducive to aquatic system health, the restoration of impaired streams, and the preservation, and improvement of aquatic connectivity, hydraulic function, native species habitat, late season water levels, and water temperatures.

The DA concerning watershed conditions, aquatic systems, related habitats, and aquatic species lacks site specific information essential to adequately assess current conditions. It does not include or refer to data from years of mandatory forest monitoring and project specific monitoring since the current forest plan's inception. The DA states, *"This analysis draws upon the best available scientific information found to be relevant to the ecosystems on the Lolo National Forest. Literature sources that were the most recent, peer-reviewed, and local in scope or at least directly applicable to the local ecosystem were selected, cited throughout, and discussed in sections specific to the data topic* (page 100)." The assessment does not fully disclose or discuss current, site-specific conditions that are necessary to assess the present status of aquatic systems and dependent populations on the LNF.

The DA states, *"Ecological integrity is addressed by assessing if key components are functioning properly and are represented according to a defined datum such as undeveloped/reference conditions, natural ranges of variability, and/or to pre-European settlement conditions* (page 99)." Yet, no evidence is provided to demonstrate that historical conditions are relevant to restoration efficacy and no definition of natural range of variability is offered. Lamers 2015 states, *"We feel strongly that it is essential to choose targets based on the actual potentials, rather than on historical data, since the latter has led to many disappointments in restoration ecology*" (page 90).

Aquatic ecosystem health indicators include water and sediment quality parameters, water quantity parameters, flow measurements that look at physical and chemical conditions of the water and sediments, and biological indicators that measure the population, health, or habitat of aquatic species of plants and animals. These site-specific, measurable indicators are not included in the DA. Table 17 (DA pages 99-100) lists key characteristics and indicators of riparian and aquatic systems, but the DA provides few statistics concerning the listed indicators on the LNF. Even the listed indicators are bereft. Table 17 lists only the "presence" of native species, not numbers or changes in numbers which would be much clearer, and more measurable indicators of ecosystem health. Under habitat fragmentation, barriers impeding movement are listed as "e.g. large woody debris, nutrients." Culverts and their effects on aquatic system function and species movement are barely mentioned.

Table 17—Key riparian and aquatic ecosystem characteristics and indicators

Key Characteristic	Indicator
Composition	
Life form presence	Presence of diverse riparian and aquatic life forms and communities
Native species	Presence of native species in historically occupied habitats
Exotic/invasive species	Presence of exotic/invasive species (plant and animal)
Aquatic habitat diversity	Presence of habitat and channel types (i.e. streams, lakes, wetlands, groundwater habitats, Rosgen channel types, aquatic ecological systems)
Riparian/wetland vegetation	Presence, lifeform, and dominance types of vegetation in riparian and wetlands (i.e. hydric/mesic/xeric, bare ground, etc.)
Structure	
Channel shape and function	Pool quantity and quality Beaver presence potential Stream width-to-depth ratios Channel and streambank stability Substrate composition
Large woody debris	Quantity of large-sized downed wood greater than 3 inches diameter, montane streams; potential recruitment (e.g. insect and disease, tree size)
Function	
Water quantity	Hydrograph departure from expected natural hydrography (e.g. dams and diversions/water withdrawal; riparian/wetland storage, groundwater extraction and recharge)
Water quality	Beneficial use attainment; riparian and wetland areas filtering sediments, stabilizing banks, etc.
Habitat fragmentation	Number of barriers impeding movement of biota and habitat elements within aquatic and riparian habitats (e.g. large woody debris, nutrients) Miles of stream artificially constrained or disconnected from floodplain access

Gravel-bed river floodplains are a critical ecosystem component that provide broad ecosystem services including movement corridors for grizzly bears and is an ecological nexus of regional biodiversity (Hauer et al. 2016, see Figure below).

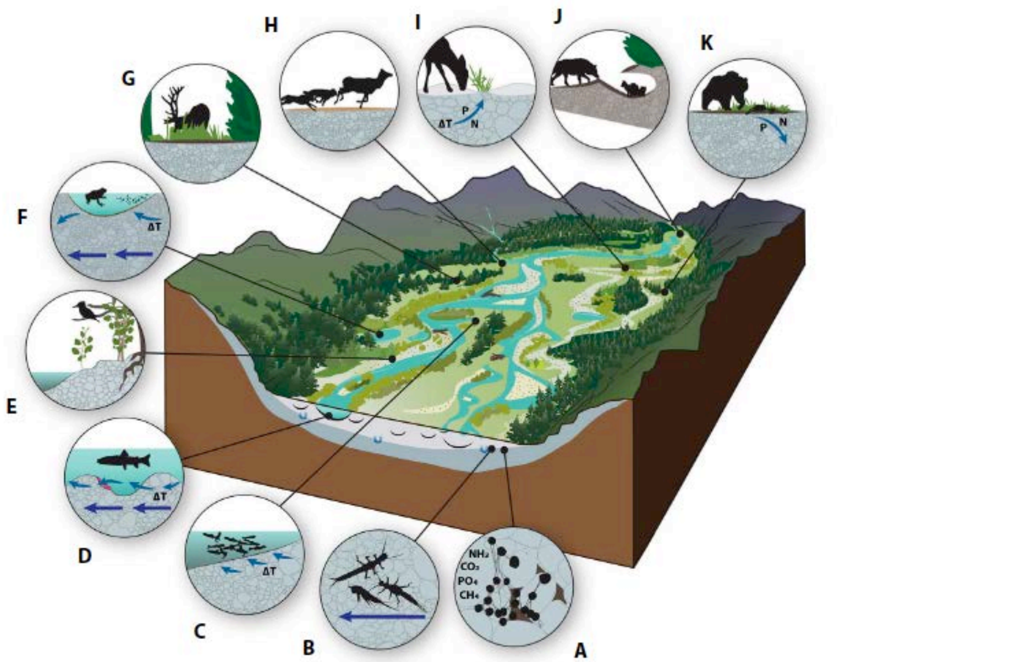

Fig. 5. The gravel-bed river floodplain as the ecological nexus of regional biodiversity. Illustration shows the complexity of the shifting habitat mosaic, the biophysical interactions among organisms from microbes to grizzly bears, and the importance of gravel-bed river floodplains as the nexus of glaciated mountain landscapes. **(A)** Microbes of the interstitial spaces of the gravel bed showing the products of processing of organic matter in the subsurface. **(B)** Crustaceans and insects that inhabit the gravels of the floodplain. **(C)** Temperature modification of surface habitats from upwelling hyporheic zone waters. **(D)** Native fishes spawning in floodplain gravels. **(E)** Riparian obligate birds. **(F)** Amphibian spawning in floodplain ponds and backwaters. **(G)** Ungulate herbivory of floodplain vegetation. **(H)** Wolf predation on ungulate populations. **(I)** Early-spring emergence of vegetation. **(J)** Wolf dens located along floodplain banks. **(K)** Use by grizzly bears and other carnivores as an intersection of landscape connectivity and sites of predation interactions (E. Harrington, eh illustration, Missoula, MT).

The DA states that, "Managing valley bottoms to restore riparian species and return them to more wet-riverine corridors will maximize ecosystems services, greatly assist fire management relative to wildfire resilience, and increase wildlife species diversity (page 102)." Valley bottoms can be a challenge without cooperation of adjacent landowners and counties, but that cooperation can be attained through education and watershed working groups. The DA continues, "Valley bottoms are very vulnerable to the impacts of human and forest management activities. Historic removal of large wood accumulations, cutting of logjams in streams (i.e. recreational fishing and floating), and individual wood (i.e. cumulative effects from access and firewood cutting and hazard tree removal) causes simplification of river-wetland corridors (page 103)." The DA mentions historic removal of large wood, and later alludes to recovery from that period, but does not acknowledge lower harvests in the recent past and the political pressure to double and triple the board feet harvests. (see April 18, 2023 congressional hearing with Chief Randy Moore. Timber targets are discussed from 1:10-1:40 https://www.fs.usda.gov/inside-fs/delivering-mission/excel/chief-moore-testimony-april-18) In the video Moore explains that the Forest Service hired a bunch of "ologists" who prevented logging and that is why they cannot meet targets. This assessment should analyze the effects of roads and disturbance necessary to meet higher timber targets. The literature is quite clear on the deleterious effects of roads on wetlands, riparian areas, and aquatic systems. Road densities have been shown to be an effective proxy for departure of aquatic environments from historical conditions, the state of current condition, and ostensibly past management (Rieman et al. 2000). The correlation of higher road densities with reduced numbers of bull trout is found throughout the Columbia River Basin, where native fisheries and land management issues overlap (Ripley et al. 2005).

The DA states that *"most streams are overly simplified because of the loss or degradation of overall natural valley bottom (i.e. wet-river corridor processes)* (page 102)." And, *"Road effects on valley bottom processes include floodplain encroachment, large wood reductions as it relates to eliminating tree presence and recruitment, undersized culverts and failures, fish passage and wood/sediment/nutrient transport blockage, access-related issues such as dispersed camping and erosion/land loss near stream banks, increased sediment deliveries, among others* (page 106)."

The Biden administration calls for cross boundary cooperation to find solutions to the climate and biodiversity crises. The LNF must work with local land owners and the county to restore river ecosystems. Kline 2010 discusses ways to find natural solutions across ownership that allow for natural river flow and process, *"Managing toward fluvial equilibrium is taking hold across Vermont through adoption of municipal fluvial erosion hazard zoning and purchase of river corridor easements, or local channel and floodplain management rights. These tools signify a shift away from primarily active management approaches of varying success that largely worked against natural river form and process, to a current community-based, primarily passive approach to accommodate floodplain reestablishment through fluvial processes.*" (page 1). Developing working relationships with and educating landowners as to the importance of natural riparian process will help create more resilient rivers and streams.

After listing the many stressors, the DA claims with no supporting evidence that, "stream habitat in general is functioning well on the LNF (page 102)." Forest plan monitoring and project specific analysis, and post project monitoring might reveal the current status of stream habitat, but these are absent in the DA. To assess stream habitat function, one would need to survey sediment impaired streams and road densities, survey for beavers, survey for aquatic plants, survey for stream bank erosion, survey for aquatic species trends, survey for endangered and sensitive species trends, survey BMPs for all roads, survey BMPs for all roads near streams, survey all roads that cross wetlands, seeps, bogs, and fens, survey for impaired or inefficient culverts, list culverts slated to be removed that have not been removed, and survey damage from allotments. This has not been completed.

The DA explains that although streams seem to be functioning well, *"Riparian ecosystems are likely departed from their potential condition and area represented relative to riparian vegetation species present and their location and presence in valley bottoms, wetlands and hillside seeps/springs, and along intermittent and perennial stream corridors. The extent of departure is not fully understood."* (page 102). The extent of departure might be better understood with the survey data listed in the previous paragraph.

The DA references roads, grazing, and mining as negatively affecting streams. *"Individual streams and distinct stream segments are known to have impacts and management actions are addressing issues through a large watershed and stream restoration program. More attention, monitoring, and remedial actions are needed pertaining to grazing impacts on allotments. Infrastructure continues to threaten specific streams and road-stream crossings, and remedial management actions are necessary*." (page 102). The Ninemile area is one success story for reclamation activities. But as the area is healing from mining effects thanks to costly reclamation, the LNF has recently proposed a logging and roadbuilding project in the area. Stringent standards should be in place to prevent further degradation in reclamation areas.

INFISH was instituted in 1995 to protect native fish by reducing negative impacts. Since its implementation, 10% of streams and 29% of perennial streams on the LNF are considered impaired by Montana Department of Environmental Quality (DEQ). *"Sources of impairments are typically related to mining, grazing, highways, road infrastructure and related habitat fragmentation, and silviculture* (DA page 80). *In the past 10 years, design features have been used to modify INFISH standards to allow for road building and logging. Surveys of project areas following strict INFISH standards and those using design features to reduce standards should be compared to compare site effects of design features. Intermittent and ephemeral streams have reduced buffers and less protections yet they "comprise over half our stream channel networks and provide many important ecosystem services."* (DA page 116). They are vital to aquatic ecosystem connectivity and their numbers are likely to increase with climate change (DA page 116). They should be provided more stringent standards and generous buffers.

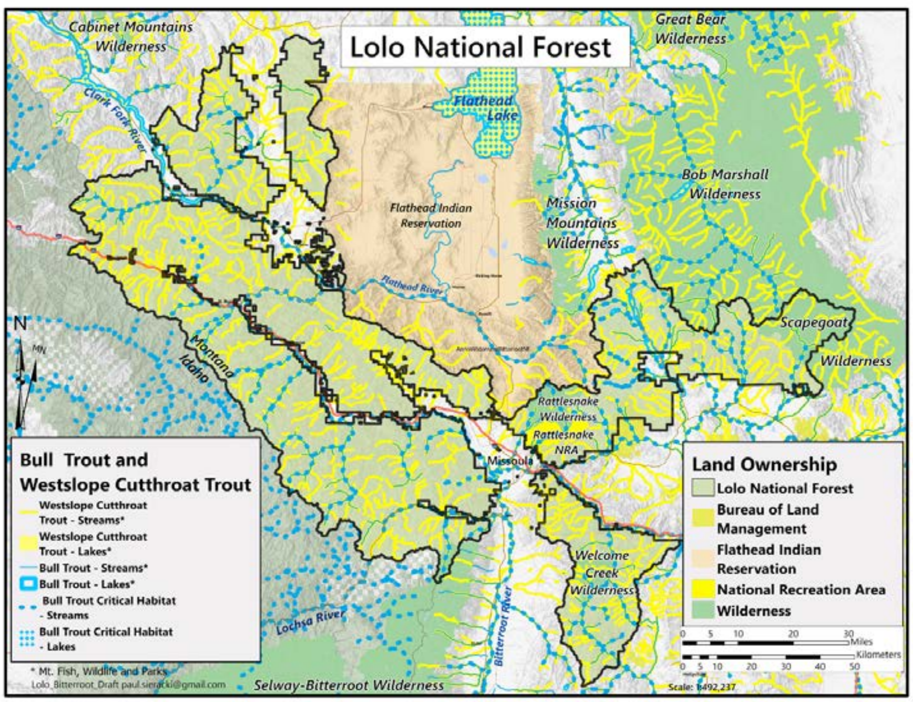

Figure 4. Bull trout Critical Habitat and Westslope Cutthroat Trout Streams, Lolo National Forests.

The DA claims the Montana Streamside Management Zone (SMZ) law includes many protections for stream channels and wetlands, including intermittent and ephemeral streams. Does the LNF have an MOU with DNRC concerning the enforcement of these laws? If so, it should be included in the assessment. The Bitterroot National Forest violated SMZ laws on the Darby Lumber Lands II project. DNRC originally fined them, but this was withdrawn because of an MOU. In the end, there was no repercussion for non-compliance. What are the agreements between the LNF and the DNRC concerning SMZ laws and compliance?

The DA uses PIBO MP data which analyzed 60 managed sites and 9 reference sites on the LNF to assess conditions. Most trends found were not significant though the DA stresses that managed sites are trending towards reference conditions (pages 106-8). This method allows for too many variables and merely demonstrates general trends. There is no way of knowing if any management activities have recently occurred in the managed sites. PIBO MP does not replace site specific monitoring after management activities over time. Post project monitoring data is mandatory to inform adaptive management requirements and is a part of all projects. Where is this information? It should be available and used to assess current conditions. PIBO MP could assess the effectiveness of INFISH if it were strictly adhered to, but design features and other mitigation methods have been used to reduce standards. Without knowing exactly what standards were followed, PIBO MP is not a valid assessment. This assessment could be used to assess streams occupied by bull trout, Westslope cutthroat trout, Idaho giant salamander, and Western pearlshell mussels, but this information is not available in the DA.

The negative trends for bank angle and vegetative bank stability found in the PIBO MP are attributed to drought (page 113). Again, there are too many variables to make this assumption. Over irrigation and stream dewatering, grazing, roads, culverts and invasive species would all be factors affecting trends.

The LNF is part of the Forest Service National Best Management Practices Program which periodically assesses BMP's on forests. Recent reviews found, "approximately 56% had excellent or good composite ratings. No reviews had fair ratings and 28% had poor ratings (Table 28) (page 182). The review does not specify what percentage were randomly selected leaving the findings unreliable. Even so, two of four aquatic ecosystems were rated poor (figure 27 page 183). A 50% score on a test is a failing grade and this includes site-specific data. Placer mining resources received poor reviews. This demonstrates a need for restrictions and protections.

On page 105, the DA states, *"Post-wildfire debris flows have significantly altered the landscape in some areas, negatively affected road infrastructure, damaged private residences (West Mullan Fire near Superior, 2013), and affected valley bottom and stream processes (Monture and Dunham Debris Flows, Walters, 2017)."* Please clarify this statement. Was any salvage logging involved in these post-wildfire debris flows and how did poorly maintained roads affect these outcomes. Aquatic ecosystems are adapted to fire disturbance. Native fish have shown to rebound quicker than non-native fish after fires (Clancy et al. 2012).

The 10 dams in the Rattlesnake Wilderness Area are being evaluated by the City of Missoula for decommissioning or rehabilitation. A dam was removed on Elsina lake in the late 2000s to enable fish passage (DA page 105). Stream and spring diversions for grazing allotments and undersized and clogged culverts, and culverts on stored roads must be addressed. The Draft claims that the LNF prioritizes replacing undersized culverts (page 105). Please list all culverts replaced over the last 10 years and those still needing replacement to back up this statement especially when, "large mass failures are imminent on the Lolo along the Route of the Olympian Railroad Grade (page 105)." What other dams exist on the LNF and what is their status? How are they affecting the streams below.

Wetland and riparian ecosystems are mapped on the LNF using aerial imaging that can mistake wetland species for upland and miss riparian areas obscured by forests. Lidar imaging, surveys, and site-specific analysis would better fulfill this mission. Water is a necessity for aquatic ecosystems and humans. As the climate warms, it will become even more crucial to existence. Tax dollars would be well spent on a complete survey of all riverine, palustrine and lacustrine areas on the forest. With these inaccuracies, the mapping found *"The potential riparian footprint is estimated to cover 80,431 acres (3.6 percent) of the plan area. Only about a third of that potential footprint is currently occupied by riparian ecosystems. This is consistent for all subbasins on the Lolo National Forest*." (page 114). The DA admits a need for surveys of fens, bogs, peatlands, and other wetlands across the forest (page 120). There should already be surveys completed in project analysis and monitoring over the years. Where is this data? "The National Hydrography Dataset reports a total of 42 springs on the Forest; only seven are named. This data layer typically underestimates the true number of springs, but no further spring records exist in the Springs Online database. The number of springs is the best indicator available to document the currently known occurrence of groundwater dependent ecosystems around springs. Many more springs likely exist, including those that discharge directly into a perennial stream, but they are not yet mapped (DA page 121). This information is essential to assess the overall status of aquatic systems on the LNF.

Leibowitz et al. (2018) stresses the importance of riparian areas as *"a critical source for allochthonous inputs of organic matter to streams, especially in headwater catchments (Tank et al., 2010). This includes large woody debris, which comes from riparian areas or hillslopes and acts to dissipate energy, trap material, and provide habitat in the stream (Sobota et al., 2006; Fritz et al., submitted)*." (pages 3-4).

According to the DA, "Springs play a key role in delivering cool water to warming streams and support late-season stream flows (Lawrence et al. 2014)." This is key for cold water dependent species. Springs and wetlands are also high in biodiversity. They provide refugia, food, and water for wildlife and birds.

The Clean Water Act (CWA) has prompted more research into water and its function. Connectivity within aquatic systems has become a prominent theme and should be a pervasive theme in the assessment and Plan Revision. Leibowitz et al. (2018) proposes a framework for assessing connectivity and how wetlands and streams contribute to downstream waters. *"Streams and wetlands affect river structure and function by altering material and biological fluxes to the river; this depends on two factors: (1) functions within streams and wetlands that affect material fluxes; and (2) connectivity (or isolation) from streams and wetlands to rivers that allows (or prevents) material transport between systems. Connectivity can be described in terms of frequency, magnitude, duration, timing, and rate of change. It results from physical characteristics of a system, e.g., climate, soils, geology, topography, and the spatial distribution of aquatic components*." (page 1). Aquatic system connectivity pertains to compliance with the CWA. Leibowitz et al. (2018) states:

> *In just the last few years, numerous studies have focused on aquatic connectivity, including: (1) connectivity between wetlands (McIntyre et al., 2014; Uden et al., 2014;*

Hayashi et al., 2016; Leibowitz et al., 2016; Vanderhoof et al., 2016); (2) connectivity between hillslopes and streams (Jencso et al., 2010; Jencso and McGlynn, 2011; Bracken et al., 2013; Reaney et al., 2013; Janzen and McDonnell, 2015); (3) connectivity between rivers, floodplains, and floodplain wetlands (Rooney et al., 2013; Vilizzi et al., 2013; Wolf et al., 2013; Zilli and Paggi, 2013; Scott et al., 2014; Jones et al., 2015; Reid et al., 2015); (4) connectivity between wetlands occurring in non-floodplain areas and rivers (McLaughlin et al., 2014; McDonough et al., 2015; Cohen et al., 2016; Evenson et al., 2016; Fossey et al., 2016; Golden et al., 2016; Rains et al., 2016); and (5) connectivity between other river system components (Giblin et al., 2014; Harvey and Gooseff, 2015; Moore, 2015; Hauer et al., 2016). Recent research also has investigated how connectivity contributes to ecosystem services (Mitchell et al., 2013; Jordan and Benson, 2015) and its importance to watershed and aquatic ecosystem management and protection of vulnerable waters (Uden et al., 2014; Crook et al., 2015; Moore, 2015; Creed et al., 2017) (p 1).

Wetlands are vital to connectivity making it essential to complete surveys. Liebowitz's framework "considers two key factors that cause this alteration of material fluxes: (1) stream and wetland functions that increase or decrease material fluxes, and (2) connectivity (or isolation) from streams and wetlands to rivers that allows (or prevents) transport of materials between the systems (pages 3-4).

It is important that the plan revision considers riverine, palustrine, and lacustrine systems singularly and as a connected system. *"Aquatic ecosystems (e.g., streams, rivers, lakes, and wetlands) can interact because of their ability to import and export material and energy, and through their ability to alter the fluxes of these materials. A key determinant of these interactions is connectivity, which describes the degree to which components of a river system are joined, or connected, by various transport mechanisms*." (U.S. EPA 2015). The connected system transports sediments, wood, and nutrients along its network and greatly affects downstream waters. *"The permeability of soils and geologic formations both can influence the range of hydrologic connectivity between non-floodplain wetlands and river networks."* (Liebowitz 2018 page 11).

Fens represent a large array of ecosystem services, including the highest biodiversity found among wetlands, hydrological services, water purification and carbon sequestration. Fens, bogs, peatlands, and other wetlands provide many ecosystem services including carbon storage. "Fens provide the high biodiversity, hydrological services, water purification, and carbon sequestration (Lamers 2015 page 198)." Protections provided by Research Natural Areas and Botanical areas should be continued and completed surveys should provide opportunity to protect those outside these designations. On the ground surveys should be conducted because "remote sensing is inaccurate (DA page 121)."

Lacustrine systems process nitrogen and provide habitat. Lake bottom sedimentation provides a window in to the past. The DA claims that higher mountain lakes have higher integrity unless there is road access. Lower elevation lakes have less integrity (DA page 118). How have these lakes been assessed? Where is the data? Intermittent streams and ephemeral flows are crucial to connectivity during spring runoff and when they are dry, they provide wildlife movement corridors. Have intermittent streams and their interactions with perennial streams been studied on the LNF?

Rivers provide riparian habitat, nutrient cycling and fish habitat. All water systems are connected at some point, even moist forest habitats should be included in the equation. Aspen and red cedar habitats are part of the matrix affecting water downstream. Springs should not be overlooked. Reducing or eliminating diversions should be a priority. On the ground surveys of springs are necessary to assess groundwater occurrences and to identify spring areas for protection. Systematic groundwater dependent ecosystem surveys should be a part of this assessment. *"Restoration of hydrological conditions, floodplains and wetlands, and large tree structure within western red cedar bottomlands, as well as, increasing type redundancy, extent, and connectivity would enhance their ecological integrity*." (DA page 121). Aspens also rely on wetlands to survive and thrive, these deciduous organisms are part of the connectivity of aquatic ecosystems. Protection of aspen groves from trampling by cattle grazing should be considered. Riparian buffers should include these systems and habitats to ensure clean water downstream. A complete study on the effects of roads on individual systems and their interconnectedness should be a part of this assessment. Beaver introduction and its affects should also be considered.

The watershed conditions framework proposed in the DA (Figure 25 page 176) does not include aquatic connectivity or soil compaction. Hahn 2016 offers a tool created by DEQ and the Montana Natural Heritage Program to assess wetland vulnerability and prioritize watersheds for preservation. Why has this method not been used to assess the LNF watersheds? *"While disturbance is a structuring factor in community composition and resilience, as such may promote greater biodiversity in an ecosystem (Supp and Ernest 2014), unfragmented landscapes where disturbances are primarily caused by natural forces (e.g., wind, floods, fire, etc.) are generally seen as conservation targets."* (Bennett and Sanders 2010) (Hahn 2009 page 16). Instead of using this method, the watershed condition framework was assessed using, "existing data, knowledge of the land, and professional judgment (DA page 175)." Professional judgement and knowledge of the land are not quantifiable or repeatable data points and should not be used to assess watershed condition. If existing data was used, it was not described or shared in the DA.

Normally fishless high mountain lakes have been stocked by FWP? Have there been any studies on the effects of continuing to stock these high mountain lakes? What species have disappeared due to the stocking of fish in historically fishless reservoirs? The DA says that these fish support ecological functions (page 118). What are these ecological functions? Low mountain lakes now include a large non-native component including curly leaf pondweed. Surveys should be done on invasive wetlands species and bio controls or other non-chemical means should be studied.

Forest soils affect connectivity in the aquatic system. Soil cover affects infiltration rates. Some pertinent considerations are suggested by a recent study like: Training an adequate number of scientists with expertise in the forest soil–water linkage; Refining BMPs and streamside management zone guidelines specific to water quality protection; Developing innovative approaches to quantify the function of soil organic matter in nutrient cycling and the linkage to water quality (Neary 2009, page 2278). Basic strategies to protect the soil/water connections would be *"(1) Minimize soil compaction and bare ground coverage, (2) Separate exposed bare* *ground from surface waters, (3) Separate fertilizer and herbicide applications from surface waters, (4) Inhibit hydraulic connections between bare ground and surface waters, (5) Avoid disturbance in steep convergent areas, (6) provide a forested buffer around streams, and (7) Engineer stable road surfaces and stream crossings*." (ibid p 2277-2278). Landslides and debris flows should also be avoided. *"Some potential mechanisms by which forest management can accelerate landslides include: Reduced soil strength (loss of root re-enforcement and root anchoring) with timber harvesting, Increased soil–water pore pressure (increased net precipitation, reduced evapotranspiration, re-routing of road runoff), Altered slope configuration (over-steepened cut-slopes and unconsolidated sidecast along roads). Side-cast roads on steep slopes and roads with inadequate culvert capacity on steep streams have high probabilities of failure and can produce landslides and debris flows with large effects on local stream systems. Landslide inventories conducted on two Idaho National Forests following major climatic events found 88% (Megahan et al., 1978) and 57% (McClelland et al., 1997) of all landslides were associated with roads*." (ibid p 2276)."

The DA alludes to new ground-based techniques to harvest timber on steep slopes. *"Best management practices to conserve soils will likely evolve for treating steep slopes mechanically. At least half of the forest treatments on the Lolo National Forest traditionally required skyline logging. A transition to new ground-based systems to treat steep ground is occurring. Soil monitoring of these new systems will usher in new protection measures."* Ground based work on steep slopes should be avoided. Liebowitz states, *"Within hydrologic landscape forms, the permeability of soil and geologic formations is an important determinant of hydrologic flowpaths (Wolock et al., 2004; Figure 6). Permeable soils promote infiltration that results in groundwater hydrologic flowpaths (Figures 6A and 6B), whereas the presence of impermeable soils with low infiltration capacities is conducive to overland flow*." (Figures 6C and 6D) (page 11). Ground based work on steep slopes will create a lack of infiltration and cause harmful debris flows. Do not assume that best practices can mitigate this deleterious effect. The DA claims, *"The nearby Bitterroot National Forest documented summer ground-based systems went from 13-16% detrimental soil disturbance in the 2000s to 7 percent in 2010s (U.S. Department of Agriculture 2021b)."* (page 190). This was due to a change in personnel and a change in methods used from repeatable and meticulous soil testing to visual surveys. It was not a result of improved logging practices and design features. The soil assessment tables show an abrupt change. As the DA states, *"Wildfire, timber harvest, and road building are the primary stressors that affect soil productivity on the Lolo National Forest over the past planning period*." (page 189).

1. Bull trout and native aquatic species

Protecting aquatic ecosystems will bolster bull trout recovery and sustain native aquatic species populations. More direct actions are also necessary to ensure the persistence of quality bull trout habitat. Areas of high aquatic integrity are in Wilderness and protected areas. *"The remaining strongholds of bull trout in the plan area are those streams and rivers that are within designated Wilderness areas or roadless areas because these areas have largely been spared the intensive land and water development over the past 150 years*." (DA page 166). There is no doubt that a strong foundation of Wilderness habitat will be key to protecting aquatic ecosystems and bull trout.

"There is an adfluvial bull trout fish population that migrates upstream from Salmon Lake, Seeley Lake, Lake Inez, and Lake Alva. The location of this geographic area is important for habitat connectivity of many species of wide-ranging wildlife." (page 11). Ninemile and Petty Creek watersheds are important producers of both bull trout and Westslope cutthroat trout (page 14). Prospect Creek and Thompson River are also strongholds for bull trout (page 13). These areas should be set aside as highly protected areas to ensure the recovery of bull trout and to strengthen Westslope cutthroat trout populations.

The 2012 planning rule § 219.9 Diversity of plant and animal communities calls for "ecosystem and species-specific approach to maintaining the diversity of plant and animal communities and the persistence of native species in the plan area." Aquatic ecosystem protections are key to maintaining bull trout and other native species on the LNF. *"Aquatic species that inhabit the plan area are adapted to cold, clean, complex, and connected systems. These habitat requirements make them sensitive to land or water use actions that degrade or reduce the quality and quantity of these elements*." (DA page 165). To comply with the 2012 planning rule and take a species-specific approach to bull trout, the plan must focus on impaired streams, sedimentation, connectivity, and warming stream temperatures. What contributes to these threats to bull trout and how can they be mitigated?

Planning rule § 219.8(B) requires that plan components ensure *"no management practices causing detrimental changes in water temperature or chemical composition, blockages of water courses, or deposits of sediment that seriously and adversely affect water conditions or fish habitat shall be permitted within the riparian management zones."* As stated earlier, riparian zones must include more than just river corridors. Riverine, palustrine, and lacustrine as well as wet forest habitats should be protected to bolster ecosystem connectivity and integrity. Management actions should not cause detrimental changes to cold, clean, complex, and connected habitats.

The DA claims that the major threats to bull trout are climate change and non-native species. Though management activities are mentioned as a problem they are not addressed thoroughly. *"On the Forest this includes bull trout and Westslope cutthroat trout whose historic migratory corridors have been severely fragmented by dam construction on major rivers and road construction in tributary watersheds*." (page 166). The DA also acknowledges many threats to Westslope cutthroat trout, "impoundments (Schmetterling 2003), (Ardren and Bernall 2017), timber harvest (Hicks et al. 1991), roads (Heckel IV et al. 2020), grazing (Peterson et al. 2010), mining (Mayfield et al. 2019), climate change (Wenger et al. 2011), (Isaak et al. 2012), (Yau and Taylore 2013), (Isaak et al. 2015), (Kovach et al. 2015), (Dobos 2015), (Young et al. 2018)) as well as competition and hybridization with non-native fish (Bell et al. 2021) (p 167)." Even with this extensive list, increased pressure to increase timber targets, and recent bills in congress funding logging, the DA concludes that, *"The presence of non-native species and climate change are perhaps now among the most severe threats to the continued existence of native, cold-water-dependent species."* (page 165). The assessment must put more emphasis on the following threats to cold-water-dependent native species: future road building, logging operations especially on steep slopes, recreation, dams, culverts, and the deteriorating road system.

The DA admits that *"continuing to reduce the effects of forest system road networks (i.e., undersized culverts and road encroachment into streams and riparian areas) are threats that forest plans can provide components to address. Additional restoration of past mining damage in streams and overall enhancement of bull trout habitat on National Forest System land are also appropriate issues for forest planning*." (page 167). But the draft does not analyze what has been done and what more needs to be done. How many culverts have been replaced? How many still need replacing? How many have not been discovered? How many roads slated for decommissioning remain on the forest? How many more should be decommissioned? How are fish barriers on closed roads handled? What are the road densities in impaired watersheds? What dams have been assessed and how many could be removed to provide aquatic connectivity?

The DA does not reveal which bull trout and Westslope cutthroat trout occupied streams are impaired. It does not list or analyze impaired bull trout critical habitat. A true assessment of the situation would include an overlay of occupied streams and impaired streams including the type of impairment. *"Findings suggest bull trout recovery efforts should be prioritized in systems where groundwater or high elevation are expected to buffer warming temperatures in systems that still contain native fish communities*." (Isaak et al. 2022, page167). Low elevations must be addressed as well. There is no reason to isolate fish communities more than they are currently. The focus should be on reducing fragmentation, increasing water flows, and reducing sediment in both high and low elevation streams.

The DA states that for bull trout, "plan-area occupancy is largely unchanged in the recent past (Bell et al. 2021) and the species, or hybrids of the species, remain common (Montana Fish, Wildlife and Parks FISHMT data queried 2022, planning record) (page167). The planning record is not available to the public and there is no definition of "recent past." Please provide the monitoring or data that demonstrate this and define the recent past. What have the trends been for the past 30, 20, and 10 years? What are the trends in each watershed? How do those trends coincide with road densities, poor culverts, dewatering, and sediment?

The DA fails to take a hard look at the four C's that bull trout need for survival and what plan components or actions are needed for a comprehensive plan to provide cold, clean, complex, and connected habitat in the future.

COLD

Bull trout are related to Arctic char and require colder stream temperatures than other trout. Strict buffers around streams and wetlands preserve cool waters by providing shade. "Riparian vegetation provides important components of rearing habitat, including shade (which often maintains cool water temperatures), food supply, channel stability, and channel structure (Furniss 1990 page 303)." INFISH buffers should remain in place for perennial streams and the same buffers and protections should be applied to wetlands, intermittent streams, and ephemeral flows. Protecting springs that deliver cool water to warming streams and bolster late stream flows is one aspect to maintaining cold habitats for bull trout and native fish.

Climate warming will be a challenge for the LNF, but there are actions to alleviate its effects. Eby (2018) found, *"The northern Rocky Mountains, U.S.A. is undergoing climate mediated shifts e.g., reduced annual snowpack, earlier annual peak snowmelt, and winter precipitation switching from snow to rain, that are contributing to changes in hydrologic and thermal regimes [12], [13], [14]. Summer water temperatures have increased up to 0.3uC/decade [15] and summer base flows are declining*." [16] (page 1). Eby 2018 notes that climate is not the only factor, *"We acknowledge that the observed relation between climate-related warming and reduction in bull trout occupancy is correlative and that other covariates we did not consider may have influenced this outcome, but the effects of temperature on bull trout distributions are consistent across its historical range."* (page 6). Climate change effects can be mitigated by protecting streams and attaining the right to maintain adequate instream flows to maintain low water temperatures and adequate flow for fish populations.

Acquiring instream flow water rights to ensure summer flows for native fish is an important action the LNF must take. The DA states, *"The implementation of a water compact between the Forest Service and State of Montana since 2007, the Lolo National Forest has acquired 12 instream flow water rights. These junior water rights set a minimum flow rate necessary to support native fisheries and aquatic ecosystems. The Forest has collected data to acquire instream flow water rights on 78 discreet stream reaches; as of 2023, 31 of those water rights have been issued by Montana Department of Natural Resources and Conservation*." (page 42). Which streams have been acquired and which are still in process? How many of these are bull trout occupied? Fischer (2010) worked with Trout Unlimited to recommend the acquisition of instream flow rights on the LNF. Here is the recommended list from that report, it includes occupation, 303(d) designation, and biological importance.

1. Clark Fork River : bull and Westslope 303(d)
2. Grant Creek of Middle Clark Fork: bull and Westslope 303(d)
3. Arrastra Creek of Blackfoot: bull and Westslope 303(d)
4. Blackfoot River of Clark Fork: bull and Westslope
5. Dry Creek Middle Clark Fork: Westslope 303(d)
6. Hogan Creek of Blackfoot: Westslope and bull trout
7. Tamarack Creek of Middle Clark Fork: bull and Westslope genetically pure cutthroat
8. Albert Creek Middle Clark Fork: bull and Westslope genetically pure cutthroat
9. Cottonwood Creek of the Blackfoot: bull and Westslope biologically significant
10. Monture Creek of the Blackfoot: bull and Westslope Very biologically significant
11. Petty Creek of the Middle Clark Fork: bull and Westslope
12. Mill Creek of the Middle Clark Fork: Westslope Important WCT spawning
13. Ninemile creek of the Middle Clark Fork: Westslope Important WCT spawning stream
14. Six Mile Creek, Middle Clark Fork: Westslope
15. Savenac Creek, Middle Clark Fork: Westslope

How many of these have been acquired? The DA should include a list like this of water rights acquired, those in process, and those that are still needed. The plan should also specify when those rights will be enforced.

National Forests have the responsibility and the ability to preserve clean water for forests, wildlife, fisheries, and communities. *"The relationship between mountainous areas, snowpack accumulation, and runoff cause National Forest System lands to function like reservoirs for downstream communities, ecosystems, and economies."* (DA page 41). Working with communities is essential. Some watersheds are closed and instream water rights are not available, but this should not stop the LNF from creating partnerships and working with local irrigators to practice more efficient water use to conserve water and protect fisheries. Irrigation will continue to be an issue as the climate warms and spring runoff begins earlier. A healthy, connected aquatic ecosystem will be imperative and water conservation will be a necessary contributor.

CLEAN

Bull trout require clean waters. Sediment impaired streams have grave effects on cold water fisheries and spawning areas. Bowerman (2014) found:

> *Survival from egg to hatch was negatively related to percent fine sediment (<1mm) in the redd and positively related to the strength of downwelling at spawning sites. Survival of eggs to fry emergence was also negatively related to fine sediment, and the best statistical models included additional variables that described the rate of downwelling and intragravel flow within the incubation environment. Fry emerged at an earlier stage in development from sites with strong downwelling appear to enhance hyporheic flow rates and bull trout egg survival, but early life-stage success may ultimately be limited by intrusion of fine sediment into the incubation environment (page 1059).*

Bowerman also found, "Spawning areas with inputs of fine sediment, such as from erosion, as well as those with active sediment transport, may be vulnerable to fine sediment accumulation within redds." (Sear et al. 2008, page 1070). Cattle trampling streambanks cause erosion and the breakdown of streambanks. This must be monitored and mitigated. There is little information concerning grazing allotments on the LNF and their relationship to specific impaired streams and bull trout occupied streams.

Roads are a major contributor of sediment in streams and have a great effect on bull trout. This should be a top priority on the forest. A 1997 USDA assessment of ecosystem components in the Columbia Basin notes that although improvements in road construction and logging methods can reduce sediment delivery to streams, sedimentation increases are unavoidable even when using the most cautious logging and construction methods (Lee 1997).

The DA should include a list of miles of road maintained within bull trout watersheds and the amount of road maintenance necessary. *"It is important to note that the Forests in western Montana support 81 percent (or 1,462 miles) of the designated spawning and rearing habitat for bull trout. Given this high percentage, and the potential negative effects of roads on streams, the management of the road system is a principal concern for bull trout (Biological Opinion of the Effects to Bull Trout and Bull Trout Critical Habitat from Road Management Activities on National Forest System and Bureau of Land Management Lands in Western Montana, 2015 page*

32).” Reiman 2000 discovered that “Human disturbance (as indicated by road density), however, was negatively correlated with [bull trout] occurrence (page 56).”

According to the DA, “Forty-four percent of the 12th code hydrologic unit code watersheds in the study area had roads in the highly vulnerable category of high combined exposure and sensitivity. The high vulnerability areas are scattered throughout the forest and are generally concentrated in lower elevations (page 27).” The assessment must look at the correlation between higher road densities and the occurrence of bull trout. According to Ripley et al. (2005) *“Results from zero-inflated Poisson regression models typically showed that bull trout abundance was positively related to elevation and negatively related to stream width, percent fines, percent cobble, slope, and levels of forest harvesting. Using the negative relation between bull trout occurrence and percentage of subbasins harvested derived from the most parsimonious logistic regression model, we forecasted that forest harvesting over the next 20 years is projected to result in the local extirpation of bull trout from 24% to 43% of stream reaches that currently support bull trout in the Kakwa River Basin.”* (page 2431).

A thorough assessment of roads on the LNF and their needed maintenance must be a part of the DA in order to provide clean water for fisheries.

Frissell 2014 found:

> Roads are ecologically problematic in any environment because they affect biota, water quality, and a suite of biophysical processes through many physical, chemical, and biological pathways (Trombulak and Frissell 2000, Jones et al. 2000). The inherent contribution of forest roads to nonpoint source pollution (in particular sediment but also nutrients) to streams, coupled with the extensive occurrence of forest roads directly adjacent to streams through large portions of the range of bull trout in the coterminous US, adversely affects water quality in streams to a degree that is directly harmful to bull trout and their prey. This impairment occurs on a widespread and sustained basis; runoff from roads may be episodic and associated with annual high rainfall or snowmelt events, but once delivered to streams, sediment and associated pollutant deposited on the streambed causes sustained impairment of habitat for salmon and other sensitive aquatic and amphibian species. Current road design, management of road use and conditions, the locations of roads relative to slopes and water bodies, and the overall density of roads throughout most of the Pacific Northwest all contribute materially to this impairment. This effect is apart from but contributes additively in effect to the point source pollution associated with road runoff that is entrained by culverts or ditches before being discharged to natural waters (page 13).

COMPLEX

A survey of streams for large woody debris, bank stability, lower bank angle, width/depth ratio and pool frequency should be included in the assessment. <u>All INFISH objectives supporting those indicators should be considered and increased if necessary to fulfill these objectives. INFISH offers strong protections for native fisheries. It should remain in place with little change.</u> According to the Biological Opinion for the Idaho Transportation Department, *“Conservation* *and restoration measures that would benefit bull trout include protecting high quality habitat, reconnecting watersheds, restoring flood plains, and increasing site-specific habitat features important for bull trout, such as deep pools or large woody debris."* (Kinsella 2005, page 26). Protected riparian buffers are essential to ensure complex stream and river systems. Large trees within a 300 foot buffer of aquatic systems should not be removed.

CONNECTED

The DA does not survey and assess dams that could be removed. Nor does it provide a survey and assessment of culverts for removal or replacement. The Montana Bull Trout Restoration Team for Governor Marc Racicot provided goals for recovery. One of those goals was to restore and maintain connectivity between historically connected Restoration/Conservation Areas (RCAs). They wrote*," Fragmentation among populations is a serious threat at different geographic scales, from larger scale RCAs to smaller scale core areas (see number 2 above). Human-caused fragmentation of populations at the RCA level disrupts the migratory corridors historically used by bull trout. Fragmented bull trout populations have an increased risk of extinction (Gilpin 1997), because the effects of risk factors such as interactions with non-native fish, mining, grazing, and forestry are locally exacerbated. Connectivity between RCAs is desirable when and where feasible to maintain/restore full migratory capacity and to help maintain viable populations.*" (pages 9-10). Reconnecting historically connected core areas within RCAs will provide opportunity for genetic exchange between populations and encourage new populations. The LNF should continue work to identify and remove dams. Culverts should be surveyed, assessed, and removed or replaced.

COMPREHENSIVE

Work to restore and maintain bull trout populations and habitat must take a comprehensive approach. The entire aquatic system that supports native aquatic species must be taken into account. Restoring all components of the system and evaluating them as a whole is necessary.

A comprehensive plan to restore the cold, clean, complex, and connected habitats for native fisheries should include extensive monitoring and reporting. Racicot's bull trout team recommended that a statistically valid population monitoring program should be developed and implemented. Has this been implemented on the LNF? The DA provides little information on the populations overall or within watersheds. Valid population monitoring programs that include both numbers and distribution are essential to determine the fate of bull trout as well as the efficacy of work done to bolster populations on the LNF. It will help identify threats in a timely manner and assess mitigation efforts. A statistically valid monitoring program for aquatic system restoration should be required and periodic reports on watershed improvements should be available to the public.

A focus on connecting and restoring the aquatic system and a comprehensive approach to bull trout recovery across the LNF will protect aquatic populations, clean water, and communities.

More management opportunities to maintain, restore, and connect aquatic systems and native aquatic species:

- Establish and enact strict, extensive buffers and associated protections for intermittent streams, ephemeral flows, and wetlands.
- Evaluate all dams and diversion structures for maintenance or removal. If dams are in Wilderness, removal should follow the parameters of the Wilderness Act.
- Limit the number and extent of water diversions.
- Monitor grazing allotments for degradation of streams and wetlands. Close allotments if damage occurs.
- Close all vacated allotments and create a method for closing allotments as they are vacated in the future.
- Decommission roads in or next to wetlands and springs.
- Decommission roads before building any new roads (including temporary) during project activities.
- Promote the designation of Wild and Scenic River recommendations in the Lolo Bitterroot Partnership Plan (LBPP).
- Special consideration should be given to streams and wetlands occupied by bull trout Westslope cutthroat trout, Idaho giant salamander, and Western pearlshell mussels.
- Attain and establish in stream flow water rights on all streams on the LNF that are available and work with water rights owners in all watersheds where water rights are closed to conserve water and reduce use.
- Introduce beavers in appropriate beaver habitat.
- Educate landowners as to the importance of beavers to late season water supply.
- Work with FWP to limit beaver trapping.
- Implement TMDLs as required by DEQ for the Lower Clark Fork, Prospect Creek, St Regis, Lower Blackfoot, and the Middle Blackfoot. Implement new TDMLs as they are required. Monitor watersheds for improvements.
- Consider how maintaining or restoring the Primary Constituent Elements of Clean, Cold, Complex, and Connected watersheds for bull trout can be accomplished through Wilderness designation. Promote Wilderness recommendations in the LBPP.
- The INFISH standards should be kept in place and applied to all stream segments occupied by native bull trout and cutthroat trout on the Lolo and Bitterroot National Forests.
- The Five Cs of bull trout protection also apply generally to cutthroat trout. These are Clean, Cold, Complex, Connected and Comprehensive.
- Large amounts of the LNF are designated as Critical Habitat under the Endangered Species Act. These specific standards are required to protect the Primary Constituent Elements of bull trout habitat:
    - Fine sediments < 6.4 mm in diameter must be limited to less than 20% in spawning habitat (Espinosa 1996) and standards must be developed to maintain groundwater.
    - All streams should average $\geq 90\%$ bank stability and that cobble embeddedness in summer rearing habitat should be $< 30\%$ and $< 25\%$ in winter rearing habitats

(Espinosa 1996). Additional indices include channel morphology including large woody debris, pool frequency, volume and residual pool volumes.
    - Stream temperatures in current and historic spawning, rearing and migratory corridor habitats should not exceed 6-8 C for spawning, with the optimum for incubation from 2-4 C (McPhail & Murray 1979); 10-12 C for rearing habitat, with 7-8 C being optimal (Goetz 1989); migratory stream corridors should be 12 C or less.
- Establish a total and open road density standard that protects and restores native fish habitat by reducing sediment, restoring hydrologic upwelling, eliminating barriers, and removing failed culverts. Climate change is expected to have serious impacts on bull trout (Bell et al. 2021). In the face of climate change, retaining thermal cover in headwaters areas is important to native fish (Kirk et al. 2022) and standards need to be set for thermal cover in Priority Watersheds that extend to the entire watershed (Frissell 1999).
- Establish and implement a statistically valid monitoring program for aquatic populations (both numbers and distribution).
- Establish and implement a statistically valid monitoring program for aquatic system restoration.
- Establish and implement a statistically valid soil monitoring program.

Consider setting measurable, time sensitive goals such as:

- Restore 7-10 watersheds to conservation status every ten years until the next plan revision.
- Close or obliterate 10-20 miles of roads within RHCAs in active restoration watersheds every ten years until the next plan revision.
- Remove at least 40 native fish passage barriers in active restoration watersheds every ten years until the next plan revision.
- Make improvements such as bank stabilization, riparian planting, or placement of woody material on at least 30 miles of stream and riparian habitat in active restoration watersheds every ten years until the next plan revision.

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Beaver

The DA highlights beaver as a keystone species providing for function and maintenance of the greatest biodiversity and ecological systems in valley bottom and associated wetland and riparian landscapes.

"Beavers are a keystone species that historically were responsible for some of the greatest biodiversity and ecological systems on the Lolo National Forest. Beavers were likely as formative to of a disturbance agent to valley bottom ecosystems as wildfires and floods. Although beaver populations are rebounding, levels remain far below potential." DA, page vii.

Beaver provide numerous ecosystem services in these environments with downstream benefits. The discussion recognizes beaver as an ecosystem driver and broadly describes its "profound influence on the habitats they occupy and drastically modify hydrologic, geomorphic, and biologic processes" largely through dam building. We would add hyporheic zone and processes to the list and refer to later sections 2.1.5 and 2.3.2, where it is presented with more detail.

The beaver population is not 'rebounding'. In their 2022 study, Scarmado et.al document widespread decline in North American beaver populations represents an estimated 80% to 98% loss of historical populations[6]. Pre-European beaver populations in North America are estimated between 60 to 400 million compared with 9–12 million beaver today. The 2023 Montana Field

[6] Scamardo, J. E., Marshall, S., & Wohl, E. (2022). Estimating widespread beaver dam loss: Habitat decline and surface storage loss at a regional scale. Ecosphere.

Guide for beaver documents fewer than 10,000 observations statewide. On the Lolo, observation densities range from low to moderate.[7]

The groundwater section (2.1.5) characterizes the landscape beaver occupy, "Pre-European colonization, the bottoms of many broad alluvial valleys in the American West were river-wetland complexes that were highly adapted to local disturbance regimes and served as hubs of biodiversity (Wohl et al. 2021). In such ecosystems there is a high degree of connection between surface and groundwater." River-wetland complexes are dynamic with beaver playing a key role *valley-wide*. The need for change stems from simplification of this river-wetland complex by settlement and management activities, including eliminating beaver and their dams and over trapping. While beaver prefer 3-6 percent gradients, the assessment reports 'beaver influence areas' are known to occupy slopes up to 12% gradient (Sylte 2020). Opportunities for upland restoration are considerable.

The section on Beaver Status and Associated Departures from Historic Conditions lists items assessed to improve understanding and future forest stewardship of ecological services supported by beaver but does not report findings. It directs the reader to section 2.3.4, which was not helpful or related. You might have meant 2.3.2 Valley Bottoms, Stream Habitat, and Associated Riparian Systems or 2.3.5 Wetlands, Ponds and Groundwater-dependent Ecosystems that inform of the importance of beaver to the function of these important areas. It would be more helpful to have a brief synthesis of key findings related to beaver in this section. Not to be nit-picky but the reader is directed to 2023 data from Montana Fish Wildlife and Parks in the project record though this is available on line[8]. Again, synthesis of information would help.

Despite the "disproportionately large effect on their environment relative to their abundance" (P. 36), current beaver populations on the Lolo are either not known or not disclosed in the assessment. Given that information gap, modeling was used to "approximate a reasonable potential beaver influence area" (P. 37). One model was based on whether streamside elevation limited access by 50–100 year floods and beaver. The assessment stated "areas that are low enough that a large flood could access could very well be influenced by beaver historically when they were unconstrained, and beaver dams existed across entire valley bottoms". However, it's not clear the model considered the **absence** of beaver as a stressor that degraded the system thus disconnecting the channel from its floodplain. Make it clear that any modeling accounts for this discrepancy in current verse pre-settlement conditions.

We are concerned that findings of limited field work by the Watershed Restoration Citizen Science Project were used to determine that the "NetMap model **overpredicts** beaver habitat in larger order streams but may capture segments of larger channels where beavers are able to make use of side-channels in broad floodplains." (P. 39). It is no surprise the crew "noted beaver activity was highest where log jams were present or larger streams had side channels" or that "beaver had difficulty establishing in simplified single channels without wood jams". We find it concerning that such observations were used to determine the model **overpredicted** beaver habitat. Results shown in Table 5—Wetlands influenced by beavers on the Lolo National Forest

[7] https://fieldguide.mt.gov/RangeMaps/GenObsMap_AMAFE01010_FS.jpg
[8] Montana Field Guides: Beaver castor canadensis. https://fieldguide.mt.gov/speciesDetail.aspx?elcode=AMAFE01010

found beaver influenced wetland area is 271 acres, a mere 0.5 percent of total wetland areas is questionable and runs counter to the valley wide environment they occupy in a properly functioning river-wetland complex.

We urge you to amplify the importance of beaver as a nature-based but currently under-utilized solution to climate change. "Reconnecting waterways to their floodplains improve water quality and quantity, supports biodiversity and sensitive species conservation, increases flood, drought and fire resiliency, and bolsters carbon sequestration."[9] There has been a burgeoning interest in study of beaver in recent decades, with focus on habitat restoration. American Rivers recently published a state of the science on restoring western headwater streams with low-tech process-based methods (2022)[10]. The final assessment must incorporate current best available science.

We recommend application of process-based principles in system restoration at multiple scales. As stated in Beechie (2010), "a stream is not a channel but a complex, dynamic, and evolving system that includes all of the area on and near the valley floor that has been affected by or directly affects fluvial processes"[11]. Process-based restoration is more sustainable and resilient than engineered channels or habitats, which are fixed in place. Restoration of natural processes requires minimal maintenance over time, and adjust to long-term stresses such as climate change.

Include local resources in the assessment. Former Ninemile District Ranger, Greg Munther, as a biologist recognized the key role of beaver and initiated informal studies decades ago. Reference to his work is absent in the assessment but has been covered in the media[12,13]. Munther's work led to recent studies on bull trout, "Munther experimented with relocating beavers from private to public land … and he protected them with trapping closures. These were informal trials, but he generally found the beavers to increase the quantity and quality of aquatic habitat. Munther's results were affirmed in 2016, when the LNF worked with the Clark Fork Coalition (CFC) to complete a *Watershed Vulnerability Assessment*. … focused on bull trout … and water supply, they found that the watershed connectivity and complexity that beavers provide might offer hope against the heat predicted in the decades ahead."[14] Note, Sylte (2020) is not cited.

The DA provides good information on beaver and the dynamics of functioning valley bottoms and associated riparian ecosystems. It recognizes beaver as a keystone species essential to properly functioning river-wetland-riparian ecosystems and that populations are far below historic levels. It would be helpful to better define those levels. The Lolo needs to undertake and refine inventory of the number and extent of current beaver dam locations, and compare with pre-settlement beaver dam locations and habitat. The assessment is clear that the system is

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[9] Beaver: The North American freshwater climate action plan. Jordan, C. & Fairfax, E., *WIRES* Water, (2022).

[10] Restoring Western Headwater Streams with Low-Tech Process-Based Methods: A Review of the Science and Case Study Results, Challenges and Opportunities. 2022. Jackie Corday for American Rivers. https://www.americanrivers.org/resource/new-report-state-of-the-science-on-restoring-western-headwater-mountain-streams/

[11] Process-based Principles for Restoring River Ecosystems, Beechie, T. et al., *Bioscience* 2010

[12] https://missoulian.com/opinion/columnists/beavers-can-mitigate-climate-change-effects/article_36eba5a8-ed66-5cdb-9602-f21741f227f7.html

[13] https://missoulian.com/news/local/ninemile-creek-straightened-by-gold-miners-restored-by-humans-and-beavers/article_44f73518-79fe-53ae-b5f1-6e5b43322252.html

[14] https://www.montananaturalist.org/blog-post/rediscovering-the-north-american-beaver/

degraded in many places and we encourage including site-specific identification and information on these areas. This is a NEED for CHANGE.

Need for Change

Develop a program and beaver recovery strategy incorporating, "improved regulation of trapping, protection of wetland habitat, translocation efforts, and natural dispersal and population increase have restored beaver populations where suitable habitat remains in much of its original range.[15]

Apply the science of beaver-based low-tech process-based stream restoration to support building climate resilience across the landscape. Not every stream is a good candidate for beaver-based restoration, so it is important to identify which ones are.

Flooding, Stream Flows, and Groundwater

This section does a good job describing the contributions waters from the Lolo deliver to headwater streams and rivers. The natural water infrastructure of the LNF – comprised of the rivers, streams, wetlands, fens, groundwater, springs and riparian areas - provide essential ecosystem benefits by serving as key components of the hydrologic cycle and biodiversity hotspots (page 41).

The assessment warns a changing climate is already shifting snowmelts and peak flows to earlier in the year, and water scarcity will likely be an issue for maintaining stream flows to support aquatic life and the needs of communities in the area. It emphasizes that, "Promoting watershed health and resilience is critical to provide ecosystem services relating to stream flows and ground water." This important concept needs to be carried forward. This section identifies climate, geology, topographic conditions, and 'other factors' as variables to predict flow regimes, but omits watershed health as a driving variable. Please specify *watershed health, floodplain connectivity, and the presence and ecological function of beaver in first to fourth order streams* as factors. These factors will become increasingly important to stream flows and wildlife habitat with the changing climate.

The assessment acknowledges that historical land use has affected the function of some watersheds, Section 2.7.2 Watershed Condition Framework (2011), indicates conditions were re-assessed in 2021. Of the 176 watersheds, 56 were rated as functioning properly, 99 were rated as functioning at risk, and 18 were rated as impaired. For watersheds that were rated impaired, roads were the most significant drivers of the rating. While we don't doubt roads degrade watersheds, the report Disappearing West identifies logging, mining, grazing and presence of beaver as also among the top indicators[16]. This is consistent with an EPA report[17]. Both can be accessed on their websites.

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[15] Boyle, S. and S. Owens. (2007, February 6). North American Beaver (Castor canadensis): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region

[16] Disappearing West, Center for American Progress.

[17] Western Mountains Ecoregion - National Rivers and Streams Assessment 2013-14 | US EPA. This ecoregion covers the mountain ranges located in CO, NM, AZ, UT, WY, MT, ID, WA, OR, and CA.

Across the Plan area, watersheds were most commonly rated as impaired for the indicators: aquatic biota, roads and trails, and aquatic habitat condition. However, the 2011 WCF did not assess for floodplain connectivity or presence of beaver. From what we understand, the WCF is being updated and will include floodplain connectivity and presence of beaver in lower order streams as indicators of watershed condition. We are hopeful that given the prominent discussion on beaver as a keystone species the Lolo will be proactive in including these in its assessment and plan as it moves forward.

Water Rights

Water scarcity is a recognized issue. We appreciate the Forest is seeking to acquire instream flow water rights to support native fisheries and aquatic ecosystems on 78 discreet stream reaches, with 31 of these issued by DNRC as of 2023. Most watersheds (83%) on the Lolo remain open for new water rights acquisition, and those that remain open are in areas identified as most vulnerable to water scarcity.

Since this section includes water rights and potential water scarcity, we think it appropriate to comment on Section 3.10.6 Municipal Watersheds and Source Water Protection Areas. The Forest Service Organic Act of 1897 established watershed protection as among three primary criteria for forest reserves. As you know parts of section 3.10.6 are too generalized. The statement, "*Additional efforts are needed to institute a consistent framework for identification and classification of source water protection areas and municipal watersheds and augment existing management direction for these areas*" is a NEED for CHANGE.

Table 97 (3.10.6) lists municipal watersheds. Notes in the table provide detail but are not adequate. Columns with ratings for watershed condition, water quantity and quality, and adequacy to meet community needs would be helpful. The discussion indicates problems in almost all watersheds. The summary statement, "Currently there is no single data source representing source water protection areas and/or municipal watersheds for the Lolo National Forest. As evidenced above, there are multiple source water designations currently in use, lending to some confusion as to the applicability of overlapping regulatory authorities. In light of the current and anticipated future agency focus on maintenance of source water values, additional efforts are needed to institute a consistent framework for identification and classification of source protection areas and municipal watersheds and augment existing management direction for these areas." is a NEED for CHANGE.

Groundwater

We think the discussion on groundwater is very good. Even with more than half of Montanans depending on groundwater for their primary water supply, available groundwater far exceeds that of surface water. There is an connection between surface streamflow and surface aquifers, but not known whether snowmelt and precipitation events or deep groundwater aquifers have larger impacts on recharging surface aquifers. Surface water recharge as seen from some wells and springs may occur during snowmelt and precipitation events. Groundwater recharge of surface aquifers via hyporheic zones may be more important to streams flow during base-flow and could be critically important to surface water quantity and temperature buffering needed to support aquatic life. The discussion prudently warns that it is incorrect to assume groundwater extraction cannot significantly alter aquifer levels.

While the LNF cannot control surface and groundwater use off forest in larger valley bottoms, it can promote watershed health in headwaters where most precipitation falls. We support restoration projects aimed at floodplain connectivity, wet meadow restoration, and beaver reintroduction in smaller headwater valley bottoms to promote groundwater recharge and slow runoff flow. We appreciate that you are considering variation on the landscape such as aspect, elevation, seasonal snowpack and prevailing winds but would like to add slope form (concave, convex, straight) with attention to processes in colluvial swales. While beaver prefer gradients of 3-6%, the DA (page 39) indicates they can occupy steeper intermittent drainages with seeps and springs. Beaver dams contribute to replenishing alluvial aquifers by trapping and storing water and redirecting surface water (Pollock et al. 2015). Stream rehabilitation and subsequent beaver colonization on the Lolo increased baseflow by at least 0.5 cubic feet per second per mile (Brissette 2016). We would like to see reference to use of low-tech process-based restoration[18]

As noted on page 361, the *"Bipartisan Infrastructure Law and Inflation Reduction Act have enacted multiple programs that explicitly focus management resources on maintaining source water integrity, be it through protective or proactive management actions. Through these programs and broader agency direction, it is anticipated that source water protection will remain a focus for the foreseeable future."* With some specifics and vision, this assessment could help identify watershed restoration needs that could help the LNF qualify for these funds.

Mycorrhizal fungi

See section above on Mycorrhizal Fungi in Unique Systems.

Ecosystem Stressors

Transportation System

<u>The Transportation System is the leading ecosystem stressor for a host of reasons.</u> The Assessment provides little information about the LNF road system, and only discloses that "There are approximately 3,165 miles of road open for public use either seasonally or year-round." DA page 61. In addition to these motorized roads there are 359 miles of motorized trails (DA at 266). The Forest Service omits the number of roads not open to the public, specifically those in the Maintenance Level 1 and 2 categories. In its 2015 Travel Analysis Report, the agency disclosed "The Lolo NF currently has 6,192 miles of NFS roads."[19] Of these roads, the Forest Service found "Approximately 112 miles were identified as "likely not needed for future use" and may be considered candidates for conversion to another use, storage for future use, or

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[18] Restoring Western Headwater Streams with Low-Tech Process-Based Methods: A Review of the Science and Case Study Results, Challenges and Opportunities. 2022. Jackie Corday for American Rivers https://www.americanrivers.org/resource/new-report-state-of-the-science-on-restoring-western-headwater-mountain-streams/

[19] USFS Lolo National Forest. 2015 Travel Analysis Report at 4 citing "NRM Infra user view II_ROAD_CORE October 3, 2014."

removal through decommissioning."[20] In the DA, the agency goes on to explain there are a number of "undetermined" roads, which fails to recognize that any roads not acquired through land exchanges are more properly defined as unauthorized roads under the regulations. 36 CFR 212.1. The Lolo Travel Analysis Report (TAR) disclosed the forest had 3,145.61 miles of unauthorized roads, bringing the total road network to 9,338.24 miles. At the time, recommending only 1.2% reduction of the combined network was woefully inadequate to meet the purposes of the Travel Management Rule (TMR) under subpart A, and to date it remains unclear how the roads situation has changed since the 2015 TAR or the Forest Service's ability to manage its road system. The presence of so many "undetermined" roads and unauthorized roads, requires that the Assessment must be informed by an updated travel analysis report.

The following explains that the transportation network is a major ecosystem stressor and the DA fails to acknowledge the associated unacceptable risks road pose to the overall ecosystem integrity of the Lolo NF. For example, the DA states:

> *"The Lolo National Forest implements Best Management Practices along with many other project design features and resource protection measures when implementing management projects. Routine road maintenance is performed, including actions such as culvert cleaning. These efforts collectively contribute to ameliorating the negative impacts of the road network and associated impacts to resources and result in an overall trend of improvement*."[21]

To be clear, BMPs and design features are not a magic wand that can adequately address the numerous ecological stressors roads cause, including habitat fragmentation and high road densities that preclude the agency from maintaining viable population of species, or recovering threatened or endangered species. Subpart A of the TMR was established in 2001, in part, to reduce the overall road system so as to make it more manageable and less harmful. However, to this day the LNF has yet to provide and implement specific management direction to identify and achieve an ecologically and fiscally sustainable road system. In other words, this goal remains an outstanding need for change, and the Forest Service must include specific plan components, including road density standards, to meet its responsibilities under both the TMR and the Planning Rule.

The Forest Service transportation infrastructure is necessary for the management of national forests and grasslands, yet indisputably it also harms aquatic and terrestrial environments at multiple scales. The construction and presence of forest roads can dramatically change the hydrology and geomorphology of a forest system leading to reductions in the quantity and quality of aquatic habitat.[22] While there are several mechanisms that cause these impacts, most fundamentally, compacted roadbeds reduce rainfall infiltration, intercepting and concentrating

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[20] *Id.* at 17.

[21] *Assessment at 61.*

[22] Al-Chokhachy, R.T. et al. "Linkages between unpaved forest roads and streambed sediment: why context matters in directing restoration." Restoration Ecology (2016) 24(5). https://doi.org/10.1016/j.scitotenv.2020.141968

water, and providing a ready source of sediment for transport.[23] In fact, roads contribute more sediment to streams than any other land management activities on Forest Service lands.[24] As a result, forest roads can have dramatic and lasting impacts on fish and aquatic habitat. Increased sedimentation in stream beds has been linked to decreased fry emergence, decreased juvenile densities, loss of winter carrying capacity, increased predation of fish, and reductions in macro-invertebrate populations that are a food source to many fish species.[25] Roads close to streams reduce the number of trees available for large wood recruitment, and reduce stream-side shade.[26] In regards to terrestrial impacts, roads and motorized trails impact wildlife through a number of mechanisms including: direct mortality (poaching, hunting/trapping), changes in movement and habitat-use patterns (disturbance/avoidance), as well as indirect impacts including altering adjacent habitat and interference with predator/prey relationships.[27] Some of these impacts result from the road itself, and some result from the uses on and around the roads (access). Ultimately, numerous studies show that roads reduce the abundance, diversity, and distribution of several forest species.[28]

Furthermore, it is well documented that, beyond specific road density thresholds,[29] certain species will be negatively affected, and some risk being extirpated.[30] Most studies that look into the relationship between road density and wildlife focus on the impacts to large endangered carnivores or hunted game species, although high road densities certainly affect other species. A number of studies show that higher road densities also impact aquatic habitats and fish, with one finding that

> 1) no truly "safe" threshold road density exists, but rather negative impacts begin to accrue and be expressed with incursion of the very first road segment; and 2) highly

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[23] Wemple, B.C. et al. "Forest Roads and geomorphic process interactions, Cascade Range, Oregon." Earth Surface Process and Landforms (2001) 26: 191-204. https://doi.org/10.1002/1096-9837(200102)26:2%3C191::AID-ESP175%3E3.0.CO;2-U
[24] Gucinski, M.J. et al. "Forest Roads: A Synthesis of Scientific Information." USDA Forest Service Pacific Northwest Research Station Gen. Tech. Rep. PNWGTR-509. Portland, OR (2001).
[25] Endicott, D. "National Level Assessment of Water Quality Impairments Related to Forest Roads and Their Prevention by Best Management Practices." A Report Prepared by the Great Lakes Environmental Center for the Environmental Protection Agency, Office of Water, (2008).
[26] Meredith, C. et al. "Reductions in Instream Wood in Streams near Roads in the Interior Columbia River Basin." North American Journal of Fisheries Management, (2014). 34:3, 493-506, https://doi.org/10.1080/02755947.2014.882451
[27] Coffin, A. "From roadkill to road ecology: A review of the ecological effects of roads." Journal of Transport Geography 15: 396-406 (2007). https://doi.org/10.1016/j.jtrangeo.2006.11.006; Fahrig, L., and Rytwinski, T. "Effects of roads on animal abundance: an empirical review and synthesis. Ecology and Society (2009) 14(1): 21; Robinson, C. et al. "A conceptual framework for understanding, assessing, and mitigation effects for forest roads." Environmental Review (2010) 18: 61-86 http://dx.doi.org/10.1139/A10-002.
[28] Fayrig and Ritwinski, 2009; Benítez-López, A. et al. "The impacts of roads and other infrastructure on mammal and bird populations: a meta-analysis." Biological Conservation (2010) 143: 1307-1316 (http://dx.doi.org/10.1016/j.biocon.2010.02.009; Muñoz, P.T. et al. "Effects of roads on insects: a review." Biodiversity Conservation (2015) 24: 659-682. http://dx.doi.org/10.1007/s10531-014-0831-2.
[29] We intend for the term "road density" to refer to the density of all roads within national forests, including system roads, closed roads, non-system roads, temporary roads and motorized trails, and roads administered by other jurisdictions (private, county, state).
[30] Robinson, C. et al., 2010.

significant impacts (e.g., threat of extirpation of sensitive species) are already apparent at road densities on the order of 0.6 km/km^2 (1.0 mi/mi^2) or less.[31]

The harmful effects from climate change is exacerbating these impacts. Just as scientists predicted, climate change is responsible for more extreme weather events, leading to increasing flood severity, more frequent landslides, changing hydrographs, and changes in erosion and sedimentation rates and delivery processes.[32] The Forest Service Office of Sustainability and Climate compiled climate change vulnerability assessments for several regions of the Forest Service discussing near-term consequences for managers to consider, including impacts to transportation infrastructure.[33] The agency found that roads and other infrastructure that are near or beyond their design life are at considerable risk to damage from flooding and geomorphic disturbance (e.g., debris slides). If road damage increases as expected, it will have a profound impact on access to Federal lands and on repair costs.[34] In addition, forests fragmented by roads will likely demonstrate less resistance and resilience to stressors, like those associated with climate change (Noss 2001).[35] This is particularly true for migrating wildlife. One of the most well documented impacts of climate change on wildlife is a shift in the ranges of species.[36] As animals migrate, landscape connectivity will be increasingly important (Holman et al. 2005), and restoring and mitigating migration routes in key wildlife corridors will increase wildlife resiliency.[37].

A Special Note on Roads and Wildfire

Often, the intersection between forest access and human wildfire ignitions receives little attention, yet one study found that study found that humans ignited four times as many fires as lightning. This represented 92% of the fires in the eastern United States and 65% of the fire

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[31] Carnefix, G., and Frissell, C. A. "Aquatic and Other Environmental Impacts of Roads: The Case for Road Density as Indicator of Human Disturbance and Road-Density Reduction as Restoration Target; A Concise Review." Pacific Rivers Council Science Publication (2009) 09-001. Pacific Rivers Council, Portland, OR and Polson, MT.
[32] Schwartz, H. et al. "In book: Climate Change Impacts in the United States: The Third National Climate Assessment Chapter: 5: Transportation." (2014). http://dx.doi.org/10.7930/J06Q1V53
[33] Halofsky, J. et al. "Climate change vulnerability and adaptation in the Blue Mountains." USDA Forest Service Pacific Northwest Research Station Gen. Tech. Rep. PNW-GTR-939, Portland, OR (2017). https://doi.org/10.1016/j.cliser.2018.03.002; Halofsky, J. et al. "Climate change vulnerability and adaptation in the Northern Rocky Mountains." USDA Forest Service Rocky Mountain Research Station (2018a) Gen. Tech. Rep. RMRSGTR-374, Fort Collins, CO (https://doi.org/10.2737/RMRS-GTR-374PART1; Halofsky, J. "Climate change vulnerability and adaptation in the Intermountain Region." USDA Forest Service Rocky Mountain Research Station (2018b) Gen. Tech. Rep. RMRS-GTR-375, Fort Collins, CO https://doi.org/10.2737/RMRS-GTR-375PART2; Halofsky, J. et al. "Climate Change Vulnerability and Adaptation in South-Central Oregon." USDA Forest Service Pacific Northwest Research Station (2019) Gen. Tech. Rep. PNW-GTR-974. Portland, OR https://doi.org/10.2737/PNW-GTR-974.
[34] Halofsky et al., 2018b.
[35] Noss, R.F. "Beyond Kyoto: forest management in a time of rapid climate change." Conservation Biology (2001) 15(3): 578-590. https://doi.org/10.1046/j.1523-1739.2001.015003578.x.
[36] Parmesan, C. "Ecological and evolutionary responses to recent climate change." Annual Review of Ecology, Evolution, and Systematics (2006) 37: 637-669. http://dx.doi.org/10.1146/annurev.ecolsys.37.091305.110100.
[37] Holman, I.P. et al. "A Regional, Multi-sectoral And Integrated Assessment of the Impacts of Climate and Socio-economic Change in the UK." Climatic Change (2005) 71, 43–73. https://doi.org/10.1007/s10584-005-5956-6.

ignitions in the western U.S.[38] Another study that reviewed 1.5 million fire records over 20 years found human-caused fires were responsible for 84% of wildfires and 44% of the total area burned.[39] Just this year, the Congressional Research Service found that "[m]ost wildfires are human-caused, 89% of the average number of wildfires from 2018 to 2022.[40] These human-caused fires undoubtedly align with access. In fact, forest roads can increase the occurrence of human-caused fires, whether by accident or arson, and road access has been correlated with the number of fire ignitions.[41] In addition to changes in frequency, human-caused fires change the timing of fire occurring essentially extending the wildfire season much longer compared to lightning-started fires.[42]

Roaded areas create a distinct fire fuels profile which may influence ignition risk and burn severity.[43] Forest roads create linear gaps with reduced canopy cover, and increased solar radiation, temperature, and wind speed. Invasive weeds and grasses common along roadsides also create fine fuels that are highly combustible. These edge effects can change microclimates far into the forest.[44] While there is little definitive research on roads and burn severity, an increase in the prevalence of lightning-caused fires in roaded areas may be due to roadside edge effects.[45] Furthermore, watersheds that have been heavily roaded have typically received intensive management in the past leaving forests in a condition of high fire vulnerability.[46]

After a forest fire, roads that were previously well vegetated often burn or have been bladed for fire suppression access or firebreaks leaving them highly susceptible to erosion and weed invasion. Roads are a source of chronic erosion following a fire, and pulses of hillslope sediment and large woody debris can result in culvert failures.[47] Fine sediment is frequently delivered to streams and reduces the quality of aquatic habitat. Further, non-native invasive

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38 Nagy, R.C. et al. "Human-related ignitions increase the number of large wildfires across U.S. ecoregions." Fire (2018) 1(4): 1-14. https://doi.org/10.3390/fire1010004.
39 Balch, J.K. et al. "Human-started wildfires expand the fire niche across the United States." PNAS (2017) 114(11): 2946-2951. https://doi.org/10.1073/pnas.1617394114.
40 See https://sgp.fas.org/crs/misc/IF10244.pdf (last accessed, June 12, 2023).
41 Syphard, A.D. et al. "Human influence on California fire regimes." Ecological Applications (2007) 17 (5): 1388–1402 http://dx.doi.org/10.1890/06-1128.1; Yang, J. et al. "Spatial patterns of modern period human-caused fire occurrence in the Missouri Ozark Highlands." Forest Science (2007) 53: 1–15. http://dx.doi.org/10.1142/9789812706713_0001; Narayanaraj, G. and Wimberly M.C. "Influences of forest roads on the spatial pattern of human- and lightning-caused wildfire ignitions." Applied Geography (2012) 32: 878–888. https://doi.org/10.1016/j.apgeog.2011.09.004
42 Nagy et al., 2018.
43 Narayanaraj and Wimberly, 2012.
44 Narayanaraj and Wimberly, 2012; Ricotta, C. et al. "Assessing the Influence of Roads on Fire Ignition: Does Land Cover Matter?" Fire. 2018; 1(2):24. https://doi.org/10.3390/fire1020024
45 Arienti, M.C. et al. "Road network density correlated with increased lightning fire incidence in the Canadian western boreal forest." (2009) 18 (8): 970–982; Narayanaraj and Wimberly, 2012.
46 Hessburg, P.F., and Agee, J.K. "An environmental narrative of Inland Northwest United States forests, 1800-2000." Forest Ecology and Management (2003) 178: 23-59 http://dx.doi.org/10.1016/S0378-1127(03)00052-5
47 Bisson, P.A. et al. "Fire and aquatic ecosystems of the western USA: current knowledge and key questions." Forest Ecology and Management (2003) 213-229. https://doi.org/10.1016/S0378-1127(03)00063-X

plant species often propagate on many forest roads, and post-fire invasion can be facilitated by wildfire disturbance or even through suppression efforts.[48]

While the Forest Service focuses its resources on wildfire suppression and reducing wildfire risk in priority "firesheds," the aforementioned studies suggest controlling access and reducing the road network could be an effective management strategy for reducing human-caused wildfires. Further, the Forest Service must recognize that road improvement and access carry substantial risks of human-caused wildfires, which must be equally weighted with any management benefits.

Benefits of Addressing Road Impacts

The ecological benefits of reducing the forest road system and performing critical maintenance are widely accepted. Reconnecting fragmented forests has been shown to benefit native species.[49] Decommissioning and upgrading roads can reduce fragmentation of both aquatic and terrestrial systems. For example, reducing the amount of road-generated fine sediment deposited on salmonid nests can increase the likelihood of egg survival and spawning success.[50] Strategically removing or mitigating barriers such as culverts has been shown to restore aquatic connectivity and expand habitat.[51] Decommissioning roads in riparian areas may provide further benefits to salmon and other aquatic organisms by permitting reestablishment of streamside vegetation, which provides shade and maintains a cooler, more moderated microclimate over the stream.[52] Further, controlling access management has been important for reducing elk disturbance and improve connectivity.[53] Similarly, restricting motorized recreation increased grizzly bear population density by 50 percent.[54] In addition, road decommissioning restores wildlife habitat by providing security and food such as grasses, forbs, and fruiting shrubs (Switalski and Nelson 2011, Tarvainen and Tolvanen 2016).[55]

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[48] Birdsall, J.L. et al. "Roads Impact the distribution of Noxious Weeds more than restoration treatments in a lodgepole pine forest in Montana, USA." Restoration Ecology (2012) 20(4): 517-523. http://dx.doi.org/10.1111/j.1526-100X.2011.00781.x

[49] Damschen, E.I. et al. "Ongoing accumulation of plant diversity through habitat connectivity in an 18-year experiment." Science (2019) 365(6460): 1478-1480. https://doi.org/10.1126/science.aax8992

[50] Switalski, T.A. et al. "Benefits and impacts of road removal. Frontiers in ecology and the environment (2004) 2(1): 21-28; McCaffery M. et al. "Effects of road decommissioning on stream habitat characteristics in the South Fork Flathead River, Montana." Transactions of the American Fisheries Society (2007) 136: 553-561. http://dx.doi.org/10.1577/T06-134.1

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Recently, researchers have been exploring the relationship of road restoration and carbon. There is the potential for large amounts of carbon (C) to be sequestered by restoring roads to a more natural state. Upon road decompaction during reclamation, vegetation and soils can develop more rapidly and sequester large amounts of carbon. Research on the Clearwater National Forest in Idaho estimated total soil C storage increased 6-fold compared to untreated abandoned roads.[56] Another study concluded that reclaiming 425 km (264 miles) of logging roads over the last 30 years in Redwood National Park in Northern California resulted in net carbon savings of 49,000 Megagrams (54,013 tons) of carbon to date.[57] A further analysis found that recontouring roads had higher soil organic carbon than ripping (decompacting) the roads.[58] Finally, a recent study in Colorado found that adding mulch or biochar to decommissioned roads can increase the amount of carbon stored in soil.[59]

Achieving a Sustainable Minimum Road System on National Forest Lands

Undoubtedly, there are numerous benefits from reducing the forest road system and controlling motorized access. In fact, the Forest Service has a long history of trying to realized these benefits. Specifically, when the Forest Service established its Roadless Rule in 2001, it also established the "Roads Rule" to address its vastly oversized and harmful road system, recognizing the need "to address a growing maintenance backlog on its existing road system, adverse environmental and social effects of old roads and some new roads, and public demand for improved access within the capabilities of the land."[60] The new Roads Rule directed the Forest Service to identify unneeded roads for decommissioning and to give priority to those that pose the greatest risk to public safety or environmental quality. However, without a deadline to fully comply, most national forests failed to meet the rule's direction, leaving the roads problem largely unresolved during a time when the agency was experiencing enormous growth in motorized recreation. In 2005, the Forest Service established a new regulatory framework to address impacts from poorly managed roads and off-road vehicles leading to the adoption of the Travel Management Rule (TMR). The Rule has three subparts: subpart A — Administration of the Forest Transportation System; subpart B - Designation of Roads, Trails and Areas for Motor Vehicle Use; and subpart C — Use by Over-Snow Vehicles. Subpart A retained the original direction under the 2001 Roads Rule, but rather than focus complying with all part of the TMR, the agency focused mostly on subpart B, with the result that the Forest Service failed to identify

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landscape—reclaiming gravel roads in conservation areas." Environ Sci Pollut Res (2016) 23, 13732–13744. https://doi.org/10.1007/s11356-015-5341-6

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a minimum road system and unneeded roads that could be decommissioned, a problem that persists to this day. Part of the problem stems from a failure to properly develop and utilize Travel Analysis Process reports. In 2009, the Forest Service updated its directives pertaining to the "science-based analysis" required under subpart A, thereby establishing the Travel Analysis Process (TAP). Once the analysis was completed, the resulting TAP reports were meant to inform NEPA-level analysis and decisions for the identification of the minimum road system. Yet, upon the release of the new travel analysis process directives, many national forests did not complete the TAP reports until the Forest Service Washington Office (WO) issued an internal memo establishing a 2015 deadline.[61] Completion of the TAP reports was an important first step towards the establishment of the minimum road system, yet there has been little progress to actually comply with subpart A under NEPA, and now many of those reports are out of date.

As the Forest Service was working to properly address its overburdened and underfunded road system, the agency also established the Watershed Condition Framework (WCF) that provides "a comprehensive approach for proactively implementing integrated restoration on priority watersheds on national forests and grasslands."[62] The WCF utilizes twelve indicators with associated attributes under four main categories to determine if a 6-HUC level watershed is functioning properly, functioning at risk or is impaired. Included among the indicators, is one titled "Roads & Trails."[63] Here it is important to note that for classification purposes, and thus analysis purposes under NEPA, the Watershed Condition Classification Guide (WCCG) utilizes an expansive "road" definition:

> *For the purposes of this reconnaissance-level assessment, the term "road" is broadly defined to include roads and all lineal features on the landscape that typically influence watershed processes and conditions in a manner similar to roads. Roads, therefore, include Forest Service system roads (paved or nonpaved) and any temporary roads (skid trails, legacy roads) not closed or decommissioned, including private roads in these categories. Other linear features that might be included based on their prevalence or impact in a local area are motorized (off-road vehicle, all-terrain vehicle) and nonmotorized (recreational) trails and linear features, such as railroads. Properly closed roads should be hydrologically disconnected from the stream network. If roads have a closure order but are still contributing to hydrological damage they should be considered open for the purposes of road density calculations.*[64]

The WCF includes four main attributes to measure when ranking the Road & Trail Indicator: road densities, the proximity to water, road maintenance and mass wasting. In numerous

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[61] See Forest Service Memorandum, March 29, 2012 by Deputy Chief Leslie Weldon, (stating, "[t]he next step in identification of the MRS is to use the travel analysis report to develop proposed actions to identify the MRS. These proposed actions generally should be developed at the scale of a 6th code subwatershed or larger. Proposed actions and alternatives are subject to environmental analysis under NEPA. Travel analysis should be used to inform the environmental analysis.").

[62] Potyondy, J. et al. "Watershed Condition Framework: A Framework for Assessing and Tracking Changes to Watershed Condition." USDA Forest Service (2011a) FS-977.

[63] Potyondy, J. et al. Watershed Condition Classification Technical Guide. USDA Forest Service. (2011b). FS-978.

[64] Ibid at p. 26 (emphasis added).

watersheds, the Road & Trail Indicator received a "poor" ranking.[65] These attributes are especially applicable to the Travel Analysis Process, particularly when identifying and measuring watershed risks. Yet, many TAPs did not include Road & Trail Indicator rankings when assessing road system risks. Given this omission and the outdated nature of most TAP reports, unit-level planning provides an opportunity to update and integrate both processes, and use the result to inform new components for forest plan revisions.

Through planning, forest managers can proactively address threats to infrastructure, and can actually enhance forest resilience by removing unneeded roads to create larger patches of connected habitat. The Forest Service published a report reinforcing the need for forest managers to be proactive in addressing environmental risks associated with roads:

> *As stated previously, watershed sensitivity is determined by both inherent and management-related factors. Managers have no control over the inherent factors, so to improve resilience, efforts must be directed at anthropogenic influences such as instream flows, roads, rangeland, and vegetation management.*[66]

As shown, the Forest Service has several resources that it can utilize during Forest Plan Revisions. In addition, the agency produced its Transportation Resiliency Guidebook that provides a review of climate change impacts on Forest Service infrastructure, and includes a step-by-step guide for identifying vulnerabilities and preparedness planning within its transportation network.[67] The guidebook recommends using the forest plan revision process as "an opportunity to analyze baseline conditions and climate change vulnerabilities and to develop climate resilient strategies for the future."[68] The Forest Service should use the transportation resilience guidebook in tandem with its Travel Analysis Process and Watershed Condition Framework to inform forest plan revisions. Future rulemaking language stemming from the APNR should include direction that will effectively integrate the aforementioned processes in a manner that will provide for an ecologically and economically sustainable road system.

We recommend the that the rules include the following directions:

- Revise the draft assessment to include findings from an updated or new Travel Analysis Process report that recommends a minimum road system sufficient for each subwatershed to achieve a "good" rating under the WCF Road & Trail Indicator attribute scores and addresses vulnerabilities identified through use of the Transportation Resiliency Guidebook. In doing so, the Forest Service should provide direction that favors road decommissioning instead of closure or storage in order to truly reduce the overall system.

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[65] Potyondy, J. et al. (2011b). ("The density and distribution of roads and linear features within the watershed indicates that there is a higher probability that the hydrologic regime (timing, magnitude, duration, and spatial distribution of runoff flows) is substantially altered."). See also, the USDA Forest Service Watershed Condition Classification and Prioritization Interactive Map (last accessed, June 13, 2023).
[66] Furniss, M.J. et al. "Water, climate change, and forests: watershed stewardship for a changing climate." USDA Forest Service Pacific Northwest Research Station (2010). Gen. Tech. Rep. PNW-812. Portland, OR.
[67] Rasmussen, B. et al. "U.S. Forest Service Transportation Resiliency Guidebook." U.S. Department of Transportation John A. Volpe National Transportation Systems Center, (2018). DOT-VNTSC-USDA-19-01, Washington, D.C. Available at: https://rosap.ntl.bts.gov/view/dot/38737.
[68] Ibid.

In addition, the TAP report must recognize the risks roads pose for human-caused wildfire ignitions. As it stands, roads often are only recognized as a benefit to provide access for fire suppression and vegetation management.

- The final Assessment must contain sufficient enough information to support establishment of objectives to identify and implement the minimum road system under NEPA.
- The final Assessment must contain sufficient enough information to support establishing specific forest plan components that will ensure all system roads are maintained to their objective maintenance level as funding allows, and store roads that cannot meet this direction.
- The final Assessment must contain sufficient enough information to support establishing specific road and motorized trail density standards to necessary to recover "federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern within the plan area."[69]

The current status of the transportation system on the Lolo National Forest is unacceptable and requires specific management direction to attain future desired conditions.

- The final Assessment must contain sufficient enough information to support establishing specific forest plan components that will ensure all system roads are maintained to their objective maintenance level as funding allows, and store roads that cannot meet this direction.
- The final Assessment must contain sufficient enough information to support establishing specific road and motorized trail density standards to necessary to recover "federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern within the plan area."[70]

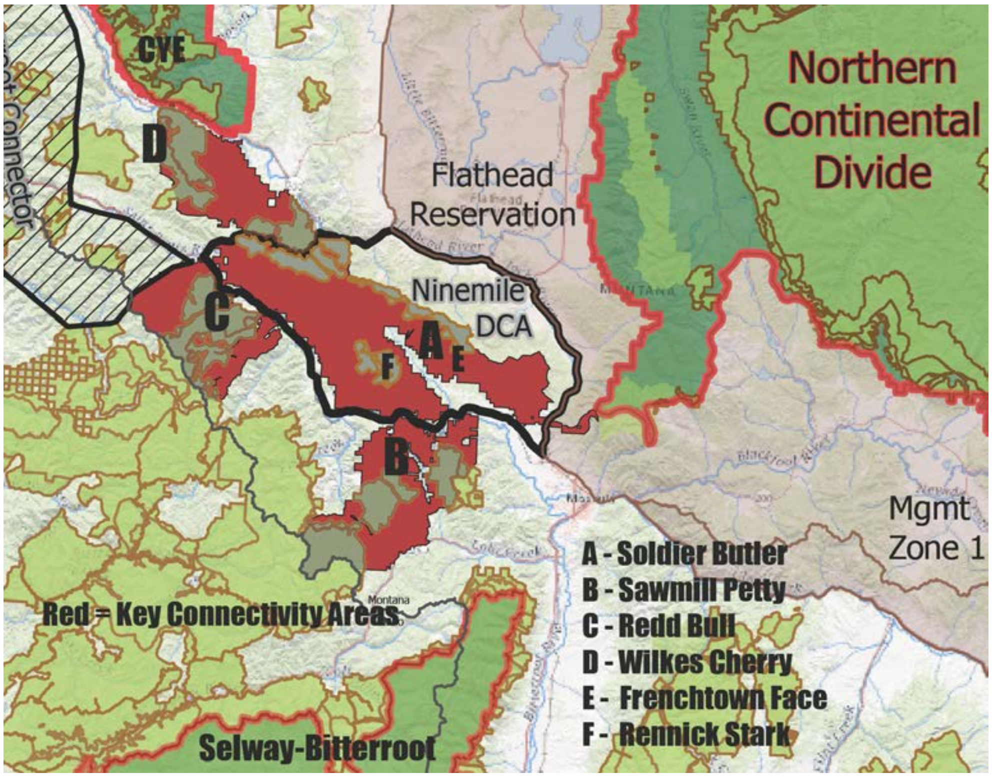
[69] 36 C.F.R. § 219.9(b)(1).
[70] 36 C.F.R. § 219.9(b)(1).

Wood Products Production and Logging

Under the current Plan, 56% of the Forest is identified as being suitable for timber harvest. This is way out of balance with other Forest resources and uses. For the purposes of Forest planning, timber production does not include harvest on non-suitable lands (Lolo BiOp page 29). The trend shows acres of silvicultural actions have steadily increased over the last 10 years, especially over the most recent 3 years. From 1986 to 2021, only an average of 35 million board feet of timber products were sold per year. Recent trends in accelerated volume sold is primarily related to post-fire salvage harvest.

"Timber harvest is increasingly used as a tool to achieve multiple resource objectives including fuels reduction, enhancing wildlife habitat, and ecological restoration." (DA).

Logging and the associated roadbuilding both permanent and "temporary" are stressing the leading ecosystem driver of habitat and species connectivity. Large timber sales with dozens of miles of roads have been proposed in the Ninemile DCA (Soldier-Butler), between the Ninemile and the Bitterroot Ecosystem (Sawmill-Petty) and in the Cabinet-Bitterroot Connector (Redd-Bull). Added to future projects for wildfire mitigation and restoration, woods products production is out of balance with a sustainable program.



Recent and Planned Large Timber Sales Within Primary Connectivity Areas.

The wood products production program on the Lolo National Forest needs to be downsized to small sales (< 5 mmbf) with no permanent roads and no clearcutting. Temporary roads must be reclaimed as part of project completion and not deferred or "stored."

While the Allowable Sale Quantity (ASQ) has been steadily rising, this is an incomplete measure of the level of activity. For example, timber cut and sold as part of salvage or restoration are not counted within the ASQ. The Total Amount Cut from all sources is a more appropriate metric for analysis. The 1986 Forest Plan also stated the expectation of 30 million board feet of firewood per year.

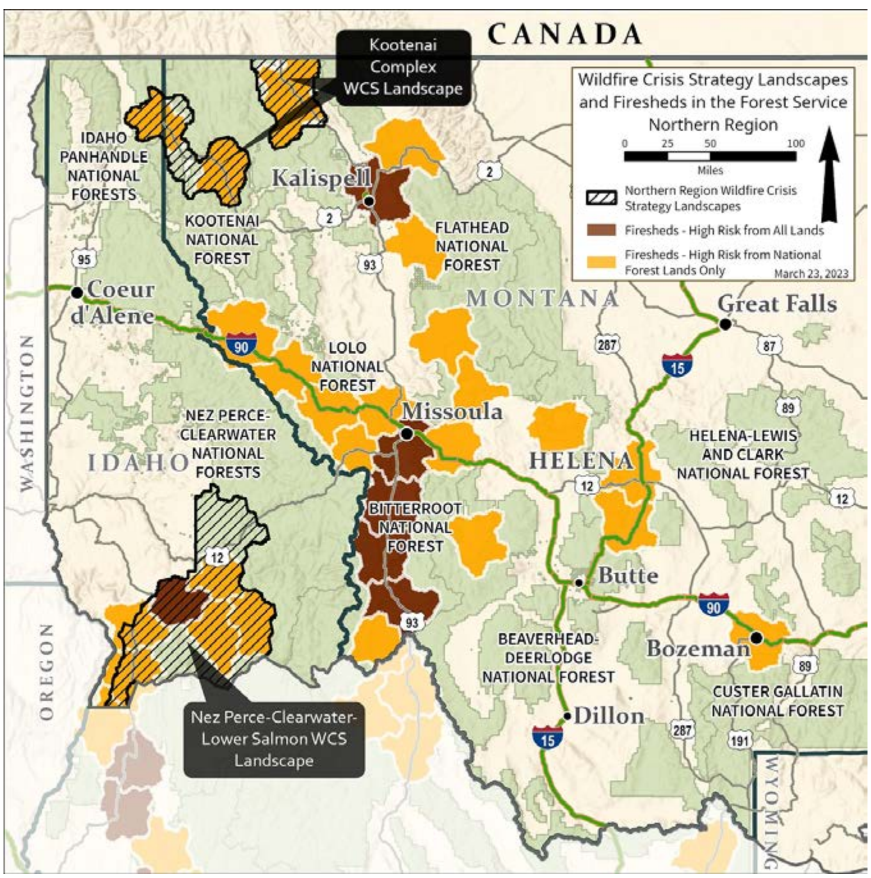
"However, it is now recognized that leaving lands previously classified as not suited for timber production untouched by vegetation management may not always achieve the resource objectives for fuels reduction, wildlife habitat, recreation, or landscape resilience. Timber harvest may be a tool to manipulate vegetation composition and structure to achieve other resource objectives on unsuited lands." (DA).

There has been a recent, more sustained peak with 54.2 million board feet sold from 2017-2021. The 2001 Biennial Monitoring Report for the Lolo includes a comparison of timber harvest acres from the period of 1987-2001 as compared to the 2018-2020.

The annual average acres of intermediate and regeneration harvest accomplished per year recently (2018-2020) represent roughly a twelve-fold increase from the average annual acres harvested from 1987-2001. This increase corresponds to the peak in timber volume sold recently as discussed in the section above. The acceleration of harvest in recent decades is in part due to post-fire salvage projects. (emphasis added).

Fuelwood is the primary non-timber product sold on the Lolo National Forest at an average of 10 million board feet per year.

The Assessment must reveal the area and volume expected to be cut as part of the Wildfire Crisis Strategy including the use of Emergency Declaration authority approved by Agriculture Secretary Vilsack. The "Firesheds" map below shows virtually the entire LNF is covered. The levels of cutting associated with Wildfire Adapted Missoula program must also be revealed.



Recreation and Infrastructure

The 2012 planning rule directs that land management plans provide for sustainable recreation (219.10(b)(1)(i). The rule defines this as *"The set of recreation settings and opportunities on the National Forest System that is ecologically, economically, and socially sustainable for present and future generations*." (emphasis added).

The current status of recreational impact on the natural resources of the LNF is largely unknown because the Forest Service has not performed the Monitoring and Evaluation required by the 1986 Plan and 2012 Planning Rule.

The DA only looks at projected use levels citing mostly non-Forest Service sources and not the environmental impacts that come with expanded use. The LNF needs to take a comprehensive look at recreation on our public lands and define the recreational carrying capacity for the Planning Area based on cumulative effects analysis. It also needs to clearly define the Special Use Permit program including the appropriateness of widespread use of Categorical Exclusions.

Recreation use is affecting the entire Lolo National Forest and there has been a rapid increase in visitation over the past decade. Annual forest visitation to the Forest is about 1,450,000 visitors (U.S. Department of Agriculture 2021a) (page 257). The top ten reasons people recreate in the plan area are hiking/walking, viewing wildlife, viewing natural features, relaxing, driving for pleasure, fishing, hunting, nature study, downhill skiing, and biking (U.S. Department of Agriculture 2023c). Not only has the human population in Missoula County increased dramatically since the 1980s (currently 121,000), non-resident use has exploded and this increase in use amongst all recreation activities has outpaced management response and mitigation of resource damage. *"Front country near rapidly growing or changing communities is under tremendous pressure from both residents and visitors."* (DA page 256).

However, data from the DA shows that recreation use on the Forest is on an unsustainable trajectory. The current trend of commercial use trips on the Forest has increased from less than 50 per year in 2015 to about 475 or 9.5 times-fold over the past 7 years. The amount of increase for various uses are:

- developed skiing (68 to 147 percent increase)
- undeveloped skiing (55 to 106 percent increase)
- challenge activities (50 to 86 percent increase)
- equestrian activities (44 to 87 percent increase)
- motorized water activities (41 to 81 percent increase)
- visiting primitive areas (33 to 65 percent increase)
- motorized off-road activities (29 to 56 percent increase)
- motorized snow activities (25 to 61 percent increase)
- hunting (8 to 23 percent), fishing (27 to 56 percent increase), and
- floating activities (30 to 62 percent increase)

•Motorized recreation has increased significantly from 2000, with a 300 percent increase in off-highway vehicle registration and a close to 200 percent increase in snowmobile registration. Nearly 30 percent of Montanans aged 16 and over participate in off-highway vehicle recreation, putting Montana in the top 10 states for off-highway vehicle recreation. (DA page 276).

•Recreation safety is a growing concern in Montana. Data shows that Montana is in the top states for fatalities related to avalanches and boating.

The DA recognizes the need but the failure to do the required Monitoring and Evaluation means it still does not have the information.

"The Lolo National Forests's long-term goal is to have comprehensive information about dispersed recreation use across the forest. Location, condition, use type, concentration, and other collected information would provide managers with a more comprehensive understanding about dispersed use particularly in concentrated use areas such as peaks, lake basins, hunting areas, shooting areas, river corridors or other destinations."

<u>This is not a long-term goal it is an immediate necessity for revision of the Forest Plan.</u>

Most forest users do not hire guides. On top of unguided use, the Lolo National Forest currently has 132 recreation related SUPs with 68 for outfitting and guiding with nearly 500 commercial trips in 2022. Guided parties tend to be far larger as there is a profit motive involved. There are another 18 SUPs for recreation events. How many people do each permittee and event bring into the Forest each year?

What will the Lolo do when receiving new applications for expanded uses? The answer may be the new SUP issued for commercial rafting on the Clearwater Canoe Trail. Without forewarning, long time users discovered a busload of rafters and this new use has changed the traditional quiet nature of the use and the solitude of the area.

<u>A moratorium on issuance of new SUPs for recreation is required pending completion of a full assessment of the cumulative impacts of recreation across the planning area.</u>

In addition to the Special Use Permit program, there are a total of 112 Recreation Infrastructure Sites including two hotels/resorts, two developed ski areas and 43 campgrounds and picnic areas.

When considering whether to expand recreation sites and infrastructure, an assessment must provide information on whether that need or service is already being met, including on non-federal lands.

The former Flathead National Forest supervisor who supported expansion of the Holland Lake Lodge said he thought the Forest Service is obligated to meet increased demand. However, without limits this can result in everything everywhere all at once. This can be seen on the Custer Gallatin National Forest which is overrun by development and recreation yet the revised Forest

Plan designated even more recreation areas and expanded the number of permitted outfitters and guides and their seasons of operations. The land and wildlife suffer from such expansions.

A major issue has become the lack of restraint from recreational users. Climbers want bolts in Wilderness, mountain bikers want to ride within Wilderness, snowmobilers want to ride off-trail in alpine habitats proposed for Wilderness designation and runners want to hold races in bear habitats. When users do not practice self-restraint, managers must step in to limit the impacts.

"Not all desired uses or future recreation trends may be accommodated on the Forest. Limits based on terrain, safety, resource availability, wildlife and other resource needs may not meet the demands of the public." DA page 256.

Some uses impact not only wildlife but other uses. Mountain bikes coming down trails at high speed is a serious conflict with hikers and horseback riders. Bikers have proposed separate trail systems: one for hikers and horseback riders and one for bikers. This only expands recreation use over a larger footprint, increasing conflicts with wildlife, soils and water quality.

The Forest Service says it tries to balance the increased demand with resource protection but how do you balance something you haven't measured? Dr. Chris Servheen, former national grizzly bear recovery coordinator, told the Interagency Grizzly Bear Committee that ample science exists to do this. This is important in determining where mountain bikes will be allowed, how many outfitter trips, party size, etc.

Before the Holland Lake controversy most of the public had never heard of Special Use Permits and Categorical Exclusions. SUPs are awarded to outfitters, guides, ski resorts and others who operate businesses on National Forests. Categorical Exclusions avoid detailed environmental analysis and are usually done without public notice and involvement.

"Approximately 82% percent of summer non-motorized, non-wilderness trails are open to mountain bikes. However, many trails were not designed for biking, resulting in some challenges in navigation and user conflicts." (DA page 267). *Mountain biking is a use that has started to grow in popularity, with users requesting dedicated trails to reduce conflicts. Although it is commonly recommended to develop closed or decommissioned roads for off highway vehicle or mountain bike trails, typically these roads were not designed nor placed in such a manner to provide satisfying recreational experiences, and do not offer the challenge, view, or recreation setting motorized users and mountain bikers are seeking out."*

The existing Lolo National Forest Plan does not measure or assess the environmental impacts from mountain biking and the forests have allowed this use and impact to increase without regulation. The graph in Figure 27, page 279 of the Draft Assessment shows that in 2021 and 2022 there were commercial trips associated with mountain biking. How were these permits allowed without impact analysis? Allowing mountain bikes on all non-motorized trails doesn't cut it. This is a particular concern in grizzly bear habitat that includes all of the Lolo National Forest. Leading scientists have found that the risk of a human/grizzly bear encounter is 14 times higher while mountain biking than on foot (Mattson 2019). A Board of Inquiry Report chaired by the former National Grizzly Bear Recovery Coordinator (Servheen et al. 2017) on the death of a mountain biker who crashed into a female grizzly bear with cubs was well-publicized. Dr. Servheen has also said that mountain biking in grizzly bear habitat is particularly conducive to bear-human confrontations due to surprise encounters. *"High speed and quiet human activity in bear habitat is a grave threat to bear and human safety and certainly can displace bears from trails and along trails. Bikes also degrade the wilderness character of wild areas by mechanized travel at abnormal speeds."* Biologists with the U.S. Forest Service found all trail-based recreational uses have negative impacts on elk, with mountain bikes and ATVs causing the greatest flight response in elk (Wisdom et al. 2018).

"Dispersed camping is a common ecosystem stressor associated with recreation on National Forest system lands. This involves camping in areas that do not provide infrastructure or facilities to support use and are not managed as developed recreation site or campgrounds. When unmanaged dispersed camping areas receive high and frequent use, health and safety issues and resource issues, such as sanitation, compaction, vegetation impacts, and erosion, can result. As use continues, additional infrastructure and recreation management may be needed to reduce resource impacts and manage these uses" (DA, page 60).

Instream wood is an essential ecosystem component serving many purposes with primary functions of flood energy dissipation and fisheries habitat. Most valley bottom streams are significantly lacking in wood as compared to historic conditions, and more wood is needed in most stream systems to improve the health of theses ecosystems. Concurrently, large instream wood and wood jams can be inconvenient or even hazardous to recreationists in terms of blocking passage to floaters and entrapment. This challenge presents a situation where public safety directly conflicts with ecological needs in these riparian systems.

As the level of development of recreation opportunities increase, so does the infrastructure required to support those areas.

11. Winter Recreation

There are about 550 miles of over-snow vehicle routes on the Lolo National Forest and 66% of the Forest is open to cross-country travel (Lolo BiOp 2023). Yet the DA states this amount is 628 miles. More than 1.4 million acres of the Forest is open to cross-country travel by snowmobiles. This is out of balance with other resources and uses.

"Other dispersed winter activities including backcountry skiing, snowshoeing, and fat tire biking have been growing in popularity.

Since adoption of the 1986 plan, recreation activities in the plan area have changed, especially related to motorized recreation activities. The use and availability of off-highway vehicles, coupled with the power and advanced technology of over-snow vehicles has provided visitors with greater ability to go places within the plan area than had previously been available to them." (DA page 270).

Cross-country areas include Lolo Creek, Mineral Peak, Shoofly Meadow and Twin Creeks. Mineral Peak is grizzly bear denning habitat (Bader and Sieracki 2022) and Shoofly Meadows is a Research Natural Area.

The Lolo BiOp states that cross-country use is allowed on about 206,000 acres of grizzly bear denning habitat. However, the BiOp states (page 24) the Lolo National Forest used a simple, unscientific approach to estimating denning habitat. *"Denning habitat on the remaining portion of the Forest uses a simplified approach. To estimate denning habitat on the remaining portion of the Forest (outside NCDE), a basic GIS exercise was completed using available data such as slope, canopy cover, and elevation as a proxy to where denning habitat could occur outside of the NCDE. Given a pack of known den sites on the Forest Outside of the NCDE, this approach likely overestimates denning habitat outside the NCDE because it is a simplified approach and is not a model that incorporates finer details such as localized den site characteristics. However, this analysis, although an overestimate of the amount of denning habitat, can provide an estimate of where denning habitat may occur. This denning habitat estimate will likely be updated as research becomes available."*

This is absolutely inexcusable. Peer-reviewed published scientific work (Bader and Sieracki 2022) was made available to the Lolo National Forest and the U.S. Fish & Wildlife Service. This is a model-based estimate of denning habitat based on 364 actual den sites and stratified as to the probability of den selection. The results are shown below. The Assessment must use the "best available scientific information", not a GIS exercise with no validity.

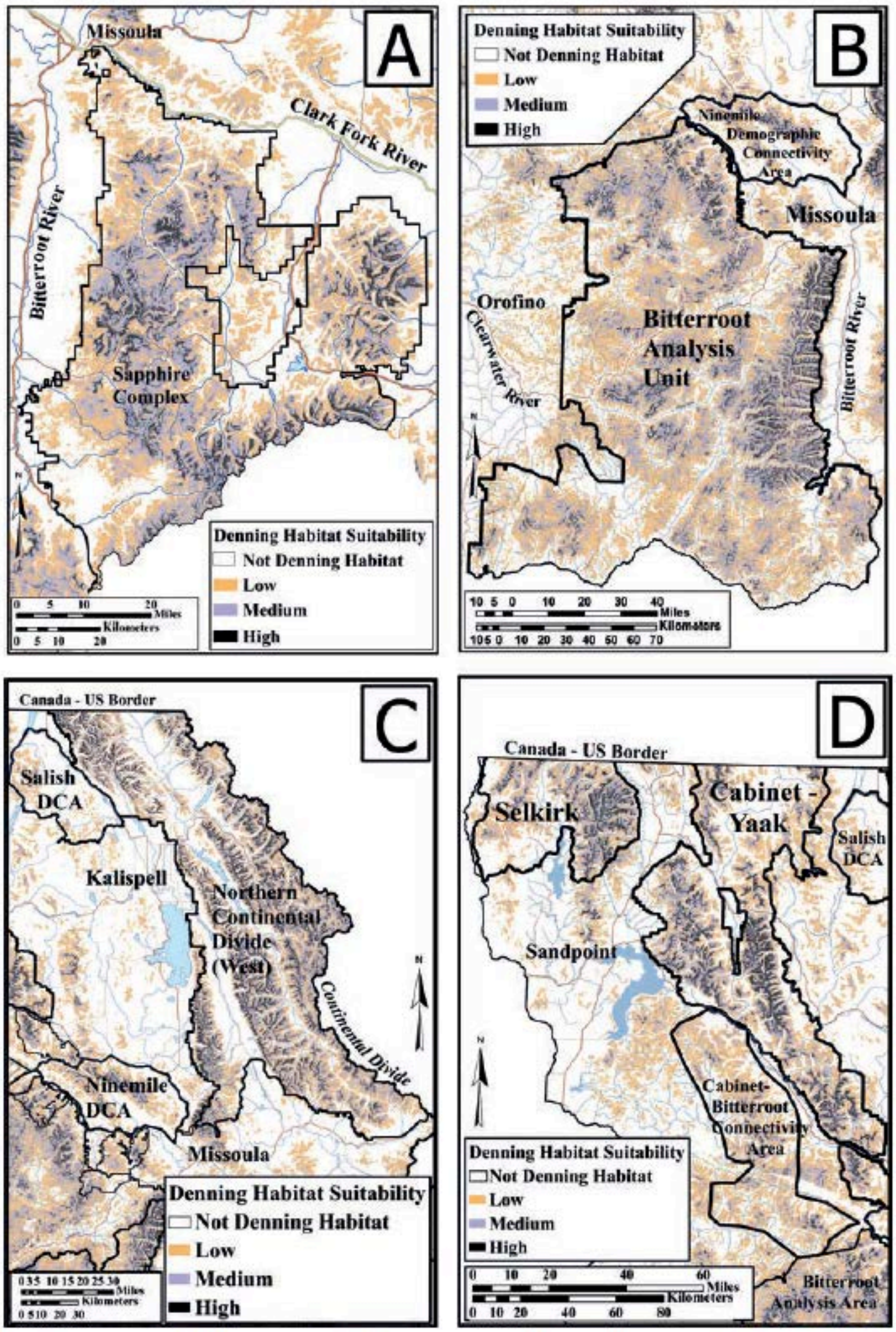


FIGURE 8. Denning suitability results for the analysis units showing the selection for steep slopes, higher elevation, and distance from open roads and water bodies. Medium- and high-suitability habitats are of the most direct importance to demographic connectivity and management.

Moreover, the discussion in the DA regarding potential disturbance to denning grizzly bears is inadequate. Disturbance and even fatalities have been documented in North America. Hilderbrand et al. (2000) documented a female grizzly bear and her two cubs killed when a snowmobile caused avalanche crushed their den. In the Banff National Park area in Alberta, which hosts a low-density bear population, six incidents have been documented in the past decade.

"…over the past decade six incidents of bears being disturbed by winter recreationists have occurred in Banff National Park and Peter Loughheed Provincial Park, AB, one resulting in human injuries. Although these incidents are isolated and rare, it may be evidence of an emerging trend. These incidents resulted in six proactive closure to provide den site security. Four other proactive closures were enacted where GPS-collared bears were denning in areas heavily used by winter recreationists. Other surprise encounters at grizzly bear den entrances in Canada have also occurred, resulting in one human fatality." (Parks Canada).

The Forest Service states that den disturbance is unlikely to be detected. However, lack of reported incidents does not mean there haven't been disturbance events. There is an increasing trend of off-trail "high-marking" and given that most of the Forest is open to cross-country travel increases the likelihood of disturbance. New technology including ski bikes allow motorized use within dense forest habitats where grizzly bears den.

Sources

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Hilderbrand GV, Lewis LL, Larrivee J, Farley SD. 2000. A denning Brown Bear, (Ursus arctos), sow and two cubs killed in an avalanche on the Kenai Peninsula, Alaska. Canadian Field Naturalist 114:498.

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12. Livestock Grazing & Range Management

Livestock allotment closure and permit retirements are two tools that are readily available to federal land management agencies in their planning and administrative processes. For example, the Caribou-Targhee National Forest (CTNF) just across the Montana border in Idaho has a provision in its Forest Plan that allows for managers to reserve or set aside rangeland areas "for wildlife and watershed restoration work." (CTNF Forest Plan, 111-155). In its 2006 Proposed Forest Plan Revision (which was later abandoned), the Lolo National Forest (LNF) proposed the closure of vacant allotments as just such a tool (2006 Proposed LNF Forest Plan, page 139). Though this effort was ultimately abandoned, the opportunity to propose and expand the administrative authority and justification for allotment closure/retirement is once again available. As the Forest Plan revision process moves forward, we strongly urge the LNF to incorporate flexible, robust, and effective allotment closure and retirement stipulations to protect irreplaceable ecological values and save taxpayer money. The comments that follow highlight problems with the livestock grazing program on the LNF that could be effectively mitigated through the use of allotment closure and retirement provisions.[70]

1) **Inadequate Grazing Program Administration**
As the LNF readily acknowledges in the DA, livestock grazing on the Forest has been steadily declining since the 1950's, with only 11 active allotments and 2,652 AUMs (DA, 341). Despite the small scale of the livestock grazing on the LNF (relative to other Forests), the extremely limited information provided in the DA (and in FOIA releases) indicates that even at such a reduced level, the grazing program has been poorly managed and that there have been and continue to be negative ecological impacts. This is made evident by the following:

- Multiple permittees appear to have been grazing – some for years at a time – under expired permits. One FOIA release received by Western Watersheds Project contained a letter from the acting District Ranger (dated 01/05/2021) to the permittee on the Four Mile allotment notifying this individual that their temporary grazing permit had expired in October of 2010. That's *eleven years* of grazing without a current permit. Similar situations occurred with other allotments on the LNF (ex. Tamarack Creek allotment). Without a current permit the proper terms and conditions are not in place to prevent livestock from causing ecological damage to public lands. This shows that range staff were either unable or unwilling to process permits and conduct the requisite environmental analysis for proper administration of the grazing program. This is the first indication that administration of the grazing program on the LNF is not meeting basic requirements and expectations.
- Despite being required by the 1986 Forest Plan, as well the individual Allotment Management Plans (AMPs) and the Annual Operating Instructions (AOIs), consistent and informative grazing allotment monitoring has not occurred on the LNF. This has been made evident by multiple FOIA requests for monitoring information on the active allotments across the Forest all of which have yielded little to no documentation over several years of requests. This reality directly contradicts statements made in the LNF 2021 Biennial Monitoring Report (MR), as well as in specific allotment AMPs. The Biennial Monitoring Report claims that data collection occurs "annually by active allotment" and that "range conditions" are one of the indicators used for this monitoring (MR, 131). Additionally, the MR explicitly claims that "annual field monitoring of those active allotments in use have shown that the Forest is compliant with Forest Plan direction." (MR, 132). There is little to no evidence that this monitoring of range conditions actually took place. For example, the FONSI issued and signed in 2012 for the Henry Creek and Swamp Creek AMP revision claims that both allotments are and will

continue to be "monitored annually" (FONSI, 4). However, looking at FOIA releases in the years following the issuing of these AMPs show little to no evidence of documented monitoring on the Swamp Creek or Henry Creek allotments. Monitoring is fundamental to proper grazing allotment administration and is the only way in which degradation of ecological conditions can be detected and then corrected for. If monitoring does not regularly occur, grazing administration will fail to protect important ecological values that can be easily and quickly degraded by livestock. The failure to adequately monitor is further evidence that very basic components of grazing program administration are not being implemented on the LNF.

- Though grazing across the LNF is relatively light compared to many other National Forests, this did not appear to prevent negative impacts caused by improper livestock management. These impacts are only mentioned in passing in the Draft Assessment section on livestock grazing: "Impacts have and continue to occur in some wetlands and stream segments; future monitoring is planned to improve our understanding and impacts will be further addressed with appropriate remedial actions." (DA page 57). Despite claims elsewhere to the contrary, this statement appears to acknowledge that monitoring has not been occurring on LNF grazing allotments and has resulted in negative impacts to ecologically important lentic and lotic sites. Furthermore, "planning for future monitoring" is not taking action. It is merely restating an intent to do what should have already been happening, at a bare minimum, throughout all allotments on the LNF. Outside of this brief statement in the DA, the public is left with sparse and extremely vague mentions of such degradation in some of the AOIs issued at the start of the grazing season. For example, the 2021 AOI for the Tyler-Genoa Allotment has this to say: "The exclosure fencing needs to be expanded at all locations. Cattle are trampling wet areas beyond the exclosure fencing. These areas (specifically Griel Springs and Genoa Springs) are considered isolated wetlands. *Trampling is degrading the natural hydrology of the area and may be damaging rare or sensitive plant and aquatic species*."[emphasis added](AOI, 1). Here we have clear evidence that the LNF is at least aware of ongoing damage being caused by improper livestock grazing, but this brief statement is all we have to go on. No monitoring data or other such documents can be found to support this. The Tyler-Genoa Allotment also happens to either overlap with or is immediately adjacent to bull trout habitat (i.e. Harvey Creek drainage). The bull trout is on of several aquatic species that will likely be harmed by this degradation. Where are the monitoring data, utilization measurements, bank alteration measurements, etc., that support this claim of livestock caused damage? Why aren't cattle being pulled off of or otherwise removed from the allotment, or at least from the pasture containing these sensitive and ecologically important areas? Again, this is further evidence that the grazing program on the LNF is not meeting basic requirements for regulation and monitoring.

Livestock Grazing

Although the DA identifies livestock as a "stressor" it completely fails to examine the vast body of scientific research explaining how livestock grazing acts as a **major** stressor of ecosystems in the western U.S. We correct and supplement the Assessment record.

From a News Release accompanying Beschta et al. (2012):

> A growing degradation of grazing lands could be mitigated if large areas of Bureau of Land Management and USDA Forest Service lands became free of use by livestock and "feral ungulates" such as wild horses and burros, and high populations of deer and elk were reduced, the group of scientists said.
>
> This would help arrest the decline and speed the recovery of affected ecosystems, they said, and provide a basis for comparative study of grazing impacts under a changing climate. The direct economic and social impacts might also be offset by a higher return on other ecosystem services and land uses, they said, although the report focused on ecology, not economics.
>
> Livestock use affects a far greater proportion of BLM and Forest Service lands than do roads, timber harvest and wildfires combined, the researchers said in their study. But effort to mitigate the pervasive effects of livestock has been comparatively minor, they said, even as climatic impacts intensify.
>
> The advent of climate change has significantly added to historic and contemporary problems that result from cattle and sheep ranching, the report said, which first prompted federal regulations in the 1890s.
>
> Wild horses and burros are also a significant problem, this report suggested, and high numbers of deer and elk occur in portions of the West, partially due to the loss or decline of large predators such as cougars and wolves. Restoring those predators might also be part of a comprehensive recovery plan, the researchers said.
>
> The problems are sufficiently severe, this group of researchers concluded, that **they believe the burden of proof should be shifted. Those using public lands for livestock production should have to justify the continuation of ungulate grazing, they said.**

(Emphasis added.) Some other key points Beschta et al. (2012), make include:

- (I)n 1994 the BLM and FS reported that western riparian areas were in their worst condition in history, and livestock use—typically concentrated in these areas—was the chief cause (BLM and FS 1994).

- Ohmart and Anderson (1986) suggested that livestock grazing may be the major factor negatively affecting wildlife in eleven western states. Such effects will compound the problems of adaptation of these ecosystems to the dynamics of climate change (Joyce and others 2008, 2009). Currently, the widespread and ongoing declines of many North American bird populations that use grassland and grass–shrub habitats affected by grazing are ''on track to become a prominent wildlife conservation crisis of the 21st century'' (Brennan and Kuvlesky 2005, p. 1)

- Climate change and ungulates, singly and in concert, influence ecosystems at the most fundamental levels by affecting soils and hydrologic processes. These effects, in turn, influence many other ecosystem components and processes—nutrient and energy cycles; reproduction, survival, and abundance of terrestrial and aquatic species; and community structure and composition. Moreover, by altering so many factors crucial to ecosystem functioning, the combined effects of a changing climate and ungulate use can affect biodiversity at scales ranging from species to ecosystems (FS 2007) and limit the capability of large areas to supply ecosystem services (Christensen and others 1996; MEA 2005b).

- Livestock use effects, exacerbated by climate change, often have severe impacts on upland plant communities. For example, … areas severely affected include the northern Great Basin and interior Columbia River Basin (Middleton and Thomas 1997).

- Livestock grazing has numerous consequences for hydrologic processes and water resources. Livestock can have profound effects on soils, including their productivity, infiltration, and water storage, and these properties drive many other ecosystem changes. Soil compaction from livestock has been identified as an extensive problem on public lands (CWWR 1996; FS and BLM 1997). Such compaction is inevitable because the hoof of a 450-kg cow exerts more than five times the pressure of heavy earthmoving machinery (Cowley 2002). Soil compaction significantly reduces infiltration rates and the ability of soils to store water, both of which affect runoff processes (Branson and others 1981; Blackburn 1984). Compaction of wet meadow soils by livestock can significantly decrease soil water storage (Kauffman and others 2004), thus contributing to reduced summer base flows. Concomitantly, decreases in infiltration and soil water storage of compacted soils during periods of high-intensity rainfall contribute to increased surface runoff and soil erosion (Branson and others 1981). These fundamental alterations in hydrologic processes from livestock use are likely to be exacerbated by climate change.

- The combined effects of elevated soil loss and compaction caused by grazing reduce soil productivity, further compromising the capability of grazed areas to support native plant communities (CWWR 1996; FS and BLM 1997). Erosion triggered by livestock use continues to represent a major source of sediment, nutrients, and pathogens in western streams (WSWC 1989; EPA 2009).

- Historical and contemporary effects of livestock grazing and trampling along stream channels can destabilize streambanks, thus contributing to widened and/or incised channels (NRC 2002). Accelerated streambank erosion and channel incision are pervasive on western public lands used by livestock (Fig. 4). Stream incision contributes to desiccation of floodplains and wet meadows, loss of floodwater detention storage, and reductions in baseflow (Ponce and Lindquist 1990; Trimble and Mendel 1995). Grazing and trampling of riparian plant communities also contribute to elevated water temperatures—directly, by reducing stream shading and, indirectly, by damaging streambanks and increasing channel widths (NRC 2002). Livestock use of riparian plant communities can also decrease the availability of food and construction materials for keystone species such as beaver (Castor canadensis).

- Managing livestock on public lands also involves extensive fence systems. Between 1962 and 1997, over 51,000 km of fence were constructed on BLM lands with resident sage-grouse populations (FWS 2010). Such fences can significantly impact this wildlife species. For example, 146 sage-grouse died in less than three years from collisions with fences along a 7.6-km BLM range fence in Wyoming (FWS 2010). Fences can also restrict the movements of wild ungulates and increase the risk of injury and death by entanglement or impalement (Harrington and Conover 2006; FWS 2010). Fences and roads for livestock access can fragment and isolate segments of natural ecological mosaics thus influencing the capability of wildlife to adapt to a changing climate.

- (F)ederal grazing fees on BLM and FS lands cover only about one-sixth of the agencies' administration costs (Vincent 2012).

Beschta et al. (2012), also discuss restoring ungulate-altered ecosystems at great length. These discussions include the following:

- The ecological effectiveness and low cost of wide-scale reduction in ungulate use for restoring public-land ecosystems, coupled with the scarcity of restoration resources, provide a forceful case for minimizing ungulate impacts. Other conservation measures are unlikely to make as great a contribution to ameliorating landscape-scale effects from climate change or to do so at such a low fiscal cost. As Isaak and others (2012, p. 514) noted with regard to the impacts of climate change on widely-imperiled salmonids: ''…conservation projects are likely to greatly exceed available resources, so strategic prioritization schemes are essential."

- … (A)ddressing the underlying causes of degradation should be the first priority for effectively restoring altered public-land ecosystems

- Because livestock use is so widespread on public lands in the American West, management actions directed at ecological restoration (e.g., livestock removal, substantial reductions in numbers or length of season, extended or regular periods of rest) need to be accomplished at landscape scales. Such approaches, often referred to as passive restoration, are generally the most ecologically effective and economically efficient for recovering altered ecosystems because they address the root causes of degradation and allow natural recovery processes to operate (Kauffman and others 1997; Rieman and Isaak 2010). Furthermore, reducing the impact of current stressors is a ''no regrets'' adaptation strategy that could be taken now to help enhance ecosystem resilience to climate change (Joyce and others 2008). This strategy is especially relevant to western ecosystems because removing or significantly reducing the cause of degradation (e.g., excessive ungulate use) is likely to be considerably more effective over the long term, in both costs and approach, than active treatments aimed at specific ecosystem components (e.g., controlling invasive plants) (BLM 2005). Furthermore, the possibility that passive restoration measures may not accomplish all ecological goals is an insufficient reason for not removing or reducing stressors at landscape scales.

- For many areas of the American West, particularly riparian areas and other areas of high biodiversity, significantly reducing or eliminating ungulate stressors should, over time, result in the recovery of self-sustaining and ecologically robust ecosystems (Kauffman and others 1997; Floyd and others 2003; Allington and Valone 2010; Fig. 5). Indeed, various studies and reviews have concluded that the most effective way to restore riparian areas and aquatic systems is to exclude livestock either temporarily (with subsequent changed management) or long-term (e.g., Platts 1991; BLM and FS 1994; Dobkin and others 1998; NRC 2002; Seavy and others 2009: Fleischner 2010). Recovering channel form and riparian soils and vegetation by reducing ungulate impacts is also a viable management tool for increasing summer baseflows (Ponce and Lindquist 1990; Rhodes and others 1994).

- While lowering grazing pressure rather than discontinuing use might be effective in some circumstances, public land managers need to rigorously assess whether such use is compatible with the maintenance or recovery of ecosystem attributes such as soils, watershed hydrology, and native plant and animal communities. In such cases, the contemporary status of at least some of the key attributes and their rates of change should be carefully monitored to ascertain whether continued use is consistent with ecological recovery, particularly as the climate shifts (e.g., Karr and Rossano 2001, Karr 2004; LaPaix and others 2009). To the extent possible, assessments of recovering areas should be compared to similar measurements in reference areas (i.e., areas exhibiting high ecological integrity) or areas where ungulate impacts had earlier been removed or minimized (Angermeier and Karr 1994; Dobkin and others 1998). Such comparisons are crucial if scientists and managers are to confirm whether managed systems are attaining restoration goals and to determine needs for intervention, such as reintroducing previously extirpated species.

- Current livestock or feral ungulate use should continue only where stocking rates, frequency, and timing can be demonstrated, in comparison with landscape-scale reference areas, exclosures, or other appropriate non-use areas, to be compatible with maintaining or recovering key ecological functions and native species complexes. Furthermore, such use should be allowed only when monitoring is adequate to determine the effects of continued grazing in comparison to areas without grazing.

- Where key large predators are absent or unable to attain ecologically functional densities, federal agencies should coordinate with state wildlife agencies in managing wild ungulate populations to prevent excessive effects of these large herbivores on native plant and animal communities.

Grazing domestic cattle has been the leading cause of watershed, stream and grassland degradation and in some cases, outright destruction (Belsky et al. 1999, Fleischner 1994, Donahue 1999). Livestock grazing occurs on 70 percent of the public lands the western United States, making it the most widespread form of land utilization in western North America. Some ecologists consider it "the most insidious and pervasive threat" to grassland biodiversity (Noss and Cooperrider 1994).

Grazing adversely affects native reptiles, mammals and songbirds, especially those that nest or forage on or near the ground (Finch et al. 1997), and may alter bird community composition (Schulz and Leininger 1991). Grazing also affects some species of small mammals, reptiles and amphibians by altering habitat or insect prey base (Kie et al. 1991). Selective grazing or "highgrading" by stock of the most nutritious plants results in loss of forage for native species, and ultimately decreases the abundance and diversity of native herbivores (Donahue 1999). Carnivore numbers inevitably decline as prey availability decreases (Brown 1992; Mech 1995) and also are often eliminated by the government at the request of the livestock industry (Robinson 2008).

Belsky and Gelbard, 2000 is a literature review of livestock as contributing to noxious weed spread.

Belsky et al., 1999 is a literature review of peer-reviewed studies concerning effects of livestock grazing on water resources:

> Livestock grazing was found to negatively affect water quality and seasonal quantity, stream channel morphology, hydrology, riparian zone soils, instream and streambank vegetation, and aquatic and riparian wildlife… through direct impacts of cattle on riparian areas and aquatic habitats, as well as indirect and cumulative effects from disturbance and impairment to the watershed uplands and drainage network. An extensive body of scientific literature has developed concerning the harmful effects of domestic livestock grazing on western public lands, on the environmental effects of deforestation, and climate change stress on ecosystems and ecosystem processes.

Belsky and Blumenthal, 1997 investigate impacts livestock grazing causes to stand dynamics and soils of upland forests of the Interior West.

Scientific studies have found significant reductions in runoff and sediment yield related to livestock grazing changes (Lusby, 1979).

The most immediate progress in healing damaged riparian areas is made under rest from livestock grazing (Platts, 1991), and studies of larger-sized livestock exclosures confirm that exclusion promotes more rapid recovery of damaged riparian areas (Duff, 1977; Belsky et al., 1999).

Alteration of fire regimes at a regional scale by cheatgrass has been quantified. (Balch et al., 2013; Bradley, et al., 2018.) The interactions between the invasive grass cheatgrass and fire regimes is a positive feedback system which has led to very extensive infestation in the western US. Wildfire and this flammable grass feed off each other. The plant grows well in areas that have been disturbed, so fire generally results in more cheatgrass, which results in more fire, which again results in more cheatgrass. Livestock grazing corresponds with increased cheatgrass occurrence and prevalence regardless of variation in climate, topography, or community composition (Williamson et al., 2019). The Rim Country 4FRI Draft EIS, U.S. Forest Service R-3, states:

> Cheatgrass invasion of ponderosa pine systems after restoration-based treatments is a burgeoning issue of significant concern (Keeley and McGinnis 2007, McGlone et al. 2009a and b). **Widespread invasion of cheatgrass often shifts invaded ecosystems into irreversible alternate stable states where cheatgrass-mediated fire intervals exclude native understory plants** (Brandt and Rickard 1994, D'Antonio and Vitousek 1992, Brooks et al. 2004).

(Emphasis added.) Growing recognition of the importance of cryptobiotic crusts to ecosystem processes has led to more concerns about the impacts of nonnative grazers. Cryptobiotic crusts are delicate symbioses of cyanobacteria, lichens, and mosses that form on the soil's surface. These crusts provide important ecological functions, including increasing organic matter and available phosphorus, increased soil stability, and increased water infiltration (Fleischner 1994). On most semiarid lands, a single footprint will virtually stop nitrogen fixation by cryptobiotic crusts and increase wind and water erosion (Fleischner 1994; Davidson et al. 1996; Donahue 1999).

Microbiotic crusts are key protective components of soil surfaces, in not only arid systems but also in forest understories, acting to stabilize soil surfaces, slow runoff, prevent soil erosion and rilling, exclude weeds and fix nitrogen. Trampling by livestock destroys these vital and protective crusts, exposes soils to erosion and accelerates desertification processes. (Anderson et al., 1981; Johansen, 1993; Beymer and Klopatek, 1992; Belnap, 1995.) Burning destroys crusts, as will logging, skidding, bulldozing roads and vegetation clearing that exposes mosses to direct sun.

The costs of public lands grazing surpasses the revenue brought in by the paltry per month currently collected by the federal government. So who pays the price? Glaser et al., 2015 find the cost to U.S. taxpayers was more than $1 billion from 2005-2015. Appropriations for BLM and Forest Service grazing programs exceeded grazing receipts by at least $120 million annually since 2002, according to the study.

This federal subsidy goes well beyond the direct costs and fees. There are vast indirect costs of grazing on public lands, including government killing of native carnivores and other wildlife.

Grizzly Bear Habitat Connectivity and Livestock Grazing

The LNF contains an important habitat connectivity component needed for the ongoing efforts to reconnect the isolated populations of grizzlies that inhabit Montana and the broader Northern Rockies region. As the DA acknowledges, the Lolo National Forest "represents important habitat connectivity for grizzly bear recovery, as it provides corridors between three of the identified recovery ecosystems; the Northern Continental Divide Ecosystem, the Cabinet Yaak Ecosystem, and the Bitterroot Ecosystem." (DA page 152). Additionally, the LNF notes the "Ninemile Demographic Connectivity Area [DCA]," an area designated in the Northern Continental Divide Ecosystem grizzly bear conservation strategy (DA page 151). The Ninemile area is a crucial demographic connector that would link up the existing Cabinet-Yaak and Northern Continental Divide populations with the high quality grizzly habitat found in the Selway-Bitterroot Recovery Zone. Establishing and protecting this connectivity corridor would enhance the genetic diversity of those extant grizzly populations and further the recovery requirements for the ESA-listed bear by allowing for expansion into the Selway-Bitterroot. A March 2023 federal court decision has recently reaffirmed the importance of the Bitterroot Recovery Zone and the judge's order compels the US Fish & Wildlife Service to undertake the planning and analysis needed to reintroduce and recover grizzlies in the Selway-Bitterroot.[70] The Ninemile DCA will play a crucial role in this effort.

There are several active grazing allotments in and immediately adjacent to the Ninemile DCA (on the Ninemile RD, Plains/Thompson Falls RD, and the Superior RD). Some of these are currently vacant, and some are being actively grazed. There are many well-known impacts regarding livestock and habitat connectivity for grizzly bears:

- **Fragmentation of Habitat:** Livestock grazing can fragment habitats by creating barriers and obstacles to wildlife movement. Fencing, infrastructure, and dense livestock grazing can impede the natural movement of grizzly bears between different areas, isolating populations and restricting their access to essential resources, such as food, mates, and suitable habitat.

- **Displacement from Preferred Corridors**: Extensive livestock grazing in areas that serve as important corridors for grizzly bears can displace bears from their preferred routes. Grizzlies may avoid areas with high human and livestock activity, altering their movement patterns and potentially increasing the risk of isolation for sub-populations. This displacement can disrupt natural connectivity and limit the genetic exchange among bear populations.

- **Barrier Effects of Infrastructure**: Infrastructure associated with livestock grazing, such as roads, fences, and water diversions, can act as physical barriers for grizzly bears. These barriers can impede or prevent bears from accessing vital habitats or crossing between different areas, further fragmenting their habitats and hindering movement along traditional corridors.

- **Increased Human Disturbance:** Livestock grazing activities can increase human presence and disturbance in areas used by grizzly bears. This can deter bears from utilizing or moving through these areas, especially when there are perceived risks or conflicts with livestock. Increased human disturbance can disrupt natural movement patterns, cause stress, and result in avoidance behavior by grizzly bears

All of these impacts are an impediment to grizzly bear recovery in and around the Ninemile DCA. If this area is to be utilized by dispersing grizzlies, it must be protected and managed in a way that facilitates this movement. Livestock grazing and all of its associated activities and infrastructure are not compatible with these goals.

We strongly urge the immediate closure of active but currently vacant allotments in and around the Ninemile DCA (i.e. Upper Ninemile, Edith-Sixmile, Four Mile, Tamarack Creek, Knowles Creek). We also urge that those allotments being actively grazed in and around the Ninemile DCA (i.e. Swamp Creek, Henry Creek) be retired and closed for wildlife protection purposes as soon as is feasible. The LNF has already wisely chosen to close several of the surrounding allotments in this area. As livestock grazing continues to decline across the forest and the values of forest users continue to shift toward the protection and restoration of native carnivores, it makes sense to phase out this dwindling though still ecologically impactful form of resource extraction.

Livestock Grazing Impacts on Bull Trout and Westslope Cutthroat Trout (WCT)

Livestock grazing has had well-documented impacts on native fisheries across the Western US. While acknowledging the impacts of forest system roads and mining activity on ESA-listed bull trout and WCT (a sensitive species), the DA completely fails to mention livestock grazing when listing the major threats to these fish that the LNF has jurisdiction over (DA pages 166-168). This is despite there being WCT and bull trout streams within or directly adjacent to active grazing allotments. Here are just some of the various direct and indirect impacts on bull trout and WCT that can result from livestock grazing:

- **Streambank Degradation:** Unregulated or poorly managed livestock grazing near streams and rivers can lead to streambank degradation. Overgrazing can result in the removal of riparian vegetation that stabilizes the banks, leading to increased erosion and sedimentation in the water. Excessive sedimentation can negatively impact the spawning habitat of bull trout and Westslope cutthroat trout by smothering eggs and reducing suitable spawning gravels.

- **Vegetation Loss and Stream Temperature**: Livestock grazing can result in the loss of riparian vegetation, which plays a critical role in providing shade and regulating stream temperatures. Without adequate shade, water temperatures can increase, especially in small headwater streams, negatively impacting both bull trout and Westslope cutthroat trout. These species require cool water for successful spawning, rearing, and survival.

- **Habitat Alteration**: Intensive grazing can damage streamside vegetation, leading to changes in habitat structure and complexity. Loss of vegetation can reduce the availability of cover and hiding places for bull trout and Westslope cutthroat trout, making them more vulnerable to predation and other threats. Additionally, the removal of large woody debris and other organic matter due to grazing can reduce the complexity of the stream habitat, which is important for juvenile fish rearing and for providing hiding places and refuge from high flows or predators.

- **Water Quality Degradation:** Livestock grazing can contribute to water quality degradation in streams inhabited by bull trout and Westslope cutthroat trout. The presence of livestock near water sources can introduce excessive fecal matter, which may contain pathogens and nutrients, into the water. Elevated nutrient levels can lead to algal blooms, reduced dissolved oxygen levels, and overall degraded water quality, negatively impacting fish health and survival.

- **Sedimentation and Water Quality**: Construction and maintenance activities associated with upland spring development for livestock use can cause sedimentation and increase the risk of erosion. Sediment can enter nearby streams, impacting water quality by reducing clarity, clogging gravel beds used for spawning, and potentially smothering eggs or suffocating aquatic insects, an important food source for Westslope cutthroat trout.

Given the lack of consistent and robust monitoring across most, if not all, grazing allotments on the LNF, there is no way to know if the above impacts are occurring as a result of livestock grazing in bull trout and WCT habitat. Particularly concerning is that what little monitoring has actually occurred shows that livestock are negatively impacting both lentic and lotic sites (e.g. the Tyler-Genoa AOI mentioned previously).

Despite having incorporated both PACFISH and INFISH standards into the LNF Forest Plan back in 1995, there does not appear to be any indication that these quantifiable standards are being monitored for adherence, nor does it appear that they have even been implemented via AOIs. Where is the stream monitoring data on sedimentation, bank alteration, and temperature that are absolutely crucial for bull trout and WCT management and recovery?

As mentioned above, the immediate closure of allotments that are active but currently vacant should be one of the top priorities for range management in the new LNF Forest Plan. This would quickly and effectively eliminate the stressors on bull trout and WCT that livestock grazing can cause. Additionally, we strongly urge that Riparian Habitat Conservation Areas (RHCA) be protected from these impacts through the prohibition of streamside disturbance – which must include livestock grazing. This would involve either the permanent removal of livestock from pastures with occupied bull trout and WCT habitat, or at the very least exclosure fencing built to keep cattle from loafing and/or trampling RHCAs and upland lentic sites. Finally, the adoption of meaningful riparian standards that are monitored regularly and enforced should be incorporated into all AOIs and AMPs. These should include, but not be limited to the following standards:

- Fine sediments < 6.4 mm in diameter must be limited to less than 20% in spawning habitat and standards must be developed to maintain groundwater.
- All streams should average ≥ 90% bank stability and that cobble embeddedness in summer rearing habitat should be < 30% and < 25% in winter rearing habitats. Additional indices include channel morphology including large woody debris, pool frequency, volume and residual pool volumes.
- Stream temperatures in current and historic spawning, rearing and migratory corridor habitats should not exceed 6-8 C for spawning, with the optimum for incubation from 2-4 C;10-12 C for rearing habitat, with 7-8 C being optimal; migratory stream corridors should be 12 C or less.

Invasive Species

Based on observations during regular visits on the Lolo National Forest, we believe invasive plants impact a much larger area than the 3.3% coverage reported in the DA. Years of overgrazing, excessive road building, and timber operations have left few sections without significant invasive spread. A statement in the Assessment that human activates and their disturbance is the main cause of invasives is spot on. The response of alien plants to such a variety of disturbance: fire, logging, livestock grazing, recreation, road and trail building many of them interacting with each other is difficult to assess. Add climate change into the equation for more uncertainties. The harm from invasives is insidious. Invasives become abundant and destructive overtime, not all at once. While they can see the spread of invasives, the general public is often not aware of the harm they cause until things become very bad.

Management tools like prescribed burns and thinning operations conducted or contracted out by the Forest Service too commonly exacerbate the spread of invasives. Best Management Practices to ensure better outcomes are only as effective as the care with which they are executed. For example, we recently observed some poor project management while on a walk on a gated road that leads to the hiking area near Mount Jumbo outside of Missoula. The gated road is accessed from Marshall Creek, not far from the abandoned ski area. There had been a large thinning of understory trees in the ponderosa, douglas fir forest along the ridgeside, with recently burned slashpiles situated almost continuously along about a mile of the road on very steep slopes just below the road. We question that burning slash on a steep slope below a road is a best management practice. In addition to the high risk of erosion, seeds from invasive species are likely to spread downslope from the burn piles to the open forest below, which currently appears in good condition.

Another area of concern in regards to invasive plants is follow-through after forest projects. We have observed that after thinning operations, the landings where timber was loaded onto trucks often became weedy while the thinned forest itself was mostly weed free. An example of this is Pattee Canyon near Missoula in which parts were thinned many years ago. The landings where the logs were sorted for transport became havens for Canada thistle and other weeds while the bulk of the thinned forest remained relatively weed free. Inspection of the sites over time could have prevented this infestation.

While we have not conducted site-specific surveys, this leaves us with the unavoidable impression that invasive plants are not always a major priority with the Forest Service. Timber production, fire-fighting, livestock, fuel reductions, recreation etc. seem to be of more importance on the Lolo NF. Weed control along forest roads and trails should be prioritized to prevent spread into the National Forest.

Invasive Fish

Many species of non-native fish are found in Lolo National Forest waters. Invasive Brook trout, due to their ability to interbreed with native Bull trout are especially problematic as Bull trout are considered a threatened species. Our native trout seem to thrive in more pristine waters than the invasives. Erosion control along the many streams and rivers needs to be prioritized. Old road beds can contribute substantially to erosion if not properly mitigated. Connectivity along streams is important to promote native fisheries. Man-made dams and improper culverts along streams should be removed where feasible. Beavers are a keystone species that enhance both water quality and retention. Beavers are helpful to the forest environment in so many ways and should be considered necessary for general forest health.

Designated Areas

The Rattlesnake National Recreation Area

Public Law 96-476 established The Rattlesnake National Recreation Area and Wilderness in 1980. The NRA (25,000 acres) is the only NRA in Region 1 and is designated as Management Area 28 in the Lolo National Forest Plan. The baseline environmental condition in the NRA has changed significantly since the 1986 Forest Plan. For example, the area is now continuously Occupied Grizzly Bear Habitat and is part of the Demographic Monitoring Area for grizzly bears in the Grizzly Bear Conservation Strategy in the NCDE. A female grizzly bear with cubs has inhabited the area. Also, the 1986 Plan did not foresee the rising recreation use levels including mountain biking that have significant impacts on Forest resources including wildlife and soils. Nor did the Plan consider climate change science.

There are several necessary amendments to the Standards and Guidelines for the NRA.

1. *On page III-145 under C. Standards 3.* Change first sentence to "Tree removal shall be limited to individual trees to eliminate safety hazards to public users."
2. *Standards C. 4.* Remove current language and replace with "Earth disturbing management activities shall be prohibited."
3. *Standards C. 9.* Remove current language and replace with "INFISH standards for riparian area protection shall be applied to streams within the NRA. Rattlesnake Creek is designated as Critical Habitat for the Bull Trout."

4. *Standards C. 12.* Remove the first sentence and replace with "Natural fire plays an important role in shaping the landscape of the NRA and adjacent Wilderness. Wildfire suppression shall be limited to protection of structures on adjacent private lands."
5. *Standards C. 14.* Remove the entire language and replace with "Road construction or reconstruction shall be prohibited within the NRA."
6. *Standards C. 15.* Remove this section entirely.

Additional Recommendations

Mountain bike use is not addressed in the current Forest Plan. The Forest Service must complete an Environmental Impact Statement on recreational use in the NRA which identifies environmental impacts, the current baseline, and alternatives.

Bikes with electric motors ("e-bikes") shall be prohibited within the NRA. Removal of any biomass from the NRA shall be prohibited. Remove the co-designation of Trail 515 as a road while maintaining legal access to the Wilderness dams.

Rattlesnake Wilderness

The Forest Service will support the city of Missoula's efforts to breach dams in the Wilderness in a wilderness-compatible way, and to restore the natural wetlands and ecological function of the wilderness lakes. Remove the co-designation of Trail 515 as a road while maintaining legal access to the Wilderness dams. If the dams are breached or overland access is no longer needed, obliterate the road above the Franklin Bridge and recommend adding the portion of the "cherry stem" above Franklin Bridge to the Rattlesnake Wilderness and designate that portion of Rattlesnake Creek above Franklin Bridge as a Wild River.

Wilderness and Recommended Wilderness Assessment

In this section we discuss the assessment for Wilderness and the areas the Forest Service recommended for Wilderness. Prior to diving into the assessment itself, some background and an introduction on Wilderness and roadless areas are in order.

Background and Introduction

The Lolo-Bitterroot Partnership, a partnership of citizens and citizen organizations, including the Flathead-Lolo-Bitterroot Citizen Task Force and Friends of the Bitterroot, came up with a citizen plan for revision of the Lolo and the Bitterroot National Forests, two forests along with the Flathead which the Forest Service previously was going to revise together but are going to be revised separately. Main topics in the plan include Wilderness Administration and Recommended Wilderness. There is also a subtopic about the Rattlesnake Wilderness. Rather than repeat the Citizen Plan, we summarize key elements below:

- <u>Wilderness Administration</u>: The Citizen Plan emphasizes, "Wildernesses will be administered such that the forces of nature and not the actions of humans define their natural conditions." This means natural fire, not agency ignited fire. The concept of non-degradation shall be applied to limit visitor impacts. The general public should generally be given priority over commercial services in wilderness administration. In sum, the Forest Service Manual states it well, "Where a choice must be made between wilderness values and visitor or any other activity, preserving the wilderness resource is the overriding value." FSM 2320.6.

- Recommended Wilderness: In addition to greatly expanding this category as recommended by the Citizen Plan, there needs to be solid direction to protect these roadless areas. Of utmost importance is banning motorized and mechanized use.

- Rattlesnake Wilderness: The new process to evaluate dam breaching in the Rattlesnake must be done by wilderness-compatible means. After this is complete, Trail 515 (the cherrystem) above Franklin Bridge should be considered for inclusion in the Rattlesnake Wilderness.

The Assessment and Wilderness

It is perplexing that the DA does not use most of the best available information for Wilderness, information the agency has been gathering for over 40 years in most instances. There are only two main instances where there is much information at all, the analysis of visitor satisfaction in Wilderness from recreation surveys and the discussion, scattered throughout the Assessment, of the small dammed lakes in the Rattlesnake Wilderness.[70] There is no discussion or analysis of whether the Forest Plan standards regarding Wilderness, including the various wilderness plans, are being met. There is no discussion of the newer wilderness character baseline monitoring that has been undertaken in Region I.[70]

Some specific examples illustrate the problem:

- The DA does not incorporate any ongoing findings of or even cite the limits of acceptable change (LAC) process and plan for the Bob Marshall Wilderness Complex, of which the Scapegoat Wilderness is an integral part. This document is available on the internet, but it is not found on the Lolo National Forest website. It is dated April 1987 and replaced appendix O-2 in the Forest Plan. It contains management direction, including monitoring, to assess what kind of changes are taking place in Wilderness, mainly due to human recreation use. Yet, there is nothing in the DA that reports the results of 35 years of monitoring and administration under the plan. The DA is silent on the condition and trend of backcountry campsites and whether those sites exceed standards for the number of sites in specific areas. It has no data on the condition or trend of recreational pack animals use of plants. The DA sheds no light on whether group size limits are working.[70] Lastly, there is no mention of the wilderness character monitoring for the Bob Marshall Wilderness Complex even though there is a Forest Service baseline assessment report from December of 2022, which presumably contains the most recent data.

- The DA does not refer to wilderness plans or wilderness character monitoring for the Selway-Bitterroot or Welcome Creek Wildernesses. While only a small portion of the Selway-Bitterroot Wilderness is within the Lolo National Forest, the entire Welcome Creek Wilderness is within the Forest. For example, there is a wilderness character monitoring report for the Welcome Creek Wilderness, dated 2013, from the University of Montana's Wilderness Institute.

- While there is reference to the Rattlesnake Wilderness plan and monitoring, the DA clearly states, "Information presented here is a summary of a subset of monitoring elements and trends specific to the non-wilderness portion of the National Recreation Area (U.S. Department of Agriculture 2022b)." Why did the Forest Service choose to omit any real assessment of the Rattlesnake Wilderness itself in the Assessment?

The Wilderness section of the DA is based in large part on the five-year recreation surveys of user satisfaction (see tables 74 through 76). Unlike the monitoring requirements of the wilderness plans, these attitudinal surveys are based mainly on perception and not numbers. The wilderness plans include metrics for number of encounters, group sizes, and the like. The attitudinal portion of the surveys, though somewhat informative, have no baseline from which to judge statutory requirements of the Wilderness Act.

The data of visitor numbers are more useful (see tables 72 and 73), though admittedly imprecise. However, the DA does not compare the visitor numbers to data on impacts that are required to be gathered by the wilderness plans. This would be very important for evaluating impacts to Wilderness from recreation.

There are a couple of other items, mentioned in other sections of the DA, that need further explanation. The only substantive reference to trail conditions in Wilderness is a short statement on page 272, in the Trails sections, that indicates it is difficult to maintain mainline trails in Wilderness, presumably due to funding. Does this apply to all mainline trails in Wilderness? To what degree is trail maintenance lacking? Also, the DA is somewhat inconsistent on the recreation opportunity spectrum (ROS) and whether Wilderness requires a primitive classification or if semi-primitive non-motorized classification is allowable. See pages 259 (the reference to the Gallatin Forest is apparently a failure of cut-and-paste editing), 260, and 304. Generally, the policy if for a primitive classification under the ROS (see the FSM 2310).

In summary, much information and data that are available and, in most instances, gathered by the agency itself were not put into the Assessment regarding Wilderness. As such, the DA is woefully deficient regarding Wilderness.

Recommended Wilderness

The DA deals only with the agency recommendation from 1986. This should not bias the agency in looking at greatly expanding the Recommended Wilderness in the upcoming revision.

Aside from that, there is little information on the trend and condition of the areas the Forest Service recommended in 1986. However, there is one major problem. The map of the recommended Bob Marshall Complex addition in the DA is different than that of the 1986 Forest Plan. The 1986 Forest Plan Map includes McCabe Creek and Spread Creek. The DA map clearly excludes McCabe Creek and most of the Spread Creek drainage. Is there an explanation for why this was changed?[70] We have no record of an amendment to the Forest Plan being done to alter the recommendation in this area.

The LNF include portions of two of the largest and most celebrated Wilderness areas in the entire National Forest System—the Bob Marshall Wilderness Complex and the Selway-Bitterroot Wilderness. Other less well-known but remarkable Wilderness lands are in the Rattlesnake and Welcome Creek Wildernesses.

The direction found in Forest Service Manual 2320.6 "The Wilderness Management Model and the Wilderness Act," will guide wilderness stewardship. Wildernesses will be administered such that the forces of nature and not the actions of humans define their natural conditions. Management interventions that alter the free play of natural forces will not occur. Naturally ignited fires will be allowed to burn to the greatest extent feasible, with control actions focused on structure protection and public safety. Manager-ignited fire will not be used in Wilderness.

Wilderness will be administered to preserve outstanding opportunities for solitude and with a minimum of regulations on visitor use. The concept of "non-degradation," as described in Forest Service Manual (FSM) 2320.6, will be used to limit recreation impacts. Motorized and mechanized vehicles will be prohibited on trails leading from trailheads to wilderness boundaries to preserve wilderness recreation experiences and discourage vehicle trespass in Wilderness. Commercial use will be allowed to the extent necessary for realizing the recreation or other benefits of Wilderness. When limits are necessary to protect wilderness conditions, commercial uses will generally be restricted before general public use.

Wilderness stewardship should in all cases adhere to Forest Service policy that states, "Where a choice must be made between wilderness values and visitor or any other activity, preserving the wilderness resource is the overriding value." FSM 2320.6.

Rock Creek Recreation Corridor

The Rock Creek area of the LNF has experienced a tremendous increase in use over the past three decades including out of state visitors from Washington and other states. Resources are being impacted including the blue-ribbon fishery. Recreation use should be capped in this area and reduced if opportunities present themselves.

No new SUPs for recreation and rafting should be issued. SUPs that expire should not be re-issued to another party.

There should be no increase in developed sites including no increase in the number of official, numbered campsites.

The LNF should consider closing the river to commercial rafting on June 15th rather than July 1. The level of truck and trailer traffic is impacting the road and put-in sites such as Harry's Flat Campground. Each campground must have at least two bear resistant food storage lockers.

Research Natural Areas

The Lolo National Forest currently has six Research Natural Areas and two Botanical Areas. These are very small and scattered and do not capture the range of unique sites in need of special management. Within RNAs, incompatible uses such as furbearer trapping should be prohibited.

Additional RNAs should be identified and designated, particularly within unique systems with rare and sensitive plant and amphibian life and communities including wetlands, fens and bogs.

Inventoried Roadless Areas

If the Forest Service has found areas contiguous with current Inventoried Roadless Areas (IRAs) that meet the definition of roadless then the IRAs should be expanded to include the contiguous areas. All IRAs should be managed to maintain their roadless condition and eligibility for Wilderness designation.

Unique Systems

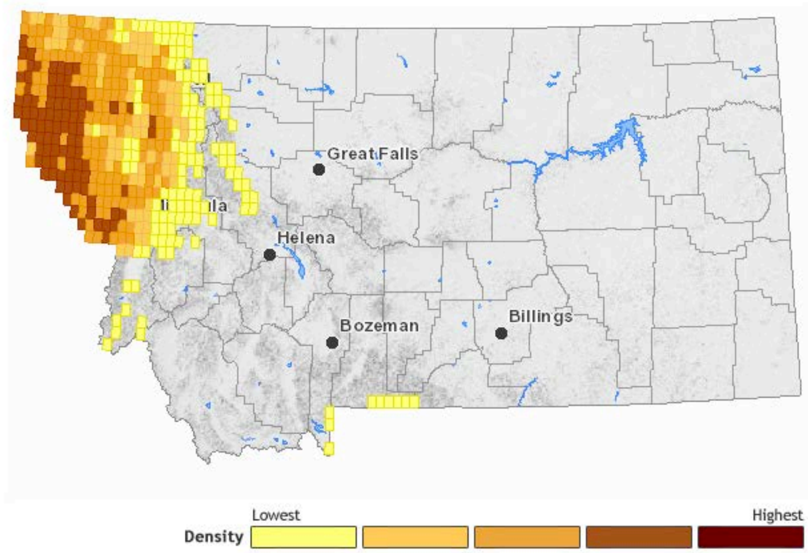
Rocky Mountain Mesic Montana Mixed Conifer Forest (Including the Coastal-Disjunct Rocky Mountain Refugium)

This unique system is present at moderate to high levels on the Lolo National Forest (see Figure below).

From the Montana Natural Heritage Program:

Ecological System Distribution

Approximately 6,521 square kilometers are classified as Rocky Mountain Mesic Montane Mixed Conifer Forest in the 2017 Montana Land Cover layers. *Grid on map is based on USGS 7.5 minute quadrangle map boundaries.*



Montana Counties of Occurrence

Carbon, Flathead, Gallatin, Glacier, Granite, Lake, Lewis and Clark, Lincoln, Mineral, Missoula, Park, Pondera, Powell, Ravalli, Sanders, Teton

Mesic Understory and Associated Species

Environment

This forest system is found in areas influenced by incursions of mild, wet, Pacific maritime air masses west of the Continental Divide in Montana. Occurrences generally are found on all slopes and aspects but grow best on sites with high soil moisture, such as lower slopes and bottomlands. At the periphery of its distribution, this system is confined to moist canyons and cooler, moister aspects. Generally, these are moist, non-flooded or upland forest sites that are not saturated yearlong. In northwestern Montana, western hemlock and western red cedar forests occur on bottomland and northerly exposures between 609-1,585 meters (2,000-5,200 feet) on sites with an average annual precipitation of 635 millimeters (25 inches) per year.

Vegetation

These forests are generally dominated by western hemlock, western red cedar, and grand fir. Disturbed sites can and occasionally do return directly to dominance by the climax tree species, but other stands are often a mixture of the climax species with seral tree species such as Douglas-fir (*Pseudotsuga menziesii*), western white pine (*Pinus monticola*), lodgepole pine (*Pinus contorta*), western larch (*Larix occidentalis*) and paper birch (*Betula papyrifera*). Engelmann spruce (*Picea engelmannii*) and subalpinefir (*Abies lasiocarpa*) may be present on the coldest sites,and ponderosa pine (*Pinus ponderosa*) may be present on the warmest and driest sites. In Glacier National Park and the Selway-Bitterroot Wilderness in Montana, western red cedar is dominant in wet ravines, well-drained flats and poorly drained depressions. Both western red cedar and western hemlock are shade-tolerant conifers that occur in similar mesic environments; however, western red cedar extends locally into slightly drier sites and occurs further south and east in Montana. Shade-intolerant grand fir is seral in western hemlock or western red cedar dominated forests and has lower moisture requirements than its associates.

Common shrubs include mountain boxwood (*Paxistima myrsinites*), thinleaf alder (*Alnus incana*), Rocky Mountain maple (*Acer glabrum*), birch leaf spiraea (*Spiraea betulifolia*), common snowberry (*Symphoricarpos albus*), bunchberry dogwood (*Cornus canadensis*), thimbleberrry (*Rubus parviflorus*), rusty leaf menziesia (*Menziesia ferruginea*), and mountain huckleberry (*Vaccinium membranaceum*). Pacific yew (*Taxus brevifolia*) can occur in a tree form in the understory on some occurrences in westernmost Montana and as a prevalent shrub in occurrences in the Swan Valley.

Composition of the herbaceous layer reflects local climate and degree of canopy closure; it is typically highly diverse in all but closed-canopy conditions. Queen's cup beadlily (*Clintonia uniflora*), western foamflower (*Tiarella trifoliata*), pioneer violet (*Viola glabella*), Canadian white violet (*Viola canadensis*), dark woods violet (*Viola orbiculata*) and beargrass (*Xerophyllum tenax*) are most the most common forbs in these forests. Other forbs include baneberry (*Actaea rubra*), pathfinder (*Adenocaulon bicolor*), false sarsaparilla (*Aralia nudicaulis*), lanceleafarnica (*Arnica latifolia*), fragrant bedstraw (*Galium triflorum*), rattlesnake plantain orchid (*Goodyera oblongifolia*), twinflower (*Linnaea borealis),* liverleaf wintergreen (*Pyrola asarifolia*) and western trillium (*Trillium ovatum*). In extreme northwestern Montana, wild ginger (*Asarum caudatum*) is a component on mesic sites with a mild temperature regime.

Ferns and fern allies also form an important component of the understoryand are indicative of the most mesic sites. Species include American ladyfern (*Athryium filix-femina*), western swordfern *(Polystichum munitum*), male fern (*Dryopteris filis-mas*), oak fern (*Gymnocarpium dryopteris*) and horsetails (*Equisetum* species). Bracken fern (*Pteridium aquilinum*) can occur in relatively high coverage (20% or greater) in mature stands, however it can form dense (up to 100%) cover in early seral stands, retarding forest regeneration. Graminoids may be absent or form a very minor component, and may include forest brome (*Bromus vulgaris*), fringed brome (*Bromus ciliatus*), Geyer's sedge (*Carex geyeri*), pinegrass (*Calamagrostis rubescens*), blue wildrye (*Elymus glaucus*), and rough leaf ricegrass (*Oryzopsis asperifolia*).

The Rocky Mountain Mesic Montana Mixed Conifer Forest also contains several unique ecosystem components including Old Growth Forest, Western Red Cedar Bottomlands, bogs, seeps, fens. Other species associated with this unique system include:

Northern Rocky Mountains Refugium Caddisfly
Northern Bog Clubmoss

Adder's Tongue
Idaho Lovage
Yerba Buena
Cascade Reedgrass
Big-leaf Sedge
Creeping Sedge
Tufted Club-rush
Fisher
Northern Bog Lemming
Marten
Northern Goshawk
Western Toad
Idaho Giant Salamander
Northern Leopard Frog
Coeur d'Alene Salamander

Old Growth Ecosystems

We present this discussion to correct and supplement the DA record concerning old-growth ecosystems because of the DA's failure to objectively weigh facts and best available science.

The Forest Service Chief's 10/11/89 Position Statement on National Forest Old Growth Values (Appendix C in Green et al., 1992) states:

> The Forest Service recognizes the many significant values associated with old growth forests, such as biological diversity, wildlife and fisheries habitat, recreation, aesthetics, soil productivity, water quality, and industrial raw material. Old growth on the National Forests will be managed to provide the foregoing values for present and future generations. …Where goals for providing old growth values are not compatible with timber harvesting, lands will be classified as unsuitable for timber production.

But instead of keeping proper prioritization, throughout the implementation of the 1986 forest plan the Forest Service too frequently prioritized industrial raw material at the expense of the other values.

In describing the ecological importance of old growth, the 1987 Nez Perce Forest Plan Final EIS at III-35 points out the critical role it plays in serving biodiversity:

> Habitat diversity is a measure of the variety, distribution, and structure of plant communities as the progress through various stages. Each stage supports different wildlife species. **One of the most critical elements of diversity in a managed forest is old growth. If sufficient old growth is retained, all other vegetative stages from grassland through mature forest will be represented in a managed forest.**

(Emphasis added.) Stands of trees meeting old-growth criteria are a part of **old-growth ecosystems,** as recognized in the above Forest Service quote, as stated in Green et al. (1992), and as discussed in Juel (2021) and the scientific sources cited therein.

Kootenai National Forest (2004) states:

> **The publication "Old-Growth Forest Types of the Northern Region" (Green et al. 1992) is to be used as a means to initially define old growth, not as a management or prescriptive guide.** The Green et al., document is not manual or handbook direction and not formally adopted as Regional guidance. It is, however, the only peer-reviewed document of old growth definitions in the Northern Rockies and recommended for use within Regional protocols. According to Green et al., old growth "…encompasses the later stages of stand development that typically differ from earlier stages in characteristics such as tree age, tree size, number of large trees per acre and basal area. In addition, attributes such as decadence, dead trees, the number of canopy layers and canopy gaps are important but more difficult to describe because of high variability". In other words, minimum attribute characteristics of trees per acre, DBH, age, and basal area along with attributes of snags, structural layering, and downed wood minimally define old growth – not any one attribute or any minimum value of specific attributes.
>
> Pages 11 and 12 of Green et al. state the appropriate use of the document. The following are pertinent quotes from the document to aid in that interpretation:
>
> 1. No set of generated numbers can capture all the variation that may occur at any given age or stage in forest development.
> 2. Because of the great variation in old growth stand structures, no set of numbers can be relied upon to correctly classify every stand.
> 3. Do not accept or reject a stand as old growth based on the numbers alone; use the numbers as a guide.
> 4. The minimum criteria are used to determine if a stand is potentially old growth. Where these values are clearly exceeded, a stand will usually be old growth. The associated structural characteristics may be useful in decision making in marginal cases, or in comparing relative resource values when making old growth evaluations.
> 5. The basic concept is that old growth should represent "the late stages of stand development …distinguished by old trees and related structural attributes."
> 6. A stand's landscape position may be as important, or more important as any stand old growth attribute. The landscape is dynamic. We need to do more than draw lines to manage this dynamic system. Consider the size of old growth blocks (large blocks have special importance), their juxtaposition and connectivity with other old growth stands, their topographic position, their shapes, their edge, and their stand structure compared to neighboring stands. Stands are elements in dynamic landscapes. We need to have representatives of the full range of natural variation, and manage the landscape mosaic as a whole in order to maintain healthy and diverse systems.

> **The Green et al. document is an aid intended to define, evaluate, and monitor old growth – not to be used as a prescriptive, management guide with minimum attribute values as thresholds. This will not achieve the objective of maintaining old growth.**
>
> Another memo from the Forest Supervisor (May 14, 2003) states, "When minimums are used, they are intended to illustrate the beginning of what could be identified as old growth—or late seral, successional development for a specific habitat group within a specific zone—not what is recommended".

(Emphases in the original.) Although we disagree with a statement in that document ("no one is advocating a 'hands off' policy toward old growth"), with its nascent hypothesizing that managing in old-growth stands might be appropriate, and with some of its interpretation of science, that doesn't nullify the point we make here on the intended purposes of Green et al and how it is being misused by the Forest Service.

Also, we incorporate into this portion of our comments the discussion on President Biden's April 22, 2022 Executive Order 14072 calling on the Secretaries of Agriculture and the Interior to "define, identify, and complete an inventory of old-growth and mature forests on Federal lands from the above section "Climate Change, Carbon Storage and Sequestration."

Please see Juel (2021), which cites many scientific references and Forest Service documents, presenting a science- and experiential-based discussion of old growth.

Thomas et al., 1988 emphasized values pertaining to wildlife and diversity in the context of laws and regulations. From a perspective recognizing that meaningful implementation of regulatory requirements must include a concomitant awareness of the limits of scientific knowledge, they advocate **for preserving all the old growth that remains**:

> The lack of quantitative information about functional attributes of old growth and habitat associations of potentially dependent plants and animals and the rapidly declining old-growth resource indicates that purposely conservative management plans should be developed and adopted. Our knowledge and understanding of old-growth communities is not adequate to support management of remaining old growth on criteria that provide *minimum* habitat areas to sustain *minimum* viable populations of one or several species. The potential consequences and the distinct probability of being wrong are too great to make such strategies defensible in the ecological sense.
>
> …The answer to— "How much?"—must be predicated on the relatively small amount of unevenly distributed remaining old growth and the current, inconclusive scientific knowledge of old-growth ecosystems. Therefore, the best probability of success is to preserve all remaining old growth and, if possible, produce more.

Peat Moss

Sphagnum systems are among the most rare and unique on the Lolo National Forest and are in need of inventory and protection including as Research Natural Areas.

Huckleberry

Huckleberry spp. are a primary food source for grizzly bears west of the Continental Divide. These subspecies depend on the abundance of pollinators and moist conditions. In years of huckleberry failures, conflicts between grizzly bears and humans, and bear mortality rise.

Whitebark Pine

The first step in restoring whitebark pine (Keane et al., 2017) is to: *Assess conditions. Conduct assessments that document the status and trend of whitebark pine forests within regions*. Yet, the LNF Land Management Plan Draft Assessment (DA) gives only a general overview of whitebark pine without any discussion of the specific conditions on LNF, oversimplifying the complexity, variability, and heterogeneity of whitebark pine ecosystems. Larson and Kipfmueller (2012) state: "Generalizations about the decline of this species do little to improve our overall understanding of whitebark pine communities and are difficult to translate into management actions.,,, A more nuanced perspective is critically important for directing management and restoration activities in whitebark pine communities, lest generalizations blur recognition of the mechanisms driving declines of this singular species and lead to more harm than good."
Although the DA Map A1-29 shows occurrences of whitebark pine on LNF, no detailed information is available. How was this inventory conducted—by field surveys or by remote sensing or by modeling? How accurate is the inventory? Are the whitebark pines in pure stands or mixed with other species? What are age distributions in each area? What is the health of each stand? What are the main stressors in **Lolo National Forest**? Are the trees cone-bearing? Where do rust-resistant "plus" trees exist? What is the degree of connectivity between whitebark pine stands? An assessment that answers these questions is necessary before a plan that will preserve and restore whitebark pine can be developed, which is step #2 in Keane et al. (2017).
The DA makes a number of assumptions about whitebark pine's conditions that may not apply to Lolo National Forest because specific conditions are unknown. There is a wide body of literature on whitebark pine, summarized in the 2022 listing in the Federal Register https://www.govinfo.gov/content/pkg/FR-2022-12-15/pdf/2022-27087.pdf , Keane et al (2017), Keane (2021), and Larson and Kipfmueller (2012), but the DA contradicts much of this science.

For example:
DA, p. 123, states: *"Management actions to improve integrity can include the planting or seeding of blister rust-resistant stock to a small degree and thinning to reduce competition. There are greater restoration opportunities associated with prescribed fire and benefits from wildfire to create suitable sites for regeneration."* However, Six et al. (2021) concluded that "in cases where planting is required, care should be used in sourcing seed, as even locations close to

one another may not be appropriate for collections…..Our results also indicate that thinning prescriptions aimed at increasing tree growth in whitebark pine should be applied with considerable caution. In our study, as well as in that of Kichas et al. (2020), faster overall growth was the strongest predictor of mortality due to D. ponderosae indicating that such treatments will not have their intended effect in P. albicaulis and may even be detrimental." Keane et al (2017) recommended avoiding "treatments designed only to reduce disturbance agents, such as fuel treatments. Embrace a holistic wildland fire policy that balances losses with gains in competition-free burned areas".

DA, p. 124, states: *"The natural selection process for resistance traits is occurring too slowly given the influence of other stressors that cause the loss of viable seed trees."* Six et al. (2021) disagreed, saying "To protect the ability of this tree to adapt to current and future conditions, the maintenance of genetic diversity should be a top priority, and practices that can reduce diversity or that may introduce maladaptive genes or swamp local adaptation should be avoided. Reliance on natural regeneration is best because it involves locally adapted seed sources drawn from the full array of diversity present in the stand and seedlings that establish will have done so under a local climatic selection filter."

DA, p. 124, states: *"A century of fire suppression has allowed shade-tolerant species to outcompete whitebark pine and change the fuel profile. There is an increased fire frequency and shift to higher severities in forests where Engelmann spruce and subalpine fir have become prevalent."* However, Larson and Kipfmueller (2012) concluded "the implication of fire suppression as a widespread cause of declines of whitebark pine communities may be inaccurate for much of the range of the species and could result in misguided restoration efforts". Similarly, the whitebark listing on the Federal Register (2022) states "we do not know at what scale the impacts of fire exclusion and resultant forest succession have affected whitebark pine".

DA, p. 124, states: *"Bark beetle outbreaks have become widespread due in part to warming temperatures which results in lower winter mortality of beetles and increases reproduction rates. The homogeneity of neighboring lodgepole pine forests in some places has led to outbreaks which can "spill" into whitebark pine forests."* In contrast, Larson and Kipfmueller (2012) said: "Suggestions that the current mountain pine beetle outbreaks are unnatural must be firmly placed within the context of the extremely short historical record relative to the pace of forest dynamics in whitebark pine communities… beetle outbreaks may play roles equal in importance to fire in creating suitable sites for whitebark pine regeneration." Furniss and Renkin (2003) found the assumption that mountain pine beetle outbreaks spread from lower lodgepole forests into higher whitebark forests may be false, and that the opposite might be true.

DA, p. 124, states: "*Climate change is an overarching stressor that exacerbates the other stressors described and directly impacts whitebark pine whose competitive advantage relies on its ability to survive cold temperatures at treeline."* But the effects of climate change on whitebark pine are still largely unknown, as summarized by Larson and Kipfmueller (2012): "The net effects of climate change may be negative for whitebark pine as a species, yet even here uncertainty and heterogeneity exist. As winter temperatures warm, much of western North America will experience lower snow packs and overall drier conditions, particularly through earlier snow melt and more intense late season droughts (Barnett et al. 2008). Drier conditions may limit the spread of blister rust spores and result in an overall reduction in the effects of this disease on whitebark pine communities (cf. Boland et al. 2004). Drier conditions are also expected to result in increased fire frequency and severity in subalpine forests (Fagre et al. 2003; Westerling et al. 2006). This may, in effect, counter any effects of fire suppression that do exist and result in a greater abundance of recently burned sites that are amenable to whitebark pine regeneration, depending on the severity of fires and their areal extent." Demonstrating just how little is known about climate change's effects on whitebark pine is a study by Flanary and Keane (2019) that found that whitebark in southwest Montana had expanded to *lower* elevations, with no evidence that it was moving upward as expected from climate change.

DA, p. 125, states: "The expected trend of this ecosystem is a continued decline, except for areas where active restoration occurs (e.g., prescribed fire and planting of stock that is genetically resistant to white pine blister rust)….Genetic depression increases the need for active restoration activities to increase the population". However, the benefits of the proposed active restoration activities are still speculative and could do more harm than good. Six et al. (2021) concluded that maintaining genetic diversity is most important, and "in cases where planting is required, care should be used in sourcing seed, as even locations close to one another may not be appropriate for collections". Larson and Kipfmueller (2012) state "the implication of fire suppression as a widespread cause of declines of whitebark pine communities may be inaccurate for much of the range of the species and could result in misguided restoration efforts".
The science of whitebark pine ecology and management is clearly complex, geographically variable, and rapidly evolving. In any case, it is premature for LNF to suggest any management activities without first having done a detailed assessment and inventory of whitebark pine on LNF. Only then can management actions, guided by the best available science, be proposed. Because knowledge of whitebark pine ecosystems is changing so rapidly, perhaps the best way to handle this in the revised LNF Management Plan is to place LNF's whitebark pine ecosystems in a Management Area (MA) of their own, with any future activities to be determined by sound science.

Larson and Kipfmueller (2012) give some final advice: "**The fundamental message we hope to convey is that management of whitebark pine communities, although urgent, must be approached cautiously with recognition of the broadsweep of time as it relates to the dynamics of these systems that exist across areas of diversetopography and extreme environmental gradients."**

References
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Western Red Cedar Bottomlands

These unique areas with trees up to 600 years old are located within the coastal-disjunct Rocky Mountain Refugium (see above).

Subalpine Larch

Subalpine Larch are found in a few areas of the LNF including the Bitterroot range near Lolo Pass and are in need of special protections.

Aspen Stands

Aspen stands are very important and unique as connected systems.

Cottonwoods

Cottonwoods are a vital component of riparian ecosystems but are in decline due to grazing and other factors. They provide shade, cavities for nesting birds and down and dead woody material essential to maintaining pool habitat for native fish. Cottonwood systems should be off limits to vegetation management.

Fungi and the Forest Ecosystem

The DA has little recognition of the role of fungi in forest ecosystems. Whereas the Forest Service now presents two lists of potential Species of Conservation Concern—one of plants and another animals—there are other kingdoms of life forms providing vital roles in the ecosystems of the Lolo National Forest. Herein we provide some correction and supplement to the Assessment record.

In the DA, mycorrhizal fungi are only mentioned—and rather briefly—in the context of baseline carbon stock and flux in the DA. The only other mention of the fungal kingdom is in regards to demonization of "fungal pathogens" (tree diseases) and making brief mention of species of cultural importance to indigenous peoples.

In identifying Needs for Change during the Assessment phase, the Forest Service must evaluate scientific information recognizing the key role of soil ectomycorrhizal networks, and investigate scientific information which suggests management-induced damage to soil ectomycorrhizal networks threatens soil/site productivity, therefore inhibiting ecological processes and functions and negatively impacting sustainability.

Scientific Background on Mycorrhizal Fungi

Numerous studies have revealed that soil biota, particularly fungi, form symbioses with plant roots (mycorrhizae), provide a suite of ecosystem services that support the integrity and resiliency of natural and human communities (Markovchick et al., 2023), especially forests. Mycorrhizae are known to reduce erosion and nutrient loss (e.g. Burri et al., 2013; Mardhiah et al., 2016), increase plant water use efficiency and water retention and cooling capacity in the landscape (Querejeta et al., 2006; Gehring et al., 2017; Wu & Xia 2005), store carbon in the ground (e.g. Orwin et al., 2011; Nautiyal et al., 2019), help plants adapt changes in climate (Gehring et al., 2017; Patterson et al., 2019), and resist pests and pathogens (Reddy et al., 2006; Rinaudo et al., 2010).

Many reports suggest that beneficial native fungi, including native mycorrhizae, are rare and frequently in decline. The Survey and Manage Standards and Guidelines of the Northwest Forest Plan found that 55% of the 234 fungal taxa in the program were found at fewer than 20 locations, and 42% were found at 10 or fewer sites (Molina 2008). For comparison, the Eastern prairie fringed orchid (*Platanthera leucophaea*) is extant in 59 populations and listed as threatened

(USFWS 2019), while its relative, the chaparral rein orchid (*Platanthera cooperi*) is found at 162 locations and is considered vulnerable (The Calflora Database 2022).

The decline of mycorrhizal fungi can be more difficult to assess because this category includes fungi that do not form large fruiting bodies above ground, such as Arbuscular mycorrhizal fungi (AMF). However, many studies report declines in mycorrhizal fungi due to various causes including land use change, invasive species, pollution deposition, and herbicide use (e.g. Meinhardt & Gehring 2012; Swaty et al., 2016; Lilleskov et al., 2019). Climate change also appears to be threatening the type of mycorrhizal fungi known to best support carbon sequestration called ectomycorrhizal fungi (EMF)(Baird & Pope, 2021).

In some cases, the dangers facing beneficial fungi mirror those for other species, and the same conservation strategies could benefit fungi (Minter 2011). For example, Clemmensen et al. (2013) found that habitat fragmentation, a common threat to biodiversity, is also a concern for mycorrhizal fungi and conservation mycology. Thus, conservation programs targeting the mitigation of fragmentation could benefit both charismatic taxa and lesser known taxa like mycorrhizal fungi. However, Cameron et al. (2019) documented geographic mismatches between terrestrial aboveground and soil (including mycorrhizal) biodiversity, finding that these mismatches cover 27% of the earth's terrestrial surface. Thus, efforts to protect areas of aboveground biodiversity may not sufficiently reduce threats to soil biodiversity (Cameron et al., 2019).

Even within areas that are protected, disturbances such as logging and thinning (Wiensczyk et al., 2002), treatments of invasive vegetation with pesticide (Helander et al., 2018), or self-reinforcing soil legacies left after invasion by exotic vegetation (e.g. Meinhardt & Gehring 2012) may quietly continue to reduce beneficial fungi, if these impacts are not recognized and specifically addressed as part of land management planning (Davoodian 2015; May et al., 2018; Willis 2018; Markovchick et al., 2023). These effects are not short-term, and ripple throughout the ecosystem, as evidenced by study after study that shows the need for and effectiveness of restoring diverse native mycorrhizal communities after various kinds of disturbance. For example, Pankova et al. (2018) found that a single fungicide application left mycorrhizal inoculum and plant outcomes far from reference levels even after five years.

Mycorrhizal networks play important roles in mitigating the impacts of climate disruption to forest ecosystems. They facilitate regeneration of migrant species that are better adapted to warmer climates and primed for resistance against insect attacks. Song et al. (2015.) To achieve these benefits all of the parts and processes of highly interconnected forest ecosystems must be preserved and protected.

Mycorrhizal fungi distribute photosynthetic carbon by connecting the roots of the same or different tree species in a network allowing each to acquire and share resources. Large mature trees become the hubs of the network and younger trees the satellite nodes. *Id.*

Mycorrhizal networks transmit water, carbon, macronutrients, micronutrients, biochemical signals and allelochemicals from one tree to another, usually from a sufficient tree to a tree in need. This type of source-sink transfer has been associated with improved survivorship, growth, and health of the needy recipient trees in the network. *Id.*

Recognition of kin is also evident between established large hub trees and their seedlings and saplings. Hub trees shuttle their kin more micro-elements and support more robust mycorrhizal networks providing them with a competitive advantage. However, hub trees also share resources with strangers, suggesting these evolutionary mechanisms exist not just for individual species but also at the community level. *Id.*

Injury to a tree from defoliation by an insect herbivore or by physically removing foliage results in the transmission of defense signals through the connecting mycorrhizal mycelium to neighboring trees. These neighbors respond with increased defense-gene expression and defense-enzyme activity, resulting in increased pest resistance. *Id.*

In Douglas-fir, sudden injury to a hub tree not only increases defense enzymes of healthy neighbors but elicits a rapid transfer of photosynthate carbon to a healthy neighbor. This suggests that the exchange of biochemicals between trees elicits meaningful changes in the senders' and receivers' behavior that enables the community to achieve greater stability in the face of a changing climate. *Id.*

While much science demonstrating the importance of mycorrhizal interactions is recent, the concepts are not new. For example, Forest Service scientists (Harvey et al., 1994) invoked the relationship between chemical properties and biological properties: "Productivity of forest and rangeland soils is based on a combination of diverse physical, chemical and biological properties." In addition, due to its high level of biodiversity, soil—far from being an inert, non-biological substrate—has been called the "poor man's tropical rainforest" (Giller 1996). The soil microbial world is known to be a foundational driver determining the habitat type, health, resiliency, and ecosystem services of natural areas (e.g. Singh & Gupta 2018; Cameron 2010; Wubs et al., 2016; Peay et al., 2016). Over 1,000 scientists and 70 institutions have urged agencies to recognize the broad relevance of the microbial world to sustaining healthy ecosystems and life on earth, and protect and harness this utility in responding to climate change (Cavicchioli et al. 2019). Yet, the Forest Service continues to ignore microbial communities when considering the tools available to support forest resilience, and when considering the impacts of their actions.

Mycorrhizal Ecosystem Services

A. Forest Service Ecosystem Services Policy & Direction

In 2005, the United Nations issued a report titled, "The Millennium Ecosystem Assessment" that significantly advanced the concepts and definitions of ecosystem services. The report identified four main categories:

- Provisioning Services such as food, clean water, fuel, timber, and other goods;
- Regulating Services such as climate, water, and disease regulation as well as pollination;

- Supporting Services such as soil formation and nutrient cycling; and
- Cultural Services such as educational, aesthetic, and cultural heritage values, recreation, and tourism.

Importantly, the Forest Service adopted these categories and definitions in its 2012 National Forest System Land Management Planning Rule (36 C.F.R. § 219.10, § 219.19):

- (a) Integrated resource management for multiple use. The plan must include plan components, including standards or guidelines, for integrated resource management to provide for ecosystem services and multiple uses in the plan area.

- …Ecosystem services. Benefits people obtain from ecosystems, including:
  - Provisioning services, such as clean air and fresh water, energy, fuel, for- age, fiber, and minerals;
  - Regulating services, such as long term storage of carbon; climate regulation; water filtration, purification, and storage; soil stabilization; flood control; and disease regulation;
  - Supporting services, such as pollination, seed dispersal, soil formation, and nutrient cycling; and
  - Cultural services, such as educational, aesthetic, spiritual and cultural heritage values, recreational experiences, and tourism opportunities.

When defining soil function, the Forest Service internal directives provides the following:

- Soil biology. The presence of roots, fungi, and micro-organisms in the upper sections of the soil.
- Soil hydrology. The ability of the soil to absorb, store, and transmit water, both vertically and horizontally.
- Nutrient cycling. Soil stores, moderates the release of, and cycles nutrients and other elements.
- Carbon storage. The ability of the soil to store carbon.
- Soil stability and support. Soil has a porous structure to allow passage of air and water, withstand erosive forces, and provide a medium for plant roots. Soils also provide anchoring support for human structures and protect archeological treasures.
- Filtering and buffering. Soil acts as a filter to protect the quality of water, air, and other resources. Toxic compounds or excess nutrients can be degraded or otherwise made unavailable to plants and animals.

(Forest Service Manual 2550.5 at 8-9.) As detailed in the following section, ecosystem services provided by mycorrhizal fungi directly relate to those identified by the Forest Service as important soil functions, and the significant benefits provided by mycorrhizal fungi must be considered in detailed environmental analysis.

B. <u>Scientific Background on Mycorrhizal Ecosystem Services</u>

Ecosystem services are defined as ecological functions and processes that contribute to human wellbeing (Costanza et al. 1997). Available data highlight the many and meaningful contributions of mycorrhizae to ecosystem services and integrity, ranging from drought resilience to pest control to climate stabilization (e.g., Christensen, 1989; Peay et al., 2016).

Below we include the definitions for each category from Costanza et al., (1997) and briefly review the fungal contributions. In Table 1, we highlight many of these studies and provide examples of some of the magnitudes of effects seen due to mycorrhizae (see effect sizes and percent changes).

Table 1: Some examples of mycorrhizal ecosystem services and effects sizes.

Ecosystem Service Category	Study	Effect Type	% Change[2]	Effect Size[3]
Climate	Clemmensen et al. 2013	carbon storage	50-70%	
Climate	Orwin et al. 2011	carbon storage	14%	
Climate	Nautiyal et al. 2019	carbon storage	82%	
Disturbance regulation	Auge et al. 2015	drought adaptation	111%	0.75
Disturbance regulation	Auge et al. 2015	drought adaptation	49%	0.4
Disturbance regulation	Auge et al. 2015	drought adaptation	24%	0.2
Disturbance regulation	Miozzi et al. 2020	reduction in disease severity	200%	
Disturbance regulation	Ruiz-Lozano & Azcón 1995	support plant growth	938%	2.34
Disturbance regulation	Ruiz-Lozano & Azcón 1995	support plant growth	3542%	3.60
Disturbance regulation	Stella et al. 2017	remove soil toxins	19%	
Disturbance regulation	Stella et al. 2017	remove soil toxins	41%	
Disturbance regulation	Stella et al. 2017	remove soil toxins	51%	
Disturbance regulation	Wulandari et al. 2016	increase plant health & growth at toxic site	125%	0.81
Disturbance regulation	Wulandari et al. 2016	increase plant health & growth at toxic site	200%	1.10
Disturbance regulation (Restoration)	Koziol & Bever 2017	support plant survival	40%	
Disturbance regulation (Restoration)	Koziol & Bever 2017	support plant growt/health	300%	
Disturbance regulation (Restoration)	Koziol & Bever 2017	increased leaves/tillers	200%	
Disturbance regulation (Restoration)	Koziol & Bever 2017	increased species richness	55%	
Disturbance regulation (Restoration)	Koziol & Bever 2027	increased species diversity	70%%	
Disturbance regulation (Restoration)	Maltz & Treseder 2015	support plant growt/health		0.63
Disturbance regulation (Restoration)	Neuenkamp et al. 2019	boost species richness	30%%	
Disturbance regulation (Restoration)	Neuenkamp et al. 2020	boost restoration plant growth		1.70

Disturbance regulation (Restoration)	Rua et al. 2016	support plant growt/health		0.25 to 1.25
Disturbance regulation, Pollination	Botham et al. 2009	support plant growt/health	30%	
Disturbance regulation, Pollination	Botham et al. 2009	support plant growt/health	23%	
Disturbance regulation, Water	Egerton-Warburton et al. 2008	support water uptake/movement	up to 7 μmol/m/hr	
Disturbance regulation, Water	Egerton-Warburton et al. 2008	support water uptake/movement	up to 6.5 μmol/m/hr	
Disturbance regulation, Water	Querejeta et al. 2006	drought adaptation	111%	0.75
Erosion control	Burri et al 2013	reduce erosion & increase soil stability	74%	0.94
Erosion control	Graf and Frei 2013	reduce erosion & increase soil stability	533%	1.85
Erosion control	Mardhiah et al 2016	reduce erosion & increase soil stability	16%	
Erosion control	Rillig et al 2010	reduce erosion & increase soil stability	116%	0.77
Erosion control	Rillig et al 2010	reduce erosion & increase soil stability	18%	0.17
Erosion control	Zheng et al 2014	reduce erosion & increase soil stability	267%	1.30
Erosion control	Zheng et al 2014	reduce erosion & increase soil stability	13%	0.12
Erosion control, Water	Andrade et al 1998	reduce erosion & increase soil stability	14%	0.13
Genetic resources	Ina et al. 2013	medical contributions by EMF	54%	0.43
Genetic resources	Ina et al. 2013	medical contributions by EMF	39%	0.33
Genetic resources	Ina et al. 2013	medical contributions by EMF	10%	
Genetic resources	Zeng et al. 2013	medical contributions by AMF	84-270%	
Habitat & biodiversity	Stevens et al. 2018	ecosystem abundance/diversity from AMF-contributed phosphorus	48%	
Habitat & biodiversity	Tracy & Markovchick 2020	habitat suitability for endangered bird	1.2 hectares	
Habitat & biodiversity	van der Heijden et al. 2015	land plants that rely on native mycorrhizae	86%	
Nutrient cycling	Bonneville et al. 2009	mineral weathering & supply	50-75%	1.61
Nutrient cycling	Quirk et al. 2015	mineral weathering & supply	400%	1.61
Nutrient cycling	Taylor et al. 2012	mineral weathering & supply	100%	0.69
Pest regulation	Abdalla & Abdel-Fattah 2000	pathogen reduction by AMF	80%	
Pest regulation	Babikova et al. 2013	residence time of pest controls	333%	
Pest regulation	Babikova et al. 2013	residence time of pests	186%	
Pest regulation	Karst et al. 2015	tree growth after pests	700%	2.08
Pest regulation	Karst et al. 2015	monoterpene production	500%	1.79
Pest regulation	Reddy et al. 2006	AMF reduction of pathogen	70%	-1.20
Pest regulation	Reddy et al. 2006	AMF reduction of pathogen	75%	-1.39
Pest regulation	Rinaudo et al. 2010	AMF reduction of invasive vegetation	45%	-0.60
Pest regulation	Rinaudo et al. 2010	AMF reduction of invasive vegetation	25%	-0.29
Pest regulation	Waller et al. 2016	AMF reduction of invasive vegetation	29%	-0.34
Pollination	Aguilar-Chama and Guevara 2012	flower mass	100%	0.69
Pollination	Cahill et al. 2008	pollinator visitation rates	193%	1.08

Pollination	Cahill et al. 2008	type of pollinators	shifted pollinator species	
Pollination	Gange and Smith 2005	flower number	63%	0.49
Pollination	Gange and Smith 2005	flower nectar sugar content	55%	0.44
Pollination	Gange and Smith 2005	pollinator visitation rates	33%	0.29
Pollination	Gange and Smith 2005	pollinator visitation rates	200%	1.10
Pollination	Gange and Smith 2005	pollinator visitation rates	100%	0.69
Pollination	Gange and Smith 2005	nectar production	50%	0.41
Pollination	Gange and Smith 2005	nectar production	81%	0.60
Pollination	Lu and Koide 1994	days to flowering	23%	0.26
Pollination	Lu and Koide 1994	flowering duration	76%	0.57
Pollination	Lu and Koide 1994	fruits produced	200%	1.10
Pollination	Lu and Koide 1994	fruits produced	350%	1.50
Pollination	Lu and Koide 1994	fruits produced	20%	0.18
Pollination	Poulton et al. 2001	flowers per plant	113%	0.75
Pollination	Poulton et al. 2001	flowers per plant	90%	0.64
Pollination	Wolfe et al. 2005	pollinator visitation rates	100%	0.69
Pollination	Wolfe et al. 2005	seed set	167%	0.98
Food & Raw materials	Elliot et al. 2020	small mammal diet	80%	
Food & Raw materials	Willis 2018	edible mushroom market	US$42B/yr	
Water	van der Heijden 2010	reduction in nutrient leaching due to AMF	60%	

Table 1 Notes:

1) See Markovchick et al., 2023 Supplement S1 for an expanded list of studies and more detailed explanation. Ecosystem service categories are abbreviated from Costanza et al., 1997, see Markovchick et al., 2023 for details.
2) Absolute value of percent change seen (always an improvement, but sometimes the improvement is an increase, and sometimes it is a decrease, for example in disease severity).
3) Effect size is either the statistic provided in the paper (there are various ways of calculating this and not all mean the same thing, see Sullivan and Feinn (2012) for a summary), or calculated as ln(mycorrhizal mean / control) from the statistics provided in the publication (if no effect size was calculated in the paper). This measure of effect size has the advantage of being directly related to percent change (Pustejovsky 2017), which can be calculated using the following equation: $(e^{\ln(R)} - 1) \times 100\%$. For example, an effect size of 0 indicates a 0% change, 0.5 indicates a 65% change, and 0.75 indicates a 110% change in the mean between treatment and control (Pustejovsky 2017).

1. *Disturbance Regulation & Response*

This category includes boosting the ability of ecosystems to respond to environmental fluctuations and dampening the influence of disturbances on the integrity of the ecosystem. Mycorrhizas assist in site clean-up, vegetation return, and protection of plants against toxins at polluted sites (e.g. Wulandari et al., 2016). They reduce invasive vegetation (e.g. Rinaudo et al., 2010). Mycorrhizal fungi enhance plant water status, survival, and productivity, including during and after droughts (e.g. Querejeta et al., 2006; Kivlin et al., 2013).

2. *Erosion Control & Sediment Retention*

This service category includes retaining soil within an ecosystem. Mycorrhizas increase the stability of soils through entangling soil particles in a "sticky string bag" to form soil aggregates. These aggregates are structured by hyphae and enhanced by stabilizing substances that hyphae secrete, such as glomalin (Rillig & Mummey 2006; Nautiyal et al., 2019). As a result, mycorrhizas play critical roles in stabilizing soil and protecting it from surface water flows (Mardhiah et al., 2016) and wind erosion (Burri et al., 2013).

3. *Food & Raw Materials*

This category includes the portion of gross primary production consisting of food and raw materials. In addition to their use to promote crop production (Reddy et al., 2006; Rinaudo et al., 2010), 350 species of mushrooms (many of which are mycorrhizal fungi) are known to be used for food (Willis, 2018). Many kinds of fungi, including some that are mycorrhizal, are used to create medicines, enzymes used in industry, and sustainable clothing, packaging, and construction materials (e.g. Bhat, 2000; Willis 2018).

4. *Gas & Climate Regulation*

This category includes regulating the chemical composition of the atmosphere, global temperature, and other climatic processes mediated by organisms. Clemmensen et al. (2013) found that a majority of boreal forest soil-stored carbon is in roots and root-associated microorganisms (including mycorrhizal fungi). Orwin et al., (2011) found that improved plant nutrient access due to mycorrhizal symbioses increased carbon sequestration. Fungal hyphae also produce exudates that promote the formation of soil aggregates, stabilizing soil and supporting continued carbon sequestration in the soil (e.g. Nautiyal et al., 2019). Mycorrhizas compete with saprotrophs (decomposers) for soil nutrients, reducing decomposition (decomposition releases carbon) and increasing soil carbon storage (Read & Perez-Moreno 2003; Fernandez & Kennedy 2016).

5. *Genetic Resources*

This category includes unique biological materials and products, along with their sources. An enormous variety of medical compounds are derived from or produced by fungi (see Markovchick et al., Supplement S1). Mycorrhizal symbioses improve plant nutrition and enhance the active ingredients of medicinal plants (Zeng et al., 2013). The effects of fungal genetics likely cascade through ecosystems. For example, ectomycorrhizal fungi are linked via plant genetics to insects, lichens, pathogens, endophytes, and soil decomposing fungi and bacteria (Lamit et al., 2015). Given the role of fungi as foundational taxa that help to structure ecosystems (e.g. Tedersoo et al., 2014), their genetic diversity may be crucial to conserving and supporting the genetic diversity at other community levels and stabilizing our ecosystems (e.g. Hazard et al., 2017).

6. Habitat & Biodiversity

This category includes habitat for resident and migratory populations, a refuge for species and biodiversity. Nearly all plants depend on the presence of mycorrhizal fungi (van der Heijden et al., 2015). Fungal contributions to plant nutrition and performance cascade through ecosystems, influencing habitat quality and resource quantity for most terrestrial species. One recent modeling effort suggests that the biomass of organisms in the Serengeti would be reduced by half without just the phosphorus provided by arbuscular mycorrhizal fungi (Stevens et al., 2018). Another preliminary, smaller-scale model indicated that simply including appropriate mycorrhizal inoculation in restoration efforts could increase the useable habitat for an endangered bird from 0 to 1.2 hectares six years after restoration (Tracy & Markovchick 2020).

7. Nutrient Cycling & Soil Formation

This service category includes the processes involved in forming, cycling, storing, and processing soil and nutrients. With complex enzymatic capabilities that allow them to access nutrients bound in recalcitrant forms, mycorrhizal fungi can forage for nutrients and mine them (e.g. Fernandez & Kennedy 2016). They may also indirectly facilitate decomposition by free-living soil microbes as they forage for nutrients in soil organic matter (e.g. Talbot et al., 2008). Mycorrhizal fungi also structure soils and reduce nutrient losses (Rillig & Mummey 2006; Parihar et al., 2019), permitting retention of nutrients necessary to build fertile soils (van der Heijden 2010).

8. Pest & Insect Regulation

This category includes regulation of populations, such as insect pests, invasive vegetation, and disease. Mycorrhizas and endophytes play key roles in this area. For example, Karst et al. (2015) found that mycorrhizas increase monoterpene production, a key chemical defense against herbivory. Mycorrhizal fungi also reduce viral symptoms, disease and invasive vegetation (e.g. Miozzi et al., 2020; Reddy et al., 2006; Rinaudo et al., 2010). Mycorrhizal fungi also appear to share pest warning signals through underground networks, permitting a coordinated call that attracts insects that control plant pests (e.g. attracting parasitoids that reduces aphids in Babikova et al. 2013).

9. Pollination

This category is defined as moving and assisting floral reproduction. Our knowledge of fungal impacts on plant-pollinator interactions remains limited, and largely focused on arbuscular mycorrhizal fungi (Barber & Gorden 2015). However, these mycorrhizas can increase average flower number, flower mass, pollen tube length, seed production, nectar production and sugar content, pollinator visitation rates, and the number of fruits produced per plant (Aguilar-Chama and Guevara, 2012; Cahill et al., 2008; Gange & Smith 2005; Lu & Koide 1994; Poulton et al., 2001; Wolfe et al., 2005). Mycorrhizas could also assist plant reproduction under climate change in two ways: 1) they can decrease time to initial flowering and increase flowering duration, reducing potential mismatches between flowering and pollinator activity (Barber & Gordon 2015; Lu & Koide 1994), and 2) they can encourage clonal growth, which could assist plant survival if pollination is reduced or impossible (Botham et al., 2009).

10. Water Quality & Supply

This combined service category includes the regulation, retention, and cleansing of water. Mycorrhizas enhance nutrient retention in vegetation, mycelium and soils - decreasing leaching that negatively affects water quality (van der Heijden, 2010). Mycorrhizal mycelia aggregate soil particles, improving soil porosity, and enhancing water infiltration and moisture retention (e.g. Augé et al., 2001; Rillig & Mummey, 2006). They mediate hydrological functioning by modulating surface soil-to-water attraction and repellency (e.g. Rillig et al., 2010; Zheng et al., 2014). Mycorrhizal hyphae infiltrate bedrock and tiny soil pores to access water, and contribute to the soil-plant-atmospheric-continuum of water dynamics and nocturnal hydraulic lift of water to upper soil layers (Allen, 2009; Bornyasz et al., 2005; Querejeta et al., 2007).

Note on Common mycorrhizal networks

Although the exact function of common mycorrhizal networks (the roots of separate plants linked by a network of fungal strands) is challenging to ascertain under field conditions, even critics recognize their existence in the field and demonstrated functions under controlled conditions (e.g. Karst et al., 2023). For example, these underground networks are known to share resources between trees, shrubs, and other understory plants in the field, with some plants known as mycoheterotrophs being entirely dependent on this setup (e.g. Karst et al., 2023; Selosse et al., 2006). Under laboratory conditions, the use of autoradiography, dye tracers, and air gap treatments provide convincing evidence that resources are shared via the connections between plants provided by mycorrhizal fungi, including carbon (e.g. Finlay et al., 1986; Brownlee et al., 1983; Wu et al., 2001), phosphorus (e.g. Finlay, 1989), water (e.g. Warren et al., 2008; Plamboeck et al., 2007; Egerton-Warburton et al., 2007), and defense signals (Babikova et al., 2013). This ability to spread resources (Peay et al., 2016) in the field would reduce risk and increase the inherent stability of ecosystems the way that financial portfolios reduce the risk of investing (Schindler et al., 2015).

While trees communicate chemically all the time through the volatile organic chemicals they produce wafting through the air, research indicating communications and resources are shared through soil, root systems, and common mycorrhizal networks (e.g. Babikova et al., 2013; Bingham & Simard, 2011; Simard et al., 2015) poses special new questions for the land and natural resources communities, due to the tendency of land management actions to impact the soil community. If the ability of trees to communally send stronger insect control signals or share resources in times of need is impacted by current tree density reduction practices, as suggested by the scientific literature referenced herein, then the Forest Service would be implicated for ignoring this large body of science, and the impact of its actions. Even the critics of the available current technologies acknowledge that given what we know about plant and fungal biology, these underground linkages, "should be common" (Karst et al., 2023), and the indications of the science are clear - this issue is not constrained to one or a few environments or biomes.

Gorzelak et al., 2015:

> …found that the behavioural changes in ectomycorrhizal plants depend on environmental cues, the identity of the plant neighbour and the characteristics of the (mycorrhizal network). The hierarchical integration of this phenomenon with other biological networks at broader scales in forest ecosystems, and the consequences we have observed when it is interrupted, indicate that underground "tree talk" is a foundational process in the complex adaptive nature of forest ecosystems.

The Forest Service must consider soil function, mycorrhizal interactions and impacts to mycorrhizal assisted ecosystem services.

Many kinds of activities and disturbance can harm soil biota, including mycorrhizal fungi. Examples include the changes to microclimates and soil compaction caused by logging and thinning activities, the application of herbicides and pesticides, pollution deposition, and the presence of, and soil legacy left behind by, non-native vegetation (Wiensczyk et al., 2002; Hartmann et al., 2014; Meinhardt & Gehring, 2012; Koziol & Bever, 2017; Helander et al., 2018). Appropriately protecting and restoring native mycorrhizal diversity and abundance offers a crucial tool to support forest resiliency. Conversely, when mycorrhizae are not protected from these effects, or are not appropriately restored, this can negatively impact forest regeneration and resiliency for many years. Unfortunately, soil biota like mycorrhizal fungi are frequently ignored in forest planning, despite Forest Service policies requiring their protection (Markovchick et al., 2023), and a regulatory and legal framework requiring their consideration and mitigation of impacts to them.

National Forest Management Act

The 2012 National Forest System Land Management Planning Rule (Planning Rule) requires revised or amended land management plans (i.e., Forest Plans) to provide for ecological sustainability, including ecosystem integrity, which necessitates "standards or guidelines, to maintain or restore the ecological integrity of terrestrial and aquatic ecosystems." 36 C.F.R. §219.8(a)(1). Further, the Forest Plans must include components, including standards or guidelines, to maintain or restore soils. §219.8(a)(2)(ii).

However, it is unclear how the DA, which failed to sufficiently consider mycorrhizal fungi (and the benefits of the entire Kingdom of fungi generally), can possibly comply with the Planning Rule. This is particularly true given the lack of consideration of the effects that management actions have on soil biota, especially mycorrhizae, and the results of their interactions with plants and animals, and the enormous cascade of effects these have on diverse ecosystem services. The DA provides insufficient consideration of mycorrhizal fungi, and soil biota, known to be system drivers. Mycorrhizal fungi are known to be ecological drivers of soil productivity, erosion protection, sedimentation protection, and water quality and resources. Further, in order to ensure ecosystem integrity the 2012 Planning Rule directs the agency to include plan components to maintain or restore function. §219.8(a)(1). Function is specifically defined as "Ecological processes that sustain composition and structure, such as energy flow, nutrient cycling and retention, soil development and retention…." (§ 219.19). Mycorrhizal fungi are known to play important roles in riparian ecosystems, protection against sedimentation, and filtering and protecting water resources.

The planning process is required to use the best available scientific information and documenting how the best available scientific information was used to inform assessments, plans, and monitoring (§ 219.3). Yet the DA includes scant mention of the vast scientific background on mycorrhizal fungi.

Mycorrhizal protection and restoration has been clearly demonstrated as required for restoring the structure, function, and composition of ecosystems, including native plant diversity and rare plants.

The Planning Rule includes a dedicated section to provide for multiple use. (§ 219.10.) As mentioned above, this includes direction to provide for ecosystem services. Specifically, it directs the responsible official to consider: "…ecosystem services… soil, surface and subsurface water quality… (5) Habitat conditions… for wildlife, fish, and plants commonly enjoyed and used by the public." *Id.* Mycorrhizal fungi, and their interactions with the plant community and management actions meaningfully affect all of these. This section also clearly requires the responsible official to consider the following:

> Reasonably foreseeable risks to ecological, social, and economic sustainability [and consider] System drivers, including dominant ecological processes, disturbance regimes, and stressors,… the ability of the terrestrial and aquatic ecosystems on the plan area to adapt to change;…[and] Public water supplies and associated water quality.

Id. Mycorrhizal fungi have clearly been shown to be the system drivers, and their reductions would and stress on plant populations and their ability to swiftly adapt to and be resilient to stressors such as drought, pests, pathogens, or the impacts of this on ecosystem services and water supplies.

The Planning Rule also clearly requires timber harvest for any reason to "be carried out in a manner consistent with the protection of soil," so these drivers of soil health and productivity must be examined in full.

Section 219.19 of the Planning Rule specifically recommends that focal species would be:

> …commonly selected on the basis of their functional role in ecosystems, and permits inference to the integrity of the larger ecological system to which it belongs and provides meaningful information regarding the effectiveness of the plan in maintaining or restoring the ecological conditions to maintain the diversity of plant and animal communities in the plan area.

Mycorrhizal fungi are drivers of so many ecosystem services, plant and habitat diversity and resilience, and crucial to maintaining and restoring ecological integrity. This clearly implicates a "need for change" to be considered as a focal species for monitoring. Some plants simply won't return without them (e.g. Koziol & Bever, 2017).

Amaranthus, Trappe, and Molina (in Perry, et al., 1989a) recognize "mycorrhizal fungus populations may serve as indicators of the health and vigor of other associated beneficial organisms. Mycorrhizae provide a biological substrate for other microbial processes."

Fungi and Dead Wood

The Assessment must evaluate scientific information indicating reduced dead wood from management and other human activities impact ecological processes and functions, therefore affecting ecological sustainability.

Rose et al., 2001 is scientific information on dead wood in forest ecosystems. Snags and down dead wood are a defining element of old growth. Rose et al., 2001 cite dozens of other scientific sources. Below, the internal citations are omitted for ease of reading:

- Interactions among wildlife, other organisms, and decaying wood substrates are essential to ecosystem processes and functions. In the process of meeting their needs, animals accomplish ecosystem work with respect to transformation of energy and cycling of nutrients in wood. For example, chipmunks and squirrels disperse mycorrhizal fungi which play key roles in nutrient cycling for tree growth; birds, bats, and shrews consume insects that decompose wood or feed on invertebrates and microbes; beavers and woodpeckers create habitats by modifying physical structures; arthropods build and aerate soil by decomposing wood material. Relations between wood decay and wildlife have been examined in several recent analyses.
- Managed forests, on average, have lower amounts of large down wood and snags than do natural forests.
- Emphasis on concepts of long-term productivity in this chapter reflects an underlying principle that habitat functions of decaying wood are inextricably linked to ecosystem processes. Careful attention to the whole ecosystem is a prerequisite to successful management of decaying wood for wildlife.
- Of the biological agents of wood decay, insects and fungi are the principal players in coniferous forest ecosystems.
- To be useful to most cavity excavators, live trees usually must contain wood in a Class 2 stage of decomposition. For example, strong excavators, such as Williamson's sapsuckers, pileated woodpeckers, and black-backed woodpeckers, select trees with a sound exterior sapwood shell and decaying heartwood to excavate their nest cavities.
- The abundance of cavity-using species is directly related to the presence or absence of suitable cavity trees. Habitat suitability for cavity-users is influenced by the size (diameter and height), abundance, density, distribution, species, and decay characteristics

of snags. In addition, the structural condition of surrounding vegetation determines foraging opportunities.

- Nutrient Cycling and Soil Fertility. Decaying wood has been likened to a savings account for nutrients and organic matter, and has also been described as a short-term sink, but a long-term source of nutrients in forest ecosystems.
- Soil is the foundation of the forest ecosystem. Large wood is a major source of humus and soil organic matter that improves soil development.
- Moisture Retention. Water stored in large decomposing wood accelerates microbial decay rates by stabilizing temperature and preventing desiccation during the summer.11, 160, 376 Moist conditions within the wood favor decay by attracting burrowing and tunneling mammals and invertebrates that improve aeration of wood, and by providing colonization substrate and moisture for mycorrhizae and other fungi. Moist .nurse logs. also provide excellent sites for seedling establishment and production of sporocarps. These processes increase retention and cycling of nutrients within ecosystems and contribute to higher biodiversity and biomass production.
- Mycorrhizae. Mycorrhiza, meaning fungus-root, is a symbiotic association of fungi with plant roots. The fungus improves nutrient and water availability to the host in exchange for energy derived from plant sugars. Mycorrhizae are necessary for the survival of numerous tree families, including pine, hemlock, spruce, true fir, Douglas-fir, larch, oak, and alder. Mycorrhizal associations are a source of nutrients to promote wood decay. By the time a log reaches more advanced stages of decomposition (Class 3) fungal colonization leads to the accumulation of nutrients in hyphae, rhizomorphs and sporocarps, especially for ectomycorrhizal fungi, where >90% of the fungal activity is associated with organic material. Ectomycorrhizal fungi decrease the ratio of carbon to nitrogen in decomposing wood, and mediate nutrient availability to plants while improving nutrient retention by forest ecosystems.
- Intensive forest management activities that have decreased the density of large snags in early forest successional stages (sapling/pole and small tree stages) may have had adverse impacts on the 61 associated wildlife species (Figure 12). Similarly, the lesser amount of large down wood in early forest successional stages may not provide as well for the 24 associated wildlife species. Such results suggest the continuing need for specific management guidelines to provide large standing and down dead wood in all successional stages.
- Other forms of decaying wood, including hollow trees, natural tree cavities, peeling bark, and dead parts of live trees, as well as fungi and mistletoe associated with wood decay, all provide resources for wildlife, and should be considered along with snags and down wood in management guidelines.
- Green trees function as a refugium of biodiversity in forests. For example, many species of invertebrate fauna in soil, stem, and canopy habitats of old-growth forests do not disperse well, and thus, do not readily recolonize clear-cut areas. The same concept holds for many mycorrhizae-forming fungal species. Added benefits of green tree retention include moderated microclimates of the cutover area, which may increase seedling survival, reduce additional losses of biodiversity on stressed sites, and facilitate movement of organisms through cutover patches of the landscape.

Soil

"Soil is a critical component to nearly every ecosystem in the world, sustaining life in a variety of ways—from production of biomass to filtering, buffering and transformation of water and nutrients." (Lacy, 2001.)

The DA largely aligns with the management paradigm focused mostly on limiting soil damage during active management activities as a way to address NFMA mandates for maintaining soil productivity. The Assessment must evaluate far more scientific information concerning the diversity of life forms in soil, which contributes to soil productivity and sustains ecological processes and functions. We incorporate our above discussion of fungi in forest ecosystems into this discussion of soils.

Maintaining natural accumulation of biomass to sustain soil biological activity

USDA Forest Service, 2006d states:

> Promoting biologic activity is the best way to remediate damaged soils (Powers, 1998). Soil flora and fauna break-up compacted soils. Soil fungal processes are especially important, primarily mycorrhizae fungi and those associated with organic matter decomposition. Biologic activity influences many physical characteristics of the soil; for example, soil aggregation and associated water infiltration and gas exchange.

Rose et al., 2001 state:

> Habitat structures in upper layers of the forest floor (soil, litter, duff) result from processes involving organic material (litter, decaying roots, vertebrate and invertebrate carrion, and fecal matter) and a diverse community of organisms, including bacteria, fungi, algae, protozoa, nematodes, arthropods, earthworms, amphibians, reptiles, and small mammals. The complex trophic web supported by nutrient and moisture conditions within the litter and duff layers transforms plant material into a variety of degradation products, thereby storing and releasing nutrients within the ecosystem.

Stevens, 1997 states:

> In the Pacific Northwest, the moisture content of a decaying Douglas-fir tree bole increased as the decay class increased until at about decay class IV the moisture content in summer was 250% of the dry weight (Maser et al. 1988). All size classes of decaying wood act as a moisture store and provide refugia for tree roots and ectomycorrhizal fungi during dry periods; however, **the larger pieces can hold more water and are therefore more effective at holding moisture and acting as refugia through long, dry spells.** When moisture returns to the site, it is a much faster process to reinvade the organic layer of soil with ectomycorrhizal root tips when refugia are scattered throughout the forest floor.

(Emphasis added.) Heilmann-Clausen & Christensen 2004 note that "**small diameter wood appear to be unable to support heart-rot agents** and other species depending on a long and diverse infection history …Therefore, we strongly recommend that **whole, naturally dead trees, representing the full range of CWD habitats**, are prioritised for natural decay in managed forests whenever possible." (Emphases added.)

How these relatively large dead logs facilitate vital soil processes is explained in USDA Forest Service, 2006d (emphases added):

> No discussion about forest woody debris and biological activity would be complete without promoting the values of brown cubical rot, and recommendations that may increase the amount of the product of this unique decomposition process across the landscape.
>
> The brown-rotters belong to the *Basidiomycota*. Their most interesting and telltale characteristic is their ability to utilize only cellulose, and their *inability* to degrade lignin.
>
> Residue left after advanced brown-rot decay is a brown, crumbly mass composed largely of lignin. In healthy forest ecosystems, especially coniferous forests, the upper-most soil horizon contains a significant portion of brown-rotted wood residues. The sponge-like properties of advanced brown-rotted wood act as a moisture and nutrient sink. Because of the high lignin concentrations, and little carbohydrate, it persists in the forest for a long time (Blanchette, 1995).
>
> The lignin product of brown rot is tremendously important in the forests of Western Montana. Since brown rot typically effects only heart wood, **it is important that large trees are allowed to die and decompose naturally in the woods**. For example, a Ponderosa pine 36 inches in diameter may possess **24 inches of heart wood**. This in turn decomposes to a **16 inch zone of brown cubical residue**. **This stuff is often referred to as soil wood**. Early logging techniques that dozed forest debris into piles then burned the organics significantly reduced the occurrence of soil wood in our forests. Soil wood possesses one characteristic that make it important; the ability to hold water. This high water holding capacity provides:
>
> - Plant available water – especially during the driest months.
> - Excellent underground habitat for all types of soil biological activity.
> - Appropriate conditions that cause a hub of mycorrhizae fungi activity.

Jurgensen et al. (1997) state:

> Virtually all of the soil wood in Inland Northwest forests is a product of brown-rot decay and comes from individual site differences, such as slope, parent material, and large residues with appreciable amounts of heartwood, soil depth, also make regional organic matter/productivity especially pine species and Douglas-fir (Harvey et al. extrapolations difficult. 1987a). **Brown-rotted wood remains in the soil for hundreds of years (McFee**

> **and Stone 1966, Harvey et al. 1981), thus affecting soil properties for long periods**. (Emphasis added.)

In order to reconstitute adequate supplies of decayed wood in soils depleted in this resource, lag periods in the 100-to 300-year range can be expected. (Harvey et al., 1981.) This indicates a large percentage of the logged portion of the Lolo National Forest is centuries away from being within the natural range of variability for fundamental ecological soil structures and soil process. This has vast implications for sustainability under the 2012 Planning Rule.

Graham, et al. (1994) state:

> Organic materials, especially humus and buried residue in the advanced stage of decay, are excellent sites for the formation of ectomycorrhizal root tips (Harvey and others 1981). Even though these materials may make up only a small portion of a soil horizon they may contain the majority of ectomycorrhizae. Ectomycorrhizae help woody plants take up water and nutrients, and their fruiting bodies play important roles in the food chains of many small rodents and larger predators (Maser 1990; Maser and others 1986; Reynolds and others 1992).
>
> Ectomycorrhizae absorb moisture and nutrients, and translocate them to their host plants, making ectomycorrhizae essential for the development of forest ecosystems (Harley and Smith 1983; Harvey and others 1979; Harvey and others 1987; Marks and Kozlowski 1973; Maser 1990). Therefore, we assume their presence and abundance to be a good indicator of a healthy, functioning forest soil. Ectomycorrhizae have a strong positive relationship with soil organic materials (Harvey and others 1981).

Forest Service scientists (Harvey et al., 1994) recognized that "Productivity of forest and rangeland soils is based on a combination of diverse physical, chemical and biological properties." Harvey et al., 1994 further explain (emphases added):

> **The Soil as a Biological Entity**
> Traditionally, some have viewed soil as inert and inanimate, and soil properties have often been perceived as distinctive but relatively unchanging—except for plant nutrients—and based on mineral constituents. The organic horizons have, until recently, been largely ignored. Soil microbes have also been ignored, except for a few high-profile organisms (such as soil-borne pathogens and mycorrhizal fungi). Predictions by forest growth models have keyed almost exclusively on vegetation, gross land form, and site characteristics—the aboveground characteristics of the last rotation were assumed to be the best indicator for predicting growth, ignoring soil and related soil-borne processes. If soil potential was reduced, the assumption was that fertilizing could offset any damage. This approach has fostered a significantly overoptimistic view of the health and productivity potential for second generation forests (Gast and others 1991, Powers 1991).
>
> Contemporary studies indicate that **soil quite literally resembles a complex living entity**, living and breathing through **a complex mix of interacting organisms-from viruses and**

bacteria, fungi, nematodes, and arthropods to groundhogs and badgers. **In concert, these organisms are responsible for developing the most critical properties that underlie basic soil fertility, health, and productivity** (Amaranthus and others 1989, Harvey and others 1987, Jurgensen and others 1990, Molina and Amaranthus 1991, Perry and others 1987). **Biologically driven properties resulting from such complex interactions require time lines from a few to several hundreds of years to develop, and no quick fixes are available if extensive damages occur (Harvey and others 1987)**.

Microbial Ecology
The variety of organisms residing in forest soils are extensive; all contribute to soil development and function, some in very critical ways (Amaranthus and others 1989). Although this section concentrates on the microbes (primarily bacteria and fungi), we recognized that **several orders of insects, earthworms, and burrowing mammals make significant and sometimes critical contributions to organic matter decomposition, soil mixing, and microbe propagule movement within many forest soils** (Molina and Amaranthus 1991, Wilson 1987).

The numbers and biomass of microbes in forest soil can be staggering; for example 10 to 100 million bacteria and actinomycetes, 1000 to 100,000 fungal propagules, and several kilometers of hyphae (fungal strands) can be present in a single gram of soil (Bollen 1974). The biomass related to such numbers is also staggering. Old-growth Douglas-fir forests of the Pacific Northwest can contain 4200 kg/ha dry weight of fungal hyphae and 5400 kg/ha of ectomycorrhizal root tips alone (Fogel and others 1973). Bacterial biomass could equal or exceed fungal biomass, and **the total biomass of an inland cedar/hemlock forest should be very nearly comparable to a coastal Douglas-fir forest. Thus, microbial biomass in eastside forests could easily reach 10,000 kg/ha and are a force to consider in management methods.**

…The ...**descriptions of microbial structures and processes suggest that they are likely to provide highly critical conduits for the input and movement of materials within soil and between the soil and the plant**. Nitrogen and carbon have been mentioned and are probably the most important. Although the movement and cycling of many others are mediated by microbes, sulfur phosphorus, and iron compounds are important examples.

The relation between forest soil microbes and N is striking. **Virtually all N in eastside forest ecosystems is biologically fixed by microbes**... Most forests, particularly in the inland West, are likely to be limited at some time during their development by supplies of plant-available N. Thus, to manage forest growth, we must manage the microbes that add most of the N and that make N available for subsequent plant uptake. (Internal citations omitted.)

In their article in *The Guardian*, Kiers and Sheldrake (2021) state, "If we want to tackle the climate crisis, we need to address a global blindspot: the vast underground fungal networks that sequester carbon and sustain much of life on Earth." They also state:

Through fungal activity, carbon floods into the soil, where it supports intricate food webs –

about 25% of all of the planet's species live underground. Much of it remains in the soil, making underground ecosystems the stable store of 75% of all terrestrial carbon. But climate change strategies, conservation agendas and restoration efforts overlook fungi and focus overwhelmingly on aboveground ecosystems. This is a problem: the destruction of underground fungal networks accelerates both climate change and biodiversity loss and interrupts vital global nutrient cycles. These networks should be regarded as a global public good to be mapped, protected and restored as a matter of urgency.

…Mycorrhizal fungal networks and the nutrient flows and processes they manage should be considered a global public good, analogous to clean air and water. For millennia in many parts of the world, traditional farming and land management practices have attended to the health of the soil and thus supported plants' fungal relationships implicitly. But over the course of the 20th century, our behaviour has led us into trouble.

A Forest Service timber sale Environmental Impact Statement (USDA Forest Service, 2014a) discusses and discloses some of the many factors related to management impacts on soils:

> Management activities can result in both direct and indirect effects on soil resources. Direct and indirect effects may include alterations to **physical, chemical, and/or biological properties**. Physical properties of concern include structure, density, porosity, infiltration, permeability, water holding capacity, depth to water table, surface horizon thickness, and organic matter size, quantity, and distribution. Chemical properties include changes in nutrient cycling and availability. Biological concerns commonly include abundance, distribution, and productivity of the many plants, animals, microorganisms that live in and on the soil and organic detritus. (Emphasis added.)

Need to change for revision: consideration of all soil properties

So in at least limited fashion, the Forest Service (USDA Forest Service, 2014a) acknowledges the need examine management activities' influence on **physical, chemical, and biological properties** in order to comply with the National Forest Management Act's mandate to conserve the productivity inherent in native soils of forest ecosystems. Yet that same EIS is exemplary of the Forest Service's narrow focus on only **physical soil properties** in the methodology they've chosen to account for management-induced changes to soils:

> The magnitude of productivity loss associated with any action is influenced by the degree, extent, and duration of adverse soil conditions within and adjacent to each activity area. Degree refers to the magnitude of change in soil properties, such as an increase in bulk density or a decrease in macroporosity, and the depth to which those changes occur. Extent refers to the area affected by such changes. Duration refers to the length of time such changes may persist on or adjacent to the site.
>
> **The criteria used to determine direct, indirect, and cumulative effects on soil productivity is the percentage of area within an individual treatment unit where**

(detrimental soil disturbance) has occurred or is anticipated from proposed activities. (*Id*., Emphasis added.)

The Forest Service's Region 1 Soil Quality Standards ("R1 SQS" for short) have been, in one form or another, the agency's primary methodology for supplementing weak Forest Plan direction in the region since at least 1999. The R1 SQS arose in Forest Service Manual and Forest Service Handbook directives in recognition of mandates in the National Forest Management Act.

USDA Forest Service, 2016a states that the R1 SQS "created the concept of 'Detrimental Soil Disturbance' (DSD) for National Forests in Region One as a measure to be used in assessing potential loss of soil productivity resulting from management activities." USDA Forest Service, 2016a explains:

> **Without maintaining land productivity, neither multiple use nor sustained (yield) can be supported by our National Forests**. Direct references to maintaining productivity are made in the Sustained Yield Act "…coordinated management of resources without impairment of the productivity of the land" and in the Forest and Rangeland Renewable Resources Act "…substantial and permanent impairment of productivity must be avoided".
>
> Soil quality is a more recent addition to Forest Service Standards. The Forest and Rangeland Renewable Resources Act (1974) appears to be the first legal reference made to protecting the "quality of the soil" in Forest Service directives. **Although the fundamental laws that directly govern policies of the U.S. Forest Service clearly indicate that land productivity must be preserved, increasingly references to land or soil productivity in Forest Service directives were being replaced by references to soil quality as though soil quality was a surrogate for maintaining land productivity. This was unfortunate, since although the two concepts are certainly related, they are not synonymous.**
>
> Our understanding of the relationship between soil productivity and soil quality has continued to evolve since 1974. Amendments to the Forest Service Manual, Chapter 2550 – Soil Management in 2009 and again to 2010 have helped provide some degree of clarity on this issue and acknowledged that **the relationship is not as simple as originally thought**. The 2009 (2500-2009-1) amendment to Chapter 2550 of the Forest Service Manual states in section 2550.43-5, directs the Washington Office Director of Watershed, Fish, Wildlife, Air and Rare plants to "Coordinate validation studies of soil quality criteria and indicators with Forest Service Research and Development staff to ensure soil quality measurements are appropriate to protect soil productivity" (USFS-FSM 2009). **Inadvertently this directive concedes that the relationship between soil productivity and soil quality is not completely understood.** In the end, the primary objective provided by National Laws and Directives relative to the management of Forest Service Lands continues to be to maintain and where possible potentially improve soil productivity. (Emphases added.)

USDA Forest Service, 2014a discusses the complexities of management-induced changes on soils:

> Management activities can result in both direct and indirect effects on soil resources. Direct and indirect effects may include alterations to physical, chemical, and/or biological properties. Physical properties of concern include structure, density, porosity, infiltration, permeability, water holding capacity, depth to water table, surface horizon thickness, and organic matter size, quantity, and distribution. Chemical properties include changes in nutrient cycling and availability. Biological concerns commonly include abundance, distribution, and productivity of the many plants, animals, microorganisms that live in and on the soil and organic detritus.

Yet the R1 SQS and definition of DSD only consider alterations to physical properties, largely ignoring chemical and biological properties. Again, this needs to change under a revised forest plan.

The Assessment must consider the significance of watershed-level and cumulative implications of chronically compacted or otherwise detrimentally disturbed soils

The agency's narrow consideration of management impacts within the R1 SQS framework avoids a bigger picture of detrimentally disturbed soils (DSD). From USDA Forest Service, 2008f:

> Many indirect effects are possible if soils are detrimentally-disturbed… Compaction can indirectly lead to decreased water infiltration rates, leading to increased overland flow and associated erosion and sediment delivery to stream. Increased overland flow also increases intensity of spring flooding, degrading stream morphological integrity and low summer flows.

USDA Forest Service, 2005d states:

> Cumulative effects may also occur at the landscape level, where large areas of compacted and displaced soil affect vegetation dynamics, runoff, and water yield regimes in a subwatershed. About 4,849 acres are currently estimated to have sustained detrimental compaction or displacement in the American River watershed due to logging, mining, or road construction. … About 4,526 acres are currently estimated to have sustained detrimental compaction or displacement in the Crooked River watershed due to logging, mining, and road or trail construction. (Emphasis added.)
>
> An estimated 73 percent (208) of past activity areas on NF lands in American River (and an estimated 69 percent (166) of past activity areas on NF lands in Crooked River) today would show detrimental soil disturbance in excess of 20 percent.
>
> American River (and most of Crooked River) is considered similar in soils and logging history to Red River, where 80 percent of sampled tractor logged activity areas did not meet Forest Plan standards. In many instances, these impacts occurred prior to forest plan implementation, but monitoring of more recent activities shows inconsistent improvement

> in practices. This degree of soil damage is consistent both with other Forest monitoring (USDA FS 1988a, 1990, 1992), and research (Krag, 1991; Froelich, 1978; Davis, 1990, Alexander and Poff, 1985).
>
> Indirect effects of soil surface and substratum erosion include effects to vegetation and hydrologic processes.

The DA fails to address hydrological impacts by not accounting for existing soil damage in watersheds, for considering the full extent of soil restoration needs.

More on this from the Forest Service's own experts. The Bitterroot National Forest admits that subwatersheds which have high levels of existing soil damage could indicate a potential for hydrologic and silviculture concerns. (USDA Forest Service, 2005b, p. 3.5-11, 12.) The Idaho Panhandle National Forests (USDA Forest Service, 2007c) acknowledge that soil conditions affect the overall hydrology of a watershed:

> Alteration of soil physical properties can result in loss of soil capacity to sustain native plant communities and reductions in storage and transmission of soil moisture that may **affect water yield and stream sediment regimes**. (P. 4-76, emphasis added.)

USDA Forest Service, 2009c states:

> Compaction can decrease water infiltration rates, leading to increased overland flow and associated erosion and sediment delivery to streams. Compaction decreases gas exchange, which in turn degrades sub-surface biological activity and above-ground forest vitality. Rutting and displacement cause the same indirect effects as compaction and also channel water in an inappropriate fashion, increasing erosion potential.

Kuennen et al., 2000 (a collection of Forest Service soil scientists) state:

> An emerging soils issue is the cumulative effects of past logging on soil quality. Pre-project monitoring of existing soil conditions in western Montana is revealing that, where ground-based skidding and/or dozer-piling have occurred on the logged units, soil compaction and displacement still are evident in the upper soil horizons several decades after logging. Transecting these units documents that the degree of compaction is high enough to be considered detrimental, i.e., the soils now have a greater than 15% increase in bulk density compared with undisturbed soils. Associated tests of infiltration of water into the soil confirm negative soil impacts; **the infiltration** rates on these compacted soils are several-fold slower than rates on undisturbed soil.
>
> …**The effects of extensive areas of compacted and/or displaced soil in watersheds along with impacts from roads, fire, and other activities are cumulative.** A rapid assessment technique to evaluate soil conditions related to past logging in a watershed is based on a step-wise process of aerial photo interpretation, field verification of subsamples, development of a predictive model of expected soil conditions by timber stand, application

> of this model to each timber stand through GIS, and finally a GIS **summarization of the predicted soil conditions in the watershed.** This information can then be combined with an assessment of road and bank erosion conditions in the watershed to give a holistic description of watershed conditions and to help understand cause/effect relationships. **The information can be related to Region 1 Soil Quality Standards to determine if, on a watershed basis, soil conditions depart from these standards.** Watersheds that do depart from Soil Quality Standards can be flagged for more accurate and intensive field study during landscape level and project level assessments. **This process is essentially the application of Soil Quality Standards at the watershed scale with the intent of maintaining healthy watershed conditions**. (Emphases added.)

Kootenai National Forest hydrologist Johnson, 1995 noted this effect from his reading of the scientific literature: "Studies by Dennis Harr have consistently pointed out the effects of the compacted surfaces (roads, skid trails, landings, and firelines) on peak flows." Elevated peak flows harm streams and rivers by increasing both bedload and suspended sediment, which is not considered in the DEIS's watershed analysis.

It is clear the Forest Service must consider the cumulative effects of past and proposed soil disturbances to assure that soil productivity will be maintained, and to address the sustainability provisions of the 2012 Planning Rule. This includes impacts from activities that include logging, motorized vehicle use, livestock grazing, etc. Such cumulative effects analysis found in the Soil and Water Conservation Practices Handbook (FSH 2509.22), which states:

> Practice 11.01 – Determination of Cumulative Watershed Effects
>
> OBJECTIVE: To determine the cumulative effects or impact on beneficial water uses by multiple land management activities. Past, present, or reasonably foreseeable future actions in a watershed are evaluated relative to natural or undisturbed conditions. Cumulative impacts are a change in beneficial water uses caused by the accumulation of individual impacts over time and space. Recovery does not occur before the next individual practice has begun.
>
> EXPLANATION: The Northern and Intermountain Regions will manage watersheds to avoid irreversible effects on the soil resource and to produce water of quality and quantity sufficient to maintain beneficial uses in compliance with State Water Quality Standards. Examples of potential cumulative effects are: 2) excess sediment production that may reduce fish habitat and other beneficial uses; 3) water temperature and nutrient increases that may affect beneficial uses; 4) compacted or disturbed soils that may cause site productivity loss and increased soil erosion; an 5) increased water yields and peak flows that may destabilize stream channel equilibrium.
>
> IMPLEMENTATION: As part of the NEPA process, the Forest Service will consider the potential cumulative effects of multiple land management activities in a watershed which may force the soil resource's capacity or the stream's physical or biological system beyond the ability to recover to near-natural conditions. A watershed cumulative effects feasibility

analysis will be required of projects involving significant vegetation removal, prior to including them on implementation schedules, to ensure that the project, considered with other activities, will not increase sediment or water yields beyond or fishery habitat below acceptable limits. The Forest Plan will define these acceptable limits. The Forest Service will also coordinate and cooperate with States and private landowners in assessing cumulative effects in multiple ownership watersheds.

Booth, 1991 further explains the relationship between soil quality conditions and hydrology:

> Drainage systems consist of all of the elements of the landscape through which or over which water travels. These elements include the soil and the vegetation that grows on it, the geologic materials underlying that soil, the stream channels that carry water on the surface, and the zones where water is held in the soil and moves beneath the surface. Also included are any constructed elements including pipes and culverts, cleared and compacted land surfaces, and pavement and other impervious surfaces that are not able to absorb water at all.
>
> …The collection, movement, and storage of water through drainage basins characterize the hydrology of a region. Related systems, particularly the ever-changing shape of stream channels and the viability of plants and animals that live in those channels, can be very sensitive to the hydrologic processes occurring over these basins. Typically, these systems have evolved over hundreds of thousands of years under the prevailing hydrologic conditions; in turn, their stability often depends on the continued stability of those hydrologic conditions.
>
> Alteration of a natural drainage basin, either by the impact of forestry, agriculture, or urbanization, can impose dramatic changes in the movement and storage of water. …Flooding, channel erosion, landsliding, and destruction of aquatic habitat are some of the unanticipated changes that …result from these alterations.
>
> …Human activities accompanying development can have irreversible effects on drainage-basin hydrology, particularly where subsurface flow once predominated. Vegetation is cleared and the soil is stripped and compacted. Roads are installed, collecting surface and shallow subsurface water in continuous channels. …These changes produce measurable effects in the hydrologic response of a drainage basin.

Noxious weeds and soil productivity

The DA does not adequately account for the long-term losses in site or land productivity due to noxious weed infestations facilitated by management actions. This includes cumulative reductions of **soil productivity** from noxious weeds. The Soil Report prepared for the Custer-Gallatin National Forest draft forest plan and draft EIS admits:

> Another source of soil disturbance prevalent on certain areas of the Custer Gallatin is infestation of lands by noxious weed species. **Weed seed** when it becomes prevalent in

> surface soil horizons **becomes a biological factor of the soil** that has the potential to **reduce land productivity** and restrict management options. Strong correlations have been found on the Custer Gallatin, especially on certain soil-landscape types, between past soil disturbance and the occurrence of noxious weeds. These **infection sites then become source areas for the spread of noxious weeds** into adjacent, non-disturbed areas. Noxious weed spread can follow disturbance since weeds have opportunistic traits and can exploit disturbed soil conditions (Williamson and Harrisburg 2002; Norton et al. 2007; James et al. 2010) typical of many pioneer species. The expansion of weed infestations into new areas can **alter nutrient regimes and organic carbon levels in the soil** which shifts the competitive balance on a site away from desired native species (Wolf and Klironomos 2005; Steinlein 2013). Management options and **growth potential** are both **reduced** when weed infestations exceed thresholds where restoration becomes difficult, creating new novel plant assemblages (Seastedt et al. 2008). Once a noxious weed becomes a co-dominant species on a site, whether in a grassland area or as a forest understory plant, **changes to the soil and reduced site potential are consistent with the concept of "permanently degraded**" as used in the National Environmental Policy Act (1970) and the National Forest management Act (1976). (Emphases added.)

The Custer-Gallatin National Forest draft forest plan draft EIS explains the very high correlation between noxious weed infestation and losses of soil productivity:

> The relationship between noxious weeds and soils is tightly intertwined. Certain types of soil disturbance (especially disturbance that exposes low quality subsoil or substrate materials or otherwise creates unsuitable surface soil conditions for establishment of native, perennial plants) will almost invariably result in localized noxious weed infestations. These become the infestation sites from which the subsequent spread of noxious weeds to surrounding areas originate in a classic source-sink fashion. In return, the presence of dense noxious weeds populations such as spotted knapweed, Dalmatian toadflax, or Canada thistle at landings, along temporary roads, or on hillsides are often accompanied by evidence of accelerated erosion due to poor ground cover in these areas. The presence of noxious weed seed in the soil, especially at high concentrations, becomes a biological property of the soil. Although this alone would not be considered detrimental soil disturbance in accordance with the 1999 Northern Region supplement, it does reduce soil productivity and at high levels, limits land management options.

USDA Forest Service, 2005a states:

> Noxious weed presence may lead to physical and biological changes in soil. Organic matter distribution and nutrient flux may change dramatically with noxious weed invasion. Spotted knapweed (Centaurea biebersteinii D.C.) impacts phosphorus levels at sites (LeJeune and Seastedt, 2001) and can hinder growth of other species with allelopathic mechanism. Specific to spotted knapweed, these traits can ultimately limit native species' ability to compete and can have direct impacts on species diversity (Tyser and Key 1988, Ridenour and Callaway 2001).

USDA Forest Service, 2006d states:

> Noxious weeds have the potential to impact long term soil productivity since their presence can affect soil chemical properties. Invasive species such as spotted knapweed (Centaurea biebersteinii DC.) and cheatgrass (Bromus tectorum L.) …can affect their growing environment, shifting soil properties to their favor (D'Antonio and Vitousek 1992). Recent findings show cheatgrass may influence soil aggregation in the top horizon because of its pulse of leaf and root litter (Norton et al 2004) with antecedent changes to carbon stores (Verburg et al 2004). These changes can play out in long term shifts in plant composition as observed by Vinton and Burke (1995). Also, spotted knapweed was found to have allelopathic influences that may negatively impact native plant species growth (Bais et al 2003).

Climate Change, Carbon Storage and Sequestration

From our reading of DA sections 2.1 Ecosystem Drivers and Stressors (subhead 2.1.1 Climate Change) and 2.10 Carbon Stocks and Carbon Pools, it is quite obvious that the Forest Service is choosing to essentially ignore the fact that climate change is, beyond any reasonable doubt of the global scientific community, in actuality a **climate crisis**. Executive Order 14008 of January 27, 2021 (Tackling the Climate Crisis at Home and Abroad) begins, "The United States and the world face a **profound climate crisis**. **We have a narrow moment to pursue action at home and abroad in order to avoid the most catastrophic impacts of that crisis** and to seize the opportunity that tackling climate change presents." Further, President Biden's Executive Order on the Establishment of the Climate Change Support Office (May 7, 2021) calls it a "**global climate crisis.**" (Emphases added). Yet any sense of urgency for the Forest Service to act on this fact is completely missing from the DA. This lack of urgency is exemplified by the misrepresentations of science and facts in a Forest Service document, "Carbon Storage and Sequestration in Land Management Plan Revision" (Lolo National Forest, January 2023) distributed at the most recent Roundtable. Therein the Forest Service states:

> For many forests, harvesting timber on sustainably managed forests may effectively "store" more carbon over time than if the forest is unmanaged. "Store" in this sense refers to carbon in the forest, carbon in harvested wood products, and the avoided carbon emissions in the atmosphere.

The Forest Service is required, under the National Environmental Policy Act, to insure the professional and scientific integrity of discussions and analyses in environmental impact statements. (40 CFR section 1502.24.) In multiple subsections, the 2012 Planning Rule requires that the Forest Service **identify the best scientific information, use it in preparation of the Assessment, and explain how that science was used**:

> § 219.3 Role of science in planning. The responsible official shall use the best available scientific information to inform the planning process required by this subpart. In doing so, the responsible official shall determine what information is the most accurate,

reliable, and relevant to the issues being considered. The responsible official shall document how the best available scientific information was used to inform the assessment, the plan decision, and the monitoring program as required in §§ 219.6(a)(3) and 219.14(a)(4). Such documentation must: Identify what information was determined to be the best available scientific information, explain the basis for that determination, and explain how the information was applied to the issues considered.

§ 219.6 Assessment. (b) *Content of the assessment for plan development or revision.* In the assessment for plan development or revision, the responsible official shall identify and evaluate existing information relevant to the plan area for the following: (5) Threatened, endangered, proposed and candidate species, and potential species of conservation concern present in the plan area;

(3) Document the assessment in a report available to the public. The report should document information needs relevant to the topics of paragraph (b) of this section. Document in the report how the best available scientific information was used to inform the assessment (§ 219.3). Include the report in the planning record (§ 219.14).

Insofar as meeting the challenge of facing the climate crisis, so far the Forest Service has failed do objectively and transparently weigh available scientific information to determine best available science. Given that situation, we do our part to correct and supplement the record by providing the following discussion.

Talberth, 2023, is a report and analysis of the draft EIS and draft Revised Forest Plan for the Nez Perce-Clearwater National Forests (NPCNF). That revision is entering its final stages, so the analysis is instructive to the Lolo National Forest's Assessment phase.

Talberth, 2023, explains that the NPCNF draft EIS and draft Revised Forest Plan fail to account for: (a) life cycle greenhouse gas emissions (emissions from logging, road building and livestock grazing) and how they're elevated over the long term as compare to natural, unlogged and ungrazed forests); (b) changes in carbon sequestration capacity (logging turns forest from net carbon accumulators into carbon emitters for at least 15 years after logging); and (c) changes in climate resiliency—which means how more much less logged forests are capable of withstanding the ongoing impacts of climate change as compared to natural mature and old forests.

Key points in Talberth, 2023 include:

- The policy and regulatory framework governing revision of national forest land and resource management plans requires careful consideration of how proposed management activities will amplify or mitigate the effects of climate change.

- The NPCNF draft revised land and resource management plan and draft environmental impact statement fail to disclose or mitigate the climate impacts associated with logging, road building, grazing and other land-disturbing activities even though the methods and sources of information to do so are readily available.

- Preliminary estimates are provided of greenhouse gas emissions associated with logging, road building, and grazing activities, and the many ways these management activities could make the land more vulnerable to climate change are reviewed.

- Across the five alternatives considered in the NPCNF Draft EIS, greenhouse gas emissions from these activities are likely to range between 335,000 and 1,200,000 metric tons carbon dioxide equivalent per year. At the high end of this range, this is equivalent to putting 250,000 new passenger vehicles on the road.

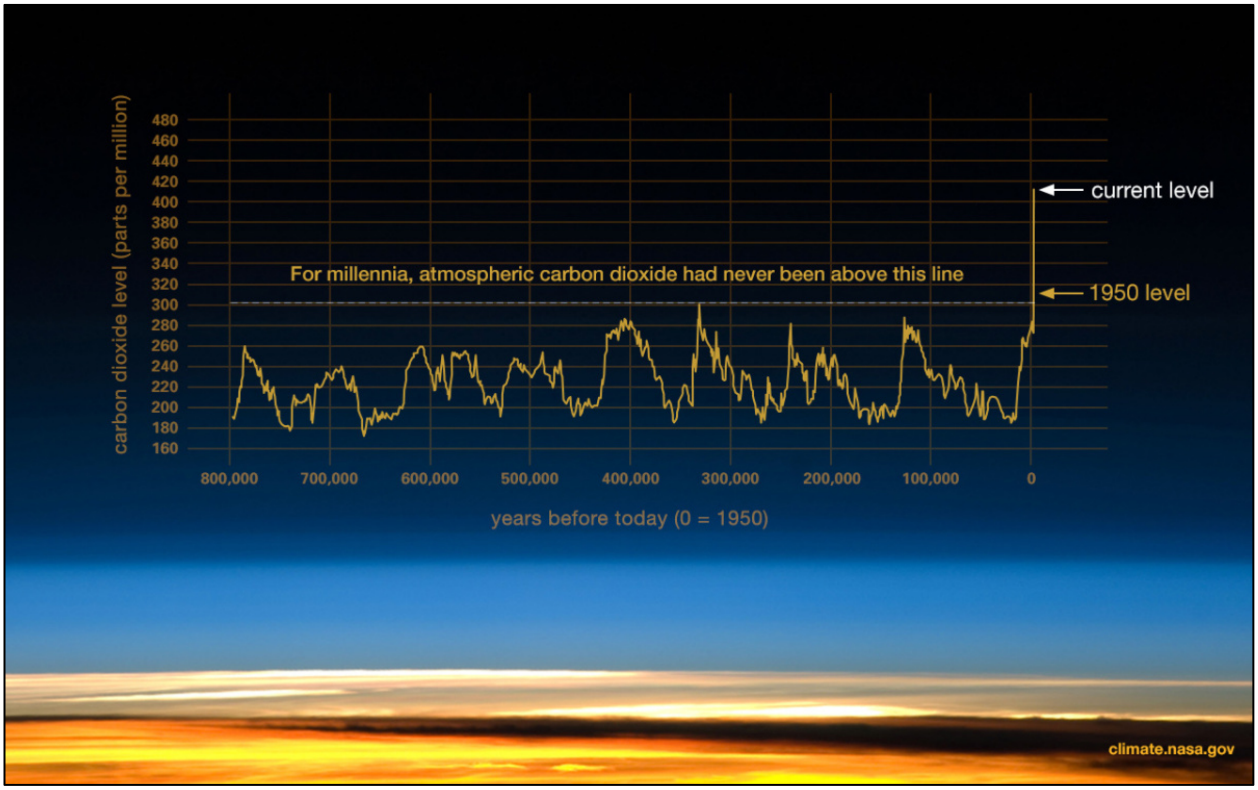
- Logging, road construction and grazing activities are also likely to amplify the effects of climate change by making the land more susceptible to heat waves, droughts, water shortages, wildfires, wind damage, landslides, floods, warming waters, harmful algae blooms, insects, disease, exotic species, and biodiversity loss.

- To comply with recent National Environmental Policy Act guidance and other climate policy directives, forest planning must incorporate this information and minimize climate impacts.

Executive Order 14008 of January 27, 2021 (Tackling the Climate Crisis at Home and Abroad) begins, "The United States and the world face a profound climate crisis. We have a narrow moment to pursue action at home and abroad in order to avoid the most catastrophic impacts of that crisis and to seize the opportunity that tackling climate change presents." Further, President Biden's Executive Order on the Establishment of the Climate Change Support Office (May 7, 2021) calls it a "**global climate crisis**" (emphasis added).

Yet the DA proceeds to vastly downplay the potential of management actions to exacerbate climate change, already on an extremely dangerous trajectory. The agency is willfully participating in the destruction of the Earth's atmosphere. The science is common knowledge by now, so it takes callous, active denial to ignore it.

According to NASA (https://climate.nasa.gov/), during ice ages Earth's CO_2 levels were around 200 parts per million (ppm), and during the warmer interglacial periods, they hovered around 280 ppm. In 2013, CO_2 levels surpassed 400 ppm for the first time in recorded history. If fossil-fuel use and other greenhouse-gas-producing activities continue at the current "business-as-usual rate," CO_2 will continue to rise exponentially.



Climate change is having a growing impact and, as the crisis escalates, communities in western Montana will face the growing challenge of living in a changed climate. The latest report (https://www.ipcc.ch/sr15/) from the UN's Intergovernmental Panel on Climate Change underscores that we likely have just 11 years to make a "rapid transformation across all industrial sectors."

The Montana Institute on Ecosystems is a statewide center based at both Montana State University and University of Montana. Their two years of research produced a scholarly work, the 2017 Montana Climate Assessment (available online at www.montanaclimate.org).

It stated that the increasingly rapid rate of climate change since the Industrial Revolution resulted from changes in atmospheric chemistry, specifically increases in greenhouse gases due to the increased use of fossil fuels, land-use change (deforestation, etc.), and fertilizer production.

The report found that changes to Montana's climate have already happened:

- Since Montana became a state (1889), global atmospheric CO_2 concentrations have increased more than 100 ppm (parts per million);
- Since 1950, average statewide temperatures have increased by 0.5° Fahrenheit (mostly in the spring) – [the most recent research indicates that Montana's temperatures have increase by 2 to 3°]; and,
- Statewide, winter precipitation has been decreasing by 0.14 inches per decade.

By mid-century, we should expect:

- Montana's average temperatures will increase by 3 to 7° Fahrenheit;
- Our maximum temperatures may increase by 3 to 7°;
- Our temperature minimums will likely increase by 3 to 8°;
- Frost-free days could increase by 24 to 44 days;
- Warming temperatures are highly likely to decrease snowpack at mid and low elevations;
- Snowmelt and peak spring runoff will occur earlier in the spring;
- Late-summer water availability will be substantially lower in snowmelt-dominated watersheds; and
- Higher temperatures will exacerbate multi-year drought.

An Undisturbed Forest Retains Moisture

There are approximately 23 million acres of forested land in Montana. Most are publicly owned and, in the western part of the state, are dominated by Douglas-fir, lodgepole pine, and ponderosa pine. Impacts from climate change will overlay currently existing stresses to our forests.

The vast majority of climate scientists agree that protecting our existing forest ecosystems is a critical part of the efforts to limit the effects of global warming. When disturbed, forests release carbon; undisturbed, forest ecosystems actively remove carbon from the air and store it. Left alone, forest ecosystems provide natural protection against extreme weather events like flooding and droughts.

Climate change, which results from global warming, increases temperatures and shifts precipitation patterns that together affect forests by lowering humidity, soil moisture, and intensifying water stress. The direct effects from climate change on Montana's forests means:

- Higher temperatures and a reduction in water availability will reduce seedling survival;
- Extreme high temperatures will reduce growth and productivity in areas where stand density is low, regardless of water availability;
- As temperatures increase, any disturbances will increase forest mortality;
- Increasing temperatures and the resulting lowering of moisture levels will likely cause an increase in the size and frequency of wildfires;
- Rising temperatures are likely to increase bark beetle survival; and
- The increase in forests mortality and contractions in forest distribution will outpace any long-term gains in forest growth and productivity, thereby causing a net loss of Montana's forested areas.

Due to the warming climate plus past and current forest management practices, Montana's forests are already under stress.

A Thinned Forest is a Dry Forest

In the face of the changing climate, forest managers can best contribute by:

- Recognizing that as climate chaos increases, management activities must be prudent and, above all else, avoid causing harm;
- Basing all management activities on the most recent peer-reviewed, scientific research;
- Integrating the projected effects from a warming climate into all management activities;
- Managing to increase all forests' ability to retain more moisture and slow spring runoff from snowmelt;
- Recognizing that disturbances from the most-used management activities ultimately reduce the health and resilience of forests; and
- Acknowledging that current forest conditions will largely determine the potential impacts from climate change.

In a March 20, 2023 Press Release introducing the SYNTHESIS REPORT OF THE IPCC SIXTH ASSESSMENT REPORT (AR6), the Intergovernmental Panel on Climate Change (IPCC) states, "This Synthesis Report underscores the urgency of taking more ambitious action and shows that, if we act now, we can still secure a liveable sustainable future for all." It goes on:

> In 2018, IPCC highlighted the unprecedented scale of the challenge required to keep warming to 1.5°C. Five years later, that challenge has become even greater due to a

> continued increase in greenhouse gas emissions. The pace and scale of what has been done so far, and current plans, are insufficient to tackle climate change.
>
> More than a century of burning fossil fuels as well as unequal and unsustainable energy and land use has led to global warming of 1.1°C above pre-industrial levels. This has resulted in more frequent and more intense extreme weather events that have caused increasingly dangerous impacts on nature and people in every region of the world.
>
> Every increment of warming results in rapidly escalating hazards. More intense heatwaves, heavier rainfall and other weather extremes further increase risks for human health and ecosystems. In every region, people are dying from extreme heat. Climate-driven food and water insecurity is expected to increase with increased warming. When the risks combine with other adverse events, such as pandemics or conflicts, they become even more difficult to manage.

A *Missoulian* article on the release of that report quotes United Nations Secretary-General Antonio Guterres: “Humanity is on thin ice — and that ice is melting fast. …Our world needs climate action on all fronts —everything, everywhere, all at once.” That article quotes from the report, “The choices and actions implemented in this decade will have impacts for thousands of years” calling climate change “a threat to human well-being and planetary health.” It quotes report co-author and water scientist Aditi Mukherji: “We are not on the right track but it’s not too late. Our intention is really a message of hope, and not that of doomsday.”

From a 2022 report, “The rise in weather and climate extremes has led to some irreversible impacts as natural and human systems are pushed beyond their ability to adapt.” (IPCC Climate Change 2022, Impacts, Adaptation and Vulnerability, Summary for Policymakers - Working Group II Contribution.) Also see news accounts “AP-Report warns of looming climate catastrophe”, “BBC-IPCC report warns of ‘irreversible’ impacts of global warming” and “AP-UN ‘house on fire’ report”.

Executive Order 13990 of January 20, 2021 (Protecting Public Health and the Environment and Restoring Science To Tackle the Climate Crisis) sets the policy of the Biden Administration to “…reduce greenhouse gas emissions; to bolster resilience to the impacts of climate change…”. Executive Order (EO) 13990 Section 5 (Accounting for the Benefits of Reducing Climate Pollution) at (a) states, “It is essential that agencies capture the full costs of greenhouse gas emissions as accurately as possible, including by taking global damages into account. Doing so facilitates sound decision-making, recognizes the breadth of climate impacts, and supports the international leadership of the United States on climate issues.”

President Biden’s April 22, 2022 Executive Order 14072 called on the Secretaries of Agriculture and the Interior to “define, identify, and complete an **inventory of old-growth and mature forests on Federal lands**, accounting for regional and ecological variations, as appropriate, and making the inventory publicly available.” (Emphasis added.) EO 14072 recognizes, “Forests provide clean air and water, sustain the plant and animal life fundamental to combating **the** global climate and biodiversity crises**, and hold special importance to Tribal Nations." (Emphasis added.) The Fact Sheet accompanying that E.O. recognizes:

> America's forests are a key climate solution, absorbing carbon dioxide equivalent to more than10% of U.S. annual greenhouse gas emissions. Federal lands are home to many of the nation's mature and old-growth forests, which serve as critical carbon sinks, cherished landscapes, and unique habitats.

The Executive Order would "Safeguard mature and old-growth forests on federal lands, as part of a science-based approach to reduce wildfire risk" and "**Enlist nature to address the climate crisis with comprehensive efforts to deploy nature-based solutions** that reduce emissions and build resilience." (Id., emphasis added.)

This is discussed in FOC's August 5, 2022 letter to the Forest Service and BLM responding to the July 15, 2022 Biden Administration Request For Information seeking input on the development of a definition for old-growth and mature forests on Federal lands and requesting public input on a series of questions, which we will make available to the Lolo National Forest revision team upon request.

On April 18, 2023 Deputy Chief, Christopher B. French issued a memo to Regional Foresters entitled "Mature Old Growth Guidance: Infrastructure and Investment Jobs Act and Executive Order 14072". It states:

> In response to E.O. 14072, we recently completed the mature and old-growth (MOG) inventory that is built on the existing old-growth definitions developed by each region over the past 30 years. The inventory methods categorize MOG using approximately 200 combinations of forest type, productivity level and biophysical setting. **We will shortly issue guidance on using this information**. Specific Forest Plan content should guide operations to maintain or contribute toward the restoration of the structure and composition of classified old-growth stands.

(Emphasis added.) Part of any reasonable interpretation of "inventory" as applied to forests would be—is any particular place in a forest **inside** the mature and old-growth inventory, or is it **not**? At this point, the Biden Administration has not produced an inventory that could answer such a question, despite the suggestion it has. No spatially specific or ecological definition of old growth was adopted, which would have incorporated the relationship of old growth and mature forests to wildlife, water, and many other natural values and ecosystem services.

The problem is largely because that so-called "inventory" relies almost exclusively upon the Forest Inventory and Analysis (FIA) dataset. As explained in the DA:

> The Forest Inventory and Analysis (FIA) dataset is a statistically sampled grid of plots that can be used to estimate the quantities of vegetation in different categories and provides a basis for measuring vegetation change through time. However, FIA is coarse with each plot

> representing approximately 6,000 acres of land, and **it cannot be used to produce a detailed spatial map.**

(Emphasis added.) In "Mature and Old-Growth Forests: Definition, Identification, and Initial Inventory on Lands Managed by the Forest Service and Bureau of Land Management Fulfillment of Executive Order 14072, Section 2(b)" released along with the French memo, we read:

> This **initial inventory report** is national in scale and presents estimates of old-growth and mature forests across all lands managed by the Forest Service and BLM. In preparing this report, published scientific literature was reviewed and scientists were consulted to understand the current work in this area and to get technical assistance in providing what was needed to respond to Executive Order 14072. **Some cited references (e.g., "in preparation" notations) have not yet undergone scientific peer review and are therefore subject to change.**

(Emphases added.) Nothing in the recently released reports nor in EO 14072 itself recognize the threat of logging to old growth and mature forests.

At this point, any lofty goals for EO 14072 as projected by the president remain remote. Of huge concern to the global community, this includes prioritizing the role of forests as natural climate solutions instead of targeting them to serve the prevailing capitalist consumptive values that chronically threaten the entire biosphere and our collective futures.

DellaSala, et al. (2023) argue:

> …for stepped-up MOG[70] protections by building on the exemplary Tongass National Forest in Alaska where roadless area protections containing MOG, previously removed under the Trump administration, were recently reinstated by the Biden administration while also supporting an economic transition out of old-growth logging and into previously logged but reforested sites. Nationwide MOG protections would establish U.S. leadership on the Paris Climate Agreement (natural sinks and reservoirs) and the Glasgow Forest Pledge to end deforestation and forest degradation. It would demonstrate progress toward 30 x 30 and present a global model for effective forest and climate response.

The Forest Service must disclose and acknowledge the legal and regulatory framework that should guide its analysis of climate impacts, including the recently reinstated CEQ GHG guidance titled, "NEPA Guidance on Consideration of Greenhouse Gas Emissions" (Feb. 19, 2021). In light of the guidance's reinstatement, the Forest Service must apply CEQ's 2016 NEPA climate guidance. The guidance contains specific directions concerning how agencies should analyze climate impacts from forest management the agency must consider.

The currently prevailing management of the Lolo National Forest causes direct, indirect, and cumulative impacts on climate change because it impacts the ecosystem's ability to store carbon. Many forest areas are currently acting as carbon sinks, meaning they are storing more carbon than they are emitting. Science makes clear that the revised forest plan, as foreshadowed by the DA, will likely worsen climate emissions.

The Council on Environmental Quality Guidance, 2016 acknowledges, "changes in our climate caused by elevated concentrations of greenhouse gases in the atmosphere are reasonably anticipated to endanger the public health and public welfare of current and future generations." It continues:

> Climate change results from the incremental addition of GHG emissions from millions of individual sources, which collectively have a large impact on a global scale. CEQ recognizes that the totality of climate change impacts is not attributable to any single action, but are exacerbated by a series of actions including actions taken pursuant to decisions of the Federal Government. Therefore, a statement that emissions from a proposed Federal action represent only a small fraction of global emissions is essentially a statement about the nature of the climate change challenge, and is not an appropriate basis for deciding whether or to what extent to consider climate change impacts under NEPA. Moreover, these comparisons are also not an appropriate method for characterizing the potential impacts associated with a proposed action and its alternatives and mitigations because this approach does not reveal anything beyond the nature of the climate change challenge itself: the fact that diverse individual sources of emissions each make a relatively small addition to global atmospheric GHG concentrations that collectively have a large impact.

So the Forest Service must quantify greenhouse gas emissions. The agency can only use a qualitative method if tools, methodologies, or data inputs are not reasonably available, and if that is the case, there needs be rationale as to why a quantitative analysis is not warranted. Quantitative tools for this analysis are available, e.g., see https://ceq.doe.gov/guidance/ghg-accounting-tools.html.

Logging exacerbates climate change. Mildrexler, et al., 2020 state:

- Large-diameter trees store disproportionally massive amounts of carbon and are a major driver of carbon cycle dynamics in forests worldwide.

- We examined the proportion of large-diameter trees on National Forest lands east of the Cascade Mountains crest in Oregon and Washington, their contribution to overall aboveground carbon (AGC) storage, and the potential reduction in carbon stocks resulting from widespread harvest. We analyzed forest inventory data collected on 3,335 plots and found that large trees play a major role in the accumulated carbon stock of these forests. Tree AGC (kg) increases sharply with tree diameter at breast height (DBH; cm) among five dominant tree species. Large trees accounted for 2.0 to 3.7% of all stems (DBH ≥ 1" or 2.54 cm) among five tree species; but held 33 to 46% of the total AGC stored by each species. Pooled across the five dominant species, large trees accounted for 3% of the 636,520 trees occurring on the inventory plots but stored 42% of the total AGC. A recently proposed large-scale vegetation management project that involved widespread harvest of large trees, mostly grand fir, would have removed ~44% of the AGC stored in these large-diameter trees, and released a large amount of carbon dioxide into the atmosphere.

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

Law and Moomaw, 2023 state: "Forests are critically important for slowing climate change. They remove huge quantities of carbon dioxide from the atmosphere – 30% of all fossil fuel emissions annually – and store carbon in trees and soils. Old and mature forests are especially important: They handle droughts, storms and wildfires better than young trees, and they store more carbon."

Law et al. (2022), in a paper entitled "Creating Strategic Reserves to Protect Forest Carbon and Reduce Biodiversity Losses in the United States" assert that "many of the current and proposed forest management actions in the United States are not consistent with climate goals, and that preserving 30 to 50% of lands for their carbon, biodiversity and water is feasible, effective, and necessary for achieving them."

In a January 12, 2023 News Release, scientists (Birdsey et al., 2023) point out that "Mature Federal Forests Play an Outsized Role in the Nation's Climate Strategy." They state:

> A new study published in the peer-reviewed journal Forests and Global Change presents the nation's first assessment of carbon stored in larger trees and mature forests on 11 national forests from the West Coast states to the Appalachian Mountains. This study is a companion to prior work to define, inventory and assess the nation's older forests published in a special feature on "natural forests for a safe climate" in the same journal. Both studies are in response to President Biden's Executive Order to inventory mature and old-growth forests for conservation purposes and the global concern about the unprecedented decline of older trees.

At a time when species are going extinct faster than any period in human history, the survival of species and persistence of healthy ecosystems requires science-based decisions. A new analysis by NatureServe addresses five essential questions about biodiversity–the variety of life on Earth–that need to be answered if we are going to effectively conserve nature. In the first report of its kind, *NatureServe (2023)* reveals an alarming conclusion: **34% of plants** and **40% of animals** are at risk of extinction, and **41% of ecosystems** are at risk of range-wide collapse. The analyses presented in the report inform how to effectively and efficiently use our financial resources to make the best conservation decisions.

In 2022 over 90 scientists working at the intersection of ecosystems and climate change sent a letter to Canada's Prime Minister Justin Trudeau "Regarding the Protection of Canada's Primary Forests." The scientists' letter states:

> When primary forests, whether in Canada or elsewhere, are logged they release significant amounts of carbon dioxide, exacerbating climate change. Because primary forest ecosystems store more carbon than secondary forests, replacing primary forests with younger stands, as Canada is doing, ultimately reduces the forest ecosystem's overall carbon stocks, contributing to atmospheric greenhouse gas levels.
>
> Even if a clearcut forest eventually regrows, it can take over a decade to return to being a net absorber of carbon, and the overall carbon debt in carbon stocks that were removed from older forests can take centuries to repay, a luxury we simply no longer have. Recent studies also indicate that soil disturbance associated with logging results in large emissions of methane (CH_4), a powerful greenhouse gas second only to CO_2 in its climate forcing effects.

In a scientific finding contradicting typical Forest Service logging justifications, Harmon et al. (2022) show the vast majority of carbon stored in trees before two large wildfires in California's Sierra Nevada mountain range remained there after the fires.

The Forest Service must also reevaluate its past assumptions about restocking success and species composition following vegetation manipulations. Significant controversy exists as to the need for such manipulations given the improper use and reliance on historic conditions. In fact, there is a high likelihood that some areas would not regenerate and will instead result in conversion to different vegetative groups. NEPA mandates that the Forest Service address scientific controversy especially pertaining to science contradicting agency assumptions.

Given the urgency of preventing additional greenhouse gas emissions and continuing carbon sequestration to mitigate climate change, it would be best to protect large trees for their carbon stores, and also for their co-benefits of habitat for biodiversity, resilience to drought and fire, and microclimate buffering under future climate extremes.

Law and Moomaw (2021) is an article in The Conversation: "Keeping trees in the ground where they are already growing is an effective low-tech way to slow climate change." They state:

> Protecting forests is an essential strategy in the fight against climate change that has not received the attention it deserves. Trees capture and store massive amounts of carbon. And unlike some strategies for cooling the climate, they don't require costly and complicated technology. … Our research shows that protecting carbon in forests is essential for meeting global climate goals.

Achat et al. (2015) state, "Compared with other terrestrial ecosystems, forests store some of the largest quantities of carbon per surface area of land." Much of the carbon stored is within the soils, with a smaller part in the vegetation. Forest management can modify soil organic carbon stocks. For example, conventional harvests like clearcutting or shelterwood cutting cause soils to lose organic carbon which is not the case for soils in unharvested forests. Not only does it lose the carbon stored in the soils, but cutting trees eliminates the trees' potential to continue to sequester carbon. *Id.*

Another recent study indicated that when trees are logged, below-ground carbon stores and ecosystems are no longer sustained where trees have been removed. (Prescott and Grayson 2023.)

In a literature review from leading experts on forest carbon storage, Law, et al. (2020) reported:

> There is absolutely no evidence that thinning forests increases biomass stored (Zhou et al. 2013). It takes decades to centuries for carbon to accumulate in forest vegetation and soils (Sun et al. 2004, Hudiburg et al. 2009, Schlesinger 2018), and it takes decades to centuries for dead wood to decompose. We must preserve medium to high biomass (carbon-dense) forest not only because of their carbon potential but also because they have the greatest biodiversity of forest species (Krankina et al. 2014, Buotte et al. 2019, 2020).

Law and Moomaw (2021a) concluded:

> Recent projections show that to prevent the worst impacts of climate change, governments will have to increase their pledges to reduce carbon emissions by as much as 80%. We see the next 10 to 20 years as a critical window for climate action, and believe that **permanent protection for mature and old forests is the greatest opportunity for near-term climate benefits.** (Emphasis added.)

Also *see* Dr. Law explaining these matters in the video, "The Surprising Truth Behind Planting Trees and Climate Change."

Other recent scientific information (Coop et al., 2020) supports the need to look beyond historical references to inform management. "(I)n a time of pervasive and intensifying change, the implicit assumption that the future will reflect the past is a questionable basis for land management (Falk 2017)." Coop et al., 2020 explain:

> Contemporary forest management policies, mandates, and science generally fall within the paradigm of resisting conversion, through on-the-ground tactics such as fuel reduction or tree planting. Given anticipated disturbance trajectories and climate change, science syntheses and critical evaluations of such resistance approaches are needed because of their increasing relevance in mitigating future wildfire severity (Stephens et al. 2013, Prichard et al. 2017) and managing for carbon storage (Hurteau et al. 2019b). Managers seeking to wisely invest resources and strategically resist change need to understand the efficacy and durability of these resistance strategies in a changing climate. Managers also require new scientific knowledge to inform alternative approaches including accepting or directing conversion, developing a portfolio of new approaches and conducting experimental adaptation, and to even allow and learn from adaptation failures.

Given the changing ecological conditions due to the climate crisis, the likely decreased effectiveness of resistance strategies described by Coop et al, 2020 and the increased risk of vegetative conversion, (especially within areas of regeneration harvest), the Forest Service cannot provide reasonable assurances that lands subjected to timber production can in fact be adequately restocked. Assurances that harvested areas will be replanted are not sufficient to demonstrate trees will be viable as climate crisis impacts increase.

Beschta et al. (2012) discuss issues regarding livestock grazing and climate change. The authors suggest that climate change is causing additional stress to already damaged western rangelands, and make management recommendations to address these implications. Among the observations of the Beschta et al. (2012) report:

- In the western U.S., climate change is expected to intensify even if greenhouse gas emissions are dramatically reduced.
- Among the threats facing ecosystems as a result of climate change are invasive species, elevated wildfire occurrence, and declining snowpack.
- Federal land managers have begun to adapt to climate-related impacts, but not the combined effects of climate and hooved mammals, or ungulates.
- Climate impacts are compounded from heavy use by livestock and other grazing ungulates, which cause soil erosion, compaction, and dust generation; stream degradation; higher water temperatures and pollution; loss of habitat for fish, birds and amphibians; and desertification.
- Encroachment of woody shrubs at the expense of native grasses and other plants can occur in grazed areas, affecting pollinators, birds, small mammals and other native wildlife.
- Livestock grazing and trampling degrades soil fertility, stability and hydrology, and makes it vulnerable to wind erosion. This in turn adds sediments, nutrients and pathogens to western streams.
- Water developments and diversion for livestock can reduce streamflows and increase water temperatures, degrading habitat for fish and aquatic invertebrates.
- Grazing and trampling reduces the capacity of soils to sequester carbon, and through various processes contributes to greenhouse warming.
- Domestic livestock now use more than 70 percent of the lands managed by the BLM and Forest Service, and their grazing may be the major factor negatively affecting wildlife in 11 western states. In the West, about 175 taxa of freshwater fish are considered imperiled due to habitat-related causes.
- Removing or significantly reducing grazing is likely to be far more effective, in cost and success, than piecemeal approaches to address some of these concerns in isolation.

From the Abstract of Beschta et al. (2012):

Climate change affects public land ecosystems and services throughout the American West and these effects are projected to intensify. Even if greenhouse gas emissions are reduced, adaptation strategies for public lands are needed to reduce anthropogenic stressors of terrestrial and aquatic ecosystems and to help native species and ecosystems survive in an altered environment. Historical and contemporary livestock production—the most widespread and long-running commercial use of public lands—can alter vegetation, soils, hydrology, and wildlife species composition and abundances in ways that exacerbate the effects of climate change on these resources. Excess abundance of native ungulates (e.g., deer or elk) and feral horses and burros add to these impacts. Although many of these consequences have been studied for decades, the ongoing and impending effects of ungulates in a changing climate require new management strategies for limiting their threats to the long-term supply of ecosystem services on public lands. Removing or reducing livestock across large areas of public land would alleviate a widely recognized and long-term stressor and make these lands less susceptible to the effects of climate change. Where livestock use continues, or where significant densities of wild or feral ungulates occur, management should carefully document the ecological, social, and economic consequences (both costs and benefits) to better ensure management that minimizes ungulate impacts to plant and animal communities, soils, and water resources. Reestablishing apex predators in large, contiguous areas of public land may help mitigate any adverse ecological effects of wild ungulates.

From a News Release accompanying Beschta et al. (2012):

> The advent of climate change has significantly added to historic and contemporary problems that result from cattle and sheep ranching, the report said, which first prompted federal regulations in the 1890s.

Some other key points Beschta et al. (2012), make include:

- If livestock use on public lands continues at current levels, its interaction with anticipated changes in climate will likely worsen soil erosion, dust generation, and stream pollution. Soils whose moisture retention capacity has been reduced will undergo further drying by warming temperatures and/or drought and become even more susceptible to wind erosion (Sankey and others 2009).
- Livestock production impacts energy and carbon cycles and globally contributes an estimated 18% to the total anthropogenic greenhouse gas (GHG) emissions (Steinfeld and others 2006). How public-land livestock contribute to these effects has received little study. Nevertheless, livestock grazing and trampling can reduce the capacity of rangeland vegetation and soils to sequester carbon and contribute to the loss of above- and below-ground carbon pools (e.g., Lal 2001b; Bowker and others 2012). Lal (2001a) indicated that heavy grazing over the long-term may have adverse impacts on soil organic carbon content, especially for soils of low inherent fertility. Although Gill (2007) found that grazing over 100 years or longer in subalpine areas on the Wasatch Plateau in central Utah had no significant impacts on total soil carbon, results of the study suggest that ‘‘if

temperatures warm and summer precipitation increases as is anticipated, [soils in grazed areas] may become net sources of CO_2 to the atmosphere'' (Gill 2007, p. 88). Furthermore, limited soil aeration in soils compacted by livestock can stimulate production of methane, and emissions of nitrous oxide under shrub canopies may be twice the levels in nearby grasslands (Asner and others 2004). Both of these are potent GHGs.

- (L)ivestock use (particularly cattle) on these lands exert disturbances without evolutionary parallel (Milchunas and Lauenroth 1993; MEA 2005a). …The combined effects of ungulates (domestic, wild, and feral) and a changing climate present a pervasive set of stressors on public lands, which are significantly different from those encountered during the evolutionary history of the region's native species. The intersection of these stressors is setting the stage for fundamental and unprecedented changes to forest, arid, and semi-arid landscapes in the western US (Table 1) and increasing the likelihood of alternative states. Thus, public-land management needs to focus on restoring and maintaining structure, function, and integrity of ecosystems to improve their resilience to climate change (Rieman and Isaak 2010).
- Natural floods provide another illustration of how ungulates can alter the ecological role of disturbances. High flows are normally important for maintaining riparian plant communities through the deposition of nutrients, organic matter, and sediment on streambanks and floodplains, and for enhancing habitat diversity of aquatic and riparian ecosystems (CWWR 1996). Ungulate effects on the structure and composition of riparian plant communities (e.g., Platts 1991; Chadde and Kay 1996), however, can drastically alter the outcome of these hydrologic disturbances by diminishing streambank stability and severing linkages between high flows and the maintenance of streamside plant communities. As a result, accelerated erosion of streambanks and floodplains, channel incision, and the occurrence of high instream sediment loads may become increasingly common during periods of high flows (Trimble and Mendel 1995). Similar effects have been found in systems where large predators have been displaced or extirpated (Beschta and Ripple 2012). In general, high levels of ungulate use can essentially uncouple typical ecosystem responses to chronic or acute disturbances, thus greatly limiting the capacity of these systems to provide a full array of ecosystem services during a changing climate.
- The site-specific impacts of livestock use vary as a function of many factors (e.g., livestock species and density, periods of rest or non-use, local plant communities, soil conditions). Nevertheless, extensive reviews of published research generally indicate that livestock have had numerous and widespread negative effects to western ecosystems (Love 1959; Blackburn 1984; Fleischner 1994; Belsky and others 1999; Kauffman and Pyke 2001; Asner and others 2004; Steinfeld and others 2006; Thornton and Herrero 2010). Moreover, public-land range conditions have generally worsened in recent decades (CWWR 1996, Donahue 2007), perhaps due to the reduced productivity of these lands caused by past grazing in conjunction with a changing climate (FWS 2010, p. 13,941, citing Knick and Hanser 2011).
- (R)educing ungulate impacts and restoring degraded plant and soil systems may also assist in mitigating any ongoing or future changes in regional energy and carbon cycles

that contribute to global climate change. Simply removing livestock can increase soil carbon sequestration since grasslands with the greatest potential for increasing soil carbon storage are those that have been depleted in the past by poor management (Wu and others 2008, citing Jones and Donnelly 2004). Riparian area restoration can also enhance carbon sequestration (Flynn and others 2009).

The DA does not cite data that quantifies the lost ecosystem services of grasslands sequestering carbon—lost because of livestock grazing.

Saunois et al. (2016a) note "the recent rapid rise in global methane concentrations is predominantly biogenic—most likely from agriculture—with smaller contributions from fossil fuel use and possibly wetlands. …Methane mitigation offers rapid climate benefits and economic, health and agricultural co-benefits that are highly complementary to CO2 mitigation." Also see Saunois et al., 2016b and Gerber et al., 2013.

Ripple et al. (2014) provide some data and point out the opportunities available for GHG reductions via change in livestock policy:

· At present non-CO_2 greenhouse gases contribute about a third of total anthropogenic CO_2 equivalent (CO_2e) emissions and 35–45% of climate forcing (the change in radiant energy retained by Earth owing to emissions of long-lived greenhouse gases) resulting from those emissions.

· Methane (CH4) is the most abundant non- CO_2 greenhouse gas and because it has a much shorter atmospheric lifetime (~9 years) than CO_2 it holds the potential for more rapid reductions in radiative forcing than would be possible by controlling emissions of CO_2 alone.

· We focus on ruminants for four reasons. First, ruminant production is the largest source of anthropogenic CH_4 emissions (Fig. 1c) and globally occupies more area than any other land use. Second, the relative neglect of this greenhouse gas source suggests that awareness of its importance is inappropriately low. Third, reductions in ruminant numbers and ruminant meat production would simultaneously benefit global food security, human health and environmental conservation. Finally, with political will, decreases in worldwide ruminant populations could potentially be accomplished quickly and relatively inexpensively.

· Worldwide, the livestock sector is responsible for approximately 14.5% of all anthropogenic greenhouse gas emissions3 (7.1 of 49 Gt $CO_2$2e yr–1). Approximately 44% (3.1 Gt CO_2e yr–1) of the livestock sector's emissions are in the form of CH4 from enteric fermentation, manure and rice feed, with the remaining portions almost equally shared between CO_2 (27%, 2 Gt CO_2e yr–1) from land-use change and fossil fuel use, and nitrous oxide (N_2O) (29%, 2 Gt CO_2e yr–1) from fertilizer applied to feed-crop fields and manure.

· Globally, ruminants contribute 11.6% and cattle 9.4% of all greenhouse gas emissions from anthropogenic sources.

· Lower global ruminant numbers would have simultaneous benefits for other systems and processes. For example, in some grassland and savannah ecosystems, domestic ruminant grazing contributes to land degradation through desertification and reduced soil organic carbon. Ruminant agriculture can also have negative impacts on water quality and availability, hydrology and riparian ecosystems. Ruminant production can erode biodiversity through a wide range of processes such as forest loss and degradation, land-use intensification, exotic plant invasions, soil erosion, persecution of large predators and competition with wildlife for resources.

· Roughly one in eight people in the world are severely malnourished or lack access to food owing to poverty and high food prices. With over 800 million people chronically hungry, we argue that the use of highly productive croplands to produce animal feed is questionable on moral grounds because this contributes to exhausting the world's food supply.

· In developed countries, high levels of meat consumption rates are strongly correlated with rates of diseases such as obesity, diabetes, some common cancers and heart disease. Moreover, reducing meat consumption and increasing the proportion of dietary protein obtained from high-protein plant foods — such as soy, pulses, cereals and tubers — is associated with significant human health benefits.

· The greenhouse gas footprint of consuming ruminant meat is, on average, 19–48 times higher than that of high-protein foods obtained from plants (Fig. 2), when full life cycle analysis including both direct and indirect environmental effects from 'farm to fork' for enteric fermentation, manure, feed, fertilizer, processing, transportation and land-use change are considered.

· In terms of short-term climate change mitigation during the next few decades, if all the land used for ruminant livestock production were instead converted to grow natural vegetation, increased CO_2 sequestration on the order of 30–470% of the greenhouse gas emissions associated with food production could be expected.

· (D)ecreasing ruminants should be considered alongside our grand challenge of significantly reducing the world's reliance on fossil fuel combustion. Only with the recognition of the urgency of this issue and the political will to commit resources to comprehensively mitigate both CO_2 and non-CO_2 greenhouse gas emissions will meaningful progress be made on climate change. For an effective and rapid response, we need to increase awareness among the public and policymakers that what we choose to eat has important consequences for climate change.

Part B- Comments on the Species of Conservation Concern List, Threatened, Endangered and Candidate Species, and Focal Management Indicator Species

Under the Planning Rule for National Forests, each National Forest must assure the viability of species and this requirement includes providing for well-distributed breeding populations across the “planning area” in this case the entire Lolo National Forest.

For example, the Forest Service would not be able to satisfy this requirement by saying we have a few animals of each species in the Wilderness. The Forest must provide for “well-distributed” populations of breeding age individuals for all Species of Conservation Concern across the entire Lolo National Forest.

The Draft Species of Concern List is completely inadequate and includes false information. Just 2 animals, 1 bird and 8 plants are identified as Species of Conservation Concern out of approximately 170 Species of Concern from the Montana Natural Heritage Program that occur in the Lolo National Forest area. There are also 62 species on the Forest Service List of Sensitive Species in and adjacent to the Lolo National Forest. For example, the Lolo concluded Westslope Cutthroat Trout, a key species under the Inland Native Fish Strategy are not a Species of Conservation Concern. Pure-strain populations are isolated and down to about 5%!

The Forest Service must include currently threatened or endangered species as well as Candidate Species as their status may change over the life of the Plan. These species should all be considered “focal species.”

•The Forest Service must include management indicator species including Grizzly Bear and Bull Trout and indicators of Disturbance-Dependent ecosystem health and function such as the Black-Backed Woodpecker. The government has been petitioned to delist grizzly bears and they may well lose Endangered Species Act protections before the Plan Revision is complete and certainly over the life of the Plan, meaning the Viability Requirements in the 2012 Planning Rule would apply.

•The Forest Service should consider species that are known to be primary food sources for indicator species such as grizzly bear including the huckleberry subspecies dependent on pollinators which are in decline. It must identify the Suckley Cuckoo and Western Bumblebees as Species of Concern. Suckley Cuckoo are an S1 at High Risk species and the Western Bumblebee is on the IUCN Red List of Vulnerable Species.

The Forest Service should include species assemblages that are representative of unique ecosystem types such as the unique assemblage of plants and animals that are largely restricted to recently and severely burned forest conditions as well as species indicative of coastal-disjunct habitats including old growth forest.

Species of Conservation Concern

The following list comes from the Montana Natural Heritage Program database narrowed down to species known to occur in the Missoula County and greater Lolo National Forest area. The Species of Conservation Concern list must be greatly expanded. The current list is arbitrarily small. Species on the following list which are currently federally listed as threatened, endangered or candidate species must be placed on the Lolo National Forest Focal Species/Management Indicator Species list.

Table 2. Species of Conservation Concern in the Lolo National Forest Area.

Species	State Status	Federal Status	Notes
Mammals			
*Grizzly Bear (*Ursus arctos*)	S2, S3	Threatened, Status pending petitions for delisting	Distribution Throughout Lolo National Forest; Demographic Connectivity Area; Umbrella species; Key Management Indicator Species for habitat connectivity for wide-ranging, migratory species
*Gray Wolf (*Canis lupus*)	S4	Sensitive, Eligible for ESA Relisting	Formerly Threatened, Legislatively Delisted; Overharvest
*Fisher (*Pekania pennanti*)	S3, Potentially at Risk	Sensitive Species (USFS)	Previously Petitioned for ESA Listing; MIS for Old Growth; Fishers occur primarily in dense coniferous or mixed forests, including early successional forests with dense overhead cover (Thomas 1993). Partially reliant on porcupine which have dramatically declined.
*Wolverine (*Gulo gulo*)	S3, Potentially at Risk	Sensitive Species (USFS)/Warranted for ESA listing	No Trapping Season; Wolverines are limited to alpine tundra, and boreal and mountain forests (primarily coniferous) in the western mountains, especially large wilderness areas. Wolverines avoided clearcuts and burns, crossing them rapidly and directly when they were entered at all.
*Northern Bog Lemming (*Synaptomys borealis*)	S2, At Risk	Sensitive Species (USFS)	Small and Isolated Populations; Northern Bog Lemmings in Montana have been found in at least nine community types, including Engelmann spruce, subalpine fir, birch, willow, sedge (*Carex*), spikerush (*Eleocharis*), or combinations of the above, often occurring in wet meadows, fens, or bog-like environments.

*North American Porcupine (*Erethizon dorsatum*)	S3, S4, Potentially at Risk	Species of Concern	Significant and Possibly Catastrophic Declines in Conifer Forests West of the Continental Divide in Montana
*Marten (*Martes americana*)	S4, Possibly Declining		Previously Petitioned for ESA Listing; MIS for mature conifer forest; Primarily a boreal animal preferring mature conifer or mixed wood forests. Severe forest disturbance can significantly reduce habitat value. Uses deadfall and snags as den sites.
Western Pygmy Shrew (*Sorex eximius*)	S3		
Preble's Shrew (*Sorex preblei*)	S3		
Bats			
Townsend's Big-eared Bat (*Corynorhinus townsendii*)	S3	Sensitive Species (USFS)	
Hoary Bat (*Lasiurius cinereus*)	S3B	Sensitive Species (USFS)	
Long-eared Myotis (*Myotis evotis*)	S3	Sensitive Species (USFS)	
Little Brown Myotis (*Myotis lucifugus*)	S3		
Fringed Myotis (*Myotis thysanodes*)	S3	Sensitive Species (USFS)	
Long-Legged Myotis (*Myotis Volans)*	S3		
Yuma Myotis (*Myotis yumanensis)*	S3		
Birds			
Great Blue Heron (*Ardea herodias*)	S3		
American Bittern (*Botaurus lentiginosus*)	S3B	Sensitive Species (USFS)	
Brown Creeper (*Certhia americana*)	S3		
Black Tern (*Chlidonias niger*)	S3B	Sensitive Species (USFS)	
Evening Grosbeak (*Coccothraustes vespertinus*)	S3		
Trumpeter Swan (*Cygnus buccinator*)	S3	Sensitive Species (USFS)	

Black Swift (*Cypseloides niger*)	S1B	Sensitive Species (USFS)	Limited distribution, very specific nesting requirements make it vulnerable to extirpation in all or part of its range.
Bobolink (*Dolichonyx oryzivorus*)	S3B		Large population declines in Montana.
Pileated Woodpecker (*Dryocopus pileatus*)	S3		
Common Loon (*Gavia immer*)	S3B	Sensitive Species (USFS)	
Cassin's Finch (*Haemorhous cassinii*)	S3		
Black-necked Stilt (*Himantopus mexicanus*)	S3B		
Harlequin Duck (*Histrionicus histrionicus*)	S2B	Sensitive Species (USFS)	Extremely limited breeding range in Montana.
Varied Thrush (*Ixoreus naevius*)	S3B		Recent population declines across Montana due to timber harvest, insect outbreaks and fire.
White-tailed Ptarmigan (*Lagopus leucura*)	S3		
Loggerhead Shrike (*Lanius ludovicianus*)	S3B	Sensitive Species (USFS)	
Black Rosy Finch (*Leucosticte atrata*)	S2		
Gray-crowned Rosy-Finch (*Leucosticte teophrocotis*)	S2		
Lewis's Woodpecker (*Melanerpes lewis*)	S2B	Sensitive Species (USFS)	
Clark's Nutcracker (*Nucifraga columbiana*)	S3		
Long-billed Curlew (*Numenius americanus*)	S3B	Sensitive Species (USFS)	
Sage Thrasher (*Oreoscoptes montanus*)	S3B	Sensitive Species (USFS)	
Brewer's Sparrow (*Spizella breweri*)	S3B	Sensitive Species (USFS)	Faces serious threats from loss of sagebrush habitat.
Great Gray Owl (*Strix nebulosi*)	S3	Sensitive Species (USFS)	
Pacific Wren (*Troglodytes pacificus*)	S3		
*Pygmy Nuthatch (*Sitta pygmaea*)	S4		Indicates ponderosa pine systems with nice big snags.
*American Dipper (*Cinclus mexicanus*)	S5		Dippers indicate streams with high water quality.
*Black-backed Woodpecker (*Picoides arcticus*)			MIS for Disturbance-Dependent ecosystems including severely burned forests that leave behind healthy abundant snag habitat.

*Northern Goshawk (*Accipiter gentilus*)	S3, Species of Concern		Goshawks nest in a variety of forest types in Montana, including Douglas-fir and Western Larch west of the Continental Divide and prefer mature and old-growth forests with a preponderance of large trees, a dense canopy, and a relatively open understory
Fish Aquatic			
*Westslope Cutthroat Trout (*Oncorhynchus clarkia lewisi*)	S2, Imperiled	Sensitive Species (USFS)	MIS for stream quality and connectivity; rely on pool habitat and cold water.
*Bull Trout (*Salvelinus confluentus*)	S2	Threatened	MIS for stream quality, temperature, pool habitat, woody debris, cobble embeddedness, sediment.
*Pygmy Whitefish (*Prosopium coulterii*)	S3		At risk species at limited/declining numbers, range and/or habitat.
Reptiles			
Northern Alligator Lizard (*Elgaria coerulea*)	S3		High age of maturity and low recruitment make species vulnerable to extirpation.
Western Skink (*Plestiodon skiltonianus*)	S3		
Amphibians			
Western Toad (*Anaxyris boreas*)	S2	Sensitive Species (USFS)	Serious population declines from infection.
Idaho Giant Salamander (*Dicamptodon aterrimus*)	S2		Found in western Montana near Idaho border.
Northern Leopard Frog (*Lithobates pipiens*)	S1	Sensitive Species (USFS)	Species of Concern in western Montana.
*Coeur d'Alene Salamander (*Plethodon idahoensis*)	S2	Sensitive Species (USFS)	
Invertebrates-Insects			
*Suckley Cuckoo Bumble Bee (*Bombus suckleyi*)	S1		Species is rare and appears to be declining. Excellent pollinator.
*Western Bumble Bee (*Bombus occidentalis*)			IUCN Red List of Threatened Species as a Vulnerable Species. Rapid population declines across its range. Excellent pollinator.

Butterflies			
Gillette's Checkerspot *(Euphdryas gillettii)*	S2		
Caddisflies			
*Northern Rocky Mountains Refugium Caddisfly (*Goereilla baumanni*)	S2		Rare and very limited and declining population numbers in Pacific Influenced Areas streams in western Montana.
A Rhyacophilian Caddisfly (*Rhyacophilian newelli*)	S2		At risk species and very limited and declining population numbers.
A Caddisfly (*Zumatrichia notosa*)	S3		Rare and uncommon.
Dragonflies			
Subarctic Darner (*Aeshna subarctica*)	S1, S2		Rapidly declining population numbers.
Eastern Ringtail (*Erpetogomphus designates*)	S1		Rapidly declining population numbers.
Brush-tipped Emerald (*Somatochlora walshii*)	S1, S2		Rapidly declining population numbers.
Mayflies			
Lolo Mayfly (*Caurinella idahoensis*)	S2		Very limited and possibly declining numbers.
Stoneflies			
Hooked Snowfly (*Isocapnia crinite*)	S2		Very limited and possibly declining numbers.
Northern Rocky Mountains Refugium Stonefly (*Soyedina potteri*)	S2		Very limited and possibly declining numbers.
Cordilleran Forestfly (*Zapada cordillera*)	S2		Very limited and possibly declining numbers.
Mollusks			
Kingston Oregonian (*Cryptomastix sanburni*)	S1		
Pale Jumping-slug (*Hemphillia camelus*)	S1, S2		
Marbled Jumping-slug (*Hemphillia danielsi)*	S1, S2		
*Western Pearlshell (*Margaritifera falcata*)	S2, Imperiled	Sensitive Species (USFS)	20% decline in populations over a decade.

Alpine Mountainsnail (*Oreohelix alpina*)	S1		
Bitterroot Mountainsnail (*Oreohelix amariradix)*	S1, S2		
Keeled Mountainsnail (*Oreohelix carinifera)*	S1		
Lyrate Mountainsnail (*Oreohelix haydeni)*	S1, S3		
Oblique Ambersnail (*Oxyloma nuttallianum*)	S2		
Smoky Taildropper (*Prophysaon humile*)	S2, S3		
Lyre Mantleslug (*Udosarx lyrata*)	S1		Globally rare.
Sheathed Slug	S2, S3		
Others			
A Subterranean Amphipod (*Stygobromus tritus*)	S1, S2		Extremely limited rapidly declining populations.
A Freshwater Sponge (*Ephydatia cooperensis*)	S1, S3		
A Millipede (*Adrityla cucullata, Austrotyla montani, Corypus cochlearis*)	S1, S3		
Plants			
*Huckleberry (*Vaccinium spp*.)			MIS for Grizzly Bear Habitat Production and Presence of Pollinators.
Wavy Moonwort (*Botrychium gallicomontanum*)	S3	Sensitive Species (USFS)	Vulnerable to herbicide spraying and road maintenance.
Western Moonwort (*Botrychium hesperium)*	S3	Sensitive Species (USFS)	Vulnerable to weed spraying and road maintenance.
Lanceleaf Moonwort *(Botrychium lanceolatum)*	S3		
Peculiar Moonwort (*Botrychium paradoxum)*	S3	Sensitive Species (USFS)	Impacted by livestock grazing, weed invasion and recreation use.
Cascade Rockbrake (*Crytogramma cascadensis*)	S3	Sensitive Species (USFS)	Rare to Uncommon.
Marsh Horsetail (*Equisetum palustre*)	S3		Grizzly bear food source.
Meadow Horsetail (*Equisetum pretense)*	S2		Grizzly bear food source.
Spiny-spore Quillwort (*Isoetes echinospora*)	S3		Scattered distribution.
Howell's Quillwort (*Isoetes howellii)*	S3		
Northern Bog Clubmoss (*Lycopodium inundatum*)	S2	Sensitive Species (USFS)	Rare in Montana.

Adder's Tongue (*Ophioglossum pusillum*)	S3	Sensitive Species (USFS)	Rare in Montana and occurs in fens and wet meadows.
Conifers			
*Whitebark Pine (*Pinus albicaulis*)	S1	Threatened Species Sensitive Species (USFS)	Major declines across large areas of its range.
Flowering Plants			
Musk-root (*Adoxa moschatellina*)	S3	Sensitive Species (USFS)	Sparse distribution and may be impacted by road and trail building.
Longleaf Oregon-grape (*Berberis nervosa*)	S1	Sensitive Species (USFS)	Very few locations.
Beck Water-marigold (*Bidens beckii*)	S2	Sensitive Species (USFS)	Threats include boating activity, lakeshore development, aquatic weeds and aquatic herbicides.
Sapphire Rockcress (*Boechera fecunda*)	S2	Sensitive Species (USFS)	Suspected on Lolo NF.
Watershield (*Brasenia schreberi*)	S1, S2	Sensitive Species (USFS)	Shallow water species threatened by boating, aquatic weeds, runoff from agricultural fields.
Obscure Evening-primrose (*Camissonia andina*)	S2		Greatest risk from invasive weeds.
Cliff Toothwort (*Cardamine rupicola*)	S3		Mission Mountains.
Coville Indian Paintbrush (*Castilleja covilleana*)	S3	Sensitive Species (USFS)	Timber harvest a threat.
Chaffweed (*Centunculus minimus*)	S2		Rare to uncommon, susceptible to human-caused disturbance in moist habitats.
Alpine Collomia (*Collomia debilis var. camporum*)	S1, S2		Low elevation scree, talus and rocky slopes. Negative impacts from humans and weeds.
English Sundew (*Drosera anglica*)	S3	Sensitive Species (USFS)	
Linear-leaf Fleabane (*Erigeron linearius*)	S2		May be threatened by developments on lands adjacent to federally-managed lands.
Hiker's Gentian (*Gentianopsis simplex*)	S2	Sensitive Species (USFS)	
Howell's Gumweed (*Grindelia howellii*)	S2, S3	Sensitive Species (USFS)	Impacted by roadside herbicide spraying.
Western Pearl-flower (*Heterocodon rariflorum*)	S2	Sensitive Species (USFS)	Impacted by hiking and ORV trails.
Water Howellia (*Howellia aquatilus*)	S3	Sensitive Species (USFS)	In post-delisting monitoring.
Scalepod (*Idahoa scapigera*)	S1, S2	Sensitive Species (USFS)	Lower slopes of Bitterroot Mountains. Susceptible to invasive weeds.
Pale-yellow Jewel-weed	S3		Rare.

(*Impatiens aurella*)			
Idaho Lovage (*Ligusticum verticillatum*)	S3		Moist forest and meadows in spruce-fir habitat.
Oregon Bluebells (*Mertensia bella*)	S2, S3	Sensitive Species (USFS)	
Stalk-leaved Monkeyflower (Mimulus ampliatus)	S3	Sensitive Species (USFS)	
Yellow Beardtongue (*Penstemon flavescens*)	S3		
Missoula Phlox (*Phlox kelseyi var. missoulensis*)	S3	Sensitive Species (USFS)	
Straightbeak Buttercup (*Ranunculus orthorhynchus)*	S1, S2		Rare in Montana.
Northern Buttercup *(Ranunculus pedatifidus)*	S3		Rare in Montana.
Toothcup (*Rotala ramosior*)	S1, S2		Rare in Montana. Found in valley bottom wetlands.
Yerba Buena (*Satureja douglasii*)	S3		Coastal disjunct found in sites near Idaho.
Mission Mountains kittentails (*Synthyris canbyi*)	S2, S3		High elevation, rocky slopes.
*Wooly-head Clover (*Trifolium eriocephalum*)	S2	Sensitive Species (USFS)	Grizzly bear food source. Timber harvest and roadbuilding may be a threat.
Wooly Clover (*Trifolium microcephalum)*	S3		Grizzly bear food source.
Flatleaf Bladderwort (*Utricularia intermedia*)	S2	Sensitive Species (USFS)	Few occurrences.
Idaho Barren Strawberry (*Waldsteinia idahoensis*)	S2, S3	Sensitive Species (USFS)	Grizzly bear food source. Susceptible to timber harvest and road management.
Nevada Clubrush (*Amphiscirpus nevadensis*)	S2		Wetlands habitat.
Cascade Reedgrass (*Calamagrostis tweedyi*)	S3		Globally rare and located in extreme western Montana.
Big-leaf Sedge (*Carex amplifolia*)	S3	Sensitive Species (USFS)	Uncommon to rare wetlands species.
Creeping Sedge (*Carex chordorrhiza*)	S3	Sensitive Species (USFS)	Rare in Montana. Fens and wet meadows.
Lake-bank Sedge (*Carex lacustris*)	S1, S2	Species of Conservation Concern (USFS)	Rare in Montana.
Glaucus Beaked Sedge (*Carex rostrata*)	S2, S3	Sensitive Species (USFS)	Rare in Montana.
Pointed Broom Sedge (*Carex scoparia*)	S1, S2		Rare in Montana. Clark Fork and Bitterroot River drainages.
Short-pointed Flatsedge (*Cyperus acuminatus*)	S1		Rare in Montana. Only two sites including Missoula and Sanders Counties.
Shining Flatsedge (*Cyperus bipartitus*)	S1		Rare in Montana. Bitterroot Valley in Missoula County.

Clustered Lady's-slipper (*Cypripedium fasciculatum*)	S3	Sensitive Species (USFS)	Most populations are on National Forest lands with negative impacts from timber harvesting.
Sparrow's-egg Lady's-slipper (*Cypripedium passerinum)*	S2, S3	Sensitive Species (USFS)	Main threat from hydrologic changes.
Delicate Spikerush (*Eleocharis bella*)	S1		Wetlands species.
Giant Helleborine (*Epipactis gigantean*)	S2, S3	Sensitive Species (USFS)	Seeps, springs, fens and thermal waters.
Slender Cottongrass (*Eriphorum gracile*)	S3	Sensitive Species (USFS)	
Coville's Rush (*Juncus covillei*)	S2, S3		Wetlands and riparian sites.
Foxtail Muhly (*Muhlenbergia andina*)	S2, S3		Damp areas, along streams seeps and along hot springs.
Annual Muhly (*Muhlenbergia minutissima)*	S3		
Dense-flower Rein Orchid (*Piperia elongata*)	S1		
Blunt-leaved Pondweed (*Potamogeton obtusifolius*)	S3	Sensitive Species (USFS)	Valley and foothills. Vulnerable to development, recreation and increased sediment and nutrient loads.
Pod Grass (*Scheuchzeria palustris*)	S3	Sensitive Species (USFS)	Fen and wetlands habitat.
Water Bulrush (*Schoenoplectus subterminalis*)	S3	Sensitive Species (USFS)	Primarily on Forest Service lands and vulnerable to development and timber harvesting.
Tufted Club-rush (*Tricophorum cespisotum*)	S2	Sensitive Species (USFS)	Fens and wet meadows in mountainous terrain.
California False-hellebore (*Veratrum californicum*)	S2	Sensitive Species (USFS)	
Columbia Water-meal (*Wolffia Columbiana*)	S2, S3		
Bryophytes			
Olympic Dichodontium Moss (*Dichodontium olympicum*)	S1		
A Conecup Moss (*Hygroamblystegium varium spp. noterophilum*)	S1		
Meesia Moss (*Messia triquetra)*	S2	Sensitive Species (USFS)	
Lyall's Polytrichum Moss (*Meiotricum lyallii*)	S1		
A Scorpidium Moss (*Scorpidium scorpiodes*)	S2	Sensitive Species (USFS)	
Narrowleaf Peatmoss (*Sphagnum angustifolium*)	S2		

A Peatmoss (*Sphagnum centrale)*	S1	
Brown Hair Peatmoss *(Sphagnum fuscum)*	S2	
Red Spoon Peatmoss (*Sphagnum magellanicum)*	S1	Species of Concern (USFS)
Mendocino Peatmoss (*Sphagnum mendocinum)*	S1	
Streamside Peatmoss (*Sphagnum riparium)*	S1	
Wulf's Peatmoss (*Sphagnum wulfianum)*	S1	
Bartram's Syntrichia Moss (*Syntrichia bartramii*)	S1	
Norwegian Syntrichia Moss (*Syntrichia norvegica)*	S1	
Antler Twist Moss (*Syntrichia papillosissima)*	S1	
Elfin Crisp Moss (*Tortula acaulon*)	S1	
Lichens		
Subcentric Ring Lichen (*Arctoparmelia subcentrifuga*)	S1	
Gray Lungwort Lichen (*Lobaria hallii*)	S2	
Elf-Ear Lichen (*Normandina pulchella*)	S1	
Fingered Shingle Lichen (*Parmeliella triptophylla*)	S1	
Western Waterfan Lichen (*Peltigera gowardii*)	S1	
Lesser Tundra Owl Lichen (*Solorina bispora*)	S1, S2	
Candidate Species		
*Monarch Butterfly (*Danaus plexippus*)		Candidate for ESA Listing

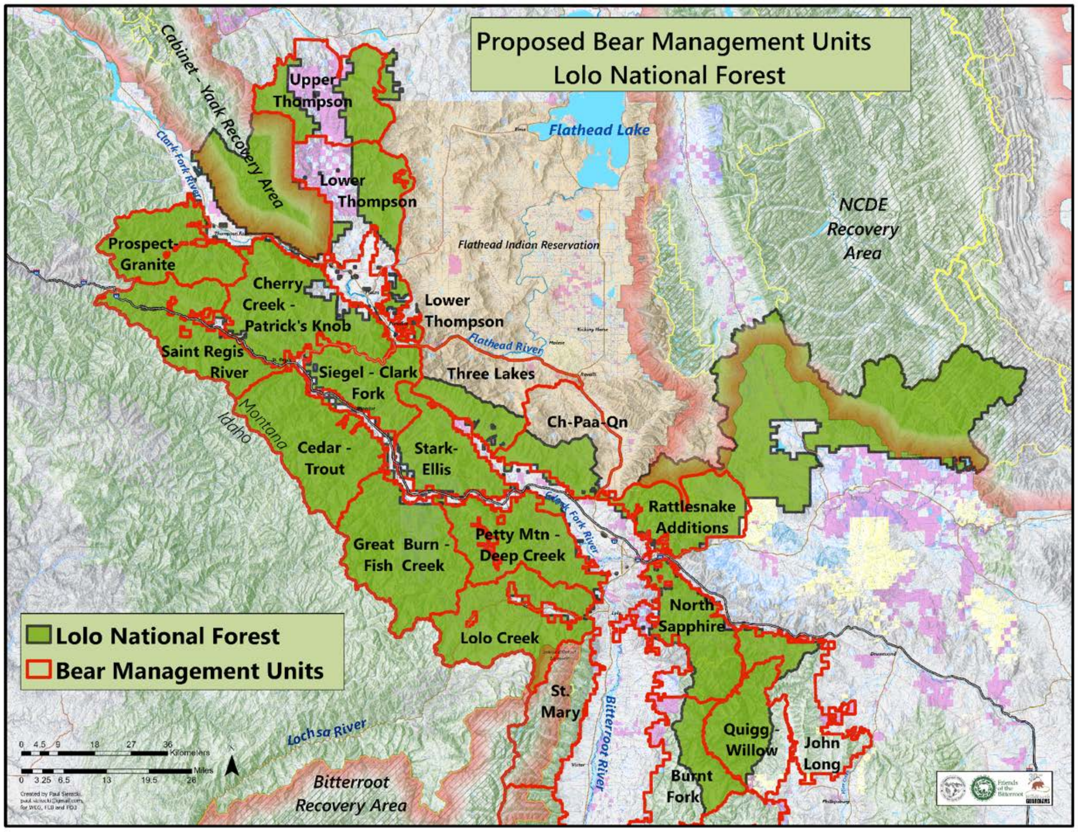
Focal Species/Management Indicator Species

Grizzly Bear- Wide-ranging Umbrella Species

As with Species of Conservation Concern, the Forest Service has an obligation to provide for well-distributed populations across the planning area of all the Focal Species/Management Indicator Species including Grizzly Bear.

Forest-wide goal 7, "For threatened and endangered species occurring on the Forest, including the grizzly bear, gray wolf, peregrine falcon, and bald eagle, manage to contribute to the recovery of each species to non-threatened status" and desired condition NCDE-DC-WL-02, *"Within the NCDE primary conservation area and zone 1 (including the Ninemile demographic connectivity area), grizzly bear habitat on NFS lands contributes to sustaining the recovery of the grizzly bear population in the NCDE and contributes to connectivity with neighboring grizzly bear recovery zones" will encourage management actions that do not impair and may enhance habitat connectivity and genetic exchange between recovery zones. Secure habitat provides an important component to habitat connectivity. While the Forest Plan does not have standards requiring management of secure habitat outside the recovery zones, certain Forest Plan management areas limit or restrict construction of motorized routes, as previously described. The NCDE grizzly bear population has been increasing in numbers and expanding its range, and the NCDE grizzly bear conservation strategy and associated NCDE grizzly bear amendment standards and guidelines are aimed at maintaining or increasing the population. We anticipate that under continued implementation of the Forest Plan, the NCDE population will be capable of serving as a source population for other recovery zones where the bear population is smaller or absent."*

To ensure this, Bear Management Units (BMUs) have been proposed between the Grizzly Bear Recovery Zones (see map below, Sieracki and Bader 2022). These are scaled to the average life range of an adult female grizzly bear and include specific habitat requirements including denning. Each of these BMUs should be occupied by at least one female/cub group.



Moreover, identification of BMUs is a start point for multi-resource evaluation of grizzly bear habitat outside of the Recovery Areas which sets the stage for improved least-cost path analyses for female grizzly bears similar to Proctor et al. (2015). In addition to geographic area, each BMU can be assessed for total road and motorized route miles and densities, percent secure core habitat per BMU measured against the 68% standard and its spatial distribution as in Sieracki and Bader (2020), denning habitats, spring ranges and so forth. These data can inform proposals for habitat protection and connectivity based on reductions in the road network, additional seasonal restrictions on motorized access and re-creation of additional secure core areas. This information is particularly useful for grizzly bear recovery planning and National Forest Plan revisions, amendments and project-level analyses.

Elk- Elk have long been considered an MIS for big game, habitat security and quality.

Westslope Cutthroat Trout- MIS for water quality, temperature and connectivity

Bull Trout- MIS for water quality, temperature and connectivity

Lynx- MIS for intact old growth forests without roads

Wolverine- MIS for intact old growth forests without roads

Wolf- MIS for predator/prey relationships

Fisher- MIS for old growth and intact forests

Marten- MIS for old growth and intact forests

Northern Bog Lemming- MIS for bog and fen habitat

North American Porcupine- MIS for intact forests

Bighorn Sheep- MIS for grasslands

Pygmy Nuthatch- MIS for old growth

American Dipper- MIS for water quality

Black-backed Woodpecker- MIS for severely burned forest areas

Northern Goshawk- MIS for older, intact forests

Pygmy Whitefish- MIS for water quality

Coeur d'Alene Salamander- MIS for mesic and old growth forests

Suckley Cuckoo Bumblebee- MIS for major pollinator

Western Bumblebee- MIS for major pollinator

Northern Rocky Mountain Refugium Caddisfly- MIS for mesic and old growth forests

Western Pearlshell- MIS for water quality.

Huckleberry *spp.*- MIS for grizzly bear ecosystems. There are long-term studies ongoing in the NCDE and the CYE to measure abundance and trends of huckleberry. The Lolo National Forest should extend this effort across the planning area.

Whitebark Pine- see section on Whitebark Pine.

Wooly-head Clover- Grizzly bear food

Monarch Butterfly- rare everywhere